March 1, 2017

Data Center and UPS Room Audit

Report #1702019

Presented by:

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INTRODUCTION Section 1

This report has been designed to provide recommendations to correct issues which pose a threat to the uninterrupted operation of the data center. In addition to this, it will provide recommendations to bring the data center up to industry standards, and in doing so, provide substantial operational savings and increased resiliency.

Keystone Critical Systems & Advisors mission is to mitigate risk within the critical space by providing a high level of knowledge within the IT environment. Our ongoing critical space involvement allows us to bring the latest technology and expertise to the client. System integration across the full spectrum of environmental support including electrical, mechanical, fire protection with ongoing support is our ultimate responsibility.

SCOPE OF AUDIT

This audit primarily focused on the total operational condition and resiliency of 4 data centers operating under the city of Ft. Lauderdale's management. The majority of time reviewing sites was spent on computer room air conditioning (CRAC) units located in the data centers. Cooling requires the most continuing maintenance and repair within all data center designs. The CRAC systems consist of the air handler, the condensing units, the line sets, dry-coolers, pumps and all supporting electrical and mechanical equipment. All systems, listed below, where examined in detail.

In addition to the CRAC units, other aspects which directly impact the reliability and efficiency of the CRAC units, such as the layout of the computer racks, the condition of the raised floor, UPS, battery cabinets, ATS's, and generators were also reviewed.

The audit that was performed on the CRAC air handlers matches what is done by Keystone CSA during quarterly PM inspections for service clients. This included checking:

- Unit set-points and logged event history
- Air filters
- The blower section for belt wear and tension, bearing wear, pulley wear

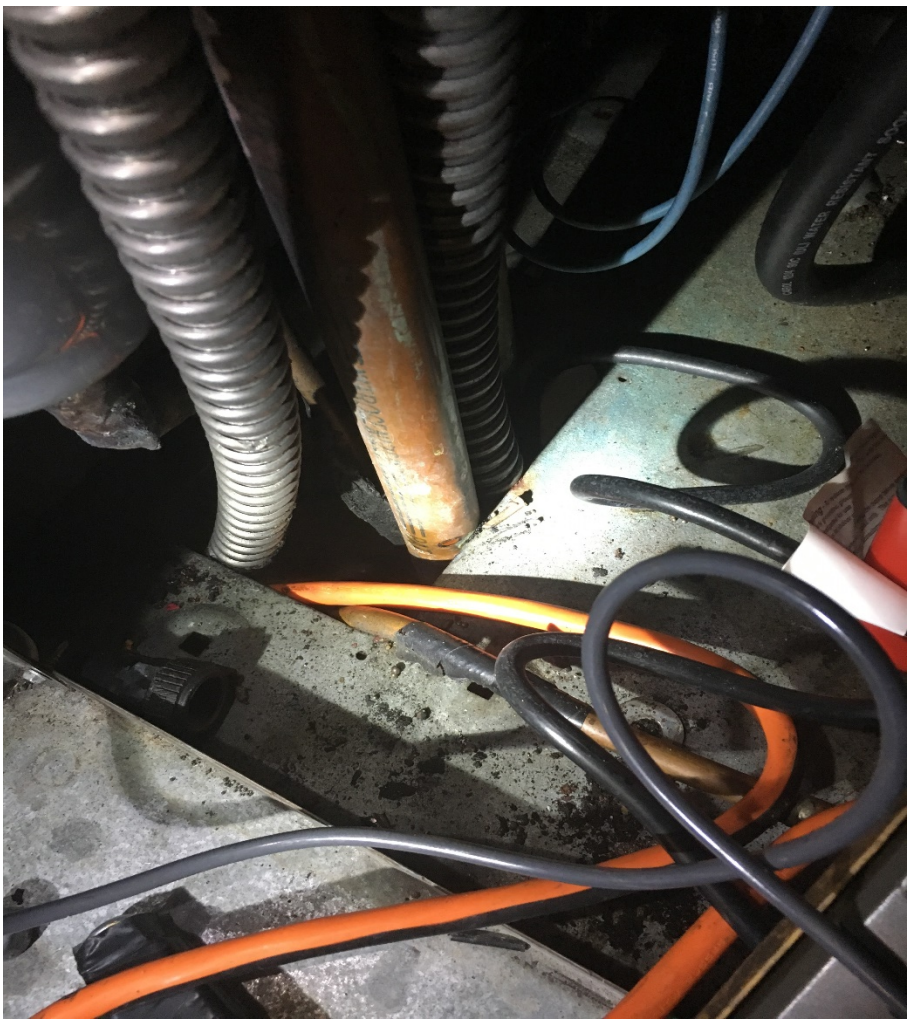
- Fan safety switch operation
- Current draw on each phase of the blower motor
- Current draw on the reheat coils
- Condensate pump and drain lines
- IR humidifier for amp draw, float switch operation, pan drain clogs, lamps, mineral deposits, and water make-up (note that the humidifiers were none functional)
- Fuses, all electrical terminals and connections, contactors for pitting, and thermal imaging
- Compressor current draw on each phase, compressor oil level, low pressure cut out switch operation, superheat, sub-cooling, suction pressure, discharge pressure
- The condition of lines internal and external of the air handler

This extensive check is very effective at pinpointing future points of failure and averages around one hour per air handler unit.

E.O.C. DATA CENTER AUDIT Section 2

The audit uncovered several issues at all of the sites reviewed, some more pressing than others. Below in each section is a bullet list of the most critically deficient and/or potentially impactful:

- Main CRAC (APC unit) not operating to capacity due to refrigeration issues & possible airflow design
- Refrigerant & water lines not supported correctly being damaged by sheet metal cutting into line
- No water detection installed at site to prevent against water leaks
- Makeshift hot-gas bypass valve installed being power by extension cord
- Roof top condenser without control wires routed to unit. Unit running all the time
- Refrigerant piping not correct per. Manufacture design installation specs
- Most batteries for UPS system over 5 years in age
- Clean agent fire suppression likely not size for space redesign correctly
- Room not properly sealed for controlling proper humidity or clean agent gas
- Estimated cost of repairs for items found during review. $126,000.00
- Estimated cost of yearly maintenance for Fire system, UPS, Batteries, Cooling $9,600.00



Unsupported hot-gas & water make up line for APC unit. The lines are in contact with sharp edge of sheet metal and are subject to rub-through. Mechanical stress is also on the joints from sagging. Also note the lack of insulation on the hot-gas lines.

This valve was added to the unit. It directly bypasses hot gas to the suction line drier at all times due to design.

1. The unit appears to have had several major repairs made to it over its short operational life. The workmanship is clearly substandard and will cause further damage to system. Due to the cool, turbulent air and high conductivity of the copper, the temperature of the hot gas lines are dropping about 30° F. The amount of heat added back to the room should not be underestimated.

PUBLIC WORKS DATA CENTER AUDIT Section 3

Below in each section is a bullet list of the most critically deficient and/or potentially impactful:

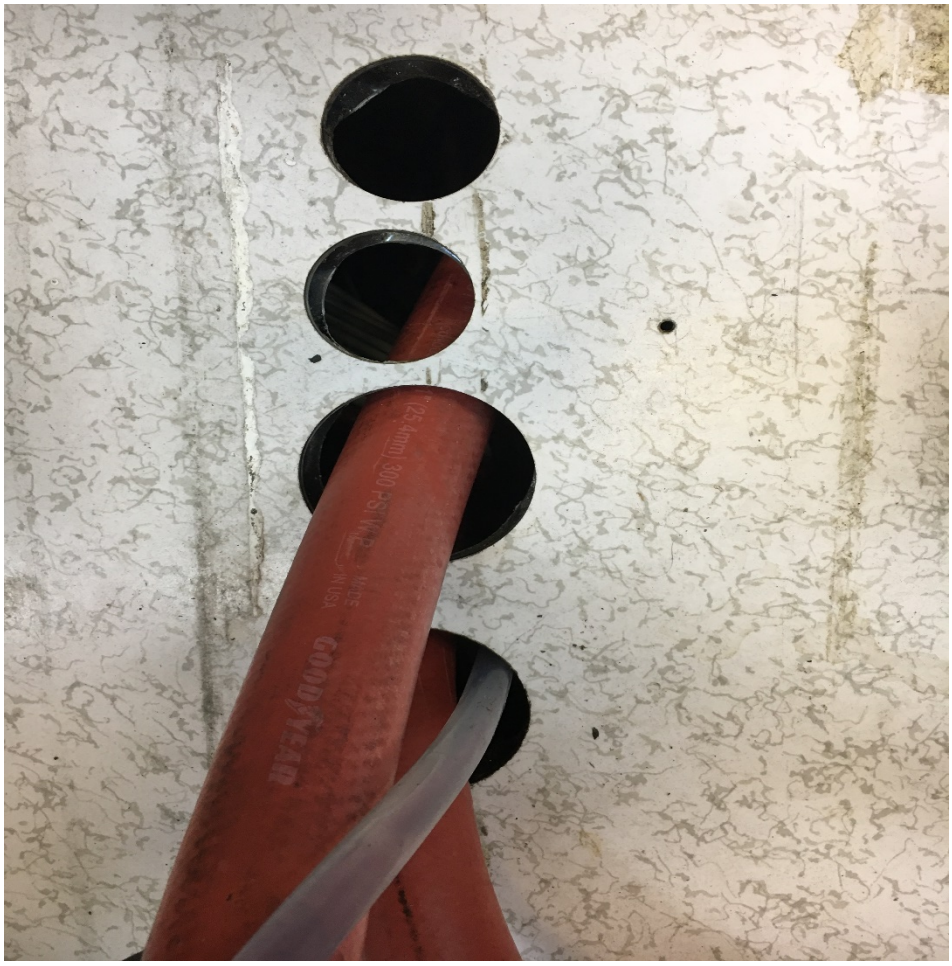
- Stulz unit leaking oil from circuit #2 TEV. Both circuits appear to be low on charge
- Condenser fan motor with bad bearings
- Condenser coil badly corroded greatly limiting heat removal capacity
- No water protection on site
- Site doesn't have fire protection
- Refrigerant line chase not correctly designed. Flooded with water
- Estimated cost of repairs for items found during review. $189,000.00
- Estimated cost of yearly maintenance for Fire system, UPS, Batteries, Cooling $9,000.00

Stulz CRAC condensing unit coil badly corroded. View from bottom shows flaking fins that are typical in 10+ year old condensing units in humid environments.

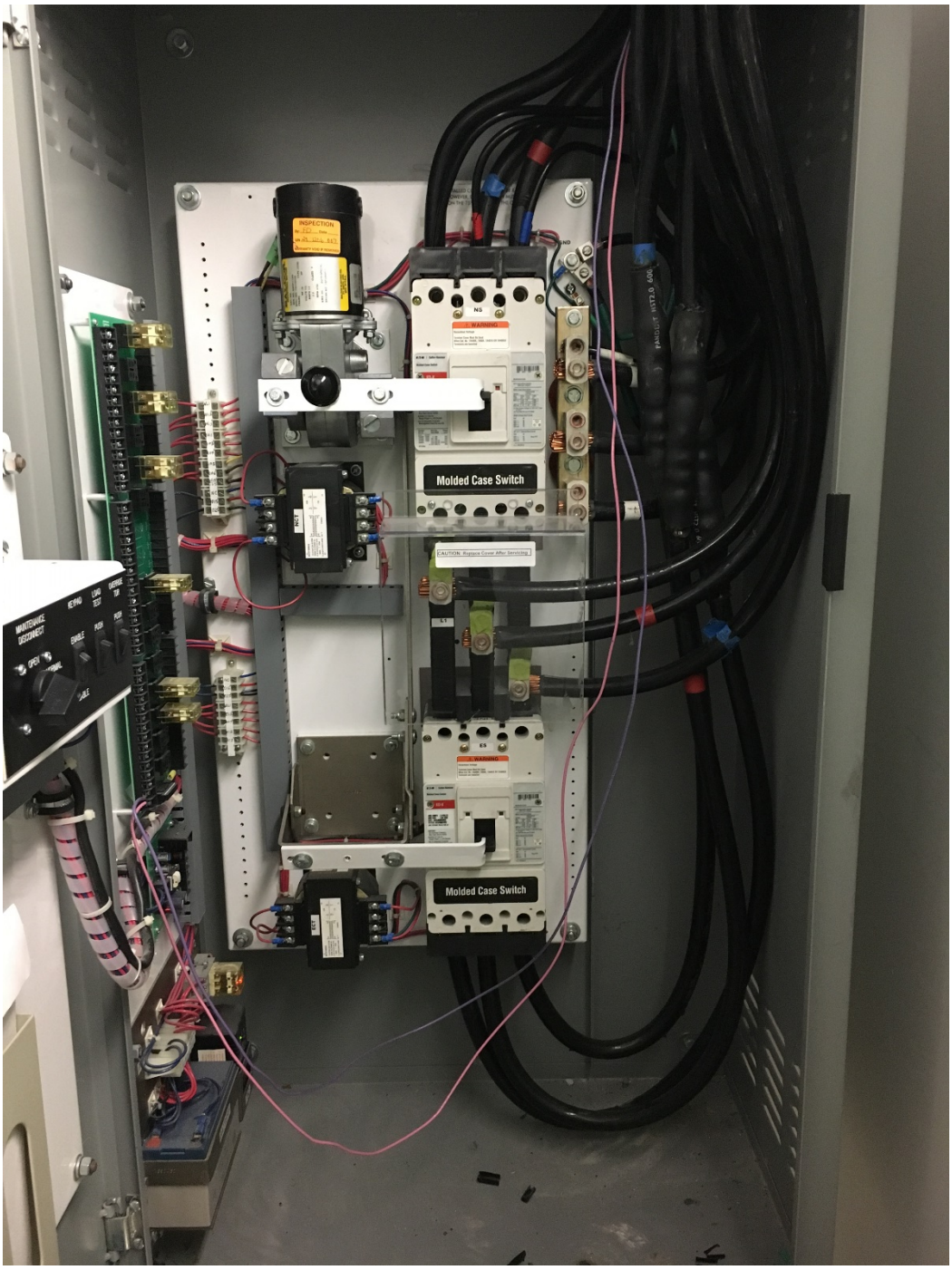
CITY HALL DATA CENTER AUDIT Section 4

Below in each section is a bullet list of the most critically deficient and/or potentially impactful:

- Data Center unprotected against fire currently
- All rooftop dry-coolers in disrepair
- 2 of 5 systems connected to cooling tower open loop
- All flexible water lines installed with newer Bosh A/C units being cut by floor tile openings. When one of these lines ruptures, it will continue to pump water into data center until cooling tower is emptied.
- Generator control wiring run inside high voltage conduit
- Estimated cost of repairs for items found during review. $445,000.00
- Estimated cost of yearly maintenance for Fire system, UPS, Batteries, Cooling $21,000.00



Flexible water lines being cut by sharp edges of floor tiles.



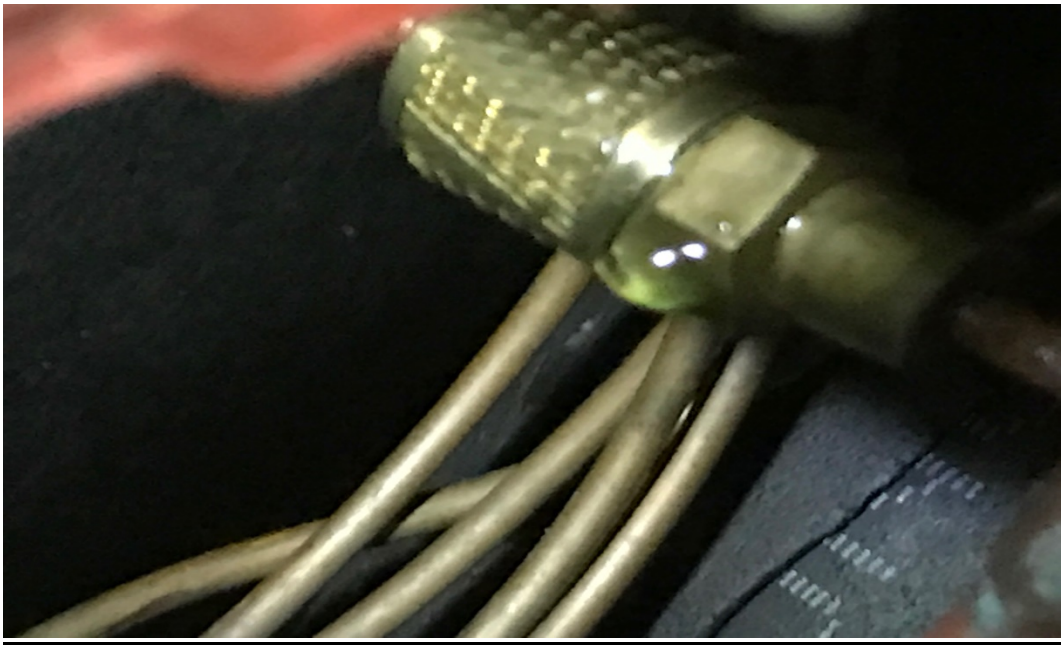
Pink and purple control wires routed inside high voltage conduit.

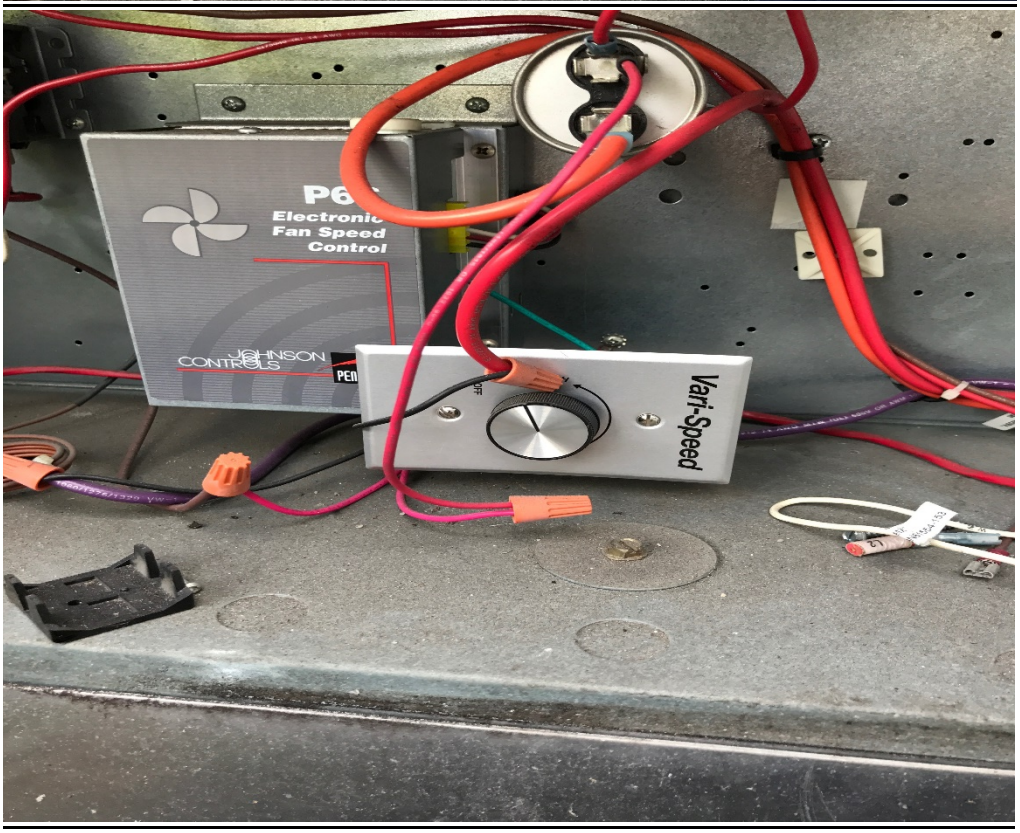
Dry-coolers bypassed and connected to cooling tower open loop.

POLICE DEPARTMENT DATA CENTER AUDIT Section 5

Below in each section is a bullet list of the most critically deficient and/or potentially impactful:

- Data Center unprotected against fire currently
- Airflow of room is extremely inefficient. Some racks exhausting air into same space as intake of others
- CRAC unit not operating to capacity due to refrigerant leaks
- Refrigerant lines not supported correctly
- Condenser extremely dirty and degraded cutting heat rejection capacity
- Condenser fan speed control bypassed with electrical rheostat
- Estimated cost of repairs for items found during review. $197,000.00
- Estimated cost of yearly maintenance for Fire system, UPS, Batteries, Cooling $10,500.00




Fan Speed
Control
JOHNSON
CONTROLS
Vari-Speed

CONCLUSION AND RECOMMENDATIONS Section 6

The goal of this report is to bring to light deficiencies with the data centers so that corrective action can be taken. This section explains several deficiencies that represent the largest risks found during free audit. There are several issues which are listed in the recommended order that they should be addressed. This order is determined based on how serious the issue is.

1. EOC center: the most pressing issues found are with the APC cooling equipment. The unit is not operating as designed due to leaks and field modifications made. Refrigerant piping is lacking necessary oil traps per design and condenser doesn't have low voltage control wireing interconnecting with air handler. Also, airflow design may be deficient to minimum requirements. The modification to space volume and lack of room being sealed will result in clean agent fire suppression being ineffective.
2. Public Works building: the most impactful issues is the Stulz CRAC. Unit is leaking refrigerant, condenser is badly degraded and piping is not designed correctly. This site is also without fire protection.
3. City Hall data center: The legacy cooling equipment at this site is degraded to the point of being inoperable. 2 of the 5-rooftop dry-coolers are bypassed and connected to cooling tower's open loop. This will likely clog the condensers of newer Bosh units very soon. The flexible piping

connected to the Bosh units is a serious risk to water damage and flooding inside building. This site has fire system disabled leaving room at risk of fire. The control wiring to generator is run inside high voltage piping. This will induce voltage in control wiring and cause issues.

4. Police department: This site has several airflow issues that limit the capacity of both CRAC units in space to effectively cool. Most supply air is directed into the hot aisle. Some racks are discharging air into cold aisle. The condenser for the Liebert equipment is extremely dirty and degraded. The refrigerant lines are not properly supported outside. The controls are bypassed to control low ambient operation. This site is without fire protection.

CONCLUSION AND RECOMMENDATIONS

After reviewing 4 data center sites, it has been found that there are several issues at all sites, some taking precedence, that should be addressed. All the sites are without correctly functioning fire system and any form of water detection. The sites are in substandard condition in contrast to industry standards. A short term and long term goal is being developed currently by the city of Ft. Lauderdale. After which Keystone CSA can provide specific quotes the best solutions moving forward.

In addition to the corrective measures, it is recommended that a water detection system be installed for each CRAC unit in the data center. Water is the #2 leading cause of loss of critical bus in data centers. If a condensate pump overflows in the floor, or condenser water line ruptures. There can be very costly and serious consequences.

Keystone CSA currently works with several local area government facilities and can help with budgetary issues unique to the industry. It is our goal to bring the data center(s) to a level that will drastically reduce the cost of operation while simultaneously increasing reliability. Fortunately, some of the pressing issues can be remedied at a relatively lost cost, especially when compared to emanate future failures.