

**MINUTES OF THE
SOUTHEAST LOUISIANA FLOOD PROTECTION AUTHORITY – EAST
SPECIAL BOARD MEETING (ARMORING SUMMIT)
THURSDAY, AUGUST 4, 2011**

The Special Board Meeting of the Southeast Louisiana Flood Protection Authority - East (Authority or SLFPA-E) was held on Thursday, August 4, 2011, in Room 256 Lindy C. Boggs International Conference Center, University Of New Orleans, 2045 Lakeshore Drive, New Orleans, Louisiana, after due legal notice of the meeting was sent to each Board member and the news media and posted.

Mr. Doody called the meeting to order at 9:15 a.m. and led in the pledge of allegiance.

PRESENT:

Timothy P. Doody, President
Louis E. Wittie, Secretary
Stephen Estopinal, Treasurer
David P. Barnes, Jr.
Thomas L. Jackson
Ricardo S. Pineda

ABSENT:

John M. Barry, Vice President
Stradford A. Goins
George Losonsky, PhD

OPENING COMMENTS:

Mr. Doody advised that representatives for the levee districts within the Hurricane and Storm Damage Risk Reduction System (HSDRRS) were invited to attend today's meeting so that everyone would receive the same information on the HSDRRS armoring. He recognized Steve Wilson, President of the Pontchartrain Levee District and Association of Levee Boards of Louisiana, Giuseppe Miserendino, Regional Director of the Southeast Louisiana Flood Protection-West (SLFPA-W), and Jason McCrossen, representing Plaquemines Parish. He explained that the U.S. Army Corps of Engineers (USACE) provided a presentation on armoring to the Coastal Protection and Restoration Authority (CPRA) and to the SLFPA-E in July. After the presentation several SLFPA-E Commissioners with engineering and technical expertise had questions and asked the USACE to provide technical information on the armoring. Technical information was provided that may have answered some of the questions. A joint meeting of the SLFPA-E's Operations and Engineering Advisory Committees was proposed. The combined membership of the two committees constituted a quorum of the Board; therefore, this Special Board meeting was called. The intent of this meeting is to help develop a consensus path forward so that the USACE does not receive conflicting information from the local sponsors. Presentations will be provided today by the USACE and CPRA, followed by the receipt of input and discussion of the issues.

Mr. Estopinal announced that Dr. Roy K. Dokka, Director of the LSU Spatial Reference Center, passed away suddenly this week. He commented on the importance of Dr. Dokka's work and his vital contributions to flood protection decisions.

Mr. Wilson stated that he appreciated the opportunity to participate in today's meeting and that the development of a consensus will ultimately help to develop a solution.

DISCUSSION OF ARMORING FOR THE HURRICANE AND STORM DAMAGE RISK REDUCTION SYSTEM.

Reuben Mabry with the USACE reviewed the armoring presentation (brief) provided at the July 21st SLFPA-E Board meeting. He stated that his perception of today's meeting is to look at the technical issues relative to armoring the HDSRRS. Hurricane Katrina brought out the need for adding resiliency to the system. The USACE was tasked by WRDA (Water Resources and Development Act) to look at the critical elements of the system, especially areas that have a propensity to fail or breach, and to make those areas more robust or resilient. Since the USACE does not typically armor in high hazard coastal environments, it had to develop the basic concepts for resiliency for a coastal environment. In light of its mission, the USACE defined armoring as a natural or artificial material placed on or around a levee, floodwall or other structure to reduce the risk to the system or component, to prevent breaching or major damage when confronted with wave attack, overflow and overtopping associated with a greater and 100-yr storm surge event. Significant data gaps had to be filled and the USACE began significant research and development enlisting a number of universities, professors and subject matter experts. A flume was built by Colorado State University (CSU) to conduct large wave testing to scientifically measure the effects of waves on various earthen materials and clays, turf reinforcement mat (TRM) and articulated concrete block (ACB). Presentation slides showed the CSU test results and the performance ranges developed (0-1.0 cfs/ft. - grass; 1.0 – 4.0 cfs/ft. – TRM and over 4 cfs/ft. - ACB). A film clip was viewed demonstrating a large wave test at the CSU facility.

Mr. Mabry explained the USACE reengaged some of the IPET Risk Assessment Team members to use the IPET risk assessment model to analyze armoring alternatives based on fragilities in order to develop recommendations. The modeling tool provided a risk informed sensibility concerning the proper level and type of armoring. The USACE typically formulates alternatives in order to ensure the optimum approach. Six alternatives were developed: three alternatives dealt with a 500-year external surge and three alternatives dealt with a 750-year external surge. The non-federal sponsor (NFS) (State) was engaged and feedback was requested. A multi-criteria decision making process is used in the alternatives evaluation process. Five criteria were used: risk and reliability (performance), operation and maintenance (O&M), cost, schedule and environmental impacts. The team deliberated about the proper weighting of the criteria and a matrix was developed. The NFS was engaged relative to criteria weighting, which resulted in the O&M weight being raised and the weights for several other criteria being lowered. Six alternatives were analyzed by the USACE team on May 25th:

500-yr Alternatives

- Alt 1 – Uniform 500-yr resiliency

- Alt 2 – Added hardened crown, adjust armoring material in accordance with resultant overtopping rate (The hardened crown adds about six inches to one-foot of height to a levee.)
- Alt 3. – Uniform 500-yr resiliency (alt 1) plus risk informed additions

750-yr Alternatives

- Alt 4 – Uniform 750-yr resiliency
- Alt 5 – Added hardened crown, adjust armoring material in accordance with resultant overtopping rate
- Alt 6. – Uniform 750-yr resiliency (alt 4) plus risk informed additions

Mr. Mabry advised that the USACE team recommended alternative three (the risk informed 500-year solution). This information was communicated to the NFS on June 6th and a follow-up meeting was conducted on June 20th. Written feedback was received from the NFS on June 24th advising that it did not want TRM or ACB used and providing an alternative. The NFS's alternative was to increase the height of flood protection by using gravity walls or other structural means to diminish overtopping so that grass could be used for armoring. The USACE was concerned that the use of a structural means to raise flood protection to provide armoring would be perceived as exceeding the 100-year level authorization. The 100-year system is in place nationwide for the purpose of the National Flood Insurance Program. WRDA directed that the system be made resilient; however, a specific level of resiliency was not indicated. Another concern was that there may not be sufficient resiliency if the system is raised by use of gravity walls or other structural means and it is overtopped. The USACE decided to look at ways to alter one of the six alternatives to minimize the use of TRM and ACB and a seventh alternative was developed. However, after evaluation alternative three again achieved the top ranking. Graphic pictorials of the armoring scenarios for alternatives three and seven were shown.

Mr. Mabry reviewed the challenges that still need to be addressed, including:

- Future Levee Lifts
- Future Authority for Armoring – There is no authorization for future armoring.
- NFS O&M Concerns
- Expedited Implementation – Armoring is anticipated to be in place by the next hurricane season (June 1st).

Mr. Mabry explained that the milestones presented in the path forward are broad and general. Money must be reallocated or reprogrammed back to the armoring program.

Mr. Doody advised that the SLFPA-E has significant concerns relative to future levee lifts and the armoring O&M. Levees that require lifts in the not too distance future should receive further consideration. He explained that June 1st is not truly the beginning of the active hurricane season and that the decision on armoring, which is one of the most critical components of the HSDRRS, should not be driven by schedule.

Mr. Wittie commented on the difficulty in achieving acceptable grass establishment with some of the heavy clays used on the last lift of the levees and asked about the contents

of the clays used in the CSU tests. Mr. Mabry explained that samples were taken by the USACE from the Bonnet Carre Spillway to ensure that the samples represented the materials used on the levees. The USACE realized that the grass establishment achieved in the tests was on a very small scale. A report about the grass establishment in the tests was written by Dr. Jeff Beasley, an LSU guide factor agronomist. The USACE asked Dr. Beasley to take some cores around the perimeter of the HSDRRS to determine whether there was a measurable difference between the materials in the system's perimeter and the test clays. If there was a measurable difference, it would have needed to be taken into consideration through a factor of safety or some other type of engineering methodology. The components of the clay are listed in the CSU report. Mr. Wittie explained that it is difficult to retain the moisture needed to achieve grass establishment without the appropriate amount of organics in the top soil of the last lift. He noted that it takes four to five years to establish a good grass root system. Dean Arnold with the USACE explained that the PI's in one of the clays taken from the spillway and sent to Vicksburg was 42, which is typically higher than it should be for good grass growth. However, a grass quality rating about 7 on a scale of 1 to 10 was achieved in the CSU tests after five months through fertilizing, watering and cutting. Therefore, the USACE came up with the enhanced grass concept in order to achieve the grass quality obtained in the CSU tests in one season in the field through fertilizing, watering and cutting rather than having to wait as many as ten seasons. The USACE is currently performing tests in the field. Mr. Wittie pointed out that the levee districts take over the grass established by the USACE's contractors and that the levee districts' normal maintenance procedures would not provide the fertilizing and watering required by the enhanced grass concept. Mr. Arnold responded that this is true for the overall levee. However, the area where wave overtopping would cause the most damage (a zone where waves flow down the levee slope, hit the inflection point plus 15-ft.) would be fertilized, watered and cut in such a way during one season so as to achieve the quality of grass obtained in the CSU testing. Mr. Wittie asked about waves striking the floodside of a levee. Mr. Arnold responded that the USACE is looking at wave overtopping and 500-year storms in the armoring effort.

Mr. Wittie asked about the potential impact of T-wall overtopping. Mr. Mabry explained that the USACE had not originally looked at T-walls due to the soundness and robustness of the structures. However, the USACE was asked to take a look at the overtopping of the T-walls and it did not see a problem. The permanent concrete structures were built to the 2057 future condition; therefore, the overbuild decreased the overtopping rates for T-walls in all cases below .2 cfs/ft. Mr. Estopinal expressed a concern about the O&M of the clay levee crown underneath the T-wall. Potentially, wave action and events far less than a 100-year event could cause cavities to develop at the base of the T-wall and the top of the levee crown. The USACE had promised that it would present a reasonable O&M mechanism to avoid or repair the voids. Mr. Doody advised that Mike Park is aware of the issue brought up by Mr. Estopinal. Mr. Mabry explained that the question was also brought up by Robert Turner, SLFPA-E Regional Director, through a list of concerns. The USACE considered the SLFPA-E's calculations and decided to have the calculations performed by its internal expertise and through a task order. Therefore, the USACE has three perspectives—the calculations performed by the SLFPA-E, the USACE's internal expertise and through a task order. He noted that there were significant differences in some of the assumptions. Syncing the assumptions could bring the calculations closer together; however, there are

differences of opinion about whether this is likely to happen. Mr. Estopinal asked whether the calculations dealt with the likelihood of wave action underneath the T-wall or the likelihood of a separation between the base of the T-wall and the levee. Mr. Mabry indicated that the USACE would look into this issue.

Mr. Pineda asked whether the armoring data used surge plus wave or just wave. Mr. Mabry clarified that the applicable wave environment coupled with surge was used to arrive at a combined effect.

Mr. Wilson explained that water (waves) flowing through the LaBranche Wetlands hits both the West Return Floodwall and the St. Charles levee. He asked the reason for a floodwall in one area and a levee in another area hit by the same wave. Mr. Mabry explained that hydraulic engineering and design drove the decision for constructing a wall versus a levee. A wall was constructed in the vicinity of the canal in lieu of a levee due to environmental conditions and space requirements. The wall was constructed to the 2057 future condition with a height ranging from 17.5-ft. at the lake to 16-ft. at the airport. The 2011 design height of the levee from the airport to I-310 is 14-ft. and from I-310 to the Bonnet Carre Spillway is 14.5-ft. The 2057 elevations for the levee are 16-ft. from the airport to I-310 and 16.5-ft. from I-310 to the spillway. Two feet of overbuilt was added in constructing the St. Charles levee to account for settlement. An average of one-half to a foot of settlement was experienced during the construction of the levee. A future levee lift is projected for about 2015 or 2016. A survey is anticipated to be conducted to determine the levee elevation within 60 days of the NCC (notice of construction complete) letter relative to certification.

Mr. Turner commented that problems seem to stem from the perceived authorization and schedule. The walls were built higher than required for the 2011 elevations to account for sea level rise and subsidence. He stated that there are extremely good reasons, particularly in light of the armoring requirements, why some of the levees should not be build only to the 2011 elevation. The current authorities could be used to construct levee lifts to raise the elevation so that the armoring will last more than just a few years. It was clarified that the typical location of past levee failures was at the bottom of the levee slope. Mr. Turner commented on the five mile stretch of I-wall constructed on top of the Hayne Boulevard levee. Should the I-wall be overtopped, water velocities similar to those used in the CSU tests would flow down the slope of the Hayne Boulevard levee. Therefore, a generalized statement should not be made that armoring is not required for walls. The USACE should evaluate every situation where a wall is constructed based on structural and environmental conditions.

Mr. Jackson asked about the potential for maintenance problems with using TRM. Mr. Turner stated that that O&M is an issue; however, he did not yet have an answer concerning the potential problems. He explained that he visited a site in Lafitte where TRM was used on a levee segment. The SLFPA-E staff is attempting to develop a list of locations within driving distance where TRM has been used for site visits and to discuss maintenance experience with owners. USACE representatives will be invited to attend the site visits. Mr. Turner stated that it appears that the success of TRM is highly dependent on the quality of the installation. The USACE intends to use an anchoring system in the installation and material and sod will be placed on top of the TRM. He stated that he would like to visit a location where the TRM was installed using the same

method intended for use by the USACE. He added that he wanted to determine how well TRM has worked in the past before categorically saying that it represents a good armoring solution. Mr. Jackson commented on the potential for grass cutting equipment to pull up loosened areas of the TRM. The CSU tests showed that turbulence was experienced around the grass root mat and that water velocities got under the mat and began to peel it back. He asked would the TRM installation be horizontal to the levee centerline and what would be done to keep water velocities from peeling back the mat. Mr. Mabry explained that the situation bought up by Mr. Jackson was due to the clay being frozen and thawed several times over a winter and the plain grass failed because of a loss of cohesion. He noted that the TRM tested by CSU did not fail. Mr. Jackson expressed a concern about drought conditions. He added that he agreed with Mr. Turner that the installation is the key to the success of the TRM and that a sufficient amount of investigation should be done from an operations standpoint. If the TRM is not successful, a tremendous cost would be incurred to pull it up.

Ricky Brouillette with the CPRA provided a presentation on the HSDRRS Wave Overtopping Resiliency (Risk Reduction) for Return Events greater than 100-year. He explained that the current design is based on hurricane and storm risk reduction design guidelines to withstand 100-year events with minimal wave overtopping. The goal of the armoring effort is to provide resiliency or risk reduction for storms with a greater yearly return frequency than the 100-year event and that would produce the type of overtopping (wave or surge plus wave) that would cause levee erosion. Some issues that must be considered include the long term settlement of newly constructed levees, future levee lifts, relevant sea level rise and subsidence. He stated that the goal should not be to reduce risks from only one mechanism of failure (erosion caused by overtopping), but to reduce all risks. The armoring team agreed that it does not make sense to look at armoring alone for risk reduction for events greater than the 100-year event. There would be so much overtopping from waves or waves plus surge in an event greater than the 100-year event that catastrophic flooding would occur even if the levees do not fail. The CPRA's perspective is that it would be short sighted to ignore the risks and not use the best available resources in the most cost effective ways. He noted that the issue results from the interpretation of the authorization language.

Mr. Brouillette explained that the CPRA used a weir equation with the USACE's performance ranges to determine the amount of overflow that could be anticipated:

Preliminary Performance Ranges		
Material	Performance Ranges (CFS)	Equivalent Water Height Overtopping Levee (weir flow) (FT)
Bermuda Grass	0-1	0.5
Enhanced Grass	0-1*	0.5
HPTRM (Reinforced Mats)	1-4	0.5 – 1.1
ACB (Articulated Concrete Block	>4	>1.1

*Estimated Value

Mr. Brouillette reviewed the CPRA's concerns:

1. While reinforcing mats (TRM) improve resiliency by hardening the levee, it does nothing to reduce the damages produced by overtopping.

2. Reinforcing mat materials have to be properly installed to avoid costly maintenance.
3. Reinforcing mats will have to be replaced every time a new lift is place.

Mr. Brouillette pointed out that the levees in St. Charles Parish will require a lift in the 2015 time frame. The USACE anticipates having armoring in place by the beginning of the 2012 hurricane season. In effect, after having spent perhaps several million dollars for armoring, it will provide about three years of partial buy down of risk before the products will have to be removed for a levee lift.

Mr. Brouillette referred to a chart that showed the fragility curves produced by the USACE's risk team. One hundred fifty-two storms were propagated with the surge and waves tracked by the hour or half hour along every reach of the system. The accumulation of water from surge and waves overtopping a reach was integrated with time and a level pool analysis was performed to distribute the water in the polder. The elevation of water is thereby established for a storm with a certain frequency of return for a condition of all fail or no fail. A no fail condition means that the levee has been armored so well that it cannot be breached; however, the levee can be overtopped. An all fail condition means that wave or surge overtopping exceeds the allowable limits of the grass resulting in breaching in the reach. The breach may be down to the levee toe with open flow through the breach and catastrophic flooding. It is hoped that armoring would achieve a level of risk reduction between the two curves (no fail condition and all fail condition). It was pointed out that level pool analysis used NAVD (North American Vertical Datum of 1988) and did not analyze conveyances. Charts showing several examples of the CPRA's data for various reaches around the system were reviewed along with the average economic damages in dollars (not annualized) associated with the water depth for a 100-year, 500-year and 750-year event.

Mr. Brouillette stated that TRM can be difficult to install and maintain. A picture of an area where TRM was installed in a segment of the Lafitte Pen Levee was shown. He explained that the TRM in this instance may have had only a couple of inches of cover and that a section of the mat had popped up posing a problem for grass cutting equipment. Mr. Miserendino pointed out the potential for TRM to slip when large tractors with grass cutters are used on the levee slope, which can result in damage to both the levee and the equipment.

Mr. Brouillette commented on the CPRA's perspective of possible recommended alternatives for improving resiliency based on the lift schedule for levees. A multi-prong approach should be used for each reach based on the environmental conditions and the history of the reach. The first recommendation is to place an additional lift now on the levees with TRM to move the next lift beyond ten years. The second recommendation is to harden the levee crown with the placement of asphalt or some other type of armoring (e.g., a gravity wall or I-wall) to increase the elevation and reduce the overtopping rate to less than one cfs.

Mr. Jackson stressed caution about the use of I-walls and against creating a mechanism similar to the walls that failed during Hurricane Katrina. He pointed out that the critical point is at the toe of the levee and suggested that this is the point that needs to be addressed. He agreed that it would be better to increase the elevation of the

system to deal with a higher storm return frequency; however, he added that the chance of this being done is very slim.

Mr. Brouillette discussed a chart illustrating the uncertainties relative to 500-year versus 750-year storm surge events. He commented that in being fair and honest about the predictability of storm surge that the 750-year storm surge event should be used as a target. He stated that there is time to evaluate the various alternatives and make fully informed decisions because the levees were constructed above the design elevation.

Mr. Brouillette commented that risk, as defined in the USACE's alternative draft report, is the hazard probability times vulnerability times the consequences. He stated that the focus should be on all of the consequences, including levee damage, loss of human life and infrastructure damage. The USACE defined resiliency as the ability for any component of the hurricane protection system to maintain its functionality, without catastrophic failure, when subjected to forces greater than its design level. He stated that the definition of resiliency should be broader and should include resiliency of the people and infrastructure, as well as the structural elements. Catastrophic failure includes not only the loss of a levee section, but also catastrophic flooding. The 4th and 6th Supplements were reviewed and provide appropriations of \$170 million and \$459 million, respectively, for armoring levees in the greater New Orleans area. About \$90 million has been used leaving approximately \$500 million in the appropriations. Both supplementals incorporate by reference 33 USC § 701n, which states:

“(a)(1) There is hereby authorized an emergency fund to be expended in preparation for emergency response to any natural disaster, in flood fighting and rescue operations, or in the repair or restoration of any flood control work threatened or destroyed by flood, including the strengthening, raising, extending, or other modification thereof as may be necessary in the discretion of the Chief of Engineers for the adequate functioning of the work for flood control, or...”

Mr. Brouillette stated that the best value for the nation, the State and the greater New Orleans area is full risk reduction and not risk reduction from waves only.

Mr. Brouillette concluded the presentation by stating that armoring will significantly reduce risks beyond the 100-year level of protection and will add resiliency to the system above the 500-year storm surge event. It will reduce residual risks, excluding overtopping and rainfall. However, residual risks cannot be eliminated without raising the walls and levees. The solution should not be schedule driven. The solution should consider quantitative risk reductions, including risk reductions that will occur to people, levees and infrastructure considering settlement, relative sea level rise, lift schedules and future flooding. He reiterated that 33 USC § 701n clearly allows elevation as an alternative.

Mr. Doody stated that the system needs to be armored; however, the date by which it must be armored is open. The decision should not be rushed just so that armoring will be in place by June 1, 2012. He stated that he hoped to develop a resolution jointly with the other sponsors to send to the USACE explaining the importance of armoring and to request that there not be a specific date and time by which to have the system armored.

Mr. Jackson expressed concern about not obligating the monies for armoring in this fiscal year because of the current economic climate. He asked if contracts are not obligated in this fiscal year, can the armoring monies be held until the next fiscal year. Mr. Mabry advised that he would bring this question back to the USACE for an answer.

Mr. Wilson asked whether armoring is required for accreditation. Mr. Mabry replied that armoring is for resiliency above the 100-year level and is not a part of the accreditation package. Mr. Wilson pointed out that it took 5-1/2 months to grow and establish the grass used in the CSU tests. He concurred that a June 1, 2012 deadline should not be pressed and that the appropriate time should be afforded to make the right decision. He commented on the subsidence taking place in St. Charles Parish and the engineering difficulties that could be encountered in attempting to place a wall atop a levee.

Mr. Doody requested that Robert Lacour, SLFPA-E General Counsel, draft a resolution to request that there not be a hard and fast deadline to complete the armoring by June 1, 2012. The resolution will be circulated to the SLFPA-W, the Pontchartrain Levee District and Plaquemines Parish in order to come to an agreement on the language. He asked if one of the reasons for the armoring deadline relates to the issue of releasing contractors, that Mr. Mabry take back to the USACE the question of the levee districts possibility taking on some of the O&M responsibilities so as not to be held to a June 1, 2012 deadline.

Mr. McCrossen advised that the NOV (New Orleans to Venice) levee in Plaquemines Parish is not scheduled for construction until 2013, which is beyond the June 1, 2012 deadline for armoring.

Mr. Doody commented that there seemed to be a consensus among the local sponsors that there should not be a hard and fast deadline of June 1, 2012. However, there is not yet a consensus on the recommendations for armoring. He suggested that the local sponsors meet without USACE representation so that a consensus can be developed on a recommendation to the State. The State will take the local sponsors' recommendations into consideration in the development of its recommendation. The State (the Non-Federal Sponsor) will then provide its recommendation to the USACE.

Mr. Miserendino asked whether a resolution should be drafted requesting the USACE to technically evaluate the State's alternatives in order to determine the best protection available. Mr. Mabry pointed out the inability of the USACE to evaluate an alternative that is not authorized. Mr. Doody recommended that the attorneys for the USACE and the sponsors discuss the language and interpretation of the authorization.

Mr. Doody requested that the local sponsors meet within the next several weeks so that a response with a clear message on recommendations for armoring can be provided to the USACE as quickly as possible.

There was no further discussion or business; therefore, the meeting was adjourned at 11:15 a.m.