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L E T T E R R E P O R T

Date: November 26, 2005

To: Michael Winka, B. Scott Hunter; Office of Clean Energy NJBPU

Cc: Alma Rivera

From: Chuck Whitaker, Jeff Newmiller

Re: Review of New Jersey's Net Metering and Interconnection Standards for Class I Renewable Energy Systems

BEW has reviewed and compared New Jersey's Net Metering and Interconnection Standards for Class I Renewable Energy Systems as defined in N.J.A.C.. 14:4-9 and found at www.bpu.state.nj.us/wwwroot/secretary/NetMeteringInterconnectionRules.pdf with the Mid Atlantic Distributed Resources Initiative (MADRI) and PJM's model found at www.pjm.com/committees/working-groups/sgiwg/downloads/20050524-item-3-madri-interconnect-proc.pdf. This review and comparison includes:

1. Comparison of the two rules side by side and identification of differences;
2. Identification of how other states or jurisdictions have handled similar issues;
3. Recommended alternatives to resolve the differences;
4. An analysis of the tariffs and interconnection agreement forms drafted to date with recommendations for improvement.

Summary

The comparison of the two documents showed few substantive differences, and exemplify the work going on around the country to standardize utility interconnection requirements. Though there is clearly work left to do, the utility interconnection process is approaching the standardization found in other construction/building activities. In building a house, for example, there are differences from one jurisdiction to another on the permitting processes, forms, and costs, on the settings for certain devices, on requirements for insulation and glazing, etc., but there is general acceptance of certified and listed equipment, such as HVAC and electrical equipment, as well as for standardized building practices, such as the NEC and the IBC.

Details of the comparison of the two documents are provided in the file "NJBPU vs MADRI.xls".

Suggestions for Revisions and Clarifications:

Items that should be considered for revision/clarification, either for resolving differences between the two documents or as recommended improvements, include the following:

NJAC 14:4-9.2 Definitions, "Point of Common Coupling": The IEEE Std 1547-2003[1] definition is:

> "3.1.13 point of common coupling (PCC): The point where a Local EPS is connected to an Area EPS."

The "harmonic limits" description used in the NJAC document (possibly from an early draft of 1547) should be replaced.

Also, Referencing an IEEE standard with its publication date, specifies the version to be used. When that document is "... amended and supplemented..." it will be re-issued with a new date. Normally the publication date is included in the reference of a standard (e.g., IEEE Std 1547-*2003*) when the intention is to not accept new versions that may be published without explicit review and approval. Consider leaving off date if you want to always use the latest version, e.g., "the most recent published version of IEEE Std 1547 when the application is submitted."

NJAC 14:4-9.5 General Provisions. The NJAC requirements imply that a system using equipment certified to IEEE 1547 is sufficient to assure compliance to IEEE 1547 (Section 14:4-9.6 is titled "Certification of customer-generator *facilities*" (emphasis added), but a facility can only be certified after it is complete and the descriptive text in the section talks about certifying the "equipment package". The document should more clearly state that systems should be installed in compliance with IEEE Std 1547-2003. Because of interpretational and jurisdictional issues, the MADRI requirements call out a PJM document that references specific sections of 1547 provides some additional details and notes what exceptions are taken. California Electric Rule 21 also takes this approach.

NJAC 14:4-9.6 (a) Certification One key issue in both documents is how IEEE 1547 requirements, and in particular certification requirements, are invoked. IEEE Std 1547.1[2] was recently published and defines the test procedures necessary to evaluate equipment to IEEE 1547. To our knowledge, there is no equipment that has been

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1 *Standard for Interconnecting Distributed Resources with Electric Power Systems*

2 *Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems*

specifically evaluated and certified (Listed) to IEEE 1547.1., Underwriters Laboratories has just completed a revision to UL 1741[3] to coordinate with and implement IEEE 1547.1. Since the changes related to 1547.1 do not address major safety concerns, but, rather, reflect the compromise consensus of a different audience with broader interests, UL has set an effective date—the date by which currently listed equipment must be evaluated to these new requirements or lose listing status—of May 2007. Note, however, that any equipment being evaluated to UL 1741 after Nov 7, 2005 should be done to these new requirements. So until May 2007, there will be a mixture of equipment meeting the new and old requirements but still considered "listed" by the listing agency. This is a reasonable approach taken whenever UL makes changes to its test standards.

The current NJAC and MADRI requirements have been interpreted to mean that to be considered "Certified" equipment must be tested to IEEE 1547 (and ostensibly 1547.1). Not only does this mean there are few if any listed/certified products currently available, it means that currently listed/certified products will either be unavailable to NJ customers or will be treated as non-certified equipment possibly requiring extensive retesting.

California is dealing with this issue in its Electric Rule 21 (www.rule21.ca.gov) by applying the UL 1741 Listing effective date—equipment tested prior to the issuance of the revised UL1741 standard will be considered certified until March 7, 2007.

A minor aside on the MADRI requirements, Appendix 9 "Certification Requirements for Small Generator Facility Interconnection Equipment" states that equipment will be considered certified if it has been tested

> "...by any Nationally Recognized Testing Laboratory (NRTL) recognized by the United States Occupational Safety and Health Administration to test and certify interconnection equipment pursuant to the relevant codes and standards listed in attachment "A"..."

Of the 15 codes and standards listed in the attachment, "only UL 1741 and IEEE C37.90 are identified in UL's OSHA NRTL scope of recognition," according to Rick Titus UL. He adds, "For the other standards identified in the list, OSHA would likely consider these standards outside the scope of the NRTL program and therefore deem these standards as "not appropriate" for inclusion in any NRTL's scope. In fact, in 2002, UL applied to OSHA for some of the other standards on the list and was denied for this very reason." Note that the tests in the other documents can be and are performed by UL, other NRTL's, and non-OSHA accredited testing laboratories and should be valid for the purposes of this certification process.

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[3] Including a revised title of *Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources*

Finally, all that's really implied in the certification described here is Type Testing—the initial testing of a particular model of equipment. Without further explanation of what certification entails—an activity you probably don't want to undertake—requiring or preferring equipment that is "Listed" to UL 1741 will address issues that go beyond Type Testing, such as production testing, requirements for retesting, assurance of on-going compliance, etc. It can be argued that Listing usually includes product and personnel safety issues that are beyond the scope of a utility interconnection agreement. However, Listed equipment also simplify the building/electrical inspection process, especially important in the smaller systems.

NJAC 14:4-9.6 (e) EDC provided equipment The intent and impact of this provision is unclear and should be explained. Alternatively, the sentence could be reworded to be more explicit, e.g., "EDC provided equipment is assumed to meet all certification requirements and needs no further testing except as may be necessary to ensure proper field wiring by applicant".

NJAC 14:4-9.7 The following table provides a comparison of the required process times for NJAC, MADRI and California Rule 21. Note that the processing time requirements for Level 2 and higher become increasingly complex and the times shown are subject to interpretational errors on the part of the reviewers. It does appear that the NJ Net Metering and Interconnection Stakeholders attempted to expedite the approval process. It will be interesting to see how actual processing times compare.

Application Processing Time, approximate

Cumulative business days from submission of a complete application

	Application Submitted	EDC Acknowldge Receipt	EDC Accepts/Rejects or Scoping Study	EDC notif. If insp/wittness test is reqd. & send Agrmnt	EC performs Supplmental Review	Applicant complets constrction submits all final forms. (assume 5 days)	EDC performs inspection/ witness test, if reqd.	**System start up**	Comments
NJBPU Level 1	**0**	3	13	16		21	26	**26**	
MADRI Level 1	**0**	10	25			30	40	**40**	
CA Rule 21 (simplified)	**0**	10	20			25	30	**30**	
NJBPU Level 2	**0**	3	18	21		26	36	**36**	App. passes review screens
	0	3	18	23		28	38	**38**	App. Fails review screens, but is still approved
	0	3	18	23 + x		28 + x	38 + x + y	**38 + x + y**	App fails, add'l "x" day review reqd. and "y" days of EDC Mods
MADRI Level 2	**0**	10	30	35		40	50	**50**	App. passes review screens
	0	10	30	35		40	50	**50**	App. Fails review screens, but is still approved
	0	10	30	35 + x		40 + x	50 + x + y	**50 + x + y**	App fails, add'l "x" day review reqd. and "y" days of EDC Mods
CA Rule 21 (Sup. Rev)	**0**	10	20		30	35	40	**40**	Supplemental Review determines no additional requirements are necessary
	0	10	20		30	35	40 + y	**40 + y**	Sup Rev determines add'l requirements; "y" days of EC mods
	0	10	20		30	35 + x + y	40 + x + y	**40 + x + y**	Sup Rev determines Int. Study necessary; "x" days study and "y" days of EC mods, "y" days of customer
NJBPU Level 3	**0**	3		3 + x		8 + x + y	23 + x + y	**26 + x + y**	Initial 3 day ack assumed (not specified) add'l "x" day review reqd. and "y" days of EDC Mods
MADRI Level 3	**0**	10	20 + x	25 + x		35 + x + y	45 + x + y	**45 + x + y**	App studies as needed="x", "y" days of EDC mods

NJAC 14:4-9.7 (c) says that the system may not contribute more than 10% of the distribution systems maximum fault current. The MADRI requirements exclude Level 1 interconnection applications (<10kVA) from this requirement, as does California Rule 21. Especially with inverter-based generation, it is extremely unlikely that an application would fail this screen and still pass the 10%/15% penetration screen 9.7 (e). And even if it does, presumably due to the existence of large machine-based generation, the incremental fault duty of <10kW inverter-based generation would add inconsequentially to the total when the aggregate generation met 9.7 (e).

NJAC 14:4-9.7 (d) does not allow simplified interconnection to network distribution systems or to transmission connected customers. Consider adding language to allow network interconnection—the Level 2 requirements would be a reasonable starting point. Also, ignoring the jurisdictional issues, it certainly seems reasonable that the

screens contained in this section would more than adequately deal with interconnecting a 10kW inverter-based generator to a transmission system and would allow such customers to participate in the Net Metering program. Admittedly, the jurisdictional issues are not trivial, but California IOU's have applied Rule 21 technical requirements to transmission connected DG not involved in wholesale market sales.

NJAC 14:4-9.7 (e) The term "circuit" used in this paragraph is not defined and is ambiguous. MADRI uses the term Line Section, which is defined similarly to its use in California Rule 21. Consider adopting the MADRI Line Section term and definition, or provide a definition. The adoption of penetration levels that differ from MADRI suggest an explicitly different intention for a "circuit".

NJAC 14:4-9.7 (i) The NJAC process specifies the EDC inspection(item (j)) prior to approval from "approval by the electrical code officials with jurisdiction over the interconnection". Note that in MADRI, the code official inspection (i.e., sign off of the building permit) is done before EDC inspection and ensures that any changes required by the code official will be included in the EDC review. Either order appears to be allowed by the language, but it could be made clearer that that code inspection then EDC inspection is preferred. The Draft Level 1 application form specifies this preferred order.

NJAC 14:4-9.8 (c) 90% short circuit interrupt: As with several of the steps, it is unclear if this is a screen or a requirement. Consider rewording to acknowledge potential benefit of DG located downstream of devices approaching their interrupt limit. Consider excluding small DG (e.g., <10kW) from this evaluation. Assessing fault duty impact via equipment interrupt capability may be problematic (is this the reason for 9.5(e)?). If 9.8 (e) is satisfied (low penetration), will fault duty be a problem (i.e., same consideration as 9.7(c) above)?

NJAC 14:4-9.8 (d) Transient Stability: It is unclear if this is a screen or a requirement. Allowable limit should be related to feeder voltage (64kV feeder should be allowed more than a 4kV feeder).

NJAC 14:4-9.8 (e) See comments on 9.7 (e) above.

NJAC 14:4-9.8 (k) See comments on 9.7 (d) regarding Transmission interconnection.

NJAC 14:4-9.8 (l) This is an area of ongoing development around the country. Collaboration with other state process, such as in California[4], Massachusetts, and New York, and with the IEEE P1547.6 activities is suggested.

NJAC 14:4-9.9 Level 3 Review Both NJAC and MADRI provide substantial details regarding the system review and impact study processes. While there are differences in text and in some of the details, they are both indicative of utility practices. MADRI includes more details in terms of queuing, allowable processing times, etc., but these items appear to be addressed in the NJAC process in a general sense. Because of the variable nature of this process, it is probably easy to over-prescribe the steps that should be taken. It will be interesting to compare examples of actual processing times to those defined here.

NJAC 14:4-9.11 (a) The NJAC approach seems to be consistent with both MADRI and IEEE 1547, both of which include statement of the type "if allowed/required by local practice.." However, this item seems to be related to initial design/requirements as opposed to post-approval requirements. Perhaps lacking a section describing interconnection requirements, this was the best home for the topic.

NJAC 14:4-9.11 (c) For broader applicability, suggest changing "inverter" in step 1 to "customer generator". Consider adopting/referencing the commissioning and periodic testing requirements defined in IEEE Std. 1547.1-2005.

Other Minor Differences:

Some of the minor differences include the following:

- The NJAC document covers Interconnection for net-metered Class I renewable generation up to 2 MW, essentially a subset of the MARDI document.
- The NJAC document has breakpoints at 10kW and 2MW whereas MADRI has 10kVA and 2MVA. This could have a 10% difference in current levels (assuming a 0.9 power factor), but since these numbers are arbitrary, they don't represent substantive differences in safety or reliability.
- The NJAC document allows machine based DR up to 2MW to be evaluated under the Level 2 Interconnection Review—MADRI is limited to Inverter based. The Fault duty and circuit (penetration)

[4] See www.rule21.ca.gov/technical_issues/network

With respect to the technical interconnection requirements, the power limits in these two documents (and in IEEE Std 1547-2003, for that matter) are arbitrary and should be viewed with some flexibility. Both the NJAC and MADRI documents distinguish "distribution systems" as being less than 69kV. A 2MW system may require significant upgrades in some locations, for example at the lower range of distribution voltages or at the end of a lateral. On the other hand, 20MW may be no problem at the upper end of the voltage range. The screening/review process provide levels below which shouldn't be a problem, above which need to be investigated more thoroughly

Review of Application Forms and Recommendations for Improvement:

A review and comparison of the NJBPU Model Application (1 Apr 2005) and MADRI model SGIP Appendix 1(19A Aug 2005) was performed. Both the NJBPU and MADRI documents include Interconnection Agreement information (Terms and Conditions in the NJBPU document, Conditional Interconnection Agreement in the MADRI document).

The following suggestions are offered:

Application Process step c. (Page 2) regarding EDC Wiring Inspection is not specified in the NJAC document. Suggest adding a discussion of this process in the Rule.

Application Process step e. requires the local AHJ to submit the Certificate of Approval. Should this be the applicant's responsibility?

Customer-Generator Facility's Information: Location of External Disconnect Switch may be difficult to describe, especially within the limited space allotted.

Customer-Generator Facility's Information "UL1741 Listed?" Unclear what might/should/must be listed. For Level 1, the inverter must be Listed.

Customer-Generator Insurance: The insurance disclosure is not referenced as part of the certification/signature.

Terms and Conditions Item 3 Safe O&M: Adding a reference to manufacturer's required maintenance and to 1547/1547.1 periodic testing wouldn't hurt.

Terms and Conditions Item 8 Termination: NJBPU omits the MADRI termination for failure to operate over 12-month period. Unless the need for this clause can be justified, suggest leaving it out.

Other minor differences between the NJBPU and MADRI forms are, for the most part, related to differences in the scopes of the two processes already addressed in the rule comparison (e.g., external disconnect, net metering, etc.).