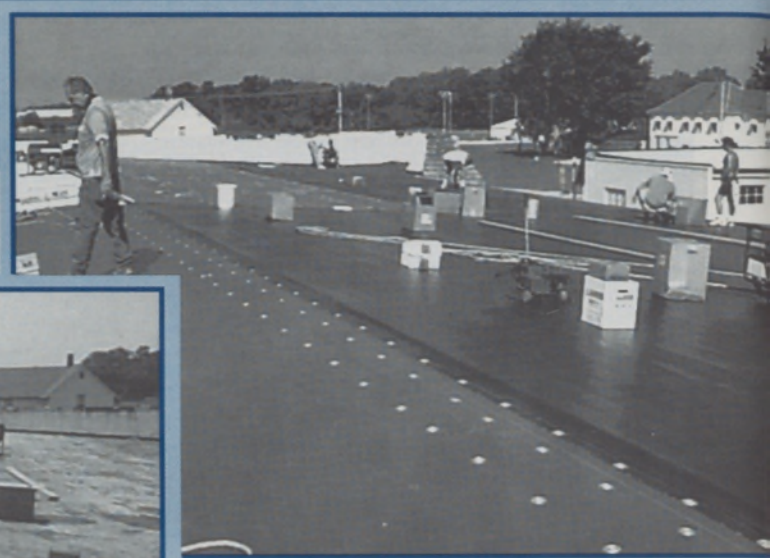


## Evaluating the Limitations of Roof Re-Cover:

# AN ORNL/RCI/SPRI COLLABORATIVE PROJECT

BY ANDRÉ O. DESJARLAIS



*Above: Three different-colored membranes have been laid to determine whether or not the color of the membrane has an impact on the drying rate of the roof.*



*Left: Completing mechanical attachment of recover membrane.*

**A** recent roofing industry survey on insulation re-use in low-slope roofing indicates the following major concerns in re-covering an existing roofing system that contains wetted insulation:

- Moisture concentration;
- Amount of roof area that is wet;
- Structural integrity of the insulation;
- Thermal performance loss; and
- Potential adverse impact of moisture on the new roofing system being installed.

To address these issues, a consortium made up of SPRI (Sheet Membrane and Component Suppliers to the Commercial Roofing Industry) and its member companies, the Roof Consultants Institute (RCI), and Oak Ridge National Laboratory (ORNL) have initiated a project to re-cover a failed roofing system containing moisture and to monitor the performance of that roofing system after the reroofing.

A building, the New Bethel Fellowship Church in Rossville, IL (approximately 100 miles south of Chicago), was identified as a potential re-cover candidate. Representatives from RCI, SPRI, and ORNL visited the church in September 1997 to assess the roof condition and compare the building to a predefined set of criteria. These criteria were:

- The size of the building should be large enough to be considered representative of a typical building but small enough to control the cost of the reroofing. Ideally, the building should be between 3,000 and 10,000 ft<sup>2</sup>;
- The building should ideally be located in a northern climate and have a conditioned interior;
- The roof system must contain an appreciable amount of water;
- The roof system must have the potential to dry downward (no vapor retarder);
- The roof system should be as "typical" as possible, i.e., have a metal deck, some insulation, and a traditional membrane;
- The deck must be structurally sound;
- Access to the roof, edge detailing, and all other aspects of the reroofing should be considered to minimize the overall project costs;
- The building owner must be willing to allow us to perform an experiment on his building; and
- Ideally, the building should be owned by a nonprofit group that would benefit from the reroofing project.

The existing roof on the church was approximately 11,000 ft<sup>2</sup> in size and was comprised of a metal deck, 1.5 inches of perlite, an aggregate covered 4 ply BUR, and an aluminum coating

applied to a cap sheet mopped over the aggregate. Core cuts were taken from eight locations to verify the construction details, examine the metal deck, and assess the amount of water contamination. Fastener pullout tests were also undertaken to assess the integrity of the deck. The visual assessments and tests verified that portions of the roof contained saturated insulation, no vapor retarder, and that the deck was sound. The roof was readily accessible and had very few penetrations. Although the building was a church, the pastor agreed to operate the conditioning equipment if the building was selected for the project.

To verify the extent of water present in the existing roofing systems, representatives of ORNL, RCI and Illinois Roof Consulting revisited the church in December 1997 to perform a nuclear moisture survey. It was discovered that over 50% of the roof area contained wet insulation.

This information was summarized at the SPRI Technical Committee meeting in January 1998. It was proposed to re-cover half of the roof with a water-sensitive low R-value insulation such as wood fiberboard while the remaining roof area would be re-covered with a water-sensitive, high R-value insulation such as polyisocyanurate foam. Half of the roof would be covered with white and black single ply membranes, creating four test combinations of insulation and membrane color.

The committee approved the building as a re-cover demonstration. Letters were sent to all SPRI member manufacturers soliciting donations of materials for this project. Genflex Roofing

Systems, Stevens Roofing Systems, Carlisle SynTec, Sarnafil, Inc., Atlas Roofing, Olympic Fasteners, Tru-Fast, Powers Fastening, Buildex Division of ITW, and W.P. Hickman Company agreed to donate materials for the project. Additionally, Genflex Roofing Systems, Stevens Roofing Systems, Olympic Fasteners, Tru-Fast, W.P. Hickman Company, J.P. Sheahan Associates, and ORNL volunteered labor to install the roof.

The reroofing was performed during the fourth week of June 1998. After brooming off the roof, 1.0-inch wood fiberboard and 2-inch, fiberglass-faced, polyisocyanurate foam were mechanically attached to the roof using fasteners with a compliance-grade base coating that meets the minimum requirements of FM 4470. Approximately half of each insulation type was covered with a mechanically-attached black or white single ply membrane. Additional fastener types possessing alternate corrosion resistance coatings and fasteners made from stainless steel were installed in the wettest areas of the existing roof.

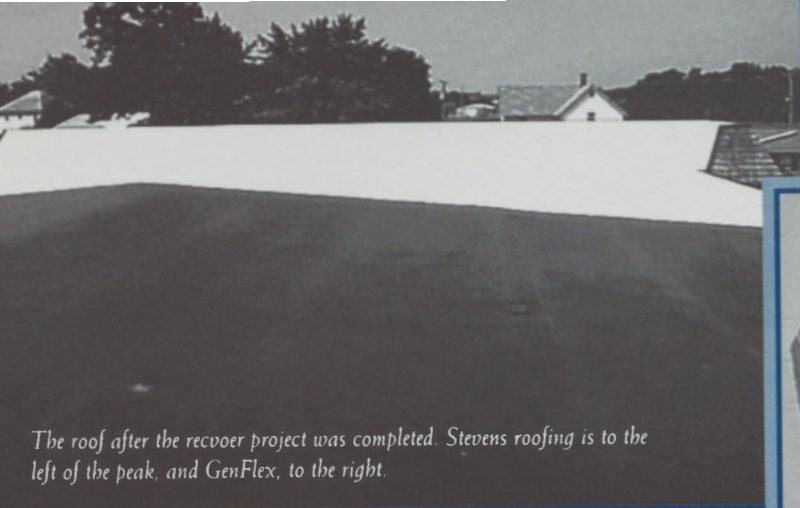
During reroofing, instrumentation was embedded into the roofing system to monitor the interior and exterior environmental conditions of the roofing system. Temperature sensors were embedded just below each membrane and over each insulation type, and temperature and relative humidity sensors were installed in the building interior. These sensors will be used to measure the exterior and interior boundary conditions to which the roof is subjected. Data have been collected since early July 1998; these data will be used to model the moisture behavior of the roofing system.

In October 1998, the roof was examined visually and



*Above: Applying the re-cover insulation. Wood fiberboard was used along the roof, and polyisocyanurate foam along the ridge. Right: Rolling out the black-colored Stevens EP roofing.*





The roof after the re-cover project was completed. Stevens roofing is to the left of the peak, and GenFlex, to the right.



Participants are pictured. Standing, left to right: J. P. Sheahan, President, RCI, Dave Scott, GenFlex, Stan Choiniere, Olympic Fasteners, Phil Childs, ORNL, unidentified, Tru-Fast Corp., Ross Robertson, Firestone. Kneeling, left to right: Peter Garrigus, Stevens Roofing, Andre Desjarlais, ORNL.

scanned nondestructively for moisture content. In addition, core samples of the existing and re-cover insulation materials were removed to calibrate the nondestructive scan results. Membrane samples were taken to monitor the reflectance changes.

The roof will continue to be monitored and twice yearly visits to the building are planned for inspection and sampling purposes. Evaluating the compressive properties of the original insulation will monitor the adequacy of the existing roof as a substrate for the re-cover roof. Fastener pullout tests will be employed to monitor the structural integrity of the deck and the corrosion protection of the fasteners. Measuring the moisture content of the existing and re-cover insulation will determine whether the original roof is drying and whether the re-cover roof is being compromised by water from the original roofing system. Moisture content data will also be used to assess a computer model that has been developed to predict the drying rates of roofing systems containing wet insulation. Finally, the reflectance of the membranes will be periodically recorded to determine the rate at which white membranes lose their reflectance due to dirt accumulation and other conditions.

The reroofing of the New Bethel Fellowship Church has already solved the building owner's short-term requirements of making the roofing system weathertight; no leaks have been observed since the reroofing was completed. The cooperation of members of the roofing community has allowed this extensive project to move forward. ■

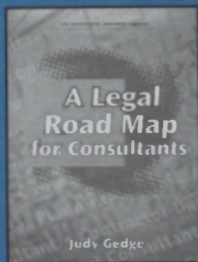
## ABOUT THE AUTHOR

**André Desjarlais** is the manager for the Building Envelope and Materials Research Programs at ORNL. He participates in ASHRAE, ASTM (as an officer), SPRI (as Re-Cover Subcommittee Chairman), RICOWI (as a director), the Federal Roofing Committee (past chairman), the National Fenestration Rating Council, and the Building Thermal Envelope Coordinating Committee (as an ASHRAE director).



**ANDRÉ DESJARLAIS**

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