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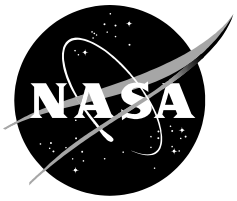

Risk Analysis for Electrical Power Outages During and After Hurricanes in the NASA Stennis Space Center and Michoud Assembly Facility Region

Risk Analysis and Solutions Innovators Report

Author Names: Christopher Potter
NASA Ames Research Center, Moffett Field, CA

July 2026

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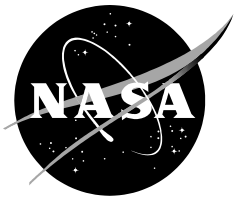

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Space Administration

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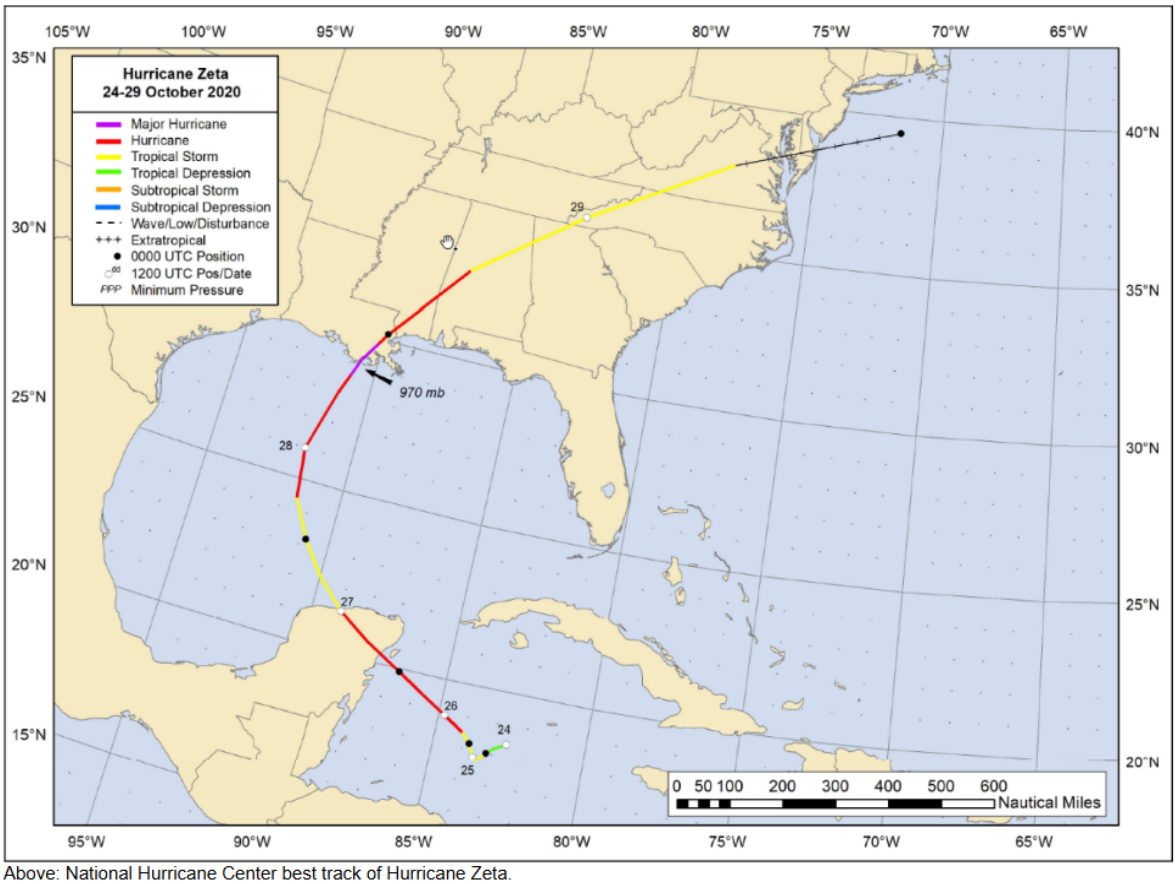
Background and Summary

Recent hurricanes in the region of southern Mississippi and Louisiana have caused widespread destruction from a combination of high winds, local flooding, and coastal storm surges. The region recently marked its 20th anniversary of Hurricane Katrina in 2005, which remains the costliest US storm on record. Hurricane Katrina caused more than $125 billion in damage and widespread levee failures that flooded 80% of the city of New Orleans and large parts of the surrounding region. Prior to Katrina, Hurricane Camille in 1969 was one of only four hurricanes to strike the U.S. mainland as a Category 5 storm with sustained winds of 175 mph. Hurricane Camille caused a 24-foot storm surge that destroyed nearly 4000 structures in Bay St. Louis and Waveland in Hancock County, MS.

More recently, Hurricane Zeta made landfall from the Gulf of Mexico on October 28, 2020 and immediately resulted in widespread power outages (Figure 1). This storm reached its peak intensity as a Category 3 hurricane with 115-mile-per-hour (185 km/h) sustained winds and a minimum pressure of 970 mbar (28.64 inHg) as it made landfall at Cocodrie, Louisiana. Zeta continued on through Mississippi and parts of Alabama with hurricane-force winds. Zeta gradually weakened as it accelerated northeastward, and became post-tropical on October 29, as it moved through central Virginia. Over 220,000 customers lost power for days across the state of Mississippi. Destructive winds gusts of over 100 mph in Bay St. Louis and in Gulfport caused tornado-like damage to roofs, siding, and trees. Zeta's storm surge exceeded 10 feet in some areas of the Gulf Coast, lifting boats onto the land and flooding low-lying neighborhoods. Over 32,000 homes were damaged across 10 counties in southern Mississippi. Highway 90, a major artery, was closed for two days from Pass Christian to Biloxi due to downed trees, flying debris, and boats washed onto the roadway.

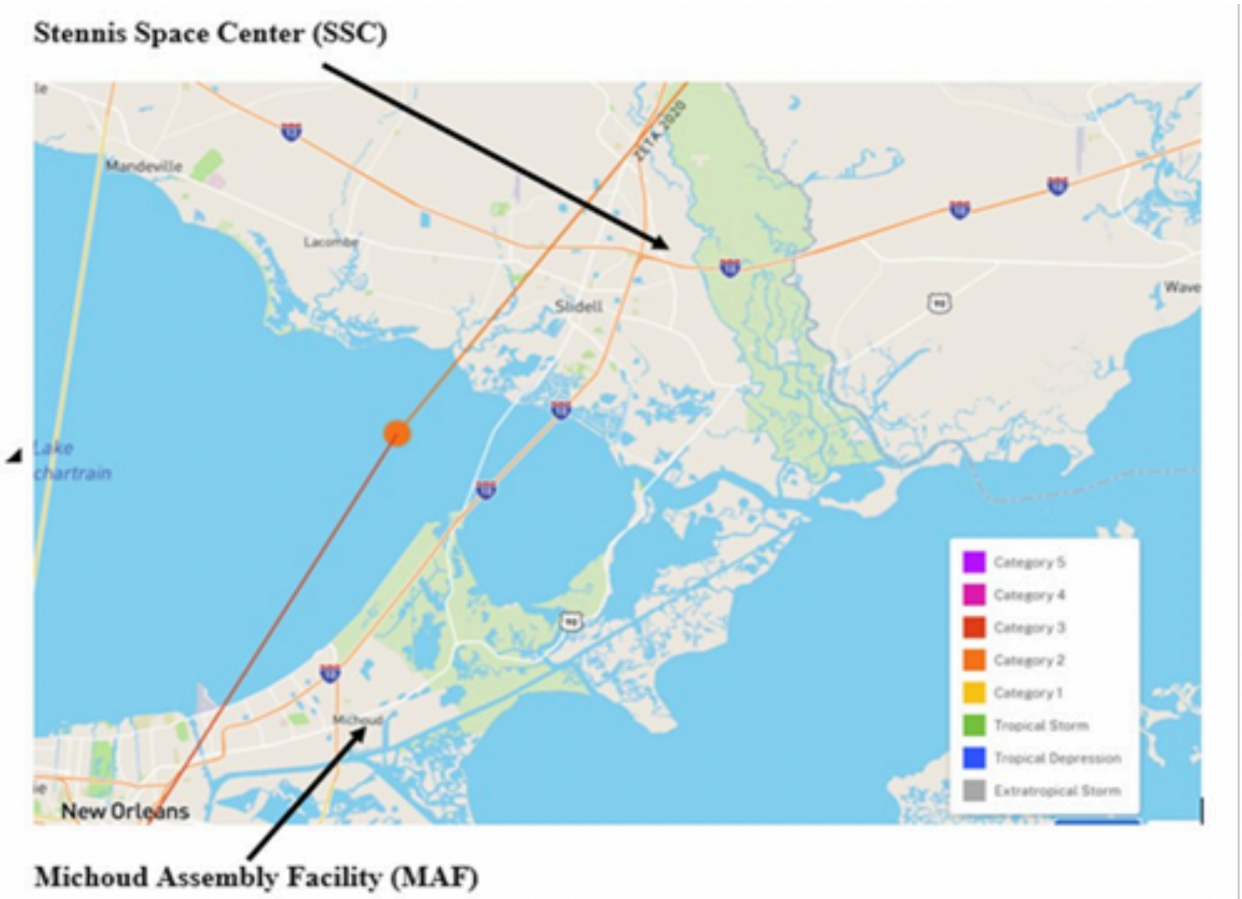
Sources:

https://www.sunherald.com/news/weather-news/article246744466.html



Above: National Hurricane Center best track of Hurricane Zeta.

Appendix A.



Hurricane Zeta began as area of disturbed weather on October 21, 2020 across the western Caribbean. Landfall occurred at Cocodrie, Louisiana with maximum sustained winds of 110 mph around 5pm ET on October 28, 2020. Through the next 12 hours after landfall, Zeta would only accelerate from its landfall speed of 24 mph to nearly 40 mph by 4am on Thursday October 29. This rapid motion for a tropical system, that was quite abnormal, would provide little time for the wind fields to weaken. Impacts from Zeta's winds were felt well inland of the Louisiana/Alabama/Mississippi coastlines. NASA reported that Zeta had winds of 112 mph at a reporting station near MAF during the worst of the beating by the storm's eyewall. Winds in the 90 mph range were recorded when the eyewall reached the Stennis area. https://www.weather.gov/tae/zeta2020

Appendix A2.

Hurricane-cause high winds and flooding often damage electrical substations and transformers, leading to disruptions in electricity supply to large sections of the Gulf Coast. Restoration of the power supply to rural areas can take days or even weeks. In the meantime, communities affected by power outages may experience difficulties accessing essential services and maintaining communication with first responders. NASA's Visible Infrared Imaging Radiometer Suite (VIIRS) Day/Night Band (DNB) can be processed to estimate outage durations and rates of electrical power restoration.

Source: Cole, T.A.; Wanik, D.W.; Molthan, A.L.; Román, M.O.; Griffin, R.E. Synergistic use of nighttime satellite data, electric utility infrastructure, and ambient population to improve power outage detections in urban areas. *Remote Sens.* **2017**, *9*, 286.

NASA's Stennis Space Center (SSC) is located near Bay St. Louis. MS. SSC is the agency's primary rocket propulsion test facility. Its main activities include testing engines and stages for missions to the Moon and beyond, advancing autonomous systems, and managing applied sciences.

During Hurricane Zeta, the Center sustained damage to its grounds, but successfully protected its most critical spaceflight hardware. The Center did lose power in some parts of its campus during the tropical storm passage. According to official assessments from NASA, widespread power outages in the region affected the Center, with some buildings remaining without power for several days following the storm.

Specific impacts of Hurricane Zeta at SSC included:

Wind Speeds: Wind speeds at the Center peaked at approximately 75 mph at the B-2 test stand level, which was lower than the gusts exceeding 100 mph recorded at the nearby Michoud Assembly Facility.

Infrastructure Damage: The facility experienced typical hurricane impacts, including downed trees and damaged power lines. Some secondary buildings sustained minor damage, though the core testing infrastructure remained intact.

Critical Hardware Safety: The B-2 Test Stand and the Space Launch System (SLS) core stage (the rocket designed for the Artemis I mission) were safely secured and suffered no damage.

Testing Delays: The storm forced a temporary "hunker down" phase, pausing the SLS Green Run testing series. Combined with a technical valve issue discovered around the same time, Zeta contributed to a delay in the highly anticipated "hot fire" test of the rocket engines.

Personnel Impact: As of 2024–2025, the SSC "federal city" has a combined workforce of about 5,000 employees, comprising NASA, Navy, and other tenants. While there were no reported injuries to NASA employees on-site during Hurricane Zeta, many employees faced significant challenges at their homes due to widespread power outages and property damage in the surrounding community, which briefly slowed the return to full operations.

Sources:
https://www.nasaspaceflight.com/2020/11/sls-post-hurricane-cleanups-prepares-green-run-valve-repair

NASA's Michoud Assembly Facility (MAF) is located near New Orleans, LA. It sustained moderate exterior damage during Hurricane Zeta's storm surge, but avoided major losses to its critical spaceflight hardware. MAF did lose power in some parts of its campus during Hurricane Zeta.

Specific impacts of Hurricane Zeta at MAF included:
Wind Conditions: During Zeta, the facility recorded sustained winds of approximately 50 mph with gusts reaching up to 101 mph.
Infrastructure Damage: The facility experienced damage to the outside and roofs of several buildings. Some of these leaks and roof issues were still undergoing repairs nearly a year later when Hurricane Ida struck MAF in 2021.
Power Outages: The area suffered widespread power outages, which initially made detailed damage assessments difficult. Some buildings remained on limited generator power for essential functions in the days following the storm.
Hardware Safety: Critical flight hardware, including the Space Launch System (SLS) rocket core stage and Orion spacecraft components suffered no damage.
Personnel Impact: While no injuries were reported among NASA employees or the onsite "ride-out crew," many facility staff were unable to return to work immediately due to personal property damage and lack of power at their homes. As the facility is located in the New Orleans East section of the city, many of the MAF's 4,000 employees reside within city limits. High winds resulted in more than 800 reported tree emergencies and over 200 downed utility poles in Orleans Parish. At least 550 homes in St. Tammany Parish sustained damage during Hurricane Zeta.

Sources:
https://www.nasa.gov/blogs/missions/2020/11/06/hurricane-zeta-impacts-sls-green-run-testing-status-update/

The purpose of this document is to report on risk analyses for electrical power outages during and after Hurricane Zeta in the region around NASA's SSC and MAF and on how NASA satellite data can inform decision-making during and after extreme storms. Data and information on power outage impacts over the region were sourced from satellite images, interviews with county emergency management officials, power company officials, NASA Center staff, and internet news searches.

This report is a product of NASA's Risk Analysis and Solutions Innovators (RASI), , whose aim is to provide the latest research results on risk management to help NASA facilities managers and their surrounding communities adapt to extreme weather events in timely and effective ways. RASI science products are created and shared through Work Groups that focus on topics such as Extreme Weather Events, Wildfires and Air Quality, Water Resources, Flooding Events, and Energy and Infrastructure.

Methods

VIIRS Satellite Nighttime Lights

VIIRS (Visible Infrared Imaging Radiometer Suite) nighttime lights (NTL) data have proven to be effective for detecting and monitoring power outages. Daily VIIRS NTL data features a spatial resolution of 15 arc-seconds (roughly 500 meters at the equator). By analyzing daily, high-resolution satellite imagery from the Day/Night Band (DNB), RASI can quantify significant drops in light radiance to identify storm affected areas. Previously published sources have demonstrated significant drops in luminosity after hurricanes and have shown that some areas did not fully recover pre-disaster light levels even a year later, highlighting recovery inequalities.

VIIRS satellite images were used to map power outage patterns following recent hurricanes at a regional scale in the counties surrounding the Stennis Space Center and the Michoud Assembly Facility. A new index (developed expressly for RASI applications) of the difference of NTL-DNB image values from cloud-free days soon after and before the landfall date of a given hurricane is called the Normalized Difference Light Index (NDLI). Negative values of the NDLI indicate a loss of electrical power to illuminate the VIIRS pixel location during the dark nighttime hours.

Sources:

Barton-Henry, K., and L. Wenz, 2022, Nighttime light data reveal lack of full recovery after hurricanes in Southern US, Environ. Res. Lett., 17: 114015.

Cao, C., Shao, X., and Uprety, S., 2013, Detecting light outages after severe storms using the S-NPP/VIIRS day/night band radiances. Geoscience and Remote Sensing Letters, IEEE. 10. 1582-1586. 10.1109/LGRS.2013.2262258.

Sentinel-1 Satellite SAR Surface Water Inundation

The Sentinel-1 satellite Synthetic Aperture Radar (SAR) produces images for mapping surface water inundation. Unlike optical satellites, SAR sensors can penetrate cloud cover and operate during both day and night, making it critical for monitoring floods

which often occur during heavy rainfall events and persistent cloudiness. Sentinel-1 provides a 10-meter spatial resolution and a 6-to-12-day revisit time, enabling detailed mapping of river widths and localized flood extents.

Sources:

Wagner, W., Bauer-Marschallinger, B., Roth, F., Raiger-Stachl, T., Reimer, C., McCormick, N., Matgen, P., Chini, M., Li, Y., Martinis, S. and Wieland, M., 2026. The fully-automatic Sentinel-1 Global Flood Monitoring service: Scientific challenges and future directions. *Remote Sensing of Environment*, *333*, p.115108.

Internet Searches of Electrical Power Outages

Internet searches were carried out to discover news reports on the electrical power outages at the county and city level, power plant damage or disruption, transmission line damage, local flooding, downed trees, and road closures caused by Hurricane Zeta.

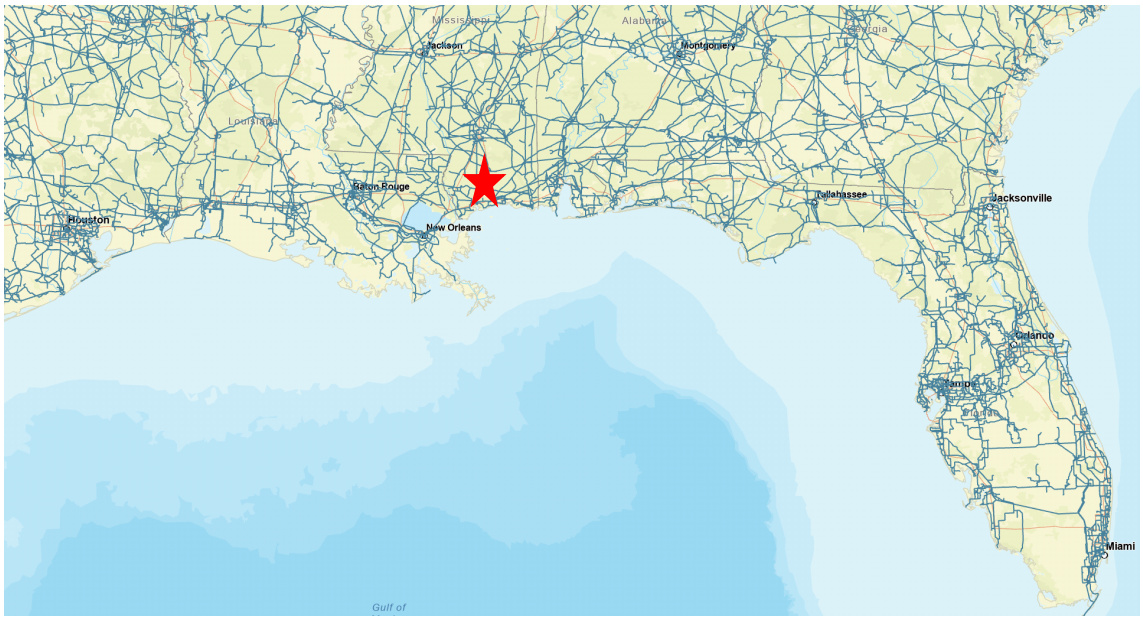
Interviews with County Officials, Power Company Officials, and NASA Center Staff

Following initial contacts made by email, telephone calls and TEAMS online meetings were held to interview county officials, power company officials, and NASA Center facilities staff on the impacts of Hurricane Zeta.

Electrical Power Plants and Transmission Line Locations

Electrical power lines and power station geo-locations serving the Stennis and Michoud communities and nearby metropolitan areas were identified and mapped using Homeland Infrastructure Foundation-Level Data (HIFLD) (Figure 2). The pixel-by-pixel (450-m resolution) differences in VIIRS NTL radiance between the pre-hurricane period and the immediate post-hurricane period were overlaid on the HIFLD vector GIS layers for power lines and power stations to assess the most vulnerable locations for damage to the electrical infrastructure.

Gulf and Southern Atlantic Coast Electric Power Transmission Lines



This GIS vector layer, utilizing data from Homeland Infrastructure Foundation-Level Data (HIFLD), depicts electric power transmission lines in the United States. Per HIFLD, "Transmission Lines are the system of structures, wires, insulators and associated hardware that carry electric energy from one point to another in an electric power system. Lines are operated at relatively high voltages varying from 69 kV up to 765 kV, and are capable of transmitting large quantities of electricity over long distances. Underground transmission lines are included where sources were available."
https://www.arcgis.com/home/item.html?id=d4090758322c4d32a4cd002ffaa0aa12

Appendix B. with SSC location show as ★

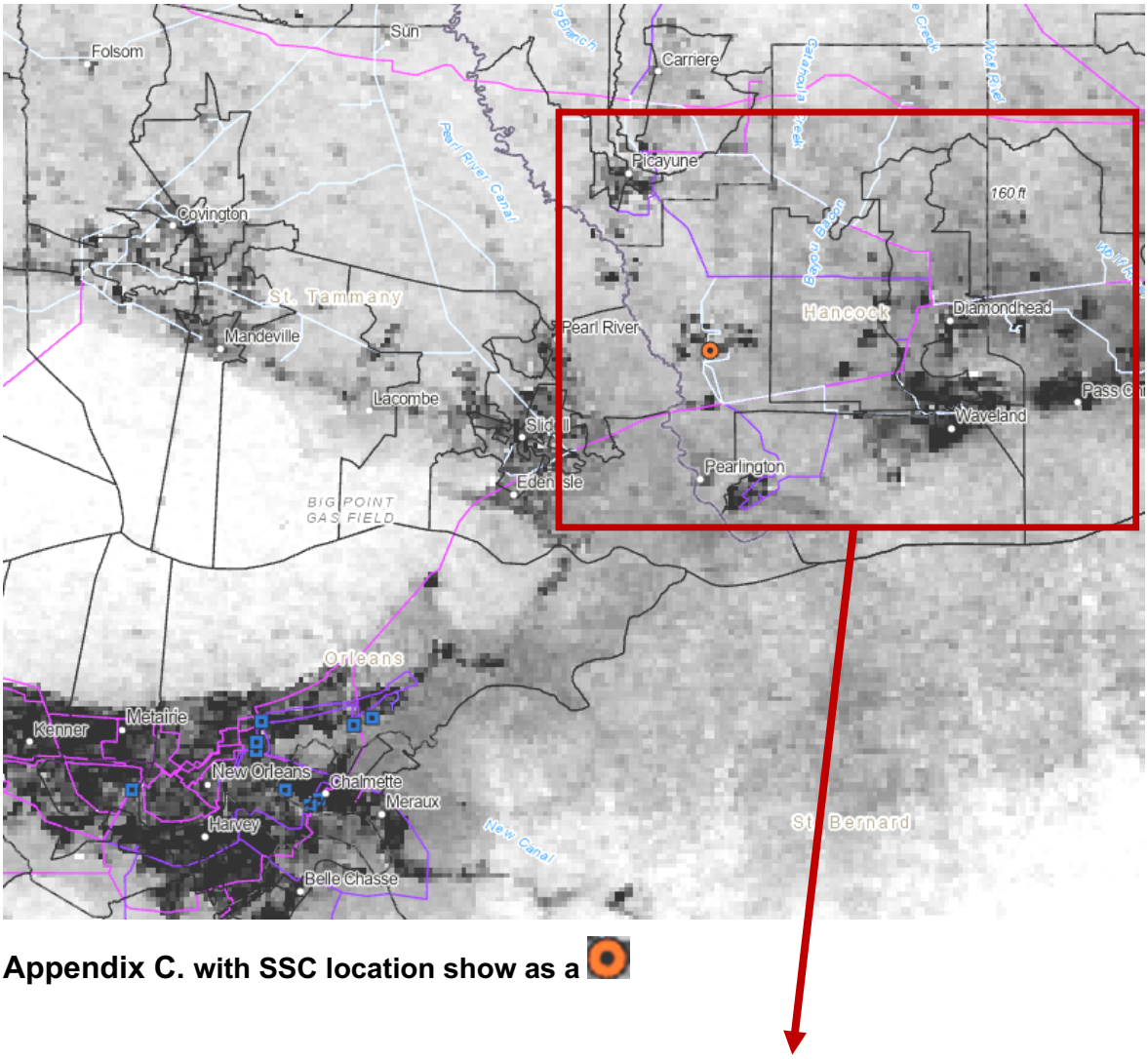
Results

VIIRS NDLI Analysis

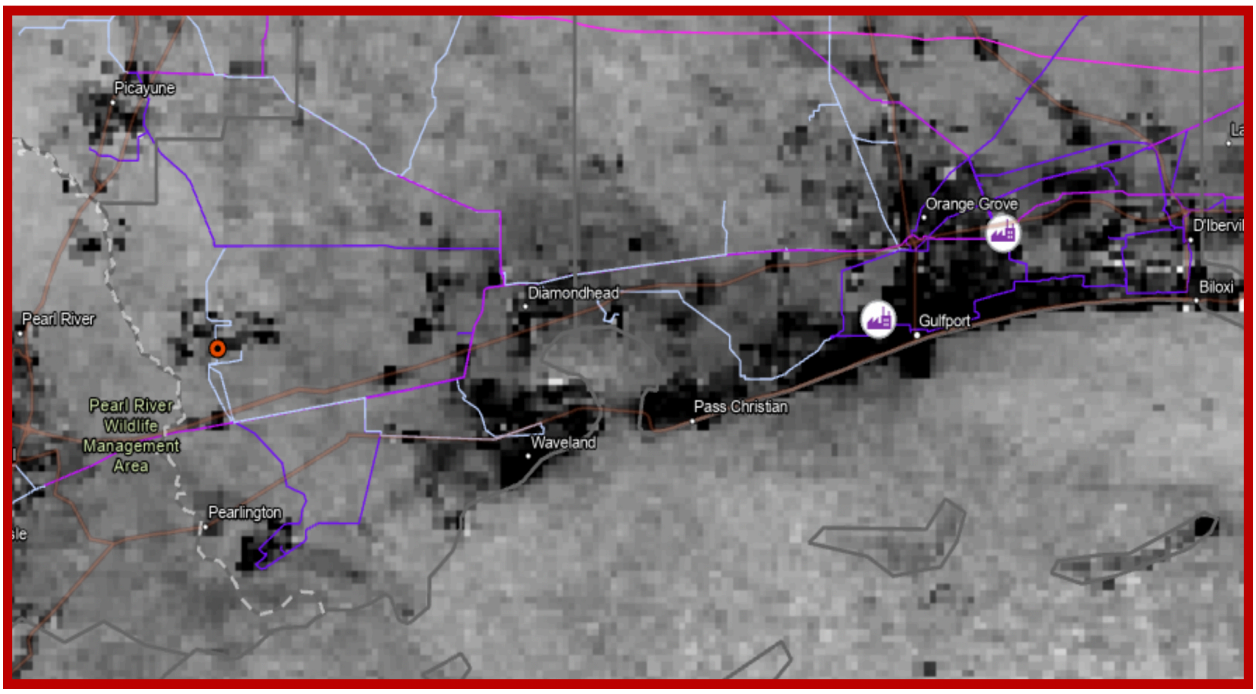
The VIIRS NDLI product image based on the difference of NTL values from before (ca. September 30, 2020) and after (ca. October 30, 2020) passage of Hurricane Zeta showed the community and neighborhood areas that had suffered the greatest extent of near-complete power outages (Figure 3). The most damaged locations were:

- Picayune in Pearl River County (30.523171°N, 89.682612°W)
- Pearl River, Porters River Landing and south to the city of Slidell in St Tammany Parish, LA (30.366646°N, 89.752671°W)
- Jackson Landing and Pearlington in Hancock County (30.218807°N, 89.580889°W)
- Kiln and Diamond Head (rural area) in Hancock County (30.400873°N, 89.444483°W)
- Bay St. Louis to Gulfport and Orange Grove in Hancock and Harrison County (30.435548°N, 89.090134°W)

The largest electrical power plants located within this regional image were Plant Jack Watson of Mississippi Power (MPC) in Gulfport, 35 miles to the east of SSC and Plant Victor J. Daniel power facility, located near Escatawpa in Jackson County. The two main transmission lines running from these power plants were (1) Transmission line ID BE74C1B4-17AC-4AE1-9CAA-ECCCABA427A7 230 V class, which passes through Orange Grove, New Hope (Harrison Co.) and Diamond Head (Hancock Co.); and (2) Transmission line ID B8F358FD-47AA-402B-86CB-64B755258FE0, 500 V class. Sub-stations McKnight and Daniel may also have supplied power to SSC under normal weather conditions, although there is no verifiable, publicly available source to confirm this.



Appendix C. with SSC location show as a


Picayune
Orange Grove
D'Iberville
Biloxi
Diamondhead
Pearl River
Gulfport
Pass Christian
Pearl River
Wildlife
Management
Area
Waveland
Pearlington

SAR Surface Water Inundation

The Sentinel-1 product image based on the difference of SAR values from before (ca. September 30, 2020) and after (ca. October 30, 2020) passage of Hurricane Zeta show the areas near SSC that suffered the greatest extent of surface flooding (Figure 4). The most damaged areas are listed below.

- Neighborhoods near Picayune, MS in Hancock County (30.52389°N, 89.727382°W)
- Open space located between Gainesville and Napolean near SSC in Hancock County, MS (30.4158721°N, 89.4885633°W)
- Open space south of Interstate 10 near SSC in Hancock County, MS (30.27686°N, 89.681720°W),
- Neighborhoods in Pearlington in Hancock County, MS (30.25608°N, 89.604816 °W)
- Neighborhoods of Diamond Head in Hancock County, MS (30.36573°N, 89.380797°W)

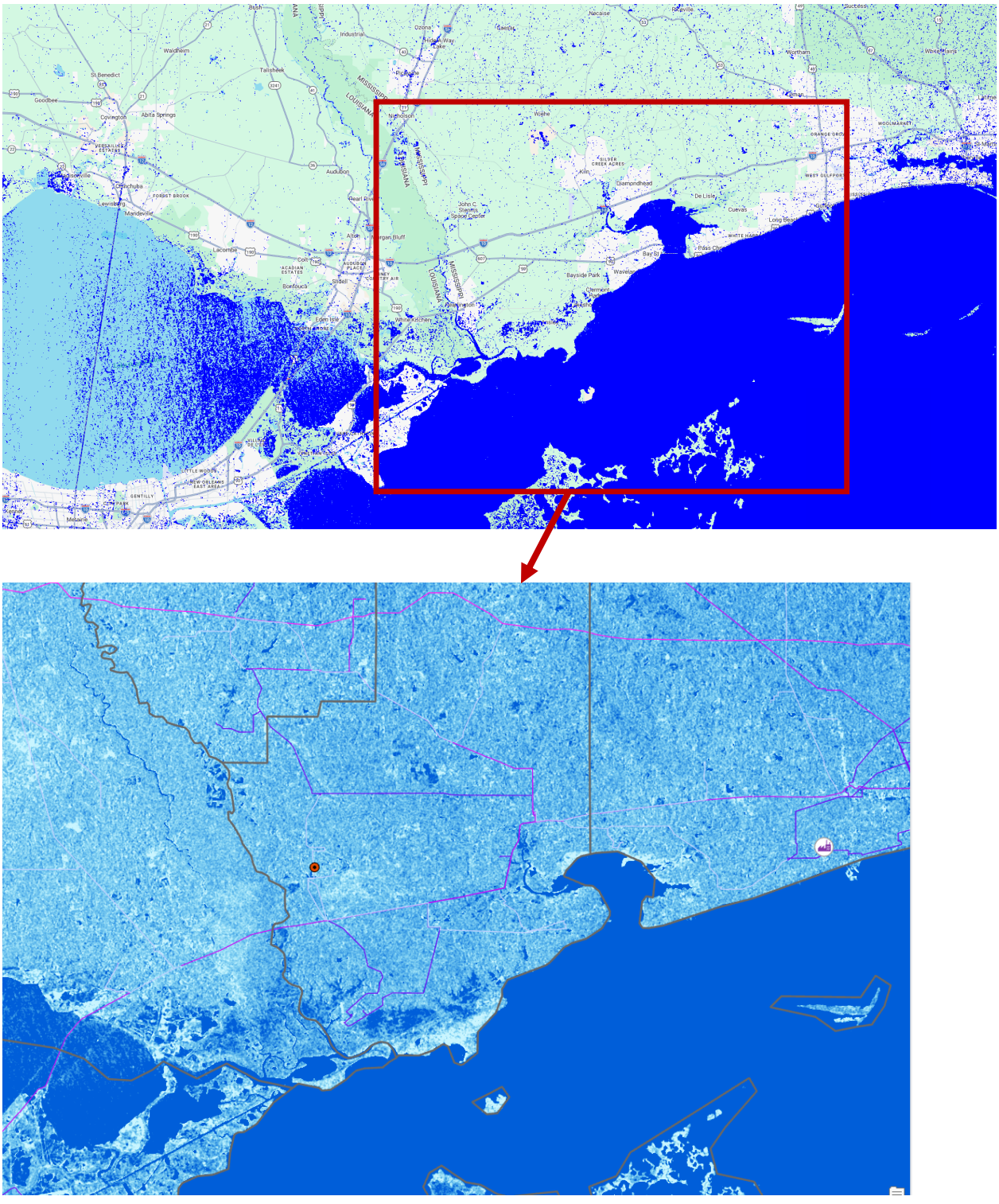
Surface flooding patterns at the Michoud Assembly Facility were detected from the passage of Hurricane Zeta on the northern and southeastern impervious surfaces in and around Uranus Avenue near the main engineering sections of the assembly facility structure and near Michoud Canal (Figure 5).

To put these findings in a larger context, subsequent storms like Hurricane Ida in 2021 caused more severe flooding issues at the MAF site, including water intrusion into buildings due to compromised roofing systems that were, in some cases, still undergoing repairs from Hurricane Zeta. Hurricane Ida brought 150 mph sustained winds, heavy rainfall, and flooding to New Orleans and surrounding parishes for six hours on August 29, 2021. At MAF, on-site emergency crews recorded 110 mph wind gusts, over 13 inches of rain, and 85 mph sustained winds before sensing devices failed from the storm.

Sources:

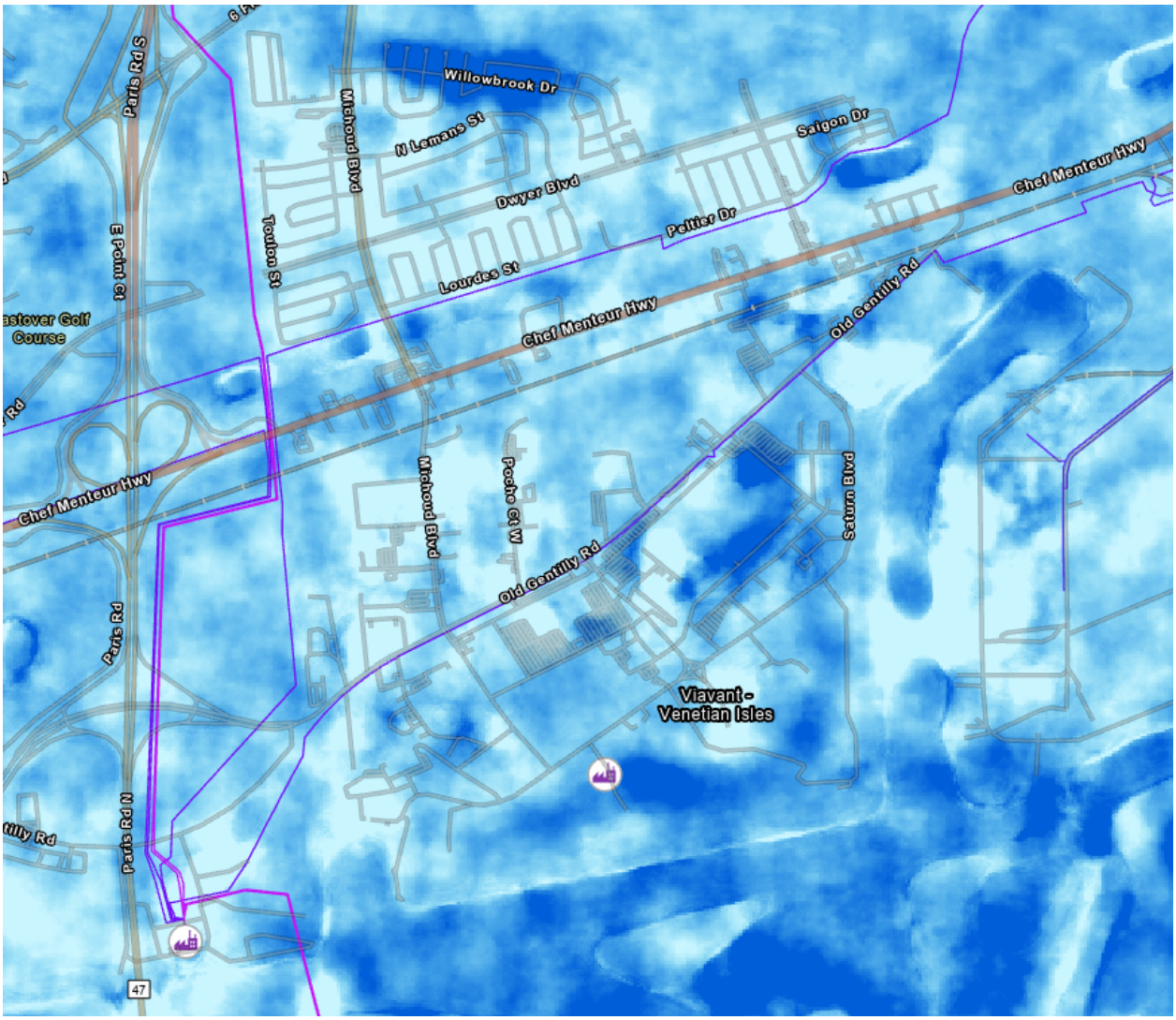
https://www.nasa.gov/centers-and-facilities/marshall/60-years-of-pride-unwavering-dedication-on-display-at-nasa-michoud-during-hurricane-ida/

Appendix D. Surface flooding patterns in Hancock County, MS detected from the passage of Hurricane Zeta. Source: Sentinel-1 satellite September 30, 2020



SSC location show as a

Appendix E. Surface flooding patterns at MAF detected from the passage of Hurricane Zeta. Source: Sentinel-1 satellite September 30, 2020



Internet Search Results

An overview of Hurricane Zeta impacts can be summarized as follows:

- Harrison County, MS: This county saw the highest number of total utility outages, with more than 100,000 customers losing power as winds gusting up to 100 mph downed trees onto lines across Gulfport, Biloxi, and Long Beach.
- Hancock County, MS: Utility officials from Mississippi Power and Coast Electric identified the corridor from Bay St. Louis to the Hancock County line as the worst impacted area for distribution system destruction.
- Highway 90, the coastal highway from Pass Christian to Biloxi was specifically closed due to a combination of debris, downed lines, and boats that had been washed inland by storm surge.
- Outages: Overall, utility crews had to replace more than 2,700 poles across the region to restore service, an effort that took approximately five to seven days for most residents. Crews aided by an additional 700 workers from outside the area replaced 600 broken or leaning electric poles.
- At the storm's peak, nearly 73,000 customers in St. Tammany and Washington parishes in Louisiana were without power, along with tens of thousands of residents in Slidell, MS.
- Coast Electric had 6,725 customers without power three days after the storm's passage. As the storm's path stretched out, nearly 10,000 customers were without power by October 31. Singing River Electric had 13,000 customers without power on October 31, 2020.

Sources:

https://www.clarionledger.com/story/weather/2020/10/29/hurricane-zeta-mississippi-power-outages-thousands/6067158002/

Numbers of homes and businesses damaged and reported in the media included these counties:

- Harrison — 7,061 homes, 195 businesses/farms and 210 public roads/buildings affected
- Hancock — 350 homes and 26 businesses/farms affected

- George — 283 homes, 2 businesses/farms and one public road/building affected
- Jackson — 1,322 homes and 42 public roads/buildings affected Stone — 37 homes, 26 businesses/farms and two public roads/buildings affected

Sources:

https://www.sunherald.com/news/weathernews/article246891417.html#storylink=cpy

https://www.foxnews.com/us/tropical-storm-zeta-gulf-coast-south-dangerous-winds-deaths-south-power-outage-georgia-louisiana-alabama

Chevron and Mississippi Power Company (MPC) faced significant operational challenges as Hurricane Zeta passed as a Category 2 storm through their primary service and production areas in Southeast Mississippi. Key impacts are listed below.

Chevron (Pascagoula & Offshore):

- Offshore Evacuations: Chevron was one of the first major energy firms to evacuate oil workers from its Gulf of Mexico platforms. As of late October 31, roughly 59% of offshore oil production and 32% of natural gas production in the U.S. Gulf remained shut-in as a precaution.
- Pascagoula Port Closure: The U.S. Coast Guard temporarily closed the Port of Pascagoula, where Chevron's largest refinery is located, to all vessel traffic due to storm surge and high wind risks.
- Onshore Precautions: While most Gulf Coast refiners aimed to "run through" the storm, Chevron's onshore facilities followed strict preparation procedures to monitor wind damage, which reached gusts of up to 100 mph in parts of the region.

Mississippi Power Company (MPC):

- System-Wide Outages: The storm caused the most significant damage to MPC's transmission and distribution system since Hurricane Katrina. At the peak, approximately 85,000 customers were without power.
- Infrastructure Impact: MPC reported "significant" system damage, particularly in Harrison and Jackson counties, where downed trees and high winds severed lines serving industrial and residential sectors.

- Restoration Performance: MPC mobilized over 1,700 outside resources from 20 states. By November 2, they had surpassed 99% restoration for their customers, completing the bulk of the work within five days of landfall.

Sources:
https://www.wdam.com/2020/10/29/mississippi-power-working-restore-power-customers-after-zeta/

Gulfport Naval Construction Battalion Center (NCBC) and its solar infrastructure experienced the following impacts during Hurricane Zeta:

- Complete Power Outage: The base was plunged into darkness as it lost all external power in the middle of the night due to the storm's 100+ mph winds.
- Performance of Solar & Microgrid: At the time of Zeta, the base's microgrid project—which integrates the 3.5 MW+ utility-scale solar array (developed with Hannah Solar/WGL) and other rooftop PV systems—was nearing completion but was not yet fully operational for emergency backup.
- System Vulnerability: Before the microgrid's completion, the base had no automated backup and relied solely on individual diesel generators; if those failed, there was no alternative power source.
- Wind Impacts: While specific mechanical damage reports for the Arcadia Solar (likely referring to the utility-scale PV site) are sparse, the storm produced 101 mph wind gusts in Gulfport, which caused "significant" damage to the region's overall transmission and distribution systems.
- Post-Storm Validation: Following the Zeta outages, the Navy conducted a successful "Blackstart Exercise" in June 2021 to prove that the now finished microgrid and solar systems could restore power independently during future landfalls.
- The 2020 outages served as the primary catalyst for finalizing the base's energy resilience strategy, ensuring that the solar array could support critical operations even when the main grid fails.

Sources:

https://www.army.mil/article/240467/mississippi_national_guard_supports_hurricane_zeta_recovery#:~:text=%22We%20are%20providing%20aid%2C%20much,Support%20Battalion%2C%20headquartered%20in%20Laurel.

Plant Jack Watson of Mississippi Power (MPC) faced its most severe storm challenges since Hurricane Katrina during Hurricane Zeta at the Plant Jack Watson area in Gulfport. This facility is 35 miles to the east of SSC and was directly impacted by the storm's path. MPC Transmission line ID BE74C1B4-17AC-4AE1-9CAA-ECCCABA427A7 230 V class, which passes through Orange Grove, New Hope (Harrison Co.), and Diamond Head (Hancock Co.), may have supplied power to SSC, although there is no reliable source to verify this supposition. While Plant Watson is famously remembered for being flooded by 16 million gallons of water during Katrina, its experience during Zeta primarily involved widespread system damage rather than a total facility loss.

- Continuous Operation: The plant, which had converted from coal to natural gas in 2015, stayed online during the storm. While it faced 100 mph wind gusts, it did not suffer the catastrophic storm surge damage seen in previous major hurricanes.
- Grid Isolation: Although the plant was generating electricity, approximately 80,000–91,000 Mississippi Power customers (nearly 45% of its base) lost power because Zeta's winds destroyed the distribution network (poles and wires), even while the generation source remained active.
- Infrastructure Damage: Zeta's high winds caused extensive damage to MPC's transmission and distribution systems. Numerous trees fell onto power lines, and the company reported that the Lucedale area was the hardest hit within its service territory.
- Massive Outages: At the height of the storm, roughly 85,000 customers (nearly half of MPC's customer base) lost power. In Gulfport, where Plant Watson is located, outages were among the most persistent.

- Restoration Efforts: MPC deployed crews from 18 different states to assist in repairs. By five days after the storm, outages had been reduced to approximately 5,000 customers, with restoration hitting 95% completion by November 2, 2020.
- Operational Status: Unlike the catastrophic flooding of Katrina that destroyed the powerhouse, Plant Watson's units—which had been converted from coal to natural gas in prior years—remained a critical part of the grid's recovery infrastructure.
- Separately, Mississippi Secretary of State Michael Watson (not related to the plant name) worked with utility providers during the Zeta aftermath to ensure that voting sites were operational for the 2020 General Election held just days later.
- Mississippi Power Company (MPC), which owns the Jack Watson plant, is the state's largest utility and a subsidiary of Southern Company.
- Original Operation: The facility, named for the company's third president, Jack Watson, began commercial operation in 1957.
- Fuel Conversion: Originally the first Mississippi Power facility to use coal, it was fully converted to natural gas in 2015 to meet federal environmental regulations.
- Current Status: The plant is comprised of three generators and ranks 10th out of 55 power plants in Mississippi for total annual net electricity generation.

Sources:

https://www.gridinfo.com/plant/jack-watson/2049

https://www.power-technology.com/data-insights/power-plant-profile-jack-watson-power-station-coal-to-gas-us/

Plant Victor J. Daniel power facility, located near Escatawpa in Jackson County, 60 miles to the east of SSC, was in the direct path of Hurricane Zeta as it moved through southeast Mississippi. Transmission line ID B8F358FD-47AA-402B-86CB-64B755258FE0, 500 V class with sub-stations McKnight and Daniel, may have supplied power to SSC. Key events regarding the plant and its staff during the storm included:

- Regional Impact: Zeta brought hurricane-force winds to the area, causing widespread damage to Mississippi Power's transmission and distribution systems 1.5.3. A substation in Jackson County lost transmission capability, which directly affected the grid around the plant 1.5.8.

- Operational Resilience: Unlike the catastrophic flooding experienced at other plants during Katrina, Plant Daniel's operations primarily focused on maintaining stability during the 85,000+ customer outages across the service territory. The plant remained a critical source of generation for the recovery effort 1.5.3.
- Continuous Generation: As Mississippi Power's largest generating facility, the plant stayed online to maintain grid stability. While its coal and natural gas units remained functional, the power it produced often couldn't reach homes immediately due to catastrophic damage to transmission lines downstream.
- Weathering the Storm: The facility was prepared with hurricane-hardened protocols, including securing large equipment and ensuring essential staff were sheltered on-site. Despite being in the direct path of the storm's eastern eyewall, the plant avoided major structural failures.
- Personnel Dedication: Michael Harvey, the Northern Division Manager (formerly of Plant Daniel), highlighted that crews worked through the aftermath, missing family functions and holidays to restore power to the community.
- Long-term Context: At the time of the storm, Plant Daniel was already under scrutiny for its aging coal units. Shortly after Zeta, in 2021, Mississippi Power confirmed plans to decommission the coal-burning units at Plant Daniel by 2027 (later adjusted to 2028) due to economic and regulatory pressures.

Sources:

https://www.sierraclub.org/press-releases/2021/04/mississippi-power-confirms-retirement-two-coal-units-plant-daniel

Entergy New Orleans (ENO) experienced the most significant impact to its power system since 2012 during Hurricane Zeta in October 2020. The storm passed directly over the city as a high-end Category 2 hurricane, causing a near-total collapse of the distribution network in many neighborhoods. Key Impacts on Entergy New Orleans included:

- Massive Power Outages: At the height of the storm, approximately 178,171 ENO customers (roughly 77% of the city) lost power. Large swaths of the city went dark, from the Riverbend to New Orleans East.

- Infrastructure Damage: The storm's 110 mph winds toppled or damaged 323 poles, 201 transformers, and 92 spans of wire within Orleans Parish alone. Widespread outages were attributed to a "vegetation hazard," as the city's tree canopy had not been naturally thinned by a major storm in years.
- Fatal Incidents: A 55-year-old man in the Gert Town neighborhood was killed by electrocution from a downed power line during the storm.
- Operational Challenges: While the city’s floodgates and major drainage pumps remained operational, a critical turbine for the drainage system broke just before the storm, leaving the city with little excess power for emergency pumping.
- Restoration Timeline: Entergy deployed a workforce of over 6,000 personnel. Power was restored to 96% of New Orleans customers within five days and 100% of those able to receive service within seven days.
- Election Priority: Because Zeta struck just days before the 2020 General Election, Entergy prioritized restoring power to all polling locations or providing "power pods" (generators) to ensure voting could proceed.
- Financial Impact: Following the storm, ENO applied for certification of costs related to the recovery, which sparked investigations by the New Orleans City Council into the utility's grid maintenance and storm reserve practices.

Sources:

https://www.nola.com/news/hurricane/power-still-out-for-thousands-after-zeta-entergy-sees-outages-lasting-through-weekend/article_730c14e4-19f4-11eb-98d1-03d11479a497.html

Picayune and Pearl River County were reported with nearly 30,000 customers initially without electric power after Hurricane Zeta made landfall on October 28, 2020. The main electrical power providers in the county were the Mississippi Power Company and Pearl River Valley Electric Power Association. Utility repair crews reported numerous downed power lines in Pearl River County, hundreds of broken power poles, and significant amounts of fallen trees on lines across the entire service area.

Sources:

https://www.facebook.com/StCoEnt/posts/10164409254515241/

Slidell, LA was in the direct storm track of Hurricane Zeta on October 28, 2020, causing power outages that left nearly the entire city in darkness.

- Total Outages: At the storm's peak, nearly 73,000 customers in St. Tammany and Washington parishes, which are primarily served by Cleco Power Company, lost power.
- Cleco operates the main transmission line running through the area known as the "Mandeville to North Slidell 230 kV line", at transmission voltage of 230 kilovolts (kV). This main transmission line feeds into local substations, where the voltage is reduced for local distribution (e.g., via 34.5 kV lines).
- Washington-St. Tammany Electric Cooperative (WST Electric) is a non-profit cooperative provides service to customers in the surrounding areas of St. Tammany Parish, as well as parts of Washington Parish in Louisiana.
- Rapid Initial Restoration: Within 24 hours (by October 29), Cleco had restored power to roughly 20,000 customers, focusing on areas like Eden Isles and Lakeshore Estates. By October 30, 95% of Cleco's Louisiana customers had their power back.
- Slidell Delays: The remaining 5% of outages were concentrated in the Slidell area, where damage to poles and transformers was most severe. Most of these residents were back online by October 31.
- Hardest-Hit Areas: Some specific locations, such as Venetian Isles, faced more extensive repairs due to debris and broken infrastructure, with full restoration for those capable of receiving power extending toward November.

Sources:

https://www.nola.com/news/communities/st_tammany/hurricane-zeta-rips-through-st-tammany-widespread-power-outages-follow-cat-2-storm/article_62cbed78-1af0-11eb-905b-6f4289faf1ac.html

Interviews with County Officials, Power Company Officials, and NASA Center Staff

Hancock County Office of Emergency Management (ca. March 31, 2026)

EMA Directors Brian Adam (retired) and Holly Bilbo (active)

Phone: 228-255-0942

The greatest impacts from Hurricane Zeta were identified within the corridor from Bay St. Louis to the Hancock County line. Highway 90, the coastal highway from Pass Christian to Biloxi was specifically closed due to a combination of debris, downed lines, and boats that had been washed inland by storm surge. Overall, utility crews had to replace more than 2,700 poles across the region to restore service, an effort that took approximately five to seven days for most residents.

Which areas and communities were the most subject to flooding around the county during Zeta and Ida?

Surface flooding in the county is common in low-lying areas not just during tropical storms, but year-around after heavy rainfall events that are not related to a hurricane. For instance, the bayous and creeks flowing in the lowlands between Picayune and McNeil are particularly susceptible flooding and quickly inundating the neighborhoods of these communities.

Which areas and communities had the most powerline damage around the county after Zeta and Ida?

The communites located between coastal highway 90 and inland highway 603 were particularly hard-hit with power outages with the passage of Hurricane Zeta, which included Bay St. Louis and Kiln.

Have there been any improvements in the County in the transmission line resistance to high winds over the past several years? If so, what were they?

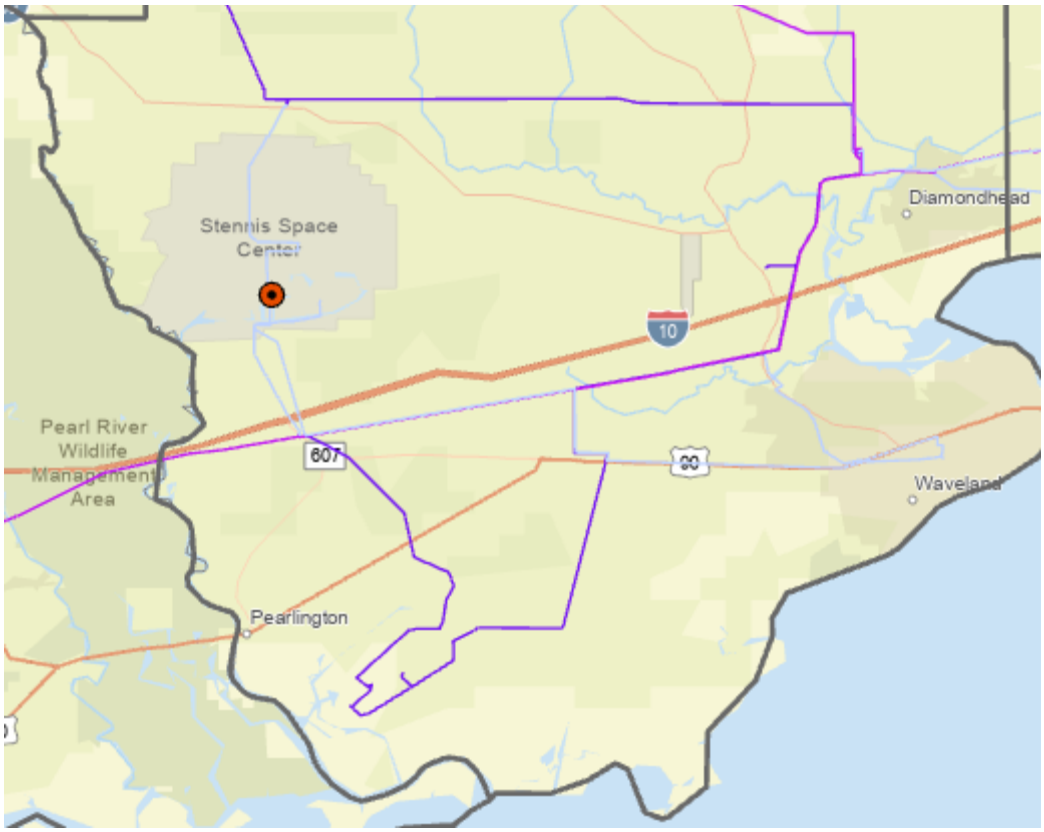
Many wooden power poles have been replaced with concrete poles in the county since 2020, making the transmission lines more resistant to wind damage.

Currently, what are your areas of greatest concern for storm damage, geographically speaking, in the County?

Low-lying inland areas near small creeks during and after heavy rainfall events and hurricanes.

Mississippi Power Company

Information from Mississippi Power Company (MPC) was received by return email from Joe Bosco, MPC federal accounts manager. It was conveyed that, in 2021, MPC initiated storm hardening efforts on their transmission system resulting in upgrading and rebuilding transmission lines, elevating control houses, and enhancing physical security through hardened fencing. The MPC initial focus has been on selected 115 kV lines south of I-10 that were originally constructed with older, wooden structures. Among the transmission lines still presently being upgraded are the Pass Christian Menge Ave–Dupont and Dupont–Kiln 115 kV projects and are expected to be completed by year-end 2028. This transmission system presumably serving SSC is shown in the figure below. Entergy Mississippi is also currently conducting the decade-long Resiliency Ramp-Up Program (begun in 2022) to replace roughly 15,500 wooden transmission structures with steel structures.



Appendix F. Powerline transmission system presumably serving SSC

The electricity for SSC is primarily supplied by MPC, maintaining the 13 kV lines and substations that feed the SSC campus. The Center also works with Coast Electric Power Association as a regional partner for some localized distribution. Much of the power to SSC in 2020 originated from an on-site substation located at Leonard Kimble Road (Figure 7 shown in the map below with the red pin marker). This substation has a total capacity of 40 MW and currently handles a load of approximately 23 MW. While the names of specific long-distance transmission line numbers are restricted for security purposes, MPC's regional transmission network typically operates at 115 kV and 230 kV and these high-voltage lines feed the local substations that then step down the voltage for SSC's 13 kV internal grid.

Source:

https://sam.gov/workspace/contract/opp/9196fc7a8277455493ae6e365ee8d3b3/view



Appendix G. SSC map and pinned location of electrical substation

SSC Facility Staff

SSC operates as a "Federal City" with employees from NASA, the Department of the Navy, and private contractors. The distribution of where most of these employees live has been estimated as follows:

County/Parish	Number of Employees	Percentage
Pearl River County, MS	1,204	23.9%
St. Tammany Parish, LA	1,203	23.9%
Hancock County, MS	**975**	**19.3%**
Harrison County, MS	927	18.4%

Source:
https://www.nasa.gov/wp-content/uploads/2025/09/s25-027-federal-city-listing.pdf

Teenia Perry, Center Operations Directorate

Amer Arshad, Electrical Engineer, Center Operations Branch

Which power lines and plants provide electrical power to SSC?

MPC provides all the electrity to SSC and three substations on SSC have smaller power transmission lines that back up the main lines from MPC.

Have there been any transmission line improvements at SSC over the past several years? If so, what were they?

Storm mitigation improvements have included construction of an MPC 115 kV transmission line tie. This tie begins at a new MPC 115 kV switching station fed from a 115 kV transmission line North of Stennis on Texas Flat Road and loops South through Stennis to the Leonard Kimball and Saturn Drive Substations, and terminates at a 115kV switching station South of Stennis. This switching station is also connected to a second 115 kV line located South of Interstate 10. A 13.8 kV project, TO 3820 / EMI ZDR3-22018 - High Voltage Pole Replacements & Repairs for Hurricane Zeta & Ida, has replaced the remaining wood poles and lines on Trent Lott (circuit 12) which feed the North Security gate and office. Aging wooden poles have been replaced with cast concrete units, as well as underground and overhead line conductors.

Has there been any documented flooding around the Center in recent years, especially after Hurricanes Zeta and Ida?

No major surface inundation was documented.

What kind of improvements would you like to make?

Summer thunderstorms have caused flooding in the Southern/Main substation due to wind damage. Leaking roofs are still a problem. Surface flooding is not a major problem at SSC. The Center still wants to improve circuit reliability that will resolve power bumps and short outages. NASA and MPC are developing on-site solar array systems to provide up to 1 MW of dedicated renewable power, reducing reliance on the external grid, primarily to feed building 8000, the Emergency Management Facility.

Conclusions

Although the cities and rural communities surrounding SSC remain susceptible to surface flooding and power outages during and after the passage of powerful tropical storms, many improvements in the electrical supply systems have been accomplished since the year 2020 following Hurricane Zeta. For instance, Mississippi Power Company (MPC) has initiated storm hardening efforts on their transmission system resulting in upgrading tower and poles with concrete, rebuilding transmission lines, elevating control houses, and enhancing physical security through hardened fencing. A major focus for MPC has been on strengthening 115 kV lines south of I-10 that were constructed with old wooden structures.

Nevertheless, winds gusts of over 100 mph that were measured during recent hurricanes in locations such as Bay St. Louis and in Gulfport will continue to cause unavoidable tornado-like damage to roofs and sidings of homes and will uproot and topple trees near power lines. Efforts to trim tall trees everywhere in Hancock and Harrison Counties may be the most effective single action to reduce the risks of future power outages in the cities and communities surrounding SSC and MAF.

NASA's Visible Infrared Imaging Radiometer Suite (VIIRS) Day/Night Band (DNB) can be processed to estimate outage durations, rates of electrical power restoration, and map power outages following a storm. This can be used by energy providers, NASA Center facilities managers, and emergency managers to analyze vulnerabilities in the power grid infrastructure, guide where to prioritize resilience efforts, and support recovery efforts post-storm.