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To: Chris Scruton (CEC)  
From: Steve Wiel  
Subject: **Cool Roof Colored Materials**: Monthly Progress Report for October 2002  
CC: Hashem Akbari, Paul Berdahl, Andre Desjarlais, Bill Miller, Ronnen Levinson

A summary of the status of Tasks and Deliverables as of October 31, 2002 is presented in Attachment 1.

## HIGHLIGHTS

- We are planning to add two new members to the PAC.

## Tasks

- 1.1 Attend Kick-Off Meeting  
**This Task is completed.**
- 1.2 Describe Synergistic Projects  
**This Task is completed.**
- 2.1 Establish the Project Advisory Committee (PAC)  
*This task is essentially completed.* However, based on the comments received at the PAC meeting, we will try to add to the PAC two more members representing consumers of cool roofing materials.
- 2.2 Software Standardization  
(No activity.)
- 2.3 PAC Meetings  
(No activity.)
- 2.4 Development of Cool Colored Coatings
  - 2.4.1 Identify and Characterize Pigments with High Solar Reflectance  
Pigment characterization this month focused on analysis of the optical properties of the 51 pigments measured to date. Our model for prediction of Kubelka-Munk scattering and absorption coefficients is being revised to (a) better account for the effects of interface reflection, and (b) incorporate contributions made by other researchers in the field. We are preparing a journal paper detailing our efforts to date.

We are considering making additional spectrometer measurements on a number of samples to add to our data set. These would be diffuse reflectance and transmittance, with the specular component excluded. These measurements are the type used by McNeil and French.

The quinacridone class of red and maroon organic pigments has appeal as cool colored pigments. These pigments have very little near-infrared absorption and are sufficiently durable to be used in automobile coatings. We are seeking information from Ciba Specialty Chemicals on the maximum use temperature of these materials to see if they could be incorporated into roofing granules. We also learned of another organic pigment that is used in the automotive market – benzimidazdone yellow (PY=Pigment Yellow 97, and PY 154).

The forthcoming new industry magazine Architectural Products Magazine will contain an article by Chris Santilli on new and emerging cool colored roofing products.

We identified a commercial laboratory that is capable of measuring organic and black carbon separately (Sunset Laboratory, Forest Grove, Oregon). This capability may be useful in the analysis of soil deposits on roofing in the future.

2.4.2 Develop a Computer Program for Optimal Design of Cool Coatings  
(No activity.)

2.4.3 Develop a Database of Cool-Colored Pigments  
(No activity.)

2.5 Development of Prototype Cool-Colored Roofing Materials

2.5.1 Review of Roofing Materials Manufacturing Methods

The review of literature is progressing on schedule. Our industrial partners will be sharing manufacturing process information with us. Akbari has talked to 3M and BASF regarding making arrangements for him to visit a few industrial sites (manufacturing of roofing materials) in the vicinity of the Bay Area.

2.5.2 Design Innovative Methods for Application of Cool Coatings to Roofing Materials  
(No activity.)

2.5.3 Accelerated Weathering Testing  
(No activity.)

2.6 Field-Testing and Product Useful Life Testing

Rick Olson and consortium members of the Roof Tile Institute are in the process of selecting and preparing cement tile roof products for field-testing on the ESRA, Habitat for Humanity (HFH) demonstration homes and for the weathering sites. The Habitat for Humanity has plans for building 12 new houses this upcoming fiscal year and ORNL has committed to supplying tile and metal roof materials for four of the new homes.

2.6.1 Building Energy-Use Measurements at California Demonstration Sites

Archie Mulligan, Executive Director for HfH, specified the start dates for construction of the new Habitat homes in Sacramento CA. (Table 1). Unfortunately, none of these homes will be on adjacent lots, and therefore we would not be able to conduct side-by-side field comparison of a standard roof color to one with “Cool Roof Colored Materials” (CRCM). However, Mulligan did state that Habitat owns a half-acre lot in south Sacramento where four homes each with composition shingle roofing will be placed. One home is presently onsite. Two of the other houses were recently blitz-built, and are awaiting placement on the lot in south Sacramento. The fourth house is slated for construction in Dec., 02.

HFH must submit a permit to the Sacramento municipality to approve subdividing the lot into four parcels for the four homes. Mulligan stated the lead-time for approval is about 5 months; therefore, ORNL is seeking other options with local and national contractors for potential demonstration sites just in case lead-time expands or approval for splitting the lot is denied.

Table 1. The start date and number of homes to be built by Habitat for Humanity in FY03.

Construction Start	Number of Homes
Dec., 2002	1
Jan., 2003	1
Mar., 2003	1
Apr., 2003	1
July, 2003	2

Jerry Vandewater of Monier Tile is reviewing the allowable top cord load for the existing roof rafters. Standard truss construction in California is typically designed for 40 pounds per square foot of combined live and dead loading. Concrete tile has a combined loading of about 15 pounds per square foot, and Vandewater therefore believes we can safely strengthen the roof structure by simply adding 1”by 3” battens to help support the dead load of the tile. The concrete tile will add about 850 to 1150 pounds per square of roof.

#### 2.6.2 Materials Testing at Weathering Farms in California

California has sixteen zones that cover the broad and diverse range of climates ranging from alpine to desert conditions. The climate zones are based on temperature, weather and energy use. The Energy Commission established each of the 16 climate zones to represent a geographic area with an established energy budget that specifies the maximum amount of energy that a building or portion of a building can be designed to consume per year. Several candidate sites have been identified from which we will select seven sites to capture the effects of weather, urban pollution and population, Table 2.

Table 2. Potential Weathering Sites for the Cool Roof Colored Materials

<b>Company</b>	<b>Contact</b>	<b>Street Address</b>	<b>City</b>	<b>ZIP Code</b>	<b>County</b>	<b>Climate Zone</b>
<i>Custom-Bilt</i>	Tony Chiovare (626) 945-2234	9845 Joe Vargas Way	South El Monte	91733	Los Angeles	9
	Don Bonnington (916) 372-7696	1347 Shore Street	Sacramento	95691	Sacramento	12
<i>Steelscape</i>	Bruce Hopkins (510) 262-4858	2995 Atlas Road	Richmond	94806	Contra Costa	3
	Renee Baker (360) 673-8236	11200 Arrow Route	Rancho Cucamonga	91730	San Bernadino	10
<i>BASF</i>	Michelle Vondran (909) 825-6292 Ext 309	1231 S. Lincoln St.	Colton	92324	Orange	8
<i>FERRO</i>	James Dunn (323) 585-7577	4200 Charter Street	Los Angeles	90058	Los Angeles	9
<i>LBNL</i>	Hashem Akbari (510) 486-4287	One Cyclotron Road	Berkeley	94720	Alameda	3
<i>Maruhachi Ceramics of America</i>	Yoshihiro Suzuki (909) 736-6221	1985 Sampson Ave.	Corona	92879	Riverside	10
<i>Monier Life Tile</i>	(949) 756-1605	7575 Irvine Ctr.	Irvine	92618	Orange	8
	(909) 822-4407	3511 N. River Ave.	Rialto	92377	San Bernadino	10
	(209) 983-1600	342 Roth Road	Lathrop	95330	San Joaquin	12
	(408) 847-2721	6500 Brem Lane	Gilroy	95020	Santa Clara	4
<i>Hanson Roof Tile</i>	(707) 678-3281	8668 Sparling Lane	Dixon	95620	Solano	12
	(909) 350-4238	10650 poplar Ave.	Fontana	92337	San Bernadino	10
<i>Eagel Roofing Products</i>	(909) 355-7000	2352 N. Locusat Ave.	Rialto	92377	San Bernadino	10
	(800) 998-3245	2191 Navy Drive	Stockton	95206	San Joaquin	12
	(949) 553-8333	17875 Skypark Cir.	Irvine	92614	Orange	8
<i>U.S. Tile</i>	Brad Heath (909) 737-0200	909 West Railroad St.	Corona	92882	Riverside	10
<i>ELK Corporation</i>	Louis Hahn (972) 872-2293	6200 Zerker Road	Shafter	93263	Kern	13
<i>Naval Facilities Engineering Command</i>	ROICC Lt. Buscher (760) 830-7402		Twentynine Palms		San Bernardino	14
	ROICC		China Lake		San Bernardino	14
<i>Humboldt State University</i>		1 Harpst Street	Arcata	95521	Humboldt	1

### 2.6.3 Steep-slope Assembly Testing at ORNL

A safety review plan was completed this period for identifying potential hazards for setup of the steep-slope assembly. The plan is required by the Safe Work Practices Research Safety (RSS) of ORNL prior to the start of construction by an offsite vendor.

### 2.6.4 Product Useful Life Testing (No activity.)

## 2.7 Technology transfer and market plan

### 2.7.1 Technology Transfer

Akbari and Desjarlais will be presenting seminars on application of cool roofs in California in an upcoming meeting of Roofing Industry Committee on Weather Issues (RICOWI) on November 15, 2002.

2.7.2 Market Plan  
(No activity.)

2.7.3 Title 24 Code Revisions  
(No significant activity.)

### **Management Issues**

- None

Attachment 1

**Project Tasks and Schedules (Approved on May 16, 2002)**

Task	Task Title and Deliverables	Plan Start Date	Actual Start Date	Plan Finish Date	Actual Finish Date	% Completion as of October 31, 2002
1.1	Attend Kick Off Meeting <i>Deliverables:</i> <ul style="list-style-type: none"> <li>Written documentation of meeting agreements and all pertinent information (<b>Completed</b>)</li> <li>Initial schedule for the Project Advisory Committee meetings (<b>Completed</b>)</li> <li>Initial schedule for the Critical Project Reviews (<b>Completed</b>)</li> </ul>	5/16/02	5/16/02	6/1/02	6/10/02	100%
1.2	Describe Synergistic Projects <i>Deliverables:</i> <ul style="list-style-type: none"> <li>A list of relevant on-going projects at LBNL and ORNL (<b>Completed</b>)</li> </ul>	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		
2.1	Establish the project advisory committee <i>Deliverables:</i> <ul style="list-style-type: none"> <li>Proposed Initial PAC Organization Membership List (<b>Completed</b>)</li> <li>Final Initial PAC Organization Membership List</li> <li>PAC Meeting Schedule (<b>Completed</b>)</li> <li>Letters of Acceptance</li> </ul>	6/1/02	5/17/02	9/1/02		95%
2.2	Software standardization <i>Deliverables:</i> <ul style="list-style-type: none"> <li>When applicable, all reports shall include additional file formats that will be necessary to transfer deliverables to the CEC</li> <li>When applicable, all reports shall include lists of the computer platforms, operating systems and software required to review upcoming software deliverables</li> </ul>	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 October 31, 2002
2.3	PAC meetings <i>Deliverables:</i> <ul style="list-style-type: none"> <li>Draft PAC meeting agenda(s) with back-up materials for agenda items</li> <li>Final PAC meeting agenda(s) with back-up materials for agenda items</li> <li>Schedule of Critical Project Reviews</li> <li>Draft PAC Meeting Summaries</li> <li>Final PAC Meeting Summaries</li> </ul>	9/1/02		6/1/05		
2.4	Development of cool colored coatings					
2.4.1	Identify and Characterize Pigments with High Solar Reflectance <i>Deliverables:</i> <ul style="list-style-type: none"> <li>Pigment Characterization Data Report</li> </ul>	6/1/02	6/1/02	12/1/04		~ 10%
2.4.2	Develop a Computer Program for Optimal Design of Cool Coatings <i>Deliverables:</i> <ul style="list-style-type: none"> <li>Computer Program</li> </ul>	11/1/03		12/1/04		
2.4.3	Develop a Database of Cool-Colored Pigments <i>Deliverables:</i> <ul style="list-style-type: none"> <li>Electronic-format Pigment Database</li> </ul>	6/1/03		6/1/05		
2.5	Development of prototype cool-colored roofing materials					
2.5.1	Review of Roofing Materials Manufacturing Methods <i>Deliverables:</i> <ul style="list-style-type: none"> <li>Methods of Fabrication and Coloring Report</li> </ul>	6/1/02	6/1/02	6/1/03		~ 10%
2.5.2	Design Innovative Methods for Application of Cool Coatings to Roofing Materials <i>Deliverables:</i> <ul style="list-style-type: none"> <li>Summary Coating Report</li> <li>Prototype Performance Report</li> </ul>	6/1/02		12/1/04		
2.5.3	Accelerated Weathering Testing <i>Deliverables:</i> <ul style="list-style-type: none"> <li>Accelerated Weathering Testing Report</li> </ul>	11/1/02		6/1/05		

### Project Tasks and Schedules (contd.)

Task	Task Title	Plan Start Date	Actual Start Date	Plan Finish Date	Actual Finish Date	% Completion as of October 31, 2002
2.6	Field-testing and product useful life testing					
2.6.1	Building Energy-Use Measurements at California Demonstration Sites <i>Deliverables:</i> <ul style="list-style-type: none"> <li>Demonstration Site Test Plan</li> <li>Test Site Report</li> </ul>	6/1/02		10/1/05		< 5%
2.6.2	Materials Testing at Weathering Farms in California <i>Deliverables:</i> <ul style="list-style-type: none"> <li>Weathering Studies Report</li> </ul>	6/1/02		10/1/05		
2.6.3	Steep-slope Assembly Testing at ORNL <i>Deliverables:</i> <ul style="list-style-type: none"> <li>Whole-Building Energy Model Validation Presentation at the Pacific Coast Builders Conference</li> </ul>	6/1/02		10/1/05		< 5%
2.6.4	Product Useful Life Testing <i>Deliverables:</i> <ul style="list-style-type: none"> <li>Solar Reflectance Test Report</li> </ul>	5/1/04		6/1/05		
2.7	Technology transfer and market plan					
2.7.1	Technology Transfer <i>Deliverables:</i> <ul style="list-style-type: none"> <li>Publication of results in industry magazines and refereed journal articles</li> <li>Participation in buildings products exhibition, such as the PCBC</li> <li>Brochure summarizing research results and characterizing the benefits of cool colored roofing materials</li> </ul>	6/1/03		6/1/05		
2.7.2	Market Plan <i>Deliverables:</i> <ul style="list-style-type: none"> <li>Market Plan(s)</li> </ul>	5/1/05		6/1/05		
2.7.3	Title 24 Code Revisions <i>Deliverables:</i> <ul style="list-style-type: none"> <li>Document coordination with Cool Roofs Rating Council in monthly progress reports</li> <li>Title 24 Database</li> </ul>	6/1/02	5/16/02	6/1/05		~ 5%