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April 18, 2016

Lisa Skumatz, Ph. D.
Skumatz Economic Research Associates (SERA)
762 Eldorado Drive
Superior, CO80027

R113 Ductless Heat Pump Evaluations: (R113),

April 18, 2016

Dear Ms. Skumatz:

The United Illuminating Company ("UI" or the "Company"), hereby submits the following comments on the "**Ductless Heat Pump Evaluations (R16)**" Draft Report by Prepared by DNV GL under subcontract to NMR Group, Inc., and dated March 13, 2016. The draft was submitted to UI on April 4, 2016, with a request for comments to be provided by April 18, 2016.

The purpose of the study was to understand the primary drivers for the low realization rates for Ductless Heat Pumps ("DHP") found in the 2013 Impact Evaluation: Home Energy Services – Income-Eligible and Home Energy Services Programs: Volume 1 (R16).

The Company would like to offer some comments and recommendations pertaining to the Study for consideration.

In general the Company is disappointed in the lack of depth of the findings presented in this study, especially given the size of the expenditure for this follow-up study. Rather than using the existing data from the R16 study to develop realization rate for various DHP installation scenario's, the recommendation is to do an additional billing analysis. There is little new information presented that can be used to update the DHP program or the CT Program Savings Document ("PSD")

The Study's conclusions for the low realization rates found in the R16 study need to be more pointed and precise.

Conclusion 1 in the report is in regard to the cooling savings factor, however in most instances cooling savings are a much smaller contributor to over savings than heating savings are. As such this cooling recommendation should be moved to the end of the recommendation list. The report should attempt to better quantify the magnitude of heating and cooling savings so that the significance, or lack of significance of the conclusion regarding PSD cooling assumption is put in perspective.

Conclusion 2 addresses that fact that in a number of instances in the R16 data set the DHPs were installed where they were replacing or supplemental to oil heat or in areas of the home that did had not been previously heated. In these cases the electrical consumption increased. UI believes that may be the largest contributor to the low realization rates.

In this regard the study did not appear to attempt to parse out these instances from the R16 data set. If this data had been parsed out it might have provided results that can be applied to each of the of the following installation scenarios.

1. DHP installed were existing residence had electric heat and Air conditioning
2. DHP installed were existing residence had electric heat and no air conditioning
3. DHP installed were existing residence had oil heat and Air conditioning
4. DHP installed were existing residence had oil heat and no air conditioning
5. DHP installed were existing space was not heated or cooled
6. DHP installed in an addition to the home.

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Conclusion 3 indicates that some participants are using their DHP systems as backup to their existing systems. This again points to the need to parse out results as we note above regarding Conclusion 2.

The study presents the following recommendations;

Recommendation 1: Update the current PSD. The Company agrees with this recommendation but as we noted regarding Conclusion 2 we are disappointed that this study did not parse out the R16 study data to facilitate updating the PSD without the need for an additional study.

Recommendation 2: Perform a billing recommendation using a more representative sample of program participants. A billing analysis was performed for Ductless Heat Pumps as part of the R16 "HES Impact Evaluation Home Energy Services—Income Eligible and Home Energy Services Programs". Again the Company is disappointed that no attempt appears to have been made in the current study to use this existing bill analysis to develop realization rates based on the various installation scenarios discussed above.

Recommendation 3: Perform on-site engineering analysis. The Company agrees that this may be an appropriate alternative to Recommendations 1 and 2, but only if those less costly options don't yield adequate results.

Recommendation 4: Educate Customers on DHP Operation strategies that generate the highest savings rates. The Company agrees with this recommendation.

Recommendation 5: Increase engagement with electric resistance heating customers... The Company agrees with this recommendation as a path towards greater realized program savings.

Recommendation 6: This may be a more appropriate approach for future billing analysis. UI agrees that this may be a better approach for billing analysis but again we suggest that the existing data for the R16 study might yield more accurate results if the analysis as dived into the various installation scenarios mentioned above.

Thank you for the opportunity to provide these comments.

Richard Oswald

Lead engineer
UIL Holding Company

The following pages contain the Company's more specific comments and suggested edits for the entire study:

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As seen in Error! Reference source not found.**, 92% of all respondents (2011 and 2013–2015) reported using their DHPs for both heating and cooling. The more the DHP is used, the more savings it should generate, and customers are using their units during all four seasons, albeit not always for all 12 months.**

Comment [PH1]: Should clarify that this is true only with the condition that it fully replaces previous system or perfect integration with backup system

pg. 10.

The majority of pre-existing cooling systems that were replaced by DHPs are no longer in use. Most participants used the DHP to serve all of their their cooling needs. Seventy two percent reported that they removed and disposed of their old system, 20% still using their pre-existing system and 9% reported that the systems remained installed but were not being used.

Comment [PH2]: Total 101% (?)

Survey respondents frequently mentioned that the DHP cannot provide adequate heat in colder weather.?. Although the savings rate of a DHP is influenced by the pre-existing HVAC system and fuel type, it is also influenced by how the pre-existing systems are integrated with the DHPs.

Nearly 17% of 2011 and 22% of 2013–2015 phone respondents reported that either they do not use the DHP during the coldest months of the winter, or that it is used as a back up to the pre-existing heating system (Error! Reference source not found.**). Sixty three percent of respondents operate their DHP as the primary heating system and use the pre-existing system as supplemental heat. Another 7% reported operating the pre-existing system in tandem with the DHP. Ten percent of respondents have transitioned to the DHP for 100% of their heating needs.**

Comment [PH3]: This there any link with the type / performances of the installed system, size of the area to heat, type of house?

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Based on respondent descriptions of how they operated their DHPs, and despite a sense that they understood the equipment, many were adopting operational strategies that lowers equipment efficiency and erodes the full potential of the DHP to save energy. Aside from reading the operating manual cover to cover, education is likely to be the only channel for customers to become familiar with information that describes the unique operating characteristics of the DHP and the operating strategies required to yield savings. Sixty-eight percent or survey respondents reported receiving an average of 36 minutes of education and training, with the 2013–2015 group tending to cite longer training periods. It is clear that the programs rebating DHPs take customer education very seriously.

Comment [PH4]: Are there specific Examples? It would be nice to know how, so that training could try to avoid them to use these strategies

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Takeback Effects

An objective of this study is to identify evidence of takeback effects from increased interior temperatures in anticipation of lower operating costs. "If I can save money with the DHP, maybe I can turn up the heat without increasing my bill." This attitude and a subsequent increase in indoor temperature settings were suggested as contributing to the low realization rate noted in the R16 study. After collecting information on customer's thermostat practices, interior set points before and after the DHP was installed, and customer attitudes, there was not enough evidence to conclude that temperature takeback was a factor in the low realization rate. There are several reasons why this is the case. Most important, it is difficult to make a one-for-one comparison between thermostatic behavior before and after installation of the DHP for three reasons:

Participants report that the DHP thermostat must be set 2-5 ○F higher than the pre-existing system just to maintain the same interior temperature.

Comment [PH5]: What system is it replacing / added to in this case? Since the DHP is mounted up on the wall, the heat can be felt differently by the occupant than coming from baseboard. Need to provide more specifics on this.

It is typical for the pre-existing system and the DHP to operate concurrently during colder months.

Thermostat settings for pre-existing equipment usually included a setback strategy but automated setback strategies are not used with the DHPs.

Comment [PH6]: What is the reason? Ui

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PSD Review

The approach taken to calculate DHP savings in the 2015 Connecticut PSD is in many ways the most advanced savings approach reviewed among neighboring states and the mid-Atlantic TRM. All of the savings formulas in the New York, New Jersey, Massachusetts, and the mid-Atlantic TRM adhere to the same core approach as the Connecticut PSD. However, the CT PSD also incorporates a savings factor that inherently includes operating efficiency and a realization rate that reflects evaluations performed since the study that produces those savings factors. All approaches reviewed used heating seasonal performance factor (HSPF) as the standard measure of heat pump heating efficiency, and seasonal energy efficiency ratio (SEER) as the cooling equivalent. Use of these values is consistent with industry practice. However, we note that HSPF does not include testing at temperatures below 17 degrees, which introduces uncertainty around its relevance for the DHP technology. A NEEP study also points out that DHP SEER rating may not be 100% representative of actual equipment performance in Connecticut because DHPs are tested under less extreme design temperatures.1

Comment [PH7]: What is the impact / error factor to be taken from this?

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Other Conclusions

The characteristics of operational patterns of DHP users indicate that this measure is a good candidate for a two-stage, variable degree-day billing analysis approach. The telephone survey and on-site audits revealed that customers adopt different strategies for integrating their DHP and their pre-existing heating systems that result in large swings of heating reference temperatures. A two-stage model (or PRISM-like analyses) calculates a unique reference temperature for each household and is the recommended approach. It is unknown whether adopting a variable degree-day model will increase or decrease the evaluated savings rate, but it should reduce statistical error and increase the reliability in the results.

Comment [PH8]: How would you define the thermostat set point for this analysis? Average customer data?

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Table 1. Overall survey response rate

Sample Description	Description	Number	Percent
Starting Sample	Phone numbers available	1,229	
Never Called	No attempts to contact were made	539	
Sample Used	Attempted to contact at least once	690	
Known Not Eligible	No eligible respondent, non-residential or terminated at screener questions	97	
Estimated additional not eligible	=(1-Percent Eligible)*(Not complete, unknown eligibility)	127	
Sample-Valid	=Sample Used – Known Not Eligible – Estimated additional not eligible	466	
Complete	=Phone interviews completed ÷ Sample Valid	124	27%
Refused	=Declined to participate in phone interview ÷ Sample Valid	51	11%
Not Completed - Eligible	=In queue to call back to complete interview with eligible respondent ÷ Sample Valid	27	6%
Not Completed - Est. Eligible	=Not completed, unknown eligibility * Percent eligible	264	57%

Comment [PH9]: What is the reason?

Comment [PH10]: Definition unclear, how are these defined?

Pg. 39
Influence of Fuel Prices on DHP Usage

[1] NEEP, Ductless Heat Pump Meta Study, November 13, 2014, p 8,9

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While the phone survey results hinted at the issue, the on-site survey provided an opportunity to understand the interplay between fuel prices and DHP use. In these visits, 3 out of 20 participants mentioned that because oil prices were so low, they were reverting to their existing oil burners as their sole heat source.

Comment [PH11]: Are these participants with oil installations?

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