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May 11, 2012

California Energy Commission
Attention: Docket No. 12-BSTD-1
Dockets Office
1516 Ninth Street, MS-4
Sacramento, CA 95814
ryasny@energy.ca.gov

Re: Docket No. 12-BSTD-1 Response to ARMA Comments Dated May 4, 2012

Dear Commissioner Douglas,

On behalf of Architectural Energy Corporation (AEC), I would like the opportunity to respond to comments submitted by ARMA on May 4 related to the proposed modifications to Title 24, Part 6 for residential and non-residential roofing. ARMA's comments call into question the conclusions of the "Nonresidential Cool Roofs" CASE study. AEC was responsible for preparing the report (available on the CEC website http://www.energy.ca.gov/title24/2013standards/prerulemaking/documents/current/Reports/Nonresidential/Envelope/2013_CASE_NR_Cool_Roofs_Oct_2011.pdf). The report provides the technical rationale behind the proposed modifications to the Standards and we firmly believe the assumptions and conclusions in the report are valid and ARMA's comments lack merit.

The CASE study demonstrates that the proposed new requirements will result in energy savings, TDV energy savings, and significant life cycle cost savings. Additionally, the report documents that there are a significant number of available products on the market and in use today that meet or exceed the proposed requirements. In fact, the proposed level of aged reflectance of 0.63 can be met with products from all major roof types. Furthermore, the proposed requirements still allow for any roofing product with a lower reflectance to comply with the Standards by following a simple trade-off with insulation, or by using the performance method for compliance. Lastly, the CASE study shows that the proposed requirements meet the cost effectiveness criteria of the Standards Rulemaking process as specified in the rulemaking document "Life-Cycle Cost Methodology" (available on the CEC website http://energy.ca.gov/title24/2013standards/prerulemaking/documents/general_cec_documents/2011-01-14_LCC_Methodology_2013.pdf).

The comments submitted by ARMA were grouped into three categories:

1. Market Consistency
2. Insulation and Solar Reflectance Trade-off
3. Cost Assumptions

No response is provided to the first category, "Market Consistency," as ARMA's comments appear to support the proposed approach of specifying a consistent prescriptive level for solar reflectance in the 2013 Standards. Responses to the latter two categories of comments are provided below.

Insulation and Solar Reflectance Trade-off

ARMA's comments suggest that the proposed approach in the Standards to allow for trade-offs between roof solar reflectance and insulation results in an excessive amount of insulation. Our understanding from ARMA's

comments and from statements made at the Standards hearings by roofing industry representatives is that they are in favor of such a trade-off procedure, and the comments in ARMA's letter, dated May 4, 2012 and signed by Reed Hitchcock, are not questioning the inclusion of this procedure, but rather the methodology used to calculate the trade-offs. ARMA presents an alternate methodology which results in requirements for lower insulation levels in the trade-off approach than those proposed for the 2013 Standards.

In response to ARMA's comments, expanded details are provided on the methodology used by the CASE team, led by AEC, that demonstrate the appropriateness of this analysis and why the methodology used by ARMA is not valid.

Analysis Methodology

The analysis methodology used by AEC accounts for:

- Hourly energy predictions
- Time dependent valuation (TDV) of hourly energy use
    - It should be noted that TDV energy is the efficiency metric used by Title 24. TDV accounts for energy consumption, peak demand, and time of use. This metric is used in the Title 24 performance compliance approach to evaluate the impact of trading-off efficiency measures.
    - TDV is also the metric used to evaluate the cost effectiveness of proposed efficiency measures in the Standards. Cost effectiveness is determined by assessing that the present value of TDV energy savings is greater than the initial cost of a proposed measure.
- The use of CEC approved hourly weather files to account for climatic variation across the state.
- The ability to perform analysis on prototype commercial building types with envelope, lighting, HVAC, and controls that conform to Title 24 prescriptive requirements and alternative calculation method (ACM) rules.
- The ability to perform analysis on a prototype commercial building type with internal gains (occupant density, lighting, plug loads) that conform to the Title 24 ACM requirements.

All of the above factors have been documented as baseline analysis criteria for the possible inclusion of measures into the 2013 Standards for both residential and nonresidential buildings. In addition, building design features and modeling assumptions affecting building energy use are required elements for analysis using the performance approach for compliance as defined in the Alternative Compliance Method (ACM) Manual. As noted above, the performance approach is the method used to determine the energy impacts of trading off energy efficiency features of a building.

The analysis methodology used by ARMA's consultants employs a simplified calculation tool called the DOE Cool Roofs Calculator. This tool does not account for the factors listed above.

- It is not based on an energy simulation using hourly weather data; hence, It does not produce hourly energy predictions
- It does not account for the price of fuel during peak periods and the effects efficiency measures have during the course of the year and during peak demand times; hence, it does not allow for TDV calculations
- It does not utilize CEC approved hourly weather files
- It does not use the same prototype commercial building type described in CASE reports that has been used for nonresidential energy measures analysis for the 2013 Standards. The ARMA analysis assumes a warehouse with no internal gains and different building use schedules than used by the CASE teams. Hence, it is not representative of the range of buildings and expected construction analyzed for the CASE measures.

The developer of the DOE Cool Roofs Calculator, Mr. Andre Desjarlais, readily admitted that this simplified tool had these limitations during a 2013 Title 24 Proceedings workshop on June 10, 2011. During this workshop Mr. Desjarlais stated that:

- The DOE Cool Roofs Calculator estimates heat flows through a roof for a space with no internal gains and will tend to underestimate the value of a cool roof for spaces or buildings with internal loads
- The tool is a regression equation and cannot export hourly energy consumption and therefore the results cannot be converted into an energy budget through the use of TDV factors
- The tool uses a fixed energy cost assumption which is not compatible with TDV

The limitations of the DOE Cool Roof Calculator explain why the ARMA calculated trade-offs values differ from those proposed in the 2013 Standards. Savings from cool roofs tend to coincide with the times of highest TDV values (which coincide with electrical system peak demand), whereas savings from insulation have a lower coincidence with periods of high TDV values. The methodology that factors in TDV will predict higher savings from cool roofs during peak periods, and therefore will require more insulation in a trade-off calculation than a methodology that assumes a flat energy rate.

A very detailed explanation of the limitations of the ARMA methodology was provided in a docketed letter from McHugh Energy Consultants on May 8, 2012. We agree with the technical response provided in Mr. McHugh's letter which concludes that the CASE team employed a sound technical analysis to calculate the trade-off requirements, and the ARMA methodology is not valid. The letter explains in detail the limitations of the methodology used by ARMA and why it will lead to underestimation of savings achieved from cool roofing systems. We agree with Mr. McHugh's recommendation that the Energy Commission should reject ARMA's docketed comments on the insulation and solar reflectance trade-off due to lack of merit.

Cost Assumptions

ARMA's comments question the quality and extent of the cost analysis conducted by AEC. The cost effectiveness calculations are a requirement under the Warren-Alquist act and AEC diligently collected cost data, representative of roofing products in California, as the basis for the proposed requirements for cool roofs. Responses to cost surveys provided data that covered a range of roofing types, geographic diversity, and product supplier type diversity. The data points support the conclusion that the proposed roof reflectance measure is cost effective.

It should be noted that forms used for the cost survey were developed in collaboration with ARMA. ARMA, through Mr. Hitchcock, provided the initial survey form for the CASE team's use in soliciting cool roof product cost information from the industry. This initial survey instrument was also vetted by a third-party roof consultant (Pacific Roof Consultants). To assist the industry in responding to our request for the price of cool roofing materials, the survey form specified a sample roofing job and asked the respondent to provide installed costs for different roofing product types or systems. Cost information using the survey forms was gathered by distributing this survey instrument by email and by follow-up telephone contact.

These surveys collected cost data from a range of product suppliers:

- roofing contractors
- roofing product distributors
- roofing product manufacturers

Several types of roofing products are typically used on commercial buildings. The results of the surveys provided cost data for the range of roofing product types that include:

- Built-up roof (BUR)

- Single ply, TPO
- Single ply, PVC
- Modified bitumen, APP
- Modified bitumen, SBS
- Roof coatings

To ensure cost data recognized regional and geographical construction and pricing differences for the state, the distribution of the survey instrument and follow-up telephone interviews were conducted with roofing product representatives from throughout the state. Not every city or county is represented in the CASE team's analysis but roofing product representatives were actively solicited in regional areas where construction activity is occurring and is expected to occur. The results of the surveys provided cost data for a range of geographical locations:

- Oakland
- Los Angeles
- Van Nuys
- Fresno
- San Bernardino
- San Diego County
- Fresno
- Livermore
- Concord
- Sacramento

ARMA's comments, and those included from a consultant, call into question whether an adequate amount of data was gathered from the surveys to draw conclusions regarding the cost of cool roofing products. The cost summary report describes the sources for the cost data, and the survey instrument used to collect the data and is summarized below:

Cost Sources

Initially, the email survey, developed in collaboration with ARMA, was sent out to roofing contractors across the state. To supplement the responses to the email survey, a phone survey was conducted to additional roofing contractors. Not all contractor respondents to the survey provided cost data for all roofing types. This is due to the fact that not all contractors install all roofing types and, therefore, are not familiar with the costs of every product type, nor do they install or have distribution sources for all roofing products. However, for the responses collected, representative costs for each product type listed above were collected. To broaden the number of survey responses, the CASE team expanded the survey to ensure that additional cost data sources were obtained for all roofing products, and utilized follow-up phone interviews. Roofing product distributors and manufacturers were contacted to gather a larger set of product costs as documented in the AEC CASE report.

Cost Survey Instruments

A variety of survey techniques were used to ensure that costs for all product types were represented across the state. Because market dynamics have much greater influence over product pricing and installation costs than randomly choosing California cities to target its survey instrument toward, the CASE team's focus was to ensure that a variety of product suppliers were surveyed, and cost information was solicited for all roofing product types in geographical and sales areas representative of construction practice. Every effort was made to gather cost data consistent with this premise. The end result of the survey was a set of cost data that represents the geographic diversity, product diversity, and product supplier type diversity in the state of California. The AEC CASE team believes the data supports the

conclusion that the proposed roof reflectance for the 2013 Standards cool roof measure is cost effective.

AEC recognizes that the Energy Commission is dedicated to making decisions based on the best information available. We strongly believe that the cost data provided to the Commission is an accurate representation of the industry's products and costs. It should be noted that the most recent comments from ARMA, while questioning both the approach and overall breadth of costs collected to represent roofing product costs, have not suggested alternative costs that are more appropriate nor have they suggested a better approach than AEC's to be used to collect this data. The AEC CASE team has provided detailed summaries of the methods used to collect cost data that is currently used by active California roofing product suppliers, whereas ARMA has provided no cost data to support their claim that the costs are not accurate.

On several occasions, the Energy Commission stated in its records of public meetings and workshops that it would incorporate cost data provided by ARMA, or any other reliable source, into the cost analysis used to support possible increases in the solar reflectance value for the cool roof energy efficiency measures.

On September 12, 2011 a cool roof stakeholder meeting was held in the Commission's Hearing Room B; the meeting was attended by ARMA members, Commission staff, IOUs, and CASE team consultants. The cool roof costs were a main topic of this meeting. Although this meeting was not transcribed, the notes from the meeting show that ARMA agreed to help staff develop a cost survey and use the survey to solicit cost data from manufacturers, installers and distributors.

On October 13, 2011 at the 2013 Title 24 Proceedings workshop, during an exchange between Commission staff and ARMA representatives, Commission staff again indicated their willingness to incorporate ARMA provided cost data into the cost effectiveness analysis. ARMA suggested that Commission staff and its consultants should reach out to contracting organizations to gather cost data. After the October workshop, the CASE team continued to pursue that course of action.

At a subsequent workshop, on March 12, 2012 the subject of cost data was discussed again between Commission staff and Mr. Hitchcock representing ARMA. During this discussion, ARMA affirmed that they provided a survey form to the CASE team for their use in collecting detailed cost information. They also acknowledged that they had offered to contribute cost data to be used in the cost effectiveness calculations. To date, ARMA has not provided any cost data that could be factored into the cost effectiveness calculations being used to help determine possible changes affecting cool roofs.

During the time period between these two workshops, the CASE team continued to conduct its survey. As previously stated, the outcome of the survey was a set of cost data from across the state of California for the variety of roofing products typically encountered in commercial building construction. The costs include material, labor, and equipment costs as provided by roofing product suppliers who are currently selling and installing roofing in California. This cost data represents the best available information for the Energy Commission to base the proposed roof solar reflectance of cool roofing efficiency measures. The costs and benefits of the proposed measure were clearly presented and are part of the record.

The comments from ARMA suggest that the cost data is not valid; however, they have provided no alternate cost data to substantiate this claim nor suggest any means to gather "better" cost data. The AEC CASE team recommends that the Energy Commission reject ARMA's docketed comments regarding the cost assumptions used by the CASE team.

In summary, we recommend that the Energy Commission includes the proposed roof reflectance measure in the 2013 standards. The AEC CASE team has demonstrated that this measure will result in energy savings, TDV energy savings, and significant life cycle cost savings. Energy Commission staff has already agreed to ARMA's suggestion of including a performance compliance tradeoff for increased insulation in lieu of a roof with a high solar reflectance value. This proposed trade-off approach will provide a prescriptive path for showing compliance with the Standards while still achieving the energy savings of the cool roof measure's intent.

Thank you for considering our responses.

Sincerely,

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