US Army Corps
of Engineers ®
New Orleans District

Interim Operating Instructions

For

The Interim Closure Structures and Temporary Pumps at 17^{th} Street, Orleans Avenue and London Avenue Canals

Jefferson and Orleans Parishes, Louisiana

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INTERIM OPERATING INSTRUCTIONS

FOR

THE INTERIM CLOSURE STRUCTURES AND TEMPORARY PUMPS

AT 17TH STREET, ORLEANS AVENUE AND LONDON AVENUE CANALS

SECTION 1 COMMUNICATION PLAN, ORGANIZATIONAL STRUCTURE AND CHAIN OF COMMAND FOR OPERATIONS

1.1 Gate Closure Activities

The interim closure structures and temporary pumps at 17th Street, Orleans Avenue, and London Avenue Canals serve to protect the flood protection systems in those areas from the storm surges of Lake Pontchartrain during storm events. The operation of the closure gates and temporary pumps, and the control of the outfall canal water elevations while receiving pumped storm water from local partner agencies requires complex decision-making and physical activities to safely accomplish the task. The Maximum Safe Canal Levels are as follows (NAVD88 Datum):

17th Street Canal - 5.0 feet

Orleans Ave. Canal – 8.0 feet

London Ave. Canal – 5.0 feet

A flowchart of activities, an associated activities matrix, and an activities checklist were developed to identify various activities that will occur should there be a storm that is threatening the New Orleans area. The flowchart and its description are given in the following subsection, 1.1.1. The activities matrix is presented and discussed in the next subsection, 1.1.2, and finally the activities checklist is presented in 1.1.3. Key activities that will occur as a storm approaches are identified and the time frames at which they will occur with respect to the predicted landfall are indicated. The time frames are meant to allow excess time to make decisions and safely accomplish tasks, but may need to be compressed for various reasons, such as accelerated storm travel. The flowcharts are intended to aid in the decision making process and to demonstrate the flow of activities. The activities matrix shows the expected activities and the time periods over which the activities occur. The checklist is to be used to efficiently manage the process of completing the activities during the operation.

1.1.1 Activities Flowchart

A flowchart of steps for closing of the gates at the closure structures titled "Gate Closure Activities" is presented on the following pages. The activities that are to occur in each step are grouped together based on the time frame in which they will occur. Each step is numbered for easy reference and further discussion of the activities within each step is provided in the following paragraphs.

Throughout the process the criteria for closing the gates will need to be continually evaluated. There are specific times listed when decisions must be made, but the criteria should be checked each time new predictions are made. The specific times noted in the flowchart are identified because at these times actions will need to be initiated. Evaluating the gate closure criteria leading up to these times will provide indications to the USACE Emergency Operations Center (EOC), the Canal Captains, the Operations Team, and the local and state partners regarding the possibility that the gates may be closed, which will allow them to better prepare. It is expected that members of the

Operations Team will be familiar with the operations to be performed and the flowchart can be used as a quick reference during actual events as a reminder of the process.

Each step has a designation related to the time of landfall. T = 0 indicates landfall of the storm. Therefore, T – 5 days for Step 1 indicates five (5) days from the predicted landfall. Since T for Steps 1 through 9 is the predicted landfall the time for each step may vary based on whether a storm begins moving faster or slows down. In addition, the time allotted for each step is based on approximate information and professional judgment, should be considered as such, and should be adjusted as conditions dictate to maintain safe operations.

STEP 1 (T – 5 days)

Step 1 simply identifies the initiation of the activities that are to occur as a hurricane approaches the New Orleans area. The National Hurricane Center provides storm advisories typically every six (6) hours. These advisories include predictions of projected storm path and projected storm intensity. When the New Orleans metropolitan area is within the 5-day cone of uncertainty, the USACE Hydraulics and Hydrology (H&H) Team will begin to evaluate the results produced by the various models from the National Hurricane Center, and other partner entities, and begin to assess the surge, wind, and rainfall predictions produced by the models.

STEP 2 (T – 5 days)

Once the threat is identified, the Operations Teams that are to install the gates and initiate pump equipment are alerted and put on standby, as are the Dive Teams and the contractor that may be required to provide helicopter transport. Local partners should be notified that the teams have been put on standby. The Communications Hierarchy dictates that the Chief of H&H will notify the EOC, who will notify the USACE Chief of Operations, who in turn should notify the Canal Captains for the three facilities, the Dive Team Inspector, and the contractor providing helicopter transport. The Canal Captains will be responsible for notifying members of the Operations Teams, the Dive Teams, and the pump station operators.

STEP 3 (T – 96 hours)

A storm within five days of landfall will continue to be monitored but no further action than described in Step 2 is necessary until 96 hours before the predicted landfall. At that time the path of the hurricane must be re-evaluated. If the New Orleans area is still within the cone of uncertainty, then preparations for closing the gates at the closure structures are initiated. If the storm has moved so that the New Orleans area is no longer within the cone of uncertainty, no preparations are initiated and the storm will continue to be monitored by the Hydraulics and Hydrology (H&H) Team and the EOC. Should subsequent predictions result in the New Orleans area being placed back into the cone of uncertainty, then preparations will be initiated starting at Step 4.

STEP 4 (T – 96 hours)

Preparations will ideally begin 96 hours before the predicted landfall to ensure that everything that can be done in advance of closing the gates will be accomplished and will not interfere with the gate closing operation. The time to prepare may be reduced due to unexpected changes in the track of a storm. The Operations Teams are activated at this point in time. The Dive Teams remain on standby until STEP 6 unless problems that require the use of a diver are encountered while testing the gates.

The activities in Step 4 involve the preparations associated with ensuring that the gates will close without incident and the pumps are ready to be initialized for operation. The first activity that needs to occur is the Operations Teams need to review the operating procedures in detail so that everyone on the team understands the process. To prepare for the tasks ahead, each team should then verify that the necessary equipment, tools, and fuel for vehicles, cranes, pump engines and generators are available and prepared at the site (see Section 2.1.2.3.1). If items are in storage they should be moved to a location on the structure or facility where they are readily available. If the crane is not already on the bridge of the structure, it should be moved there at this time. Also, each team should verify provisions for personnel are available and prepared at the temporary closure structures, pump stations, and local safe locations where they may stay during the storm.

Once the crane is positioned and tools and equipment have been put into position, the installation of each needle gate should be tested to ensure it can properly seat in the gate notch. If problems are encountered then the Dive Team should be activated and deployed to investigate and correct any problems that are discovered. All preparatory items with respect to the operation of the pumps should be performed as described in Section 2.2.3.7.1 (Preliminary Systems Check); however, these items should be the last of the preparatory actions to be performed.

Monitoring the storm and stages in the lake will be critical items when Step 4 is reached. The models used to predict the effects of the storm on the New Orleans area will be integral to the decision made regarding the closure of the gates. The H&H Team will assimilate the information being provided by the various model predictions and periodically report results to keep the New Orleans District Commander and the EOC, who will report to the local and state partner agencies. The Communications Hierarchy should be used to disseminate the information in the report up the chain of the command as well as to the local and state partners as described in Section 1.2. A sample report, outlining information that should be distributed by the H&H Team, is shown in **Appendix A.**

STEP 5 (T – 48 hours)

If the activities identified in Step 4 have not been completed by the time the storm is projected to be 48 hours from landfall, these activities should continue until they are completed. Once the activities outlined in Step 4 have been completed the Operations Teams should remain in position at the closure structures and await directions regarding the closing of the gates.

Monitoring the storm and stages in the lake should continue in Step 5. The H&H Team should continue to issue reports (sample in Appendix A) and provide information requested by the EOC. The Communications Hierarchy should be used to disseminate the information in the report up the chain of the command as well as to the local and state partners.

STEP 6 (T – 36 hours)

Monitoring of the storm and the lake stages continues into Step 6 but it is during Step 6 that a decision may be made regarding the closure of the gates. The predictions made and assimilated by the H&H Team will need to be used to make a decision with respect to closing or not closing the gates.

The decision regarding the closing of the gates is provided in detail in flowchart C1. The decision to close the gates is based on a predicted surge to established Safe Canal

Levels in Lake Pontchartrain. The Safe Canal Levels are as follows: 17th Street and London Avenue Canals are Elevation 5.0 (NAVD88), and Orleans Avenue Canal is Elevation 8.0 (NAVD88). The decision to close the gates will be made by USACE District Commander in consultation with the USACE Chief of Emergency Operations and the Chief of H&H.

Flowchart C1 also identifies Phase I and Phase II for closing the gates. Phase I is initial closure to reduce the number of gates that need to be put in place as the storm approaches and conditions worsen while allowing pumping at the Local Partner outfall canal pump stations to occur if rain bands are creating an early rain event. Phase I will result in two (2) gates being placed at the Orleans Ave. Closure Structure and four (4) gates being placed at the London Ave. and the 17th Street Closure Structures. The outermost gates are the gates to be placed during the Phase I operation.

If the decision is made to initiate the Phase I gate closure, then the Dive Team should be activated if the team was not already on site due to problems encountered in STEP 4 during the testing of the gates.

STEP 7 (T – 24 hours or timed by Decision Criteria (C1))

Storm monitoring and reporting continues as described in the previous three steps. The decision regarding closure of the structure should be re-evaluated during Step 7 with respect to implementation of Phase II of the gate closure as shown in flowchart C1. The criteria for making the decision for the Phase II portion of the gate closure is the same as outlined in Step 6. The decision to close the gates is based on a predicted surge to established Safe Canal Levels in Lake Pontchartrain. The Safe Canal Levels are as follows: 17th Street and London Avenue Canals are Elevation 5.0 (NAVD88), and

Orleans Avenue Canal is Elevation 8.0 (NAVD88). The decision to close the remaining gates will be made by USACE District Commander in consultation with the USACE Chief of Emergency Operations and the Chief of H&H. However, if the prediction has dropped below Safe Canal Levels, then the remaining gates will not be placed and consideration will need to be given regarding the removal of the gates that were placed during the Phase I portion of the gate closure. If the prediction of surge is near Safe Canal Levels, a decision may be made to keep the gates in place until a later report indicates a reduced threat or until the event has passed.

If the criterion results in implementation of the Phase II closure, then the model predictions should be used to determine when the placing of the remaining gates must be initiated. Two criteria will be used to determine the starting time for initiating the gate placement. The first criteria, to ensure gates are in place before the critical stage in the lake is reached, is to initiate the Phase II placement of the gates six (6) hours prior to the predicted surge reaching Safe Canal Levels in the lake. The second criterion is to initiate the Phase II placement of the gates six (6) hours prior to the predicted maximum sustained wind speeds reaching 30 mph. This criterion is included primarily for the safety of the crew and so that they are not working in conditions that will prevent them from accomplishing their tasks safely. See STEP 8 for Phase II initiation cut-off timing.

The pumps should be initialized before gate closure to handle raised canal water levels during high rain events. Prior to initializing the pumps the areas around the pump intakes should be checked a final time to ensure that there is nothing near the intakes, including people, animals, or debris. A general check of the canal in the vicinity of the closure structure and the pumps should be performed to identify items that could create problems at the pump intakes. Should such items be identified they should be removed. Each structure will be equipped with a motorized flatboat to facilitate removal. The pumps can then be initialized as described in Section 2.2.3.7.2, which is a description for starting the pumps for manual operation.

The operation of the pumps is described in flowchart C2 but once the pumps have been started according to the instructions in Section 2.2.3.7.2 the pumps will operate automatically based on the floats that are a part of the pumps. While the process is automatic, flowchart C2 describes the process that results in the pumps being turned on or off by the floats.

Once the gate placement and initialization of the pumps has been completed, those involved in the operation should safely stow equipment and tools and be moved to safe locations. Cranes should be moved to locations adjacent to the structure bridges prior to the Operations Teams moving to the safe location.

Based on the predicted storm data from the EOC and the construction status at each structure, the Chief of Operations will determine if personnel will remain at the Outfall Canal Control Houses, be relocated to local safe locations or evacuated to remote safe locations. Until the control houses are complete, the Outfall Canal Teams shall report to the MVN reservation for a category 1 or 2 storm. For a category 3 or 4 storm, they will be stationed at the LADOTD building on Lakeshore Dr. For a category 5 storm they shall be evacuated to a remote location. Canal Captains shall be stationed at the S&WB Pump Stations for up to a Category 3 Storm. For a storm above Cat. 3, they will follow the plan for the Operations Teams. Monitoring of canal status and control of structure pumps shall be performed by the EOC Team located at the MVN Reservation Bunker in the event the Canal Captains are moved away from the S&WB Pump Stations. Methods of transport will be designated by the Chief of Operations to best ensure personnel safety. Personnel will have government-issued vehicles and helicopter evacuation service can be scheduled as storm and transportation conditions dictate. Regardless of their locations, contact should be maintained between a member of the Operations Teams and the Canal Captains during the storm event. The Dive Teams should be moved to a safe structure locally for storms predicted to be Category 2 or less.

STEP 8 (T – 12 hours)

Depending on the predicted conditions, placing the gates may be completed by the time Step 8 starts or the gate placing operation may still be underway. The predictions of surge and wind speed will dictate the initiation of the Phase II gate placement. Due consideration must be given to what storm conditions are expected to be after the gates are installed and the pumps are initialized to permit the personnel that are part of the closure operation will be out of harm's way as they travel to local safe locations or are being evacuated to remote safe locations. Therefore, T-12 hours prior to landfall of the storm should serve as a cut-off for starting Phase II gate placement. See STEP 7 for descriptions of those activities required during and after Phase II gate placement

Monitoring of the storm by the H&H Team and the EOC should continue and reports should continue to be provided to local and state partners.

STEP 9 (T – 6 hours)

Conditions will rapidly deteriorate in the final six hours before landfall. Activities at the structure should be completed and all team members should be in safe and secure positions. The H&H Team will continue to monitor the storm and the predictions. The

Canal Captains will need to closely monitor the canal levels since rainfall will likely begin to increase, leading to increased pumping at the canal pump stations. Through the working relationships established in the Water Control Plan, the Canal Captains will primarily be observers at the Local Partner pump stations but if the canal level rises to one foot below the Safe Canal Levels they will notify the pump operators and continue to communicate with the operators to verify they are adjusting pumping accordingly. If canal levels rise to the Safe Canal Levels then the Canal Captains will notify the pump operators and continue to communicate with them to ensure they adjust pumping to not exceed the Safe Canal Levels. The Canal Captains will remain in contact with the Operations Chief throughout the storm and inform the Operations Chief when the pump station pumps have either been throttled back or shut down. The procedure will reverse when canal levels lower and the Canal Captains will inform the pump station operators when canal levels are below Safe Canal Levels so they can adjust pumping accordingly. For steady flow conditions, the targeted level for the canals will be in the range from 3 to 4 ft. (NAVD88 Datum) this will provide desired suction head to maximize flow for Interim Control Structure Pumps while not approaching the Safe Canal Levels. Flow meters will provide discharge flow rate data for each Interim Canal Structure Pump. Canal Captains will coordinate with Local Partner Pump Stations to achieve steady flow under these conditions.

STEP 10 (T = 0)

Once landfall is made, the storm predictions will become less critical for the New Orleans area as it moves through the area and monitoring the actual meteorological statistics will become more critical. The H&H Team will monitor these items and provide information to the EOC that can be distributed to the Canal Captains and the local and state partners. The Canal Captains will continue to monitor the canal levels and will communicate with the pump station operators to ensure they adjust pumping to maintain water in the canal at or below the Safe Canal Levels.

STEP 11 (T + 6 hours)

A decision regarding the removal of the gates should occur during Step 11. Conditions will typically be improving and the projections of the conditions from the storm coupled with the lake and canal levels will be used to make a determination regarding the time when the gates can be removed.

Flowchart C3 shows the process for determining when the gates can be opened. The key factor for opening the gates is that the elevation of the water in Lake Pontchartrain must be lower than the Safe Canal Levels before the gates can be opened. If levels in Lake Pontchartrain remain elevated beyond T + 12 then the H&H Team should provide estimates when the lake level will reach the Safe Canal Levels. However, the gates should only be opened when the lake level has receded to the Safe Canal Levels and not at a time predicted by the H&H Team. If the water level in the lake recedes quickly, a second criterion for removal of the gates is that the wind speed has dropped to 30 mph or less.

As weather permits prior to or during Step 11, the Canal Captains, Operations Teams (if not on-site), and Dive Teams should relocate to the structure and the Operations Teams should prepare for removal of the gates. Operations Chief will coordinate timing and method of personnel transport back to the structure. The Canal Captains will continue to monitor the canal levels and will communicate with the pump station operators to ensure they adjust pumping so as to not exceed the Safe Canal Levels.

STEP 12 (T + 12 hours)

The H&H Team will continue monitoring the lake and canal levels and providing predictions as needed regarding the receding lake levels. The H&H Team will notify the EOC when the elevation in Lake Pontchartrain has reached the acceptable level relative to the Safe Canal Levels. The EOC will notify the Operations Chief, who will notify the Canal Captains at this time and the Canal Captains will direct the Operations Teams to begin the removal of the gates. Also, the Canal Captains will continue to monitor the canal levels and will communicate with the pump station operators to ensure they adjust pumping so as not to exceed the Safe Canal Levels. The Operations Teams should make preparations leading up to this notification and should be ready to begin the gate removal immediately. The gate removal process should be performed as described in Section 2.1.3.4. After the gates are removed the pumps should be deactivated as described in Section 2.2.3.7.5.

1.1.2 Activities Matrix

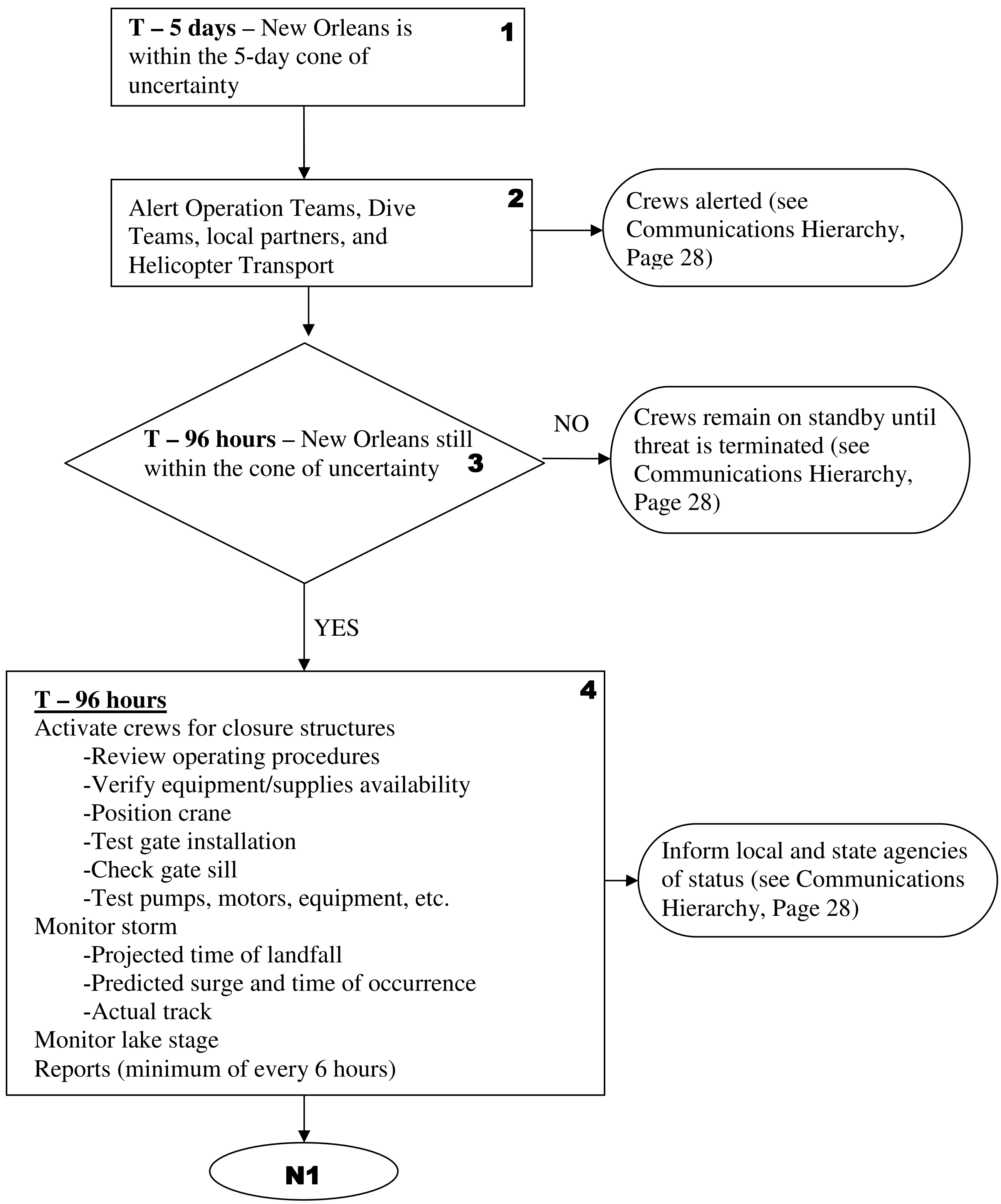
In association with the Activities Flowchart an Activities Matrix was developed (follows the Activities Flowchart) and is titled "Gate Closure Activity Matrix." This matrix is another tool to be used to make preparations in advance of the storm and to assist in an understanding of when activities are to occur. All affected parties can monitor preparations based on the Activities Matrix and use it to anticipate timing of activities. Emergency operations personnel should become very familiar with the activities matrix and understand when activities are to take place as a storm approaches.

1.1.3 Activities Checklist

Following the Gate Closure Activity Matrix is the Gate Closure Activity Checklist. The checklist is to be used as a tool during a storm event to manage decisions and efforts and ensure that all activities are accomplished. The checklist identifies each activity to be performed and numbers each activity. The step in the Activities Flowchart that is associated with a particular activity is referenced as is the section in the O&M Manual where more detailed information on the activity may be obtained. This checklist may be adjusted according to the needs of those using it, and can serve as a document of record.

GATE CLOSURE ACTIVITIES

Landfall occurs at T = 0



N1

5

<u>T – 48 hours</u>

Crews continue preparation (see Step 4)
Monitor storm
- -Projected time of landfall
- -Predicted surge and time of occurrence
- -Actual track

Monitor lake stage
Reports (minimum of every 6 hours)

→ Inform local and state agencies of status (see Communications Hierarchy, Page 28)

6

<u>T – 36 hours</u>

Monitor storm
- -Projected time of landfall
- -Predicted surge and time of occurrence
- -Actual track

Monitor lake stage
Make decision regarding gate closure
- -Predicted surge in Lake Pontchartrain > Safe Canal Levels
  (go to flowchart C1, Page 19)

Perform Phase I closure (some gates)
Reports (minimum of every 6 hours)

→ Inform local and state agencies of status (see Communications Hierarchy, Page 28)

→ **C1**

7

<u>T – 24 hours</u>

Perform Phase II closure (see flowchart C1, Page 19)
Initialize pumps (go to flowchart C2, Page 20)
Remove and position operations crews
- -Relocate or Evacuate Dive Crew
- -Relocate Canal Captain to pump station or Evacuate
- -Secure Operations Team at closure structure or Evacuate

Monitor storm
- -Projected time of landfall
- -Predicted surge and time of occurrence
- -Actual track

Monitor lake stage
Reports (minimum of every 6 hours)

→ Inform local and state agencies of status (see Communications Hierarchy, Page 28)

→ **C2**

N2

N2

8

T – 12 hours

Decision cut-off time for Phase II gate closure and pump initialization if not already started

Monitor storm
- -Projected time of landfall
- -Predicted surge and time of occurrence
- -Actual track

Monitor lake stage

→ Inform local and state agencies of status (see Communications Hierarchy, Page 28)

9

T - 6 hours

Monitor canal levels, Canal Captain reduces or stops Local Partner pump station pumping if required

Monitor storm
- -Projected time of landfall
- -Predicted surge and time of occurrence
- -Actual track

Monitor lake stage

Report

→ Inform local and state agencies of status (see Communications Hierarchy, Page 28)

10

T = 0

Monitor storm
- -Actual track

Monitor lake stage

Monitor canal levels

Report

→ Inform local and state agencies of status (see Communications Hierarchy, Page 28)

N3

N3

11

<u>T + 6 hours</u>

Monitor storm
- Actual track

Monitor lake stage

Monitor canal levels and adjust Local Partner pumping as required

Make decision regarding gate opening
- Lake stage in Lake Pontchartrain
- Predicted stages in Lake Pontchartrain
- Wind speeds

(go to flowchart C3, Page 21)

Relocate Canal Captain and Operations and Dive Teams to structure as weather permits if not already on-site

→ Inform local and state agencies of status (see Communications Hierarchy, Page 28)

→ **C3**

12

<u>T + 12 hours</u>

Monitor storm
- Actual track

Monitor lake stage

Monitor canal levels

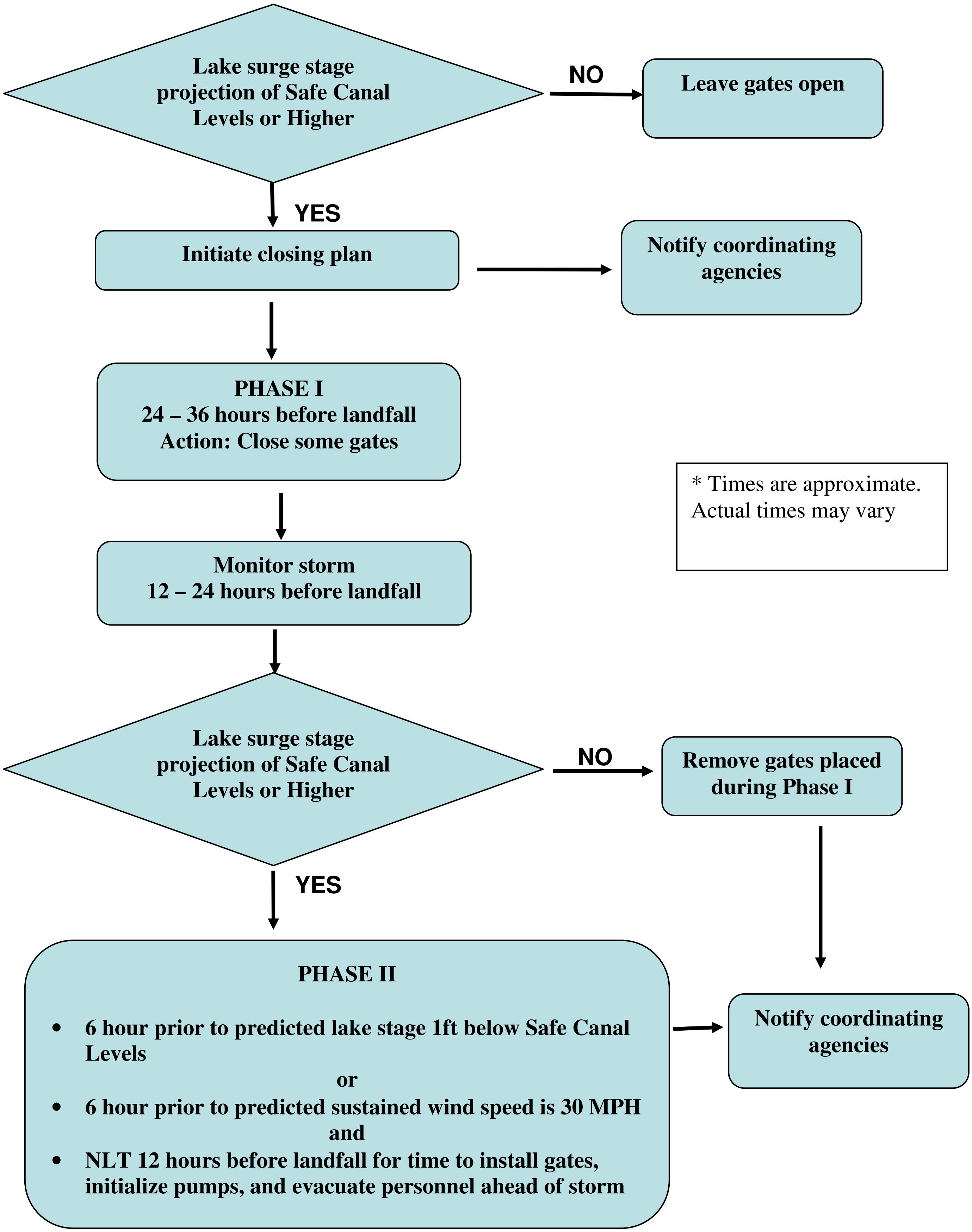
Relocate crew to structure if not done in Step 11

Open gates

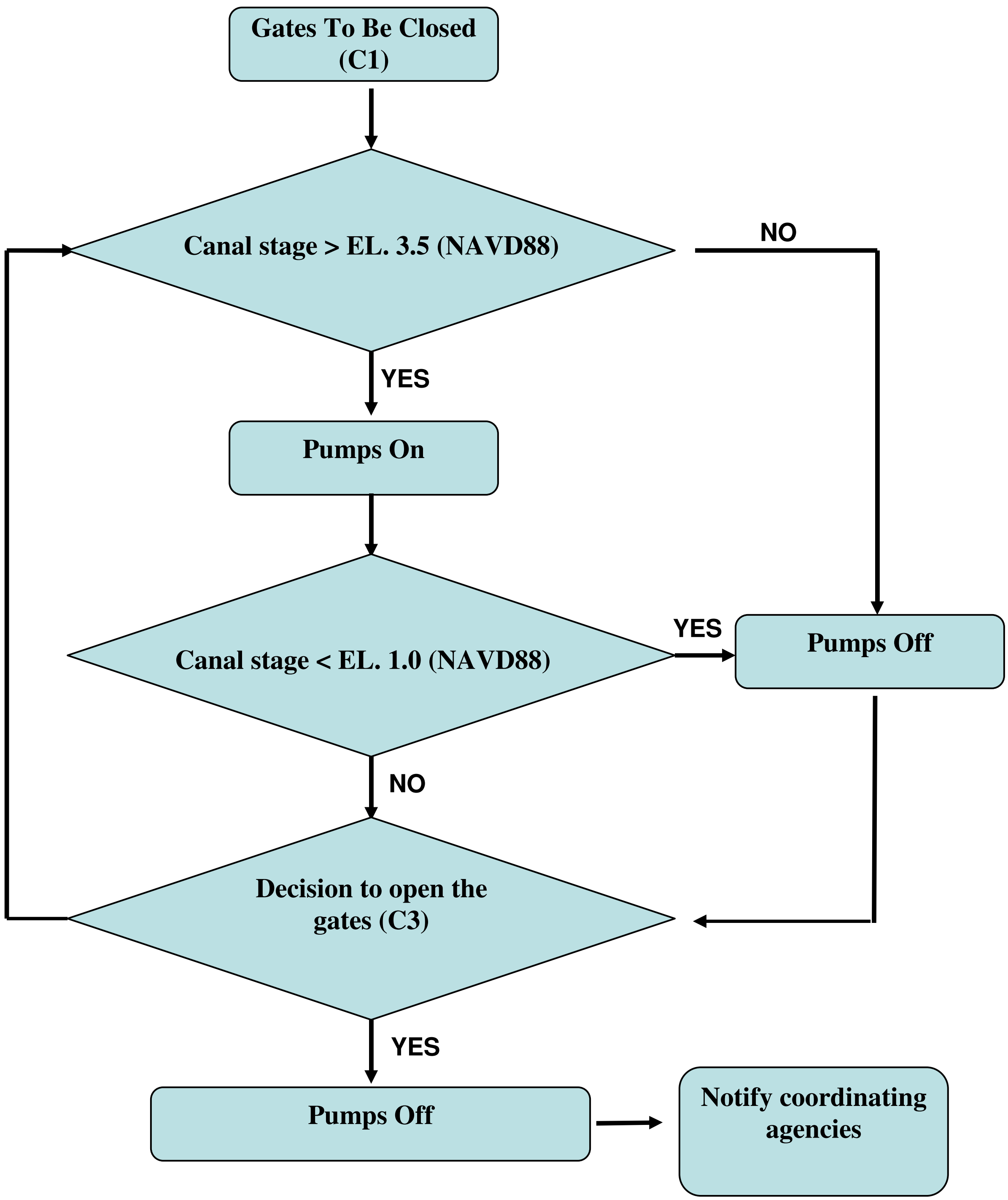
Deactivate pumps

→ Inform local and state agencies of status (see Communications Hierarchy, Page 28)

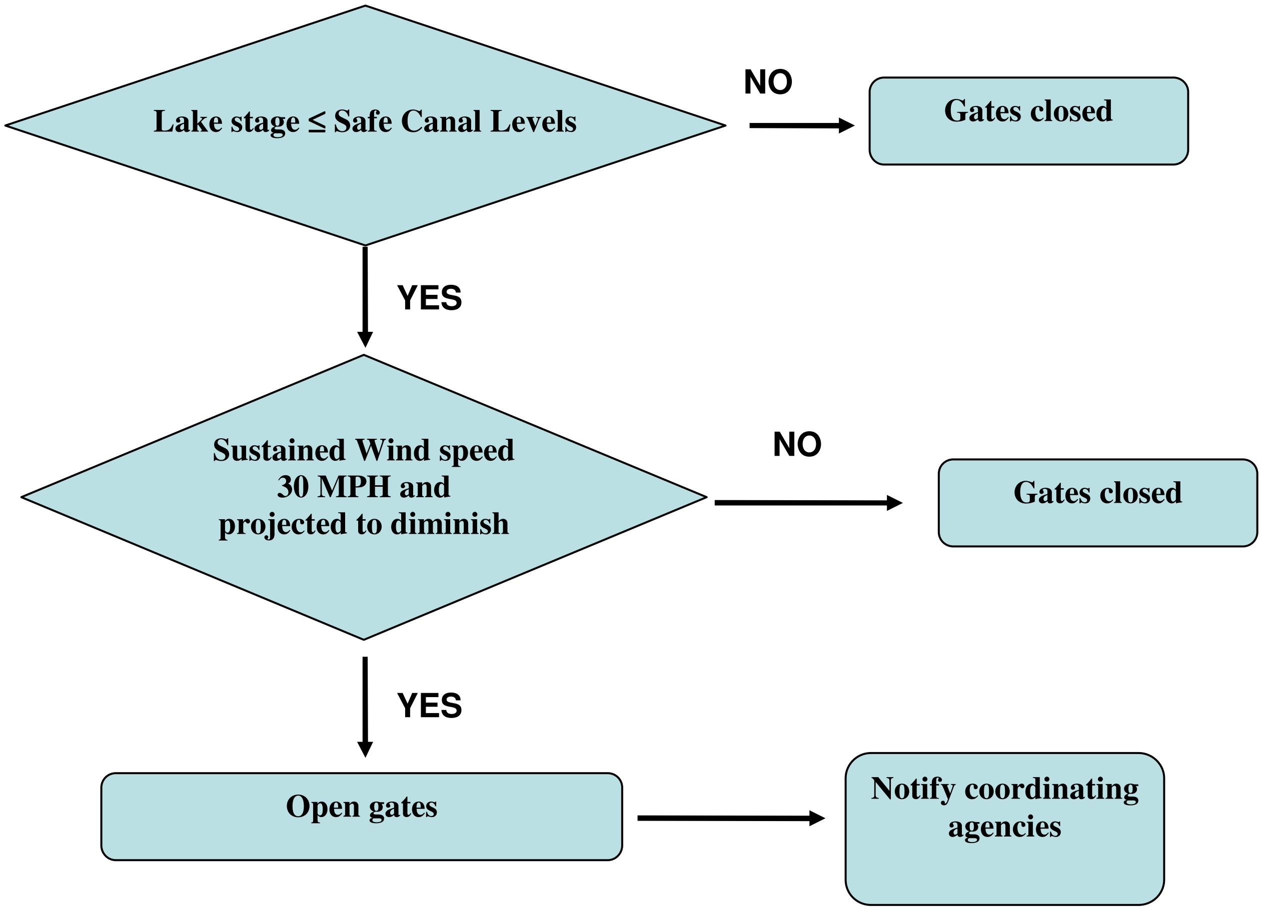
* DECISION TO CLOSE GATES



PUMPS ACTIVATION CRITERIA (C2)



DECISION TO OPEN GATES (C3)



Gate Closure Activity Matrix

Activity #	Activity	120-96 hours before predicted landfall	96-48 hours before predicted landfall	48-36 hours before predicted landfall	36-24 hours before predicted landfall	24-12 hours before predicted landfall	12-6 hours before predicted landfall	6-0 hours before predicted landfall	0-6 hours after landfall	6-12 hours after landfall	12+ hours after landfall
1	Alert operating team/dive team/local partners/helicopter transport; place on standby	X									
2	Activate crews and review closure structure operating procedures ▪Verify equipment/tools/fuel/provisions availability		X								
3	Monitor storm location predictions	X	X	X	X	X	X	X			
4	Monitor lake stage predictions (models)	X	X	X	X	X	X	X	X	X	X
5	Test gate installation		X								
6	Determine if gate sill is clean		X								
7	Schedule Operations personnel if needed to work on gates and clean sill if needed		X								
8	Test pumps, motors, equipment, etc.		X								
9	Monitor actual storm track		X	X	X	X	X	X	X	X	X
10	Monitor actual lake stage		X	X	X	X	X	X	X	X	X
11	Mobilize Operations team/dive team to closure structures			X							
12	Position crane (and other equipment) to site		X								
13	Decision to close gates ▪Predicted surge ▪Actual water stages ▪Wind speeds ▪Placement order of gates				X	X					
14	Close gates				X	X					
15	Notification of Public Agencies				X						
16	Initialize temporary pumps					X	X				
17	Relocate personnel to safe location – local or remote					X	X				
18	Monitor canal levels/adjust Local Partner pumping as required						X	X	X	X	X
19	Decision to open gates ▪Predicted drop of lake stages ▪Actual water stages ▪Wind speeds ▪Removal order of gates									X	
20	Relocate personnel to closure structures								X	X	X
21	Open gates – deactivate pumps								X	X	X

GATE CLOSURE ACTIVITIES CHECKLIST

Complete	Activity No.	Step No.	Activity Description	Responsible Party	O&M Ref. Sect.
T – 5 days					
	1	2	Alert Operations Team	Canal Captain	1.2
	2	2	Alert Dive Teams	Canal Captain	1.2
	3	2	Alert Helicopter Contractor	Chief of Operations	1.2
	4	2	Alert Dive Team Inspector	Chief of Operations	1.2
	5	2	Provide storm report	H&H Team Lead	1.2
T – 96 hours					
	6	4	Activate Operations Team	Canal Captain	
	7	4	Review operating procedures	Operations Team	
	8	4	Verify equipment/tools/fuel/provisions availability/relocate to structure	Operations Team	2.1.2.3.1
	9	4	Position crane	Crane Operator	2.1.2.3.2
	10	4	Test gate installation	Canal Captain	2.1.2.3.2
	11	4	Activate Dive Team, if necessary	Canal Captain	
	12	4	Check gate sill	Dive Team Chief	2.1.2.3.2
	13	4	Test pumps, motors, and equipment	Mechanic	2.2.3.7.1
	14	4	Provide storm report	H&H Team Lead	
	15	4	Update status to partners	Chief of EOC	
T – 48 hours					
	16	5	Confirm preparations are complete	Canal Captain	
	17	5	Provide storm report/Monitor Lake Stages	H&H Team Lead	
	18	5	Update status to partners	Chief of EOC	
T – 36 hours					
	19	6	Decision regarding Phase I closure	Commander	1.1.1
	20	6	Perform Phase I closure, activate Dive Team if not already on site.	Canal Captain	2.1.2.3.2
	21	6	Provide storm report/Monitor Lake Stages	H&H Team Lead	
	22	6	Update status to partners	Chief of EOC	
T – 24 hours					
	23	7	Decision regarding Phase II closure	Commander	
	24	7	Inform pump station operators of gate closure decision	Canal Captain	2.1.2.3.2
	25	7	Perform Phase II closure	Canal Captain	2.1.2.3.2
	26	7	Initialize pumps	Canal Captain	2.2.3.7.2
	27	7	Relocate/Evacuate dive team	Operations Chief	

Complete	Activity No.	Step No.	Activity Description	Responsible Party	O&M Ref. Sect.
	28	7	Secure Operations Team at structure/Evacuate	Operations Chief	
	29	7	Relocate Canal Captain to Local Partner pump station/Evacuate	Operations Chief	
	30	7	Provide storm report/Monitor Lake Stages	H&H Team Lead	
	31	7	Update status to partners	Chief of EOC	
T – 12 hours					
	32	8	Phase II Closure Decision Cut Off Time	Commander	
	33	8	Provide storm report	H & H Team Lead	
	34	8	Monitor Lake Levels	H & H Team Lead	
	35	8	Monitor Canal Levels	H & H Team Lead	
	36	8	Update status to partners	Chief of EOC	
T – 6 hours					
	37	9	Monitor canal levels/Adjust pumping	Canal Captain	1.1.1
	38	9	Provide storm report/Monitor Lake Levels	H&H Team Lead	
	39	9	Update status to partners	Chief of EOC	
T = 0					
	40	10	Monitor canal levels/Adjust pumping	Canal Captain	1.1.1
	41	10	Provide storm report/Monitor Lake Levels	H&H Team Lead	
	42	10	Update status to partners	Chief of EOC	
T + 6 hours					
	43	11	Monitor canal levels/Adjust pumping	Canal Captain	1.1.1
	44	11	Relocate Canal Captain and Operations and Dive Teams to the structure if not already on-site	Operations Chief	
	45	11	Operations Team initiates preparation for opening gates	Canal Captain	
	46	11	Decision regarding opening gates	Commander	1.1.1
	47	11	Provide storm report/Monitor Lake Levels	H&H Team Lead	
	48	11	Update status to partners	Chief of EOC	
T + 12 hours					
	49	12	Decision regarding opening gates (if not finalized in Step 11)	Commander	1.1.1
	50	12	Open gates	Canal Captain	
	51	12	Deactivate pumps	Canal Captain	
	52	12	Update status to partners	Chief of EOC	

1.2 Communication Hierarchy

A flowchart has been developed showing the chain of command with respect to the various USACE entities that will be involved in the gate closure activities as well as the local and state agencies that will be impacted by the gate closures and pump operations at the Interim Closure Structures. The flowchart follows Section 1.2 and is titled "Flowchart of Communication Hierarchy" and includes the names of individuals and contact information. More detailed contact information for the people shown in this flowchart is provided in Section 1.3. This organizational chart is provided as a quick graphical reference for the organizations and the key personnel involved in the required communications as a result of the operation of the three closure structures. Generally the organization and direction of the flowchart is from the top down, however, double arrows indicate that there will be exchanges of information between some individuals in recognition that the decision process will not be made independently and without input from others who are familiar with the criteria for closing the gates.

Factors influencing the decision to close gates are outlined in detail in Section 1.1. The decision to close the gates will be made by USACE District Commander in consultation with the USACE Chief of Emergency Operations and the Chief of H&H who will be in regular contact with the H&H Team. The H&H Team will receive information to be used in predicting the storm surge, the maximum wind speeds, and the rainfall totals. The source of information will include storm data and information from several different predictive models. The team will assimilate the data collected and through the Chief of H&H will provide their prediction of storm surge, maximum wind speeds, and rainfall amount to the Chief of Emergency Operations and the District

Commander.

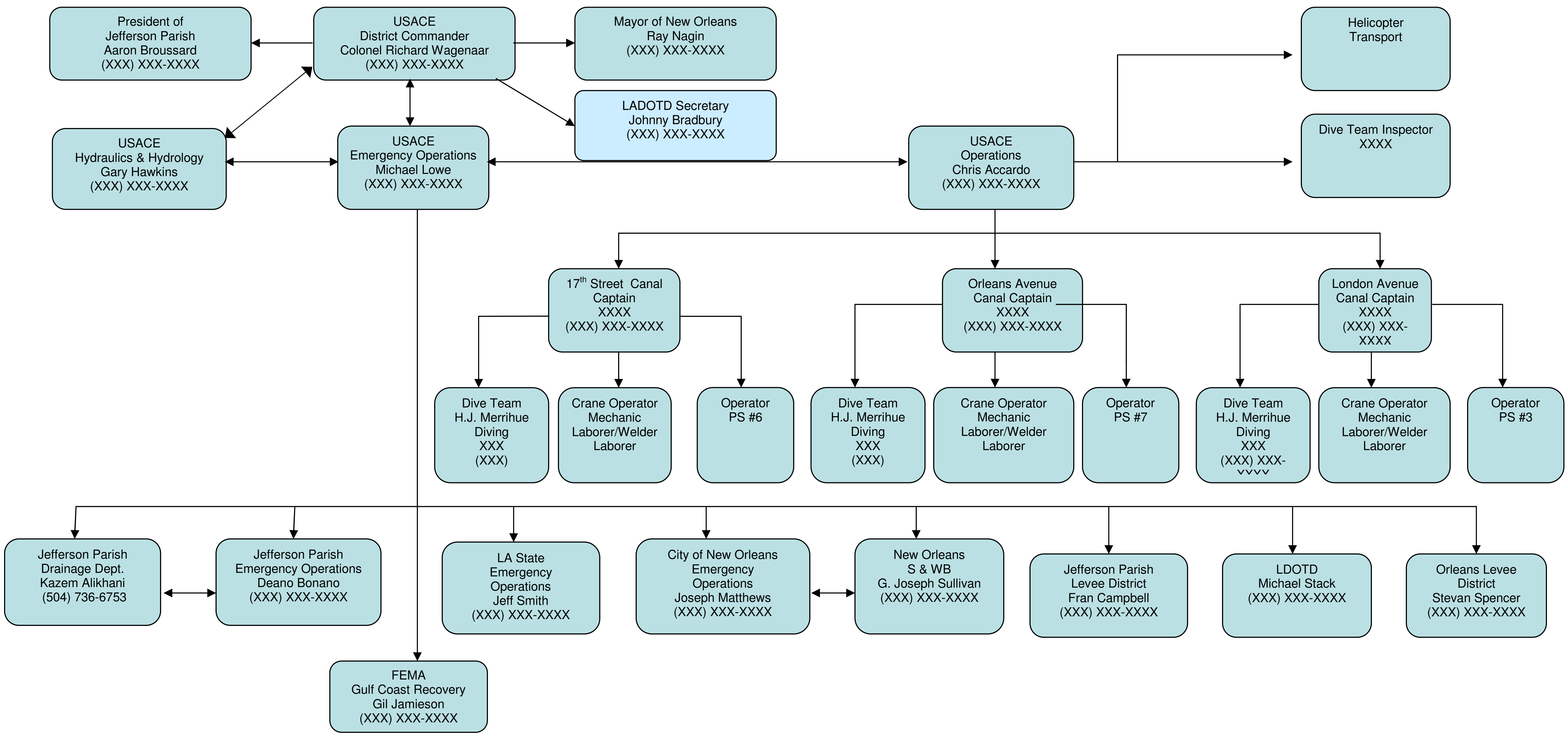
Once the District Commander has made the decision to close the gates he will inform the Chief of Emergency Operations of the decision as well as the Mayor of New Orleans, the President of Jefferson Parish and the LADOTD Secretary. The decision to close the gates will be communicated by USACE Emergency Operations Chief to the USACE Operations Chief. The USACE Emergency Operations Chief will also call the City of New Orleans Emergency Operations Chief, State of Louisiana Emergency Operations Director, Jefferson Parish Emergency Operations Officer, New Orleans Sewerage and Water Board General Superintendent, Jefferson Parish Drainage Department Director, East Jefferson Parish Levee District Director, Orleans Parish Levee District Director and the LADOTD Regional Administrator. The individuals in these positions will be responsible for informing the appropriate officials within their organization of the decision to close the gates.

The Operations Chief will communicate the information to the three Canal Captains. The Operations Chief will maintain regular communications with the Canal Captains who will work with the Operations Teams as the gates are closed and during the storm will be located at the New Orleans S&WB pump stations. Pump Station No. 6 is located on the 17th Street Canal, Pump Station No. 7 is located on the Orleans Avenue Canal and Pump Station No. 3 is located on the London Avenue Canal. The Operation Teams will be located at the interim closure structures or evacuated to a safe location as discussed in Section 1.1. The Canal Captain will stay in communication with the mechanic of the Operations Team using communications equipment as outlined in Section 1.4.

Canal Captains will keep the operators of canal pump stations informed of the activities that are occurring at the interim closure structures with respect to gate closures and the operation of the temporary pumps at the closure structures. Once the gate closure is complete and pumps are initialized, the Canal Captain will relocate to the S&WB pump station at the head of the canal or another safe location as described in Section 1.1.1. The Canal Captains will observe canal levels and confirm that pump station operations are being performed in accordance with the Water Control Plan agreed to by the Corps of Engineers and the local interests. Canal Captains will also be responsible for conveying any questions or concerns up the chain of command that pump station operators may have during an emergency operation.

There will need to be regular communications throughout a storm event as indicated in the Gate Closure Activities flowchart. At each step in the Gate Closure Activities flowchart it has been indicated that local and state agencies should be informed of the status (Step A1). To aid in providing the status to the individuals at these agencies a report format is provided in Appendix A that will help the H&H Team and the EOC ensure that pertinent information is passed along to those that will be affected by the decisions being made. The EOC should pass along the information to the Chief of Operations and to the local and state agencies shown on the Flowchart of Communication Hierarchy.

Flowchart of Communication Hierarchy



1.3 Agencies Involved, Key Personnel and Contact Information

The following provides a list of all of the agencies (federal, state, and local) that will be impacted by the emergency operations associated with the Interim Closure Structures. A point of contact is provided for each agency as well as the contact information for that individual. The individuals identified will be those who will be contacted when the activities in the gate closure process begins to take place.

<u>U.S. Army Corps of Engineers, New Orleans District</u>

Col. Richard Wagenaar, Commander

Office: (XXX) XXX-XXXX

<u>U.S. Army Corps of Engineers, New Orleans District, Emergency Operations</u>

Michael Lowe, Chief

Office: (XXX) XXX-XXXX

<u>U.S. Army Corps of Engineers, New Orleans District, Operations</u>

Chris Accardo, Chief

Office: (XXX) XXX-XXXX

<u>U.S. Army Corps of Engineers, New Orleans District, Hydraulics and Hydrologic Branch</u>

Gary Hawkins, Chief

Office: (XXX) XXX-XXXX

<u>City of New Orleans</u>

Ray Nagin, Mayor

Office: (XXX) XXX-XXXX

Jefferson Parish

Aaron Broussard, President

Office: (XXX) XXX-XXXX

Office: (XXX) XXX-XXXX

Louisiana Department of Transportation and Development

Johnny Bradbury, Secretary

Office: (XXX) XXX-XXXX

FEMA

Gil Jamieson, Deputy Director for Gulf Coast Recovery

Cell: (XXX) XXX-XXXX

State of Louisiana, Homeland Security and Emergency Preparedness

Jeff Smith, Director

Office: (XXX) XXX-XXXX

Louisiana Department of Transportation and Development

Michael Stack, District Administrator DTOD 02
Office: (XXX) XXX-XXXX

City of New Orleans, Office of Emergency Preparedness

Joseph Matthews, Chief

Office: (XXX) XXX-XXXX

Colonel Terry Ebbert

Office: (XXX) XXX-XXXX

New Orleans Sewerage & Water Board

G. Joseph Sullivan, General Superintendent

Office: (XXX) XXX-XXXX

Office: (XXX) XXX-XXXX

Orleans Parish Levee District

Stevan Spencer, Director of Flood Protection

Office: (XXX) XXX-XXXX

Jefferson Parish Emergency Operations

Deano Bonano, Deputy Chief of Administration

Officer for Emergency Operations and Director of Emergency Management

Office: (XXX) XXX-XXXX

Office: (XXX) XXX-XXXX

NOTE: In Mr. Bonano's absence, ask for the Emergency Coordinator on call.

Jefferson Parish, Department of Drainage

Kazem Alikhani, Director

Office: (XXX) XXX-XXXX

Ali Pirsalehy, Assistant Director

Office: (XXX) XXX-XXXX

East Jefferson Parish Levee District

Fran Campbell, Executive Director

Office: (XXX) XXX-XXXX

There will be a crew at each of the Interim Closure Structures consisting of a Canal Captain, an Operations Team, and a Dive Team. Provisions will need to be provided for the Operations Team since they will be located at the structures during the storm event. Provisions should include food, water, bedding and supplies necessary in sufficient quantity to stay at the closure structures before, during and after the storm event.

The crews for each of the structures are as follows:

17th Street Canal Structure Crew

	Primary	Alternate
Canal Captain	XXXX (XXX) XXX-XXXX	
Crane Operator	XXXX (XXX) XXX-XXXX	
Mechanic	XXXX (XXX) XXX-XXXX	
Laborer and Welder	XXXX (XXX) XXX-XXXX	
Laborer:	XXXX (XXX) XXX-XXXX	

Orleans Avenue Canal Structure Crew

	Primary	Alternate
Canal Captain	XXXX (XXX) XXX-XXXX	
Crane Operator	XXXX (XXX) XXX-XXXX	
Mechanic	XXXX (XXX) XXX-XXXX	
Laborer	XXXX (XXX) XXX-XXXX	
Laborer	XXXX (XXX) XXX-XXXX	

London Avenue Canal Structure Crew

	Primary	Alternate
Canal Captain	XXXX (XXX) XXX-XXXX	
Crane Operator	XXXX (XXX) XXX-XXXX	
Mechanic	XXXX (XXX) XXX-XXXX	
Laborer and Welder	XXXX (XXX) XXX-XXXX	
Laborer	XXXX (XXX) XXX-XXXX	

In addition, a Dive Team will be available to respond to each of the three interim closure structures. The Dive Team is not required to be on site until the Phase I closure is initiated (STEP 6) unless problems are encountered during testing of the gates (STEP 4). The Dive Team will be supplied under the Indefinite Delivery, Indefinite Quantity Contract to H.J. Merrihue of St. Rose, Louisiana (Contract No. W912P8-06-D-0060). Points of contact are:

XXXX, (XXX) XXX-XXXX

XXXX

Office: (XXX) XXX-XXXX

H.J. Merrihue will be responsible for the removal of the Dive Team following the gate closure operation and for providing a safe location. The Dive Team will return to the closure structures as soon as possible after the storm so that they are available to assist in the removal of debris that may interfere with the gates being opened.

If the Chief of Operations determines that transportation by helicopter may be needed there are blanket purchase agreements (BPA) with two helicopter services. The agreements are with:

HPI (Contract No. W912P8-06-A-0001)

Heliworks, Inc. (Contract No. W912P8-06-A-0002)

The Chief of Operations will need to initiate contact with the Logistics Branch at the New Orleans District for flight pre-approval to ensure that the capability exists for an expedited response.

In addition to the above information being made available, the Chief of Emergency Operations will maintain a more detailed list of contact information for the individuals listed above. The list will include the home telephone numbers, cellular telephone numbers, pager numbers, and e-mail addresses. Because personal information (home telephone and cellular telephone numbers) will be on the detailed list of information the distribution of this list will be limited and the Chief of Emergency Operations will determine the individuals that will require a copy of the list.

1.4 Methods of Communication

Because communications during an emergency are so critical multiple methods of communication will be available to those who are participating in the gate closure activities. The primary method of communication between the Chief of Operations and the Canal Captains and members of the Operations Teams will be with LOEP radios. Cellular telephones will be the secondary method of communication and as a backup to the cellular telephones, satellite telephones will be available. These three methods of communications are summarized in the table below.

Method of Communication	Priority of Use	Individual	Type of Equipment	Comments
LOEP Radio	Primary	Chief of Operations	Base Station	Located at Port Allen Lock
		Canal Captain	Hand Held	
		Crane Operator		
		Mechanic		
Cellular Telephone	Secondary	Chief of Operations	Cellular Telephone	Land line access at Port Allen Lock
		Canal Captain	Cellular Telephone	Personal cellular telephones utilized as needed; numbers will be available to other team members
		Crane Operator or Mechanic		
Satellite Telephone	Back-up	Chief of Operations	Satellite Telephone	Located at Port Allen Lock
		Canal Captain		
		Crane Operator or Mechanic		

Radio communications between the Corps of Engineers personnel noted in the above table will occur on channel 1 for EOC, channel 2 for Security, channel 3 for Locks and channel 4 for Outfall Canal Operations Teams. The S&WB also use radios on their own frequency for communications between the various pump stations to coordinate pumping activities. One Corps of Engineers radio will be furnished to the S&WB for communications in addition to having the Canal Captains stationed at their respective S&WB pump stations.

SECTION 2 – OPERATION

This section of the Interim Operating Instructions contains the details associated with operating the gates, pumping units, and other appurtenant items associated with the interim closure structures. A general description of each item is provided as well as information regarding aspects associated with the operation of each item. This section provides the information that will be needed by personnel for safely operating the closure structure when a storm is approaching.

2.1 Gates

The gates at the closure structures permit open flow of the outfall canals during normal meteorological events but will prevent storm surges in Lake Pontchartrain from entering the canals in the event of a hurricane. This portion of Section 2 will describe the gates and provide information about use of the gates prior to hurricane season, during hurricane season, immediately prior to arrival of a hurricane, and immediately after a hurricane hits. It will provide the background about the gates and a procedure to be used for the various different conditions (i.e. prior to hurricane season, during hurricane season, etc.)

2.1.1 Description

Each gate is just under 12 feet wide and is 25-1/2 to 27 feet tall and weighs approximately 15,000 to 21,000 lbs. There are eleven (11) gates at the London Avenue Canal Interim Closure Structure, five (5) gates at the Orleans Avenue Canal Interim Closure Structure, and eleven (11) gates at the 17th Street Canal Interim Closure Structure. Gates will be lowered into their closed position through the use of a crane positioned on the bridge that is supported by the pile frame.

The gates at each of the closure structures are vertically framed needle gates. These gates distribute applied loads vertically to a bearing point near the top of the gate and to a point at the bottom of the gate. The bottom reaction occurs within a notch in the sill of the gate structure and the top reaction is at a bearing beam supported by the pile frame structure. A schematic elevation of the gate and the support structure is shown in **Figure 2.1**. The gates are similar to bulkheads used for dewatering at some navigation locks.

Guide columns are incorporated into the structure to guide the gates into the notch in the sill. The gates are stored within these guide columns and are supported in the stored position by pins that are inserted through holes in the columns into holes in the gate. These holes are near the bottoms of the gates at the London Avenue and Orleans Avenue Closure Structures but are near the top of the gates at the 17th Street Closure Structure. A second set of holes is located near the bottom of the gates at the London Avenue and Orleans Avenue Closure Structures to allow pins to be inserted to hold the gate in place when it is closed. For the gates at the 17th Street Closure Structure the holes used for storing the gates is used to hold them in place during storm conditions. The pins are supported by dogging devices on the structure. Dogging devices are located on the top of the bearing beams for all three structures. The 17th Street Closure Structure also has dogging devices at Elevation 30.44 (center of pin) that is used when the gates are in the stored position. The bottom of the gate is at Elevation 5.0 when it is in the stored position for the London Avenue Control Structure and the Orleans Avenue Control Structure and at Elevation 7.0 for 17th Street Closure Structure. The gates are to be left in the stored position throughout the year unless maintenance is required.

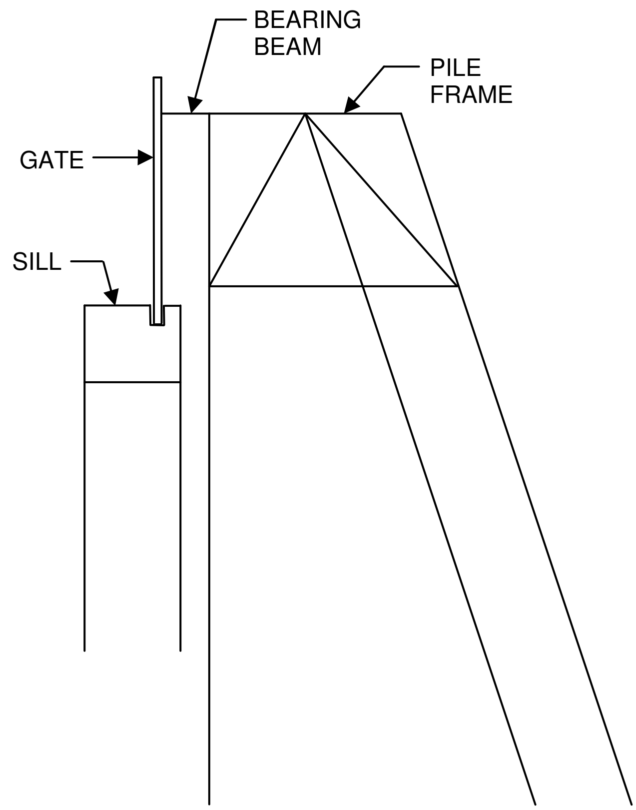


Figure 2.1. Schematic elevation of the London Avenue Canal and Orleans Avenue Canal Closure Structures gate and structure. 17th Street Canal Closure Structure is similar.

At the London Avenue and Orleans Avenue Closure Structures, the sill is a sheet pile system comprised of two rows of sheet piles that extend between tie-in points on the east and west banks of the canal, diaphragms between the two rows of sheet piles that are also comprised of sheet piles, and a concrete cap at the top. The two rows of sheet piles resist the lateral load with a moment-resisting couple that results in tension in one row of sheets and compression in the other row. The diaphragms add additional stiffness to the system and the concrete cap ties the system together. The sill at the 17th Street Closure Structure also consists of two rows of sheet piles and the frame is contained within and restrained by the sill. The pile frame is contained within the sill.

The bearing beam is mounted on the pile frame. The lateral load applied to the bearing beam is resisted primarily by the battered piles within the pile frame located on the protected side of the structure.

2.1.2 Preparation for Operation

To ensure that the gates operate properly should a hurricane threaten the New Orleans area, preparations will need to be performed prior to the start of hurricane season, during hurricane season, and when the chances of a hurricane entering the vicinity of New Orleans are first identified. Making the preparations outlined in the paragraphs below will greatly reduce the possibility of problems being encountered when the time for putting the gates into position arrives. While making each of the preparations below the temporary closure structure, pump engine platform, and facilities should be visually surveyed for any signs of damage, vandalism, or deterioration. Remedial measures should be pursued to address any issues found.

2.1.2.1 Before Hurricane Season

Prior to the hurricane season certain activities should be performed with respect to the operation of the gate. The primary concerns are with checking the notches in the sill for obstructions and with ensuring the gate can move unobstructed into the closed position. Details for the activities to be undertaken are described in the following paragraphs and should be completed no later than May 1st each year so that if a problem is discovered that there is ample time to correct the problem. The check of the notches and the gates should be performed in conjunction with the test of the pumping units as described in subparagraph 2.2.

2.1.2.1.1 Check Gate Slots in Sill

Because the notches in the sill structure provide the reaction for the bottom of the gates it is imperative that these notches be free of all foreign material and obstructions. The notches may fill with silt between the end of one hurricane season and the start of the next. It is also possible that other obstructions, such as tree limbs or trash, will get lodged in these notches.

To ensure that the gate will properly seat in the notch, the notch should be checked at each structure by a diver. The diver should go along the entire length of each notch of the structure. A high pressure hose should be available for the diver to use to blow out silt that may have accumulated in the notches. The diver should locate foreign objects that may be in the notches and if they are small enough, he should remove them. If the diver encounters an object that is larger than he is capable of moving the diver should secure the object with cables that will allow it to be removed by a crane.

2.1.2.1.2 Check Gate Operation

Once the diver has completed his inspection and has confirmed that all materials have been removed, the operation of each gate should be tested. The gates will be dogged in the open position throughout the year and are to be lowered into position by a crane that is on the bridge of the closure structure. Each gate will have the rigging used to raise and lower the gates already in place and a laborer will simply need to connect the lifting cable of the crane to the rigging.

Each gate on each structure should be put into its closed position. To accomplish this, the gate will need to be lifted slightly to allow the dogging pins to be removed. Once the dogging pins are removed the crane can lower the gate until the lifting cables go slack. Once the cables are slack the dogging pins should be inserted into the holes near the top of the gate that are meant for locking the gate into the closed position. If the dogging pins can be inserted when the gate is down, this will confirm that the notch in the sill is free from obstructions. If the dogging pin cannot be inserted when the cables are slack, the diver shall be sent to check the slot again.

The process of putting the gate into the closed position will also ensure that something has not occurred to the gate or the guide column that will impede the operation of the gate. The crane operator should lower the gate slowly and at a constant speed. The process of putting the gate into the closed position should be closely observed. If during this process it is observed that as the gate is lowered it does not continue at a constant rate, the top elevation of the gate where the interruption occurred shall be noted and the gate shall go through the operation procedure a second time. If an interruption occurs again at the noted location then an inspection of the guide columns along their full height, as well as the portion of the gate within the guide columns shall be performed to determine what is causing the gate to hang up. Any defects found shall be repaired, and the procedure shall be repeated.

2.1.2.2 During Hurricane Season (General)

Once hurricane season has started, certain activities should be performed at regular intervals so that issues that could potentially interfere with the operation of the gates can be identified and addressed without the threat of an approaching storm.

Operation of the gates should be performed every three (3) weeks. Gate operation should be performed in the same manner as described in paragraph 2.1.2.1.2 for the check of gate operation prior to the hurricane season. A diver should be brought in to inspect and assist in removing obstructions if they are encountered.

2.1.2.3 Approaching Storm

When there is a storm in the Gulf of Mexico, preparations must be made in anticipation that the storm may make landfall at or around the New Orleans area.

2.1.2.3.1 Mobilization Requirements

The gate closure activities as described in Section 1 indicate that when an approaching storm is five (5) days from landfall, and New Orleans is within the cone of uncertainty, the Operations Teams, Dive Teams, and equipment for operating the closure structures should be alerted and placed on standby. When the storm is within 72 hours of predicted landfall, the Operations Teams and Dive Teams should be activated and operation procedures should be reviewed and an inventory of the required equipment performed. The equipment that will be required for gate operation of each closure structure includes:

- Crane
- Ratcheted puller (come along)
- Sledge hammer (beat dogging pins into position)
- Two-way radio set (local communications)

The crew needed for gate operation at each closure structure should include:

- Crane operator
- Mechanic
- Laborer / welder
- Laborer

In addition, a dive crew should be available at each closure structure in the event that problems are encountered during the gate placement.

2.1.2.3.2 Gate Placement

Gate placement as a storm approaches may occur several times during the operation. Initially, each gate will be lowered into position to ensure gate notches are clear. If a gate is lowered and the dogging pin can be placed, then the gate can be raised to its stored position. If the dogging pin cannot be placed then divers should be sent to investigate, identify the obstruction, and take measures to remove it. The gates will then need to be put into position during the Phase I and Phase II portions of the gate closure as described in Section 1.1.

To close a gate, it will need to be lifted slightly to allow the dogging pins to be removed. A come along may be needed to remove the dogging pin. Once the dogging pins are removed the crane can lower the gate until the lifting cables go slack. Once the cables are slack the dogging pins should be inserted into the holes near the top of the gate that are meant for locking the gate into the closed position. If the dogging pins can be inserted when the gate is down, this will confirm that the notch in the sill is free from obstructions. The eye bolt may need to be removed from the dogging pin and a sledge hammer used to move the pin into place. This process for closing the gates is identical to that described in subparagraph 2.1.2.1.2.

Once all gates have been closed at the end of Phase II, the crane and all other equipment should be removed from the closure structure bridge to a safe location. The location of the crane and the equipment should be near the closure structure so that during the recovery period they can be deployed quickly. The crane should be located on high ground adjacent to the structure so that deployment after the storm will not be impeded by flood waters from a major rain event. Once the crew has moved the crane and equipment to the safe location they should go to the designated area until instructed by the Canal Captain to return to remove the gates.

2.1.3 After A Storm

The tracking of storms will continue for a period of time after they have made landfall. Actual data as well as the predictions by the model will be used for the decision-making process regarding the removal of the gates.

2.1.3.1 Removal Conditions

The gates will remain in place until the conditions described in Section 1.1 are met. The Operation Teams should mobilize and be ready to open the gates as soon as approval is given to open the gates. Approval will be given by the District Commander, through the Communications Hierarchy.

2.1.3.2 Required Crew

The crew needed for opening the gates at each closure structure is identical to those required for closing the gates and should include:

- Crane operator
- Mechanic
- Laborer / welder
- Laborer

The Dive Team should return to the closure structure as soon as possible after the storm has passed.

2.1.3.3 Mobilization Requirements

The equipment that will be required for opening the gates at each closure structure include:

- Crane
- Ratcheted puller (come along)
- Sledge hammer (beat dogging pins into position)
- Eye bolts for dogging pins
- Miscellaneous small tools

2.1.3.4 Open Gates

Once the conditions identified in subparagraph 2.1.3.1 have been met, and Approval has been given by the District Commander, the gates may be raised. The gates should be raised starting with the center gate. Subsequent gates should be removed in a sequence that will result in the most timely removal of the gates.

To raise a gate the crane must be hooked to the lifting mechanism and raise the gate slightly to allow the removal of the dogging pins. If the eye bolts were removed during closure and were not reinserted, it may be necessary to insert the eye bolts and use a come along to extract the dogging pins. Once the pins have been removed the gate may be slowly raised until the holes for the dogging pins at the bottom of the gate line up with the dogging pins. The pins should be inserted into the holes and this may require removal of the eye bolts and use of a sledge hammer to beat the pins into place. Once the dogging pins are in place, the crane should let the gate down slowly until the weight of the gate is resting on the dogging pins. The crane may then be unhooked from the gate. The same procedure can be used for each gate.

2.1.4 Coordination

Coordination will be a key component for successful operation. Close communications between all affected parties will enable the most effective protection against flooding. It is important that the information from the model that results in activating a crew be conveyed to the USACE Chief of Operations by the H&H Team Chief so that he can contact Canal Captains for each of the closure structures. It will also be important for the Operations Team and the Dive Team to be readily available and in contact with their Canal Captains as a storm approaches.

Local Partner Authorities should be notified when the crews are activated as described in Section 1. Activation of the crews for the closure structures will signal to the Local Partner Authorities that the gates may be closed. Close contact with the Local Partner Authorities will need to be continued throughout the decision process for closing the gates so that they can make suitable preparations.

2.1.4.1 Crew Deployment

The crew required to operate the gate will be the Operations Team and the Dive Team. The members of the Operations Team should be familiar with the pumps and the pump operation, since they will be responsible for operating the pumps.

The crew for each closure structure will have a Canal Captain who will serve as the primary point of contact. The Canal Captain will be required to have multiple forms of contact information on file, as shown in Sections 1.2 and 1.3. The Canal Captain should have all of the necessary contact information for the individual crew members and will be responsible for ensuring that each crew member is contacted and that plans for activation of the crew are properly conveyed.

During the hurricane season it is imperative that the points of contact and all crew members notify the individual to whom they report if they will be out of the area and unable to respond to an approaching storm. Alternate crew members have been designated in the event a crew member is unavailable.

2.1.4.2 Interaction between Government Agencies

The Corps of Engineers will be monitoring approaching storms and conditions and will need to make certain information being gathered is passed along to the local and state government agencies. The organizational structure and chain-of-command to be used in the event of an approaching storm are in Section 1.2 of these instructions and must be followed carefully. Notification will be performed in accordance with the Gate Closure Activities Flowchart and the Flowchart of Communication Hierarchy provided in Section 1 of these instructions.

2.1.4.3 Initializing Pumps – Stopping Pumps

Initializing the pumps must be done in coordination with Phase II (final) closing of the gates. Pumps should be initialized after all gates on a canal are closed to ensure adequate water levels for priming. However, pumps should be initialized before or during gate closure if Local Partner pump stations are pumping stormwater into the canals at the time of gate closure. Once the gates are closed the pumping system may be activated so that the pumps will start at the predetermined canal level of +3.5 ft. (NAVD88 Datum) and stop when the water levels in the canals drop to +1.0 ft. (NAVD88 Datum). Under normal circumstances this will be accomplished automatically by the pump control system. The pump control system may be also be overridden by the SCADA remote monitoring and control system and pumps can be started or stopped at any time. For steady flow conditions, the targeted level for the canals will be in the range from 3 to 4 ft. (NAVD88 Datum) this will provide desired suction head to maximize flow for Interim Control Structure Pumps while not approaching the Safe Canal Levels. Flow meters will provide discharge flow rate data for each Interim Canal Structure Pump. Canal Captains will coordinate with Local Partner Pump Stations to achieve steady flow under these conditions.

2.2 Pumping Units

The various components of the pumping units are described in the following paragraphs. The primary components of the pumping units are the pumps, the hydraulic power units, and the hydraulic lines that connect the pumps to the hydraulic power units. Subparagraph 2.2.3.7 provides the operating instructions for the pumping units. Should a decision be made to close the gates then the operating instructions should be followed at approximately the same time as the gate closure. Instructions are provided for preliminary, automatic, and manual operation. Information is also provided on stopping the pumps after a storm has passed.

2.2.1 General

Each Orleans Parish Canal has multiple pumping units manufactured by MWI Corporation located in Deerfield Beach, Florida. The pumps are MWI model HAC360PO. Each pump has a nominal capacity of 107,000 gpm at a total dynamic head of 13 feet. Orleans Avenue Canal has ten (10) installed pumps, 17th Street and London Avenue Canals each have twelve (12) installed pumps. A complete spare pump drive was purchased for each of the canals. The pumping equipment is arranged symmetrically around the centerline of the canals, with half of the pumps on one side and the other half on the opposite side.

Each pumping unit consists of two separable major mechanical components; the water pump, located in the canal on the protected side of the closure gates, and the hydraulic power unit (HPU), located on an elevated equipment platform. The two components are connected by hydraulic fluid transmission piping. The HPU consists of a diesel engine driver, two (2) hydraulic vane pumps, control valves, filters, strainers, accumulators, pressure gauges, hydraulic fluid, a hydraulic fluid reservoir, hydraulic oil cooler and an assortment of safety switches. The HPU components are mounted on a single frame at the factory and shipped assembled to the canal sites. At the canal sites the HPUs are installed on two elevated equipment platforms. One platform is on the west side of each canal the other on the east side. The west side platforms support the HPUs for the pumps on the west side. The east side platforms support the HPUs for the east pumps. The top of the equipment platforms is set at Elevation 12.5. The HPUs are protected from the weather by a metal building open on the lower half. Located on one end of each platform is a 20,000 gallon diesel fuel tank for operating the HPUs on the platform and two (2) diesel generators. The fuel storage tank will supply approximately four (4) days of continuous pumping.

Connecting the HPU with the associated pump are four 3" schedule 80 pipe hydraulic transmission lines and a 1" motor case drain. Two of the 3" lines are used for fluid return and the third is fluid supply. The 3" lines are supported by a series of steel frames. The 1" case drain line is attached by straps to one of the 3" lines. The high pressure supply and return lines provide the power from the HPU to turn the pump impeller at 300 rpms. The case drain line prevents pressure from building inside of the motor casing due to internal motor leakages. The motor case drain line drains into the HPU fluid reservoir. Blockage in the case drain will cause motor failure or motor seal damage.

2.2.2 Water Pump

The water pump consists of the suction bell and strainer, impeller, hydraulic drive motor, motor housing, hydraulic fluid cooler, discharge column and discharge elbow. When operated at 300 rpm the water pump is capable of from 102,000 gpm at 14.8 feet of TDH (total dynamic head) to 112,000 gpm at 10.3 feet TDH. The overall efficiency of the impeller at these two conditions is 75.3% and 69.3%, respectively. The total weight of the pump assembly is 17,600 lbs. The complete pump assembly is painted inside and outside with bitumastic enamel equal to Zophar Triple A brand.

2.2.2.1 Suction Bell

The suction bell assembly is manufactured from structural steel 3/8" thick conforming to ASTM A36. The inlet diameter is 94 1/2" inches and the discharge diameter is 60 inches. The inlet bell is constructed to minimize vortex formation by maintaining equal pressures and velocities across the entrance. Bars are welded across the suction bell mouth to prevent entrance of large sticks, logs or other debris. The suction inlet bell face is installed horizontally. The suction bell is provided with zinc anodes cathodic protection for submerged components. The bottom of the suction bell is set at Elevation (-) 5.0.

2.2.2.2 Impeller Bowl Assembly

The impeller bowl assembly is a single stage, shop assembled unit consisting of a venturi housing, stainless steel liner, propeller shaft, bearings, and stainless steel impeller blades. The venturi housing is manufactured from 1" thick alloy steel conforming to ASTM A242 and is fitted with a machined removable housing liner of 300 series stainless steel with a minimum thickness of 3/16".

The impeller is housed in the impeller bowl section of the pump. The impeller imparts energy or lift to the water thereby allowing the transfer of water from a lower elevation to a higher elevation. There are several classifications for impellers depending on the flow of water relative to the axis of impeller rotation. The impeller used on the pumps provided are classified as propeller and are characteristics of low head pumps or pumps that are design to lift the pumped water from 0 to about 20 feet. Other characteristics of low head impellers are that they resemble a ship propeller and the pumped water flows thru the impeller parallel to the axis of rotation. The propeller in the MWI pump is 60" in diameter and is designed to operate at 288 revolutions per minute. The impeller or propeller is made of ASTM A304 stainless steel. The propeller is balanced and secured to a taper shaft with an alignment key and locknut.

The propeller shaft is manufactured from stainless steel and is designed to transmit full load torque plus impact. The impeller shaft is supported and contained in place by three multiple angular contact bearings. The shaft bearings are designed for an L_{10} life of 50,000 hours and lubricated by low pressure hydraulic oil. The impeller shaft and bearing assembly are contained in a machined bearing housing centrally supported by flow straightening vanes in the impeller bowl assembly and are protected against sand particle intrusion. The bearings are designed to accept thrust in either direction.

2.2.2.3 Hydraulic Coolers

On the outside of the impeller bowl, and mounted 180 degrees apart from each other, are two hydraulic fluid coolers. The fluid coolers are located on the low pressure return line from the pump. Coming off of each cooler is a low pressure return line quick disconnect. On the side of the diffuser section of the pump are two high pressure disconnects for the high pressure supply lines. There is also a quick disconnect for the case drain.

2.2.2.4 Hydraulic Motor Assembly Section

The hydraulic motor assembly section consists of the assembly housing, hydraulic motor, impeller shaft coupling, and inlet and outlet port pipe connections. The assembly housing is manufactured from 3/8" thick alloy steel conforming to ASTM A242. The housing assembly contains a Rineer 125 Series four port vane hydraulic motor coupled to the propeller shaft. The hydraulic motor, bearings, shaft, and coupling are enclosed and sealed to permit totally submerged operation in any position. The hydraulic motor is provided with supply and return pipes extending through the assembly housing and terminating with quick coupling connections. The hydraulic motor is mounted on the discharge side of the propeller to minimize NPSH requirements, avoid clogging of the intake, and induce more efficient oil cooling.

2.2.2.5 Discharge Tube and Elbow

The discharge tube and elbow assembly is manufactured from abrasive resistance steel conforming to ASTM A36 with a minimum wall thickness of 3/8".

2.2.3 Hydraulic Power Unit (HPU)

2.2.3.1 General

The HPU shall consist of an oil reservoir, a fixed displacement hydraulic pump, a diesel engine and interconnecting piping, valves, and accessories, all mounted on a fabricated steel base with lifting eyes. The steel base with all equipment mounted measures 196" X 85" and weighs 18,000 lbs. The diesel engine drives two hydraulic pumps in an open loop hydraulic circuit. An open loop hydraulic circuit is one in which the hydraulic pumps draw fluid directly from a reservoir that is at atmospheric pressure. Between the reservoir and each pump is a suction strainer to filter out particles that can damage the pump. The hydraulic pumps pump into a common header which supplies high pressure fluid to the associated water pump hydraulic motor. The water pump hydraulic motor then converts the energy contained in the high pressure fluid to shaft rotational energy to run the impeller. Once the fluid passes through the motor, it exits at a much lower pressure. In the transfer of energy there is heat built up in the fluid from frictional losses of the fluid and mechanical components. Much of this heat is dissipated to the canal water by the oil coolers attached to the side of the impeller housing. In the hydraulic circuit, the coolers are located on the discharge, or low pressure return line side of the water pump motor. Additional heat is also dissipated in the fluid transmission lines between the HPU and water pump and in the fluid reservoir. After the hydraulic fluid leaves the coolers, it then passes through a filter located near the reservoir and returns to the reservoir to be re-circulated by the pumps. Protecting the system from over pressurization is a pilot operated bypass valve located at the HPU on the high pressure side of the circuit. The bypass valve can also be operated by a flow control valve for manually operating the pump or by a two position solenoid valve for automatic pump operation. The solenoid valve is spring-returned to the open position. With the solenoid in the de-energized position the bypass valve is kept open or vented and the system will not pressurize. The solenoid valve is used in conjunction with automatic pump operation to unload the hydraulic pumps and diesel engine. The position of the bypass valve can be verified by the site glass located at HPU. When the bypass valve is open, fluid is being circulated back into the reservoir. This is evident by flow in the bypass site glass. When the pump is operating there should be no evidence of flow in the site glass.

2.2.3.2 Hydraulic Pumps

There are two hydraulic pumps per HPU. They are Dension, Model T7ED, double vane pumps. The pumps are driven from the engine through a Durst, Model 2PD10 pump drive. The drive is a gearbox which incorporates a remote heat exchanger and an auxiliary circulation pump to maintain the pump drive oil temperature. The circulation pump is activated when the pump drive surface reaches 120 degrees Fahrenheit. If the temperature rises above 170 degrees Fahrenheit, the diesel engine drive will shut down and the system will need to be manually reset after determining the root cause of the elevated temperature.

2.2.3.3 Safety Systems

The hydraulic system has the following safety systems that shut down the diesel engine.

1. Low fluid level in the hydraulic reservoir. Operation is from a float in the reservoir.

2. Reservoir hydraulic oil temperature over 150 degrees Fahrenheit. Operation is from a temperature switch located in the reservoir.

3. High vacuum at the inlet to either hydraulic pump. Usually caused by a clogged strainer or a collapsed hose.

4. Hydraulic Pump Drive housing temperature over 170 degrees Fahrenheit.

2.2.3.4 System Relief Valve

The main system relief/unloading valve is capable of bypassing the entire flow of the two Dension vane pumps back to the reservoir. The valve can be activated three ways. The first is by a two position solenoid valve normally kept open by a spring. In this position the relief/unloading valve operates as a system bypass and the output of the Dension pump is returned to the reservoir with a relatively low pressure drop. In order not to bypass fluid to the reservoir, the valve solenoid must be energized. Located in a parallel path with the solenoid valve is a direct acting relief valve. The direct acting relief is normally held closed by a spring. Acting against the spring is a small piston and system pressure. As the system pressure rises to overcome the spring pressure, the valve will open to bypass just enough fluid to keep the system pressure at the relief valve setting. Whenever the relief is open, the fluid that is dumped goes from maximum system pressure to near atmospheric across the bypass valve. The change in pressure and the fluid flow results in energy being release at the bypass valve. The energy release is in the form of heat. A situation where all of the pump output is being dumped, i.e. jammed pump impeller will result in the fluid quickly heating up and the temperature limits being exceed. If this should happen, the engine will shut down when the fluid reservoir reach 150 degrees Fahrenheit.

2.2.3.5 Fluid Control Components

2.2.3.5.1 Two Position Solenoid Valve

The two position solenoid is the same one mentioned in the previous paragraph. It is used to load and unload the pumps when operating in the automatic mode only if the loading valve is open. When the solenoid is de-energized, the valve is open and the bypass valve is consequentially open. When the solenoid is energized, the valve is closed and consequentially the bypass is closed. Since the two (2) Dension pumps are mounted to the engine, the solenoid valve is used to unload and load the system and hence the diesel engine. This feature acts as an electric clutch and allows for starting, stopping and running the engine without a load. The solenoid valve is essential for automatic operation. It is not required for manual operation.

2.2.3.5.2 Accumulator

The accumulator prevents slamming of the bypass valve whenever the two position solenoid valve is shifted.

2.2.3.5.3 Loading Valve

The loading valve located in the panel is a variable delivery flow control valve. Its function is to provide a means to manually operate the system bypass valve. Closing the valve will cause the bypass valve to close. Opening the valve will cause the bypass valve to open. The loading valve is only effective if the two position solenoid valve is de-energized or open. To de-energize the solenoid valve, place the automatic/manual switch to the manual position.

2.2.3.5.4 Vacuum Gauges

Between each pump suction and suction strainer is a vacuum gauge. The vacuum gauges measure the amount of pressure below atmospheric at the inlet of the pumps. Gauge pressure readings below -5" of mercury will result in activating safety shutdowns on the engine.

2.2.3.5.5 Hydraulic Pressure Gauge

Located in the control panel is a hydraulic pressure gauge. The gauge senses the pressure in the control part of the bypass valve circuit. Generally, this is the same as the pressure in the pump and motor circuit.

2.2.3.5.6 Suction Strainers

Located on each pump inlet is a suction strainer. The strainers are course filters usually made of a fine mesh screen. They are designed to keep relatively large particles from getting into the pumps.

2.2.3.5.7 Filters

There is a single filter in the system. It is located on the return line from the hydraulic motor. Fluid leaving the filter discharges into the reservoir. The filter has a pressure gauge to indicate the differential pressure drop across the filter element.

2.2.3.6 Engine

2.2.3.6.1 General

The engine which powers the hydraulic system is a Caterpillar model 3412 DITTA rated for 735 Hp @1800 rpm, continuous duty rating “A”. The operating limits for an “A” rated engine are:

1. No hour or load factor limitation.
2. Continuous operation at full load.
3. Average load factor to approach 100%.
4. Typical operating hours per year is over 4000 hours.

The engine is a 12 cylinder, 4 stroke unit with a displacement of 1649 cubic inches. Combustion system is direct fuel injection. Aspiration is dual turbocharged with after-cooler. The exhaust system is 8” diameter dry type. Cooling system is jacket water, radiator fan and air to air heat exchanger. The engine net dry weight is 4,720 pounds. Fuel consumption at full load and 1800 rpm is 35.7 gallons per hour. Fuel type is No. 2 diesel.

2.2.3.6.2 Coolant System

Approximately one-third of the fuel burned in an engine is carried away as heat in the coolant system. Another one-third is lost in the exhaust system and one-third goes to producing power. As a result, a proper design and operating coolant system is essential. On the Series 3400 Caterpillar engines the coolant system operates as follows. Starting at the engine driven water pump, water or coolant leaves the water pump and flows along two paths. The first path is to the turbochargers after-cooler, and then to the cylinder heads on the engine. The second path is from the pump to the engine oil cooler, then through the engine block to the cylinder heads. The flows recombine in the cylinder heads. Upon leaving the cylinder head, the combined flow is divided by the temperature regulator. Based on temperature, the regulator sends part of the flow to the radiator and the rest back to the pump inlet. The portion that goes to the radiator is cooled with the help of the radiator and radiator fan and then retuned to the pump inlet. Maximum design temperature at the inlet to the water pump is 210 degrees Fahrenheit. Temperatures in excess of 210 degrees will cause excessive cavitation in the water pump and will result in a reduced flow rate through the pump. The engine pump is a gear driven centrifugal pump. The engine is equipped with a jacket water temperature gauge and high temperature shutdown.

2.2.3.6.3 Fuel System

The Caterpillar engine is equipped with a direct fuel injection system. The fuel system on the engine consists of a water separator, primary filter, transfer pump, fuel pressure regulator, priming pump, secondary filter, fuel pressure gauge, injection pump, injectors, governor, speed control and excess fuel return line. The system operates in the following manner. Fuel is suctioned from the fuel tank and passes through the water separator and primary filter to the transfer pump. From the transfer pump the fuel passes through a pressure regulator and priming pump to a secondary filter. After the secondary filter is a fuel pressure gauge which indicates the pressure of the fuel entering the injection pump. At the injection pump, fuel is metered and pumped at high pressure to the fuel injectors. The metering done at the injection pump is controlled by the engine governor. The engine governor is preset by the operator by means of a speed controller to a pre-selected speed and the governor regulates the injector pump and fuel flow to the cylinder to maintain the pre-selected speed. Since the fuel transfer pump pumps at a constant rate and the engine fuel demands vary with load and speed, there is excess fuel being delivered to the injection pump. The excess fuel is retuned to the fuel tank by the return line. The injector function is to spray the high pressure fuel in the proper pattern and at the proper time in the piston's stroke. The governors provided with the engines are speed droop mechanical governors with a 10% speed droop. This means the full load speed can be as much as 10% less than no load speed.

2.2.3.6.4 Lubrication System

The lubrication system provides lubrication to internal components of the engine, serves as a coolant for parts that cannot be cooled by water, and washes wear debris from the engine's internal components. The lubrication system has an oil cooler that is cooled by the engine jacket water system. Disposal oil filters are provided for trapping and removing wear particles and contaminants.

2.2.3.6.5 Starting System

The starting system for the engine is a 24 volt DC battery, electric start. Battery,

battery box and cables are supplied with the engine. There is a 24 volt 45 ampere alternator for charging the battery and supplying engine instrument electrical power when the engine is running. An ammeter is supplied to indicate amperage output. The starter is activated through a key switch that controls a 24 volt starter motor relay. The 24 volt alternator output is used to power the 24 volt coolant pump for the Dension hydraulic pumps.

2.2.3.6.6 Exhaust System

The exhaust system supplied with the system is a dry manifold exhaust. The exhaust elbow is 8”. The silencer is critical grade and is affixed with an 8” inch rain cap.

2.2.3.6.7 Safety Devices

The diesel engine has several safety systems that shut down the engine for the following system failures.

1. Low fuel level in the day tank

2. Low Oil Pressure

3. High jacket water temperature

2.2.3.7 Operating Instructions

Preparation for Operation

a. Engines should be inspected, started, and run weekly.

b. Pumps should be inspected and engaged every three (3) weeks and flow should be established when a 4 ft suction head is available for priming the pumps.

c. The remaining portions of the system, cranes, equipment, and fuel levels should be inspected at the same three (3) week interval.

2.2.3.7.1 Preliminary (Systems Check)

Engine:

a. Perform a general inspection of the engine. Check for evidence of fluid and exhaust leaks, lose hardware and fasteners, condition of battery and battery cables, frail wiring and loose connections. Pay particular attention to the condition of fluid hoses and drive belts.

b. Check for evidence of coolant and oil leaks.

c. Check oil and coolant level.

d. Add oil and coolant as required.

e. Check fuel level in day tank.

f. Drain water from the fuel/water separator.

g. Check that all guards are in place and areas around rotating components are clear.

Hydraulic Unit:

a. Perform a general inspection of the hydraulic system.

Check the condition of hydraulic hoses. Look for loose fasteners and connections.

b. Check for evidence of hydraulic fluid leaks.

c. Check hydraulic fluid level.

d. Open all ball valves that were closed at the end of the previous operation to limit the extent of spills.

Pump:

a. Check the waterway around the pump intake. As the pump will create a powerful suction when running, check the area for people and pets. Check the area for large objects which may be sucked into the pump. Take appropriate action to clear the waterway.

b. Check the hydraulic line coming from the pump especially the hydraulic hoses and fittings. Repair any problems found.

c. Check the pump anchors for loose or badly deteriorated bolts.

d. Check pipe flanges and look for any sign of movement between flanges. Check flexible connectors for signs of distress.

e. Check the general condition of the discharge pipe and look for any signs of stress, settlement and corrosion.

Hydraulic Transmission Lines:

a. Walk the hydraulic transmission line from pump to HPU. Check for any sign of stress and hydraulic fluid leaks. Check for any problem with the pipe supports, such as settlement, corrosion and loose hardware.

Fuel System:

b. Open 3” brass ball valve on the fuel supply line located at the 20,000 gallon fuel supply tank. Ball valves are open when the handle is positioned parallel to the valve and closed when the handle is positioned across the valve.

c. Open 1” brass ball valves at the day tank on either side of the fuel strainer.

d. Check for fuel leaks.

2.2.3.7.2 Pump Starting (Manual Operation)

Once the above checks have been made and any problem discovered remedied, the pump can be started.

a. Place the Manual/Automatic selector switch to MANUAL.

b. Open the loading valve located at the HPU control panel. (This is done by turning the valve stem counterclockwise 1/2 turn. This action will cause the bypass valve to dump pumped hydraulic fluid back to the system reservoir rather than send it to the pump.)

c. Proceed to start the diesel engine.

1. Open any closed fuel line valves.

2. Turn the key switch to the ON position. (In this position the CHECK ENGINE/DIAGNOSTIC LAMP will begin to flash. This will continue until the engine starts and proper engine oil pressure is achieved.)

3. Depress the start button with the throttle in the idle position until the engine starts, but not longer than 30 seconds. **Do not increase the throttle.** (Normally the engine should start in a few seconds. Engaging the starter motor for more than 30 seconds at a time without a 2 minute break between starts may overheat the motor and cause damage to the starter. If the engine has been sitting idle for several or more weeks and fails to start, it may be necessary to bleed the injectors. Check the engine manual for this procedure.)

4. After the engine has started, let it idle a minimum of 3 minutes and until the water temperature begins to rise. During this time check all engine gauges. Engine operating oil pressure should be in the normal range. If not, shut the engine down. During the warm-up, check for any fluid or air leaks. Raise the engine speed to 900 rpm and again check for fluid and air leaks.

5. Slowly increase engine rpm to the unloaded operating speed of 1830 rpm. At this time check the air filter indicator. If showing red, shut down the engine and replace the air filter.

Note: Extended operation at idle and/or no to low load should be avoided to prevent carbon built-up in the cylinders and excessive oil consumption.

d. With the engine at operating speed, **very slowly** close the unloading valve. As the valve is closed the hydraulic system bypass will begin to close. (Closing the valve suddenly can damage the pump, engine and/or hydraulic system.)

e. Check the engine speed. If the engine speed is below 1800 rpm, re-adjust the engine throttle/governor to bring the speed back up to 1800 rpm. (The engine speed may decrease by as much as 180 rpm from no-load to full load.)

2.2.3.7.3 Pump Starting (Automatic Operation)

Once the above checks have been made and any problem discovered remedied, the pump can be started. The pump will now be operated from water level detection devices on the inlet side of the pump. The water level detection device will have a level for pump start and a lower level for pump stop. Operation will include starting the engine, running it through a warm-up cycle, engaging the pump by activating the two position solenoid valve in the hydraulic circuit, and finally, bringing the engine up to operating speed.

a. Place the Manual/Automatic selector switch on the HPU to AUTO.

b. Place the switch on the engine instrument panel to AUTO.

c. Open the loading valve on the HPU control console by turning 1/2 turn in the clockwise position.

d. Set the no-load engine speed to 1850 rpm.

2.2.3.7.4 During Operation (System Checks)

During operation perform the following checks.

Engine:

a. Check the engine oil pressure and water temperature.

b. Check for fluid leaks.

c. Check for any unusual noise or vibration.

d. Check air filter indicator.

e. Check exhaust for leaks.

f. Check the exhaust. The exhaust should be clear.

Hydraulic Pressure Unit:

a. Check the bypass site glass. With the pump operating there should be no indication of fluid flow.

b. Check the fluid level of the reservoir.

c. Check pressure gauge reading on the return line filter. Readings of 50 psi or more indicates need for replacement.

d. Check the vacuum pressure on the inlet to each pump. Clean strainer when vacuum reaches -4 psi.

e. Check for fluid leaks, and any unusual noise or vibration.

f. Check the temperature of the hydraulic fluid.

Pump:

a. Check the pump inlet waterway for people, pets and large objects.

b. Check for any unusual noise or vibration.

c. Check for fluid leaks.

d. Check discharge pipe and vacuum breaker valve for leaks.

Hydraulic Transmission Line:

Check the transmission line for evidence of leaks and movement.

Fuel System:

Check for evidence of fuel leaks.

2.2.3.7.5 Pump Stop (Manual Operation)

a. Slowly reduce the engine operating speed to low idle.

b. SLOWLY unscrew the HPU loading valve 1/2 turn in the counterclockwise direction. This will cause the bypass valve to open.

c. Check the bypass site glass for evidence of hydraulic fluid flow. (Fluid flow in the site glass is evidence fluid is being bypassed.)

d. Increase the engine speed to 700 rpm and run for 4 minutes. (This allows the coolant and oil temperatures to decrease and stabilizes internal coolant and oil temperatures.)

e. Reduce engine speed to low idle for 2 minutes.

f. Turn the key switch to off.

2.2.3.7.6 Pump Stop (Automatic Operation)

Once the inlet water way is pumped down to the lower water level detection device the pump operation will stop. Stopping the pump is done in the reverse order. First the engine is slowed to idle. Then the two position solenoid in the hydraulic circuit is electrically deactivated opening the valve, thereby unloading the engine. The engine is then run through a cool down cycle and stopped.

2.2.3.7.7 Post Operation

Engine:

The following should be performed after the engine has been shut downed for 10 minutes. The 10 minute shut down allows the engine to cool down and the oil to drain back into the crankcase.

a. Check oil level in the crankcase. Maintain oil level between the ADD and FULL marks.

b. Repair any leaks and tighten any loose hardware observed during operation and after shutdown.

c. Check the service hour meter and perform any maintenance required in the engine manufacturer O&M manual.

d. Top off fuel tanks to prevent moisture accumulation.

e. Check the coolant level. Maintain level as per manufacturer O&M manual.

f. If freezing temperatures are expected, check antifreeze levels as required. Use only the antifreeze types recommended in the manufacturer O&M manual.

Hydraulic Power Unit (HPU):

a. Check for evidence of fluid leaks.

b. Perform scheduled maintenance as recommended in the manufacturer O&M manual.

c. Check fluid level in the hydraulic reservoir. Maintain fluid level 4" from top of reservoir to reduce condensation build-up. Close all ball valves to limit possible spills.

Pump:

a. Check for signs of distress.

b. Check hose and connecting piping for evidence of fluid leaks.

c. Check pump anchorage and loose fasteners and hardware.

Hydraulic Transmission Lines:

a. Check for evidence of fluid leaks.

b. Check for distress in the piping and pipe supports.

c. Check for loose hardware.

Fuel System:

a. Close 3” brass ball valve on the supply line located near the 20,000 gpm tank.

b. Close 1” brass ball valves at the day tanks.

2.3 Fuel System

2.3.1 General

Each elevated pump equipment platform houses a main 20,000 gallon diesel fuel storage tank. The main fuel tank provides fuel for 5 or 6 pump drives and two (2) diesel generators. Each pump drive has a 200 gallon day tank and transfer pump and the generators each have a gravity feed under skid mounted day tank. The fuel system requires no special operating procedure other than what is provided for operating the pumps and generator. The normal position for each valve is provided in the valve description below. Normally, the only problem that will be experienced with the fuel system is the fuel. The fuel shall meet the requirements of ASTM D975 for type 2-D diesel fuel. Condensation can be controlled by keeping the fuel tank topped off and bacteria can be controlled by adding a fuel additive. Still, if the fuel is not refreshed every several years, there still may be problems. The condition of the fuel should be monitored through quarterly analysis in this case. A log shall be kept of all fuel deliveries, system inspections and analysis.

2.3.1.1 Main Tank

The main tank is manufactured from a 1/4" steel plate shell and 5/16" steel plate ends and is fabricated in accordance with UL Standard 142. Located on the top of the tank is a 3" pressure vacuum vent, a 24" man-way with cover, 10" emergency vent, 4" cam-lock emergency fill port, a fuel level probe for a digital level gauge, and a 6" fuel fill port for the 3" fuel fill line. The fuel fill port is connected to a 3" aluminum tube that extends to within 3" of the bottom of the tank. At the top of the drop tube is a 3" overfill prevention valve.

Located on the bottom of the tank is a 1 1/2" tank drain with a 1 1/2" full port ball valve with a locking handle. Downstream from this valve is a short nipple and cap.

On one end of the tank is a site tube to provide a visual confirmation of the level of fuel in the tank. The site tube has shutoff valves on both ends. On the other end of the tank is a 3" fuel supply line connection.

The tank interior is not painted. The exterior is painted with 2 mils of red oxide primer and topped with 2 mils of aluminum pigmented enamel. The tank is surrounded by a concrete retention wall designed to retain 20,000 gallons of fuel. The retention basin has a 4" drain line extending below the elevated platform to a 4" valve located 5' above finish grade.

2.3.1.2 Day Tanks

The day tanks are supplied with the pump equipment and are mounted on the HPU skids. The tanks are single walled with a 200 gallon capacity. They are manufactured by Pryco Inc. Each tank is supplied with a 2 gpm, Pryco positive displacement pump driven by a 1/3 horsepower, 120 volt electric motor. Operation of the pump is by floats inside of the day tank. The pump draws from a 3” fuel supply line running under the elevated platform. Prior to reaching the pump the fuel passes through a strainer which removes any large particles. There is a bypass line around the strainer to allow cleaning without stopping the pump. The fuel is further filtered at the engine by two replaceable filter elements and a water separator. The fuel tank is supplied with a supply and return line connection for the engine and an over flow that is piped back to the main storage tank. The tank is also supplied with a 2” vent connection.

2.3.1.3 Valves

2.3.1.3.1 Supply Line Valves

The supply line to the pump has a main 3” brass ball valve with a locking handle located near the main fuel tank. This valve should be maintained in the closed position and locked when the station is not in use to limit potential spills. The valve is in the closed position when the handler is positioned across the valve. There is a 3” emergency shut off (fire link) valve which is spring loaded and retained open by a fusible link. The valve is automatically activated by excessive heat and should not be tampered with. There are also valves at each day tank. Theses valves should be maintained in the closed position when the station is not in service.

2.3.1.3.2 Fill Valves

There is a 3” brass ball valve with a locking handle located on the primary fill line. This valve should be maintained in the closed lock position when the tank is not being filled.

There is also a 2” brass ball valve with a locking handle and 2” back flow check valve for the emergency fill connection. This valve should be locked in the closed position when not in use.

2.3.1.3.3 Tank Site Glass Valves

There are 2” spool valves located on either end of the tank site glass. The lower valve should be closed when not observing fuel levels in the tank.

2.3.1.3.4 Tank Drain Valve

The tank drain valve is a 1 1/2” brass ball lockable handle valve. The valve should be maintained in the closed position and locked.

2.4 Discharge Piping and Siphon Breaking Valve

The pumps are arranged along the inlet canals in groups of 5 to 6 pumps. The pumps discharge into two 9 foot outside diameter steel pipes. In the case of 6 pumps, three pumps discharge into one 9 foot pipe and three into the other. In the case of five pumps, three pumps discharge into one 9 foot diameter pipe and two into the second. The 9 foot discharge pipes extend through a steel sheet pile circular cell which is filled and then topped with a 5 foot concrete cap. Supporting the pile cap are numerous “H” piles of considerable length. The top of the circular cells is at Elevation 16.0 and the centerline of the 9 foot discharge pipes is at Elevation 6.5. Where the discharge pipe penetrates the cell, there is a 5 foot wide concrete side wall extending down to Elevation 0. On the flood side of the cell, the discharge extends out 12 feet and then is angled down at about a 60 degree angle from horizontal. At Elevation 1.0 the discharge pipe terminates horizontally, leaving an oval discharge cross section. The discharge pipe is designed for pump discharge when lake stages are at elevations of approximately 4.0 or above. At lake stages of Elevation 1.0 or less it may not be possible to establish a siphon as the discharge end of the pipe may not be fully submerged.

On the inlet canal side of the cells the pumps are arranged to discharge into the top and along the length of the 9 foot pipes. The individual pump discharges are 5' outside diameter. The pump discharges are identical except for the horizontal run required to reach the discharge pipe. From the pump, the pump discharge runs through a segmented 90 degree elbow with a top centerline Elevation 19.0. From there it runs horizontally from 11 to 28 feet, depending on the location of the pump relative to the 9 foot discharge pipe. The pump discharge then turns downward through a second segmented 90 degree elbow to the 9 foot pipe. On top of each of the pumps horizontal discharge, at Elevation 21.5, is an anti siphon and air release valve. The valve is a 12" model manufactured by Harris Industries.

Discharge piping is painted with cold tar epoxy with a minimum expected life of 10 years and probable life of 20 years.

2.5 Equipment Failure and Diagnosis

The following is a guide to probable causes and solutions to some of the problems that may be encountered. If a problem cannot be resolved on an operator level, a qualified mechanic should be consulted.

ENGINE DIAGNOSIS

PROBLEM	PROBABLE CAUSES	SOLUTION
Engine fails to crank	Loose battery cables Dead battery Loose connection or broken wire in the starting circuit. Bad starter relay Bad starter	Clean and tighten battery cable. Replace battery. Tighten loose connection or replace damaged wiring. Replace starter relay. Replace starter.
Engine cranks but will not start or starts and then stops.	Fuel not getting to the cylinders.	Check fuel level in day tank for proper level. If low, Check position of fuel valves Check transfer pump operation. Check condition of suction strainer. Bleed any water from water separator. Check condition of fuel filters. Replace as needed. If engine has been idle for several weeks, prime fuel system and look for fuel leaks.
Engine cranks but will not start or starts and then stops.	Low oil pressure	Check oil level. Check wiring in the low oil pressure safety shutdown circuit.
Engine runs for a while and then stops	Fuel not getting to the cylinder. Engine overheating. Safety shutdown.	Perform the same checks for engine cranks but will not starts or starts then stops. Check coolant level. Check fan belt. Check radiator blockage. Check the safety shutdown condition including low oil pressure, high coolant temperature, low reservoir level, high hydraulic pump temperature or high reservoir temperature. If shutdown condition doesn't exist, check for faulty components in the shutdown system.

HYDRAULIC POWER UNIT

PROBLEM	PROBABLE CAUSES	SOLUTION
High system pressure. Oil in bypass sight glass.	Impeller jammed by debris Hose quick coupling not fully seated Hydraulic line restricted	Shut down unit and remove debris. Shut down unit, disconnect and reconnect coupling. Check for kink hoses and straighten. Check for closed or partially closed valves in the transmission lines.
Sudden decrease in pressure or low pressure.	Bypass valve is open Loading valve is open Relief valve setting has changed. Change in engine speed. Loss of hydraulic fluid. Hydraulic pump(s) lost suction. Water intake blocked.	Check the bypass site glass. If the bypass is open, there will be evidence of flow. If flow is evident, check position of loading valve. It should be close for manual operation when pumping. If operating in the automatic mode, check power to the two position solenoid. The valve is powered closed and spring opened. Closing the loading valve (normally open in the automatic mode) would increase the pressure if the solenoid is malfunctioning. Check the relief valve to see if it has been tampered with. Reset the engine throttle to 1800 rpm Check for evidence of fluid loss. Check the vacuum gauge on the pump suction. It should be reading between 0 and -5 psia. If -5psia or more, clean the intake strainer. Shut the pump down and clean the intake.
Sudden shutdown	Safety shutdown tripped	See “Engine runs for a while and stops” under Engine malfunctions.

FUEL TRANSFER PUMP

PROBLEM	PROBABLE CAUSES	SOLUTION
Fuel level in day tank not being maintained.	Suction line valves to the fuel pump are closed.	Open suction line valves.
	No power to the fuel pump.	Check pump power source and circuit breaker.
	Clogged intake strainer of fuel pump.	Open bypass valves and close valves on either side of strainer. Remove and clean strainer.
	Main fuel tank is empty.	Refill main fuel tank.
	Pump "on" float is stuck in the pump off position.	Free the stuck float.

2.6 Plant Electrical Power Supply

2.6.1 General

Electrical power is supplied to each side (East & West) of closure structure and pumping facility by two separate power sources which operate independently. The two power sources are commercial power supply and either of two 35kw engine generator sets. Power can be supplied to each side of the facility from either of the two sources. The commercial power supply is interlocked via an automatic transfer switch with the generator power supply thus preventing the engine generator from being paralleled with the commercial power supply. The commercial power supply is used for all operations under normal conditions. If commercial power is interrupted either of two 35 kw diesel engine generators are used to supply power for all operations.

2.6.2 Commercial Power

Commercial power is supplied to the facility by Entergy Corporation. The power company supplies single phase power at 120/240 Volt at both the east side facility and the west side facility of each canal. Power is distributed throughout the station from the panel "LL-WEST" or "LL-EAST" respective of the station side.

2.6.3 Engine Generator Set

Two 35 kw diesel generators with weather-protected enclosures (rated for 150 MPH winds) supply each side of the facility to back up the commercial power system. The diesel engine generator sets are provided so that the station can be operated in the event of a power failure. Each generator is equipped with a 12-volt battery which is used to start each diesel engine. Batteries are kept fully charged by a battery charger which uses commercial A.C. power. Each generator delivers 120/240 volt, 1- phase power to the 120/240 volt, 200 ampere frame generator circuit breaker located on the generator skid. Generated power is distributed throughout the station from panel LL.

2.6.4 Description

The following descriptions are given for the 35 kw diesel engine generator set components:

a. Engine. The 35 kw generator is driven by a diesel fueled naturally aspirated, four-cycle Cummins Engineer-Model 4B3.3G1 with a net continuous rating at 1800 rpm of 51 BHP for prime power applications. The engine is cooled by an integrally mounted radiator, and is supplied fuel from a dual wall sub-base mounted 70 gal day tank which is in turn supplied by the station bulk fuel tank via gravity feed. The engine, generator, fuel tank and control panel are installed on a common, fabricated steel skid, anchored to the engine platform floor at through spring mounted vibration isolators. The following is a description of the auxiliary system.

1. Air Intake System. Engine combustion air is taken from within the enclosure. The intake air is filtered through a dry-type air cleaner, consisting of a metal

housing with a removable cover, a replaceable paper filter cartridge and a dust cap.

2. Exhaust System. Exhaust gas from each cylinder bank is piped through a muffler housed within the weatherproof enclosure and exhausted out the top of the enclosure.

3. Starting System. The engine is started by an electric motor driving a drive assembly that meshes with the flywheel ring gear. The electric motor is powered by a 12 volt battery pack. During operating periods the battery is charged with the engine's alternator and voltage regulator. During inactive periods the battery charge is maintained with an Onan 4-stage 12 volt battery charger.

4. Lubricating System. The lubricating oil system consists of an engine driven oil pump, an oil level gauge, a spin-on canister-combination full flow filter with bypass. Low lube oil pressure registers on an oil pressure gauge located in the generator control panel and sounds an alarm. If the oil pressure continues to drop to a pressure switch in the lube oil system will energize the shutdown solenoid and stop the engine.

5. Cooling System. The cooling system consists of an engine driven water pump. A water temperature gauge is located on the generator control panel. High coolant temperature is initiated at the engine control panel as an alarm and if temperature reaches shutdown limits the engine is shutdown.

b. Generator. The 35kw alternator is a 120/240 volt, 1-phase, 60 Hertz, 1800 RPM single bearing generator manufactured by the Onan Company. The generator is rated for continuous power with a 105 degree C rise at 0.8 power factor.

c. Engine Instrumentation and Controls. The engine instrumentation and controls are contained in the generator control panel which is mounted inside of the generator housing.

d. Control System. The Power Command Control is an integrated generator set control system providing governing, voltage regulation, engine protection, and operator interface functions. Power Command Controls include integral Amp Sentry protection. Amp Sentry provides a full range of alternator protection functions that are matched to the alternator provided. Controls provided include Battery monitoring and testing features, and Smart-Starting control system. Included is an Echelon LonWorks network interface. Alarms, Engine Protection, Alternator data, Engine data, etc. are illustrated on the submittal data sheets included within this O & M manual.

2.6.5 Operation

2.6.5.1 Starting and Operating

The starting and operating procedures for operating the station from the engine generator is as follows:

a. Check lube oil level using the dipstick provided with the engine. All lube oil as required.

b. Check fuel tank gauge and verify that the fuel level is above the halfway mark.

c. Check fuel line connections for leaks. Tighten as required.

d. Check coolant water level in the heat exchanger tank.

e. Open station service entrance disconnect switch which will initiate the start circuit from the automatic transfer switch. Generator should accelerate up to required speed and voltage and once the voltage is stable at 120/240 V a transfer should occur and the panel LL should be energized via the generator.

f. Return to commercial power occurs once the service disconnect is close and commercial power is restored to the ATS. The ATS will transfer the load to commercial power after a time delay (set at 30 seconds). The generator will run unloaded through a "cool down" period (set for 5 minutes) and then shut down.

2.6.5.2 Maintenance

Maintenance procedures for the generator set may be found in the instructions contained in the Manufacturer's Operators Manual.

2.7 Station Electrical Distribution Equipment

2.7.1 General

The electrical distribution panel at East and West stations is rated 200 Amp,120/240 volt 1- phase, 60 Hz is manufactured by Square D Company (Orleans Canal) and consists of one 42 circuit panel (LL) with intepel TVSS protection module. The panel is a main lugs only type.

2.7.2 Safety

All electrical adjustments, maintenance and inspections shall be performed by competent personnel experienced in this type of work. All work to be performed on or in the vicinity of current carrying parts shall be undertaken with the following precautions in mind:

a. Except where the nature of the work requires or an extreme emergency exists, work shall not be done on or near energized equipment. If work must be performed near equipment connected to the line side of the main service disconnect. Entergy

Corporation should be notified so that they can open the cutouts for the transformer bank that serves the station. This will de-energize the line side of the commercial power. Only qualified personnel should perform the work and extensive precautions should be taken to guard against accidents. Insulated tools, rubber gloves and insulating mats shall be utilized.

2.7.3 Panel LL

The panel contains the equipment and devices as indicated in the schedule on Sheet E2. Additional features are as follows:

a. TVSS

Transient voltage surge suppression (TVSS) is provided integral to the panel.

b. Circuit Breakers

Circuit breakers are molded, case, heavy duty, air type, automatic trip, manually operated with trip free operating mechanisms of the quick-made, quick-break type. The breakers are provided with combination thermal and instantaneous magnetic trip units and are the interchangeable type. Operating handles clearly indicate if the breakers are in the "ON", "OFF", or "TRIPPED" position.

2.8 Water Level Control

2.8.1 General

Canal water level is monitored by ultrasonic level detectors at the structure and pumping of water over the closure gates is controlled by operating pumps at the pump platform via the engine platform pumps hydraulic. The sequence of operation is as follows:

1. All 6 pumps on respective sides (East & West) will be started in 2 stages and will

stop at a common stop level.

2. Stage 1 will start pump No. 1 and after an engine warm up period the pump will ramp up to speed over a period of approximately one minute. Following a time delay of 1 to 2 minutes, pump 2 will start, warm up and ramp up to speed. Following another time delay pump 3 will start. Should the level decrease to the stop float, all 3 pumps will shut down but the engines will continue to run for a cool down period.

3. Should the level continue rise after stage 1 has started, stage 2 pumps will start in the same manner.

4. The pump control panel will be powered by the engine batteries, diodes will be used to isolate an engine while it's cranking.

5. A pump controller has been furnished to change the starting sequence after each pumping cycle.

6. Note that at least 2 pumps must run to establish a siphon in the manifold pipe and therefore the grouping of the 3 pumps in 2 stages was selected for pumps at the 17th St. Canal and London Ave. Canal. At the Orleans Ave. Canal the pumps are grouped with 3 pumps in the first stage and 2 pumps in the second stage.

7. The pump control system may be overridden by the SCADA system and pumps can be started or stopped at any time.

8. Float switches have been provided for back up control and will start all the pumps on a high level alarm. The pumps will run until the level reaches the stop float switch.

The water level sensing is by an ultrasonic measuring unit designed for non-contact measurement of liquid level.

2.8.2 Ultrasonic Control Unit

The main control unit has a NEMA 4 watertight control enclosure and is wall mounted. The unit is a solid state system with electronics designed for operation on 120-volt AC with factory calibration for the water levels being measured, and with provisions for final adjustments of same in the field. The accuracy of the system is within +1% under constant temperature. The control unit is equipped with five optional individually adjustable contacts, each with a SPDT relay output for each set point rated at 10 amperes resistive at 125-volts AC. The method of control is a series of high power pulses sent to the remote mounted sensor which is transformed to acoustical pulses. The echoes received by the sensor from the water level is sent back to the control unit where they are amplified, and a DC voltage proportional to the distance from the water is used to shutdown the pumping units and also activates the digital meter mounted on the control panel.

2.8.3 Sensors

The sensors are mounted remotely from the control unit in the pump bays for measuring water elevation. The coaxial cable used to interconnect the sensors with the control unit is run in a separate conduit apart from any power or control. The sensors are rated for operation from -30ºF to 170ºF and are watertight. They are of the non-contact design and include no moving parts or mechanical linkages. The sensors are furnished with pre-amplifiers that raise the level of the received echo above the noise level on the cable.

2.8.4 Maintenance

The water level control shall be maintained in accordance with the manufacturer's instructions in the manual furnished with the equipment.

2.9 Lighting System

2.9.1 General

Lighting used at the structure consists of fixtures using incandescent lamps, fluorescent lamps, and metal halide lamps. Outdoor lighting fixtures are mounted on the exterior columns of the platforms and poles at the closure structure & pump platform. The entire lighting system is on the emergency generator to provide safe operation & egress in the event of a power failure. When a power failure occurs, the automatic transfer switch operates to energize panel LL from the generator. When power is restored the panel LL and the lights are switched back to utility power. All fixtures are supplied by 120V circuitry.

2.9.2 Fixtures

The type of fixtures installed at the pumping station are as follows:

F1 8-Foot, vapor-title, wet location listed, IP65 rated, linear fluorescent fixture; fiberglass housing; stainless steel latches; clear acrylic lens; (4) T8 lamps (two per cross-section); electronic high ambient and low temperature ballast; 120- volt; provide with brackets as required for mounting.

F2 4-foot, low profile wraparound fixture; corrosion-resistant steel housing; acrylic diffuser; (2) T8 lamps; electronic high ambient and low temperature ballast; 120-volt.

F3 Quartz floodlight; 300-watt; 120-volt; aluminum housing; tempered glass lens; swivel knuckle / slipfitter hardware as necessary for mounting.

F4 Vaportite, enclosed and gasketed, wet location rated compact fluorescent

"Globe-Type, Industrial" fixture; aluminum housing; stainless steel hardware; 2) 13-watt DTT lamps; high ambient/ low starting electronic ballast; 120-volt; provide with conduit reducers and stanchion mounting hardware as necessary.

F5 Quartz floodlight; 500-watt; 120-volt; aluminum housing; tempered glass lens; hardware as necessary for mounting.

F6 Metal halide floodlight; 175-watts; 120-volt; aluminum housing; tempered glass lens; swivel knuckle / slipfitter hardware as necessary for mounting.

Manufactures submittal data is attached within this O & M manual.

2.9.3 Maintenance

When servicing fixtures, damaged gaskets should be replaced. Also lenses and diffusers that have been broken or cracked should be replaced. Lamps should be replaced with the type, wattage, color, etc. as shown for the fixture. In no case should lamps be of higher wattage than the rating of the fixture.

APPENDIX A

STORM REPORT

Progress Report on Approaching Tropical Storm or Hurricane

Predicted Landfall
Date:____________________
Time:____________________

Storm Name:_____________________________
Date of Report:___________________________
Time of Report:___________________________

Lake Pontchartrain Predicted Surge Elevations

Time Before Landfall	Predicted Elevation	Time After Landfall	Predicted Elevation
T – 24 hours		T + 6 hours	
T – 18 hours		T + 12 hours	
T – 12 hours		T + 18 hours	
T – 6 hours		T + 24 hours	
T = 0 (landfall)			

Predicted Rainfall

Time Frame	Predicted Rainfall in the Time Frame
T – 24 hours thru T – 12 hours	
T – 12 hours thru T = 0	
T = 0 thru T + 12 hours	
T + 12 hours thru T +24 hours	

Predicted Sustained Wind Speed

Time Before Landfall	Predicted Wind Speed	Time After Landfall	Predicted Wind Speed
T – 24 hours		T + 6 hours	
T – 18 hours		T + 12 hours	
T – 12 hours		T + 18 hours	
T – 6 hours		T + 24 hours	
T = 0 (landfall)			

Expectation of Gate Closure

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Additional Information

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