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IMCOM-Southeast Region: Fort Gordon Retuning Workshop

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September 2010

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Pacific Northwest National Laboratory
Richland, Washington 99352

Executive Summary

PNNL staff held the Building Retuning workshop at Fort Gordon, Georgia, July 27-29, 2010. The workshop consisted of 1 day of classroom training and 2 days of hands-on training. Seven staff members from the Directorate of Public Works' (DPW) energy management office and the base maintenance contractor attended the workshop. The central goal of the class is to examine current heating, ventilation, and air conditioning (HVAC) operations and to present no- and low-cost energy-saving ideas that can be incorporated on a daily basis to improve both energy efficiency and operations. The general findings and recommendations are presented below.

The building automation system at Fort Gordon requires a point-by-point update to ensure that the control system is displaying the information and controls that are available in the buildings. The air and water flows in all of the buildings should be retested and balanced to improve the reliability of the building automation system. Smaller buildings can be added to the control system and setback periods implemented.

General maintenance of the HVAC equipment is lacking. During the training, PNNL staff noticed that coils were dirty, fan belts were missing or loose, condensate pans and/or floor drains were plugged and full of water (which adds more humidity to the building), and damper actuators were disconnected or wired open. Damper actuators that are deliberately disconnected either introduce 100% outside air (which wastes energy) or 100% return air (which impacts indoor air quality).

The best control systems will not benefit Fort Gordon without proper maintenance in the facilities. Although the team identified some issues with the control system, the majority of problems reflect inadequate equipment maintenance. Fort Gordon can benefit immensely by working to reverse the current maintenance culture on post.

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Description of ARRA program

On February 13, 2009, Congress passed the American Recovery and Reinvestment Act (ARRA) of 2009 at the urging of President Obama, who signed it into law 4 days later. A direct response to the economic crisis, the Recovery Act has three immediate goals:

- Create new jobs and save existing ones
- Spur economic activity and invest in long-term growth
- Foster unprecedented levels of accountability and transparency in government spending.[1]

The Installation Management Command, Southeast Region (IMCOM-Southeast) submitted three proposed projects for ARRA funding, offering 50% co-funding on each task. The Region was awarded the following projects:

- Building Retuning Training
    - Fort Gordon Retuning Training (IMCOM-funded)
    - Redstone Arsenal Retuning Training (ARRA-funded)
- Renewable Energy Assessment
    - Fort Gordon (ARRA-funded)
    - Installation TBD (IMCOM-funded)
- Solar Hot Water
    - Installation of metering equipment on nine buildings at Fort Campbell to study hot water usage patterns (IMCOM-funded)
    - Solar hot water system analysis and forecasting (ARRA-funded).

This report documents the findings from the Building Retuning Training workshop at Fort Gordon, Georgia.

[1] Source: http://www.recovery.gov/

Background

The IMCOM mission is to provide the Army with the installation capabilities and services to support expeditionary operations in a time of persistent conflict, and to provide a quality of life for soldiers and families commensurate with their service. [2]

The Southeast Region is responsible for delivering all facets of installation support including care of soldiers and families; morale welfare and recreation; education services, food and laundry; religious support; force protection; fire and emergency services; public works; environmental; residential housing; and execution of Department of Defense (DoD) base realignment.

IMCOM-Southeast, which was activated October 1st, 2002, uses a host of innovative business practices, such as common levels of support, competitive sourcing, and a business improvement methodology that maximizes shareholder value by achieving the fastest rate of improvement in customer satisfaction, cost, quality, process speed, and invested capital to effectively manage Army installations.

The IMCOM-Southeast team includes Anniston Army Depot, Blue Grass Army Depot, Fort Benning, Fort Bragg, Fort Buchanan, Fort Campbell, Fort Gordon, Fort Jackson, Fort Knox, Fort McPherson, Fort Polk, Fort Rucker, Fort Stewart, Holston Army Ammunition Plant, Milan Army Ammunition Plant, Mississippi Army Ammunition Plant, Military Ocean Terminal (MOT) Sunny Point, Pine Bluff Arsenal, Redstone Arsenal, and US Army Garrison, Miami (see Figure 1).

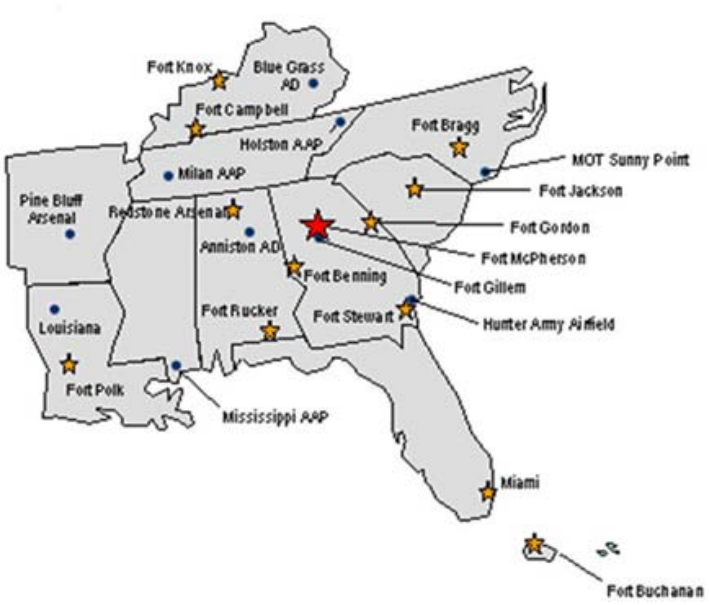

Figure 1. IMCOM-Southeast Installations

[2] Source: IMCOM HQ Website. http://www.imcom.army.mil/hq/about/mission/

The Region supports the senior commander for each installation by relieving him or her of the requirement to oversee day-to-day garrison operations. The Region exercises installation management, provides for public safety, provides for sound stewardship of resources, executes community and family support services and programs, and maintains and improves installation infrastructure.

IMCOM-Southeast is one of six regions under the Installation Management Command, which is headquartered at Arlington, Virginia. IMCOM was first organized as the Installation Management Agency in 2002. In 2006, IMCOM was activated as a three-star command that includes the former Installation Management Agency, the former Community and Family Support Center and the Former Army Environmental Center under a single command as a direct reporting unit.[3]

[3] Source: IMCOM-Southeast website. http://www.imcom.army.mil/regions/southeast/about/history/.

Task Description: Building Retuning Training

Periodic retuning of building controls and heating, ventilation and air conditioning (HVAC) systems can help eliminate operation faults and improves building efficiency. *Retuning is a systematic, semi-automated process of detecting, diagnosing, and correcting operational problems with building systems and their controls*. The retuning process can significantly increase energy efficiency at low or no cost – and the impact is immediate. Unlike the traditional retro-commissioning approach, which has a broader scope, retuning primarily targets HVAC systems and their controls. In addition, retuning uses monitored data, when available, to assess building operations even before conducting a building walk through.

Pacific Northwest National Laboratory's (PNNL) developed a building retuning and retro-commissioning course for the State of Washington (http://buildingefficiency.labworks.org/lg_bldg_training.stm). Since its development, it has been expanded and customized for other government organizations and private corporations. The course is targeted at operations and maintenance (O&M) staff, HVAC technicians, controls specialists, and energy management staff. After completing the course, the participants are asked to continue the process on their own, retuning additional buildings and reporting the results back to the instructors. The idea is to train the people who can affect real change at an installation rather than always bringing in outside "experts" to retune buildings.

Site Description

Fort Gordon, located near Augusta, Georgia, is home to the U.S. Army Signal Corps, Signal Center, and Provost Marshall General School. Fort Gordon covers 56,000 acres and has a work force of 4,600 civilians and more than 12,000 soldiers.

Classroom and field training was held at Fort Gordon in Augusta, Georgia the week of July 27-29, 2010. Seven staff members from the Directorate of Public Works' (DPW) energy management office and the base maintenance contractor attended the workshop. The central goal of the class is to examine current HVAC operations and to present no- and low-cost energy-saving ideas that can be incorporated on a daily basis to improve both energy efficiency and operations.

Building-Specific Findings

The retuning team and class participants evaluated control systems in several buildings on post during the hands-on portion of the workshop. Specific results in those building are presented below, followed by a summary of general findings and recommendations.

DARLING HALL 33720

Outside Walk Down:

- The team found several second floor windows open during the morning walk down (see Figure 2). Occupants complained that they were cold, which indicates better space temperature control is needed.

Figure 2. Open windows at Darling Hall

- There are many outside doors that open into the main lobby. Facility staff should look into installing vestibules or air curtains into the main lobby area to stop the waste of conditioned air and outside air infiltration.

- On the southwest side of the building, there is a set of double doors that opens into the main lobby (Figure 3). The door has an automatic sensor that opens the door as people approach. Although only one person approached the door, both double doors opened into the lobby instead of one. The door sensor is very sensitive to movement in the inside hallway, opening both double doors when someone passes by in the hall. Site staff should eliminate both double doors from opening at the same time and adjust the door sensitivity to stop nuisance door opening to the outside.

Alternatively, handicapped door assist buttons could be added to provide automatic door function only when needed.

Figure 3. Double automatic doors on Darling Hall

Building Inside Walk Down:

- The main lobby has a lot of glass, and it is well lit for the current use. Either provide accessible light switches so that staff can turn off lobby lights on sunny days, or install lighting controls that will dim or turn off lighting as needed.

- The team found two variable air volume (VAV) thermostats for the lobby (VAV-02-21 and VAV-02-20) mounted at the east entrance doors and on the outside wall (see Figure 4). These should be moved away from the door and off of the outside wall so that they accurately measure the indoor air temperature.

Figure 4. VAV Thermostats located near exterior door.

- The team noted numerous complaints on the second floor east offices that the space temperature was too hot. The team found that the VAV supply air registers were supplying reduced flow because additional air filters had been installed in the diffusers. As a test, the team removed a few of the filters, which resulted in an increase in the air flow. The filters were reinstalled later because the internally-lined duct insulation was coming loose and being blown on the occupant's desks. This was traced all the way back to the main supply fan for this zone. This is a serious performance and health problem that needs to be addressed. Each VAV box and reheat coil should be checked for obstructions.
- In the first floor east mechanical room, the team found supply and return dampers with the damper actuators disconnected and wired open (see Figure 5).

Figure 5. Dampers disconnected and wired open

- In the second floor east mechanical room, the team again found supply and return dampers with the damper actuators disconnected and wired open. Supply fan belts were loose and need to be adjusted. The team noticed that the outdoor air and return air damper actuators had their pneumatic control signal disconnected, which defaults the damper position to 100% return air. This condition can have a very serious impact in indoor air quality. The static pressures probe for the variable frequency drive (VFD) control is installed only about 5 feet from the discharge of the supply fan. The probe should be moved further down the duct for proper static pressure control. The team also found the dirty coils, a partially plugged fan squirrel cage, and ducts that were full of insulation.

- In the third floor east mechanical room, the team found loose supply fan belts and grooved motor sheaves that should be replaced. The team also found dirty coils, a partially plugged fan squirrel cage, and ducts that were full of insulation. The chilled water drain pan was full of water because the drain line was plugged. Excess water in the drain pan will cause extra humidity to be introduced into the supply air.

- In the first floor west mechanical room, the chilled water drain pan was also full of water from a plugged drain line. Again, this condition will increase the humidity in the supply air. The controls on the outdoor and return air damper actuators had been disconnected, which defaults the dampers to 100% return air. This condition can have a very serious impact on indoor air quality. The damper linkage between the two actuators is loose, which is causing the shaft to slip on the clamp. Site

staff need to verify the actual static pressure for this system. The pressure gauge in the field showed a pressure of 1.0 in., while the front end control screen showed 1.5 in. Depending on which measurement is accurate, the control system may be running the fan slower than it should, which could explain the lack of air flow.

- In the second floor west mechanical room, the air handler is very noisy. The team found that the outdoor air and return air actuators are linked together, but only one damper has control air hooked to it. Like the other air handling units (AHUs), the team found that the linkage was loose, causing the shaft to slip on the clamp. Site staff need to either remove the linkage between the two actuators and supply the same control signal to both actuators or remove one of the actuators and leave them hooked together. This AHU is set up for 100% return air because of the slipping on the damper shaft (see Figure 6).

Figure 6. Disconnected damper actuators

- In the third floor west mechanical room, the team found more damper actuators that were disconnected and wired open. The outdoor air and return air actuators had their control air disconnected, which results in 100% return air. Again, this condition can have a very serious impact in indoor air quality. The damper linkage between the two actuators was again coming loose, causing the shaft to slip on the clamp. The relief damper actuator was loose on the damper shaft causing it to slip.

- In general, this building needs maintenance done on all AHUs. Coils need to be cleaned, squirrel cages need to be cleaned, damper actuators need to be set up properly, ducts and VAV boxes should be inspected and

cleaned as needed to ensure the design air flow is achieved. The whole system needs a building test and air balance.

SALTZMAN HALL 29811

Outside Walk Down:

- The team found all windows and doors were-single pane glass or Plexiglas (see Figure 7). This facility has a substantial amount of square footage in glass. These should be replaced with newer energy-efficient windows and doors.

Figure 7. Saltzman Hall Exterior

- Noticed a few open doors and windows. These need to be kept closed while cooling equipment is operating.
- Found cold air (65° to 68°F) coming out from underneath the crawl space through the vents. This indicates that ducts are leaking into the crawl space and should be repaired.
- The team observed that one of the east inline return fans was making a lot of noise, but the team could not access them to determine which one.

West Mechanical Room Walk down:

- The floor drain is plugged, which floods the floor and introduces extra humidity into the building.

- The AHUs old outdoor air dampers are rusted and do not close all the way. This is causing extra outdoor air to be brought into the AHU. The extra outdoor air needs to be conditioned, causing an increase in energy use.

- In the south AHU (either #1 or #2), the motor was very noisy.

- The chilled water pump VFD differential pressure sensor was hooked across the inlet and outlet of the chilled water pump. This pressure sensor needs to be located farther away from the pump to get a more steady and constant reading. Under the current conditions, the VFD may be continuously "hunting" for the desired set point because of fluctuations in the pressure sensor.

- The team found a broken coupling for an inline pump, likely a perimeter hydronic heating pump for baseboards. This needs to be repaired.

East Mechanical Room Walk down:

- The east mechanical room has the same problems as previously noted for the west mechanical room.

- On AHU #4, the drain pan was plugged, and water was leaking out of panels onto the floor. The fan belts were loose and the outdoor air dampers were not all closed.

- The return fan for AHU #4 was not running. To compensate, the supply fan VFD runs at full load to move the same amount of air. The VFD was calling for 59.8% and still may not be moving as much air as is needed.

- Of the three fan belts on AHU #3, one was missing, one was very loose, and the other was doing all of the work.

MOTORCYCLE TRAINING 11307

- This building was used for the classroom portion of the retuning workshop. The building was being overcooled, and it was in constant operation mode with no temperature setback. There were two thermostats, one for each air-conditioning unit. Both thermostats were set at 69°F. Although this building is not on the site direct digital control (DDC) system, the site needs to start adding additional buildings like this one to the DDC system. By simply controlling thermostat set points and introducing setback periods, the site could save significant amounts of energy in these smaller facilities. In the meantime, remove the old thermostats and install

programmable thermostats to shut these systems down at night and on weekends.

General Field Findings

Building Automation System:

- Most of the equipment is running 5 days a week and 24 hours a day. There appears to be a weekend schedule in place to turn off the HVAC equipment. All the graphics and data points that are mapped to the building automation system need to be updated. An up-to-date data and control point list will help with troubleshooting and give the operator the ability to better assess the equipment performance. The control system interface for many buildings was missing basic control points like fan start-stop commands and variable frequency drive speed readings. All of the buildings could use a retest and balance of the air and water flows to improve the reliability of the building automation system and to ensure that it is working correctly.

Mechanical Rooms and Equipment Maintenance:

- General maintenance of the HVAC equipment is not being performed adequately. General housekeeping issues include: dirty coils, missing or loose fan belts, plugged condensate pans that were full of water (which adds more humidity to the building), disconnected or wired open damper actuators, dirty blower wheels, and loose damper blades that do not close all of the way (introducing excessive amounts of outside air). All of these items are part of the general maintenance of HVAC equipment.

Building HVAC equipment:

- Address the lack of general maintenance that is needed for proper operation of HVAC equipment in the buildings at Fort Gordon. PNNL staff recommend systematically selecting large facilities and implement the low-cost/no-cost measures that were discussed in the class. It is recommended that a small team, consisting of an engineer, energy manager and technician work as a group to implement measures and measure results. With no building meters in place, the ability to quantify savings from each of these recommendations is not possible at this time. After a couple of facilities have been completed, this template could then be used in many other facilities. The first measure to address would be the use of occupied modes. Fort Gordon has started addressing this, and it appears that most of their systems can be set back. A control scheme that looks at night temperatures and maybe humidity would allow the air handlers to be turned off for a significant period of time each day. It is

also recommended to close all outside air makeup systems and leave exhaust fans off during morning warm-up and high/low limit night/weekend operations. It is recommended that a supply air reset schedule be added as the next phase of the retuning process. It should be noted that many buildings had windows open during the heat of the day; this would suggest that the occupants were cold and that there is no type of temperature reset in place that is measuring and assessing the temperature inside these zones.

Central Plant Equipment:

Fort Gordon should move away from operating the equipment in the central plant by hand or in manual modes. Instead, use the building automation system that is installed and ready to operate the central plant. This will allow the building automation system to run the central plant based on the needs inside of the buildings, rather than running at a constant set point regardless of actual loads and building needs.

Conclusions

The best controls systems will have no effect without proper maintenance of HVAC systems in these facilities. The majority of issues found in these buildings can be attributed directly to a lack of proper maintenance. This assessment did identify control system issues that can be addressed– an inconsistent DDC system interface screen, broken or poorly located sensors, and a lack of control on smaller buildings. In the buildings visited, however, the maintenance issues are the most important concern -- insulation in ductwork, disconnected actuators, plugged drains, and belt issues should all be addressed. Fort Gordon can benefit immensely by working to reverse the current maintenance culture on post.

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