

CEMVN-ED-HE

21 July 2010

MEMORANDUM FOR: Chief, Structures Branch

SUBJECT: IHNC Lock Replacement Gate Bay Designs – Load Case Summary for Riverine Load Cases

1. As requested, the subject load case summary is attached
2. Points of contact are Mayra Flores, ext. 2459, and Don Alette, ext 2435.

Encl
as

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IHNC Lock Replacement Load Cases Summary of Decision-making Process and Supporting Documentation

Final Submittal Date: 8 Jul 2010

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Introduction:

The IHNC Lock Replacement project will experience several different operational conditions and water levels after construction. This document will list and explain the load cases on the Lock associated with the whole range of operations and storm events. **Table 1** below shows the list of load cases, the water levels (using the NAVD88 datum, epoch 2004.65) for the river and canal side, and the resulting head differential in feet. All of these load cases represent static loads from water levels and do not include any dynamic loads from waves or boat impacts. The table is followed by a discussion of how the values were determined, along with supporting documentation and analysis.

**Table 1
IHNC Lock Replacement
Differential Design Heads**

#:	Condition:	River Side (ft NAVD88)	Canal Side (ft NAVD88)	Head (ft)
1	Hurricane, Maximum Head Stillwater	2.0	12.5	-10.5
2	Operation, Maximum Direct Head	17.3	-0.8	18.1
3	Unusual Operation, Maximum Direct Head + SS	19.3	-2.6	21.9
4	Unusual Oper., Max. Dir. Head + FB + SS	24.1	-2.6	26.7
5	Normal Operation	17.3	-0.8	18.1
6	Operation Reverse Head Navigation Limit	0.0	8.0	-8.0
7	Usual Maintenance Dewatering	8.3	4.0	4.3
8	Unusual Maintenance Dewatering (Gatebays only)	17.3	-0.8	18.1

* SS = Structural Superiority FB = Freeboard

Discussion and Supporting Documentation:

Load Case #1:

The canal side design stage for this load case is based on a conservative estimate of the maximum water surface elevation that would occur if the lowest elevation along the floodwalls paralleling the IHNC is overtopped during occurrences of high stages in the IHNC. As shown on a map entitled "IHNC Reaches 1, 2, and 3 (as of March 14, 2008)" that was developed by the Hurricane Protection Office, the floodwall paralleling the west side of the IHNC has lower top of wall elevations than the floodwall paralleling the east side, and no modifications to the west side floodwall that would alter these top of wall elevations are planned. The lowest top of wall elevations along the west side floodwall north of the location of the north end of the proposed lock range from 12.2 to 12.4 ft NAVD88 (2004.65). Based on these elevations, 12.5 ft NAVD88 (2004.65) is a conservative estimate of the water surface elevation that would occur just north of the proposed lock during an overtopping of the west side floodwall. Due to the large storage volume that is available within the area on the protected side of this floodwall, it would be very unlikely that this water surface elevation would be exceeded.

For the river side (flood side), 2.0 feet NAVD88 (2004.65) will be the design stage used. This stage was determined using the table on page 5 of this document that was prepared for the assessment of the Mississippi River – HSDRRS co-located work. As a conservative approach, the 152 storms were evaluated using a low discharge in the Mississippi River. The minimum still water level that was computed

at the river side of the IHNC Lock (River Mile 91) was 2.10 ft. NAVD88 (2004.65). This stage was rounded to the next lowest even foot to obtain 2.0 feet NAVD88.

Load Case #2:

The river side stage for this load case is 17.6 feet NGVD29. This stage is the Project Flood Flow Line elevation as shown in the latest flowline publication for the Mississippi River Levees (1973 Refined MR&T Project Flood Flowline, June 78). Using -0.3 as the conversion factor between the 0 feet NGVD29 datum plane and the 0 feet NAVD88 datum plane gives 17.3 feet NAVD88.

The canal side stage is the 95% duration stage at the canal side gage, which was computed using the period of record 1983 – 2009. Although a rigorous study of the occurrences of canal side stages coincident with flood stages on the river side was not completed in connection with development of these load cases, it is noted that 1) whenever flood stages on the river side are caused entirely by riverine events, and neither river side nor canal side stages are affected by abnormally high tides, occurrences of river side stages and canal side stages are completely independent events and 2) inspection of a list of annual minimums on the canal side shows that almost all of them since 1978 (70/30 flow distribution at the Old River Complex has been strictly followed since 1978) have occurred during the Mississippi River flood season of December through June. Stages very rarely remain below the 95% duration canal side stage of -0.8 ft NAVD88 for durations of more than about 1 day, with durations of about 2 to 8 hours below that elevation being more typical. This 95% duration stage is therefore sufficiently conservative (but not overly conservative) for this load case.

Load Case #3:

The river side stage is determined by adding 2 ft of structural superiority (the minimum required by DIVR 1110-1-16) to the river side stage shown for Load Case #2.

For the canal side, the record low stage was researched for the period of record from 1983 to 2009. The lowest reading found was -2.61 feet NAVD88 which occurred on March 8, 2008.

Load Case #4:

The river side stage is a top-of-wall stage determined by adding the authorized freeboard to the river side stage shown for Load Case #3. The authorized freeboard at this location, as per House Document No. 308, is 4.8 feet.

For the canal side, the record low stage was researched for the period of record from 1983 to 2009. The lowest reading found was -2.61 feet NAVD88 which occurred on March 8, 2008.

Load Case #5:

The river side stage for the Normal Operation load case was determined using EM 1110-2-2100, "Stability Analysis of Concrete Structures" (1 Dec 05), which defines normal operation condition as maximum loading conditions with a return period of no more than 10 years (annual probability of 10%). As a result of regulation due to operations of the Morganza floodway and the Bonnet Carre Spillway, the 10% annual exceedence discharge is the same as the project flood discharge (1,250,000 cfs); therefore, the 10% stage is the same as the project flood flow line (17.3 feet NAVD88).

The canal side stage is the 95% duration stage at the canal side gage, which was computed using the period of record 1983 - 2009. Although a rigorous study of the occurrences of canal side stages coincident with flood stages on the river side was not completed in connection with development of these load cases, it is noted that 1) whenever flood stages on the river side are caused entirely by riverine events, and neither river side nor canal side stages are affected by abnormally high tides, occurrences of

river side stages and canal side stages are completely independent events and 2) inspection of a list of annual minimums on the canal side shows that almost all of them since 1978 (70/30 flow distribution at the Old River Complex has been strictly followed since 1978) have occurred during the Mississippi River flood season of December through June. Stages very rarely remain below the 95% duration canal side stage of -0.8 ft NAVD88 for durations of more than about 1 day, with durations of about 2 to 8 hours below that elevation being more typical. This 95% duration stage is therefore sufficiently conservative (but not overly conservative) for this load case.

Load Cases #6:

This load case represents the extreme reverse head navigation limit during which the new lock would still be in operation. For the canal side (protected side), 8 feet NAVD88 is the AWSE that was recently determined for the interior reach along the IHNC and GIWW canals during occurrence of a 1% hurricane event. This AWSE would result from the combination of controlled overtopping of the Lake Borgne Storm Surge Barrier and Seabrook Floodgate, pumping of interior drainage into the canals, rainfall directly on the canals and a wind setup of 0.5 ft. As a result of a 3 Mar 2010 phone conversation with Deborah Keller, Chief of Engineering at the Port of New Orleans, the Florida Ave Bridge will not be a controlling factor for navigation at a stage of 8 ft because its span will be stored in a raised position during a hurricane event; therefore, lakebound vessels passing through the lock will still have navigation access to the area along the IHNC between the north end of the new IHNC lock and the Almonaster Bridge.

For the river side (flood side), 0 foot NAVD88 will be the design stage used. This stage is the recommended coincident stage during a hurricane on the canal side, as shown on the table on page 5 of this document. As a conservative approach, the 152 storms were evaluated using a low discharge in the Mississippi River.) The table shows the Minimum SWL of all 152 Storms during low discharge. The minimum still water level that occurred at the river side (mile 91), as a result of drawdown from abnormal low wind tides, was 2.10 (ft.) (NAVD88 2004.65). As stated in the text at the bottom of the table, it has been decided to use 0.00 foot NAVD88 as a conservative estimate for this minimum still water level.

Load Case #7:

For the canal side stage for the "Usual Maintenance Dewatering" load case, stages were determined by using raw gage data from the IHNC canal side gage (76160) and adjusting it to make it comparable to present conditions. These stages were adjusted to reference them to NAVD88, epoch 2004.65 and to account for gage subsidence. For the canal side stage, a duration analysis, for the months of August through November, was performed giving a 5% exceedance of 2.20 feet. When low, intermediate, and high eustatic sea level rise scenarios results for the year 2059 are added to the 5% exceedance stage of 2.20 feet, the respective stages obtained are 2.49 feet, 2.85 feet, and 4.04 feet. (The low scenario is based on a liner projection of historic rate 1.7mm/yr. The intermediate and high scenarios are based on NRC Curve I and NRC Curve III, respectively. These curve values can be found in the EC 1165-2-211.) The stage of 4.04 feet NAVD88 obtained using the high eustatic sea level rise scenario provides a sufficiently conservative (but not overly conservative) value. The eustatic sea level rise values were calculated using the EC 1165-2-211, 1 July 2009, Water Resource Policy and Authorities Incorporating Sea-Level Change Conditions In Civil Works Programs.

For the river side maintenance dewatering stage, a duration analysis of Tarbert Landing discharge values using the low water period of 1 August to 30 November for each year in the period of record 1978-2009 yielded a 5% exceedance discharge of 573,400 cfs. According to the 2008 rating curve constructed for the IHNC river side gage (01340), using a 2-day lag for Tarbert Landing flow, the corresponding stage at this location is 6.49 feet NAVD88. Future eustatic sea level rise values (low, medium, and high scenarios) for the year 2059 were determined using guide lines from EC 1165-2-211, 1 July 2009, Water Resource Policy and Authorities Incorporating Sea-Level Change Conditions In Civil Works Programs. The current HEC-RAS model for the Mississippi River was then used to translate these values from the Venice gage location to the river side of the proposed IHNC Lock, yielding respective corresponding stage values of 6.74 feet, 7.10 feet, and 8.27 feet. The value of 8.27 ft NAVD88,

incorporating the high eustatic sea level rise scenario result, provides a sufficiently conservative (but not overly conservative) value.

Load Case #8:

The river side stage for this load case is 17.6 feet NGVD29. This stage is shown in the latest flowline publication for the Mississippi River Levees (1973 Refined MR&T Project flood Flowline, June 78). Using -0.3 as the conversion factor between the 0 feet NGVD29 datum plane and the 0 feet NAVD88 datum plane gives 17.3 feet NAVD88.

The canal side stage is the 95% duration stage at the canal side gage, which was computed using the period of record 1983 – 2009. Although a rigorous study of the occurrences of canal side stages coincident with flood stages on the river side was not completed in connection with development of these load cases, it is noted that 1) whenever flood stages on the river side are caused entirely by riverine events, and neither river side nor canal side stages are affected by abnormally high tides, occurrences of river side stages and canal side stages are completely independent events and 2) inspection of a list of annual minimums on the canal side shows that almost all of them since 1978 (70/30 flow distribution at the Old River Complex has been strictly followed since 1978) have occurred during the Mississippi River flood season of December through June. Stages very rarely remain below the 95% duration canal side stage of -0.8 ft NAVD88 for durations of more than about 1 day, with durations of about 2 to 8 hours below that elevation being more typical. This 95% duration stage is therefore sufficiently conservative (but not overly conservative) for this load case.

2007 ADCIRC Storm Set – Minimum Still Water Level (SWL) in River for all 152 Storms				
ADCIRC Point ID (Q-set)	River Mile	Approximate Water Surface Elevation at Beginning of Storm (ft. NAVD88 2004.65)	Minimum Still Water Level (SWL) of all 152 Storms (ft. NAVD88 2004.65)	Difference (ft.) (= drawdown)
169	0	2.02	1.81	-0.21
170	10	2.27	2.10	-0.17
171	18	2.54	2.33	-0.22
172	23	2.70	2.12	-0.58
173	30	2.90	1.99	-0.91
174	34	2.98	1.99	-0.98
175	39	3.18	1.83	-1.35
176	43	3.31	1.86	-1.45
177	44	3.42	1.93	-1.49
178	62	3.48	2.06	-1.43
179	66	3.53	2.31	-1.22
180	69.9	3.57	2.35	-1.22
181	77	3.61	2.37	-1.24
182	81	3.68	2.45	-1.22
183	84.2	3.75	2.61	-1.13
184	91	3.79	2.10	-1.69
185	103	3.94	2.37	-1.57
186	115	4.11	2.30	-1.82
187	122	4.21	2.33	-1.88
188	128	4.30	2.24	-2.07
189	138	4.48	2.42	-2.06
190	147	4.67	2.75	-1.92

Table B-1 ADCIRC Lows in Mississippi River

Table B-1 shows that extreme drawdown due to hurricane winds does not occur in the Mississippi River for the 152 ADCIRC synthetic storms from the 2007 storm set. The differences between the starting water surface and the lowest surge level is between -0.17 and -2.07 ft. The minimum surge of all 152 storms is always above 0.00 ft. NAVD88 2004.65, a value that has been used in the past as a conservative estimate for low water. It is recommended to continue to use 0.00 ft. (NAVD88 2004.65) for low water calculations.