The U.S. Department of Defense Tests Metal Roof Technology Integrating Renewable Energy and Sustainability Features

According to Washington, D.C.-based Energy Star, there are 4.8 million existing commercial buildings in the U.S. and 40 percent of them were built prior to 1970, a time when energy efficiency was not the priority it is today. As a result, our nation has a large inventory of buildings that are poorly insulated and are using inefficient appliances, air-handling equipment, lighting and windows.

The new integrated roof system was installed over an 11,900-square-foot metal roof on a 10,000-square-foot Security Forces building at Goodfellow Air Force Base, San Angelo, Texas. The new metal-over-metal retrofit roof integrates cool roofing, solar-power generation, solar thermal, rainwater catchment and above-sheathing ventilation in one holistic system.
The good news is work has already begun on the use of new building technologies and systems to implement energy-efficient solutions to these buildings. In fact, a number of federal agencies and departments have stepped up their activities to set an example toward meeting new efficiency goals. Consider the following:

- Executive Order 13514 was signed by President Barack Obama in 2009 to seek lower greenhouse-gas emissions in federal buildings of 28 percent by 2020.
- The U.S. General Services Administration has established its high-performance building department to ensure all retrofit buildings feature sustainable design characteristics, including those that improve energy efficiency, optimize the use of potable water, manage storm-water runoff, and improve the interior comfort and air quality of the 500,000 buildings GSA oversees.
- The U.S. Department of Energy remains focused on research into more energy-efficient building products, technologies and systems, including retrofit applications. DOE’s Office of Energy Efficiency and Renewable Energy provides millions of dollars to improve materials, manufacturing processes and supply chains for photovoltaic systems used in retrofit applications.
- Even the U.S. Department of Defense, which is the world’s largest consumer of energy, is taking a leadership role in energy sustainability and retrofit solutions for the 2.4 billion square feet of buildings it operates. By installing a test retrofit project at Goodfellow Air Force Base, San Angelo, Texas, DoD is learning how today’s roofing technologies can enhance its energy-efficiency goals.

Through the use of the DoD Environmental Security Technologies Certification Program (ESTCP), the military is providing grants to industry to demonstrate commercially available and sustainable novel technologies, products and systems aimed at meeting DoD’s energy- and water-conservation goals.

One such ESTCP grant was awarded in 2010 to a team of metal construction-industry-leading companies and the Metal Construction Association, Glenview, Ill. The approximate $1 million grant is being used to demonstrate a retrofit metal roof system with integrated renewable energy technologies that showcase a holistic assembly of six different roofing system components. The ESTCP grant was awarded to this team in particular because the group offered the only retrofit metal roof system integrating other energy-saving technologies to form a building envelope.

The Installation

The project targeted retrofitting an 11,900-square-foot metal roof on a 100,000-square-foot Security Forces building at Goodfellow Air Force Base.

Prior to the installation of the roof system, DoD’s Oak Ridge National Laboratory, Oak Ridge, Tenn., installed a data acquisition system to monitor various temperatures and heat information on the building. In addition to measuring energy data, the building’s utility billing information was collected. When the baseline of energy usage was established, installation of the retrofit metal roof system began in April 2012 and was completed in June 2012. The integrated technologies were installed in the following manner:

- Additional insulation, using rigid insulation board, was placed over the existing roof to meet the current code requirements.
- A waterproof roof underlayment was then applied over the insulation.
- A radiant barrier was installed over the underlayment.
- An integrated solar thermal system using a closed-loop tubing array with...
a water/glycol mix heat-exchange medium was installed over the radiant barrier to optimize the heat transfer.

■ The thermal purlin used to position the solar thermal system tubing is configured to allow for above-sheathing ventilation (convective cooling) to take place from the eave to the ridge.

■ Panels of 24-gauge standing-seam metal roofing, prepainted with a polyvinylidene fluoride cool coating, were laminated with a thin-film PV system and then installed directly over the solar thermal system.

The holistic use of these integrated components into one retrofit system is designed to maximize electricity generation and minimize the cooling load of the building. In addition, the solar-thermal technology that is integrated into the retrofit cavity will optimize the energy generated for domestic hot water and space heating.

The project is expected to yield more than 750,000 MBtu of energy per year through savings from energy-efficiency improvements to this building or harvested energy generated from solar-power systems on the roof. With the local utility costs taken into account, Goodfellow Air Force Base is estimating a savings of $11,750 per year on this building thanks to the retrofit roof.

With the retrofitted integrated metal roof system in place, the surface of the roof is now being used to capture rainwater in an above-ground cistern with a 10,000 gallon capacity. It is estimated that a typical 2 inch rainfall in the San Angelo region will generate 6,500 gallons of rainwater being captured from one side of the roof. The rainwater will be used for irrigation purposes on the base. Estimates suggest 131,000 gallons of potable water per year will be saved from being used for irrigation.

The Data

With the full installation and commissioning now complete, the plan is to have ORNL continue monitoring data during the next 12 months. Data will be taken on:

■ temperatures
■ heat transfer
■ energy output from the photovoltaics
■ energy consumed by the building
■ water usage

The ESTCP, DoD and project team are confident this integrated retrofit roof system will perform as predicted and allow for the technology to be transferred throughout DoD as well as to other federal agencies and ultimately into the commercial building sector.

The unique demonstration project at Goodfellow Air Force Base in San Angelo, Texas, will be the subject of a series of articles in Retrofit. The individual component technologies have been evaluated and used commercially for many years. However, the integration of the technologies as distinct components of an integrated metal roof retrofit assembly has never before been demonstrated.

During the next year, we will highlight the technologies used on the roof, culminating in a final article showcasing the results of Oak Ridge, Tenn.-based Oak Ridge National Laboratory’s data acquisition system.

www.retrofitmagazine.com
View a video that provides an overview of the energy-reduction program at Goodfellow Air Force Base, San Angelo, Texas.

Building Science, Proven Solutions and Installation Experience Are the Right Fit

Combine the building science expertise and proven solutions of Dow Building Solutions and the installation experience of Paramount Metal Systems to deliver high-performance metal buildings. Just look at the dramatic results they have achieved on some recent projects:

**New Construction**
- Energy savings of up to 70 percent and up to three times less air leakage

**Retrofit**
- Heat flux reduction of up to 94 percent through roofs and 91 percent through walls

With 60 years of building science experience, Dow has a proven product lineup for new and retrofit jobs. Dow’s leading solutions meet continuous insulation and mandatory air barrier requirements for more energy-efficient, sustainable buildings:

- **THERMAX™ insulation** – A high R-value continuous insulation that qualifies as an air barrier and has excellent fire performance characteristics
- **FROTH-PAK™ Foam Insulation** – Seals gaps at roof/wall junctures

Paramount and its associates add more than 100 years of experience in design, manufacturing and installation to offer a “one source call” for the best results.

**Full Team Support Delivers Results**

Paramount Metal Systems, along with key associates Dow Building Solutions, Pfister Energy, Roof Hugger and MBCI, recently completed a major retrofit at Goodfellow Air Force Base in San Angelo, Texas. Preliminary data is showing positive results!

**Get Ready for Action**

Dow and Paramount are ready to bring energy savings, cost containment and performance to your next metal building job. Visit [www.dowmetalbuilding.com](http://www.dowmetalbuilding.com) or call 1-866-583-BLUE (2583) for information about the impact Dow products can have on metal building performance. And check out [www.paramountmetalsystems.com](http://www.paramountmetalsystems.com) or call 1-800-505-9062 to see how Paramount’s capabilities ensure the highest quality standards.

*Read the instructions and Material Safety Data Sheets carefully before use

®™Trademark of The Dow Chemical Company (“Dow”) or an affiliated company of Dow