

CaseStudy: The Pentagon

Washington D.C.

Securing Our Nation's Defense



The Pentagon, the largest low-rise office building in the world, was constructed during World War II to serve our nation's wartime administrative needs. The building is part of the federal government's ongoing effort to increase employee productivity and operational efficiency, reduce energy consumption, and modernize outdated equipment. In addition, terrorist incidents in 2001 meant a shift in priorities to ensure security for these 23,000 employees who are dedicated to our nation's defense. Johnson Controls is involved in the Pentagon's 20-year, \$1.2 billion renovation project – from early design to daily operations – to make certain it is a safe, efficient and productive place.

Renovation is being completed in phases, one "wedge" at a time, while ensuring all building systems such as; security, fire, safety, lighting, mechanical, electrical, HVAC and utilities are maintained with minimal employee disruption. Perhaps most challenging is integrating these diverse systems into one that will improve management, support mission-critical functions, have no single point of failure, last for decades – and be cost-effective. Additionally, the Pentagon needed to control its \$1.1 million monthly electric bill for the 6.6 million-square-foot building.

Command Central

Achieving these multiple goals required development of a Building Operations Control Center (BOCC). The Pentagon contracted Johnson Controls through the U.S. Army Corps of Engineers Engineering and Support Center Worldwide Utility Monitoring Control System (UMCS) contract. Johnson Controls was responsible for design, engineering, commissioning, furniture, consoles, audiovisual systems and training for operators of the BOCC, which is now command central for every building system.

In the BOCC, Johnson Controls Metasys® building automation system provides a way to measure and manage environmental comfort, energy usage and lighting control. It responds to emergency conditions and optimizes operational strategies. The system shares data and sends commands to thousands of monitoring and control points. Through the BOCC, building managers know all systems are working effectively and are informed about security, indoor environmental quality, and operational efficiency.

Through Metasys, the Pentagon is able to plan and reduce energy use. Metasys also is connected to the Pentagon's photovoltaic solar array. It sends information about the amount of electricity being generated from the cells to a large billboard demonstrating to the community the Pentagon's environmental commitment. The system provides monitoring and control of electrical service and distribution systems, including a cable management system, emergency lighting, fire protection, un-interruptible power supplies and emergency sprinkler system.

Johnson Controls also is helping replace antiquated internal building systems to bring the Pentagon up to current building, fire protection and life safety codes, and accessibility standards. The renovation work involves the demolition and removal of all partitions, ceilings, floor finishes, mechanical, electrical, plumbing, fire protection, and communications systems.

Saving Lives in a Crisis

The BOCC is intended to help the Pentagon operate more efficiently and increase employee productivity, but through the unfortunate events of September 11, 2001, it also is being cited as helping save lives. After the plane struck the World Trade Center, Steve Carter, liaison to the Pentagon Renovation Program, and his team began lockdowns, securing mechanical and electrical areas, and searching for unauthorized people and unusual packages.

Minutes later, when the Pentagon was attacked, the fire alarm and HVAC systems completely lit the BOCC's monitor screens, indicating fire in the newly completed wedge. Fortunately, the renovated areas were not fully occupied, greatly reducing casualties.

Johnson Controls employees immediately went to the BOCC and used the system to control air pressure in different parts of the building, get system fans running, and determine where equipment was down. This helped contain the fire and minimize the spread of smoke. "You can't imagine how important it was to have a programmer on hand to make all of this happen automatically," recalls Carter. "The Johnson Controls employees were invaluable."

"The systems we put in place were instrumental in getting smoke out and keeping the fire contained," explains Carter. "In a matter of hours, we took systems that were installed to save energy and improve indoor environments and used them to provide air barriers. This stopped smoke infiltration, minimized the spread of damage, and most importantly, potentially saved lives. If there is a silver lining in this very dark cloud, it's that the experience gained will provide us with a system second to none."

Team Efforts

For the next several weeks, the Johnson Controls team worked 12-hour days, setting up a remote monitoring site, going through the entire building to monitor equipment, opening and closing air dampers as



Skylights in the Wedge 1 cafeteria provide natural daylight to Pentagon employees.

"Because the building was hit in one of the renovated areas, as opposed to a wing that hadn't yet been worked on, I think it's safe to say we did survive it better because of the features that were added as part of the renovation."

John F. Irby
Director of Federal Facilities Division
Pentagon



During the demolition and abatement program, everything was removed from Wedge 1, with 70% of the 83 million pounds of debris recycled.

necessary, and pumping fresh air into occupied areas. Their efforts helped keep 4.5 million square feet operational while the fire continued to burn in 1 million square feet of the building. The day after the incident, many Pentagon employees could go back to work. Key military command centers remained in the building and did not have to relocate to other sites. "Our response began with the basic philosophy of Johnson Controls. We are totally integrated with our customers," says Rohollah Mahboobi, Johnson Controls Pentagon site manager. "We believe: One building, one system, one team."



The Building Operations Command Center (BOCC) is a sophisticated, wall-to-wall monitoring system with around-the-clock personnel overseeing all building functions.

Proceeding According to Schedule

The overall renovation is proceeding according to schedule, and Johnson Controls is a major solutions provider in several realms.

"We are enormously pleased with the work that has been accomplished thus far," says Carter. "We've assembled a highly professional and dedicated team of designers, engineers, contractors and support staff for this historic and comprehensive renovation of the Pentagon, and their work exemplifies extraordinary efforts."

Incorporating Green Design

Through all the high-tech improvements, the Pentagon Renovation Program is focused on sustainability and environmental processes. By incorporating the U.S. Green Building Council's Leadership and Energy in Environmental Design (LEED) program into its projects, the Pentagon is realizing multiple benefits.

"Number one, it's the right thing to do, and number two, it can save us money in the long run," says Theresa Pohlmann, special assistant for sustainable construction for the Pentagon Renovation Program. "Some of the thinking in the construction business is that the environmentally safe and sound practices have to cost more. Well, they don't have to cost more, but in many cases they can make construction easier, smarter and faster."

Johnson Controls continues to assist in renovating each wedge by upgrading the indoor air quality, providing energy-efficient lighting and improving the building envelope. The reconfiguration is providing modern, flexible, open office space, readily adaptable to accommodate future organizational changes and technological advances in office equipment, work space environments, and building energy management and control systems.



FBI Agents, firefighters, rescue workers and engineers work at the Pentagon crash site.

The BOCC provides:

- Central Monitoring
- Life Safety Smoke Control
- Fire Alarm Detection
- Fire Evacuation System
- Fire Sprinkler System
- Gas Detection System
- Water Leak Detection System
- HVAC Control
- Access Control
- Lighting Controls
- Room Temperature and Humidity Control
- Custom reports
- Integration to the Metasys System
- Power Monitoring
- Electrical metering

As a result of these improvements, American taxpayers will save money through efficient operations and controlled energy use. And the thousands of Pentagon employees know that they are going to work in a safe and comfortable facility.

"It's not just a contract to the Johnson Controls Pentagon field office," Carter says. "They're a committed team that feels as much ownership of our place as we do – they're really quite amazing. I would have hated to try to go through this event without their professional knowledge, technical abilities and personal commitment."

Pentagon Facts

Total Land Area: 583 acres
Area covered by Pentagon building: 29 acres
Parking space: 67 acres for 8,770 vehicles
Cost of building in 1941: \$49,600,000
Gross interior floor area: 6,636,360 sq. ft.
Employees: 23,000
Total length of corridors: 17.5 miles

Number of
Stairways: 131
Escalators: 19
Elevators: 13
Fire hose cabinets: 672
Rest Rooms: 284
Lighting fixtures: 16,240
Electrical Fixtures: 4,900
Drinking fountains: 691



Johnson Controls Pentagon team
First row: Season Hickcox, Dan Delgados, Rohollah Mahboobi, Behrooz Mahboobi, Stanley Carl Berry
Second row: Robert Andrews, Jarvis Cain, Chad Hensen, Mike Hallberg, Carols Alfaro, Stephen Bauman
Third row: Mike Ganskopp, Dave Nichols, Ed Decker, Kevin Hensen
(Not pictured: Tom Bray)

"We can't imagine having to struggle through the events of 9/11 without the Johnson Controls team. It's not just a contract to them. They're a committed team that feels as much ownership of our place as we do — they're really quite amazing."

Steve Carter
Liason to the Pentagon Renovation Program
