H. Continuity of Operations (COOP) and Environmental Issues for Infrastructure

In every community, infrastructure plays a key role in operations of critical facilities as well as sustaining everyday functions of the government, citizens, and businesses. Without basic utilities such as electricity and water, community functions can become crippled and critical facilities can lose the ability to provide vital services such as health care and public safety.

During disaster events that are severe in magnitude (longer return intervals) and scope (area) like Hurricane Katrina, utility systems are generally offline for longer periods of time than for the more frequent or smaller storms. Often, substantial infrastructure not typically affected in smaller storms is damaged or destroyed. These "big ticket" systems are needed to enable the smaller parts of the system to operate. Only the larger contractors have the cashflow and bonding capacity to handle much larger scale projects expected if a utility system major overhaul

or repair is required. Furthermore, the less typical or more complex the system, the more focused the skill set that is required. Because these larger and more complex systems were not anticipated to be damaged in such a fashion, larger storm events also awaken the owners to the realization that they were more threatened or at higher risk than originally thought. This may result in rethinking the situation and increasing the capacity or reducing the risk to such high priority systems for future events. These efforts require time to study the situations, design options, brief decision-makers, gather any funding required for high-price repairs or upgrades, and implement the plan. However, for all of the time that systems remain offline or at partial capacity, there are negative impacts to regional economics.

H.1 Electrical Power Systems

Electricity is generally distributed from power stations to users via transmission lines, substations, transformers, and secondary services. During major storms, including hurricanes, wind and flooding can impact power systems by knocking down power lines or directly damaging transformers or substations. Approximately 70 percent of all power outages are caused by weather-related events.

Interruption in service not only disrupts peoples' lives and businesses, but can also be life-threatening for those who are dependent on electrically-powered medical equipment, such as respirators. Longer duration loss of power has a wider impact on the whole community and its economy; during outages, businesses cannot fully function and many residents can be out of work for several days or even weeks.

For critical and essential facilities such as hospitals or police stations, the loss of power can severely dampen functioning capacity. Hospitals are required to have emergency generators, which must be sized to carry specific electrical loads based on the design occupancy. On the other hand, police stations, Emergency Operations Centers (EOCs), and other key government facilities are usually equipped with generators, but the generators only provide a fraction of the power normally used, requiring the facilities to run at limited capacity. Facilities must plan and prioritize ahead of time to address how they will provide essential services with limited power, how they will plan for water supply needs (e.g., drinking water, water for food preparation and chillers, etc.) and what contingencies they have for those services they cannot provide.

H.1.1 Regional Impacts

As a result of Katrina, over 1.7 million people in the Gulf states and 1.3 million customers in southeastern Florida lost power when the storm made landfall. Electrical distribution systems were heavily impacted in Mississippi by Hurricane Katrina. Fuel pipelines were damaged, resulting in fuel shortages throughout the southeast. These fuel shortages came very close to shutting down electrical utility pole treatment operations, which are critical to the restoration of power. FEMA expedited coordination with local and state officials, and utility pole and oil company executives to ensure that tens of thousands of gallons of various fuel types necessary for utility pole treatment continued to be supplied when and where needed. Without such quick coordination, the electrical system restoration would have taken much longer. It is these unexpected

incidences caused by major storms that have unanticipated, yet potentially severe consequences in restoration, repair, or reconstruction.

H.2 Water Supply Systems

Water is delivered to users from treatment plants via water distribution systems composed of pipes, storage tanks, and pumps. Water distribution systems depend on electricity to power the pumps that deliver the water to the end user. Most systems are equipped with backup generators powered by fuel, which require human intervention for refueling and are, therefore, vulnerable during storm events such as hurricanes. The systems can also be directly impacted if pumps are flooded and contaminated, or if water mains are damaged.

Water is obviously essential to sustain basic daily activities within communities, and for many critical and essential facilities such as hospitals, water must be available in order to provide the most basic health care services to the community. For example, the loss of domestic water prevented the use of air conditioning units and curtailed operations at the Garden Park Medical Center in Gulfport. The air conditioning units at the nearby Gulfport Memorial Hospital remained operational because the hospital was connected to a municipal well as an alternate water source.

H.2.1 Regional Impacts

Because of damaged caused by Katrina, a water main in downtown New Orleans broke, resulting in the loss of potable water within the city. Additionally, many coastal towns sustained heavy damage to potable water systems. Since the storm surge impacted areas much farther inland than originally thought possible, as part of recovery, these towns have to rethink how best to replace the water lines and where to place them. This requires researching potential new sites, purchasing right-of-ways, determining where the higher hazard limits are (such as velocity zones), deciding what amount of risk (based on the hazard limits) to deem acceptable (this is done by community decision-makers), and determining how best to either avoid risks or design to mitigate against them. There are parts of systems that simply cannot be economically designed or constructed to withstand major storms such as Hurricane Katrina. In these situations, the designers must provide options to the decision-makers, who must then decide what levels of risk they are willing to accept. This process, which includes gathering information as to the hazards, risks, damages, grant programs, and funding avenues; developing the concepts and options using the information gathered; briefing the appropriate decision-makers and receiving feedback; and modifying solutions and designs as appropriate until ultimate decisions are made, takes time.

With so much debris created by major events (millions of cubic yards), high and wide piles of debris can be everywhere. Debris removal contractors sometimes pick up debris prior to evaluating what exactly is being picked up. With their heavy machinery blindly delving into large debris piles, they sometimes unwittingly pull up fire hydrants and other system components, further damaging the system, during recovery operations.

H.3 Sewage Treatment Facilities

Sewage treatment facilities process wastewater conveyed from individual businesses, residences, and other community facilities via a system of pipes. Flow to the treatment facilities is generally gravity flow because it is more economical and easy to maintain. As a result, sewage conveyance and treatment systems are typically in low-lying areas. Treated sewage is also generally released into water bodies, so these treatment facilities are often in the floodplain, making them more vulnerable to damage from flooding.

As with water treatment systems, sewage treatment requires electricity for pumping and processing. When electrical power service is interrupted, treatment facilities must depend on generators to remain functional. These facilities require human intervention and a fuel source.

Additionally, breaks in the conveyance system as a result of a major storm event can lead to environmental contamination, as well as the spread of disease, as humans come in contact with unprocessed sewage materials. Also, when sanitary and stormwater sewer systems are combined, the system can become overwhelmed during a major precipitation or flooding event, which can result in an overflow release of untreated sewage at either overflow points designed as part of combined sewer systems or at the treatment plant itself. Similarly, when there is infiltration of stormwater into the sanitary sewer system via cracks in pipes, manholes, or illegal connections, the system might also be pushed beyond capacity, leading to an overflow release at the treatment plant. Overwhelming the system might also lead to sewer backups, which can damage the interior of buildings and pose health risks.

H.3.1 Regional Impacts

In the case of Hurricane Katrina, sewage treatment plants, sewage lift stations, and other system components were heavily impacted. As with the water systems, areas farther inland than originally thought vulnerable were impacted. Those areas already deemed vulnerable received far more floodwaters than expected. With high flood levels and surge velocities come significant amounts of debris, which can impact structures and facilities with tremendous force, leading to further damage to infrastructure.

H.3.2 Facility-Specific Impacts

A wastewater treatment plant in Diamondhead, Hancock County, Mississippi, with ground elevations of roughly 6 feet, had saltwater flooding up to 20+ feet. The saltwater flooding caused destruction of many system components, including pumps and electrical panels, and resulted in hundreds of thousands of dollars in damages. Furthermore, the system did not operate up to capacity, resulting in raw sewage bypassing the treatment facility and traveling directly into nearby rivers and streams. Multiple lift stations were similarly damaged when their pump systems and electrical panels were destroyed by the saltwater.

Mitigation/improvement options are being reviewed for the system. One option is to move the plant to a higher location, which would require purchasing new land, building a redesigned tie-in system to accommodate the new location, and planning for completion of various grant

applications for Federal funds, without which the project could not proceed. For lift stations, there was discussion about what flood levels to design for in terms of elevation and/or protection of electrical panels and critical and essential gear, since Katrina elevations were simply not viable. Options must be designed by architectural and engineering firms who understand the grant programs in order to present viable, achievable, and fundable options in their coordination with decision-makers.

H.4 Pre-Disaster Planning for Critical and Essential Infrastructure

In the preceding sections, the MAT has detailed the issues associated with the loss of critical and essential infrastructure, both to individual facilities and to entire communities. This section will briefly discuss mitigation and planning efforts that can be implemented at any organizational or municipal level to significantly reduce the impacts of future disasters, and why it would be beneficial to any community to undertake these efforts.

H.4.1 Continuity of Operations Plans

One of the most important tools that a community, organization, or individual facility can develop is a Continuity of Operations (COOP) plan. COOP plans have long been a priority of the Federal Government, and Federal Preparedness Circular 65 (July 26, 1999) has made the preparation of COOP plans mandatory for all Federal agencies. According to this document, COOP planning is an effort to ensure that the capability exists to continue critical and essential agency functions across a wide range of potential emergencies. The objectives of a COOP plan include:

a. Ensuring the continuous performance of an agency's critical and essential functions/operations during an emergency

b. Protecting critical and essential facilities, equipment, records, and other assets

c. Reducing or mitigating disruptions to operations

d. Reducing loss of life, and minimizing damage and losses

e. Achieving a timely and orderly recovery from an emergency and restoration of full service to customers

An effective COOP plan will integrate with state Comprehensive Emergency Management Plans (CEMPs) and local contingency plans, and will allow for site-specific refinement. As a community or an individual facility determines its critical and essential functions and operations, the protection of these assets becomes clearer to all involved. The main components of a viable COOP plan are:

- Identification of critical and essential functions
- Delegations of authority/orders of succession

- Alternate facilities
- Interoperable communications
- Vital records and databases
- Tests, training, and exercises

This planning process seeks to bring together all stakeholders within a community or planning region to prioritize services, determine backup assets, and establish best practices for quickly returning critical and essential services to citizens after an incident.

H.4.2 Addressing Losses of Infrastructure in a COOP Plan

A robust COOP plan at the state or municipal level should include protection of utility services as an critical and essential function. As such, the planning process would bring together all stakeholders (i.e., utility providers, government agencies, first responders, and others) to discuss the best practices for resumption of service immediately following an incident. Because basic utilities are integral to such a wide number of other critical and essential functions and to effective communication, the COOP plan should address losses of key utility infrastructure on two levels:

1. **The immediate, post-incident actions –** EOCs should be chosen based on their ability to operate without utilities. Sites with generators, portable bathroom facilities, and supplies of potable water must be chosen or developed in order to adequately address resumption of critical and essential functions.

2. **The longer-term, recovery actions –** An effective COOP plan will have documented best practices for resumption of service in the event of utility infrastructure loss. Some systems, because they cannot be reasonably duplicated or protected before an incident, will have to be repaired or replaced during the recovery phase. A COOP plan should include contact numbers from neighboring municipalities, states, or contractors that can be called upon to assist with recovery efforts. Likewise, emergency supplies that will be needed to restore utilities to certain priority locations can often be pre-positioned in hardened facilities.

Using hurricane planning as a specific example, the scope of such incidents are often such that neighboring towns are not able to adequately support each other and there is widespread damage to critical and essential utility infrastructure. In areas where hurricanes are possible, potential storm inundation and damage should be considered when establishing EOC sites, pre-positioning needed supplies, or developing communications strategies. With a hurricane the size and strength of Katrina, the only effective planning step is to ensure that municipal plans are integrated with state-wide plans and resources from neighboring towns, counties/parishes, and states identified. Not every emergency can be adequately mitigated with the resources available to a town or utility provider; however, the planning process seeks to reduce risk wherever possible and allow for accelerated resumption of services. In incidents similar to Hurricane Katrina, that acceleration may only allow utility service to be restored 6 weeks later, as opposed to 8 weeks, but any improvement is essential to the affected community.

H.4.3 Steps Beyond COOP Planning

A good disaster or emergency preparedness plan will address the larger issues of how to continue operations and provide critical and essential services after a variety of potential impact events. The COOP plan, however, should just be one tool used by communities to achieve proper emergency preparedness. Other steps that can be taken to reduce the impact of future incidents include:

1. **Critical Infrastructure Identification, Assessment, and Mitigation –** Threat and vulnerability assessments should be performed on all assets identified as critical and essential. For utilities, the buildings, delivery systems, and associated infrastructure can all be assessed for potential threats. These data can be used to correctly prioritize limited protection budgets. A high-quality, normalized threat assessment will provide a community with recommendations about which threats can be cost-effectively mitigated. Where possible, critical and essential infrastructure can be hardened or relocated to reduce future risk.

2. **Training and Exercises –** A COOP plan is only effective when stakeholders have been adequately trained. Exercises (tabletop, functional, or full-scale) are excellent ways to test the adequacy of plans and assess the participants. Lessons learned from exercises can be used to improve planning documents and identify correctable weaknesses.

3. **Frequent Stakeholder Communication –** This step is integral to all others and is the only real way of preparing for and responding to emergency incidents. As key stakeholders become familiar with each other, the common benefits of planning are more easily realized. Cooperation on establishing EOCs, communications protocols, and conducting exercises before an incident is the best method of ensuring cooperation during the incident.

All components described in this planning process are fully scalable and can be implemented by communities and/or utilities of all sizes. A rigorous approach to planning and mitigation will greatly reduce the pains of response and the costs of recovery.