BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE
STATE OF CALIFORNIA

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Order Instituting Rulemaking to Consider Smart Grid Technologies Pursuant to Federal Legislation and on the Commission's own Motion to Actively Guide Policy in California's Development of a Smart Grid System.

R.08-12-009

REPLY COMMENTS OF THE LAWRENCE BERKELEY NATIONAL LABORATORY DEMAND RESPONSE RESEARCH CENTER

IN RESPONSE TO THE DIRECT QUESTIONS PERTAINING TO THE PANEL PRESENTATION OF MARY ANN PIETTE

March 26, 2010

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On March 17, 2010 the Demand Response Research Center (DRRC) participated on a panel session entitled "Academia & Research – All the possibilities for a Smart Grid & Roadmap to build it." The Director of the DRRC presented an overview of the research, development, and performance of Open Automated Demand Response (OpenADR), a research effort initially funded by the California Energy Commission Public Interest Energy Research Program (PIER).

During the presentation, OpenADR was described as a non-proprietary standards-based communications data model that provides a technology neutral platform for communicating price, reliability, and demand response event signals between the utility or Independent System Operator (ISO) and individual or aggregated groups of electric customers. OpenADR's design objective was to maximize the use of customer energy management and control systems. OpenADR was designed specifically to provide "activation information", to encourage customer participation and choice, and not to directly control customer end-uses. The DRRC presentation described the historical research and development of OpenADR and provided an overview of documented results from 2003 to 2010. OpenADR was identified by the National Institute of Standards and Technology

(NIST) on its preliminary list of 16 potential national standards to guide development of the Smart Grid.

At the conclusion of the DRRC presentation, Administrative Law Judge Sullivan clarified the CPUC interest in OpenADR. "OpenADR looks very promising. One of the things we think of as a regulatory agency is ..do we make it a requirement that the infrastructure deployment plans include an OpenADR as well as some sort of HAN or other devices." ALJ Sullivan went on to pose six questions, as follows:

1. *Does that make sense to go in that direction?*
2. *Would you have any cautions for us to including that type of requirement?*
3. *What are the risks that we have of either locking things in or messing things up?*
4. *What can we do to ensure that the investments reflect a broad public interest, doesn't use obsolete technology, and doesn't lock us into one choice?*
5. *What lessons and recommendations do you have?*
6. *Does that make sense or is OpenADR too fast and loose a concept?*

During the afternoon panel session Marcel Hawiger representing Toward Utility Rate Normalization (TURN), made statements stating that OpenADR was very expensive and that customer directed price-response was questionable and ineffective. In an open comment during the question and answer session, Paul DeMartini, Vice President for Southern California Edison (SCE), described the OpenHAN (HAN) and Smart Energy Profile 2.0 (SEP) work also underway by NIST, suggesting the CPUC consider those options in addition to OpenADR, which some attendees incorrectly assumed to mean they were competing, mutually exclusive options.

In the remainder of this submittal, we provide a brief overview of OpenADR to clarify several technical points relevant to ALJ Sullivan's questions and to describe the relationship between OpenADR and the SEP initiatives raised by Mr. DeMartini. We then respond directly to each of ALJ Sullivan's questions.

<u>Is OpenADR Compatible with Smart Energy Profile 2.0 (SEP)?</u>

OpenADR and SEP are not mutually exclusive. They can coexist and provide complimentary support for a wide range of utility-customer Smart Grid applications. While each option is in a

different stage of the development and standards process, public interest will be best served if both are integrated into Smart Grid.

The unique values that OpenADR and SEP bring to the Smart Grid and how they can be integrated are established by their similarities and differences, specifically.

- OpenADR and SEP both provide application layer data models that communicate (provide messages) over digital networks to support machine-to-machine readable price, reliability (event), and information signals for display devices that can be acted upon automatically by customer systems and devices.
- OpenADR and SEP will both conform to NIST development efforts to standardize industry pricing, signaling, and scheduling data models. In other words, when conformed, the OpenADR and SEP price, signaling, and scheduling messages will be identical.
- OpenADR price, reliability (event), and information signals are published on secure servers at the utility (or ISO) to be transmitted over secure high-speed (broadband) public Internet connections directly to the participating customer premise, to aggregators, or to bridge clients that translate Internet signals for broadcast to address legacy and special purpose small commercial and residential systems over other types of communication channels. SEP signals are transmitted over the secured utility advanced metering infrastructure (AMI) communication system through the digital interval meter and into the customer premise.
- The OpenADR system does not monitor, measure, or collect any customer, device, or other data from customer sites, preserving customer firewall protections and substantially reducing potential privacy issues.
- Software clients that access the utility server for OpenADR signals can be embedded directly in customer systems and devices or provided by low-cost add-on devices. SEP signals require customer equipment that meets specific manufacturing, design, and processing capability compatible with device registration and monitoring requirements. SEP is designed to operate within the customer premise. OpenADR is designed to operate between the utility or CAISO and customer premise and stop at the on-site embedded client.
- OpenADR signals are designed to be automatically monitored by customer equipment, to trigger customer pre-programmed control strategies. SEP supports similar voluntary

customer response, however it also supports utility managed direct control and mandatory options.

- OpenADR has been used in financially binding utility pricing and demand response programs for five years with large commercial and industrial customers. Industry research and support for product development and testing with residential customers is also underway. The timeline for testing and the commercial availability of SEP prototypes is not yet certain. Newly revised OpenHAN and SEP2.0 requirements documents were just released this month.

OpenADR provides capability to support proven retail and wholesale commercial and industrial applications, the integration of aggregators, and options for integrating legacy small commercial and residential systems. SEP will eventually provide a complimentary set of potential direct control and other utility-valued applications.

An announcement this week[1] by UISOL and Tendril significantly demonstrates expanded industry support for the integration of OpenADR and SEP into utility enterprise systems. UISOL, who provides the DRBizNet system for the CAISO, PJM, and several utilities, announced that they have integrated OpenADR into DRBizNet providing capability that "..allows utilities to fully automate all Demand Response management business and operational processes with greater efficiency and transparency.[2] The UISOL-Tendril announcement not only confirms support for OpenADR but also confirms the ability of OpenADR and SEP to coexist within a single utility system.

> "DRBizNet© and the Tendril platform are based on OpenADR, one of the first standards adopted and ratified by the NIST Framework and Roadmap for Smart Grid Interoperability. In addition, Tendril utilizes the ZigBee® Smart Energy Profile to provide additional open standards to support Home Area Networks and consumer-based energy management devices. "[3]

[1] Tendril and UISOL Integrate Energy Management Platforms to Deliver an End-to-End Demand Response Solution to the Smart Grid
http://www.businesswire.com/portal/site/home/permalink/?ndmViewId=news_view&newsId=20100323005730&newsLang=en

[2] Ibid 1

[3] Ibid 1

Is OpenADR Expensive?

There are two costs associated with the implementation of OpenADR; (a) utility program costs and (b) customer implementation costs. Utility program costs for the initial implementation of OpenADR (AutoDR) included utility administrative as well as one-time CPUC authorized incentives and technical assistance funding intended to seed the market for non-utility, market-based support.

The evidence to-date does not support the claim that OpenADR is expensive. The evidence to-date confirms that non-utility, market-based support for OpenADR is in fact actively participating in expanded implementation.

The DRRC has conducted three different evaluations of actual OpenADR one-time implementation costs for samples of large commercial customers for the 2003-2005 (Table 1), 2006 (Table 2), and 2008 (Table 3) target time periods. All three evaluations provide the average dollar cost per kW based on actual customer response to a critical peak pricing option. The $51-$76 per kW- cost range is particularly low since it represents a one-time investment that continues to support customer participation in subsequent years.

Two facts highlight the low cost nature of OpenADR implementation. First, several of the facilities listed in Tables 1 and 2 have three or more years of continuous participation in utility pricing and other DR options, all without any additional investment. Second, as the market for OpenADR has expanded, energy management system and control vendors have begun to develop and embed OpenADR software clients in their systems. Embedding OpenADR makes it an automatic option that can be implemented as part of the building commissioning effort, eliminating the need to retrofit OpenADR after the fact. Providing OpenADR as an embedded client during building commissioning means that customer demand response strategies will be integrated with and programmed concurrent with building efficiency and other operating strategies. Integrating demand response strategies during building commissioning will eliminate most of the costs included in Tables 1-3.

A confirming example of this trend is the recent Honeywell announcement that they will embed OpenADR software clients in 700 installations to help achieve 80MW of demand response under SCE's Critical Peak Pricing program.[4]

[4] http://www.automatedbuildings.com/releases/dec09/091212025505berkeley.htm

Is Customer Directed Price Response Questionable and Ineffective?

The evidence to date does not support the claim that customer-directed price response is questionable or ineffective.

OpenADR supported critical peak pricing (CPP) began in 2003 with proxy test sites. Customers with OpenADR capability have been on actual CPP rates since 2004. Figure 1 provides a summary of the average peak load reduction results over all CPP events for the period from 2003 through 2009. On average, commercial customers have consistently demonstrated a consistent 14% reduction in peak load in response to CPP. Industrial customer OpenADR participation was added in 2007, which is indicated by a substantial increase in the average overall participant response for the years 2007-2009.

ALJ Question 1: Does it make sense to "make it a requirement that the infrastructure deployment plans" include an OpenADR as well as some sort of HAN or other devices"?

OpenADR could be included as a standard infrastructure deployment plan requirement for Smart Grid implementation.

In the Report to NIST on the Smart Grid Interoperability Standards Roadmap the Executive Summary makes the following statement: "The electricity grid can only get so smart without a framework for interoperability. This framework will identify a suite of standards that enable the integration of diverse technologies."[5] OpenADR is one of the original sixteen standards identified by NIST to facilitate development of the Smart Grid. OpenADR is the only standard identified by NIST that connects the utility (supply side) and customer (demand side) by providing a means to communicate price, reliability (event), and information signals. OpenADR provides the framework referenced by NIST that has demonstrated capability to integrate: (a) wholesale (CAISO) and retail options; (b) multiple pricing and demand response options, and; (c) expansive energy management and control technology options for all classes of customers.

Establishing a common, open standard like OpenADR to support utility, CAISO, and third-party information / service providers will facilitate a more orderly, lower cost, and more interoperable Smart Grid.

[5] Report to NIST on the Smart Grid Interoperability Standards Roadmap, June 17, 2009, pp.iv. http://www.nist.gov/smartgrid/InterimSmartGridRoadmapNISTRestructure.pdf

PG&E's Participating Load Pilot with the CAISO in 2009 provides a perfect illustration of how OpenADR facilitates Smart Grid development. As the DRRC presentation described, three PG&E commercial customers (>200kW) on Critical Peak Pricing rate (CPP) with OpenADR, switched over to the CAISO Participating Load Pilot without the need for any additional investment in equipment and only minor adjustments to their demand response strategies. OpenADR provided the platform that enabled the customer, PG&E, and CAISO to quickly develop and implement an entirely new Smart Grid option, at no additional cost to the customer.

It is important to remember that OpenADR is not a program and not a device. OpenADR provides a platform for delivering and acting upon "messages" that may include price, reliability (event), and information signals. In PG&E Participating Load Pilot, all that changed was the source and content of the message. Price signals from PG&E were replaced by signals from CAISO. The customer energy management systems and demand response strategies responded accordingly.

CPUC approval of the advanced metering business cases for each of the three IOU's included a requirement for OpenHAN (HAN) in conjunction with the Smart Energy Profile 2.0 (SEP). While the requirements specifications for the HAN-SEP paradigm are still in the early stages of development by NIST, the HAN-SEP paradigm is already an integral part of each IOU Smart Grid deployment plan. The background information presented earlier in this response, clarifies that OpenADR and the HAN-SEP paradigm are in fact compatible initiatives that can and should be able to productively coexist. OpenADR and HAN-SEP provide customers and system operators with different but complementary sets of options. Furthermore, because OpenADR has already been tested and implemented, its' adoption will allow the CPUC to move forward immediately with proven Smart Grid options that can provide visible customer benefits that leverage the AMI investment, while allowing the time necessary to complete HAN-SEP development. Once development is complete, the additional in-premise capabilities provided by HAN-SEP can be harmonized with OpenADR or whatever other standards may evolve.

OpenADR was initially endorsed by the CPUC in an Assigned Commissioner Ruling [6] in 2006 based on its first three years of performance. In the ensuring four years, OpenADR has continued to

[6] Assigned Commissioner's Ruling Augmenting August 6, 2006 Ruling Requiring Utility Proposals to Augment 2007 Demand Response Programs, Commissioner Michael R. Peevey, August 22, 2006. http://docs.cpuc.ca.gov/efile/RULINGS/59082.pdf

demonstrate exceptional performance and expanded support for a wide range of retail and wholesale demand response and pricing options. OpenADR should be considered a required element in all Smart Grid deployment plans.

ALJ Question 2: Would you have any cautions for us to including that type of requirement?

There are four issues that the CPUC should be aware of and may need to address related to the adoption of OpenADR or any other Smart Grid framework standard.

A. Develop Validation and Testing Criteria for Pricing and DR Applications

There is a need to develop validation and testing criteria to assure that each OpenADR pricing and demand response application is consistently defined and supported. Validation and testing may not be an issue within a service area where a single utility or other entity has exclusive rights to offer a rate/price or demand response option. Validation and testing will need to be addressed if multiple entities (aggregators or other service providers) are allowed or authorized to support pricing and DR options.

B. Develop Certification and Testing Criteria for DR Controls and Hardware Devices

There is a need to develop certification and testing criteria to assure that energy management and control devices are capable of uniformly responding to validated OpenADR pricing and DR applications. Hardware certification addresses interoperability within and across service areas and provides assurance that a programmable controllable thermostat will respond similarly regardless of where it is installed.

C. Aggregator Applications May Introduce Proprietary Applications and Hardware

OpenADR can support signaling from a utility to the customer premise. OpenADR can also support signaling from the utility to an aggregator. Utility-to-customer signaling will be open, non-proprietary and provide customers with flexibility to adapt to new pricing and DR initiatives. Utility-to-aggregator signaling will be open to the aggregator, however aggregator-to-customer signals will most likely be proprietary, which may require aggregator provided proprietary hardware. Requiring aggregator-to-customer signaling and hardware to conform to OpenADR, SEP, and other NIST standards need to be addressed as a potential contractual matter. Proprietary communication and hardware standards for aggregator or other third-party service providers will have impacts on system operations, customer adaptation and operating cost, and the "public interest" issue raised in ALJ Question #4.

D. Not All Pricing and DR Applications are Smart Grid Compatible

OpenADR can support a wide variety of pricing and DR options, however, some existing DR options and many existing tariffs are not easily translated into Smart Grid applications. In other words, OpenADR cannot support applications that are inherently not Smart Grid compatible.

ALJ Question 3: What are the risks that we have of either locking things in or messing things up?

OpenADR is technology and communication hardware neutral. It uses existing programming language standards (e.g. XML) and accepted Internet protocols (e.g. TCP/IP). Implementation experience to-date demonstrates that OpenADR provides a platform with the flexibility to support and adapt to almost any utility-customer application and hardware environment. OpenADR will conform to the pricing, signaling, and scheduling data model standards being developed as part of the NIST process, assuring forward compatibility with yet underdeveloped systems and control equipment.

Expanding support from energy management and control equipment vendors that are developing and implementing OpenADR compatible systems provide a marketplace measure that significantly reduces the risk that a CPUC adoption might encounter. The DRRC presentation identified fifty (50) vendors that currently support OpenADR implementation. The recent announcement[7] by UISOL and Tendril significantly demonstrates expanded industry support for OpenADR.

ALJ Question 4: What can we do to ensure that the investments reflect a broad public interest, doesn't use obsolete technology, and doesn't lock us into one choice?

OpenADR provides an open, non-proprietary standards-based platform to support the delivery of price, reliability (event), and information signals. OpenADR is neutral to and can support most widely-used communication channels from narrowband to broadband. OpenADR is also neutral to customer energy management systems and control hardware. DRRC testing and implementation has clearly demonstrated that low cost options are available that provide OpenADR with capability to address multiple vendors and existing legacy as well as new state-of-the art options for all customer segments.

[7] Ibid 1.

Each of the California investor-owned utilities has already acquired and operates its own OpenADR demand response automation server (DRAS).

The public interest is best served by investments that provide a standards-based platform with a track record demonstrating low costs, flexibility, industry support, and the capability to support, and ability to quickly adapt to a changing technology environment. OpenADR provides this capability.

ALJ Question 5: What lessons and recommendations do you have?

A. Lessons Learned.

The panel presentation documented the DRRC OpenADR development and implementation accomplishments over the past seven years. This experience has produced three key "lessons learned" that respond to the first part of this question, specifically:

1. Developing OpenADR on an open, non-proprietary Internet Protocol model provided a flexible platform with the capability to support: (a) multiple communication options and legacy as well as state-of-the art energy management and customer control systems; (b) fast development of a wide range of retail and wholesale DR and pricing options, and; (c) strong, rapid support from industry energy management system, hardware, and software vendors.
2. Providing customers with Internet-based electronic price, reliability (event), and information signals and letting the customer choose how best to structure their response produces greater customer satisfaction and more substantial, consistent energy and demand reduction impacts than conventional utility control.
3. Providing customers with capability to automate their response to price, reliability (event), and information signals produces a very reliable, low cost, long-term demand response resource.

Recommendations.

The DRRC recommends that the California Energy Commission (CEC) and CPUC work together on issues regarding the adoption of OpenADR, SEP, or other Smart Grid. The DRRC has identified the following considerations.

- Establishing OpenADR as an interim standard could proceed in parallel but on an accelerated time schedule with the NIST related standards effort.

- Establishing OpenADR as a standard for California would not necessarily duplicate the NIST national effort but could inform the NIST national effort and accelerate development of third-party systems and equipment.
- A California early adoption could assist NIST in producing a more complete national standard.
- There is a need for development of verification and testing criteria for a CPUC approved inventory of pricing and demand response applications and collaboration with industry to identify one or more independent organizations that can manage the ongoing conformance process.
- There is a need for development of a framework and/or certification and testing criteria for a preliminary inventory of energy management systems and demand response control equipment.
- There is a need to identify options to harmonize OpenADR with the data models and other requirements that will be produced out of the final NIST process.

1. Examine what OpenADR implementation plans are appropriate for large commercial and industrial customers with demand greater than 200kW.

   Investor-owned utility and DRRC OpenADR research and development with the largest commercial and industrial customers have established a rich data base of experience and case studies. Vendor support for this customer segment is well established and a high proportion of the customers have both the systems and controls and experience necessary to support implementation. The CEC and CPUC could collaboratively determine what OpenADR applications and level of implementation are appropriate and consistent with state demand response, pricing, and renewable portfolio objectives.

2. Examine what OpenADR research, development, and implementation plans are appropriate to address small commercial and residential customers.

   Small commercial and residential customers share similar operational and technical situations. Energy use is typically dominated by a few large applications and there is generally a lack of automated controls. Existing DRRC and vendor community research could be augmented by additional utility pilots both to evaluate a broader range of

communication options and to encourage development and availability of low-cost control technologies. Research plans and objectives could focus on a common inventory of pricing and DR applications and then examine alternative utility, aggregator, and third-party communication and delivery options. Research could also explore and assure compatibility options to harmonize OpenADR and SEP 2.0.

ALJ Question 6: Does that make sense or is OpenADR too fast and loose a concept?

OpenADR was developed to address CPUC, CEC, and legislative concerns that arose out of the California energy crisis in 2000-2001. Research and development activities have been strongly supported by CEC PIER investments and CPUC policy and program support. Accomplishments to-date have been substantial, with confirmation by independent industry investment and national recognition through OpenADR's nomination as a Smart Grid standard.

OpenADR is a proven option. It has been thoroughly tested, documented, and vetted in the public arena. OpenADR is not a "fast and loose concept".

Table 1. DRRC-PG&E OpenADR CPP Research 2003-2005

Company	Avg kW Savings	Avg % Savings	Max kW Saving	Total Setup Cost	Cost Per kW
ACWD	52	20%	84	$12,824	$153
B of A	111	2%	227	$1,614	$7
Chabot	18	5%	46	$4,510	$97
50 Douglas	61	21%	85	$2,000	$24
2530 Arnold	61	16%	92	$2,000	$22
Echelon	78	25%	110	$3,620	$33
Gilead	71	10%	208	$7,500	$36
IKEA	219	12%	272	$5,050	$19
Oracle	45	10%	65	$375	$6
Target	33	10%	56	$3,312	$60
USPS	202	15%	265	$12,000	$45
USPS	**951**	**13.4%**			**$57.62**

Table 2. DRRC-PG&E OpenADR CPP Implementation 2006

Participants	Avg kW Savings	Incremental CPP charges (dollars)	Implementation	
			Total Cost	Cost Per kW
Office C1	96	$241		
Office C2	65	-$576		
Detention Center	123	$1,769	$3,500	$12
Office A	97	$1,513	$13,324	$137
Office B	316	$7,370	$2,900	$9
Museum A	3	-$39	$6,010	
Office D	98	$2,213	$3,620	$37
Office E+	11	$1,303		
Lab A1	39	$3,191		
Lab A2	13	$3,565	$4,500	$71
Retail A2+	88	$364	$6,360	$73
Office F	91	$613	$1,875	$21
Retail B1	65	$1,565	$3,312	$51
Average	**85**	**$2,099**	**$4,127**	**$51**

Table3. DRRC-Seattle City Light OpenADR CPP Pilot 2008

Participant	Controls Vendor	Controls Cost ($)	Control Strategy Cost	Total Cost	Cost Per kW
McKinstry	ATS	$3,780	$1,071	$4,851	$231
Seattle Municipal Tower	Siemens	$4,007	$1,071	$5,078	$10
Target (2 stores)	ALC	$6,500	$1,071	$3,854	$33
Seattle University	ESC	$3,414	$1,071	$4,057	$32
Average		**$3,414**	**$1,071**	**$4,057**	**$76**

Figure 1. OpenADR Large Commercial and Industrial Demand Response (Demand Bid, Capacity Bid, CAISO Participating Load)