

# **NORTH CAROLINA DEPARTMENT OF ADMINISTRATION**

## **2022 AGENCY RESILIENCE STRATEGY REPORT**

**(March 11, 2022)**

The North Carolina Department of Administration (DOA) provides a broad range of diverse governmental services to the citizens of North Carolina, including services to approximately 100 State owned buildings in Wake County. Technical and maintenance oversight of building engineering services for the buildings administered by the Department of Administration is provided by the Facility Management Division within the Department of Administration. The State Construction Office, another division within the Department of Administration, provides engineering services for the downtown Raleigh state government complex. The effect of climate and other stressors on the cooling, heating, electrical, and storm water systems at these buildings are important concerns to be addressed by the DOA through increased resiliency efforts.

### **CONDITIONED SPACE AND TEMPERATURE EXTREMES**

DOA uses district energy systems to provide heating and cooling for the larger buildings in the downtown Raleigh state government complex. Central chiller plants connected to chilled water loops provide chilled water to meet cooling needs in the major buildings including operational temperature requirements for data systems, elevator equipment, and other building systems. Likewise, a central heating plant with steam boilers are connected to the steam loop serving the heating needs of the major buildings. Some resilience strategies include: Thermal Energy Storage (TES) tank; chillers located at key buildings to supplement cooling provided by the central plants on peak days; and connection points to support temporary chillers in the event of a critical failure.

### **EXTREME HEAT**

DOA, through the Facility Management Division, provides chilled water to many State-owned buildings in the downtown Raleigh state government complex, as described above. Chilled water supplied to these buildings is produced by large chillers located at two primary chilled water plants, plus smaller chillers located at several individual buildings. This chilled water is supplied to numerous air handling units in the downtown complex buildings to cool the buildings throughout the year. The peak cooling loads occur in the summer months; however, demand for chilled water in these buildings continues in every season. Data centers, server rooms and IT Data closets are among the cooling loads that remain year-round.

The major climate stressor with respect to chilled water is extreme heat which exceeds the ability of the chilled water system to provide adequate quantities of chilled water. This could lead to loss of building use if the buildings in the downtown Raleigh complex cannot be maintained within acceptable summer temperatures. Potential consequences of loss or inadequacy of chilled water capacity range from uncomfortably warm buildings to complete loss of building use due to excessive interior temperatures and/or humidity. An important consideration in terms of indoor comfort, especially during summer months, is the reheat of conditioned air to reduce indoor humidity levels. Reheat in the downtown Raleigh state government complex is accomplished with

the use of heat provided by the downtown boilers. Therefore, indoor comfort during the summer months is reliant on both chilled water and steam provided in the downtown energy plants administered by DOA.

Our government buildings and the associated cooling system design for each were based on American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) standards which listed the expected environmental temperature. As weather temperatures increase above the design temperature the buildings will experience more challenges in maintaining a comfortable environment for the user groups. Adequate chilled water system capacity currently exists to handle the summer cooling load on a typical summer day in DOA buildings. However, during peak summer cooling loads, the existing chiller plants are at maximum capacity. Some of the downtown buildings served by the chilled water loop also have chillers located at the buildings. These chillers are needed during the hottest days.

Strategies for resilience include the use of Thermal Energy Storage (TES). A three million gallon Thermal Energy Storage Tank was added to the downtown chilled water system in 2007. The tank can be charged by filling it with chilled water during non-peak hours. The TES can be used to supplement the cooling capacity by discharging it during the peak cooling hours. This also allows plant operations to shift peak electrical usage to non-peak hours. This is beneficial to DOA, the utility provider, and the wider community. Maintenance and repair of the TES is required.

Ample boiler capacity is available to provide steam for reheat purposes in the summer months.

Funding was approved at the end of 2021 to expand the chiller plant to add an additional chiller to the central chilled water system, to add a separate summer boiler capability to the downtown heating plant, and to repair the Thermal Energy Storage tank. The additional chiller will increase system capacity to better allow the central plant to meet the cooling load on peak days. The additional chilled water capacity also allows DOA to extend the chilled water loop to begin serving existing buildings that are not currently on the central chilled water system.

The existing heating plant currently has sufficient boiler capacity to meet the heating load for the complex, even on a peak day for heating load. Multiple boilers provide a level of system resilience for meeting heating load needs on the coldest days in Raleigh. Although not intuitive, boilers are needed throughout the year for comfort control, and more importantly for humidity control. The summer steam load is much lower than winter. The current configuration requires all of the boilers in the plant to shut down in order to perform the full required maintenance on the boilers and the plant. Unfortunately, shutting down all of the boilers for maintenance results in loss of the ability to maintain proper humidity control. The addition of the summer boiler capability will allow the existing heating plant to be isolated from the heating loop for plant shut down and maintenance, while allowing the new summer boiler to continue to serve the off-season steam needs of the downtown complex. It also allows an extended period of time for maintenance during the summer, when humidity control is critical.

Museums in DOA maintained facilities are a great example of buildings with critical requirements for humidity control. Museum exhibits and artifacts require humidity control for proper long term preservation.

The chiller plant and heating plant expansion and improvements are currently in the design phase. Design considerations include more efficient plant operations and operational flexibility. The chiller plant expansion will add one additional boiler, as well as space to add one chiller in the future.

Auxiliary connections for chillers provides resilience. An auxiliary connection point was added several years ago to the Salisbury Street Chiller Plant to enable a temporary chiller to feed the chilled water loop in the event of a main chiller failure. Some important buildings also have connection points for temporary chillers. Examples of temporary connections at critical facilities: DHHS; Chiller Plant 2; Legislative Building.

A major non-climate stressor is the aging infrastructure of the downtown complex chilled water system. Ongoing maintenance of the chilled water infrastructure, principally piping and primary and secondary chilled water pumps, is required to maintain the resilience of the chilled water system.

## **EXTREME COLD**

The downtown State Government Complex in Raleigh is heated by four large boilers in the Central Heating Plant near the Albemarle Building. These boilers burn natural gas and/or fuel oil to produce the steam needed to heat approximately twenty-five major buildings in Raleigh's Downtown State Government Complex including the State Capitol Building, Legislative Building, Legislative Office Building, and Governor's Residence. The steam provided to these buildings not only heats these buildings but also heats potable water and enables all-season humidity control in the buildings.

Winter temperature setpoints in State owned buildings served by the downtown energy complex can be lowered to provide reduced indoor winter temperatures, allowing a reduction in energy consumption for heating purposes.

The boilers in the central plant burn natural gas and fuel oil, which are fossil fuels. For resilience, DOA will continue to focus on energy efficiency, well maintained and operated plants, and efficient control of building systems. District energy, or central plants with distribution loops, when well maintained and operated, are more energy efficient than each building having dedicated chillers and boilers. A district energy system also offers resilience in its ability to manage the load when equipment failures occur and when equipment shutdown is required for maintenance or repair.

HVAC Controls that can be monitored remotely are often called building automation systems, or BAS. Such systems can help facilitate energy efficient building operations and plant operations. A resilience strategy is to upgrade the building automation infrastructure, including technology upgrades for aging automation systems.

## **ELECTRICAL POWER LOSS**

DOA and other agencies occupying buildings administered by the Department of Administration provide a broad range of diverse services to the citizens of North Carolina. Loss of any of the buildings administered by DOA could result in serious disruption of governmental services.

Electrical power is essential to the proper operation of all buildings. This power is necessary, not only for lighting but also for heating, cooling, ventilation, computer & communication systems, and dehumidification in these buildings as discussed above. Major climate stressors that affect and can shut down building electrical systems are high winds, storm conditions and flooding associated with hurricanes and other high wind events. Electrical system reliability is dependent on the severity and duration of tropical storms. Ice storms and heavy snowfall may also result in loss of electrical power.

Loss of electrical service in any of the downtown complex buildings will necessitate evacuation of the building until the electrical outage is resolved. All of the buildings are equipped with emergency lighting systems to facilitate orderly evacuation in the event of power loss.

Generators are typically provided in the larger buildings to meet pumping requirements, fire protection and provide power for lighting and data systems during extended power outages.

The vulnerability and risk of electrical power loss to the downtown Raleigh state government complex is considered low to moderate, depending on the severity and duration of the storm or flooding event. There is a low likelihood of extended electrical power loss but a moderate likelihood of temporary electrical power loss. It is likely that electrical power loss in the Raleigh state government complex will affect much of the downtown area in addition to the State complex of buildings. Although it is not possible to quantify the level of risk, the risk is directly linked to the utilities and their ability to provide reliable electrical power, including their ability to restore power following unscheduled power outages. Risk factors include increases in frequency and severity of heavy rainfall, storm, and hurricane events in North Carolina.

As additional load is placed on the electrical grid through new construction and increased reliance on electric vehicles, the capacity of the electrical grid to deliver the needed power to all utility customers is a threat to resilience. It is impractical for DOA to duplicate the electric power generation capability to supply electrical power to the DOA maintained buildings. Therefore, DOA is reliant upon the utility provider for reliable electrical power to operate the buildings.

To address the potential loss of electrical power associated with severe weather events, DOA resiliency strategies include: Standby generators at major buildings; provisions for temporary connections of generators; Uninterruptible Power Supply (UPS) installation in data centers to ride through brief loss of power; use of work from home and remote working arrangements.

Major DOA facilities have standby generators for use during utility disruption. These generators typically are not intended to carry the entire building load. They are for targeted areas in buildings and maybe used to power critical electrical loads. The top priority for building generators is life

safety systems and building egress lighting. Some generators provide backup power for data centers. Uninterruptible Power Supply (UPS) is generally a battery system to provide the capability for a critical load to ride through brief utility power outages and transition to and from generator power without loss of power. UPS systems can also provide time to gracefully shut down critical systems, when power is not restored in a timely manner. Although most of the DOA generators run on diesel fuel, the Nature Research Center (NRC) generator runs on natural gas. This generator can run for an extended period of time providing required power to the live exhibits.

Some buildings have provisions for temporary connections to generators. DOA plans to add auxiliary connections for temporary generators during new construction, and as part of upgrades of electrical systems in buildings.

In response to COVID-19, many employees who worked in DOA maintained buildings were asked to work from home or some other remote working arrangement. The use of laptop computers and Virtual Private Networks (VPN) are examples of exercising a resilience strategy. That experience will help develop remote working options that may be used when conditions such as extreme weather events or power outages are encountered.

## **STORM WATER**

Heavy precipitation can cause significant damage to public and private structures and utility services. This, in turn, disrupts provision of government services, often coming during times when government services are critically needed.

The consequences of urban flooding include property damage, as well as damaged infrastructure and utilities, sewer lines and pump stations. When pump stations and sewer lines are damaged important infrastructure must be replaced. Additional investments in storm water resilience are needed to counter the threat of flooding.

## **SUMMARY**

Challenges to resilience in State buildings managed by the Department of Administration can be grouped into three time frames:

### NEAR TERM (0-2 years)

- Identify aging major systems; prepare cost estimates and develop budget requests for replacing aging major systems to provide resilience.
- Develop and use work from home (WFH) and remote working strategies that can be quickly implemented

### MEDIUM TERM (2-5 years)

- Chiller Plant Expansion & Construction has been approved and will take several years to bring on line

### LONG TERM (5-10 years)

- Install additional taps/connections for temporary chillers and temporary generators.

- Building automation infrastructure technology upgrades
- Upgrade & replace aging generators
- Upgrade & replace aging elevators
- Replace major systems that are approaching end of service life for resilience