2016 Record Flooding in the Entergy System

Hartburg and Kentwood Substations

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Timeline

- **March 8 – 9, 2016:**
  - 18-21” of rain in northern Louisiana
  - More than a foot of rain over the southern part of the Toledo Bend Reservoir

- **Wednesday, March 9**
  - All (11) flood gates at Toledo Bend opened

- **Tuesday, March 15**
  - Sabine River reaches record crest near Deweyville of 33.24ft.
  - 1884 ➔ 32.20 ft
- Approximately 4 ½ ft of water
- Berm and water pumps around control buildings
- 1 inch of water in control houses
  - No damage
- Motor mechanisms for switches all (28) under water
An inch of water or less got into the 2 existing control houses.
All of the 500kv dead tank breakers had their control cabinets go under water anywhere from 8 -12”
Average water level in dead tank breaker cabinets
500kv live tank breaker, no water in the cabinet
Water level in Autotransformer termination cabinet.
MOS cabinets went under water. Foam applied to prevent leaks didn’t work.
Emergency Switching
Original Model
Bypass Model
Settings Revisions
Nelson -> Hartburg -> Cypress Bypass

- Increased Zones 1 to protect 80% of both lines
- Increased Zone 2 to protect 120% of both lines
- Decreased Zone 2 timer to 10 cycles
  - Due to stability issues and critical clearing times.
- Used existing tone for pilot protection
**Settings Revisions**  
Mt. Olive -> Hartburg Auto-> Helbig Bypass

- Increased Zone 1 to protect 80% of the line-auto-line configuration.
- Increased Zone 2 to protect 100% of the first line and 50% of the shortest second line
  - Decreased Zone 2 timer to 10 cycles
- Increased Zone 3 to protect:
  - $120\% (Z_{1st\ Line}) + (Z_{Longest\ 2nd\ Line} \ast infeed\ ratio)$
- Breaker failure pickups changed
### Challenges

- **Delta Tertiary of Hartburg Auto XFMR**
  - Zero sequence infeed
  - **Solution:**
    - Used caution when setting ground distance reach elements for both ends
    - Mt. Olive affected enormously and CT ratios had to be changed
  - **Unavoidable Risk:**
    - Not tripping for a line end fault with Zone 2
Challenges
Mt. Olive – Helbig Line

- Certain point on the transmission line between Helbig and the auto transformer that the relays at Mount Olive would not be able to see a fault until after Helbig trips.
  - Helbig could trip in 5 cycles
  - Mt Olive would trip in 31 cycles (for the above scenario)
Recovery

- Replace and raise all (28) motor operators.
  - ~ 80,000 ft of control cable
- Replace and raise all outdoor distribution panels – Ten DC panels, five AC panels
- Raise station service transformers, generator, and propane tank.
Kentwood Flooding 2016
Flood Timeline

**KENTWOOD SUB:** Located in Flood Zone AE. The lowest point in the station is approximately 7 ½ft below flood level.

**FRIDAY, AUGUST 12, 2016:**
 Torrential rainfall began from a slow-moving low pressure system causing the nearby Tangipahoa River to rise above flood stage.

**SATURDAY, AUGUST 13, 2016:**
 Rain continued as the low pressure system began to shift west causing the Tangipahoa River to start subsiding.

**SUNDAY, AUGUST 14, 2016:**
 By Sunday, the water began to recede at the substation.
CONTROL HOUSES:
As shown in the photograph there was approximately 4 ½ ft of water, reaching the bottom of the control old.

The new control house was on site and installed but did not take on any water. The new control house sits on pillars which are 5ft above grade.

There was no damage to the equipment inside both control houses.
Damaged Low Voltage Breakers:
As shown in the photographs all of the low voltage breakers took on water and needed to be replaced. The breakers were approximately 3ft high during the flooding. No mitigation plan was put into effect prior to the flood.
Resolution for Low Voltage Breakers:
The breakers were raised to 6ft above ground. All new conductors were installed to the new control house. Portions of the overhead bus had to be modified and raised to allow proper clearance for the raised breakers.
Damaged Motor Mechanism Cabinets:
As shown in the photographs the water leaked inside some of the motor mechanism cabinets.

Resolution for Motor Mechanism Cabinets:
Motor mechanism cabinets were replaced and/or raised 2 ½ ft. The bottom of the cabinets were raised to approximately 6 ft to prevent damage for future flooding.
Damaged Outdoor Metering Cabinet:
As shown in the photographs the water got inside the outdoor metering cabinet. Damaging the meters and cables. Water seeped in the cable jackets onto the conductors.

Resolution for Metering Cabinet:
A new metering panel was ordered and relocated inside the new control house. All new meters were purchased and field cables were replaced.
Challenges

• As a result from the flooding, several pieces of outdoor equipment were damaged (junction boxes, station service AC panels, low voltage breakers, motor operator cabinets, XFMR cabinet, metering panel, and large quantity of cable)

• With the station being de-energized, and under construction with the installation of the operating bus and HV breaker, the team faced time constraints finding replacement equipment.
  – To mitigate this equipment was borrowed from other projects and jurisdictions.
    • (2) XFMR Diff Panels slated for another project were modified and used for the Kentwood XFMR Protection Scheme (EMI).
    • (2) Feeder breakers were modified to serve as transformer main beakers.
Challenges (cont’d)

• Utilized the station outage to increase equipment reliability by decommissioning the old control house and moving the SCADA equipment and XFMR protection panels over to the new house.

• Coordination between multiple groups (Telecom IT, Relay Design, Substation Design, Construction, Metering, etc.)

• Time Was The Major Factor
  – The TOC wanted to get McComb to Amite line re-energized incase Amite sub was to overload and/or drop load.
Conclusion

- The team was able to re-energize the station within the allowed outage time frame.
- Outdoor equipment was raised to prevent future damage from future flooding.
- All electromechanical relaying panels were replaced with microprocessor relaying.
- The old control house was decommissioned and all equipment was connected in the new control house.
- Entergy personnel and contractors worked safely and efficiently without any accidents or injuries.
Thank you

Questions?