DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
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NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF

13 November 2013

CEMVR-EC-DM/CEMVN-ED-E

MEMORANDUM FOR Commander, Mississippi Valley Division (CEMVD-PD-N/Mr. Rayford Wilbanks)

SUBJECT: Independent External Peer Review of the Hurricane and Storm Damage Risk Reduction System (HSDRRS) Gulf Intracoastal Waterway (GIWW) – West Closure Complex (WCC)

1. Reference the Final Independent External Peer Review (IEPR) Design Review Report for the Independent Review of the Greater New Orleans Hurricane and Storm Damage Risk Reduction System (HSDRRS) Gulf Intracoastal Waterway (GIWW) West Closure Complex and the IEPR: Final Construction Site Visit Summary Report for the HSDRRS GIWW WCC, both dated December 22, 2011, and Subject Memo dated February 10, 2012, transferring the disposition of the IEPR to the New Orleans District (MVN) Protection Restoration Office (PRO) through the National Planning Center of Expertise for Coastal Storm Damage Reduction, CEPCX-CSDR.

2. The IEPR review panel consisted of eight (8) panel members selected by the Battelle Memorial Institute with technical expertise in eight (8) major engineering disciplines (Geotechnical, Structural, Civil, Hydraulic, Mechanical, Materials, Electrical, and Operations and Maintenance Engineering). The IEPR effort consisted of a review of the project design documentation, numerous meetings, teleconferences, as well as site visits to the project at different times throughout construction.

3. A total of 384 comments were submitted by the IEPR Team. The USACE PDT evaluated each comment and provided a response that included specific revisions that have been made to the Design Documentation Reports (DDR) and Geotechnical Reports, as appropriate.

4. The following comments from the IEPR Report by the reviewers are furnished to highlight important or critical items that were discussed, as well as, outstanding items. Comments from the report are reproduced here in *italics* followed by the USACE response.

A. General Comments

(1) In the May 2010 IEPR project update and briefing, the IEPR Panel learned that a significant amount of design and construction had occurred that was not subjected to the IEPR process. While the USACE PDT concurred, it cited time constraints and the desire to prevent design and construction delays as reasons

for proceeding without performing IEPR activities. In closing the comment, the IEPR Panel noted the concerns and expressed non-concurrence because initiation of IEPR activities was not dependent on completion of the DDRs, especially for many of the geotechnical engineering design, analysis, and construction issues.

The scope of the IEPR was such that design & construction was not to be delayed. The Design Summit yielded design changes which reduced cost, subsequently delaying the completion of DDR's and the IEPR review.

(2) *Time constraints were cited as the reason why certain activities were not performed during construction. For example, the large sector gate's temporary cofferdam used spiral-welded pipe (SWP) piles as load-carrying members in its construction. This was one of the first applications of such piles for this purpose by USACE on HSDRRS projects. Therefore, for a variety of technical reasons, an IEPR panel member commented that time constraints were not sufficient to preclude follow-up pile driving analyzer work on selected production piles. The IEPR Panel closed the comment because the IEPR review was conducted after construction occurred, so the USACE PDT could not make modifications to the monitoring program for these piles. Furthermore, USACE PDT personnel indicated that the pile driving analyzer would be used to monitor and document pile installation.*

SWP were approved by MVD specifically for the cofferdam prior to the completion of the SWP study because everyone was confident at the time that SWP would be acceptable for this use and approved for USACE in the very near future.

Bending tests were conducted on SWP during the SWP study. All piles in a foundation are subjected to both axial and bending stresses. The SWP study applies to the king piles. PDA (pile driving analysis) was conducted on 6 of the king piles after being driven to their final tip elevations to assess their integrity. The PDA tests concluded that there was no indication of pile damage and that all piles had integrity values of 100 percent at the end of redrive.

(3) *Early on during the IEPR, the IEPR Panel was instructed to review the DDRs and to use the appendices for reference only. The Panel commented that under this restriction, a proper engineering review could not be conducted, and that fact-based opinions about the adequacy and appropriateness of the engineering parameters, the analytical approaches, and the results used to guide design and construction could not be formulated. Following discussions in DrChecks and in*

a September 2010 teleconference, the USACE PDT agreed that reports from project consultants and the reports' appendices were part of the DDRs and should be reviewed as part of the IEPR. Given this answer from the PDT, the IEPR Panel closed the comment and thereafter, IEPR activities included reviewing the DDRs, appendices, other supplemental documents, and follow-up commentary provided through the DrChecks process.

The Pump Station DDR is large (over 5700 pages). The scope of work attempted to limit the review time to critical items per the HQ review charge (four questions). The reviewers were not restricted from reviewing the appendices. If reviewer feels the info pertinent to the review charge, then that section of the appendices should be reviewed and commented upon.

(4) *Some questions arose about the ECI process itself, and what was learned and changed by the design team as a result of the use of the ECI process. There also were concerns that the ECI involvement occurred too late in the process to be effective. The USACE PDT responded that the award to the ECI contractor was made early in the design process and was effective as it resulted in incorporating changes in the design. In closing the ECI related comments, the IEPR Panel suggested that the PDT provide greater documentation of the process in log format and assure that design changes be included in the final DDR. The Panel believes those lessons learned could be very beneficial to future design teams assigned to work on similar projects.*

ECI Contract was awarded in April, 2009, early in the design phase. ECI Contractor (Gulf Intracoastal Contractors) has been extensively involved in design reviews. When GIC proposed changes, the USACE closely reviewed and incorporated those changes into the design.

An ECI AAR has been conducted by MVN and several lessons learned were identified and available for use on future ECI projects.

(5) *During the review of the DDRs, the IEPR Panel commented that the level of detail was on occasion insufficient to make evaluations and formulate opinions about the adequacy or appropriateness of the analysis and design as required. In support of those comments, ER-1110-2-1150 was cited. Following discussions in DrChecks and in the September 2010 teleconference, USACE evaluators agreed that the content and level of detail presented in the DDRs would be enhanced. This USACE evaluator comment addressed the Panels' concerns and the related comments were closed. The agreement to enhance the content*

of the DDR's resulted in additional clarity and better documentation for many aspects of the project documents. Specifically, this resulted in better documentation, descriptions, and discussions of critically important geotechnical issues such as:

a. Area and site geology
b. Stratigraphic profiles
c. Field and laboratory data interpretation and data validation methods
d. Parameter selection, including data sources and selection rationale
e. Assumptions and their implications and limitations on design, construction, and performance
f. Sources of information and citations of important supporting or supplemental studies and references

DDRs lagged behind plans & spec packages in general due to the time constraints of the project. However, DDRs and Geotech reports have been updated to not only address IEPR comments but to also complete the documentation process. Additionally, EDC DDRs are currently being finalized and reviewed.

(6) *The IEPR Panel inquired about the types of cement being used for the project to ensure that Type III cement is avoided in these water control structures because Type I/II was specified in the project specification documents. The panel members drew attention to the specification of both types of concrete to ensure that tricalcium aluminate (C3A) content in any Type I cement used in place of Type II would be less than 8 percent. USACE provided assurances that Type II cement was used in all project phases. Given this assurance the IEPR Panel closed the related comments.*

A master specification for structural and mass concrete was developed thru the ECI process for the entire project. Refer to the master specs for concrete and material source requirements.

(7) *The IEPR Panel questioned the combinations of cement, fly ash, and blast furnace slag used. The Panel indicated that some proportions of the cementitious components used on the 404(c) wall favored the use of higher mineral admixture. In the opinion of the panel members, the durability of the concrete could be best ensured with lower proportions. References were provided by USACE from the American Concrete Institute (ACI) to support the higher proportion used. The rationale for the higher proportion of the mineral*

admixture was to control high temperature in mass concrete components of the structure. The IEPR Panel accepted the opinion of ACI and closed the comment.

A master specification for structural and mass concrete was developed thru the ECI process for the entire project. Refer to the master specs for concrete and material source requirements.

(8) The IEPR Panel expressed concern that the Estelle Water Control Structure was intended to be operated manually during a storm event rather than remotely. If, for some unforeseen reason, this structure is not closed at the proper time, the integrity of the entire complex will be compromised. The USACE PDT commented that there will be back-up control systems for closure of the sector gate, and the comment was closed.

There is no remote operation, and the gates are powered by a portable generator. Permanent power and remote operation would have added significant costs to the project.

(9) *The IEPR Panel recognized that effective system performance is directly affected by how the individual project features/components are operated in concert with each other and how they are maintained. The IEPR panel members therefore believe that the production of an O&M Plan/Water Control Manual that clearly describes the operational triggers and protocols is essential and should be subject to the IEPR process. The USACE PDT provided assurance that the O&M manual would be subject to IEPR review, and the comment was closed.*

The routine maintenance/inspection schedule is outside the scope of the design DDR. The WCC OMRR&R Manual & Water Control Plan (WCP) both underwent DQC and PDT reviews. The WCP has been finalized and approved by MVD. The OMRR&R Manual is currently being finalized and will be submitted to MVD for final approval.

(10) *The IEPR Panel was concerned about the long-term viability of the GIWW WCC system with regard to O&M and asked who will be the O&M entity. USACE responded that the Coastal Protection and Restoration Authority (CPRA) of Louisiana (State of Louisiana agency) is the non-Federal sponsor for this project. As such, the CPRA will be responsible for long-term O&M. The Panel recognized that the State of Louisiana agency has an impressive record of water management achievement, but lacked experience with operating a pump station*

or sector gate as large as those proposed for the GIWW complex. The Panel agreed that the CPRA was a capable O&M entity and closed the comment.

CPRA also works closely with local drainage and levee authorities who may be designated to operate the complex (at the discretion of CPRA).

(11) *The IEPR Panel raised questions regarding connections between the individual project components, such as the 404(c) wall and the sector gate, all of which were answered by the project designers appropriately and professionally. In closing the related comments, the panel members further noted that such concerns/questions are not uncommon while reviewing 95% documents.*

A hard connection was avoided. The connection details were coordinated between the final plans of the pump station and large gate, as well as, the closure wall and the 404c T-Wall. The Closure Wall has a Tie-In T-Wall that was utilized to connect to the large gate. Further clarification was provided via subsequent RFIs from the contractor.

B. Pump Station Comments

(1) The IEPR Panel had questions about having plans designed to handle flotation of a partially constructed structure in the event of a major flood. USACE responded that preventing flooding or flotation during construction is the responsibility of the contractor and the comment was closed.

The dewatering during construction to prevent flooding or possible floatation due to groundwater is the responsibility of the contractor and is to be maintained by his means and methods.

(2) The IEPR Panel questioned what thermal analysis was performed for the very large foundation and wall concrete pours to determine reduced pour heights or additional reinforcement for crack control in the mass placements. USACE responded that a master specification for structural and mass concrete was developed through the ECI process for the entire project and the comment was closed.

A master specification for structural and mass concrete was developed thru the ECI process for the entire project. Refer to the master specs for concrete and material source requirements. Thermal analysis was performed by the contractor in the ECI process to determine proper mix designs.

(3) The IEPR Panel questioned why protective pile dolphins were not used. USACE responded that such protection systems would be designed by the Mississippi Valley Division, New Orleans District (MVN) for upstream and downstream of the pump station. The comment was closed by the Panel with the understanding that MVN would include that documentation in the final DDR and that an independent review of that section would be performed by the team or another party.

Dolphin design was not part of the PS design. The dolphins were designed by MVN for the entire WCC site. A Dolphin design is detailed in the Large Sector Gate DDR and underwent DQC, BCOE & ITR review.

(4) For the 100% Pump Station DDR, the IEPR Panel was concerned that the total hydraulic capacity of the pump station was stated differently in different places in the DDR and was apparently less than the total pumping capacity of the local parish pumping stations contributing to the project. After additional documentation was provided and reviewed, and after extensive discussions with USACE personnel were held, the review comments were addressed and the comments were closed. Specifically, the inconsistencies in the total hydraulic capacity of the pump station were corrected. In addition, additional material justifying the corrected pump station capacity was provided and reviewed.

There are 11 pumps rated at 1,740 cfs at design head leading to 19,140 cfs station capacity. The DDR has been updated to be accurate and consistent.

(5) The IEPR Panel considered the risk of a fuel-driven fire and smoke event in the pump station and safe house. Comments related to ventilation and personnel safety in the safe house were resolved by responses provided by USACE and the comments were closed. Considering its importance, fire protection was considered during the construction site visits.

The operators have the ability to shutdown an engine from the control room (PLC and hardwire) or locally at the pump control panel upon authentication of an alarm from the fire alarm system. The action of shutting down the engine closes fuel supply solenoid valves which are normally closed (energize to open). There is no other automatic fuel shutoff system. An analysis has been performed to address specific code requirements for the pump station and safehouse.

(6) The IEPR Panel noted the 100% Pump Station DDR was silent on the design of the pump station sluice gates. The USACE responses in DrChecks provided a

clear description of the design requirements for the sluice gates, and the panel members understand these sluice gate design criteria will be added to the Pump Station DDR. The panel was satisfied with the USACE response and the comment was closed.

The Sluice Gate design criteria/requirements are located in a separate DDR. References located in the PS DDR in regards to the sluice gates have been updated.

(7) The IEPR Panel made several comments related to electrical issues during the review of the Pump Station DDR. The primary electrical issues involved adequate redundancy in the utility service, the physical protection of the fuel supply and electrical service to ensure continued service during a storm event, and maintenance of communication facilities. Issues were communicated through DrChecks, and the panel members were satisfied that proper consideration was given to providing adequate electrical and communication systems to serve the pump station and the related comments were closed.

The fuel tanks are steel double walled ballistic proof and the piping from the fuel farm is double walled for reliability and redundancy. Fuel to the engines is just as important as it is to the emergency generators in order for the pump station to serve its purpose. The reliability of the fuel system was given high priority in the design. The day tank for the generator will provide enough fuel to start the generator units to power the fuel transfer pumps if necessary.

Surge protection to protect the equipment has been designed in detail and is specified for instrument power, analog signals, and telecommunications. The specification sections can be found in 40 95 00 parts 2.5.2, 2.5.3, and 2.5.4.

Power line configuration is by Entergy Corp. They are responsible for the feeds that provide service to the site.

All fiber optic pathways are installed in a manner to afford maximum protection from physical damage, e.g. the pathway to the fuel tank farm is installed below grade with concrete encasement. Physical protection of pathways will increase the reliability of the fiber optic network and all communication systems.

C. Sector Gate Comments

(1) The IEPR Panel questioned why the Preliminary – 95% Submittal of the DDR rather than a more final version was being reviewed since construction was well under way. The USACE responded that the DDR would not be finalized until construction is completed for inclusion of any final changes. The comment was closed by the reviewer.

DDRs are a living document during design and construction. The EDC DDRs are currently being finalized and reviewed.

(2) The IEPR Panel questioned whether any thermal analysis had been performed for the 10-foot-thick base slab to determine if additional crack control reinforcement or reduced pouring sequence should be provided. The PDT responded that the CTL Group had provided the thermal analysis and provided additional explanation in its response, and the Panel closed the comment.

Thermal modeling was performed by CTL Group for each mass concrete structure to predict concrete temperatures and temperature differences as a function of time. Modeling used the US Concrete mix designs developed for this project and considered the range of expected placement conditions. The thermal modeling was performed using CTL's software originally based on the Schmidt Method. CTL then developed a thermal control plan for each structure to limit the maximum concrete temperature to less than 160 degrees F and limit the maximum differential temperature to 50 degrees F (since limestone aggregate is used). Temperature monitoring using maturity equipment is also performed to assure that the maximum temperature and maximum temperature differential are not exceeded.

(3) The IEPR Panel questioned whether any model testing had been performed on this large sector gate, since the gate is 10 times heavier than typical gates in the United States and since buoyancy tanks are being utilized. Methods for confirmed reliability for such a large gate performing in service conditions were also questioned. The PDT responded by providing additional text to be added to the DDR that contained supportive information for the design and construction process and the Panel closed the comment.

The below text has been added to the paragraph in the DDR and summarizes the model testing completed and the redundant closure mechanism added in case of primary machinery failure: The presence of the buoyancy tanks necessitated an alteration of the sector gate nose at the point where the gates miter. Model testing in the 1970s showed that the geometry of the gate at this location was critical to the forces on gate operating under reverse head. Because of this alteration, model testing was conducted on an existing gate with modified geometry matching that of the buoyancy tanks to determine if the operating forces increased due to this geometry. Model testing showed that no increased loads are seen on the gate during operation during a reverse head condition due to the geometry of the buoyancy tanks. A report summarizing the model testing can be found in Appendix V of the DDR. Because of the size of the gate and the risk associated with a closure of its size when relying on buoyancy, a redundant closure mechanism was installed on both gates in the event that the operating machinery malfunctions. The redundant closure mechanism consists of a series of electrically operated capstans located adjacent to the gear that allow the gates to be closed with high strength rope.

(4) The IEPR Panel requested that more information be provided on other cofferdam types and schemes that were investigated or considered, noting that the DDR should serve as a paper trail for the design and analysis process. In addition, the Panel questioned whether any in-the-wet schemes were considered or ECI revisions made. The PDT responded that more DDR information is not necessary because cofferdams are temporary construction and that the ECI contractor did not suggest any in-the-wet techniques, so none were investigated. The comments related to the cofferdams were closed by the Panel.

More detailed information is not necessary for the cofferdam, especially considering that it is a temporary structure and was removed in less than a year. The ECI Contractor provided input and was not in favor of any "in-the-wet" techniques; therefore they were not investigated.

(5) A series of comments related to clarifications or inconsistencies between the drawings, specifications, and the DDR were made on the drawings of the hinge, bearing, and bracket assembly on the sector gate and were mostly minor; those comments focused on constructability and provisions for future gate maintenance. The final construction of the hinge and bearing resolved these comments, as described by the USACE responses to the panel member's comments in DrChecks. Based on these responses, the Panel closed the comments.

The hinge pin is tightly supported by both the upper and lower hinge plates. The drawings have been modified to show the tight fit on the lower plate and provide a tolerance. No bushing is being added as the maximum bearing load on the plates is 20 ksi and the gate will not be operated frequently.

A modification increased the key size to 2" square to handle additional stresses imposed by service and maintenance loads.

The expansion/contraction of the hinge and pintle will be in the hundredths of an inch. There is vertical clearance on the top and bottom of the ball and bushing and clearance at the bottom of the pin for lateral expansion. Grease has been added between the pin and the ball per modification to provide lubrication for vertical movement. The hinge pin was greased prior to insertion into the hinge ball. There is a 1/2" clearance between the hinge casting and the hinge plates. Construction tolerances were checked to ensure this gap was maintained.

The entire gate assembly was constructed in the shop and lifted into place at the site. The only field connection was the bolting of the gate to the hinge base casting.

The current arrangement has been used successfully on other USACE projects without incident and will be maintained for this project. Additionally, many of the components were already fabricated so a change in system at that point could have created delays.

(6) The IEPR Panel made several comments related to electrical issues during the review of the Sector Gate DDR. The primary electrical issues involved the completeness of the electrical calculations to demonstrate adequate service capacity, the physical and electronic protection of the system to ensure continued service, and adequate, efficient lighting of the facilities. Issues were communicated through DrChecks, and the Panel closed the related comments satisfied that proper consideration was given to providing adequate electrical and communication systems to serve the sector gate.

The DDR was updated with the sector gate complex electrical load and the size of the feeder from the pump station.

Transient voltage surge suppressors (TVSS) were installed in the motor control center and the panelboard in the Control House. The TVSS units were installed to interface the main bus bars of the MCC and the panelboard. The TVSS units provide a high degree of equipment protection for internally and externally generated voltage spikes and over-voltages.

A ring network topology was considered during initial design. However, due to limited space and access, a single duct bank was incorporated to accommodate the cables for the sector gate complex. There are spare conduits in the duct bank for future use.

PLC system equipment is supported by UPS within Control Cabinet CC0 inside the Control Room (CS0) located in the Pump Station Safe House and also within CC1 inside control house (CH1) indicated on Drawing Sheet E-351. The DDR paragraph has been edited to state this.

The DDR has been revised to indicate the use of high efficiency HPS fixtures for exterior flood lighting. Fluorescent fixtures are used for illuminating the interior of the control house.

D. 404(c) Wall Comments

(1) *The IEPR Panel commented that for better documentation in the DDR and a more complete paper trail, the DDR should contain a number of plates or sketches and key references to contract plans (to serve as more of a stand-alone document). USACE responded that complete design drawings will be added to the final DDR and the comment was closed.*

Complete design drawings have been added to the DDR.

(2) The IEPR Panel was concerned about how the construction of the ~4,000-foot-long wall would be sequenced and suggested that information on checkerboard placements, starting/ending point locations, pouring frequency, etc., preferred by the PDT/ECI Contractor should be added to the final DDR. The USACE PDT responded that such information would be added. The panel members requested to see the additional discussion and closed the comment.

Discussion about preference for sequencing of work was added to the DDR.

(3) The IEPR Panel questioned the analysis of expansion and contraction along the ~4,000-foot-long wall and justification for only one-half-inch expansion joints between monoliths. Joint details are shown on the contract plans, but no text is provided in the DDR. USACE responded that expansion joint details and monolith lengths are in accordance with the HSDRRS Design Guidelines, no thermal analysis was performed, and special methods are not required for expansion control. USACE further stated that information will be provided in the final DDR and the Panel closed the comment.

The text in the DDR is a quote from the HSDDRS Design Guidelines. No thermal analyses were completed for the wall stem. The expansion joint details and monolith lengths are in accordance with the Design Guide. A paragraph was added that documents this. No special methods are anticipated for expansion control.

(4) The IEPR Panel was concerned by the lack of design documentation in the DDR for the protective steel dolphins, which are a critical element for the protection of the 404(c) wall. USACE responded that the dolphin designs were covered in a separate design package (WBV-90Q) not provided to the Panel. The IEPR Panel accepted the USACE response and closed the comment.

The protective steel dolphins are covered in a separate design package (WBV-90Q). Reference to steel dolphin design was added to the DDR.

E. Closure Wall Comments

(1) *Because the temporary cofferdam piling is planned to be reused for the permanent combination wall, the IEPR Panel was concerned about the acceptance criteria for the reused sheet and SWPs. The USACE PDT provided an explanation in DrChecks of the processes for cleaning, inspection, and acceptance per dimensional tolerances that are covered on the plans and in the technical specifications. The Panel accepted the USACE explanation and closed the comment.*

The final report by the spiral welded pipe innovation team was issued in February 2010. The team's recommendations included tolerances on pile out-of-roundness, straightness, radial offset, weld reinforcement, misalignment of weld bead, wall thickness, and outside diameter. Also included in the recommendations were weld quality requirements and depth to thickness (d/t) limits. Per the SWP innovation team report, if the piles exceeded a d/t limit of 55 (which was the largest d/t ratio that had actually been previously tested) the piles were to be tested utilizing a four point bend test to demonstrate adequate performance (minimum ductility ratio of 2). The spiral welded pipe piles for the cofferdam were 7/8" thick, with a radius of 54" thus providing a d/t ratio of 61.7, which slightly exceeded the d/t limit of the innovative team's recommendations.

All the piling from the cofferdam that was reused for the closure wall was tested (dimensionally and weld tested) to assure they met the same requirements as new piles per the SWP report. Some new piles were purchased for the closure wall to minimize risk in the schedule due to potential difficulties in pulling piles and rolling schedules for new piles. The cofferdam piles were pulled and no damage from driving, pulling, and handling was observed.

The use of spiral welded pipe piles installed on a batter or subject to bending loads is consistent with the recommendations of the innovation team's SWP report. The following has been added to the DDR in section 4.1.11.5: "Past experience with spirally-welded pipe piles have identified some concerns with their use. These concerns include weld quality assurance to prevent unsatisfactory performance during driving, potential disturbance of the soil frictional resistance by the external weld bead, geometric tolerances for effective field splicing, and dimensional proportions to guarantee structural capacity. A report prepared by the Spiral Welded Pipe (SWP) Innovation Team (Phase IV Report: "Spiral Welded Pipe Piles For Coastal Structures, February 2010") addressed these concerns and identified limitations and requirements for the use of SWP piles. The recommendations from this report were incorporated into the West Closure Complex specifications."

(2) The IEPR Panel asked whether corrosion protection should be provided on the temporarily exposed steel structure above El.-1.5 until it is encased in concrete for the permanent structure. The USACE PDT stated that no corrosion protection was necessary for that portion of the structure because it will be in place only for interim protection, the anticipated exposure period will be less than 1 year, and the structure will then be removed for installation of the permanent structure. Given this response, the Panel closed the comment.

No corrosion protection was provided as this portion of the structure was in place only for interim protection and the exposure period was less than one year. The exposed area was removed for installation of the permanent structure.

(3) The IEPR Panel had several comments concerning the comparison performed between Alternatives 1 through 4, stating that more detail and clarifications were necessary to explain the selection process. Furthermore, an Alternative 5 was dismissed without further discussion. Additional information and justifications were included in the PDT's response in DrChecks. The panel member suggested adding the additional information in the DDR and closed the comment.

It was determined by the design team and the construction contractor that the tie-in t-wall foundation had to be constructed prior to dewatering the cofferdam to meet interim protection, so there was limited time to develop options and we were provided well defined parameters within which to develop options. Options were limited by constructability issues inside the cofferdam so there was little room for variation. The subtle differences contributed to the decision made. As stated in the DDR, alternative 5 was ruled out by inspection. Documentation of this was updated in the DDR.

(4) The IEPR Panel had specific safety concerns with the timing of cutting the interim closure wall during the summer of 2011. The USACE PDT noted the concern and stated that the schedules for that activity would be negotiated. In closing the comment, the panel members recommended that the final schedule be negotiated as close to November 30 as feasible in order to maximize protection during the hurricane season.

The design for Phase II of the Closure was completed after the design cut-off date for negotiations; therefore it is considered a mod. Schedules for this activity were established after negotiations were complete.

Ultimately, this item was addressed, as construction on the permanent closure wall did not commence until after hurricane season ended.

F. Sluice Gate Comments

(1) The design of the sluice gates themselves was not included in the DDR, and the IEPR Panel requested that this information be added. The PDT noted that the original specification required cast iron gates that met a performance specification, however, the contractor submitted an alternative stainless steel gate constructed of welded built-up members. New calculations for the stainless steel gate designed by the contractor were submitted and approved by the USACE PDT, and this information will be included in the final DDR. The Panel appreciated the complete response provided by the USACE and closed the comment.

The original specs required a cast iron gate that met a performance spec. The Contractor submitted a stainless steel alternative that gained favor given the reduced maintenance. The alternative stainless gate is constructed of welded built up members. The main girders act compositely with the skin plate; the girder was designed as a simple supported span. Calculations were submitted and approved by the Government. Those calculations have been added to the DDR.

(2) The IEPR Panel questioned whether the design and DDR documentation should include information on debris impact, since the planned protection dolphins may not prevent that load case from occurring. The USACE PDT

responded that a debris impact load of 0.5 kip per linear foot would be added to the DDR and the Panel closed the comment.

The dolphins are closely spaced such that vessel impact is low risk; only a debris loading was applied to the sluice gate. The following sentence was added to Section 5.1.5.4 of the DDR. "A debris impact loading was added to the sluice gate design, which is discussed in Section 5.1.9 of this DDR". The following sentence was added to Section 5.1.9 of the DDR. "A debris impact load of 0.5 kip per linear foot was added to the criteria."

(3) The IEPR Panel requested an explanation on the 3-inch expansion joint requirement noted in the DDR and shown on the plans. In response to the request, USACE PDT provided a detailed explanation in DrChecks of how the 3-inch expansion joint requirement was arrived at. In closing the comment, the Panel suggested adding the description provided in DrChecks to the DDR for clarity.

The three inches of deflection was based on lateral movement due to pile foundation deflection, elastic shortening of the piles and global settlement of the pile foundation. The lateral movement of the foundation was negligible. The total differential vertical settlement of the sluice gate was less than ½". The ½" of vertical differential results in 1" of lateral movement at the roof line. The Pump Station also experienced less than ½" of differential vertical settlement, this results in less than 1/4" of lateral movement at the roof line. We conservatively held 1" of lateral movement for each building. Thermal expansion was added to the effects of settlement. Thermal expansion was based on a 70 degree temperature change. This added 1/8" for the sluice gate and ¾" for the pump station. This approximate 1" of expansion was added to the 1" from each building due to differential settlement; conservatively totaling 3". The word "to" was changed to "due".

(4) The IEPR Panel asked whether a thermal analysis was performed for sluice gate pours greater than 4 feet thick. The USACE PDT explained its use of the Level 2 analysis per ETL 110-2-542 and provided information to be included in the updated DDR. Given this additional information, the Panel closed the comment.

A level 2 thermal analysis was performed; a summary of the modeling has been added to the DDR. The criteria for the level 2 analysis is described in ETL 110-2-542. See attachment for the information that will be added to the updated DDR.

(5) The IEPR Panel noted the omission of governing loads for the concrete base slab design, while such information was provided in subsequent DDR sections. The USACE PDT stated that it would provide that information along with accompanying calculations in the updated DDR. Based on this response the Panel closed the comment.

The governing load case will be included in the referenced section of the DDR and has now been properly identified. All other information can be found in the calculations and no other references or sketches are deemed necessary.

G. Outstanding Issues

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

The operating procedure for the pump station during a storm event includes transferring all of the facility's electrical loads from the utility to the standby generators. These generators are expected to run for the entire duration of the storm event. This is a preemptive action because the utility's service to the pump station is entirely overhead from the electrical substation and it may be compromised during the storm.

The conduits on the access bridge are Schedule 40 steel pipes, ranging from 1 inch to 5 inch nominal I.D. They are attached to the access bridge by pipe supports installed on 6'-6" centers on the south side (except at bents where they are 10'-0" apart) and 6'-3" to 6'-9" centers on the north side (except at bents which are also 10' apart). The pipe supports are fabricated with W6X15 beams to which uni-strut conduit supports are attached. The conduits are rigidly attached to the uni-strut with conduit clamps. The maximum distance between horizontal supports allowed by the National Electrical Code for 1" conduit is 12' and as the conduit increases in diameter, this distance also increases. As an example, a 5" conduit may be supported every 20'.

If impacted by flying debris, the conduits may bend, but not fail to the point of exposing their conductors. Conduits are routinely bent to 90 degrees in the field utilizing hydraulic- powered benders. Should the conduits deform in cross section, the conductors within comprise only 40% of the total cross sectional area of the conduit.

This is also a National Electrical Code requirement. Therefore, it is also unlikely that the conductors would be damaged in the case of an impact large enough to cause the conduits to deform.

A modification was issued to add protective netting to close the gap between the dolphins on the intake side of the pump station. This netting was provided to address concerns regarding the potential that a loose barge could access the protected area inside the dolphins and impact the fuel, power and/or control lines that run along the access bridge. The protective netting is provided to prevent the impact of a loose barge.

(2) Fuel oil return system issues *- During the final IEPR visit, the Panel learned of fuel spills from the fuel oil return tank. The cause of the spills was due to the fuel oil return pump controls being left in manual mode or in the OFF position when the dewatering pumps were started. The Panel also learned that the alarms for the fuel oil return system are local to the return tank and do not show up on the control screens near the diesel pumps or in the operator's room where operators are more likely to hear/see them.*

The panel made two recommended changes to the control system which they believe would prevent the overflow of the tank from occurring and also warn the operators in multiple areas that the tank was in danger of overflowing. The USACE recognized the issue and is implementing their own solution which would warn the operators if the fuel oil return pumps are not in auto and provide procedure controls for starting the main pumps. The Panel acknowledged the USACE solution but is still of the opinion that their specific recommendations should be implemented.

Each engine's fuel supply line contains a solenoid valve (NC) at the engine and motorized valve (NC) at its day tank that are closed if the engine is not running. They receive a close signal upon ANY manual or automatic engine shut down. Therefore, fuel from the day tank to the engine will cease to flow when the engine is off.

The ability for an operator to quickly shut down any operating engine exists. Operators have four ways to shut down each engine at the engine control panel, at the pump control panel, at the stop shunts in the Control Room, and via the SCADA system. Therefore, the operators have multiple ways to quickly shut down engines at any time including a fire event.

Return fuel and waste oil tanks are double walled with leak detection in the interstitial space. Both tanks have exterior concrete containment as well. Containment also exists at each engine. There are two capped drains in each engine area. One drain is for oil products, and is piped to the waste oil tank. The other is for other liquids, and it is piped to the floor drain system.

The fuel transfer system is a separate system on a "per pod basis". It provides fuel to the engine day tanks (hence engines) in the pod it serves, and it is not directly connected to any engine. The system operates based on levels in the day tanks and return system. The fuel transfer system is not in continuous operation when engines are running and is based on engine fuel usage rates, which result in the supply system and return system operating less than 50% of the time. Operators have the ability thru the SCADA system to disable the fuel transfer supply pumps should it be necessary to do so. Supply and return fuel lines in the engine room run along the north wall only. All lines are visible. Drip pans are above any nearby electrical panels. The remainder of the fuel lines in the building, the return tanks, and the waste oil tank are below the main operating deck. Everything is visible for operator inspections. In addition, there are CCTV cameras at the equipment deck level below the main operating deck and the main operating deck itself.

5. **Conclusion**. The IEPR of the West Closure Complex was conducted as required, and in accordance with, all applicable laws and USACE regulations. The reviewers of this project were instrumental in providing an additional view of the design documents, including design basis and criteria. At all stages of the review the peer reviewers demonstrated their command of the topics and their desire to contribute meaningfully to improvements to Corps specifications, design calculations, and overall documentation of the design process. They are all to be commended and thanked for their service. The final Design Document Reports (DDRs) and Geotechnical Reports have been updated and are available for reference. This memo closes out the action of the Independent External Peer Review Process.

6. The POC for this action is Timothy M. Ruppert, P.E. at (504) 862-2106 or Matthew Coffelt, P.E. at (309) 794-5743.

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