BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking on the Commission's Own Motion to Improve Distribution Level Interconnection Rules and Regulations for Certain Classes of Electric Generators and Electric Storage Resources.	R.11-09-011 Filed September 22, 2011

CLEAN COALITION'S REPLY COMMENTS ON JUNE 21 2013 WORKSHOP ON SMART INVERTER FUNCTIONALITIES AND RECOMMENDATIONS FOR UPDATING TECHNICAL REQUIREMENTS IN RULE 21

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August 30th, 2013

CLEAN COALITION'S REPLY COMMENTS ON JUNE 21 2013 WORKSHOP ON SMART INVERTER FUNCTIONALITIES AND RECOMMENDATIONS FOR UPDATING TECHNICAL REQUIREMENTS IN RULE 21

The Clean Coalition is a California-based nonprofit organization whose mission is to accelerate the transition to local energy systems through innovative policies and programs that deliver cost-effective renewable energy, strengthen local economies, foster environmental sustainability, and enhance energy resilience. To achieve this mission, the Clean Coalition promotes proven best practices, including the vigorous expansion of Wholesale Distributed Generation (WDG) connected to the distribution grid and serving local load.

The Clean Coalition drives policy innovation to remove major barriers to the procurement, interconnection, and financing of WDG projects and supports complementary Intelligent Grid (IG) market solutions such as demand response, energy storage, forecasting, and communications. The Clean Coalition is active in numerous proceedings before the California Public Utilities Commission and other state and federal agencies throughout the United States, in addition to work in the design and implementation of WDG and IG programs for local utilities and governments.

The Clean Coalition appreciates the opportunity to submit the following Reply Comments on the June 21 2012 Workshop on Smart Inverter Functionalities.

Comments

1. General Reply Comments

The Clean Coalition wishes to acknowledge the collaboration of the Smart Inverter Working Group, and in particular SIEA, CALSIEA, and the DRA in working toward consensus positions on issues. While perspectives and the focus of concerns vary, we believe substantial alignment has been achieved in delineating an effective path toward realization of the benefits of substantial deployment of advanced inverters.

In addition to responses to specific recommendations made by parties in opening comments, we attach a recent investigative report developed at UC Berkeley under the direction of the Clean Coalition addressing a number of issues raised by parties in

opening comments, in addition to providing relevant background for the Working Group and interested parties who may not have elected to submit comments at this time.[1]

We believe all parties share common goal of ensuring customers have equal access and opportunity to generation choices, and to clean, reliable, safe and secure power at the least total net cost.

The Clean Coalition supports the use of advanced inverter functionality as a core component of integrated intelligent grid (IG) operation to achieve these goals. Along with energy efficiency, demand side management (including appropriate energy storage and broad application of demand response) and distributed generation serving local loads, advanced inverter functionality reduces the costs of integrating clean but variable energy into the existing electrical systems. As advanced inverter capabilities are deployed and utilized, both controllable and autonomous functionality can provide voltage support, frequency support, resilience and ride through of system anomalies, and improved visibility. Since most distributed generation and storage systems, including all PV systems, include inverters, the marginal cost of utilizing inverters with increased functionality can avoid much costlier investments that would otherwise be required in stand alone facilities, distribution and transmission upgrades, and additional generation.

That being said, we note broad agreement that it is both appropriate to indicate to manufacturers at the earliest opportunity the functionalities anticipated to be of use, and to only require such functionality where and when it this is anticipated to be cost effective, and where the value does not result in a net cost burden against either system owners or non-owner ratepayers.

The Clean Coalition joins in support of phased implementation of inverter requirements, including an initial permissive period starting immediately after the publication of a revised version ANSI/UL 1741. Mandatory requirements should allow sufficient time for development, certification and inventory allocation to avoid undue cost or disruption for installers, customers and manufacturers.

As clear criteria need to be issued well in advance to avoid delays in design, certification, procurement and interconnection planning, the Commission should continue

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[1] Advanced Inverters for Distributed PV: Latent Opportunities for Localized Reactive Power Compensation' (2013); Tessa Beach, Alina Kozinda, Vivek Rao:
1) Reactive power for a general audience (Section I)
2) Germany's management of distributed PV systems and advanced inverter-produced reactive power (Section II)
3) Sensitivities of potential reactive power valuation models (Sections III & IV)

to actively pursue and incorporate stakeholder input and proceed to establish the appropriate range of required functionality to avoid such delays.

We note broad agreement that there are likely significant cost implications that will need to be addressed that once new requirements and operational standards are adopted. Several of the proposed new features could have a significant negative impact on system revenue and new rate structures will need to be developed to mitigate these impacts.

The Clean Coalition also notes support of CESA, SIEA, CalSIEA, DRA and other parties in the recommendation to identify customer classes or minimum project threshold sizes below which certain mandated requirements would not apply, as the relative cost impact of these new requirements will vary by project size and type. A similar approach has been implemented in Germany and we support a review of the technical requirements to determine the relative benefit of each function when applied to smaller systems. We urge the commission to consider cost impact of these smaller systems and provide a waiver of those functions which unfairly impact system cost while providing little to no benefit to the utility.

2. SEIA & CALSIEA Joint Comments

The Clean Coalition agrees substantially with the comments presented by the Joint Parties and notes much commonality of position between the two organizations. Many points are addressed in response to other party's opening comments, however we highlight the following here:

- **Recognize the value of the benefits to the grid that may be cost-effectively provided by advanced inverters in commercial and residential applications**

  The Clean Coalition agrees that the cost benefit of the various advanced functions should be evaluated for both large commercial and small residential systems. The recommended functions should be structured appropriately with some waivers given to smaller installations. The question of benefits and costs is addressed in detail below in response to recommendations of DRA. We continue to support adoption of updated technical standards to facilitate the use of advanced inverter capabilities.

- **Develop a standard means of compensation for grid services support provided by advanced inverters and allow the DG sector to participate in ancillary services markets**

  The Clean Coalition shares support for the development of appropriate compensation methods and rate structures that will encourage voluntary use of advanced inverter functions by system owners. Any new compensation method

or rate structure should adequately consider the value of these ancillary services to the utility and to the larger goals for widespread use of renewable energy within the State.

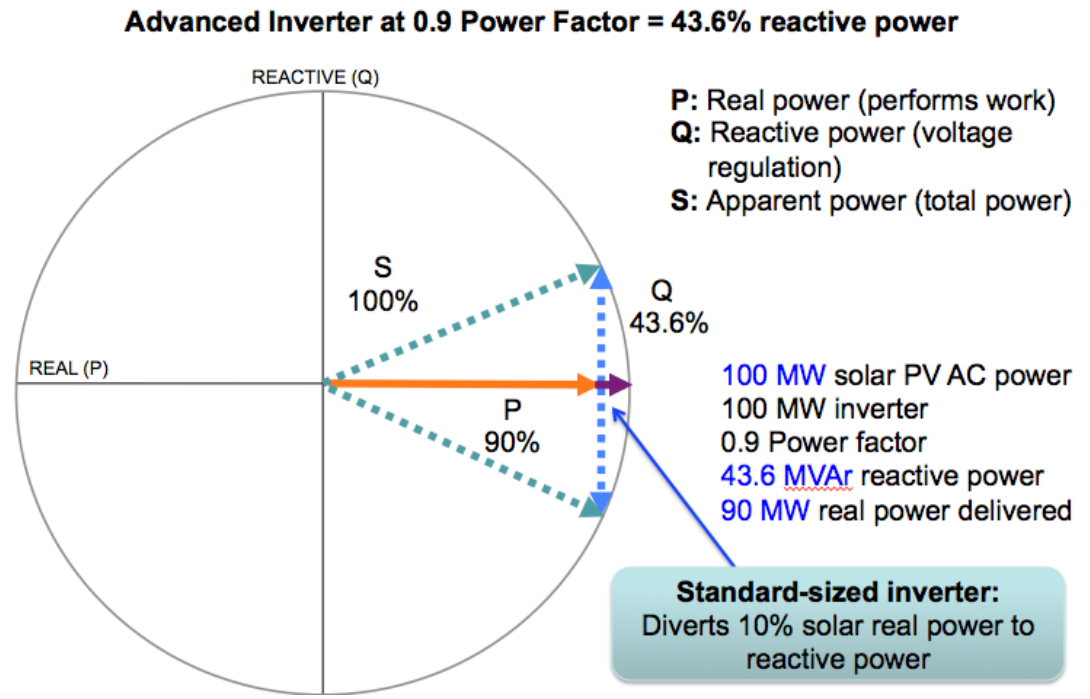
- **Examine the benefits of providing local reactive power support from distributed inverter-based resources and the potential for inverter-based distributed generation to provide voltage support to the transmission grid**

Both Parties support a detailed examination of the benefit of local reactive power support and identification of potential interactions between multiple autonomous DER systems operating in parallel. SEIA/CALSIEA recommend a narrowing of the power factor range requirements from the present +/- 0.1 to a lower value that will still provide significant ability to provide voltage support while minimizing the revenue impacts to system owners.

We wish to clarify in consultation with other parties that the Clean Coalition recommends a +/- 0.1 variability in the required average power factor range, resulting in a power factor (PF) of +/- 0.9, as this results in the most efficient provisioning of reactive power, allowing 45% of the maximum possible VAr output with no more than a 10% relative use of real power or reduction of output during periods of generation. We do not object to the ability to adjust PF further, and allowing a PF of +/- 0.7 will provide moderately greater VAr provisioning capacity during periods of critical need, however there are potential higher equipment costs and rapidly diminishing returns and increased impact on metered real power output as the PF is adjusted across a greater range. It would be both inefficient to incur costs not commensurate with value, and inappropriate to require system owners to do so if not compensated in some manner.

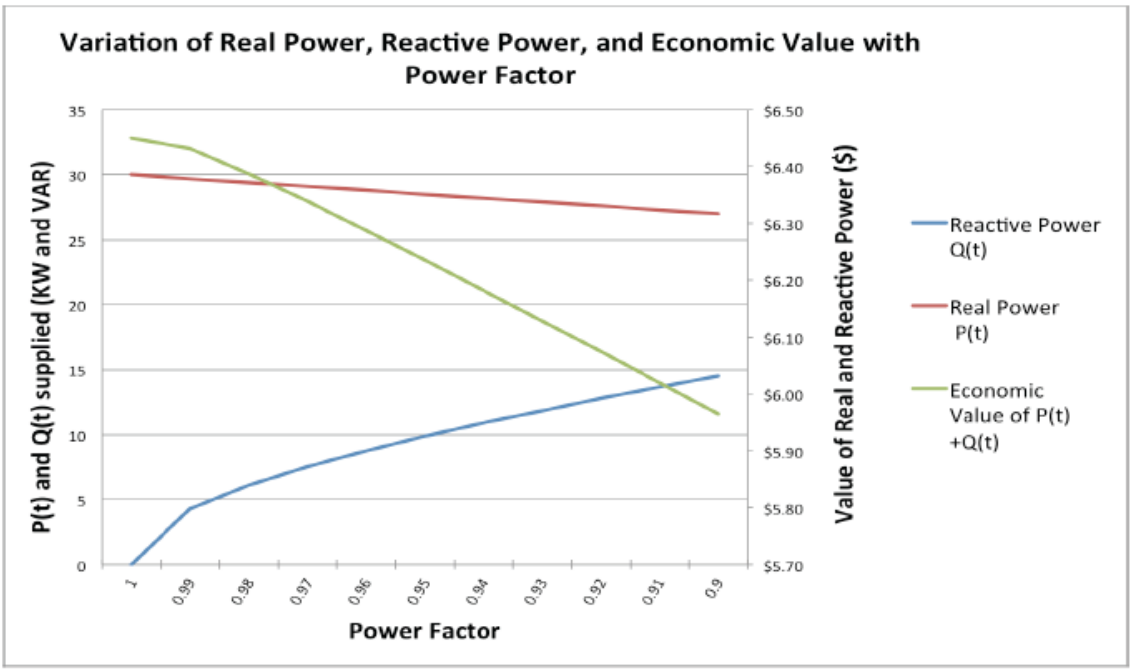
This is demonstrated in the following figure illustrating the relative reactive power (VAR) output and real power required at a 0.9 PF and how this would change with lower settings, and a graph of the change in economic value of reactive power production as the PF is reduced; in this example, taken from the above referenced report, the net value of reactive power production is positive only above a PF of 0.9.

Power circle showing inverter P (real), Q (reactive), S (complex) power output capability. Note the large range of reactive power output at a 0.9 Power Factor (shown in this example with 10% inverter headroom relative to real power output).



Source: Clean Coalition

Variation of real power, reactive power, and value of real plus reactive power with power factor. Assumes a 30 kW PV system with 30 kVA inverter and values of $.215 and $.011 for real and reactive power respectively.[2]



[2] ibid.

The Clean Coalition supports consideration of new revenue or ownership arrangements as needed to ensure that newly introduced values and costs are appropriately apportioned or compensated with a minimum of complexity. We have identified significant installation, equipment transfer, and cost of ownership issues to be addressed in the current Phase II of the Rule 21 proceeding and recognize that changes in equipment functions and services may impact existing models.

3. CESA

The comments of CESA are substantially in alignment with those presented by several other parties and the Clean Coalition agrees on a number of points raised

- **There is Insufficient Basis for Developing Requirements Outside of Existing National Standards Development Processes**

There are legitimate concerns raised regarding requirements that are not aligned with national standards, as also expressed by DRA. Given the time required for even initial deployment of certified equipment with advanced functionality, yet alone the deployment of significant quantities of such equipment and the readiness of utilities or the CAISO to utilize this functionality in system operation, there is time for further development of national standards.

California should continue to inform and encourage progress on revisions to IEEE 1547 and endeavor to avoid a proliferation of subnational standards if progress meets the needs of the State's distribution and transmission system operators. The Commission may additionally allow utilities flexibility in their system operations as needed in advance of final adoption of updated national standards. The Clean Coalition believes the Working Group and the Commission have been and should continue to proceed carefully to address stakeholder concerns and ensure that any necessary state specific standards adopted in advance of national IEEE operating standards updates are aligned with current and anticipated development of national standards and are unlikely to conflict with such.

California may also separately adopt standards regarding the functionality available in newly installed equipment so that such equipment is in place once operational standards utilizing this functionality are adopted. However, in doing so, the Commission should work closely with manufacturers to ensure that the range of both hardware and software functionalities required is compatible with the manufacture of equipment meeting nationwide standards. California is a very large market, and will primarily bear the cost of national delays in the deployment and utilization of advanced inverter functionality, but this must be balanced

against the fact that proliferation of incompatible standards will burden manufacturers, resulting in somewhat higher equipment costs for customers and some risk of legal challenge.

Distributed Generation customers, and ratepayers in general, are clearly better served when a modest increase in equipment costs is more than offset by savings in integration or interconnection costs, as noted in the opening comments of PG&E (at 3). While such tradeoffs are wholly warranted, cost effectiveness should still be considered with regard to the equipment standards to ensure they reflect the value and likelihood of utilizing these functionalities, and with consideration for each customer class, so as not to impose unnecessary costs. For instance, a three phase interconnected system may more easily provide some services to the electrical system than a single phase interconnection, and effort of adding this functionality to a single commercial scale facility is less than that of adding it to numerous small facilities of the same total capacity.

- **The Proposed Timeline is Unrealistic**

The Clean Coalition agrees that the proposed timeline may require modification to reflect the practical realities of the standards development process. An 18 to 24 month adoption period following publication of an ANSI/UL Standard is the minimum practical time period to avoid a substantial disruption of the industry.

- **Uses Cases Are Needed**

The Clean Coalition agrees with the call from multiple parties for clarification regarding the use cases related to proposed required functionalities and the likelihood and value of their use. In addition we believe such cases should reflect differences in customer classes and system size where relevant.

- **Trials Are Needed Before Determining Requirements**

The Clean Coalition also supports a phased implementation of inverter requirements, including an initial permissive period starting immediately after the publication of a revised version ANSI/UL 174. Mandatory requirements should allow sufficient time for development, certification and inventory allocation to avoid undue cost or disruption for installers, customers and manufacturers.

As clear criteria need to be issued well in advance to avoid delays in design, certification, procurement and interconnection planning, the Commission should continue to actively pursue and incorporate stakeholder input and proceed to establish the appropriate range of required functionality to avoid such delays.

- **Cost Implications Should be Considered before Requirements are Adopted**

There are likely to be significant cost implications that will need to be addressed that once new requirements and operational standards are adopted. Several of the proposed new features could have a significant negative impact on system revenue and new rate structures will need to be developed to mitigate these impacts.

The Clean Coalition also reiterates that the relative cost impact of these new requirements will vary by project size and type. We support a review of the technical requirements to determine the relative benefit of each function when applied to smaller systems. We urge the commission to consider cost impact of these smaller systems and provide a waiver of those functions which unfairly impact system cost while providing little to no benefit to the utility and ratepayers in general. We continue to share with CESA, DRA, and others the recommendation of consideration of minimum project size thresholds, below which those mandated requirements would not apply, as has been implemented in Germany.

- **Performance Should be Measured at the Point of Common Coupling**

The Clean Coalition agrees that the recommendations for measurement of power flows at the point of common coupling ("PCC") requires clarification. As measuring and controlling power flows at the physical PCC can add significant cost, especially for small DER, we recommend allowing this to be at the effective PCC, i.e. the point at which no additional customer equipment is present between the point of measurement and actual PCC. We concur with the CESA recommendation that The Rule 21 Working Group should be directed to determine appropriate circumstances in which the power flow control functions could be applied at the DER output point instead of the PCC.

The Clean Coalition has previously highlighted the importance of accounting for both real and reactive power provided to the utility, and appropriate compensation opportunities for provision of services, whether fixed or controllable. Our prior recommendation for consideration of measurement of the DC output of wholesale generation on the generator side of the inverter, and potential utility ownership and operation of the inverters on wholesale interconnections was once possible approach to consider in addressing these issues, but it is premature to recommend the best approach prior to further attention by the Working Group.

4. PG&E

- **Net savings can be realized by customers**

The Clean Coalition notes with support that PG&E affirms (at p. 3) the contention that improved inverter functionality, including standards for autonomous functions, may reduce the cost of DG interconnections and support higher DG penetration levels, allowing more customers to benefit from DG systems.

We would add that the incremental cost of the functionalities should be evaluated based on system size and the relative benefit provided to the transmission and distribution system.

- **Improving Standards for Autonomous Inverter Functions Should be Undertaken First**

The Clean Coalition agrees that the Working Group should first focus on the autonomous features, such as voltage and frequency setting changes to allow voltage and frequency ride through during a system disturbance.

Implementation of additional advanced features should be delayed until the effectiveness of these functions can be proven and value of the uses cases has been established.

We also support the development of clearly defined power output and VAr production ramping functions so that the operation of one inverter is not likely to interact adversely with adjacent inverters.

- **Challenges Posed by Automatic Control Functions**

The Clean Coalition supports the evaluation of various automatic control systems by the Working Group. We agree with PG&E that automatic control systems are complicated and the multiple control devices may work against each other if the control schemes are not adequately coordinated. We join with others in supporting further investigation, development and field testing of automatic control systems for multiple devices operation in coordination with each other and existing utility control equipment.

While it is appropriate to establish functional capacity ranges for equipment to be safety tested and certified without delay, we concur that it is be premature to include any automatic voltage and frequency control system requirements in Rule 21 in the near term, until such functionality can be proven to be safe and effective, and the adoption period compliant with sec 1254 of the 2005 Energy Act is defined. The time required for this process indicates the importance of avoiding delay in addressing the prerequisites. New equipment standards should reflect and incorporate operational ranges both the current IEEE 1547 and anticipated in updates in order to have the greatest likelihood of long term value and "future proofing".

- **Communication-Based Functions Require Coordination**

The Clean Coalition also supports continued Working Group evaluation of communication-based inverter functions. We concur with PG&E that significant additional work is needed to verify communication-based functions can communicate with the utility system and with each other as needed.

Priority should be given to utilization of the fast acting and autonomous functionality available with advanced inverters, and this should include the ability of settings for such functions to be respond to signals from the system operator and default to safe mode in the event that communication is lost, such as during potential islanding. Utilization of existing utility and non-utility communication infrastructures should be considered against the costs and benefits of alternatives, including power line carrier communication, smart meter signaling, and internet communications.

PG&E correctly identifies a lack of clarity on the correct balance or functionality and integration between the utility grid and inverters and the need for cost benefit analysis for these functions. We would add that this will vary across different size systems and customer classes.

5. SCE

1. Comments on the Working Paper's Testing Plan

The Clean Coalition supports SCE's and PG&E's position to allow the Working Group to modify the Testing Plan to permit flexibility regarding the scope and schedule of the mandatory functions. The Working Group should adjust the process in response to actual testing and determination of system safety and reliability. We also believe parties have correctly identified the need for additional study, field testing and analysis of the proposed functions to insure that

they work as anticipated. We concur that these testing efforts should be prior to making final decisions about Rule 21 modifications or mandatory requirements, and note that the adoption period for new equipment certification standards will allow approximately two years for trial before related Rule 21 modifications could require compliance.

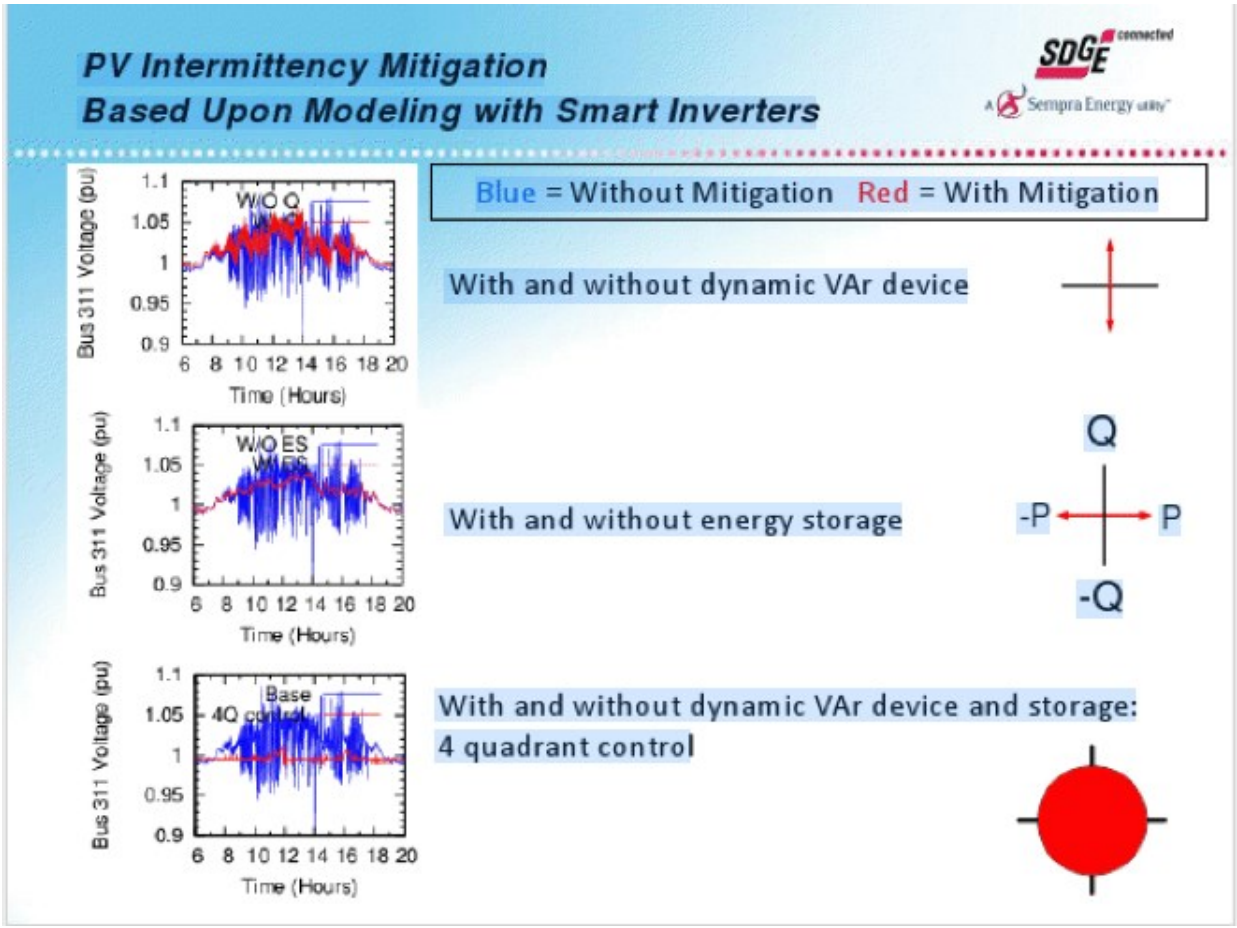
The Parties agree with SCE and urge the commission devote careful consideration to the costs and benefits of any major changes that could require a considerable investment by utility ratepayers. In particular, the parities feel a detailed analysis should be conducted for small residential systems to determine the relative cost benefit of each of the recommended mandatory functions.

The Clean Coalition concurs with SCE's recommendation to first focus on autonomous features that could result in UL certification requirements and test plans. We support the development of a limited initial set of key autonomous features including:

- Voltage and frequency settings to allow voltage and frequency ride through during a system disturbance
- Clearly defined power output ramping functions to minimize interactions between various DER devices
- Voltage mitigation measures should also be considered where warranted to minimize voltage fluctuations experienced by other distribution customers, including gradual power ramp up and ramp down (where short term storage or site specific forecasting is available).

The following graphic[3] illustrates the opportunity for advanced inverters both alone and combined with storage to address voltage variation and make the grid reliable with high penetration DG. This graphic separates the effects of the real power (P) & reactive power (Q) components of advanced inverters:

[3] San Diego Gas & Electric advanced inverters slide from California Public Utilities Commission Energy Storage Workshop on January 14, 2013



- The 1st example is pure +/- Q, which definitely reduces the range, but cannot always shave off the excessive peaks that exceed the 5% upper limit because a pure reactive load does not move the real voltage down that much.
- The 2nd example is pure +/- P from the energy storage with the inverter fixed to a power factor of 1.0 (no reactive power); it definitely narrows the range since the battery can now add load to that node to help lower the peaks, but there is still quite a bit of variability.
- The 3rd example with the full ranges of P & Q available (all 4 quadrants of the circle) does an amazing job of controlling the voltage.

As previously noted, we agree with a broad range of parties that any Rule 21 requirements for autonomous features should be aligned with national standard as much as possible to avoid the inefficiencies and cost to develop separate design and test procedures for California. Within the range of national equipment

standards however, operational standards should reflect the results of field experience and local circumstance while seeking alignment with concurrent development and updates of IEEE 1547.

- **Comments on the Working Paper's Scope**

The Clean Coalition does not necessarily agree with SCE and PG&E that it is premature to focus on automatic control functions that require communication capabilities.

We note broad acknowledgment of the position that both automatic control functions and communication-based functions can facilitate higher levels of distributed generation penetration. We do agree that of the two approaches, the communications based functions are more complicated and present significant challenges, including device coordination, potential infrastructure costs and possible device costs.

While we concur with SCE's proposal to give the Working Group the flexibility and time needed to adequately analyze the challenges and the viability of each of these potential functions, we also believe early priority should be given to the requirement of control functions that are responsive to status setting signals. Such one-way signaling receivers are relatively simple and inexpensive to incorporate through a variety of modalities, and early signal receiver standards will deploy valuable functionality that will be available for use when the signaling systems are employed, while operating in default settings until that time and during any loss of such signaling. Likewise, signal propagation through power line or radio frequency transmission is neither notably complex nor expensive. While more advanced communication is evaluated, consideration should be given to rapid adoption of more limited but valuable and robust base capacities.

6. SDG&E

- **Timing of Adoption**

The Clean Coalition acknowledges that SDG&E is currently experiencing high rates of growth in customer owned PV systems, and that compliance with voltage conservation targets and operating limits may impact the cost or ability of additional customers in some areas from installing DG under current inverter and system operation standards. We support rapid adoption of updated ANSI/UL 1741 standards to allow the use of equipment that may alleviate customer costs or constraints, and we support Commission consideration of requests to adjust operating standards in advance of national adoption. While certified equipment with advanced capabilities should be available at the earliest opportunity, there

should be no requirement for its use until the national adoption period is completed, and variations from national operating standards should be minimized.

- **Testing of DER Functions**

The Clean Coalition joins with SIEA and CALSIEA in opposing SDG&E's recommendation to use certification data from products sold in foreign markets. While we are sympathetic to this approach, and strongly support the utilization of readily available equipment and the adoption of mutually compatible standards, US certification is necessary. Use of such equipment on customer-sited DER installations without US certification would be a violation of the National Electrical Code (NEC)4 and, as a consequence, illegal under California State law. The Parties therefore urge the ALJ to reject this suggestion.

- **Supporting Arguments**

The California has adopted the 2008 edition of the NEC as a minimum set of requirements. The California Electrical Code does allow local jurisdictions to add additional requirements above and beyond the NEC but they may not waive the minimum NEC requirements. NEC Article 90.7 requires equipment to be examined by qualified organizations. In the United States the qualified organizations are the Nationally Recognized Testing Laboratories (NRTLs) which regulated by OSHA[5] as required by Title 29, Part 1910 of the Code of Federal Regulations (29 CFR Part 1910). Utilities and over governmental laboratories are not NRTLs and therefore are not authorized to conduct product certification testing. NEC Article 110.3 defines the requirements for examination, identification, installation, and use of such equipment. While NEC article 110.3 does not specifically required use of listed equipment, PV systems are covered under NEC articles 690 and 705. NEC article 690.4(D) specifically requires equipment used in PV systems to be listed for the application. Equipment listed for other applications is not suitable for installation in permanent PV power systems. Customer sited PV equipment is therefore required to be Listed by an NRTL and evaluated to ANSI/UL 1741. Use foreign certifications does not meet the basic legal requirements for use in California.

7. CPUC Division or Ratepayer Advocates (DRA)

In response to communication from DRA, the Clean Coalition wishes to amend our prior characterization of the current IEEE 1547 standard as "obsolete". Clearly

[4] *National Electrical Code*, NFPA 70, National Fire Protection Association®
One Batterymarch Park, Quincy, MA 02169-7471

[5] Ocupational Health and Safety Adminsitration

the current standard continues to function as intended and has neither been replaced or otherwise made redundant. Our intention was to point out that 1547 was not designed to meet the needs of efficient system operation with high penetrations of DG and this is the basis for the ongoing consideration of the updated 1547.8 and interim 1547a that guided much of the recommendations submitted to parties for consideration.

- **The Clean Coalition agrees with several of the recommendations made by the DRA, including:**
  - A ruling to further define and clarify the purpose and process of the Working Group
  - Additional outreach to other stakeholders to insure a true consensus and representative process.
  - More transparent documentation of Working Group discussion
  - The addition of a phase for consideration of costs, that will consider a reasonable balance between the costs and the benefits to ratepayers to implement any proposed inverter functionalities.
  - Potential Grid Benefits Must Be Comprehensively Considered in the Context of an Existing Regulatory Regime, Conversion Costs, and the Relative Costs and Benefits of Application to Small Systems,

While the Clean Coalition supports each of the above recommendations by the DRA and the general preference for deferral to national standards, open architecture, and coordinated efforts, we also note that these legitimate and appropriate considerations should be both pursued and balanced against unduly delaying progress or implementation.

- **Potential Grid Benefits Must Be Comprehensively Considered in the Context of an Existing Regulatory Regime, Conversion Costs, and the Relative Costs and Benefits of Application to Small Systems**

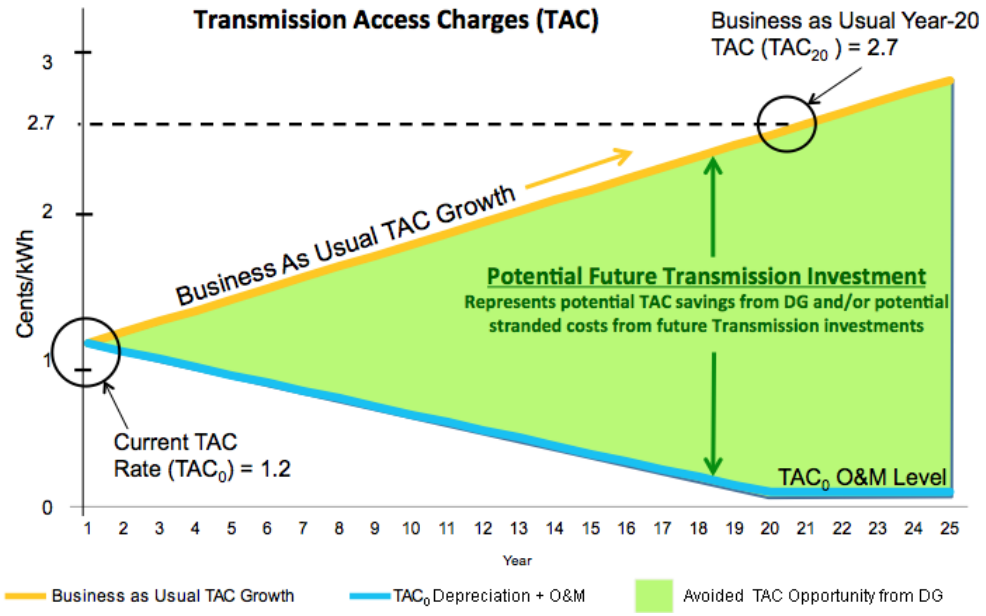
Recognizing the value in addressing the impending need earlier rather than later, the Working Group and Commission have been very effective in development of the draft proposals and initial presentation to parties in this proceeding. It is important to build upon this good work and maintain an effective, inclusive, and timely path forward as California approaches 12,000 MW of DG and 33% RPS targets by 2020 and continues to higher levels of clean, secure, sustainable and local energy sourcing in the years following.

The CEC, CPUC, and utilities have recognized the challenges and potential costs of integrating these valuable new energy supplies into an existing electrical system

and operating standards not designed to take advantage of these resources, and have also recognized the opportunity presented by advanced inverter functionality among other intelligent grid solutions to allow DG/DER to provide needed support, services, and net benefits to the electrical system.

The costs and constraints associated with current system functionalities and operating standards are well known to Parties active in this proceeding and ongoing revisions to the State's interconnection processes, and net cost reductions will increase the cost effective opportunities for broad application of DER, both to directly serve customer loads and supply energy wholesale to the utilities to serve local demand.

We remind parties of the great additional value in any reduced need for ratepayer investment in both additional peaking and flexible capacity, which are more costly due to their relatively low capacity utilization, and the very substantial capital and ongoing equity costs exceeding 10% per annum on billions of dollars in new transmission infrastructure that can be deferred or avoided. As shown in the graph below, transmission related charges alone, if left unchecked, will rise to a current value cost of 2.7¢/kWh within 20 years.



The use of installed advanced inverters is also much more cost effective than the addition of traditional voltage regulation equipment, ranging from load tap changers to capacitor banks to the addition of synchronous condensers.

As detailed in the attached report, the capital costs alone of simply providing reactive power through capacitor banks is approximately equal to the cost of comparable commercial inverter capacity at $2.3/kVAR-yr, however much of the inverter capacity required would already be deployed and available as DER systems

are installed by customer generators and fewer if any dedicated facilities would need to be procured by ratepayers. Providing reactive power locally avoids significant transmission-related costs due to the ability to provide conservation voltage support at points along a distribution circuit and avoiding the greater inefficiencies related to reactive power transmission compared to real power. The real energy required for VAR provisioning is equal, or less when provided closer to the targeted need, although procurement compensation will need to be redirected to the new local DG providers.

The current approach to DG/DER, especially NEM facilities, discounts both their actual and potential contribution to the electrical system, resulting in redundant procurement for both capacity and regulation.

For example, the 290 MVar of area reactive power support required following the unplanned shutdown of the San Onofre Nuclear Generating Station and temporarily provisioned through the conversion of Hunting Beach Generation Station to synchronous condensers can alternatively be provided by advanced inverters associated with 570 MW of PV in the same service area if those inverters operated at a 0.9 PF and sourced real power from the distribution system when the PV was not generating, just as the current approach does twenty-four hours a day.

The overwhelming response to regional PV procurement programs by SCE and LADWP clearly demonstrate the market interest and ability to provide this capacity, and the CPUC has proposed targets of 745 MW of storage throughout Southern California by 2020 in addition.

Distributed provisioning of reactive power through DG or local storage with advanced inverters sources the reactive power where it is needed. This not only reduces the relatively high losses experienced in the transmission of reactive power, but supports greater implementation of conservation voltage, resulting in reduced real power requirements as well.

Since DG being installed anyway can provide both capacity and regulation services, making these services visible and available to system operators avoids the ratepayer cost of additional non-DG resources to provide these services. Ensuring that new DG installations are performed with forward compatible equipment to the extent practical is sensible planning, especially where there is insignificant cost. To that end, we strongly support the use of Smart Inverters, although we recognize that there may be a case for delaying or modifying adoption of such standards for small/residential systems (ex <10 kW).

- **Relevance of the German Experience and Implementation Timing for Amendments to Rule 21 Requirements**

As noted in the attached report, Germany, which, under their Feed in Tariff program, has successfully installed 32 gigawatts of PV, including 9,000 MW from systems below 30 kW on customer premises, has already experienced challenges with high penetrations prior to the introduction of advanced inverter functionality, and is now requiring that these either be retrofitted or switched to reduced 0.7 power factor operation largely to address voltage and VAr needs with their high penetration of DG.

The Clean Coalition seeks agreement on the importance of California getting ahead of this issue, in order to avoid the very substantial cost of either retrofits to the inverters or distribution system equipment and additional conventional resources at the transmission level. We do not see evidence that the State is currently experiencing the same issues except in isolated cases, but will need to begin significantly utilizing mitigation measures within the 3 year timeframe concurrent with that required to develop, adopt, and implement solutions, including both standards and the deployment of related equipment.

"Reactive power supply is the key controller of voltage in alternating current (AC) power systems. **Reactive power supplied locally could be a major player in improving system reliability as well as improving system efficiency**."

Oak Ridge National Laboratory (2008)

8. Conclusion

Advanced inverter functionality is less expensive than traditional alternatives for facilitating high penetrations of renewable energy in distribution networks and supporting the integration of intermittent renewable generation. Timely deployment and utilization will allow utilities to defer customer charges for distribution and transmission grid upgrades that would otherwise be required to integrate planned levels of DG.

The Clean Coalition appreciates this opportunity to provide reply comments and looks forward to continuing to work with the Commission and other stakeholders on these important issues for the successful transition to secure, sustainable, and cost effective energy supplies with equal access for all customers.

Respectfully submitted,

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Dated: August 30th, 2013

Attachment: Advanced Inverters report by the Clean Coalition and UC Berkeley –

'Advanced Inverters for Distributed PV: Latent Opportunities for Localized Reactive Power Compensation' (2013); Tessa Beach, Alina Kozinda, Vivek Rao:

1) Reactive power for a general audience (Section I)
2) Germany's management of distributed PV systems and advanced inverter-produced reactive
power (Section II)
3) Sensitivities of potential reactive power valuation models (Sections III & IV)