BEFORE THE MARYLAND PUBLIC SERVICE COMMISSION

CASE NO. 9207

IN THE MATTER OF

POTOMAC ELECTRIC POWER COMPANY

AND

DELMARVA POWER AND LIGHT COMPANY

REQUEST FOR THE DEPLOYMENT OF ADVANCED METER INFRASTRUCTURE

DIRECT TESTIMONY OF NANCY BROCKWAY

ON BEHALF OF THE

MAYLAND OFFICE OF PEOPLE'S COUNSEL

OCTOBER 20, 2009

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Exhibit___(NB-1) Resume and list of testimonies of Nancy Brockway

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Exhibit___(NB-4) NIST principles for privacy protection

I. INTRODUCTION

Q. Please state your name, your business affiliation, and your address.

A. My name is Nancy Brockway. I am the principal of NBrockway & Associates, a firm providing consulting services in the areas of energy and utilities. My address is 10 Allen Street, Boston, MA 02131.

Q. On whose behalf are you testifying in this proceeding?

A. I am testifying on behalf of Maryland Office of People's Counsel (OPC).

Q. Please briefly describe your qualifications and experience.

A. Since 1983, my professional focus has been the energy and utility industries, with particular attention to the role of regulation in the protection of consumers and the environment. I was a Commissioner appointed to the New Hampshire Public Utilities Commission, serving from 1998 to 2003. Earlier, I was for several years a hearing officer and advisor to the Maine Public Utilities Commission and then to the Massachusetts Department of Public Utilities, where I served two years as General Counsel of the commission. I was an expert witness on consumer and low-income utility issues for seven years, with the National Consumer Law Center. Since leaving the New Hampshire Commission, I have been a consultant on regulatory utility issues to regulatory commissions, ratepayer advocates, low-income energy groups, and others. I also spent several months serving as the Director of Multi-Utility Research and Analysis with the National Regulatory Research Institute. While at NRRI, I researched and wrote a key objective study of the impact of advanced metering structure and related pricing options on residential consumers. I have written comments and filed testimony in the

Massachusetts Smart Grid proceedings now ongoing. My resume is attached as Exhibit___(NB-1).

Q. Have you previously testified before this Commission?

A. No. I recently filed testimony for the Maryland Office of People's Counsel in Case No. 9208.

Q. Have you testified on utility matters before other Commissions?

A. Yes. I have filed testimony in over 30 proceedings. I have appeared before fifteen state or provincial regulatory commissions.

Q. What is the purpose of your testimony today?

A. I have been asked to review the Smart Grid filing of Potomac Electric Power Company (Pepco) and Delmarva Power And Light Company (Delmarva) (collectively PHI or "the Companies"), to:

- analyze the evidence regarding the likely residential demand and energy reductions enabled by the Companies' proposed Smart Grid program,
- review uncertainties in the evolution of smart grid technology and protection of consumer privacy that could affect costs and timing of prudent investments,
- review potential adverse impacts of the Companies' proposed PHI Dynamic Pricing rider on vulnerable residential customers,
- analyze the impact of the proposed Smart Grid program on residential consumer rights and protections, and
- make recommendations for mitigating adverse impacts on residential customers associated with the proposed Smart Grid program.

Q. Is your testimony intended to be a stand-alone presentation?

A. No. My colleague J. Richard Hornby, of Synapse Energy Economics, Inc. is presenting testimony dealing with, among other things, the analysis of costs and benefits for the proposed Smart Grid deployment. He will discuss the extent to which uncertainties in key assumptions that I discuss bear on the strength of the cost-benefit analysis. My colleague David J. Effron, of Berkshire Consulting Services, is presenting testimony to address the Companies' proposed cost recovery mechanism.

Q. Please summarize your conclusions.

A. My conclusions are as follows:

- Estimates of demand response to the PHI Dynamic Pricing (DP) riders are subject to uncertainty. Participation rates are subject to uncertainty. Assumptions as to persistence or sustainability of demand response are subject to uncertainty. Estimates of energy savings from PHI DP riders are subject to uncertainty.
- There are effective alternatives for obtaining demand response that can be put in place today, without requiring the massive investment needed for AMI.
- Standards and protocols necessary to design and operate an advanced metering infrastructure, and to protect consumer privacy, are still in a state of flux, and investments made now, before the standards have been established, are at risk of obsolescence.

It would be prudent to wait a year or more on detailed AMI design and on AMI deployment to see if the ambitious NIST standards-development schedule has been successful. In such a case, PHI (and its customers) would not have to take the risks of an early adopter (much less a pioneer).

- Implementation of dynamic pricing puts vulnerable customers at risk.
- Installation of advanced meters will open the door to practices such as remote involuntary disconnection, prepayment metering, and use of service limiters, all of which threaten customer access to service.

- Proposed notice provisions for the election of alternative options under the DP rider are too restrictive.
- The label "critical peak rebate" is misleading and confusing given the manner in which the Companies propose to return benefits of CPR customer load reductions to next year's CPR customers as a group.

Q. Please summarize your recommendations.

A. I recommend the following:

- Before moving ahead with their AMI plans, the Companies should update their cost-benefit evaluations of the proposed smart grid installation to take into account the uncertainties as to the level of likely demand and energy reduction and as to the persistence of such reductions in response to the smart metering program, and if the utility wishes to proceed on the basis of the estimates used in this filing, it should do so at its own economic risk,
- PHI should be required to demonstrate that comprehensive and effective cyber security, interoperability and privacy standards, and strong enforcement mechanisms, are in place before it proceeds with deployment of that advanced metering infrastructure,
- In the short term, PHI should pursue Direct Load Control and other proven programs to obtain demand reductions.
- The Companies should take steps to identify potentially vulnerable customers and develop and provide means of mitigating the risks they face as a result of the deployment of smart metering and PHI DP rider pricing, including use of

volumetric rates, rather than fixed per customer rates, to recover the cost of the smart grid installations.

- The Companies should agree that they will not use their proposed AMI technologies to undermine the consumer protections afforded Maryland electricity customers now by law, regulations and practice, including protections against unfair and unreasonable service termination, and before including remote disconnection capability in their AMI present a definite plan for its proposed use of remote disconnection containing adequate consumer and public safeguards, for Commission review.
- The Companies should revise and liberalize their proposal for locking customers in to a DR option for one year periods and requiring 30 day advance notice of the intent to change options, unless they demonstrate that such limitations are essential to prevent unreasonable levels of gaming by residential customers.
- The Companies should revise their Critical Peak Rebate to provide rebates to individual customers, or change the name to more accurately reflect the mode of returning benefits to customers.

II. DESCRIPTION OF PHI AMI PROPOSAL

Q. Please describe the investments PHI intends to make in its residential service under its AMI proposal.

A. PHI intends to install hourly-read meters at the premises of all its Maryland Delmarva and Pepco customers. These meters will be fitted with a network interface card (NIC) that will allow communications between the meter and utility data collectors, as well as communication with a customer's Home Area Network (HAN), if any, using the ZigBee™ radio protocol. PHI plans to include a remote connect/disconnect switch in residential premises. In addition, the Company plans to install an enterprise-wide communications infrastructure. PHI also proposes to make what it calls AMI-related communications upgrades (Gausman Direct, p. 38). PHI will also install network management systems and meter data management systems. PHI plans to integrate the AMI systems deployed in the Maryland and Delaware Delmarva service areas with Delmarva's existing systems.

Q. What rates and programs does PHI propose to offer residential customers in Maryland using its AMI?

A. PHI plans to implement what it calls the DP Rider. Under the DP rider, there will be three options for Standard Offer Service (SOS) residential customers: the critical peak rebate (CPR) rate, the flat SOS rate, or critical peak pricing (CPP). The default rate for customers who do not choose among these three options will be the critical peak rebate rate. PHI plans that the new rider would be fully implemented by the end of the first quarter of 2011 for Delmarva Maryland and mid 2011 for Pepco Maryland. SOS customers could change to a different option under the DP rider once a year. They will receive 30 days' notice of the opportunity to opt out of their current rider option, and move to one of the other two (Bumgardner Direct at fourth unnumbered page, lines 13-14). Non-SOS customers will not have these three PHI-provided options.

Q. You have used the terms "default" and "opt out." Please define these terms, and also the term "opt in."

A. The terms "default," "opt out" and "opt in" refer to the choices the customer has with respect to taking service on the rate. A default rate is one that will apply if the customer makes no affirmative choice for a particular rate. A customer on any given rate may choose to change to a different rate under the terms of the tariff (in this case, once a year, upon giving 30 days' notice). To do this, they have to opt out of the rate they are now on. If they are not defaulting to the default rate, the customer must affirmatively choose another available rate. The customer is said to opt in to the different rate.

Q. Will the utilities install enabling technologies in the homes of participating customers?

A. No, only to the extent the customer is enrolled in the Direct Load Control program, discussed below, in which a switch or thermostat is placed on the central air conditioning unit or heat pump at the eligible customer's premises, and used to cycle the unit(s) off in exchange for an incentive payment. Other enabling technologies, such as water heater timer switches, programmable thermostats, or lighting controls are not provided as part of the AMI programs of the utilities (Response to OPC DR No. 21A). Customers may purchase and install such enabling technologies themselves. *Id.*

Q. Please briefly explain how the two new rates, CPR and CPP, are priced, starting with the Critical Peak Rebate option.

A. Both "critical peak" rates, CPR and CPP, differ from the flat SOS generation rate in that different prices are charged when the utility calls a critical peak event. Under the DP rider, a critical peak event can be called no more than 15 days out of the year, and for no longer than the 4 hours between 2 P.M. and 6 P.M, or a maximum of 60 hours. These hours are typically in the summer, during a business day. In the case of the critical peak rebate (CPR), as proposed by PHI, customers would pay the same rate as the flat rate SOS customers, but would obtain a CPR adjustment in the year following for their share of the overall reduction in usage by CPR customers during that year's critical peak (e.g., Exh. JRB-3). This adjustment can only be to the customers' benefit; if CPR customers use more than their baseline amounts, they pay the flat SOS rate for that usage. This adjustment to the CPR rate in the following year is the "rebate" to which the name of the rate refers. The CPR customers' reductions are defined relative to a baseline set by average of the customer's usage in the highest load hours of the last 30 days (Exh. JRB-3).

Q. Please explain how the PHI Critical Peak Pricing option would work.

A. Critical Peak Pricing (CPP), in contrast to CPR, is a form of explicit time-varying pricing. Customers on the tariff are charged very high generation rates per kWh during the times called as critical peaks. Because the high rates during those 60 hours bring in more revenue than the flat SOS tariff for each kWh that CPP customers use during those hours, the charges for the non-critical peak hours are adjusted slightly downwards, to maintain revenue neutrality.

Q. Please describe how the so-called "rebate" will be credited to CPR customers.

A. Each year, PHI will calculate the level of benefit per kWh for the upcoming peak season. As part of this calculation, the estimated resource value of critical peak reductions will be adjusted by the aggregate benefit from the prior year, spread across all the maximum potential kWh of critical peak reduction. (e.g. 60 hours) (Bumgardner Direct, antipenultimate page at lines 21-25, penultimate page, lines 1-5, fourth page before last, line 11).

III. AMI DEMAND AND ENERGY RESPONSE UNCERTAIN

Q. Do the Companies quantify the amount of demand reduction they expect to see as a result of customer participation on the CPR and CPP rates?

A. Yes. The Companies estimate the amount of demand and energy reduction the system will experience as a result of the Dynamic Pricing rates, and use this information to justify the proposed investment in AMI.

Q. On what does PHI base its demand response estimates?

A. PHI Witness Faruqui developed the estimates of demand response to the Dynamic Pricing rates. PHI Witness Faruqui first estimated the numbers of customers with AMI in any given year, based on PHI deployment plans. (Faruqui Direct, pp. 17-18). PHI Witness Faruqui then assumed that at first, 100% of residential SOS customers would be taking service under the CPR option of the rider, because this would be the default option under the PHI plan (*Id.* at 19). PHI Witness Faruqui assumed that after the initial implementation of the rider, 55% of residential customers would be taking service under the CPR option, 20% would be on the CPP option, and the remaining 25% would be on the flat SOS rate (*Id.* at 5). PHI Witness Faruqui developed these participation assumptions based on market research conducted by Momentum Market Intelligence (MMI) as part of the California Statewide Pricing Pilot (CA SPP) (Response to Staff Data Requests, July 17, 2009, No. 47).[1] PHI Witness Faruqui then applied estimates of price elasticity for each of the three groups, derived from the recent Baltimore Gas & Electric Special Energy Pricing (SEP) pilot, to local weather conditions, load shapes and load levels (*Id.*).

Q. On what does PHI Witness Faruqui base his estimates of the level of demand response of the customers in each DP rider group?

[1] Momentum Market Intelligence, *Customer Preferences Market Research (CPMR): A Market Assessment of Time-Differentiated Rates Among Residential Customers in California*, research conducted December 2003, prepared for Southern California Edison, Pacific Gas & Electric, and San Diego Gas & Electric. Appendix D, Section 4.4, Enrollment Rate, pp. 29-33.

A. PHI Witness Faruqui used price elasticity assumptions drawn from the 2008 Special Energy Pricing Pilot performed by Baltimore Gas & Electric (2008 BGE SEP) (Faruqui Direct, p. 5).

Q. Are there sources of uncertainty in the estimate of likely demand reductions in response to the proposed Dynamic Price rider?

A. Yes. There are three key types of uncertainty in the Companies' estimate of likely demand reductions in response to the proposed Dynamic Pricing rider. They are the following:

- Uncertainty as to the response of the actual customers who will respond to a real rate, as opposed to pilot participants.
- Uncertainty as to the persistence of demand responses throughout the project forecast period.
- Uncertainty as to the energy savings attainable in response to critical peak pricing and rebates.

I discuss each of these uncertainties below.

Q. What are some of the adverse consequences that could follow from deployment of AMI and related pricing options in light of the uncertainties you describe in your testimony?

A. As discussed further by OPC Witness Hornby, benefit to cost ratios that appear positive may in fact be negative if rosy predictions made by the Companies are not realized in actuality. Costs will be incurred beyond the sum of benefits gained. In the case of AMI, the customers stand to lose in such a situation, although they will have little control over deployment decisions, unless the Companies ensure that they will hold the customers harmless from an overestimation of benefits. This issue is particularly important where, as here, the Companies do not explain how any demand reductions that are obtained will be monetized through the PJM process.

A. UNCERTAINTY AS TO REAL TARIFF CUSTOMER RESPONSE

Q. What do you discuss in this section of your testimony?

A. In this section, I discuss the potential differences between the types of customers who have participated in the pilots from which PHI draws its estimates of customers responding to the actual tariff, and customers likely to take service under the tariffs if they are implemented not as pilots but as part of the utilities' ordinary tariff offerings. I also discuss the likely uncertainties such differences introduce into estimates of the amount of demand response achievable from institution of the DP rider rates. I further discuss uncertainties in the demand response estimates developed in the cited pilots.

Q. What do you mean by uncertainty as to the types of customers who will respond to a real rate, as opposed to pilot participants?

A. There are a number of reasons why a customer will participate in a pilot, and respond to the incentives contained in that rate. However, the motivation of the customers who participate in a pilot may not be representative of the motivations of customers generally. In social science pilots, the differences between the customers who participated in the pilot, and the universe of customers who will be on the tariffed DPR rider, would constitute "selection bias." This is not a pejorative term – it does not imply intentional bias, but rather simply refers to a mismatch between the pilot treatment group and the general population that could undermine the usefulness of the pilot results.

Q. How could the motivations of pilot participants be different from the average customer?

A. In the 2008 BGE SEP pilot referenced by PHI Witness Faruqui as the source of his elasticity estimates for PHI, participants were offered a $150 appreciation payment for their participation (See PHI Witness Faruqui's evaluation of the 2008 BGE SEP, p. 27).[2] It goes without saying that such an inducement will not exist under the PHI DP riders. In addition, during the selection of participants, according to the 2008 BGE SEP report, a significant number of those approached by PHI as potential participants declined the invitation or later dropped out (*Id.* at 6). The evaluators could not know why some who were invited to participate declined, and all the reasons why participants would drop out (*Id.*). It is possible that the same factors that led customers to decline the invitation or drop out of participation will affect customers in the general population, and that these customers would not show as much demand response. Of necessity, pilots are artificial situations. They involve human beings, not test tubes.

Q. Does the Customer Preferences Market Research (CPMR) cited by PHI Witness Faruqui support his assumptions as to participation of customers in the DP riders?

A. The CPMR provides some useful information about possible customer responses, but it is a survey of opinions and attitudes, not the review of an actual DP rider deployment, and not even the evaluation of a pilot DP rider. The authors of the CPMR themselves caution more than once that questions remain about the relationship of the survey and consumer choices in "real" markets (CPMR, p. 5). As they explain, "it is important to recognize that this research is constrained by the fact that ultimately it is customer research and not a real market environment." *(Id.* at 4).

> [The research method used here], discrete choice ... works by asking customers what choices they would make under certain constraining conditions. Whether or not those are the choices customers would make under real conditions (i.e., when

[2] Per Response to OPC DR 4-24, this evaluation is available at BGE_SEP_Summer_2008_Report.pdf.

customers have “skin in the game,” that is they have to live with the consequences of their choices), and whether or not the constraining conditions assumed in the research either accurately represent the key features of real markets, or do not affect customer choices ultimately, are all factors that can affect the inherent validity of the data collected through discrete choice analysis *(Id*. at 5-6).

Q. Has PHI run sensitivities to explore the impacts of other rates of participation?

A. In response to Staff DR, July 17, 2009, Question 49, PHI states that it has not performed studies of the demand reductions under alternate scenarios of customers opting into and out of DR rider alternatives.

Q. Has PHI tried to determine if it requires the participation levels it estimates in order for consumers to break even?

A. No. In response to Staff DR, July 17, 2009, Question 50, PHI states that it has not performed a study to determine the level of participation at which the present value of revenue requirements equals the present value of revenue.

Q. Are there factors present in other AMI pilots that cause you to be cautious in assuming that customers generally will respond at the same level as participants in those pilots?

A. Yes. Possible differences in pilot and tariff offerings from other pilots include the following:

- Cash incentives for participation.
- Requirement to join a membership organization with an emphasis on energy efficiency and environmental issues.
- Requirement that applicants be able to read and understand letters of solicitation sent by their utility.
- Need to be reachable by the utility within the time frame of the solicitation of interest.

- Interest in helping solve the state's energy problems or responding to an energy crisis.

Q. Why is it hard to develop a comprehensive understanding of the likely reactions of customers to actual DR riders?

A. There are a large number of factors that are understood to influence consumer decision-making, and it would take an enormous pilot to capture them all.

Q. Can you provide some sense of the variation among groups of consumers?

A. As is well known, marketers routinely separate consumers into numerous discrete groups for purposes of targeting products and services, and their advertising and sales. Different firms and authors have different ways of categorizing customers. A list of commonly-used attributes for segmenting markets is provided by Steven J. Moss in his paper, *Market Segmentation and Energy Efficiency Program Design*, published in November 2008 by the California Institute for Energy & Environment:[3]

- Demographics
- Geographic (e.g., neighborhoods, feeder lies, or distribution planning areas)
- Decision pathways (e.g., individual or institution; renter or owner)
- Knowledge
- Needs
- Values
- Attitudes
- Motivations
- Preferences
- (Energy) use patterns
- Access to financing
- Access to information
- Trust levels
- Competing products
- Equipment turnover patterns
- Behaviors associated with the product and/or service
- Sensitivity to price or features
- In the case of businesses, their size in terms of employees and energy use,

among other variables.

[3] Available at http://uc-ciee.org/energyeff/documents/MarketSegementationWhitePaper.pdf.

The inability of pilots to capture all of these potentially influential differences among the customers as a whole introduces some uncertainty into the applicability of pilot results.

Q. Can you give an example of a mismatch between pilot participants and real life customers on a critical peak tariff?

A. Yes. The experience of Pacific Gas & Electric in 2008 suggests that pilots may not provide a firm basis for estimating post-pilot participation.[4] After a pilot that indicated high average responses to critical peak pricing, PG&E introduced critical peak pricing (SmartRate™) on an opt-in basis to its customers in Bakersfield and Kern counties in California. The Company solicited 100,000 customers to participate, and about 7.5% of residential customers who received the invitation did opt to take service under the SmartRate™. Load reductions per customer were in line with per customer load reductions forecast on the basis of the California pilot. However, the initial experience with PG&E's critical peak tariff produced unexpected results as to the types of customers who opted to take service on the rate. According to the Impact Evaluation, a "disproportionate number of CARE customers enrolled in SmartRate relative to the share of CARE customers in the Bakersfield area."[5] CARE customers are low-income customers who take service under a reduced rate of the same name. The report observed that, whereas approximately 35 percent of Kern County residential electricity customers who were sent marketing materials were low-income rate customers, 56 percent of customers who enrolled in SmartRate™ in 2008 were low-income rate customers. The report also noted that, as had been expected based on the pilot, CARE customers had

[4] Material on the PG&E critical peak pricing experience is drawn from Stephen George, et al. *2008 Ex Post Load Impact Evaluation for Pacific Gas and Electric Companies' SmartRate™ Tariff, Final Report*, December 30, 2008.

[5] Stephen George, et al. *2008 Ex Post Load Impact Evaluation for Pacific Gas and Electric Companies' SmartRate™ Tariff, Final Report*, December 30, 2008, at 4.

much lower demand reductions (both in absolute and percentage terms) than non-CARE customers on the critical peak rate. The average load reduction by CARE customers across the critical peak period for the nine critical peak days called that summer was 11.0 percent. By contrast, the average load reduction of non-CARE customers was twice as great, at 22.6 percent. One possible reason that low-income customers were over-represented among SmartRate™ customers, according to the evaluators, was that such customers were on the lookout for opportunities to reduce their bills, and associated new offerings by the utility as such opportunities.

Q. What do you infer from the PG&E experience with SmartRate™ in 2008?

A. The disproportionate take-rate for the tariff by customers with relatively low average demand responses gives rise to a question about whether pilot responses (in terms of average load reductions time numbers of participants) can be used to predict the overall load reductions that the tariff will produce.

Q. Is there further support for your opinion that estimates of demand reduction in response to AMI-supported prices are uncertain?

A. Yes. A recent Federal Energy Regulatory Commission Staff Report[6] shows that the level of customer participation and associated demand reductions are by far the most uncertain factors in estimating the impacts of AMI-supported demand response programs.

B. UNCERTAINTY AS TO PERSISTENCE OF DEMAND REDUCTIONS

Q. Are the Companies' projections of sustained participation in demand reduction in response to its proposed DP rider solid?

[6] The Brattle Group, Freeman Sullivan & Co., Global Energy Partners, LLC, *A National Assessment of Demand Response Potential*, prepared for the Staff of the Federal Energy Regulatory Commission, June 2009. Note that PHI Witness Faruqui was a key contributor to and co-author of this report.

A. No. As with other aspects of the Companies' assumptions as to demand reductions (and associated benefits), there is no basis for assuming that year in and year out, over the full project horizon, residential customers will participate in the numbers and to the extent projected by PHI. There is thus considerable uncertainty in the Companies' estimate of long-term demand reductions from the introduction of dynamic pricing.

Q. Is the sustainability or persistence of demand responses to the DP riders an important factor in assessing the benefits of the DP prices?

A. Yes. As PHI Witness Faruqui says in response to OPC DR 4-6, persistence of impacts is necessary to realize the benefits quantified in our analysis, "because that is what is driving the long run deferral or avoidance of incurring new generation costs."

Q. Are there reasons to question the period of years over which initial DP rider load reductions will persist?

A. Yes. Although there have been numerous pilots, and a number of utilities have started full deployment of critical peak tariff designs on an AMI platform, there is not a long track record to point to. Most pilots have run one summer, or at most two. The longest pilot ran 4 years, and for a number of reasons may not provide results transferable to the PHI situation. Full deployments are very new, and as noted above in the PG&E case, are already producing surprises. For this reason, caution should be exercised in extending results from one or two summers to a number of years.

Q. What does the FERC Staff study on achievable demand response say about assumptions for participation in price-based demand response options?

A. The National Assessment for Demand Response Potential, prepared by PHI Witness Faruqui and others for the FERC staff, notes at p. 62 that only "limited" experience with price-based demand response has been gathered to date. The study acknowledges that "there is very little experience and research to date upon which to base" assumptions as to participation rates. *Id.* Based on the experience of Pacific Gas & Electric, the authors concluded that over the long term, 5% would be a conservative estimate of residential participation.

Q. Can you cite an example of a surprising difference between pilot participation (and demand reductions) and the demographics of a real-life AMI-facilitated tariff?

A. Yes. The most recent experience for a dynamic rate for residential customers involves the Pacific Gas & Electric Company SmartRate™ tariff, which is a critical peak pricing tariff that was offered in 2008 to residential customers in the part of the PG&E service territory where AMI meters had been installed. The program was offered through direct mail and roughly eight percent of customers enrolled after a single mailer.[7] Retention rates were estimated based on the percentage of pilot participants who remained on the rate for one year after the pilot was concluded, without the pilot financial incentives and for residential customers in spite of having to pay an incremental meter charge (*Id.*). The authors acknowledged that at least in one case, the participation rate might be expected to drop after the expiration of the first-year bill protection offered to the C&I customers who remained on the critical peak/TOU rates beyond that first year (*Id.*).

Q. Are there other reasons to question the length of time over which the estimated load reductions will persist?

A. Yes. If we look back to the efforts of regulators to introduce time-of-use pricing in the 1970's and 1980's, we see a pattern of initial interest in the rates, participation leveling off, and eventual consumer abandonment of the rates. That period in regulatory history was similar to today, in that a number of events came together to focus public attention

[7] Freeman, Sullivan Group, *2008 Ex Post Impact Evaluation for Pacific Gas & Electric Comnpany's SmartRate™ Tariff: Final Report, December 2008,* p. 4. Available at http://www.smartgridnews.com/artman/uploads/1/3_PGE_SmartRate_Ex_Post_Analysis_12-30-08.pdf.

on the costs (and environmental impacts) of electricity. Many commissions led the electric utilities under their jurisdiction to offer time-of-use rates on a voluntary basis. A number of residential customers signed up for these TOU rates at first. But they did not remain on the rate for the long haul. For example, one major New England utility had 26,500 residential customers on its TOU rate in the mid-80s, but in 2004, only 11 customers remained on the rate.

Q. Are there other examples of customer interest in time-varying rates not persisting over time?

A. Yes. In response to the Western market crisis in 2001, Puget Sound Energy introduced time-of-use rates on a default (opt-out) basis in an effort to curb peak demands. In the first year, almost all residential customers remained on the rate. However, in the next year, when the utility proposed to show the costs of the tariff implementation (e.g. smarter meters) in rates, customers began opting out rapidly, and the public outcry against the rate pushed the Company to withdraw it.

Q. Are you saying that customer participation in the PHI Dynamic Rate Tariff options will not persist?

A. I am saying that there is great uncertainty as to whether the demand reductions in response to the proposed PHI Proposed Dynamic Rate Tariff options will persist. Early interest may erode, and possibly quickly.

C. UNCERTAINTY AS TO LEVEL OF REDUCED ENERGY

Q. Does PHI Witness Faruqui claim any energy savings for PHI's proposed DP rider?

A. PHI Witness Faruqui has included an assumed energy reduction of 1.5% in all non-critical-peak hours in his estimation of the benefits of customer response to the DP rider options (Faruqui Direct, p. 8, note 4).

Q. To what does PHI Witness Faruqui ascribe the energy reduction he assumes in his analysis?

A. PHI Witness Faruqui states that "residential customers will reduce their consumption during all hours as a result of having better feedback information about their electricity consumption patterns (Faruqui Direct p. 8, lines 7-10, footnote omitted).

Q. On what basis does PHI Witness Faruqui assert that better feedback information will incent residential customers to reduce their consumption in all hours?

A. In response to OPC DR 4-11, cites a survey he conducted of the conservation benefits from customers having access to better information about their electricity consumption behavior.[8] In that same response, PHI Witness Faruqui cites an article titled "Efficiency and Demand Response: Twins, Siblings or Cousins."[9]

Q. Do the articles cited by PHI Witness Faruqui demonstrate that the DP rider options will induce energy conservation outside the critical peak hours?

A. No. They provide meager or anecdotal support for the energy conservation assumption.

Q. Does the literature demonstrate that feedback to customers produces clear and quantifiable consumption reductions?

A. No. The literature reviews do not paint a very clear picture of likely responses to in-home displays. Some literature reviews conclude that in-home displays produce measurable reduction in usage. Others are less definitive, or even cautionary. Often-cited in support of in-home displays is a literature review prepared 2006 in Sarah Darby of the Oxford [England] University Environmental Change Institute, entitled "The

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[8] "The Impact of Informational Feedback on Energy Consumption – A Survey of the Experimental Evidence," provided as an electronic file in response to OPC DR 4-11.

[9] Chris King and Dan Delurey, "Efficiency and Demand Response: Twins, Siblings or Cousins." Arlington, VA. Public Utilities Fortnightly, March 2005, p. 54.

Effectiveness of Feedback on Energy Consumption."[10] Additional study results compiled by SMIP advocates include reports by the Brattle Group.[11]

Q. Does the Darby study support the Company's expectations as to energy reductions from in-home displays?

A. The Darby study does collect some apparent support for the idea that some kinds of feedback can induce energy conservation, and suggests usage reductions could range from 5% to 15%. However, these results should not be the basis for $100 million in investments. The results cited in the study are mixed, some of the often-cited studies are not relevant to North America, and the studies do not yet answer all the relevant questions, as can be seen from the characteristics of the studies Darby reviewed. Darby looked at a total of 38 studies. However, only 18 of them were related to the kinds of direct feedback that PHI asserts will lead to significant conservation, such as in-home displays. Of these only four actually studied effects of in-home-displays; the balance involved improving feedback by going from bimonthly billing to monthly billing. Ten of the relevant studies were done in Europe; Darby herself acknowledges that cultural and other differences can affect the results (Darby report, p. 9). Of the 18 relevant studies, six included intensive education (such as home visits or conservation affinity groups), which is not proposed for the PHI service territory. Seven of the 18 had no controls, or very small sample sizes, including three of the studies of some form of in-home display. Fourteen were done before 2000 (including two of the four studies of in-home displays).

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[10] Available at http://www.eci.ox.ac.uk/research/energy/downloads/smart-metering-report.pdf .

[11] *See* Ahmad Faruqui and Lisa Wood, *Quantifying the Benefits of Dynamic Pricing in the Mass Market,* Appendix G, January 2008. Available at http://www.brattle.com/_documents/UploadLibrary/Upload663.pdf. *See* Ahmad Faruqui, Sanem Serguci and Ahmed Sharif, *The Power of Informational Feedback on Energy Consumption: A Survey of the Experimental Evidence."* 2009. The Brattle Group: Discussion Paper. Available at http://www.brattle.com/_documents/UploadLibrary/Upload772.pdf.

Eight of the studies were done before 1990 (including one of the four in-home display studies). Half the studies ran 5 months or fewer, with 6 running only 1 or 2 months in total. Sustainability over several years was not established by these studies.

Q. Are there other recent reviews of the value of real-time feedback, such as through in-home displays?

A. Yes. Recently, the Florida Solar Energy Center (FSEC) published a report on the potential of residential energy feedback devices.[12] In this study, the authors recited earlier studies suggesting a meaningful reduction in overall energy as a result of real-time feedback. The authors cautioned, however, that more research is needed to understand how and the extent to which real-time feedback causes lower usage (citations omitted):

> Early research suggested that effective energy information to consumers can be a powerful means of altering behavior and consumption....However ... behavioral influences of feedback [are] largely un-researched in recent years. Also, occupant interest in energy feedback will likely be influenced by the relative price of energy...another area where available research information is dated. Little, too, is known about the degree to which feedback display design itself determines the magnitude of reduction, although the available information would suggest that bold, vivid displays are best...Another potentially critical topic is the potential interaction with critical utility pricing signals....Information is also lacking on behavioral persistence...

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[12] Danny Parker , David Hoak, Alan Meier and Richard Brown, *How Much Energy Are We Using? Potential of Residential Energy Demand Feedback Devices*, FLEC-CR-1665-06, originally published as part of the Proceedings of the 2006 Summer Study on Energy Efficiency in Buildings, ACEEE, Alsilomar, CAS, August 2006. Available at http://www.fsec.ucf.edu/en/publications/pdf/FSEC-CF-1665-06.pdf.

Q. Does the FSEC study on feedback devices include any further cautionary information?

A. Yes. First, one wall-mounted display feedback device tested by the authors took nearly three hours to install. The device also measured apparent power without correction for power factor, resulting in readings that were inaccurate by 7.9% on average. The other device had an average relative error of 3.7%. The devices were also unable to discern small loads, such as a garage door opener or a cordless phone.

Q. Is there further support for your view that utilities should be cautious in assuming any energy savings from feedback provided via the AMI and DP rider options?

A. Yes. The Electric Power Research Institute (EPRI) recently issued a comprehensive report on the state of current knowledge about the effects of "feedback" on customer usage behavior.[13] EPRI reviewed studies discussed in the Darby and Faruqui papers in an effort to quantify the value of in-home displays in producing a conservation effect (energy savings). EPRI considered the Darby study and others, including studies of the effects of time-varying pricing as a form of feedback. EPRI concluded that "residential electricity use feedback" can be an effective tool. However, EPRI cautioned that further research is necessary on such points as "participation levels, the persistence of feedback effects, the relative value of different types of feedback, dynamic pricing interactions, and distinguishing the effects of feedback among different demographic groups" (Feedback Research Synthesis, Executive Summary, p i). EPRI's identification of gaps in the state of our knowledge about impacts of feedback is attached to my testimony as Exhibit___(NB-2).

[13] *Residential Electricity Use Feedback: A Research Synthesis and Economic Framework.* EPRI, Palo Alto, CA: 2009. 1016844 (*Feedback Research Synthesis).* Available at http://www.opower.com/LinkClick.aspx?fileticket=MFQLSk4GQD4%3D&tabid=76.

Q. What do you conclude about the reliability of the Darby paper and similar compilations of studies of feedback pilots in predicting usage reductions in response to feedback?

A. The Darby study and similar compilations of studies published to date cannot support any particular assumptions about energy conservation responses to the feedback of critical peak period electricity usage and bills.

Q. With respect to energy consumption changes associated with Smart Meter pilots in North America, what do the evaluations show?

A. It is hard to evaluate the change, if any, in energy consumption brought about by Smart Meter prices and associated initiatives. Not all demand response pilots estimate energy consumption changes associated with the pilot treatments. Where they do, estimates of energy consumption changes in evaluations of Smart Meter pilots in the United States and Canada range from modest usage reductions to actual usage *increases*. There are a number of hypotheses about what prompts customers to change their usage, up or down. But there is little focused research that can tell us why this pilot showed no consumption change, that pilot showed consumption reductions, and this pilot showed consumption increases.

Q. Please provide some examples of instances in which customers increased usage while participating in a Smart Meter demand response pilot.

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A. There are a number of examples of energy usage increases in Smart Meter pilots. In the California Special Pricing Program, in one mild-temperature period, customers in one treatment group increased load by 8 percent.[14] In a real time pricing pilot fielded by the

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[14] Karen Herter, Patrick McAuliffe and Arthur Rosenfeld, "An exploratory analysis of California residential customer response to critical peak pricing of electricity," Energy, 32 (2007):25-34 (Exploratory Analysis). Available at www.elsevier.com/locate/energy. *See also* Pat McAuliffe and Arthur Rosenfeld, "Response of Residential Customers to Critical Peak Pricing and Time of Use Rates During the Summer of 2003," California Energy Commission, September 23, 2004.

Pacific Northwest National Laboratory, peak load decreased by 15 to 17 percent, but overall energy consumption increased by approximately 4 percent. Similarly, AmerenUE found that participants in its Residential TOU Pilot who were on the CPP rate with a smart thermostat (the treatment group that consistently shows the highest demand responses to such AMI-supported pricing) increased their usage during the three-hour period after the end of a critical peak period, by 11.6%.[15] Evaluators of the Anaheim (CA) Critical Peak Pricing Experiment found that customers in the treatment group used more energy on the critical peak days than the control group (Impacts, p. 30). In Ontario, participants increased load during one critical peak period *(Id*. at 40). Time-of-Day-Only customers in the Idaho Power pilot increased their consumption during on-peak hours in one of the years of the pilot *(Id*. at 38).

Q. As to energy savings, what do you conclude from the Smart Meter pilot results?

A. I conclude that it would not be prudent, at least based on evidence to date, to include estimated energy consumption reductions as an expected result of introducing the AMI-based DP rider options.

IV. AN EFFECTIVE ALTERNATIVE TO AMI – DIRECT LOAD CONTROL

Q. Are there effective and less costly ways to obtain residential consumer critical peak reductions than by installing AMI and implementing dynamic pricing based on hourly meter reads and two-way communication networks?

[15] Research Reports International, "The Impacts of Dynamic Pricing on Electricity Usage (Impacts)," p. 20.

A. Yes. Many utilities have had good results from a Direct Load Control program.

Q. Do the PHI Companies offer a direct load control program?

A. Yes.

Q. Please briefly describe the PHI direct load control (DLC) program established for Maryland.

A. On April 18, 2009, the Commission approved the proposals of Pepco and Delmarva to implement a residential Direct Load Control (DLC) program in their respective service areas. These DLCs are voluntary demand response programs open to customers with central air conditioning or heat pumps. They do not rely on the implementation of AMI. In exchange for payments of $40, $60 or $80 respectively, the participating customers allow the utilities to install either an outdoor cycling switch or a programmable thermostat that allows the utility to control the home's central air conditioning system during critical peak energy use hours. The payments increase as the percent of time the utility may cycle off the central air conditioning or heat pump during the peak hours.

Q. Is the present DLC program of Pepco and Delmarva successful in reducing demand?

A. Yes. According to the Ten Year Plan (2008-2017) of Electric Companies in Maryland, prepared by the Commission for the Maryland Department of Natural Resources in February, 2009,[16] for the 2011/2102 PJM RPM Capacity Auction, Pepco bid and cleared 102 mW of demand reduction, and Delmarva bid and cleared 25.6 mW of demand reduction on the basis of their DLC programs.

Q. Is the present DLC program of Pepco and Delmarva cost effective?

[16] Ten Year Plan at 33 - 34. All references here are to this description, unless otherwise noted. Available at webapp.psc.state.md.us/intranet/sitesearch/whatsnew/Ten%20Year%20Plan%202008%20-%2018.pdf.

A. The Pepco benefit/cost ratio was estimated at about three to one (3 to1), and the Delmarva benefit/cost ratio for the Direct Load Control program was estimated at seven to one (7 to 1).

Q. Is there any reason why the DLC program could not be continued even if AMI installation were put off?

A. No.

Q. Has PJM accepted bids to provide Direct Load Control in its capacity market?

A. Yes. PJM has accepted load control bid into the 2011/2012 PJM RPM Capacity Auction from both Pepco and Delmarva in Maryland (Ten Year Plan, pp. 33-34).

Q. What do you conclude about the relationship between AMI and the Companies' Direct Load Control programs?

A. I conclude that AMI is not necessary for the Companies to successfully achieve residential load reductions through their ongoing Direct Load Control programs. Should the Companies want to obtain demand reductions pending eventual implementation of AMI, they need not wait before fielding a direct load control program.

V. AMI INFORMATION TECHNOLOGY ISSUES

A. UNFINISHED CYBER SECURITY AND INTEROPERABILITY STANDARDS

Q. Please now turn to the question of the dynamic nature of information technology in the advanced metering industry. To what extent has the industry settled down, and developed protocols and standards of general applicability?

A. Advanced metering infrastructure is still experiencing rapid technological development. Vendors are promoting their solutions to technical problems, while industry groups are meeting with government facilitation in an attempt to establish common standards, especially in key areas such as cyber-security and interoperability.

Q. Please explain what you mean by cyber-security.

A. Cyber-security refers to the security of the information passing over the communications networks of the smart grid, and to the security of controls over system components, such as circuit breakers and other components of the system essential to the functioning of the grid. It also refers to the security of customer data (privacy), discussed below under Consumer Protection issues. Security may be compromised by equipment or operational faults, as well as intentional breaches by hackers, and unauthorized access to data and controls.

Q. What is "inter-operability"?

A. Interoperability refers to the ability of any given component of the smart grid to communicate with the other components to which it is connected, passing data, and commands, smoothly, quickly and accurately back and forth. Protocols for data transfer must be compatible, if not identical, for components to be interoperable.

Q. Does the interconnection of elements of the grid under AMI create openings for breaches in the cyber security of the grid?

A. Yes. AMI is essentially a huge and complicated communications and data processing network, or more accurately, a network of networks. Sensitive information will pass over the communications networks set up to administer dynamic pricing and to manage grid functions. New and remotely-programmable controls of various grid components will be installed. Communications systems such as enterprise networks for core business data processing, network access and backhaul, neighborhood or local area networks, and home area networks, will be created and interconnected. The systems will be tied together more than ever. They will be more complex than ever. Interoperability, size, complexity and novelty provide opportunities for unauthorized data and control access.

Q. In what ways will the advanced metering and smart grid infrastructure be vulnerable to cyber-attacks?

A. There are a number of cyber-security vulnerabilities of AMIs that have been identified so far, and as with all complex information technology solutions, there are vulnerabilities that have not yet been, and cannot reasonably be, foreseen. Among the known vulnerabilities are (a) physical tampering with elements of the network, (b) eavesdropping in on or jamming wireless signals that connect Smart Meters to neighborhood data collection points, (c) password compromises, (d) unauthorized data collection [including privacy violations], (e) suboptimal priority for data transfer over public (e.g. cellular) networks, (f) lack of control of internet paths and reliability, and (g) denial-of-service attacks (in which an unauthorized user generates a huge number of messages to go over the system, which overloads the communications system and triggers interruptions of the system).

Q. Are these vulnerabilities theoretical, or have important systems been compromised in similar ways in reality?

A. A cyber security expert from SAIC, a firm offering cyber security services, recently noted to the Kansas Corporation Commission the following examples of cyber security breaches:[17]

1998	Telephone switch hack closes an airport
2000	Gazprom central control is hacked
2000	Disgruntled water-treatment plant employee in Australia rigs controls to release sewage
2001	Hackers protesting US/China conflict enter US electric power systems
2003	Worm shuts systems down at Davis-Besse nuclear plant.

[17] Gib Sorebo, *Smart Grid Security*, a presentation to the Kansas Corporation Commission, September 18, 2009.

2006 Zotob virus shuts down GM Holden Ltd car manufacturing plant

2007 Aurora demonstration shows a remote hacker can cause physical harm to a generator.

Other evidence of grid vulnerability was reported in the Wall Street Journal of April 8, 2009, citing the fact that an electricity grid in the United States had been penetrated by spies, possibly Russian or Chinese. The report, quoting industry and government sources, also noted that hackers had penetrated electrical systems abroad and tried to extort money to avert damage.

Q. Are there other examples of cyber security breaches in the electric grid of today?

A. Yes. In 2007, a disgruntled employee of the California ISO (CAISO) allegedly tried to access the system's emergency power cut-off, and in the process shut down much of the ISO's data center over a weekend. Luckily the only damage, besides the physical damage to equipment, was that CAISO could not get access to the energy trading market. Upon arresting him, the FBI warned that, had the employee carried out this attack during normal business hours, "electric consumers in the Western United States would have experienced disruptions in their electrical supply".

Q. Have there been official complaints about lax security in the grid today?

A. Yes. In May, 2008, the General Accountability Office (GAO) released a report identifying numerous vulnerabilities at the Tennessee Valley Authority (TVA) that put the nation's biggest public power company at risk of cyber attacks.[18] Among other things, according to the GAO, the TVA used poorly implemented passwords, relied on lax logging practices, failed to install key software patches, and had firewalls that were improperly configured or were bypassed. A less formal but equally sobering report,

[18] Available at http://www.gao.gov/new.items/d08526.pdf.

published on the on-line journal "Security" quotes a "hacker" hired by a utility to explore vulnerabilities in one manufacturer's meters.[19] The vulnerabilities, this security consultant said, are ripe for abuse. The consultant asserted that the new meters needed to make the smart grid work are "built on buggy software that's easily hacked." At the Black Hat ("benign hackers") convention in Las Vegas this summer, this senior security consultant demonstrated a "worm" that he had created that could infect a particular brand of smart meter, and move back and forth between the meters at homes and businesses in a smart grid network. The consultant said it would be possible to program the worm to infect other manufacturers' smart meters.

Q. Please give an example of a plausible but intolerable breach of cyber-security under the smart grid.

A. As the "black hat" security consultant noted, the inclusion in the meter of a module permitting a meter to be turned off remotely through signals sent from a central location creates a risk that a hacker could get into the control system for meters, and remotely disconnect power to hundreds of thousands of customers.

Q. What is one of the weakest links in maintaining cyber security of any IT functions, such as those in the interconnected smart grid?

A. It is well known that human error or failure to maintain secure practices is a weak link in cyber security. An frequently cited example of this phenomenon is employees' failure to observe rules for security of passcodes, frequency of passcode changes, and the like.

Q. The electric industry is aware of the importance of cyber security. Would they not be expected to exercise heightened vigilance to prevent human errors from compromising security?

[19] Available at http://www.theregister.co.uk/2009/06/12/smart_grid_security_risks/.

A. While employees of electric utilities may be more aware of the importance of cyber security than those in other industries, they are still human beings, and subject to making errors. A recent allusion to this reality came in an April 7, 2009, letter to industry stakeholders from Michael Asante, the Chief Security Officer of the North American Electric Reliability Corporation (NERC), the organization charged by the Federal Energy Regulatory Commission (FERC) with overseeing industry efforts to maintain reliability (including the prevention of cyber-compromises). In his letter, reporting on the results of a 2008 self-certification compliance survey for NERC Reliability Standards CIP-002-1 – Critical Cyber Asset Identification, Mr. Asante noted that some industry members failed to identify their assets as "Critical" and thus falling under the Standard. Mr. Asante went further and warned the industry of the danger of less than constant vigilance to prevent breaches of cyber security.

Q. Are there other reasons to be concerned about the security of IT programs and networks, such as the Smart Grid?

A. The sheer complexity of the interconnected IT applications for a smart grid makes it almost impossible for system engineers to anticipate, and thus to provide protections from, all possible problems that might occur - what we refer to as "glitches" or "bugs" when talking about our own personal computers. As a result, one must anticipate that some bugs will be present, and at some time will cause some form of system failure.

Q. What has Commerce Secretary Locke said about the importance of cyber security?

A. Announcing the release of the draft Roadmap in late September, Secretary Locke commented that cyber security is an area in which:

> ...we need to take the time to do it right because security must be designed deliberately into the foundation of the Smart Grid. It cannot be added on

later, and it must be uniform. Having 48 of 50 states implement security specifications will not suffice. The Smart Grid gets its "smarts" from sophisticated computer systems—but that also provides vulnerability.

Q. How, if at all, can an industry address cyber security risks?

A. Utilities must (continue to) participate actively in the various stakeholder processes addressing the multitude of interoperability and security standards being developed for the smart grid. IT managers must not only run as many simulations of real life use of their new systems as they can foresee before they allow them to go operational, to test the system's ability to handle foreseeable problems, but the utilities must also be vigilant once the system is in place, identify problems as they occur, and develop and install software upgrades to "patch" the problem. We are familiar with Microsoft security upgrades – their engineers spend a great deal of time reacting to and trying to overcome bugs in the software not found until after deployment. Utilities and their contractors will have to do the same.

Q. How can utilities deal with the "human problem"?

A. Good security controls are just a beginning in an effort to reduce human error, or malicious tampering. Training of staff must be initiated and refreshed frequently. The importance of cyber security must be stressed often, and observed by management.

Q. Will such diligence prevent a loss of service associated with a cyber attack?

A. Not absolutely. One prominent school of thought in cyber security is that any given software can be compromised by the persistent and knowledgeable hacker. Consider that for years we have planned our generation and transmission "iron in the ground" capacity so as to have no more than one day's outage in ten years. We will now have to expect cyber security breaches, from time to time, and the resulting outages or other damages despite our best efforts.

Q. Are there standards in place for utilities to follow to minimize threats to the cyber security of the smart grid, and to assure the smooth interoperability of its various parts?

A. There are some standards in place for some aspects of the smart grid.

Q. Please outline the status of efforts to develop industry-wide standards.

A. Under the Energy Independence and Security Act (EISA) of 2007, the National Institute of Standards and Technology (NIST) is taking the lead in promoting comprehensive standards in the area of interoperability.[20] As part of this effort, NIST convened the Cyber Security Coordinating Task Group, and is promoting the development and implementation of associated cyber security standards. As yet, it is not possible to be sure when NIST and the entities developing the standards themselves (i.e. IEEE, NERC) will be able to complete their work. NIST has issued a "roadmap" for the work needed to get from here to standards (the draft NIST Framework and Roadmap for Smart Grid Interoperability Standards on PHI DP September 24, 2009), and has set timing goals for release of standards in the most important topic areas by the end of 2010. The roadmap itself, however, is not a set of standards. And the timing goals for standard release are very ambitious.

Q. Are there reasons to expect that important smart grid standards will not be in place before the end of 2010, if not later?

A. Yes. NIST and industry members are pushing hard to complete the primary standards work. But NIST cautions that "several hundred standards that are identified or developed over the span of several years may be required to achieve secure, end-to-end

[20] Available at http://www.nist.gov/smartgrid/.

interoperability across a fully implemented Smart Grid."[21] The NIST roadmap uses qualifying language to describe its expectations for full standard release by the end of 2010, saying for example that its priority action plan will address "many" (as opposed to "all") of the needed modification to standards already denoted as "consensus" standards.[22] In prepared comments released with the Roadmap, Commerce Secretary Locke likened the Roadmap to a designer's first detailed drawing of a complex structure. "It presents a high-level conceptual model to ensure that everyone is on the same page before moving forward to develop more detailed, formal Smart Grid architectures."[23] Similarly, as NIST describes the challenge on its web page:

> The task is akin to developing standards for the next-generation telecommunications network. This effort has spanned many years, continues to evolve, and involves dozens of standards development organizations. Also, like the telecom network, the Smart Grid is almost entirely owned and operated by industry. Therefore, Smart Grid interoperability and cybersecurity standards must reflect industry consensus, with active participation, and where required, leadership and coordination by government.

Q. Are there other technology issues facing PHI and its regulators in their choice of Smart Grid approaches?

A. Yes. The rapid development of not only the technologies but also of the rate designs and related AMI functionalities makes the job of the system planner very complicated. Best

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[21] Available at http://www.nist.gov/smartgrid/standards.html (Roadmap).

[22] Roadmap, p. 38.

[23] Available at http://www.nist.gov/public_affairs/releases/smartgrid_092409.html.

practices require that the designers of the hardware, software and communications networks engineer the system to a well-defined end-state of functionalities for the system (use cases). Exactly what information does who need for what purpose at what time? Utilities such as PG&E and Oncor have experienced difficulties when they chose technologies that turned out not to have certain desired functionalities (in these cases, desired by the regulators). PG&E customers are paying incremental costs for functions that conceivably could have been integrated less expensively had they started with those specifications in mind before designing and bidding out the metering project. Oncor finds itself trying to recover the costs of a metering choice that was rendered obsolete when the state of Texas determined that utilities must provide different functionalities in their smart meters. Inasmuch as proponents of the smart grid point to the possibility of benefits not yet imagined, the continuing evolution of the smart grid presents challenges to system planners, especially at this early stage in its development.

Q. Are there financial risks of moving ahead before the industry and government have settled on standards for cyber security and interoperability?

A. Yes. The fact that some technical standards are still being finalized creates a risk that additional costs may be incurred if some of the technologies deployed now prove to be incompatible with the standards that are ultimately established in the future.

Q. Have policy leaders on smart grid issues recognized the risk facing pioneers and early adopters?

A. Yes. Commerce Secretary Gary Locke spoke to these risks in his presentation to the GridWeek conference in Washington on September 24, 2009. As he said on regarding the need for cyber security and interoperability standards:

> These standards are needed immediately to ensure we don't prematurely

> render otherwise viable products obsolete. For example, we don't want smart grid meters—the key communication device that links utilities with consumers—to suffer from "beta versus VHS" rivalries.[24]

Q. Can the risks of moving ahead before technological standards are in place be eliminated by contractual provisions with vendors?

A. Not fully.

Q. Given the risks of moving ahead before standards are settled, and the difficulty of using contract provisions to protect consumers, should PHI go ahead at this time with its proposed deployment?

A. It would be prudent to wait a year or more on AMI deployment to see if the ambitious NIST standards-development schedule has been successful. In such a case, PHI would not have to take the risks of an early adopter (much less a pioneer). If the utility does not want to wait, the utility should hold the customers harmless from the potential disruption and cost of having to redesign and retrofit their smart grid system to take account of changed requirements.

B. UNRESOLVED PRIVACY CONCERNS

Q. Please describe the privacy issues that arise in the case of the smart grid and advanced metering infrastructure.

A. As noted above, the interconnectedness of the smart grid makes data carried over the communications networks vulnerable to improper access by unauthorized persons. The advanced metering infrastructure will at a minimum capture and store data on all consumers' hourly usage. This information could be used to estimate which customers have which types of appliances and equipment at home. It could be used to estimate

[24] Available at http://www.commerce.gov/NewsRoom/SecretarySpeeches/PROD01_008443.

whether a customer is home, weekdays, or for several weeks during vacation. If customers install Home Area Networks and tie their appliances and computer in to the network, that network could be hacked, and specific information about electricity usage could be obtained. To the extent all these systems are hooked into the customer's internet connection, the customer's computers could be at risk, as well.

Q. If no HAN were installed, and hackers could only get usage data, why would or should customers care? This is not the type of data customers usually consider private, is it?

A. Intrusions into privacy raise major issues for customers. One cannot assume that what a utility consultant might find merely interesting would not trigger a concern among consumers about breaches of privacy. Media coverage of smart grid deployment is already causing some consumers to voice concerns over privacy if the utility collects usage data.[25] The success of any AMI deployment will depend on the long-term ability to protect the privacy of customer information.

Q. How does NIST characterize the problem of safeguarding consumer data privacy in the smart grid era?

A. In the draft Roadmap released September 24, 2009, NIST noted that the major benefit provided by the Smart Grid, the ability to get richer data to and from customer meters and other electric devices, "is also its Achilles' heel from a privacy viewpoint" (Roadmap, p. 84). NIST went on to say that privacy advocates have raised serious concerns about the type and amount of billing and usage information flowing through the various

[25] *See*, for example, the critical posting by Bob Sullivan, October 9, 2009, "What will talking power meters say about you?" together with comments from concerned readers, about the Pepco Maryland smart grid deployment, available at http://redtape.msnbc.com/.

components of the Smart Grid, information "…that could provide a detailed time-line of activities occurring inside the home."

Q. How is NIST handling privacy concerns?

A. NIST has set up a task force to coordinate efforts to identify privacy issues and develop ways to address them.

Q. What are some of the problems NIST has identified in dealing with consumer privacy concerns?

A. In a NIST draft report on Smart Grid Cyber Security Strategy and Requirements,[26] the authors stated that a major problem facing the smart grid today is the lack of coordination among different government jurisdictions with responsibility for protecting consumer privacy:

> Most states have general laws in place regarding privacy protections. However, these laws are most often not specific to the electric utility industry. Furthermore, enforcement of state privacy related laws is often delegated to agencies other than public utility commissions, who have regulatory responsibility for electric utilities. Research indicates that, in general, state utility commissions currently lack formal privacy policies or standards related to the Smart Grid. Some individual utility implementations of the Smart Grid are currently at an early stage, while others are more fully developed. Utilities at an early stage of implementation may have not yet documented or implemented privacy policies, standards, or procedures for the data collected throughout the Smart Grid. Comprehensive and consistent

[26] NIST IR 7628, released in September 2009 (NIST Cyber Security Draft 7268), p. 8, available at http://csrc.nist.gov/publications/drafts/nistir-7628/draft-nistir-7628.pdf.

> definitions of personally identifiable information (PII) do not typically exist at state utility commissions, at FERC, or within the utility industry. The lack of consistent and comprehensive privacy policies, standards, and supporting procedures throughout the states, government agencies, utility companies, and supporting entities that will be involved with Smart Grid management and information collection and use creates a privacy risk that needs to be addressed.[27]

Q. What does the NIST draft report on cyber security recommend about protecting privacy of personally identifiable information (PII)?

A. The NIST report authors set out ten high-level principles for which specific standards must be developed in the areas of (1) Management, Accountability and Training, (2) Notice and Purpose for PII Use, (3) Choice & Consent to use PII, Collection of PII, (4) Use and Retention of PII, (5) Individual Access, (6) Disclosure and Limiting Use of PII, (7) Security and Safeguards, (8) Accuracy and Quality of PII, (9) Openness, and (10) Monitoring and Challenging Compliance. The principles are set out in my Exhibit___(NB-4). The NIST draft report recommends that standards be developed to address the privacy risks it has identified.[28]

Q. Given the state of uncertainty and lack of standards for protecting personally identifiable information in the smart grid, how can customers' rights to privacy be protected?

A. The smart grid should not be put in place before these privacy principles are translated to specific norms, embraced by the industry, and properly enforced. Given the rudimentary and jumbled state of smart grid privacy standards at this time, it will take some time (likely more than one year) to develop a good starting point for protecting the data that is

[27] NIST Cyber Security Draft 7628, p. 8.

[28] *Id.* at 9-10.

to be collected. Even then, as with the general problem of cyber security, it may not be possible to stop all unauthorized access to customers' data. The public deserves to be educated about the risks that come along with the benefits of the emerging smart grid. This is not only good policy from the consumer perspective, it will be essential to attaining widespread public support for smart grid deployment.

VI. AMI IMPACTS ON VULNERABLE CUSTOMERS

Q. Turning now to the impacts of the proposed AMI and PHI DP rider rates on vulnerable customers, please explain what you mean by the term "vulnerable."

A. A vulnerable customer in this context would be one who is unable to move load off the critical peak, or at least cannot do so without risk to health and safety.

Q. Please identify the key categories of vulnerable residential customers.

A. Vulnerable customers include low-use customers, low-income customers, disabled customers, and the socially isolated, among others. Low-use customers tend to use only the electricity they need for essentials, such as lighting and refrigeration. Low-income customers are disproportionately low-use, and in general, low-income customers have tended to reduce loads in response to critical peak tariffs at a lower rate than non-low-income customers. Others who may have difficulty moving reducing their existing peak loads include low-income shift workers, and parents with small children at home. Disabled customers include customers who must have electricity to power medical equipment. Along with socially isolated customers, the especially at-risk group also includes customers who are not capable of taking initiatives to respond to peak time rebates.

Q. Is there data specific to Maryland that supports your assertion that low-income customers tend to be low-usage customers?

A. Yes. Exhibit___(NB-3) presents a table and a chart prepared by the Maryland Department of Human Services, Office of Home Energy Programs, showing the distribution of Electric Universal Service Program (EUSP) grants by usage level. The state agency prepared this as part of its FY 2008 report on the EUSP, under which low-income Marylanders receive grants to help pay for needed electric service. The report was filed in Case No. 8903, as Item 335, Attachment C. As can be seen clearly on the bar chart on page two, the low-income customers receiving EUSP grants cluster at the low end of the range of annual usage levels. The usage levels with the highest numbers of households range between 5000 and 7000 kWh a year (the midpoint, 6000 kWh/year, is 500 kWh per month, below the average for all households).

Q. Are low-income customers the only customers who tend to have lower usage?

A. No. If the Maryland PHI customer usage is similar to that of BGE, for example, one could estimate that a large percentage of PHI customers have relatively low usage. Such customers will have difficulty reducing loads further.

Q. Does PHI have data that would permit a Pepco-specific and Delmarva-specific breakdown of the residential class by monthly usage granular enough to identify percentages of low usage and high usage customers?

A. No. The bill frequency analyses provided in response to OPC DR 2-13 only show one breakpoint in residential customer usage, at the average usage.

Q. Can customers who are unable to move load off the critical peak periods benefit from the DR riders?

A. The Companies have not studied this question. Customers who cannot reduce critical peak loads must still pay for the AMI system and smart metering investment that is used to provide rebates to other customers. These bill impacts will not be trivial, especially in the case of low-income customers. In addition, in order to economize and take advantage of the rebates, low-income and other vulnerable customers may reduce their usage at critical peaks below levels consistent with health and safety.

Q. Why do you say that low-use customers have difficulty moving load off critical peaks to take advantage of peak time rebates?

A. One analysis of the California pilot showed that low-use customers did not respond to critical peak pricing, or peak time rebates.[29] Another evaluation found some load response on the part of low-use customers, but significantly less than the response of high-use customers.[30] This stands to reason, as such customers are unlikely to have large amounts of discretionary demand that can be moved off critical peaks.

Q. How did low-income high-use customers fare in the California special pricing pilot?

A. According to Herter's analysis, low-income high-use customers experienced adverse bill impacts (higher bills) under the pilot tariffs, even before counting the cost of the advanced metering infrastructure. For reasons that are not yet well enough understood, they did not reduce loads at the critical peak times. While low-income customers may be expected to try to reduce their bills by taking advantage of the PHI DP rider rate, many will be unable to do so and will not receive financial benefits.

Q. Are there other aspects of the DP rider that will pose problems for some vulnerable customers?

A. Yes. As discussed further below, there are strict time and process limitations on opting in and out of the various rider options. These limitations will be difficult for some

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[29] Karen Herter, "Residential implementation of critical-peak pricing of electricity," *Energy Policy* 35 (2007): 2121-2130 ("Herter"). Available at www.elsevier.com/locate/enpol.

[30] Charles River Associates, *Impact Evaluation of the California Statewide Pricing Pilot*, March 16, 2005 ("CRA"). Available at http://www.energy.ca.gov/demandresponse/documents/index.html#group3.

vulnerable customers to navigate, and many of these customers are likely to end up on DP options that are not optimal for their situation.

Q. What should be done to address the problems facing vulnerable customers under critical peak tariffs?

A. The most important step, short of not going ahead with the deployment of the AMI at all, is to keep the costs of the deployment down as much as possible. This will help mitigate the bill impacts on customers who cannot take advantage of the rebates. Requiring a robust benefit/cost ratio will help to keep the pressure on deployment costs. Holding customers harmless from (a) excessive spending on deployment, (b) insufficient savings to offset deployment costs for all customers, or (c) both, would also help protect customers who cannot participate directly in the Peak Time Rebate.

Q. Are there other ways to mitigate the burdens that PHI DP rider will place on vulnerable customers who cannot take advantage of PHI DP rider "rebates"?

A. Yes, smart grid costs should be recovered on a volumetric rather than fixed basis. In this way, low-use customers who cannot take advantage of PHI DP rider tariff benefits will not be as burdened with costs of the new system as they would be under fixed charge cost recovery. For more discussion of volumetric cost recovery, please refer to the testimony of OPC Witness Hornby on this topic.

Q. Are there other steps the Company can take in an effort to mitigate the adverse impacts on vulnerable customers?

A. Yes. Utilities generally should also do in-depth research to identify customers who are vulnerable to the adverse effects of PHI DP rider pricing and AMI costs, and understand why they have difficulty moving usage off critical peaks (or do reduce loads but at risk to their own health and safety). Based on this knowledge, and working with community groups, the utility can develop targeted outreach to such customers to assist them in understanding the tariff, taking advantage of rebates where it is reasonable, and connecting such customers with resources that can help them manage their usage and bills most effectively, given their circumstances. I should caution, however, that such efforts are unlikely to identify and fully protect all vulnerable customers. They should not be seen as a solution for the problems that deployment of advanced metering will bring for such customers.

Q. What are some ways for the Company to obtain information on likely customer response before deciding on the details of a program like the distribution of in-home displays to all customers?

A. There is no failure-proof single method, but there are a number of methods for gauging likely customer response that can be used. Looking at what has been the response to similar programs in other utility service areas is helpful. Telephone or written surveys can be used, and have the benefit of allowing the utility to obtain responses from a random sample of its customers. Focus groups are only roughly representative of the customer base (the limit on numbers in any one group prevent a random sample approach). At the same time, they are fairly inexpensive, and they get at consumer attitudes that cannot be ascertained through a multiple choice survey. In addition, pilot deployment of the program can help identify ways in which it does or does not suit consumer needs. Some utilities have used the so-called ‘deliberative polling” approach, in which a group of customers (larger than a focus group, but small enough to fit in a modest-sized auditorium) are invited by the utility to give their opinions about a certain topic. Then the participants are led through a series of presentations and exercises to explore factual and policy issues of which they might not have been aware. The participants are then polled again, with the idea that the interactive and educational process of the deliberations might change some participants' views, and thus better represent how consumers might respond after sufficient education and a sensitive deployment.

Q. Do you have experience as a regulator with these methods?

A. Yes. When I was a Commissioner in New Hampshire, we were trying to steer the electricity industry to competition. We hired a firm that conducted a number of telephone surveys for us to help us understand how different policies would be received, and help us decide on timing of various initiatives. The results were instructive and helpful. In addition, as we decided whether to extend retail competition to the natural gas industry, we conducted focus groups to learn what customers knew about the topic and how they would react if we opened the business to competition. I personally had my eyes opened to likely customer interest in natural gas competition by the contributions of focus groups (some of which I was able to observe via a remote video hookup).

VII. CONSUMER PROTECTION

Q. Please turn now to the issues of risks to consumer rights and protections posed by the universal deployment of an advanced metering infrastructure.

A. There are three categories of risks to consumer rights and protections that I will discuss. The first is the threat of unfair and unnecessary disconnections as a result of the use of smart metering for remote disconnection, prepayment metering and service limiting. Next are the potentially unreasonable limitations on a customer's right to change DR rider options. Last are risks of customer confusion as a result of using the term "rebate" to describe the flow of benefits from prior years' load reduction to CPR participants in any given year.

A. RISKS OF UNNECESSARY AND UNFAIR DISCONNECTIONS

Q. How does implementation of smart grid technology increase the risks of unnecessary and unfair disconnections of residential households?

A. Smart meters can be used to introduce three practices, each of which pose risks to certain customers of unnecessary or unfair disconnections. First, smart meters can be installed with modules that permit the utility to disconnect the power to a customer's house remotely, by flicking a switch at the utility's offices, without sending a technician to disconnect the meter. Second, smart metering provides a relatively inexpensive foundation for implementing pre-payment metering. Third, smart metering provides a relatively inexpensive foundation for implementing service limiters.

Q. How does remote disconnection increase risks of unnecessary and unfair disconnection?

A. Today, to cut off power to a customer, the utility sends a technician to the premises to "pull the meter". This process provides an opportunity to avert disconnection in the case of a payment-troubled household threatened with disconnection for non-payment. When a technician comes and pulls the meter, the customer gets final notice of the impending shut-off. Also, the customer has an opportunity to pay any delinquencies on the bill, and avert shut-off. This "last knock" notice and opportunity help prevent unnecessary shut-offs by providing an opportunity for the customer to fix the problem that led to the disconnection decision. The in-person disconnection also provides an opportunity to work out problems with the utility. Remote disconnection eliminates this "last knock" notice to the customer, and final opportunity to resolve bill issues.

Q. Are there circumstances where remote disconnection makes sense and does not threatened consumers' access to utility service?

A. Yes. In the event of voluntary terminations, such as at move-in and move-out of premises, remote disconnection would not threaten consumer rights. Further, if the utility were to send out an employee to make the "last knock" before a remote termination, the customer's rights could be preserved. Such an employee would not need to be an electrician, or bring a service truck to the location when making the last knock visit, but could presumably call in the results of the visit to the control center. The employee would need to be able to take payments on account, and work out payment arrangements or refer the customer in real time to a customer service representative authorized to make such arrangements and avert the disconnection. In this way, savings from avoiding the meter pull could be realized without undermining access to service.

Q. How does prepayment metering risk unfair and unnecessary disconnections?

A. Under a prepayment metering approach, power will flow only so long as the customer has paid in advance. The customer puts money in the meter to get power, typically through a smart card, which operates much like a prepaid wireless or long-distance card. If the smart card amount is used up, and the card is not "recharged," the customer's service will be disconnected. In practice, the result is that customers are disconnected without the advance notice and consumer protections afforded by regulation and utility practice.

Q. Is there evidence that customers end up shut off from service as you suggest?

A. Yes. The French distribution utility, Electricité de France (EDF), at one time required delinquent customers to accept prepayment metering as a condition of continuing to receive service. They abandoned that practice after their sociologist's research found that low-income and other vulnerable customers were cutting themselves off, inadvertently, when they were unable to charge up their prepayment smart cards. Because the disconnection was automatic, and "remote" (at least from the awareness of the utility), there was no advance notice, nor an opportunity to work with the customer to arrange for help paying the bill, make payment arrangements, or otherwise manage the customer's payment difficulties in a humane and practical way. As a result of this research, EDF changed its policy, and does not allow such vulnerable customers to take service under a prepayment arrangement.

Q. Are there other recent examples of consumer protection violations with the use of pre-paid metering of electricity?

A. Yes. A recent investigative news report from Texas (where deregulated electricity commodity vendors can offer service on a pre-paid only basis) tells of vulnerable pre-paid electricity customers being cut off without notice.[31] Families with children have had to abandon their homes. A paraplegic who requires air conditioning to maintain a safe body temperature lost his electricity on days when the temperature exceeded 100 degrees. A heart failure patient who needed power for an oxygen machine was cut off twice in one summer.

Q. Has another public service commission reviewed the fairness of prepayment metering in connection with advanced metering deployment?

A. Yes. The Massachusetts Department of Public Utilities recently dismissed the smart grid filing of a major electric distribution utility in the state because it proposed to pilot prepayment metering among low income customers. The Commission found that such metering would violate regulations promulgated to ensure safe and reasonable access to

[31] Steve McGonigle and Ed Timms, "Cutoffs, complaints abound with Texas' prepaid electric providers," Dallas Morning News, October 4, 2009.

service, including advance notice of pending disconnection and an opportunity to dispute the bill.

Q. Please describe how service limiters present risks of unfair and unnecessary disconnection.

A. Service limiters are just what they sound like: devices that cause a circuit breaker in the meter to trip open if the amount of electricity used exceeds a preset limit. Like a circuit breaker, they can be reset under certain circumstances. In essence they put a customer at risk of the power going off without advance notice if usage happens to exceed the limit. As in the case of prepayment metering, tripping the service limiter causes a disconnection without notice and an opportunity to take care of the bill.

Q. Can you give an example of a service limiter causing an unfair and unnecessary disconnection?

A. Yes. This past winter, a 93-year old gentleman from a town in Michigan froze to death because a service limiter was put on his meter. He had fallen behind in his bill, and the (municipal) utility had a policy of putting on service limiters until bills were paid up. The fellow was found dead in his freezing cold house. On the kitchen table was found money sufficient to pay the bill. The fellow never got a chance to pay his bill before disconnection – he may not have been able to get to the meter to reset it, he may not have understood that he could do that, or how. But in any event, he suffered a painful death because the service limiter tripped in the middle of winter.

Q. How do you recommend the Commission prevent these risks of unnecessary and unfair termination of service?

A. I recommend that the Commission make findings to the effect that these three uses of the smart metering installation pose risks of unnecessary and unfair loss of electric service, and that the Commission will not accept them as an element of smart metering deployment. Utilities would retain the right to petition for a change in the policies, practices and regulations, but consideration of such changes should take place only in proceedings that are focused enough on the issue to permit a full exploration of the facts and the ramifications.

B. BARRIERS TO CHANGING RIDER OPTION

Q. How can residential SOS customers change the rider option under which they are taking generation service?

A. According to the proposed Pepco and Delmarva Dynamic Pricing riders, customers will only be allowed to switch to a different rider option once a year. In addition, customers must give 30 days' advance notice. This approach is somewhat similar to the open enrollment period in a health insurance plan from an employer.

Q. Are these limitations on switching options reasonable?

A. No. It is not reasonable to insist on 30 days' notice of intention to switch to another option.

Q. What are some concerns you have about the limitations proposed for SOS customers' opportunity to switch to other DP rider options?

A. Customers may not realize that they have only a limited window of time to move off a particular option. Some customers may have difficulty dealing with decision-making and communication with the Companies around this question. Customers need more notice of the deadline, more time to choose, and clear and flexible opportunities to express their choice.

Q. What do you recommend?

A. The proposed tariffs, when filed for approval, should contain better protections for customers' rights to switch options. The Companies should be required to notify customers by separate communication (i.e. not merely a bill stuffer) that the "open enrollment" period for the DP rider options will begin as of a certain date up to a week in advance of the period, and hold the switching option open for 45 days. The Companies should not set the end of the switching period any closer than 5 working days before the new service year. In other words, in early November the Company should start notifying DP rider customers that the open enrollment period will begin in the second week of November and close the week before New Years (actual dates would be used, per the calendar of any given year). The Company should provide notice that is likely to make all DP rider customers aware of the open enrollment period. The Company should accept customer option elections in as many formats as possible, and not require a written format or a specific form.

C. MISLEADING OFFER OF "REBATE"

Q. Do you have a concern about using the word "rebate" in the name of the Critical Peak Rebate rider option?

A. Yes. Customers understand rebates to mean discounts taken at the time of purchase, or redeemable by an individual customer within a certain time from the time of purchase. The financial benefit provided to CPR customers under the PHI Dynamic Pricing rider does not provide a discount at the time of purchase (i.e. the critical peak hours), and is not redeemable by the individual.

Q. Why do you say that the financial benefit of the CPR is not redeemable by the individual?

A. The financial benefit caused by the action of any given customer in reducing load relative to that customer's baseline during critical peak periods is not identified and returned to that customer. Rather, it is aggregated with all the reductions CPR customers made from their respective baselines that year, and spread across those CPR customers who remain on the rate (or join the rate) in the next year.

Q. Are you arguing that this mechanism for providing CPR customers' reduction-caused-benefit to CPR customers in the next calendar year is unfair?

A. Not necessarily. My main concern at this point is that the CPR be given a different name, to prevent customers from being, or feeling, misled by the name and advertising for the rate. If the term rebate is used, the Companies should return the benefits earned by each individual customer to each individual customer at the close of each critical peak season, by separate check or by bill credit.

Q. Is it important for customer acceptance of a new rate that the terms of the rate be clear, and customers do not feel the label of the rate misleads the consumer?

A. Yes. A confusing and misleading name for a rate, once exposed to be an inaccurate description of the terms of the rate, will be taken by some customers as a reason to doubt the accuracy and good will of the utility in other areas of the demand response offering.

VIII. CONCLUSIONS AND RECOMMENDATIONS

Q. What do you conclude based on your review of certain issue raised in this docket?

A. My conclusions are as follows:

- Estimates of demand response to the PHI DP riders are subject to uncertainty. Participation rates are subject to uncertainty. Assumptions as to persistence or sustainability of demand response are subject to uncertainty. Estimates of energy savings from PHI DP riders are subject to uncertainty.

- There are effective alternatives for obtaining demand response in place today, without requiring the massive investment needed for AMI.
- Standards and protocols necessary to design and operate an advanced metering infrastructure, and to protect consumer privacy, are still in a state of flux, and investments made now, before the standards have been established, are at risk of obsolescence.
- It would be prudent to wait a year or more on detailed AMI design and on AMI deployment to see if the ambitious NIST standards-development schedule has been successful. In such a case, PHI (and its customers) would not have to take the risks of an early adopter (much less a pioneer).
- Implementation of dynamic pricing puts vulnerable customers at risk.
- Installation of advanced meters will open the door to practices such as remote involuntary disconnection, prepayment metering, and use of service limiters, all of which threaten customer access to service.
- Proposed notice provisions for the election of alternative options under the DP rider are too restrictive.
- The label "critical peak rebate" is misleading and confusing given the manner in which the Companies propose to return benefits of CPR customer load reductions to next year's CPR customers as a group.

Q. What do you recommend to address the problems you have outlined in your testimony?

A. I recommend the following:

- Before moving ahead with their AMI plans, the Companies should update their cost-benefit evaluations of the proposed smart grid installation to take into account the uncertainties as to the level of likely demand and energy reduction and as to the persistence of such reductions in response to the smart metering program, and if the utility wishes to proceed on the basis of the estimates used in this filing, it should do so at its own economic risk,
- PHI should be required to demonstrate that comprehensive and effective cyber security, interoperability and privacy standards, and strong enforcement mechanisms, are in place before it proceeds with deployment of that advanced metering infrastructure,
- In the short term, PHI should pursue Direct Load Control and other proven programs to obtain demand reductions.
- The Companies should take steps to identify potentially vulnerable customers and develop and provide means of mitigating the risks they face as a result of the deployment of smart metering and PHI DP rider pricing, including use of volumetric rates, rather than fixed per customer rates, to recover the cost of the smart grid installations.
- The Companies should agree that they will not use their proposed AMI technologies to undermine the consumer protections afforded Maryland electricity customers now by law, regulations and practice, including protections against unfair and unreasonable service termination, and before including remote disconnection capability in their AMI present a definite plan for its proposed use

of remote disconnection containing adequate consumer and public safeguards, for Commission review.

- The Companies should revise and liberalize their proposal for locking customers in to a DR option for one year periods and requiring 30 day advance notice of the intent to change options, unless they demonstrate that such limitations are essential to prevent unreasonable levels of gaming by residential customers.
- The Companies should revise their Critical Peak Rebate to provide rebates to individual customers, or change the name to more accurately reflect the mode of returning benefits to customers.

Q. Does this conclude your testimony?

A. Yes.