Power Generation

June 27, 2003

Burl W. Haar
Executive Secretary
Minnesota Public Utilities Commission
121 7th Place East, Suite 350
St. Paul, Minnesota, 55101-2147

RE: Comments on Technical Standards for Distributed Generation Equipment
Docket No. E999/CI-01-1023

Dr. Haar, the comments of Cummins Power Generation to the proposed requirements in the referenced Docket are enclosed.

Cummins Power Generation (CPG) is a global power leader and a division of Cummins Inc., a corporation of complementary business units that design, manufacture, distribute and service electrical power generation and control systems, engines and related technologies, including fuel systems, controls, air handling, filtration and emissions control products. Headquartered in Columbus, Indiana (USA), Cummins Inc. serves its customers through more than 500 company-owned and independent distributor locations in 131 countries and territories.

CPG is vitally interested in distributed generation and the requirements for equipment used in that application. Workable and reasonable interconnection standards make it possible for distributed generators to be considered a power generation choice by electric and energy customers. In addition, expanded opportunities for distributed generation serve the following public policy goals:

(1) Enhance competitive energy and electricity markets
(2) Assist in achievement of local communities' energy sustainability goals by the integration of high efficiency distributed generation within their land-use plans
(3) Complement the power grid, imbuing the system with flexibility, resiliency and reliability
(4) Comport with federal and state environmental initiatives and regulation

CPG and its distributors in North America offer a variety of small power generation products. These include diesel synchronous generator sets; rich and lean burn reciprocating natural gas synchronous generator sets in simple cycle and combined heat and power applications, microturbines and control systems including power transfer and interconnection equipment. Some CPG distributors also offer photovoltaic (PV) modules through agent agreements with PV companies. CPG is also active in the development of fuel cell products.

CPG and its distributors have found that interconnection requirements can be a major

impediment to distributed generation. CPG has been actively involved in the development of the IEEE1547 standard for interconnection of distributed generation equipment and we understand the numerous technical and policy issues confronting distributed generation. CPG therefore supports efforts to adopt simplified, expedited, appropriate and reasonable interconnection standards and procedures for distributed generation under the jurisdiction of the Minnesota Public Utilities Commission. Reasonable, uniform and consistent interconnection standards will enhance the continued development of distributed generation, and result in more reliable, lower cost, and better overall efficiency for all power users.

For over 20 years I have worked on utility interconnected equipment applications and have represented Cummins interests in many venues. As a member of the writing group for the IEEE1547 standard and an active participant in the FERC meetings to establish standard requirements and procedures for distributed generation applications, I have personally been exposed to the positions and issues of all the parties in this marketplace. As an engineer, I have tried to listen with an open mind to the positions of all the parties, and this leaves me with a good perspective on issues related to the interconnection of distributed generation.

I have reviewed the technical requirements proposed in this docket and find them highly biased toward a utility perspective of the issues. I believe that if adopted in the current form, the technical requirements proposed will be a significant impediment to the use of distributed generation in Minnesota. The proposed requirements leave all the control of the use of distributed generation equipment in the hands of utility service providers whose interests are not always directly aligned with the overall public interest. I sincerely hope that the comments enclosed will assist the Commission in understanding how the requirements can be written to keep the utility power system safe and reliable, and at the same time support the development of other energy resources.

Cummins and its industry partners are continuing to review the technical requirements of this document, and respectfully reserve the right to provide further comments at a later date.

Sincerely,

Gary Olson
Technical Counsel

Attachment

## General Comments and Issues

The following general comments are offered on the technical requirements document. Detailed comments on a section by section basis follow.

### 1. Safety

There are numerous statements in the text of the document requiring equipment and installations to be "safe". Over the years we have seen numerous examples of excessive requirements in the name of "safety".

The commission is undoubtedly aware that the production, distribution, and even the use of electrical power is NEVER intrinsically safe. This means that any installation or equipment can be labeled as "unsafe" if the reviewer is left to judgement as to suitability. Safety requirements must be carefully described, or they can quickly become onerous.

Ideally, the use of general terms such as "safety" and "safe" should be used only in the foreword and introduction of a technical document, with specific technical descriptions used in the text of the document to meet the required levels of safety.

### 2. IEEE 1547 Duplications and Exceptions

IEEE1547 was developed over the course of several years with the effort of literally hundreds of industry experts representing a broad cross-section of electric service providers, regulators, equipment suppliers, and to a lesser extent, users. By contrast, the Attachment 2 requirements appear to have been developed by a group dominated by electric service providers, with little input from equipment suppliers or users.

For the State of Minnesota to adopt requirements that differ from the requirements of IEEE1547 is to imply that somehow a small, probably biased, group of Minnesotans has greater expertise than the aggregate IEEE working group. Clearly, the IEEE process is more open, provides greater technical discussion, and serves the needs of the people of the State of Minnesota to a greater degree than the current technical document that is proposed.

Use of separate set of standard requirements, while also requiring compliance to IEEE1547, sets up a natural conflict between the two documents, and raises serious issues as to which standard should be used when the requirements conflict.

The IEEE1547 (draft 11) standard has now been approved by the IEEE standards committee and is moving to publication. The Minnesota requirements should require compliance to the IEEE1547 standard, and neither add to or subtract from them without very careful technical consideration.

The only additional valid technical requirements that may be considered for inclusion in the Minnesota technical requirements are those that relate to closed transition transfer switches. This is a valid action because the IEEE1547 standard specifically excludes these devices from consideration in that standard. Even these should be considered carefully, since the general consensus of the IEEE working group was that closed transition transfer switches will have such

a small impact on the utility grid that they are not worthy of consideration in an interconnect standard. This conclusion was based on the fact that manufacturers reported that thousands of these switches are currently installed and in active use, and no one documented any disruption of utility power or safety issue related to their use.

## 3. Process and Contract Requirements within the Technical Requirements

There are numerous examples of contractual requirements being inserted into the technical requirements document. The technical requirements should be purged of these requirements to the maximum extent possible. Inclusion of contractual requirements in the technical document leaves open the probability of conflicting requirements between the contract and technical documents.

There are also numerous comments that read more like an application manual, or advice, rather than requirements. A technical standard should make requirements, not give advice.

## 4. Inclusion of Open Transition Transfer Equipment

Perhaps the most offensive and unreasonable requirements of document relate to the extension of utility supervision over the use and application of open transition transfer switches.

This is unreasonable from a technical perspective because an open transition transfer switch by definition NEVER operates in parallel with the utility service to a facility, and its operation cannot result in any compromise to the safety or reliability of the utility service. A transfer switch does switch load off and on to a utility service, but the impact of that is no different than motors or other loads that automatically start and stop on the system. Does the standard attempt to regulate loads in the name of "power quality"? Obviously not.

Open transition transfer switches in the US must comply with the requirements of UL1008, and are universally pre-certified by UL (or potentially other NRTL organizations) for use in facility distribution systems. To burden owners and suppliers with requirements in addition to those in UL1008, and fees for site evaluations is totally unnecessary.

Design of facilities and installation of open transition transfer equipment is supervised by existing electrical approval authorities and practices, and need not be amended for distributed generation applications. Remember, there are literally thousands of these devices in service in Minnesota already. Are we proposing that the utility distribution system is unsafe or unreliable because they are there? If you are, then you should be also proposing what you're going to do to fix that problem, which would be far more widespread than the use of a few isolated distributed generation sites.

All the requirements related to open transition transfer switches should be struck from the Technical Requirements.

**Specific Comments**

| Section | Comment |
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| Foreword | The foreword makes no comment on the need for distributed generation equipment to be installed and operated in a fashion that does not result in the degradation in the quality of power supplied to utility customers. This is a major objective of IEEE1547, and is alluded to in the document, but not stated in the foreword. |
| Foreword, paragraph 7 | IEEE1547 covers any type of equipment in any installation that is operated in parallel with the Area EPS. It does not provide dissimilar requirements for small equipment. Rationally, the performance requirements of an installation do not change with small kW size, so the technical performance requirements should all be in one place. A different process may reasonably cover contractual issues. CPG has not reviewed the technical requirements for small equipment for any other potential problems. |
| 1. Introduction, paragraph 2 | IEEE1547 covers the use of DG equipment in network applications. While it is true that every application should be reviewed for acceptability, the suppliers reported to the IEEE1547 working group that there were many cases where DG equipment was operating on the load side of network protectors without problems. So, it is unreasonable to assume that ALL applications on the load side of a network protector are impossible. |
| 1. Introduction, paragraph 3 | Again, it is true that some applications are not suitable for DG equipment, but the standard cannot be vague as to the criteria for deciding on the suitability of a site. The wording of this paragraph implies that any area EPS operator could conclude that any site would reduce the reliability of power, based on opinion only, without technically valid justification. |
| 1. Introduction, B) | We suggest that the word "minimum" be struck from the first paragraph. As noted previously, IEEE1547 should stand as the technical requirements, and the contract documents and introduction already note that site reviews are necessary that might highlight required infrastructure changes as a result of equipment interconnection. |
| 1. Introduction, D) | Modify wording to indicate clearly that the area EPS operator will decide on needed changes to the area EPS, but can't change the technical requirements for interconnection equipment without clear technical justification. The process of qualifying sites should include "protest" provisions to cover cases where an area EPS operator makes requirements that are considered by the equipment owner to be unreasonable. |
| 1. Introduction, E) | This document should address interconnection equipment only. Comments related to isolated systems and equipment are neither valuable nor required. The introduction should clearly state the scope of the document, and this paragraph should be deleted. |
| 1. Introduction, F) | This paragraph includes many reasonable requirements, but they mostly relate to process, not technical requirements. This paragraph should simply state that equipment should be installed in compliance to all applicable local, state, and federal codes and standards; and that compliance to the requirements of IEEE1547 is required. |
| 2. References | IEEE1547 references these documents, so inclusion here is unnecessary and can lead to problems in keeping the document current. For example, I |

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| | believe the IEEE100 standard is no longer active. This section should refer only to the UL, NEC, and NESC, which are not referenced by 1547. If the standard references are left in, some might interpret this as justification for requiring additional testing or qualifications beyond those in 1547. |
| 3. Types…B)i, ii | Open transition and "quick" open transition transfer switches do not interconnect to an area EPS, so should not be described and requirements should not be included for them. Effectively, UL1008 describes what an open transition transfer switch is, and there are no technically valid requirements for their installation that are not already covered in the UL1008 requirements. |
| 3. Types…B)iii | While closed transition transfer switches do parallel with a utility service for a very short period of time (typically less than 100mS), they are near universally considered to be a non-issue from an interconnection perspective. Note that they do not typically include active synchronizing capability, but do have independent parallel time limit relays. These functions are a standard part of the product design, and their safety is validated by UL to long-established standards. The wording in this paragraph implies that some parts (particularly the timing relay function) should be provided by external components. |
| 3. Types…B)iv | Technically, a soft-loading transfer system should have all the features of an extended parallel operation. This is a requirement of IEEE1547. Since they have these capabilities, it is probably not necessary to have a separate maximum parallel timer. Several of the statements in this, and the next paragraph sound contractual, rather than technical. |
| 3. Types…B)v | Requirements for inverters vary significantly from IEEE1547. The comments that use the term "necessary protection" imply that additional protective equipment might be needed, when IEEE1547 states that if type certified with particular capabilities, no extra equipment is required. |
| 4. I & T…A) | The requirements of these sections are covered in IEEE1547 and should not be repeated. |
| 4. I & T…A)iii | Re: (3), Synchronous generators should, in general, never be operated at leading power factor, as it can result in damage to the machine. Control equipment provided for these machines controls power factor and does not allow operation in potentially damaging modes. IEEE1547 covers this in an acceptable fashion. |
| 4. I & T…A)iv | Grounding of facility power distribution systems is more appropriately covered in IEEE142. There are also several specific NEC requirements for grounding of facility distribution systems that may conflict with the substation grounding practices. Therefore, the document should not require compliance to IEEE 80. |
| 4. I & T…A)v | This paragraph is a contractual requirement, not technical. It would be more appropriately covered in the foreword. |
| 4. I & T…B)i | The words "any faults" are inappropriate. Technically, it is not possible to detect some types of fault condition, regardless of what equipment is provided at a site. Consequently, IEEE1547 requires specific devices and performance, rather than nebulous, undefined and impossible performance. Again, this standard should defer to 1547 and not include this paragraph. |
| 4. I & T…B)ii | Operating limits and performance are covered in IEEE1547 and should not be rehashed in this document. Note specifically that many types of system |

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| | operation can cause voltage changes in the range of 4%. It is unreasonable to make a requirement on a DG system that is not required of an overall facility operating system. |
| 4. I & T…B)iii, iv | These conditions are covered by IEEE1547, so should not be covered here. The performance of equipment to prevent these conditions is required, so the operation of the equipment at a site should never cause these conditions to occur. Contractual documents perhaps could include the wording that states that if equipment appears to be disrupting the area EPS, it should be shut off. |
| 4. I & T…B)v | The reference to open transition transfer switches should be eliminated from this section. Rather than specifying hardware, IEEE1547 requires that any source that closes to the area EPS must do so within prescribed performance windows. This is a much more technically precise and valid approach than simply stating that specific hardware be used. The requirements of this section could allow an area EPS operator to make unreasonable requirements for performance, or make no requirements, either of which are undesirable. |
| 4. I & T…B)v, 3 | This paragraph is of particular concern, because it conflicts with the requirements of IEEE1547, and because it is technically non-specific and allows judgement without guidelines by the area EPS operator reviewing a site.<br><br>IEEE1547 covers requirements for prevention of islanding and re-connection after an area EPS failure. These requirements recognize that, like in many protective-relaying situations, it is not possible to design a perfect anti-islanding system. However, use of the provisions of IEEE1547 results in the best practical system performance, and defines specific, achievable technical requirements to meet that requirement. Pending IEEE1547.1 standard covers how testing must be done to validate that performance.<br><br>This paragraph also makes comments stating that under some undefined conditions the area EPS operator might require transfer trip equipment. This is technically not specific, in conflict with IEEE1547, and should be removed. |
| 4. I & T…B)vi | This paragraph covers contractual conditions and not technical requirements. It is reasonable that a customer should be disconnected if his facility disrupts the area EPS, but the place to require that is under contract, not technical requirements. |
| 5. GMM&C… | The requirements of this section are covered in IEEE1547. In general, the requirements here exceed those in IEEE1547, and they are worded such that a DG operator could be exposed to thousands of dollars of expense for remote metering and control equipment that may or may not be used or even reasonable to supply.<br><br>There are many utilities in Minnesota, and I would guess that they have many different remote monitoring and control equipment types, and a wide variety of interests in monitoring and control. CPG has installed many large systems (>1000 kW) in Minnesota, and none were required by the utility to be remotely monitored. It is therefore questionable to require remote monitoring on all equipment. |

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| | In general, DG equipment is installed for the benefit of the owner, not the area EPS operator, and the owner does not benefit from the remote monitoring of the equipment by the area EPS operator. Rather, the area EPS operator benefits by knowing more about the loading on the system. Since automatic response to abnormal operating conditions is built into DG equipment by requirements of IEEE1547, it is really not an operating requirement for a utility to be able to directly control the equipment—rather, it is something the area EPS operator would LIKE to do. At that point, the benefiting party should pay for the equipment. |
| Table 5 | In several cases load metering is required to allow the area EPS operator to calculate total system peak load and energy reserve compliance. While this makes sense from a strictly technical sense, is this actually required by specific rules of the regional reliability council? If the actual reserve requirement of the area EPS is regularly reduced by the use of DG, is it reasonable to not take advantage of that?<br><br>SCADA control of the "interface breaker" implies that the area EPS operator might actively control that device on a regular basis. Since the device is controlled by the protection equipment provided in an emergency situation, and if it doesn't automatically operate in that condition there is no technical reason to expect that you could operate it remotely, there is not a clear justification for this.<br><br>If the equipment is to be turned on for the benefit of the area EPS operator, then the equipment to do that at the operator's discretion should be funded by the operator, or costs should be factored into the contractual arrangements with the DG owner. |
| 5. GMM&C…A) | It is possible that the point of common coupling and the metering point are in different locations. |
| 5. GMM&C…B) | The requirements of this section are greatly in excess of the IEEE1547 requirements for remote monitoring and control. In particular, the need for transmitting the position of transfer switches is unreasonable. |
| 6.Protection | In general, much of this section includes contractual requirements (ie, if you put equipment in, it must meet IEEE1547), or application advice that is inappropriate for a technical requirements document.<br><br>IEEE1547 includes requirements for protection devices, including not only performance, but also testing provisions. The requirements of this section are in excess of those requirements, and are onerous, particularly to smaller systems. (Larger systems commonly use "utility grade" devices.) However, from a technical perspective, as the capability of DG control and protection equipment advances, it is probable that protective equipment will be integrated within DG control systems, and type-tested and certified. The requirements should be clear in stating that IEEE1547 compliance is required, and that requirements beyond that are not intended.<br><br>The statement "and meet other requirements as specified in the area EPS interconnect study" is a blank check that would allow an area EPS operator to |

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| | make literally any requirement, without recourse to the DG operator.<br><br>In general, the requirements for protection were thoroughly reviewed in IEEE1547, and there should be no requirements in excess of those for most applications.<br><br>The statements regarding provisions for transfer trip at the discretion of the area EPS operator again provide and opportunity for adding cost to a site without technically verifiable justification. The technical requirements should state when they would be required. In nearly all cases the combination of anti-islanding provisions in the DG equipment and reclose blocking in the area EPS provide suitable means to meet the goals of system reliability and safety. IF this requires upgrades or changes to the area EPS system, then the DG operator should pay for them, but not at unreasonable cost levels. |
| 6.Protection | Re: parallel limit timing relay<br>As noted previously, in general, there is no reason for specifying this device and requiring its use as a separate piece of equipment. If used, there is no justification for having a specific relay device, or making that device a not a part of another control. If the power transfer control system does not operate, there is no reason why any independent system would be any more or less reliable than an individual device. |
| Table 6A | Eliminate this table. Requirements are in IEEE1547. |
| 7.Agreement | This is part of the contract, not the technical requirements. |
| 8. Testing…A) | Much of this section is general technical advice, and not technical requirements. It is reasonable to require 3rd party certification of equipment performance, but not IEEE929 (this standard deals with inverter equipment).<br><br>It is possible that UL will certify some types of equipment under other standards. That is still being discussed. Because of this, it may be better to state that there be 3rd party certification to verify compliance of equipment to the requirements of IEEE1547, which is more general but covers all types of equipment.<br><br>The standard should state the basis for approval of an application. What will be reviewed? What is the basis for acceptance? |
| 8. Testing…B) | Note that IEEE1547 includes both type tested and non-type tested requirements. The statement that "It is the customer's responsibility…to install the protective measures required by the area EPS" leaves the door open for the area EPS operator to make any requirement, both reasonable and unreasonable. IEEE1547 includes requirements for all sites, and states testing requirements at design level, production, and commissioning. The testing requirements in this section conflict or are in excess of many of the IEEE standard requirements.<br><br>Note that until IEEE1547.1 is passed, there is a need for suppliers to provide test procedures to verify performance of the equipment provided. |

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| | IEEE1547 includes commissioning requirements, but not maintenance testing. Because of this, it is reasonable to include requirements for this type of testing, but the requirement for testing is contractual, the tests are the only things that should be in the requirements document.<br><br>The statements in this section related to final system sign-off are contractual in nature, not technical requirements. |
| Figure 1 | This figure should be deleted because it applies to open transition transfer switches, which should not be covered in this document. Note that it includes many errors of omission. |
| Figure 2 | This figure should be deleted because it applies to open transition transfer switches, which should not be covered in this document. Note that it includes many errors of omission. Also, the protection shown for the generator is under the control of the NEC, and should not be duplicated here. In most systems, the fail to disconnect timer will isolate the area EPS from the facility, rather than disconnecting the generator set. The "25" functions are inherent to the ATS control when provided. |
| Figure 3 | This drawing includes several functions not required by IEEE1547. These include: 47, 51N, 50/51, sometimes 32, and 62PL. The interconnect standard should not address requirements for generator protection, because the document specifically says that it does not attempt to describe requirements for protection of customer-owned equipment. |
| Figure 4 | This drawing includes several functions not required by IEEE1547. These include: 47, 51N, 50/51, transfer trip, 67, sometimes 32, and 62PL. The interconnect standard should not address requirements for generator protection, because the document specifically says that it does not attempt to describe requirements for protection of customer-owned equipment. |
| Figure 5 | IEEE1547 does not require 47, 50/51, or 51 functions. |