Staff Report

AUGUST 10 HIGH WIND EVENT SUMMARY AND FOLLOW-UP

November 6, 2020

BACKGROUND:

This report is intended to provide the City Council with a detailed summary of the events that occurred during the August 10, 2020 high wind event, known as a derecho. City staff completed an After-Action Review of the event on September 22 and has included key lessons learned in this report. **This report is intended to be informational; no Council action is expected. City staff will incorporate lessons learned into new procedures and potentially into proposals for future budgets or capital improvements to be better protected against a similar event in the future.**

STORM AND BACKGROUND INFORMATION:

In the late morning on Monday, August 10, the City experienced a devastating derecho. A derecho is a severe storm that forms rapidly and affects large areas with high winds. The storm formed over western Nebraska and passed over Ames on its way to Illinois and Indiana. Ames experienced windspeeds up to 90 miles per hour across large areas of the City for approximately 30 minutes, with rain and lower speed winds continuing for an additional 45 minutes. Significant portions of the surrounding region were damaged, resulting in competing demands for key resources in the response to the disaster.

The Ames Municipal Electric System has the ability to generate electricity locally, using two natural gas-fired power boilers at the Power Plant (Unit 7 and Unit 8), and with two gas turbine units located at a remote site. Additionally, the utility can import electricity from three separate transmission tie lines (69 kV line to Johnston, 161 kV to northeast Ankeny, and 161 kV to Boone). At the time of the storm, the Utility was generating electricity at the Power Plant with Unit 7, and was importing the remaining power needed using transmission lines. Unit 8 was unavailable due to a maintenance outage.

INFRASTRUCTURE DAMAGE AND INITIAL SITUATION SIZE-UP:

The City's Emergency Operations Center opened as the storm passed. This facility has a backup generator. Staff from the Distribution division of Electric Services mobilized immediately to determine the extent of the damage to critical facilities. Crews began to drive along the transmission lines to identify the damage and what would be required to repair them. Meanwhile, Power Plant staff assessed the local generation equipment and worked to start one of the gas turbines.

The storm caused catastrophic damage to the two transmission tie lines to the south. On the larger 161 kV line, approximately a dozen custom-designed laminated poles were felled by the wind. Significant lengths of the smaller 69 kV line were destroyed. The 161 kV line connecting to Boone was struck by a tree, but this line was in the best condition of the three transmission lines. This line is owned by the City of Ames. Electric staff immediately began repeated efforts to contact the owner of the equipment on the other end of the line, ITC, to verify the line was not energized on the other end. This verification was needed before the tree could be removed. The City arranged for a tree removal crew to standby until a representative from ITC was contacted to allow the tree to be removed.

The Unit 7 turbine-generator in operation at the time of the storm experienced a “trip,” meaning it was disrupted by the damage to the transmission system and disconnected itself from the electric grid to prevent catastrophic damage to the unit. The operators at the Power Plant took steps to preserve the heat in the boiler so the unit could be restarted as quickly as possible.

The storm resulted in all 28,500 customers of the Electric utility being out of electricity. Assistance was requested through the County Emergency Operations Center for large generators to assist with powering critical facilities. Three generators were ultimately provided; one did not function properly after it arrived and it was sent back in the early morning hours Tuesday, August 11.

While the assessment of the damage to the electric infrastructure began, staff from Public Works Operations, Traffic, Resource Recovery, and Parks and Recreation began to clear tree debris from streets. The initial emphasis for clearing began on arterial streets, particularly around the hospital, to ensure that access was available for any life safety needs. Following that, staff worked towards residential streets. Trees with power lines wrapped in them were left until they could be assessed; however the goal was to ensure emergency services could access any property, even if it was only from one direction.

Due to the electrical outage there was also no power at traffic signals. Of the 71 signalized intersections across the City, 22 have battery backup operations. Portable stop signs were delivered to locations with the highest traffic volumes; however, due to the widespread damage there were not enough portable stop signs to cover all the remaining intersections. The battery backup locations began running out of backup power by late afternoon Monday. Small generators began to be dispatched to strategic locations in coordination with the Police Department to maximize traffic safety and operations.

ATTEMPTS TO GENERATE OR IMPORT ELECTRICITY:

The storm damage caused irregularities in some control equipment at the Power Plant. Valves became stuck open and control systems did not correctly reflect the operational status of equipment. The hard rain from the storm caused water to accumulate inside the Power Plant and pumps to remove it were not operational due to the electrical outage.

Utility-sized electrical generators require some outside energy source to be able to start. Electricity is required to operate the controls, fans, pumps, valves, motors, and other equipment associated with each generator. Without an electrical connection to the outside world, and without any functioning local generation, the utility began what is referred to as a “black start” procedure. This relies on starting a small generator, which can then start a larger generator.

One of the gas turbines is connected to a high-pressure tank of air which allows the turbine to spin and start as the air is released. Unfortunately, the tank of air did not contain enough pressure to start the turbine, which required that a mobile generator be connected to it to refill the air tank. A mobile generator was called in from the Water Pollution Control Plant (WPC), which was wired to the air tank at the gas turbine site. Wiring in the generator took approximately 90 minutes and pressurizing the air tank took another 60 minutes. Electric Services then attempted to start the turbine, but the turbine did not start on the first attempt. Filling the air tank for a second attempt would take another 60 minutes.

As this was taking place, substation crews worked to inspect and repair equipment in the electric substations. Electric crews drove the transmission lines that form a loop from substation to substation throughout the City. Crews cleared these lines of branches and made repairs. Work continued through the afternoon into evening on the Monday of the storm to get transmission or generation functional.

Meanwhile, staff at the Power Plant was monitoring the battery backup systems at the plant. These systems power: 1) plant controls, 2) motors that keep the turbine shafts slowly spinning when not operating to avoid warping them, and 3) pumps that circulate oil to create seals that prevent hydrogen from escaping from the generator enclosures. A nearly pure hydrogen environment is used in the generator enclosures to keep the generators cool. As the batteries that keep these seals in place drain, the plant staff has to consider a controlled removal of the hydrogen from the generator to avoid an uncontrolled release that could result in an explosion hazard. Unfortunately, the process to replace the hydrogen so the unit may operate again takes approximately two days. This would mean the unit could not generate electricity during that time.

After approximately seven hours, the batteries for the Unit 7 hydrogen seal drained. Plant staff performed emergency procedures to purge Unit 8 of hydrogen and connect the Unit 8 batteries to Unit 7. Unit 7 lost hydrogen for approximately five minutes before this could be completed, but the additional batteries kept the seals intact until power was restored to the Power Plant later that night.

WATER SUPPLY PROTECTION EFFORTS:

As the outage progressed, staff from Water and Pollution Control was monitoring the situation in the Water Treatment Plant. This facility has a backup generator to power the treatment facility and allow it to continue producing drinking water. However, with no

electricity to the water wells, the plant was not able to continue putting treated water into the distribution system. Projects have been planned in the Capital Improvements Plan to provide backup electrical power to water wells, but these projects have not yet occurred. Aid was requested from Story County for large generators to power the water wells and keep the water utility operating.

The public was requested to conserve water to preserve the pressure in the system as long as possible, and Water Treatment operators drew down tanks of water at the Plant to keep pressure in the distribution system. Had the pressure in the water distribution system dropped too low, the system could have become contaminated, and a boil order would have to be issued for several days once water could be produced again.

The mobile generator from WPC was initially connected to the gas turbine site to attempt to start re-energizing the Electric Utility. After the initial attempt to start one of the gas turbines, it became apparent that the more urgent need was to get mobile electricity to several water wells to avoid losing the drinking water system. Shortly after 7:00 p.m., Electric Services staff assessed the various well fields to determine which was best suited to be connected to the generator. The generator was disconnected from GT 1 and reconnected to wells at the Youth Sports Complex well field by 9:27 p.m. Prior to the energization of these wells, Electrical Utility power was restored to the well field south of Lincoln Way.

With approximately one hour to spare before the water distribution system would reach a critical pressure loss, raw water began flowing into the Water Treatment Plant. Throughout that night, water production slightly outpaced water consumption. Staff continued efforts to connect the WPC generator to the Youth Sports Complex wells as a backup in the event power was lost again.

ENERGIZATION BEGINS:

At 7:12 p.m. on Monday, August 10, ITC confirmed that the Boone tie line was open at its western terminus. This confirmation allowed the City to clear the tree from the line so power could begin to be imported to the City. The Stange Road substation became energized around 8:45 p.m. Then, Electric staff began the methodical process of energizing the substations in sequence, ultimately energizing five substations Monday night (Stange Road, Ames Plant, Dayton, Top O Hollow, and Haber Road). This process takes time, as the utility must ensure the electrical load remains stable. If load is picked up too quickly, the instability could cause safety mechanisms to trip and power to be lost. This would necessitate starting the re-energization procedure again from the beginning.

The four substations prioritized for re-energization Monday night were those that connected to water wells, the hospital, and Iowa State University. The remaining substations were energized based on how quickly the transmission lines in between could be cleared.

From each substation, a number of feeder lines distribute power to various neighborhoods. There are approximately 50 feeder lines in Ames. Feeders were cleared Monday night to the hospital and water wells. Ultimately, approximately 20% of the City's expected electrical load was re-energized Monday night. Energizing operations were halted at 11:08 p.m. so staff could allow crews to rest and to prepare strategies for the following day's work.

On Monday, August 10, a contractor with specialized equipment was contacted to begin repairs on the southern 161 kV transmission tie line to Ankeny. Authorization was completed on Tuesday morning to rapidly spec and transport poles and begin the demolition and reconstruction process.

On Tuesday, work continued to re-energize the remaining substations and clear feeder lines so various areas of Ames could be re-energized. This clearing work involves removing branches and isolating faults by disconnecting them from the main feeder lines. Priority was given to feeders that served two long-term care facilities whose residents were ready for discharge from the hospital once power was restored to those facilities. This would free up capacity for patient care in the hospital. By Tuesday night, all the City's substations and all the feeder lines extending from them had been re-energized.

The City's Outage Management System experienced software problems as the outage progressed, resulting in inaccurate information (and at times no information) being displayed to the public map. This was a lower priority for staff to address early in the disaster—crews were focused on getting transmission and main feeder lines cleared, so individual neighborhood-level outages were not yet being addressed. Later, staff tried to clear these issues and ultimately resorted to manual entries of fuse and switch numbers to update the outage maps. The inaccuracies on the public maps for the system led to confusion among the public about which areas of the City were experiencing outages and which had been re-energized.

Mid-day Tuesday, August 11, City Hall was re-energized. Unfortunately, a fault occurred when the backup power system tried to switch over to utility power. This resulted in a loss of power to the systems attached to the backup power supply (emergency operations center, City phones, City internet, and servers-including the utility's electrical outage management system). This outage also disabled the City's ability to take 911 calls and non-emergency police calls in the Emergency Communications Center. As designed, these 911 calls automatically switched to Story County for dispatching. However, the Police non-emergency number and other phones within City Hall were disabled. During the two hours of this outage, Electric Line crews in the field were unable to complete switching as quickly due to the loss of communications and outage management system servers.

Approximately 80% of the City's customers (by estimated load) were re-energized by Tuesday night, August 11. The areas remaining out were primarily those that had: 1) overhead electrical lines, and 2) mature trees that had fallen on lines. The most heavily impacted areas were north of downtown, the south of campus area, Southdale, Oak-to-

Riverside, and the Ontario area. Two strike teams consisting of Parks and Recreation and Public Works maintenance staff and Electric Services staff were assembled and began working ahead of the line restoration crews to remove downed trees that were entangled with wires. These two strike teams continued to work for several days clearing specific areas.

MUTUAL AID FOR ELECTRIC SERVICES:

Electric line crews were called in for mutual aid from a several communities:

- Algona
- Cedar Falls
- Denison
- Glidden
- Eldridge
- Lehigh
- Maquoketa
- Webster City
- Winterset

Several of these cities sent multiple crews at a time or in succession. Additionally, Electric Services hired a contract line crew from Zoske for several days. Electric Services' tree trimming contractor was utilized to clear trees on downed lines, as was an additional tree contractor retained for very large tree work. Staff from Public Works and Parks and Recreation were paired with Electric Services staff to remove trees and branches from downed lines. This dangerous work required Electric Services staff to verify that lines were de-energized before the lines could be touched.

Electric Services Substation Electricians were sent throughout town to replace fuses to re-energize individual customers outside the main area of repairs.

Re-energization work focused on areas that could re-energize the largest number of customers as quickly as possible. Crews primarily worked 16-hour shifts during daylight hours to complete repairs more quickly and safely compared to overnight shifts.

COMMUNICATIONS DISRUPTIONS:

Communications were significantly impaired by the storm – cellular networks were not functional for portions of the community and for different providers. The City, ISU, Story County, and other agencies rely on a radio system that has only recently been deployed.

A temporary radio system was in use at the time of the storm. The temporary system relies on antennas that are connected via fiber lines. Two antennas serve the Ames area: the Ames tower and the Wallace Hall tower. The towers multi-site, meaning the towers work like a network. With the fiber line down, the towers failed to multi-site. The result was that radios connecting to one tower could not be heard by radios connected to the other tower.

City staff attempted a number of fixes for this problem, since it is not possible to control which tower a radio connects to. The first priority was to fix the fiber line. This fiber line is maintained by Windstream. Windstream was unable to make the repairs until the City repaired electrical lines in the area where the fiber was. Staff, working with the radio system provider RACOM, next attempted to force the radios to only use the Wallace Hall Tower. This would have provided adequate coverage for the city. This approach also failed as the radios would not stay locked on to a tower. RACOM then applied a patch to the radio consoles in the communications center. This allowed the communications center to hear both towers, but did not fix field operations. On Friday, RACOM applied a new patch to allow the radios to all hear each other. This worked better than the initial patch but still resulted in degraded service. At around 10:00 a.m. Saturday, August 15, Windstream repaired the fiber line to the towers, returning the radio system to pre-storm condition.

It should be emphasized that the permanent radio system relies on microwave transmitters to communicate with each other as opposed to fiber lines (although there will be back up fiber lines). This level of redundancy should keep a similar event from affecting the permanent system in the same way. All towers have generator backups.

PUBLIC INFORMATION:

Initial efforts to push out public information were hampered by the loss of cellular infrastructure, but the primary mode of communication was through social media supplemented by the City of Ames website and other communication tools. During the outage and aftermath, the City of Ames social media Twitter and Facebook accounts each gained nearly 2,000 additional followers, which is a notable increase in less than two weeks. Also, City of Ames Instagram was used, and the Ames Police Facebook and Twitter accounts. The Emergency Operations Center utilized the Story County Iowa Alerts system on several occasions to provide information via text messages, email, and voice calls to registered users.

A hotline was established Monday night, August 10, for residents to call in and get basic information about the outage. This hotline transitioned from the COVID hotline to storm information and remains in operation answering questions on both crises.

Face-to-face information began with door knocking on Monday, Aug. 10, and continued through Wednesday, Aug. 12. On the afternoon of August 12th, information stations were established in neighborhoods that were heavily impacted and far away from the main area of the outage. Information was provided to these information sites regarding crew work locations, timing of the repairs (as best as could be estimated), and clean-up efforts.

These sites were initially located at Optimae Life Services on South Hazel Avenue, at the intersection of Hughes and Ash Avenue, in Country Gables Park, and at Sawyer Elementary School at the intersection of Ontario and North Dakota Avenue.

Door knocking continued in select neighborhoods on Thursday, Aug. 13 and Friday, Aug. 14. The Information Centers were active on the weekend, Saturday, Aug. 15 and Sunday, Aug. 16, with hours from 10 am to 6 pm. The information centers concluded on Sunday, August 16th, when the remaining outage areas were reduced to approximately 350 customers out. Neighborhood teams were then established for Monday, Aug. 17 and Tuesday, Aug. 18 to walk door-to-door and make contact with neighbors remaining out of electricity.

The information centers were modified during the disaster, with the Optimae and Country Gables sites closing as electrical repairs in those neighborhoods were completed. A site was established at Bethesda Lutheran Church on Northwestern Avenue to serve neighbors in the main area of the outage.

Throughout aftermath of the storm, hundreds of Ames residents called the hotline, left comments on City social media, used direct messaging programs, and visited the special web page set up on the City website (www.CityOfAmes.org/Storm2020) Not every comments was answered individually, but posts on social media included graphics, photos, and updates. The posts were frequent and responsive as circumstances allowed. During this period, five separate videos were disseminated including an overview of destruction, an explanation of a service line, and self-haul debris site information.

ICE:

City staff attempted to obtain ice for distribution to the public early in the outage. Unfortunately, ice was in high demand for several days. A truck with 2,500 18-pound bags of ice was delivered to City Hall for distribution to the public on Saturday, Aug. 15. Approximately 2/3 of the ice was distributed for free throughout the next several days, and the remaining ice was offered to the state Emergency Operations Center for distribution in other storm-damaged communities.

SUBSEQUENT STORM FRIDAY NIGHT:

On Friday evening, August 14, a storm caused outages for an additional 250 customers. Customers along Todd Drive and customers in the Teagarden neighborhood who had been re-energized earlier in the week lost power a second time due to the storm. Electric crews worked through 2 a.m. to restore power, returning several customers to service that night. On Saturday morning, August 15, Ames Electric crews focused on completing repairs to these areas so customers could be returned to service, before returning to areas that had been without power since the beginning of the storm.

TRANSMISSION REPAIRS:

The contractor repairing the 161 kV transmission line to Ankeny made repairs from Tuesday, August 11 through August 17. Critical parts needed to complete the repairs were not delivered as expected on Saturday, August 15, so City staff contacted staff of the delivery service on Sunday. The delivery service sent staff to open trucks and locate the packages with parts, allowing the repairs to continue Sunday afternoon, August 16. On Monday, August 17, a tree was discovered on a remote section of the line. The tree was removed, and the 161 kV line to Ankeny was returned to operation at approximately 8:00 p.m. Monday, August 17.

FINAL RE-ENERGIZING EFFORTS AND TRANSITION TO RECOVERY:

On Tuesday, August 18, two additional outages occurred, which affected approximately 60 total customers on Campus Avenue and at Prairie View East. These were repaired that day, as efforts continued to address the remaining outages from the original storm. The last outage affecting multiple customers was repaired at approximately 7:00 p.m. on August 18, and shortly thereafter, all the remaining known individual customer outages were repaired.

On Tuesday morning, August 19, the City closed the Emergency Operations Center and transitioned to a virtual EOC. Efforts transitioned to assessing the electric infrastructure for limbs or trees that had the potential to cause additional outages, completing permanent repairs to equipment that was fixed in a temporary manner, and cleaning up dangerous limbs and trees on public property. The City continued efforts to collect and dispose of private storm debris.

STORM DEBRIS DROP-OFF AND COLLECTION:

On Tuesday, August 11, in accordance with the City's storm debris management plan, City staff conducted a survey of neighborhoods to determine the extent of the damage. The extent of the damage met the criteria for establishing tree debris pick-up across the entire City.

Staff established a plan for a drop-off site for debris on August 11 at the former coal pile site (308 East Avenue) across the railroad tracks from the Power Plant. There was not adequate space available at the existing tree debris site at 700 East 13th Street to accommodate the public and City crews. The coal pile site was prepared for customers and opened in less than 24 hours at 7 AM on Wednesday, August 12 and remained open daily, including weekends until Friday, September 4. The coal pile site was staffed with volunteers or City staff (when available).

During the initial response some tree debris material was simply pushed to the side of the street to allow for emergency access. Public Works staff began gathering and hauling that debris away by Wednesday, August 12.

Parks and Recreation staff worked to identify and eliminate hanging tree branches in areas where public safety was a concern. Staff also worked to clear areas where secondary outages may occur from weak or damaged branches falling back onto repaired electric lines.

The City announced it would formally begin picking up debris from curbside locations on Monday, August 17. Public Works staff split into four teams and began picking up debris from 7 AM to 7 PM. A mapping system was developed and updated daily showing where the debris pickup had occurred and where the crews were moving to next. This map was shared with staff that took phone calls, published to the City website, and pushed out on all social media channels.

On Tuesday, August 18 a request for mutual aid was placed to Story County Emergency Management to assist with the debris pick up. The Iowa Department of Transportation (IDOT) responded to the request with haul trucks and loaders on Thursday, August 20. The daily numbers varied, however at their peak, the IDOT had 33 staff members and equipment loading and hauling debris in Ames. The IDOT took their debris to the 700 East 13th Street site to not overwhelm the public site at the former coal pile. The IDOT staff worked until Saturday, August 29. Public Works staff continued to work alongside the IDOT and completed the first pass of curbside pickup on Friday, September 4.

A third tree debris location was established on Wednesday August 19, for City staff only at 3915 Mortensen Road, east of the Ames Middle School. This location allowed for much quicker hauling routes thus increasing the speed at which debris could be picked up and removed from streets.

Due to the limited amount of public right of way in areas and the extensive damage, a final round of curbside pickup was announced to begin on Tuesday, September 8. Staff again used the mapping system and completed the second round of pickup on Wednesday, September 16.

Iowa Homeland Security bid a statewide tree grinding and disposal contract to assist communities in their debris handling efforts. The advantage of this system is that there is no local funding match necessary when being reimbursed by FEMA. The City requested mutual aid to be included in this contract on Friday, August 28. Grinding and disposal operations were completed in October.

LESSONS LEARNED:

From the September 22 After-Action Review, a selection of lessons identified is provided below:

1. **Emergency Operations Center:**

Notification that the Emergency Operations Center was opened did not occur in a comprehensive manner at the start of the storm. This was due in part to the lack of electricity for landlines and email, as well as intermittent cellular service.

The Emergency Operations Center was located in the Police Department, in a room constructed for this purpose. However, this facility has never before been used for an emergency lasting longer than one day. Given the security access issues and the needs of the Police Department to use that space for its regular operations, staff believes it would have been more effective to move operations to the Water Plant after the first day. The Water Plant has a backup EOC facility, which would allow for more space to manage operations.

Backup EOC members were not utilized to the extent they could have been. This resulted in a smaller number of individuals each having a larger span of control than practical. This incident also reinforced the need for additional training for EOC members regarding the Incident Command System.

Staff identified several opportunities to make more use of videoconferencing programs, such as Microsoft Teams, to coordinate with people who were not physically in the same room or to provide briefings to a larger group at one time. With pandemic precautions in effect, videoconferencing could have been more widely used to effectively communicate once internet service was restored.

2. Public Information:

The lack of electricity made communication with the public difficult. Additionally, media in the area were not focused specifically on Ames due to the widespread nature of the storm. Therefore, the City needed to both create and distribute information.

The high volume of questions received via social media illustrated the need for more City staff members to be trained in responding to social media inquiries. Although Story County Iowa Alerts was used several times during the outage, staff believes this system could have been used more regularly to provide updates to residents who had no other outlet for information.

Information from the public regarding damage could have been more comprehensively uploaded into SeeClickFix, which could then be used as the real-time reporting tool to confirm when issues have been fixed or to answer questions from callers.

A plan should be developed for neighborhood information sites throughout the City, so once the order is given to activate the sites, they can be set up in locations familiar to residents.

3. **Electric Restoration**:

The influx of mutual aid crews required the coordination of hotels, meals, radios, supplies, and other items that were handled by Electric Distribution staff rather than the Emergency Operations Center staff. This was time-consuming for the small crew at Electric Distribution.

Procedures can be established for the thorough inspection of each electrical circuit, so Electric staff can more quickly assess the damage, the time to restore, and the prioritization of restoration. This would help some customers be re-energized more quickly in instances where the circuit has no faults and the restoration is relatively simple.

Power Plant staff identified 30 issues resulting from the storm. These include preparation of procedures for some of the unique conditions experienced with this storm, programming decisions in control software, and equipment that did not function for the duration of the outage.

4. **Debris Removal:**

   The need to remove significant amounts of debris revealed that the City's storm debris clean up policy should be reviewed. This policy was last updated in 1999 and some of the references within the plan need to be updated. Additionally, alternative sites for dumping tree debris and procedures to direct private tree contractors to dump sites could be developed.

5. **Water Production:**

   The need for standby power at water wells and the Technical Services Complex became apparent in this extended power outage. The Water Department staff also identified the need for additional communications equipment to stay informed about the status of the storm and response efforts.

NEXT STEPS:

City staff is preparing the upcoming Budget and 5-year Capital Improvements Plan and will explore adjustments to these plans to address the vulnerabilities identified after the storm. Prior to the pandemic, City staff was planning to undertake a large-scale disaster simulation exercise in April 2022. This exercise has been delayed, but the experience gained from this storm event will be used to prepare for a more effective disaster simulation.