State of South Carolina

Governor Henry McMaster — Thomas S. Mullikin, Chairman

South Carolina Floodwater Commission

GRID SECURITY TASK FORCE

BACKGROUND

A. Risk of Flooding to Grid Security

Grid security is an important sector requiring measures to safeguard during a flooding event. A key element of resiliency and recovery during a flooding event is the safety, security, and continued operation of the electric grid for the State of South Carolina. Not only is it important to maintain critical infrastructure assets, it is also imperative for the reassurance of South Carolinians to provide sanitary essentials, continued recovery, and continuity of normal activities.

If South Carolina experiences weather conditions similar to the 2015 flooding event, there could be a potential impact to the grid. The main impacts in 2015 were due to torrential run-off of surface water washing away soil bases around wooden utility distribution poles, and additional structural damages to homes and businesses that prevented power from being restored. The most vulnerable locations were the utility infrastructure assets located on, adjacent, or downstream from compromised dams. Both distribution and transmission electrical structures, as well as natural gas piping, were impacted as result of erosion resulting in catastrophic dam failure.

The most destructive element that was not part of the 2015 flooding to the electric grid was wind. During Hurricanes Matthew, Irma, Florence, and Michael, the element of wind coupled with drenching rains provided a much greater threat to grid security. The various system control centers for transmission; dispatch operations for distribution; and the control rooms for each power generating plant must be secure and equipped with secondary power sources in order to continually provide operation and monitoring of the various electrical systems.

B. Overview of the Electric Grid Functionality

The electric grid is comprised of three basic elements – generation, transmission, and distribution.

1. Generation – South Carolina is blessed with very reliable generation assets fueled by nuclear, coal, and natural gas. South Carolina is also blessed with wonderful rivers and lakes that provide hydro-generated energy as well.

2. Transmission – Electrical transmission structures are either wood, concrete, or steel. Flooding has very little impact on these facilities. Transmission wood is typically able to handle 50 – 75 mph winds with little impact with the exception of large trees falling from outside existing rights-of-way. Such up-rooting can occur within wind speeds of 30 – 50 mph given ground saturation levels. Concrete structures can typically bear wind load above 100 mph, but the weight of concrete makes construction difficult due to the sheer weight of a solid concrete structure. Steel transmission is the most improved material for transmission. Light, flexible, and sturdy steel structures, whether direct imbedded or bolted to foundations provide wind loading up to 150 mph. Their slip-jointed construction also avoids the weight of concrete poles as well. As long as these structures are not located in vulnerable areas such as dams and high velocity water run areas, they do not represent a significant risk to the grid regarding a flood. A flood with high winds, however, presents vulnerabilities. Finally, there are very limited underground electrical transmission facilities that would be subject to the same risks as natural gas pipelines.

3. Distribution – In South Carolina, approximately 80% of electrical distribution lines are above-ground, with approximately 20% underground. Underground is typically placed into service in high-density neighborhoods and typically represents a non-standard service. Impacts from flooding to overhead distribution is minimal unless facilities are in vulnerable areas such as weak dams or high-water flow areas resulting in severe erosion. Flooding, coupled with wind, can begin impacting distribution when wind speeds reach up to 35 – 40 mph.

OBJECTIVES

1. Research and identify the critical infrastructure assets; existing power plants and major electrical substations that have been inundated by storm surges and/or flooding in previous natural disasters effecting SC. If needed, identify a plan of action for the construction to retrofit and/or remove existing power plants and electrical substations located on, adjacent, or downstream from compromised dams to increase the resiliency to flooding.

2. Research and develop a plan to implement for effective mobilization and logistics of utility crews to impacted flood areas.

3. Identify the electrical distribution infrastructure that are in high risk areas affected during previous flooding events in SC.

DELIVERABLES

1. **Research and identify the critical infrastructure assets; existing power plants and major electrical substations that have been inundated by storm surges and/or flooding in previous natural disasters effecting SC. If needed, identify a plan of action for the construction to retrofit and/or remove existing power plants and electrical substations located on, adjacent, or downstream from compromised dams to increase the resiliency to flooding.**

The critical infrastructure assets that are deemed priority will be located in areas near the major river systems across SC. Once those target areas are identified, organize a roundtable discussion with all existing electric utility providers in the target areas deemed critical to discuss and implement a future plan of action in an event of flooding.

The electric grid generation target areas to include are:

Nuclear – During a flood and wind event, nuclear plants must reduce power and disconnect from the grid when wind speeds are predicted to reach 75 mph. This was certainly the case in North Carolina when Hurricane Florence impacted the Brunswick area. South Carolina's nuclear units are all located away from coastal areas, but it is possible wind speeds could potentially impact locations in Hartsville, Fairfield, Oconee, and York counties. These units, however, are highly regulated from a plant safety, public safety, and reliability perspective, and such events are simulated on a regular basis.

Coal – Although not as scrutinized as much as nuclear, coal-fired power plants share similar wind restrictions but more from a practical standpoint. All coal-fired structures generate steam for power production, and therefore have open-air or enclosed boilers. Wind loading conditions can result in personnel being grounded and unable to perform maintenance on these multi-storied (average seven to ten stories), tubed hot boxes. As a result, these generating facilities can be rendered inoperable during such conditions due to the fact that access is via suspended girders and walkways.

Another impact of coal-fired facilities due to flooding is the inability to receive deliveries of coal for fuel. A major impact of Hurricane Florence, as well as the Flood of 2015, was the wash-out of certain railroad trestles that prevented trains to deliver coal to various power plants. In fact, even though Hurricane Florence caused less damage to railroads in South Carolina than the flood of 2015, normal train traffic was unable to resume until all tracks could be traversed and confirmed to be safe. This process took up to two weeks. During this time, coal trains needed to re-supply coal-fired plants were stranded at various depots from the mines of West Virginia and Kentucky down to side tracks throughout South Carolina.

The most critical risk for coal-fired facilities during a flood event is the potential impact to ash-ponds near navigable water-ways. Just like cinders in a fire place, ash is a combustible by-product of coal and is stored on-site at coal generating facilities. Although utilities in SC, for the most part, have initiated volunteer clean-up of such sites by way of beneficial recycling with concrete manufacturers or moving ash into more hardened, lined ponds, legacy issues remain. Thorough inspection of existing dams for ponds and complete evaluation of the "board-feet" of difference between historical river elevations in comparison to dam heights is a critical means of establishing proper preparation for such events. In fact, in 2018, during Hurricane Florence, the South Carolina Public Service Authority utilized deployment of Aqua Dam. Aqua Dam is a water-filled, rubberized bladder system that is deployed upon dams vulnerable to over-topping by floodwaters. Santee Cooper was able to add approximately thirty-seven inches in height and six feet in width to its Grainger Generating Plant ash-pond dam in Conway, SC and successfully prevented the Waccamaw River from over-whelming to the ash pond. It should be noted that Grainger has been retired from service, yet its ash ponds (2) remain.

Natural Gas – Natural Gas generating facilities can be impacted by high wind conditions just as coal-fired plants. The more imminent threat to natural gas generating facilities occurs when weather impacts the Gulf of Mexico affecting off-shore natural gas and oil rigs. Curtailment of supply typically follows the abandonment of such rigs resulting in an inability to obtain adequate fuel supply. A secondary risk to natural gas generating facilities due to flooding is having both interstate and intrastate pipelines that serve generating facilities to be exposed to hydraulic pressure or breach as a result of erosion or flood waters.

Hydro – Hydro generating facilities utilize flowing water from a river or a reservoir to turn a turbine and generate electricity. One would assume that a hydro facility would do well to have an over-abundance of water. This is certainly not the case given that these facilities must prepare for such a deluge by making room in a reservoir to receive such an influx of water. In addition, it must be mindful of downstream flows that could impact areas. Also, these hydro facilities are equipped with emergency floodgates to allow for a release in order to protect the reservoir under federal licensing guidelines. A final challenge in South Carolina is that different utilities are interconnected by common watersheds. Thus, coordination of generating facilities within these watersheds is absolutely necessary.

2. **Research and develop a plan to implement for efficient and effective mobilization of state utility crews during future areas impacted by flooding; including:**

(1) The bridges and roads that potentially could be affected by the flooding and will not be accessible route;
(2) Material delivery methods to the effected sites; and
(3) Track equipment to ferry resources and material.

3. **Identify the electrical distribution infrastructure that are in high risk areas affected during previous flooding events in SC.**

(1) Underground distribution can actually be subject to more damage during a flood. Switch cabinets and transformers flood causing operation failure and outages; and
(2) In the coastal areas of South Carolina, high tides coupled with severe flooding can result in salt water intrusion rendering electrical distribution useless. During Hurricane Matthew, numerous underground facilities subjected to salt intrusion were temporarily replaced with overhead facilities in order to restore power to customers.

IV. TIMELINE

Objective 1

(1) Research and identify the critical infrastructure assets; existing power plants and major electrical substations that have been inundated by storm surges and/or flooding in previous natural disasters effecting SC.
(2) If needed, identify a plan of action for the construction to retrofit and/or removal of the existing power plants and electrical substations located on, adjacent, or downstream from compromised dams to increase the resiliency to flooding.

Objective 2

Research and develop a plan to implement for the efficient and effective mobilization of the state utility crews during future areas impacted by flooding.

Objective 3

(1) Identify the electrical distribution infrastructure that are in high risk areas affected during previous flooding events in SC.
(2) Develop a path forward to update the infrastructure based on high to low priority.