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To: Chris Scruton (CEC)
From: Steve Wiel
Subject: **Cool Roof Colored Materials**: Monthly Progress Report for May 2005
CC: Hashem Akbari, Paul Berdahl, Andre Desjarlais, Nancy Jenkins, Bill Miller, Ronnen Levinson

A summary of the status of Tasks and Deliverables as of May 31, 2005 is presented in Attachment 1.

HIGHLIGHTS

- We released a beta version of our coating formulation software ("Pinwheel: a tool for the design of color matched coatings with high solar reflectance") to our industrial partners. **This completes Task 2.4.2**.
- The completion date for the deliverables of Tasks 2.5.2, 2.6.4, 2.7.2, and 2.7.3 has been postponed to the end of June 2005.
- John McCaskill of Elk Corp., Bob Scichili, a consultant with Custom-Bilt Metals, Mark Wiebusch of Modern Trade Communications and Scott Kriner of Akzo Nobel Coatings Inc. began helping to develop a Market Plan for accelerating the penetration of cool colored roofing materials into the California market.

Tasks

1.1 Attend Kick-Off Meeting
Task completed.

1.2 Describe Synergistic Projects
Task completed.

2.1 Establish the Project Advisory Committee (PAC)
Task completed.

2.2 Software Standardization
(No activity.)

2.3 PAC Meetings
Task completed.

2.4 Development of Cool Colored Coatings

2.4.1 Identify and Characterize Pigments with High Solar Reflectance
Task completed.

2.4.2 Develop a Computer Program for Optimal Design of Cool Coatings
We released a beta version of our coating formulation software ("Pinwheel: a tool for the design of color matched coatings with high solar reflectance") to our industrial partners. Five manufacturers are currently testing the application. **Task completed**.

2.4.3 Develop a Database of Cool-Colored Pigments
Task completed.

2.5 Development of Prototype Cool-Colored Roofing Materials

2.5.1 Review of Roofing Materials Manufacturing Methods
Task completed.

2.5.2 Design Innovative Methods for Application of Cool Coatings to Roofing Materials
We are writing an article on "Innovative Methods for the Application of Cool Coatings to Roofing Materials" to be completed in June.

2.5.3 Accelerated Weathering Testing
Work on the manuscript on accelerated weathering is awaiting the completion of the manuscript of task 2.6.4. We expect to complete this report by the end of June 2005.

2.6 Field-Testing and Product Useful Life Testing
Residents have moved into the new homes demonstrating cool colored asphalt shingle roofs and the field data is online being logged at ORNL. Data shows the cool colored shingles are effectively reducing the shingle's surface temperature and therefore the heat flux penetrating the roof drops roughly 15% of that measured for the conventional shingle roof.

2.6.1 Building Energy-Use Measurements at California Demonstration Sites
Asphalt Shingle Demonstrations: The residents at 2605 Loggerhead Street and at 2605 Eel Street have moved into the new homes demonstrating asphalt shingles with and

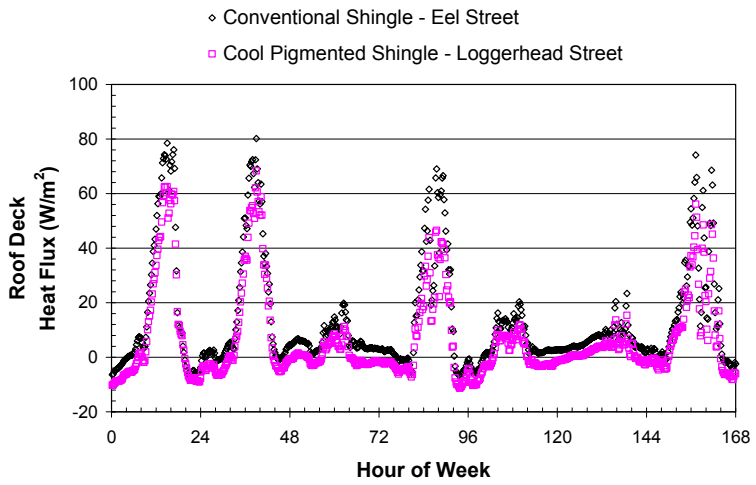

Figure 1. Heat flow through the west facing roof deck for the pair of homes in Redding, CA demonstrating shingles with and without CRCMs.

without cool colored coatings. Field data shows the cool colored shingles are about 3°C (5°F) cooler at solar noon that the conventional shingles. As result, the cool roof has reduced the heat flux penetrating the west facing roof by roughly 15% of that measured for the roof with conventional pigmented shingles (Figure 1). Rain on the 3rd, 5th and 6th days of the week caused the drops in heat flow seen in Figure 1 for both homes.

Painted Metal and Concrete Demonstrations: Data for the week of May 27 through June 2, 05 shows that the all residents in Fair Oaks, CA are now air-conditioning their respective homes (Fig. 2). Previous validation work with SMUD showed the whole house power transducers measurements were within 1½ % of measurement of the utilities' watt-hour meter. The pair of homes with painted metal roofs shows a 20% reduction in whole house power for the week of data shown in Figure 2, which is due in part to the cool roof system. However, data for the pair of homes with concrete tile roofs shows the home with cool colored tile roof used 25% more power than the home with

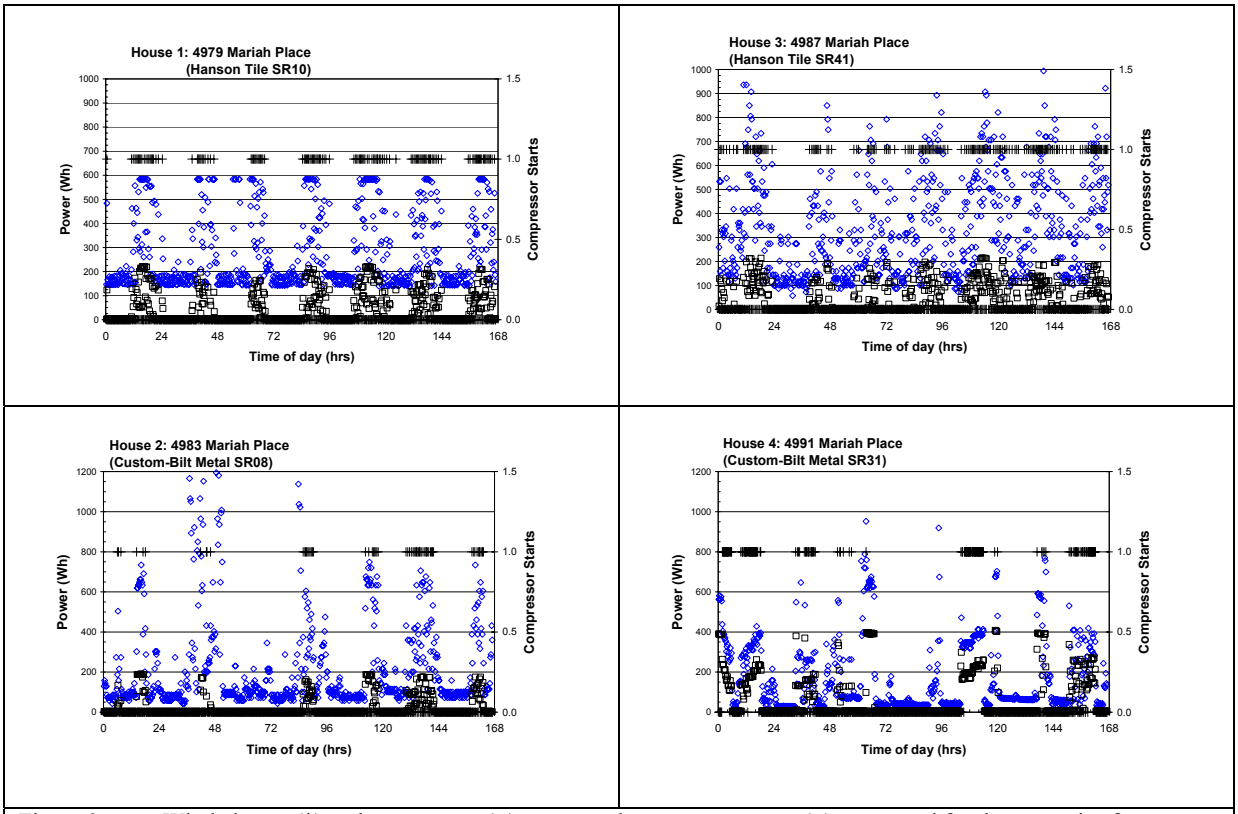

Figure 2. Whole house (◊) and compressor (□) power and compressor starts (+) measured for the two pair of demonstration homes in Fair Oaks, CA. Data collected for the week of May 27 through June 2, 2005.

conventional tile roof. A review of the supply air and return air data shows the home with cool roofs has the thermostat set at a lower temperature than the home with the conventional tile roof. Miller had requested the thermostats be set at 72°F. Efforts will be made to work with the residents at 4979 and 4989 Mariah Place and establish a common thermostat setting.

2.6.2 Materials Testing at Weathering Farms in California

ORNL's Environmental Science Division (ESD) is in process of measuring the elemental composition of the dust collected from the roof samples exposed at the seven CA

weathering sites. Dr. Susan Pfiffner is also working to complete biomass analysis of samples gathered from the weathering sites.

2.6.3 Steep-slope Assembly Testing at ORNL

The ridge vents to the clay and concrete tile roofs and the asphalt shingle roofs were opened in May. Hence field data is now being acquired for the case where attic and underside venting of the tile occurs with the ridge vent open as compared to earlier data with the ridge vent closed.

2.6.4 Product Useful Life Testing

Having earlier completed an outline and bibliography for our review article on weathering of roofing, we are currently writing the article. The article lists the various physical, chemical, and biological stresses on roofing materials and discusses how manufacturers tailor their manufacturing processes to manage these stresses. We hope to complete the current draft by June 30.

2.7 Technology transfer and market plan

2.7.1 Technology Transfer

Levinson presented a talk on the design of cool nonwhite coatings at the RCI symposium Cool Roofing—Cutting Through the Glare in Atlanta on May 12.

W. Miller made a presentation at the RCI conference "Cutting through the Glare" on May 12- 13, 05. He presented the paper "Experimental Analysis of the Natural Convection Effects Observed within the Closed Cavity of Tile Roof Systems," and discussed reduced data for the concrete tile roofs under field study at ORNL.

Akbari presented a paper on aging and weathering cool roofing membranes at the RCI symposium Cool Roofing—Cutting Through the Glare in Atlanta on May 12.

Akbari presented two papers titled "Potential of Urban Heat Island Mitigation" and "Cool Colored Roofs to Save Energy and Improved Air Quality" at the First International Conference on Passive and Low Energy Cooling for the Built Environment, May 19-21, 2005, Santorini, Greece.

Akbari gave a lecture on "Urban Heat Island Mitigation" on May 23, at the University of Athens, Greece.

Akbari gave three lectures titled "Cool Colored Materials for Roofs," "Cool Surfaces and Shade Trees: To Reduce Energy Use and Improve Air Quality in Urban Areas," and "International Energy Outlook and Potentials of Energy Efficiency" at the 1st International Conference on Green Buildings: The Future in the UAE, on May 2-3, 2005, Dubai, UAE.

2.7.2 Market Plan

The draft market plan prepared in April by Akbari was forwarded to John McCaskill of Elk Corp. and to Bob Scichili, a consultant with Custom-Bilt Metals, for their review and input. Both McCaskill and Scichili stated the market plan in original content was too long and did not address market. Scichili shared the document with Mark Wiebusch of Modern Trade Communications and Scott Kriner of Akzo Nobel Coatings Inc. Wiebusch and Scichili are working to accelerate attention on the "Cool Roof" initiative, and are planning a series of advertisements and articles with technical input provided by the "Cool Team" that will reach about 30,000 architects subscribing to Modern Trade

Communications. Both individuals are rewriting the plan into a hard hitting tool that will accelerate use of cool colored roofing materials.

2.7.3 Title 24 Code Revisions

Akbari continues working with PG&E and the Energy Commission to develop a plan for code change proposal for sloped-roof residential buildings.

We have developed preliminary estimates of savings obtained from the installation of cool colored roofs on air conditioned houses in all California climate regions. A short report summarizing these estimates was prepared in May 2005. We are currently working to finalize the report.

Management Issues

This is the last scheduled regular monthly progress report. We will prepare one extra for June to report the completion of four unfinished tasks (2.5.2, 2.6.4, 2.7.2, and 2.7.3) that had been expected to be completed in May. Since the project has been extended through December 2006 to accommodate additional testing (Tasks 2.5.3, 2.6.1, 2.6.2, and 2.6.3), Akbari and Scruton will discuss options to report progress on this testing to the CEC project manager.

Attachment 1

Project Tasks and Schedules (*Approved on May 16, 2002; Revised schedules approved November 2004*)

Task	Task Title and Deliverables	Plan Start Date	Actual Start Date	Plan Finish Date	Actual Finish Date	% Completion as of 5/31/2005
1	**Preliminary Activities**					
1.1	Attend Kick Off Meeting *Deliverables:* • Written documentation of meeting agreements and all pertinent information (**Completed**) • Initial schedule for the Project Advisory Committee meetings (**Completed**) • Initial schedule for the Critical Project Reviews (**Completed**)	5/16/02	5/16/02	6/1/02	6/10/02	100%
1.2	Describe Synergistic Projects *Deliverables:* • A list of relevant on-going projects at LBNL and ORNL (**Completed**)	5/1/02	2/1/02	5/1/02	5/1/02	100%
1.3	Identify Required Permits	N/A		N/A		
1.4	Obtain Required Permits	N/A		N/A		
1.5	Prepare Production Readiness Plan	N/A		N/A		
2	**Technical Tasks**					
2.1	Establish the project advisory committee *Deliverables:* • Proposed Initial PAC Organization Membership List (**Completed**) • Finalize Initial PAC Organization Membership List (**Completed**) • PAC Meeting Schedule (**Completed)** • Letters of Acceptance (**Completed)**	6/1/02	5/17/02	9/1/02		100%
2.2	Software standardization *Deliverables:* • When applicable, all reports will include additional file formats that will be necessary to transfer deliverables to the CEC • When applicable, all reports will include lists of the computer platforms, operating systems and software required to review upcoming software deliverables	N/A		N/A		

Project Tasks and Schedules (contd.)

Task	Task Title and Deliverables	Plan Start Date	Actual Start Date	Plan Finish Date	Actual Finish Date	% Completion as of 5/31/2005
2.3	PAC meetings (**Completed)** *Deliverables:* • Draft PAC meeting agenda(s) with back-up materials for agenda items • Final PAC meeting agenda(s) with back-up materials for agenda items • Schedule of Critical Project Reviews Draft PAC Meeting Summaries • Final PAC Meeting Summaries	9/1/02	6/1/02	6/1/05		100% (6/6)
2.4	Development of cool colored coatings					
2.4.1	Identify and Characterize Pigments with High Solar Reflectance *Deliverables:* • Pigment Characterization Data Report (**Completed)**	6/1/02	6/1/02	12/1/04 → 12/31/04		100%
2.4.2	Develop a Computer Program for Optimal Design of Cool Coatings *Deliverables:* • Computer Program (**Completed)**	11/1/03	11/1/03	12/1/04 → 5/1/05		100%
2.4.3	Develop a Database of Cool-Colored Pigments *Deliverables:* • Electronic-format Pigment Database (**Completed)**	6/1/03	7/1/03	6/1/05 → 12/31/04		100%
2.5	Development of prototype cool-colored roofing materials					
2.5.1	Review of Roofing Materials Manufacturing Methods *Deliverables:* • Methods of Fabrication and Coloring Report (**Completed)**	6/1/02	6/1/02	6/1/03		100%
2.5.2	Design Innovative Methods for Application of Cool Coatings to Roofing Materials *Deliverables:* • Summary Coating Report **(Draft Prepared)** • Prototype Performance Report	6/1/02	6/1/02	12/1/04 → 5/1/05		~ 99%
2.5.3	Accelerated Weathering Testing *Deliverables:* • Accelerated Weathering Testing Report	11/1/02	10/1/02	6/1/05 → 10/1/05		~ 60%

Project Tasks and Schedules (contd.)

Task	Task Title	Plan Start Date	Actual Start Date	Plan Finish Date	Actual Finish Date	% Completion as of 5/31/2005
2.6	Field-testing and product useful life testing					
2.6.1	Building Energy-Use Measurements at California Demonstration Sites *Deliverables:* • Demonstration Site Test Plan (**Completed)** • Test Site Report	6/1/02	9/1/02	10/1/05 → 10/1/06		90%
2.6.2	Materials Testing at Weathering Farms in California *Deliverables:* • Weathering Studies Report	6/1/02	10/1/02	10/1/05 → 10/1/06		80%
2.6.3	Steep-slope Assembly Testing at ORNL *Deliverables:* • Whole-Building Energy Model Validation • Presentation at the Pacific Coast Builders Conference • Steep Slope Assembly Test Report	6/1/02	10/1/02	10/1/05		88%
2.6.4	Product Useful Life Testing *Deliverables:* • Solar Reflectance Test Report **(Draft Prepared)**	5/1/04	5/1/04	6/1/05 → 10/1/05		90%
2.7	Technology transfer and market plan					
2.7.1	Technology Transfer (**Completed)** *Deliverables:* • Publication of results in industry magazines and refereed journal articles • Participation in buildings products exhibition, such as the PCBC Brochure summarizing research results and characterizing the benefits of cool colored roofing materials	6/1/03	6/1/02	6/1/05		100%
2.7.2	Market Plan *Deliverables:* • Market Plan(s) **(Draft Prepared)**	5/1/05	4/1/05	6/1/05		50%
2.7.3	Title 24 Code Revisions *Deliverables:* • Document coordination with Cool Roofs Rating Council in monthly progress reports (**Completed)** • Title 24 Database **(Draft Prepared)**	6/1/02	5/16/02	6/1/05		90%

Project Tasks and Schedules (contd.)

Task	Task Title	Plan Start Date	Actual Start Date	Plan Finish Date	Actual Finish Date	% Completion as of 5/31/2005
VII	Critical Project Review(s) *Deliverables:* • Minutes of the CPR meeting					
XII (C)	Monthly Progress Reports *Deliverables:* • Monthly Progress Reports (**Completed)**	6/1/02	6/1/02	6/1/05		100% (36/36)
XII (D)	Final Report *Deliverables:* • Final Report Outline • Final Report	3/1/05 → 3/31/06		10/1/05 → 10/1/06		
	Final Meeting *Deliverables:* • Minutes of the final meeting	10/15/05		10/31/05		