

SECDEF Environmental Award Nomination – Fiscal Year 2008

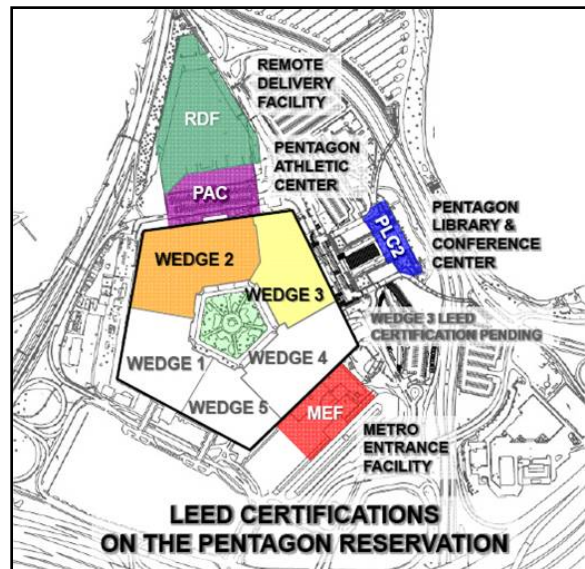
Pentagon Reservation - Pollution Prevention - Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management

Introduction

As a component of Washington Headquarters Services (WHS), the Pentagon Renovation and Construction Program Office (PENREN) is responsible for the design and construction of the Pentagon Renovation. The Pentagon had not undergone a major renovation since it was built in the 1940s, so bringing the facility into compliance with current building codes is the primary purpose of the project. Prior to work starting on the renovation of the Pentagon, none of the building systems met current building code, nor operated as effectively as needed to support the mission.

In 2001, PENREN developed design guidelines and performance criteria to manage the design process over a construction schedule that spans more than a decade. In the guidelines are sustainability performance criteria that were created to provide a healthy, comfortable and productive work space for occupants, and include targets for energy efficiency, environmentally preferable products and enhanced indoor environmental quality.

To date, PENREN has renovated more than three million square feet of the original Pentagon. PENREN has also completed four new major projects on the Reservation that include a secure materials-handling facility, a library & conference center, a new visitor's center at the Metro station, and an indoor athletic facility for the Pentagon's 25,000 occupants. These four projects, plus the Wedge 2 renovation, account for five LEED certifications and 1,642,000 SF of Department of Defense floor space. The U.S. Green Building Council (USGBC) is currently evaluating the Wedge 3 project, another 1,000,000 SF, for LEED® Certification, and PENREN will also be pursuing LEED Certification for 2,000,000 SF of the Pentagon that has yet to be renovated.



PENREN has made great strides in accomplishing many aspects of Executive Order 13423, including energy efficiency, water efficiency, environmentally preferable products, solid waste recycling, and sustainable design and construction.

Implementing sustainable design and construction

Sustainable design and construction practices have been integrated into the delivery process of all PENREN projects. Through this approach, PENREN has become a leader in implementing sustainability measures while balancing budget constraints, project schedule, life safety, operations & maintenance and security requirements. PENREN has successfully delivered high-performance facilities through early establishment of sustainability requirements and goals.

The Sustainability and Environment Integrated Product Team (SE IPT), established in 2001, serves as PENREN's champion for the advancement of sustainable design and construction. Monthly SE IPT meetings have provided a forum to connect sustainability intent with proven results, and update attendees on lessons learned, best practices, emerging technologies and green products. This forum was, and still is, essential for the successful delivery of high performance facilities on the Pentagon Reservation.

PENREN's sustainability on design-build projects starts with the Request for Proposal (RFP), which establishes specific criteria in the project's performance requirements. Key components of the RFP include Performance Criteria Matrices that identify functional requirements in the areas of accessibility, durability, flexibility, life cycle costs, maintainability, operability, redundancy, replaceability, and security, cross-referenced to systems and components that can impact that performance (e.g., ceilings, walls, floors, doors, windows, mechanical, electrical, plumbing and others).

PENREN's RFP structure is based around performance criteria to provide for flexibility in design and to allow the contractor to pursue the best solutions that meet project requirements and constraints. Through its significant experience, PENREN has adapted this RFP to influence project teams to use an integrated design process.

Keys to designing and constructing a building to support efficient operations:

- Provide easy access to HVAC systems for routine maintenance and repair activities.
- Coordinate the furniture layout with the design of other building systems such as ventilation and lighting systems.
- Reduce the need for harsh cleaning products through judicious design and use of environmentally friendly building materials.
- Reduce water usage by using low flow plumbing fixtures.
- Use native plant species in landscaping to help reduce the need for irrigation.

Criteria Attributes	System Type	Ceilings			Walls		Mechanical	Electrical	Plumb
		1	2	3	1	2			
Accessibility		X	X				X	X	X
Acoustics/ Sound Transmission		NRC 0.55	NRC 0.65	NRC 0.45	STC 45	STC 45	X	X	X
Durability		X	X	X	X	X	X	X	X
Energy Efficient							X	X	X
Existing-Equal Appearance									
Flexibility		X	X			X	X	X	X
Glare Control									
Life Cycle		X	X	X	X	X	X	X	X
Light Reflectivity		LR 0.80	LR 0.83	LR 0.78	LR 0.75	LR 0.75			
Maintainability		X	X	X	X	X	X	X	X

Figure 1. Sample excerpt of a Performance Criteria Matrix¹.

During the design phase of projects, PENREN reviews the construction documents and contractor’s proposed scheduling of the project to ensure sustainability requirements are being addressed. The scope of these reviews includes project specification and design drawings to ensure materials and components are being specified to help meet the performance criteria. The construction contractor’s schedule is reviewed to verify that highly absorptive materials, such as carpeting, are installed after potentially contaminating materials have completely cured or are removed from the space. This attention to schedule allows the contractor’s Indoor Air Quality (IAQ) measures to clear out any volatile organic compounds (VOCs) that may have been emitted from other products during installation.

In the construction phase, PENREN’s SE IPT actively monitors on-going job site activities with a focus on ensuring healthier indoor air quality. Performance areas for this include the construction IAQ management plan, the procurement of environmentally preferable materials and the protection of materials stored in the construction zone. The SE IPT observes the contractor’s efforts to incorporate sustainable materials and practices and provides feedback on a routine basis to help achieve a superior performing facility.

Solid waste diversion

PENREN has established a process for removing construction waste from the high-security Pentagon and hauling it to an area where contractors can screen and sort the construction waste for recyclables.

¹ From Dahl, Horman & Nielsen. (2007). “Transforming sustainable project delivery by establishing project design and management expectations in the request for proposals”, ASCE Construction Research Congress, May 6-8, Grand Bahama Island, The Bahamas.

To date, the Renovation and modernization of the Pentagon wedges has achieved a cumulative waste diversion rate of 59%. On the Wedge 2 project alone, 16,425 tons of materials were diverted from landfills, with much of it being recycled. 10,157 tons of the diverted material was concrete and masonry that could be reused on site as fill in other applications. More recently, the Pentagon Library and Conference Center project achieved a 76.5% waste diversion rate, establishing a new benchmark for PENREN projects.

In addition to the obvious benefits of reducing the amount of waste sent to landfills, the renovation of the Pentagon serves other environmental goals that are recognized in the LEED rating system's 'Building Reuse' credit. By reusing existing buildings, the life cycle of building stock is extended and material and cultural resources are conserved. When avoiding the construction of a complete new building, an even greater amount of waste is avoided and the negative environmental impacts related to the extraction, manufacture and transportation of new materials is greatly reduced. Additionally, utility system infrastructure to the building, such as electricity, steam, domestic water and sanitary lines, are already in place.

Green Purchasing

PENREN has green purchasing policies to establish preference for products that are bio-based, energy-efficient, water-efficient, and contain recycled-content material. PENREN has a strong record of procuring environmentally preferable products and has progressively increased the amount of "green" components and materials with each subsequent project. Products with recycled content material accounted for 24.7% (6.7% post-consumer and 18.0% pre-consumer) of the total material costs for the Wedge 2 project. For Wedge 3, products with recycled-

content material accounted for 32.0% (9.0% post-consumer and 23.0% pre-consumer) of the total cost of all products for this project.

Measurement and Verification (M&V) devices help operators:

- Troubleshoot O&M problems. Many building system deficiencies become manifest within a few years following installation - M&V data allow for diagnostics.
- Evaluate the performance of sustainable technology used on the project.
- Increase energy savings by utilizing electrical and mechanical building systems more effectively.

Contributing significantly to PENREN's increasing percentages of recycled-content materials are commonly used interior fit-out components such as acoustical ceiling tiles, gypsum wall board, metal doors, and metal wall studs.

Energy efficiency

Since 2003, total energy use on the Pentagon Reservation has increased only 6.67% despite modernizing 3,000,000 SF and constructing another 394,135 SF of new space, while greatly increasing information technology capabilities to support the mission.

The Renovation office space design for the Pentagon includes greater ceiling height along the exterior walls to allow for further daylight penetration, thereby reducing the demand for artificial lighting. The mechanical system includes Fan Powered Induction Units, which provide conditioned air to the offices more efficiently than a traditional HVAC system by reducing the amount of centralized air handling units required for the building. Also, building envelope performance was improved by incorporating higher efficiency exterior windows and sealing the building's shell. This helped minimize air infiltration, improve the insulation value of exterior walls and, consequently, decreased the heating and cooling loads.

Water efficiency

PENREN projects have included design measures to significantly reduce potable water demands for both plumbing fixtures and lawn irrigation systems.

The primary source of lawn irrigation water for the Pentagon Reservation is non-potable water drawn from the adjacent Potomac River lagoon. Significant water saving features included in designs are drip irrigation systems and evapotranspiration-based control systems. The 90% efficiency of a drip irrigation system is significantly greater than the 65% efficiency of a conventional above-ground irrigation system. The control system includes rain sensors and weather logic software, which enable precise water management.

PENREN's design-build team keeps abreast of advances in water conservation technologies and will incorporate higher-efficiency components where feasible.

Transferable Lessons Learned²

- Require that needed LEED documentation be included with shop drawing submittals or link progress payments to receipt of LEED documentation.
- Maintain emphasis on sustainability from design start through construction completion.
- Provide contractors, vendors, and suppliers with some degree of sustainable design and construction training to increase awareness/understanding about their roles and responsibilities for ensuring that sustainable requirements and goals of the project are met.
- Ensure design submittals satisfy the high-performance green building standards established by the design intent documents.
- Ensure proposed sustainable materials meet or exceed all performance requirements.

² Excerpted from Dahl, Nielsen, et al. (2006) "PENREN Handbook for Sustainability & Constructability". Pentagon Renovation and Construction Program & Penn State Lean & Green Research Initiative.

- Plan for the delivery of specific materials just when they are needed to help minimize the amount of landscaping disturbed by construction activities.
- Develop the design to help minimize the amount of construction waste generated on-site. Incorporate design strategies that allow for prefabrication of building components off-site.
- Establish and maintain a current working knowledge of sustainable practices and available green building materials.
- Salvage and reuse construction materials where feasible.
- Use locally manufactured materials that allow for easier reconfiguration of interior spaces, renovation, and deconstruction.
- Select fittings, fasteners, adhesives and sealants that allow for future deconstruction so that building materials can be salvaged and reused with little or no damage.
- Minimize piping and ductwork bends to help reduce material, installation and operating costs.
- Include sustainable design and construction items on weekly team meeting agendas to help ensure that the contractor is collecting and compiling documentation that will satisfy LEED criteria.
- To help ensure the adequacy of needed LEED documentation, establish a single folder for each LEED Credit, and within that folder have a section for each designer or contractor that has roles & responsibilities for achieving that specific credit.
- Use design and construction meetings, project records, memos and other project communication methods to reiterate and reinforce the high-performance, green building aspects of the project.
- Conduct periodic reviews of the design intent documents and in the normal course of design and construction meetings, reinforce the design intent statement.
- Improve construction safety by making on site contractors aware of the long-term effects on worker health from exposure to harmful building products and materials.

Summary

PENREN's success in resource efficiency, green procurement and solid waste diversion is directly attributable to PENREN's implementation of sustainable design and construction strategies. Balancing comfort, sustainability and building security requirements for the world's largest low-rise office building is not an easy job. To many people, these attributes may seem to conflict with one another. Yet sustainable construction creates synergistic solutions that benefit the environment, the economy, building occupants, and mission accomplishment. Implementing security measures would seem to complicate the equation, yet our leading teams continually identify synergies among these varied goals.

The Pentagon Renovation and Construction Program Office is committed to pursuing sustainability in every aspect of the Program. While the Program has already been frequently recognized for projects that have achieved LEED certification from the U.S. Green Building Council (USGBC), this is only the beginning. PENREN will continue to apply sustainable design strategies on all projects and pursue LEED certification on applicable projects. PENREN's SE IPT, in collaboration with their Defense Facilities Directorate counterparts, strive to keep Pentagon facilities at the forefront of integrated sustainable design, construction, and building operations & maintenance.