

Subject 2200 (1741)
(In reply, refer to Subject 2200)

333 Pfingsten Road
Northbrook, IL 60062
November 26, 2002

**TO: UL's Ad-Hoc Committee for Distributed Generation Equipment;
Subscribers to UL's Standards Service for
Stationary Engine Generator Assemblies,
Inverters, Converters, and Controllers for Use in Independent Power Systems**

**SUBJECT: Report on the Ad-Hoc Meeting to Develop a Testing Protocol/Outline of Investigation
for Distributed Generation Equipment Performance**

A meeting of the Ad-Hoc Committee to develop a testing protocol/Outline of Investigation for Distributed Generation Equipment Performance was held on October 8, 2002. The purpose of the meeting was to determine the degree and support of interest in developing this UL Outline of Investigation. The meeting was co-sponsored by Underwriters Laboratories, Inc. (UL) and the Gas Technology Institute (GTI.)

The following topics were discussed at the meeting:

- 1) The purpose and need for an Outline of Investigation for the Performance of DG Equipment***
- 2) Overview of the development process for a UL Outline of Investigation***
- 3) Stakeholder expectations***
- 4) Proposed scope of the Outline of Investigation***
- 5) Proposed system Boundaries***
- 6) Review of the sections, subsections, and some of the requirements to be included in the Outline of Investigation as presented at the meeting***
- 7) Outline Development Schedule***
- 8) Parallel Efforts***
- 9) Miscellaneous Topics***

COMMENTS DUE: January 8, 2003

The following report is not intended to be a verbatim transcript of the discussion at the meeting, but is intended to record the significant features of those discussions.

GENERAL

Robert Pence, the Ad-Hoc Chair, welcomed the committee members and guests to the first meeting of UL's Ad-Hoc Committee to develop a testing protocol/Outline of Investigation for Distributed Generation Equipment Performance. He requested that the members participate openly to help develop the best Outline of Investigation possible.

The Chair explained that the purpose of the meeting was to discuss the development of the Outline of Investigation for the Performance of Distributed Generation Equipment. The issues chosen for the agenda topics were the key areas UL and the Gas Technology Institute (GTI) have identified where discussions will be necessary. Mr. Pence introduced GTI's Ted Bronson, noting that GTI was a co-sponsor of the Ad-Hoc meeting and requesting his opening comments. Mr. Bronson noted that one of the barriers to DG deployment has been the uncertainty of performance of emerging distributed energy (DE) technologies. To address this issue, GTI and UL have been in discussion regarding the development of a performance standard since 1999. He noted that GTI brings hands-on equipment knowledge and testing experience of DE equipment, while UL brings an internationally recognized accreditation processes and standards. Mr. Bronson went on to state that for GTI views UL's direct involvement in the development of a protocol or outline of investigation for DG equipment performance is paramount if such a standard is to have an impact on the market. He noted that this meeting is the culmination of an initial project performed by UL and GTI to identify support and key issues associated with the development of this outline of investigation.

It was emphasized that the goal for the Ad-Hoc Committee is to help develop the appropriate performance requirements for the Outline of Investigation so that the needs and concerns of manufacturers, utilities, and users are considered.

AGENDA TOPICS

1. The Purpose and Need for an Outline of Investigation for the Performance of DG Equipment

DISCUSSION

The Chair mentioned that the purpose of the Ad-Hoc meeting is to address, within the format of a round table discussion, the development of a performance protocol/outline for certain types of distributed generation (DG) equipment, primarily microturbines, turbines, reciprocating engines, and BCHP Systems (Cooling, Heating, and Power for Buildings), more recently referred to as Integrated Energy Systems (IES.) The focus will be to determine the level of effort and support required for a performance-based document to evaluate the various performance characteristics related to these types of DG equipment. Such performance characteristics will include, but not be limited to, emissions, efficiency, fuel consumption, and noise.

GTI's Ted Bronson noted that DE has emerged as a consumer power option, however market penetration over the past few years has been flat. He noted that there are many reasons for this, among them uncertainty of DE equipment performance and on how that equipment will perform on the grid. He stated that GTI and UL are proposing the development of this outline of investigation to:

- Minimize risk,
- Remove uncertainty on equipment performance,
- Optimize applications,
- Address emerging DE emissions standards / precertification requirements,

- Reduce time for local permitting, and
- Increase awareness of positive benefits of DE equipment.

UL mentioned that an Outline of Investigation covering performance characteristics of DG equipment would serve the following purposes:

- a) The Outline will confirm that the DG equipment performs (or doesn't perform) within the manufacturers published power, emissions, and efficiency.
- b) When a DG product manufacturer submits a product to be evaluated to the Outline, UL will evaluate the product and a test report will be generated. The manufacturer can then present the test report to prospective clients and to the authorities having jurisdiction (AHJ's.)
- c) The Outline will standardize the multiple test methods that do exist in order to test the DG equipment to one set of performance tests. Only then can the DG equipment be compared to other DG equipment fairly since the DG equipment will have been tested to the same performance tests under the same conditions.

A representative of industry mentioned that if the product fails to meet its power and efficiency ratings, the purchaser has the option of seeking restitution via the manufacturer's guarantee. GTI replied that after the product is tested to the requirements contained in the Outline, the report of performance will be created and this report can be given to a prospective purchaser containing verified performance of the equipment across a wide range of operating conditions. Therefore the purchaser will be more informed before the purchase is made.

A representative of industry mentioned that he receives a lot of phone calls from interested parties inquiring about performance issues of DG products.

UL and GTI mentioned that these products have not yet gained widespread acceptance in the marketplace. Therefore, compliance with the Outline may lead to more goodwill being associated with the engine/generators.

2. Overview of the development process for the UL Outline of Investigation

DISCUSSION

UL mentioned that an Outline of Investigation contains the requirements used by UL to investigate products prior to their publication in a UL Standard. An Outline of Investigation is to be developed when a product (or in some cases, a service or test procedure) that is not covered by the scope of an existing standard is submitted to UL for investigation. The basis for the Outline of investigation shall be the requirements applied for the certification of the new product using the applicable requirements from existing UL Standards and appropriate requirements contained in documents developed by other Standards Development Organizations. New requirements and test procedures that relate to the particular design and use of the new product are also to be developed as necessary.

A representative of industry asked if a product evaluated to an UL Outline can bear an UL service mark if the product complies with the requirements contained in that Outline or does the product have to be evaluated to a UL Standard in order to bear a UL service mark? UL mentioned that an Outline is a published document that contains UL's requirements that are used to certify a product when a published Standard is not available. Therefore, if the product complies with the requirements contained in the Outline, the product is eligible to bear a UL service mark.

A representative of industry asked, "If the Outline is developed, will UL be the only testing laboratory that can test products to that Outline?" UL replied that any organization can purchase a UL Outline or Standard and evaluate a product to that Outline or Standard. However, a product can only be eligible to bear an UL service mark if it was evaluated by Underwriters Laboratories Inc.

A representative of industry asked UL if the Outline would be accepted overseas. UL mentioned that there is a trend to harmonize the USA requirements with the equivalent IEC or ISO requirements. If the industry requests that such a harmonization effort takes place for this Outline, UL would help to develop the harmonized requirements.

A representative of industry asked if the Outline would contain references to requirements contained on other standards (written by other standards development organizations) or would the Outline contain the text of those requirements? UL mentioned that in the standards writing process, if material is taken verbatim from a standard of another organization, whether or not the document of the other organization contains a copyright notice, UL has to request, in writing, that the other organization grant written permission to reproduce the specific material in the UL Outline. A credit statement shall be included in the Outline, preferably as a footnote, referencing the reproduced material. This statement shall be given in the form dictated by the organization involved if their permission is so qualified.

3. Stakeholder expectations

DISCUSSION

UL mentioned that some of the "stakeholders" impacted by this project are:

- a) Manufacturers,
- b) EPA, CARB, and other emissions regulatory bodies,
- c) Utility Companies, and
- d) Purchasers of the equipment.

GTI mentioned that some DE equipment has not gained wide acceptance in the market place yet. Compliance with the planned Outline may help reduce perceived risk and boost sales. UL and GTI realize, however, that cost is an issue that must be considered in the development of this outline.

UL mentioned that the cost of performance testing could be lessened if combined with a concurrent safety evaluation and that it may be possible for manufacturers to conduct the tests at their own facility with a UL engineer present to witness the tests.

A representative of industry asked how will the manufacturers notify the potential purchasers that the product was evaluated to the Outline. UL mentioned that the DG equipment could either:

- a) contain a label(s) with the results of the testing printed on the label,
- b) contain a label that references a testing report.

A representative of industry asked what will the Outline add to the numerous EPA, CARB, and other individual state requirements that already exist? GTI mentioned that the planned Outline would contain performance test requirements over a range of varying conditions. This would be a benefit that the Outline would add since current ratings of equipment is at ISO standard reference conditions.

4. Proposed Scope of the Outline of Investigation

DISCUSSION

GTI mentioned that the planned scope of the Outline would cover:

- a) DG equipment with a range of 1 kW to 3 MW,
- b) DG equipment in its "standard configuration" and also "custom configurations" at the manufacturer's request,
- c) the DG equipment and its system control software,
- d) the DG equipment covered would include reciprocating engines, turbines, microturbines and packaged BCHP systems,
- e) the testing requirements would result in a standard test report instead of pass/fail criteria,
- f) the test report would contain performance results over a range of input criteria such as ambient temperatures, fuel flow rates, and the like,
- g) the test report would contain "curves" of the performance results when the performance results are charted with the input criteria.

A representative of industry mentioned that it is important to test the turbine/generator system and the turbine/generator software system since the software controls the air/fuel ratio, efficiency, emissions, etc. UL and GTI concurred.

GTI mentioned that the efficiency of the equipment may vary depending on at least the following variables: (1) ambient temperature, (2) fuel pressure, (3) exhaust back pressure, (4) humidity, and (5) the barometric pressure. It was also noted that microturbines can come in recuperated and non-recuperated versions which have significant differences in efficiency and performance. GTI suggested that the Outline should include in its reporting format a set of curves representing key changes in performance per variable change. Each set would plot the varying efficiency, emissions, or power quality of the equipment versus one of these variables.

GTI stated that the current practice of reporting just one efficiency value for a piece of DG equipment does not provide enough information for prospective customers. By evaluating the product and reporting the results on a number of curves, a wealth of additional information is provided to the purchaser. GTI noted that if a company installs a microturbine unit in Dallas, Texas, it may be more important to them how the equipment operates in the summertime at 100°F versus ISO conditions.

A representative of industry mentioned that the tests for DG equipment are typically of three types:

- a) start-up tests,
- b) endurance or field tests, and
- c) laboratory tests (which can be used to verify manufacturer's claims.)

This representative asked if the planned Outline could be characterized by one of these types of tests. GTI mentioned that the Outline would contain laboratory tests. It was noted that the outline may be expanded to include provisions for field testing.

A representative of industry asked how many units will be required for testing? UL mentioned that it would depend on the size of the unit, the nature of the tests, and existing certifications of the components involved. Follow-up service testing may also be required to verify that the production line units are being built exactly like the sample(s) submitted to UL for testing.

A representative of industry mentioned that turbine/generator systems can be highly customized. For example, the purchaser may (or may not) require a heat recovery system, and the installation site could be:

- a) at sea level or in Colorado (altitude differences means gas density and pressure variations,)
- b) located in the tropics or in a colder climate (temperature differences.)

GTI noted that this indeed may be the case for many of the larger units, however, a trend is emerging towards packaged systems to reduce installation costs.

A representative of industry asked if all DG equipment would be evaluated the same or would the tests be tailored to how the product is designed. UL mentioned that every product would be evaluated the same way for each test requested. However, if a DG product does not have a heat recovery system, there will be no need to conduct the tests contained in the Outline that evaluate heat recovery systems.

5. Proposed System Boundaries

DISCUSSION

GTI presented a diagram of the proposed DG equipment boundaries that the Outline would cover (attached as Appendix C.) A representative of industry asked if the system included a component which "cleans" the gas before it enters the engine, would that component also be tested to the Outline? GTI mentioned that whatever can be contained "on the skid," or is considered a "packaged system" is what can be tested.

The group concurred with the system boundaries.

6. Review of the proposed sections, subsections, and some of the requirements to be included in the Outline of Investigation as presented at the meeting

DISCUSSION

Todd Kollross of GTI presented the first draft of the Table of Contents of an Outline (attached as Appendix D.) The Ad-Hoc Committee reviewed this Table of Contents. The following is a report of the discussion that occurred. Please note that only those sections that were discussed are shown. (The entire Table of Contents is contained in Appendix D.)

Section 3 – Definitions, Clause 3.2 – DG Thermal Production Equipment

A representative of industry mentioned that the Outline should not cover thermal production equipment since that equipment should have its own Outline due to its complexity. GTI mentioned that thermal production equipment will not be evaluated separately, only as part of a packaged system.

However, GTI mentioned that if the thermal production equipment isn't included "on the skid" with the DG equipment, the available heat produced by the equipment will be measured and recorded. A representative of industry mentioned the available heat isn't easily measured since it varies depending on the flow rate and type of heat transfer fluid. GTI stated that flow rate and temperature will be measured.

Section 3 – Definitions, Clause 3.4 – Performance Parameters

3.4.1 Electrical Efficiency

A representative of industry asked if a rating system can be established for DG equipment similar to the SEER system used for central a/c units.

According to a DOE website, the efficiency of Central A/C units is governed by U.S. law and regulated by the U.S. DOE. Every A/C unit is assigned an efficiency rating known as its seasonal energy efficiency ratio (SEER). The SEER is defined as the total cooling output (in Btu-British thermal units) provided by the unit during its normal annual usage period divided by its total energy input (in Watt-hours) during the same period. The SEER is displayed on a yellow label affixed to the A/C unit. Higher SEERs are better. The minimum SEER allowed by law for a central A/C is 10 for a split system or 9.7 for a single-package unit. The best available SEER is about 18, while many older units have SEER ratings of 6 or less. Most consumers should look for a SEER of 12 or higher when buying a new A/C system. See:http://www.eren.doe.gov/buildings/consumer_information/aircen/cenabout.html for more information.

UL mentioned that such a system has many benefits such as:

- a) It provides an easy method for consumers to understand the electrical efficiency.
- b) It requires manufacturers to design products that are more and more efficient to remain competitive in the marketplace.

3.4.4 Parasitic Loads

GTI mentioned that for the purposes of the tests contained in the Outline, parasitic loads will be defined as a component which draws electricity from the DG equipment and is necessary for DG equipment operation. An example is external gas compressors.

3.4.6 Exhaust Gas Emissions

A representative of industry mentioned that CARB already requires the DG equipment to comply with strict exhaust gas emission requirements. UL mentioned that the Outline may contain a reference to the CARB requirements and those requirements will have to be followed if the DG equipment is to be installed in California. GTI mentioned that the New York emission requirements are as strict as the California requirements. A representative from CARB mentioned that the Texas requirements covering DG equipment state that if the DG exhaust gas emissions comply with the CARB emission requirements, no additional testing is required. UL mentioned that such a testing requirement could be proposed to be added to the Outline.

Section 3 – Definitions, Clause 3.6 – Fuels

A representative of industry asked if the fuel characteristics would be defined. GTI mentioned that the intent is to identify the different types of fuel that can be used with DE equipment. In addition, some analysis of the DE equipment performance under different fuels may be requested by the manufacturer.

It was suggested that this section be consistent with the Performance Test Code on Gas Turbines, ASME PTC 22.

Section 5 – Measurements

A representative from industry suggested that a “Section 5.4 – Deviation from Test Conditions” be added to the outline.

Section 6 – Calculations

GTI mentioned that some of the data measured during testing will be used in the efficiency calculations. These calculations will be included in Section 6 of the Outline. It was suggested that the following calculations be added:

6.7 Power Rating

6.8 Mass emissions

6.9 Noise

Section 7 – Performance Tests

GTI mentioned that their approach to performance testing of DG equipment is to operate the equipment through a wide range of tests and environmental conditions while assessing equipment performance (efficiency, emissions, power quality.) The performance tests will be conducted while varying just one parameter at a time. By doing this, a series of curves will be produced which will show the effect on the efficiency, emissions, or power quality that the varying parameter has. For example, if the varying parameter is temperature, the efficiency may decrease as the temperature is increased.

GTI mentioned that all performance tests will be conducted at steady state conditions. Steady state is typically obtained after 15 minutes of operation. A representative of industry noted that DG equipment may need a “break in” time prior to testing. GTI concurred saying that infantile failures can occur on initial units.

GTI noted that a section covering acoustic testing would be added.

Clause 7.4 – Combustion/Ambient Air Temperature

A representative of industry asked what would constitute the lowest test temperature for the DG equipment. GTI mentioned that the test temperature range could be 0°F to 100°F, or through the manufacturer’s specified conditions. GTI acknowledged that this would require a cold room and, due to the expense involved, many manufacturers are not equipped with such a cold room.

Clause 7.5 – Combustion Air Humidity

A representative of industry mentioned that humidity can lead to long term reliability issues but, in general, humidity has no effect on the efficiency of the unit. GTI concurred and agreed to remove this section from the outline.

Clause 7.8 – Transient Loading Capability through 7.11, Mode Change

A representative from industry suggested that these tests be called Electrical Characteristics and include:

- 1) stand alone operation,
- 2) grid parallel operation,
- 3) transient loading, and
- 4) power factor.GTI concurred.

A representative of industry suggested that DG communications (that are used to aggregate multiple DG units) be considered as part of the standard. GTI noted that this may be out of the scope of this DG performance standard and that it may be appropriate to address with other standard development efforts.

Clause 7.11 – Blackstart (if applicable)

GTI mentioned that this test will determine how fast the current and voltage reach their steady-state values.

A representative of industry suggested that comments also be sought from the component manufacturers. For example, if the temperature rise in the alternator during a blackstart needs to be addressed, the alternator manufacturers are in a better position to address the concern rather than the DG equipment manufacturers.

Section 7 – General

GTI also mentioned that vibrational testing requirements may also be added to the Outline.

A representative of industry suggested that the Outline be divided into four sections:

- a) Units rated 25 kW and less,
- b) Units rated between 25 kW to 300 kW,
- c) Units rated 300 kW to 1.5 MW,
- d) Units rated 1.5 MW to 3 MW.

This representative of industry mentioned that the type of required tests may vary according to these four sections.

Another representative of industry disagreed saying that any DG equipment should be evaluated identically to the requirements contained in the Outline.

GTI mentioned that they would prepare a matrix of required tests.

Section 9 – Marking and Nameplate Data (system ratings)

GTI asked the Ad-Hoc members for suggestions as to how the DG equipment ratings should be published. A representative of industry mentioned that a label could be attached to the product. The label would inform the reader that the DG equipment was evaluated to the Outline. The label could also contain a reference to the test report.

Another representative of industry asked if additional information could be added to the label along with the reference to the test report. Such additional information could be:

- a) maximum power output at ISO standard reference conditions,
- b) electrical efficiency at ISO standard reference conditions,
- c) emissions at ISO standard reference conditions.

UL and GTI said there is a limit as to what can be included on the label. Otherwise the label would contain too much information.

7. Outline Development Schedule

DISCUSSION

GTI mentioned that the Outline development schedule is tentatively:

- a) Publish the October 8, 2002 Meeting Report by November 26, 2002.
- b) Issue the proposed Outline of Investigation for Industry Ad-Hoc Committee review and comments by February 15, 2003.
- c) Receive comments by March 15, 2003, and incorporate them by April 15, 2003.
- d) Validate protocols from April 15, 2003, to July 15, 2003.
- e) Publish the Outline of Investigation by September 2003.
- f) Standard development target completion by September 2004.

8. Parallel Efforts

DISCUSSION

GTI mentioned that several labs are developing their own protocol including AEP's Dolan Technology Center, Oak Ridge National Laboratory, and the California Energy Commission (University of California at Irvine.) It was noted that UL has published the first edition of the Safety Standard for Inverters, Converters, and Controllers for Use in Independent Power Systems, UL 1741; and the first edition of the UL Safety Standard for Stationary Engine Generator Assemblies, UL 2200.

UL mentioned that they have been working to expand the scope of UL 1741 to reflect the current trend in the use of interconnection equipment (inverters, converters, output controllers) for independent power equipment such as microturbines, wind turbines, fuel cells, and stationary engine generator assemblies. Concurrently, considerable work has been done by an IEEE working group to develop the Standard for Interconnecting Distributed Resources with Electric Power Systems, IEEE P1547. The proposed draft of the IEEE standard covers all forms of grid tied DG products. UL noted that these standards are safety standards and they do not cover equipment performance which is the charter for this subject Outline of Investigation.

GTI noted that the Association for State Energy Research and Technology Transfer Institutions (ASERTTI) has recently issued an RFB "Protocol Development for MTGs and MTGs with CHP." It was noted that the approach stated in the document is very complimentary to the UL GTI approach, though it adds field test protocol. The UL/GTI team bid on this RFB to cover a majority of the cost of the development of this Outline of Investigation. It was noted an award is expected shortly.

A representative of industry mentioned that a multitude of standards already exist that covers related products and asked why is another standard being developed. GTI and UL noted that although standards exist they are not addressing all the performance factors of DE equipment, and pointed to the ASERTTI RFB requesting the development of a very similar protocol.

9. Miscellaneous Topics

DISCUSSION

UL mentioned that they currently evaluate DG equipment from a safety point of view. If the product complies with the safety requirements, the product is "Listed" by UL. UL continues to develop new product categories to address the safety issues. Attached as Appendix G is a list of 39 categories. In addition to safety testing, UL offers a multitude of services – such as validation, efficiency, and acoustics testing to both manufacturer-specified and recognized standards.

ACTION ITEMS

The Ad-Hoc Committee developed the following action items:

- 1) Outline development committee to address the issue of a manufacturer performing testing at their facility and receiving UL Certification.
- 2) Outline development committee to address including a field testing section of the outline of investigation.
- 3) Outline development committee to address the number of units required for testing and potential followup testing.
- 4) Outline development committee to address the practicability of using a system similar to the SEER system.
- 5) Outline development committee to address emission testing requirements.
- 6) Outline development committee to address break-in time in the outline.
- 7) Outline development committee to consider obtaining input from component suppliers.
- 8) GTI to prepare a test matrix.
- 9) UL and GTI to revise the Table of Contents according to the discussion in Section 7 of this meeting report.

REQUEST FOR COMMENTS

Comments on this report should be made in writing and may be sent by fax to (847) 313-3038 or by mail to the attention of Alan McGrath at UL's Northbrook Office. Comments may also be sent via E-mail to Alan.T.McGrath@us.ul.com. Please reference all correspondence to Subject 2200. Note all comments received are public and may be circulated to others. If you respond by fax or E-mail, please include your full name and company name and address to ensure a reply.

ALL COMMENTS DUE: January 8, 2003

Attached as Appendix A is the Ad-Hoc membership roster and a list of those who attended the meeting. Attached as Appendix B is a listing of the text of the slides of a MS Powerpoint presentation presented by GTI. Attached as Appendix C is a chart of the Distributed Generation System Boundary presented and discussed at the meeting. Attached as Appendix D is the proposed Table of Contents of the draft Outline of Investigation for the Performance of DG Equipment that was presented and discussed at the meeting. Attached as Appendix E is a tabulation of other organizations standards covering distribution generation products. Questions regarding interpretation of requirements should be directed to the responsible UL Staff. Please see Appendix F of this bulletin regarding designated responsibility for the subject product categories.

* * * * *

NEXT MEETING

The Chair thanked the Ad-Hoc members for their participation and support. At this time, the next Ad-Hoc meeting is tentatively scheduled for the second quarter of 2003.

Unless specifically requested to do so, UL will not acknowledge comments indicating concurrence with these proposals.

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APPENDIX A**AD HOC ROSTER AND ATTENDANCE AT THE OCTOBER 8, 2002 MEETING OF UL'S AD-HOC COMMITTEE FOR DISTRIBUTED GENERATION EQUIPMENT**

Name	Company
Berry, Charles	GTI
Bronson, Ted	GTI
Chin, Grant (via teleconference)	California Air Resources Board (CARB)
Chippas, Steve	MWH Energy Solutions
Collins, John	American Society of Healthcare Engineering
Cuttica, John	University of Illinois
Dettmer, Greg	Elliot Energy Systems
Duhamel, Mike	Marathon Engine
Fox, Bryan	Capstone
Huynh, Co	Calnetix
Jonas, Jeff	General Power Systems
Kollross, Todd	GTI
Kuklinski, Gus	DTE Energy Technology
Lane, Chris	Generation Equipment Services Co.
Lindsey, R.	Caterpillar
Madden, Debra	Solar Turbines
Magera, Marty	UL
Melberg, Hans	Waukesha Engine
McDonell, Vince	University of California Irvine
McGrath, Alan	UL
Mehrayin, Kourosh	Bowman
Nichols, Dave	American Electric Power
Nowakowski, Gary	US Department of Energy
Olsen, Kevin	GTI
Papas, Garry	Marathon Engine
Patel, Jignesh	Keyspan Energy
Pence, Robert (Chair)	UL
Ruetschlin Harry	UL
Schwedler, Rod	Southern CA Gas
Sember, Jim	Kohler
Watts, James	Ingersoll-Rand
Whittall, Herb	Electrical Generation Systems Association

APPENDIX B**Text from slides of a MS Powerpoint™ presentation presented by GTI****Slide One – Need for a Protocol / Outline of Investigation**

DE emerging as consumer power option, however market penetration has been flat

- Uncertainties over equipment performance
- Uncertainty on how equipment will perform with the grid

GTI and UL proposing development of outline to

- Minimize risk
- Remove uncertainty on equipment performance
- Optimize applications
- Address emerging emissions standards / pre-certification requirements
- Reduce time for local permitting Increase awareness of positive benefits of DE equipment

Slide Two – Scope of DG Equipment

Reciprocating Engines, Turbines, Microturbines, and CHP Systems

- Most key parameters assessed for performance consistent between equipment
- Facilitates comparisons of different DE equipment and systems
- Minimizes costs and committed resources to development of national protocols and development of standards

Fuel Cells Separate at a later date

- Uniqueness of fuel cells and hydrogen production systems

Slide Three – Approach

Operate equipment through a wide range of tests and environmental conditions while assessing equipment Performance:

- Power Quality
- Efficiency
- Emissions

Why

- Reduce Risk / Remove Doubt

- Optimize Applications
- Market Concerns
- Utility in NY citing Microturbine environmental performance at less than 100% load
- How will equipment perform in the Summer?

Slide Four – Performance Tests

Fuel Supply Pressure Variance

Exhaust Back Pressure

Intake Air Pressure

Intake Air Temperature

Intake Air Humidity

Thermal Energy Production / Heat Recovery

Electrical Characteristics

- Transient Loading Capability (ISO and Parallel)
- Power Factor
- Mode Change

Black Start

Slide Five – Reports and Equipment Rating

Performance Curves

- Emissions
- Load
- Efficiencies

Labels

- Max Power Output
- Fuel Efficiency
- Emissions
- Noise

Slide Six – Other Parallel Efforts

Several Labs developing own protocol

- AEP's Dolan Technology Center
- ORNL
- CEC / UCI
- UL 1741 (Interconnection, not performance)

ASERTTI RFB "Protocol Development for MTGs and MTGs with CHP"

- Similar / Complementary to UL/ GTI Approach
- Adds feature of "field test protocol"
- Currently focusing on Equipment specific
- Microturbines, then Recips, then Fuel Cells
- UL / GTI Team Bid Award
 - expected 10/16/02

Slide Seven – Schedule

Phase 1 Tasks (Jan '02 – Present)

- Codes and Standards Review
- Initial UL / GTI Planning Meeting
- Document Outline
- Boundary Document Development of Ad-Hoc Industry Committee
- Conduct Initial Meeting with Ad-Hoc Advisory Group
- All Complete with Meeting Report

Slide Eight – Schedule (Continued)

Phase Two

- Form Collaborative of Established Protocol Developers (11/01/02)
- Prepare Draft Protocols (11/1/02 – 2/15/03)
- Critical Project Review (Ad-Hoc Industry Committee) (2/15/03 – 3/15/03)
- Final Draft UL Outline of Investigation (4/15/03)

Phase Three

- Validate Protocols (4/15/03 – 7/15/03)

Phase Four

- Publish UL Outline of Investigation (7/15/03 – 9/15/03)

Phase Five

- Standard Development (9/15/03 – 9/15/04)

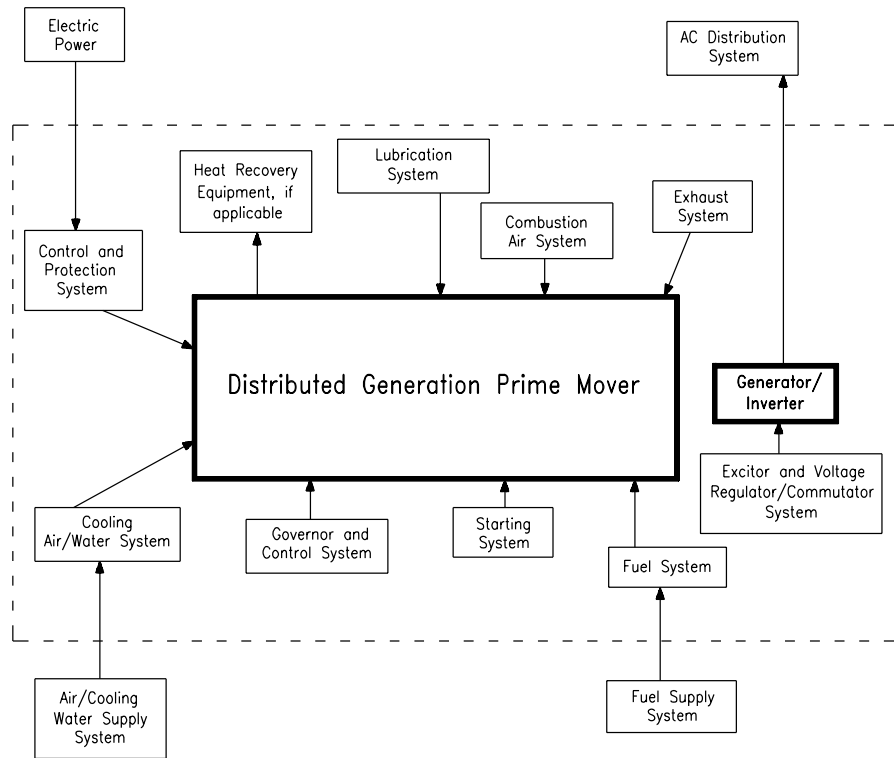
Slide Nine – Schedule (Continued)

With ASERTTI Process (expected award 10/16)

- Form Collaborative of Established Protocol Developers (11/1/02)
- Establish Stakeholder Group (COMPLETE)
- Report listing Parameters to be tested and established System boundaries (NEAR COMPLETE)
- Prepare Draft Protocols (11/1/02 – 2/15/03)
- Critical Project Review (2/15/03 – 3/15/03)
- Final Draft Protocol Report (4/15/03)
- Validate Protocols (4/15/03 – 8/15/03)
- Publication of National Testing Protocols / UL Outline of Investigation (8/15/03 – 9/30/03)

APPENDIX C

Chart of the Distributed Generation System Boundaries



S4603

APPENDIX D

Proposed Table of Contents of the draft Outline of Investigation

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Section 2 -- Reserved

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3.1.3 Reciprocating Engines

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3.2.1 Absorption Chiller

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3.2.3 Heat Recovery Steam Generator

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APPENDIX E**Tabulation of Related Standards**

The following is a tabulation of some of the standards covering subjects that are applicable to DG equipment. Many of these standards can be purchased from www.global.ihs.com

British Standards

1. BS 6916-7, Method of Evaluating Engine Performance including Fuel Consumption
2. BS 7698-1, Reciprocating internal combustion engine driven alternating current generating sets, Part 1: Application, ratings and performance.

ASME

3. ASME B133.4, Gas Turbine, Control and Protection Systems
4. ASME B133.8, Gas Turbine Installation Sound Emissions
5. ASME B133.9, Measurement of Exhaust Emissions from Stationary Gas Turbine Engines
6. PTC 50 - 200X, Draft of the Performance Test Code 50 on Fuel Cell Power Systems Performance
7. PTC 22 - Performance Test Code on Gas Turbines

ASTM

8. ASTM D 6522, Standard Text Method for Determination of Nitrogen Oxides, Carbon Monoxide, and Oxygen Concentrations in Emissions from Natural Gas-Fired ...Combustion Turbines...Using Portable Analyzers. Prepared by ASTM (and GRI)

IEEE

9. IEEE 387 - 1995, Standard for the Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations
10. IEEE 929, Recommended Practice for Utility Interface of Photovoltaic (PV) Systems, Sponsor is the IEEE Standards Coordinating Committee 21 on Fuel Cells, Photovoltaics, Dispersed Generation, and Energy Storage
11. IEEE 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
12. IEEE P1547, Draft 10, Standard for Distributed Resources Interconnected with Electric Power Systems
13. IEEE 1129 - 1992, Recommended Practice for Monitoring and Instrumentation of Turbine Generators
14. IEEE 1159 - 1995, Recommended Practice for Monitoring Electric Power Quality

ISO

15. Annex A of ISO-2314, The Standard for Gas Turbines, Annex A contains the Acceptance tests for combined-cycle power plants
16. ISO 3046 Series – Reciprocating internal combustion engines a) Part 1, Performance b) Part 3, Test measurement c) Part 4, Speed governing d) Part V, Torsional vibrations e) Part 6, Overspeed protection, 3 pages, 1990. f) Part 7, Codes for engine power
17. ISO DIS 3977-8, Draft Standard for Gas Turbines, Procurement, Part 8: Inspection, testing, installation, and commissioning
18. ISO TR 14396, Reciprocating internal combustion engines – Determination and method for the measurement of engine power
19. ISO 6190, Acoustics – Measurement of sound pressure levels of gas turbine installations for evaluating environmental noise – survey method
20. ISO 8178 Series, Standards Covering Reciprocating internal combustion engines – Exhaust emission measurement – a) Part 1: Test-bed measurement of gaseous and particulate exhaust emissions b) Part 2: Measurement of gaseous and particulate exhaust emissions at site c) Part 3: Definitions and methods of measurement of exhaust gas smoke under steady-state conditions d) Part 4: Test cycles for different engine applications e) Part 5: Test fuels f) Part 6: Report of measuring results and test g) Part 7: Engine family determination h) Part 9: Test cycles and test procedures for test-bed measurement of exhaust gas smoke emissions from compression ignition engines operating under transient conditions i) Part 10: Test cycles and test procedures for field measurement of exhaust gas smoke emissions from compression ignition engines operating under transitory conditions
21. ISO 9614-2, Acoustics – Determination of sound power levels of noise sources using sound intensity – Part 2: Measurement by scanning
22. ISO 11042-1, Gas turbines – Exhaust gas emission – Part 1: Measurement and evaluation

JIS

23. B8006, Pressure Measurements of Performance for Reciprocating Internal Combustion Engines
24. B8007, Temperature Measurements of performance for reciprocating internal combustion engines

API

25. API 7B-11C, Specification for internal-combustion reciprocating engines for oil-field service

NFPA

26. NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines And Gas Turbines

Mil Specs

27. MIL-STD-2203, Energy Monitoring and Control Systems, Performance Verification and Endurance Tests, Russell Reynolds
28. MIL-STD-890, Environmental Control, protection, and design requirements analyses

SAE

- 29. SAE-J1349, Engine Power Test Code – Spark Ignition and Compression Ignition – Net Power Rating
- 30. SAE-J1995, Engine Power Test Code – Spark Ignition and Compression Ignition – Gross Power Rating
- 31. SAE-J1621, Engine Retarder Dynamometer Test and Capability Rating Procedure
- 32. SAE-J1312, Procedure for Mapping Performance – Spark Ignition and Compression Ignition Engines

AS (Australian Standard)

- 33. AS-4594.8, Internal combustion engines – performance, Part 8: Engines for road vehicle use – test code, net power

CSA

- 34. C22.2 No. 100, Standard for Motors and Generators, Industrial Products

NEMA

- 35. NEMA MG-1-1998, Motors and Generators
- 36. NEMA MG-2-1989, Safety Standard and Guide for Selection, Installation and Use of Electric Motors and Generators
- 37. NEMA SM 24-1991, Standard for Land Based Steam Turbine Generator Sets 0 – 33,000 kW

IEC

- 38. IEC 60545, Guide for Commissioning, Operation and Maintenance of Hydraulic Turbines
- 39. IEC 60308, International code for testing of speed governing systems for hydraulic turbines
- 40. IEC 61400-12, Wind Turbine Generator Systems, Part 12: Wind turbine power performance testing
- 41. IEC 60034-1, Rotating Electrical Machines, Part 1: Rating and Performance
- 42. IEC 60034-2, Rotating Electrical Machines, Part 2: Methods for determining losses and efficiency of rotating electrical machinery from tests (excluding machines for traction vehicles)
- 43. IEC 60034-3, Rotating Electrical Machines, Part 3: Specific Requirements for Turbine-Type Synchronous Machines
- 44. IEC 60034-22, Rotating Electrical Machines, Part 22: AC generators for reciprocating internal combustion (RIC) engine driven generator sets

NREL

45. DG Power Quality, Protection and Reliability Case Studies Report, Program: Reliable, Low Cost Distributed Generator/Utility System Interconnect, GE Research & Development Center

46. Making Connections – Case Studies of Interconnection Barriers and their Impact on Distributed Power Projects, Case studies of interconnection barriers and their impact on distributed power projects

U.S. DOE

47. U.S. Installation, Operation, and Performance Standards for Microturbine Generator Sets, DOE's Pacific Northwest National Laboratory

48. Distributed Generation Interconnection Manual, Texas Public Utility Commission, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy CEC (California Energy Commission)

49. Micro Turbine Generator (Distributed Generation) Project, California Energy Commission

EPRI

50. EPRI TR-113894, Reciprocating Engines for Stationary Power Generation – Technology, Products, Players and Business Issues, written by GRI and EPRI

ASHRAE

51. American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc.'s, (ASHRAE's), Technical Committee (TC) 9.5, is titled "Cogeneration Systems." TC 9.5 currently has working groups on the following subjects: (a) Microturbine Cogeneration, DA-00-7-4, (b) Distributed Generation, DA-00-7-1, Distributed Electrical Generation Technologies and Methods for Their Economic Assessment, (c) Distributed Generation, DA-00-7-3, Control of Distributed Electrical Generation System.

APPENDIX F**DESIGNATED RESPONSIBILITY FOR UL PRODUCT CATEGORIES (COVERING DG EQUIPMENT)**

FTSR, ENGINE GENERATORS
FTSR2, ENGINE GENERATORS – COMPONENT
FTSR3, ENGINE GENERATORS – UNLISTED COMPONENT
FTSR7, ENGINE GENERATORS – CERTIFIED FOR CANADA
FTSR8, ENGINE GENERATORS – CERTIFIED FOR CANADA – COMPONENT
IUXX, FUEL GAS BOOSTER COMPRESSOR EQUIPMENT
IUXX2, FUEL GAS BOOSTER COMPRESSOR EQUIPMENT – COMPONENT
IUXX7, FUEL GAS BOOSTER COMPRESSOR EQUIPMENT – CERTIFIED FOR CANADA
IUXX8, FUEL GAS BOOSTER COMPRESSOR EQUIPMENT – CERTIFIED FOR CANADA – COMPONENT
IRGN, FUEL CELL EQUIPMENT
IRGN2, FUEL CELL EQUIPMENT – COMPONENT
IRGX, STATIONARY FUEL CELL POWER PLANTS
QHYZ, AC MODULES
QHWJ, DISTRIBUTED GENERATION POWER SYSTEMS EQUIPMENT
QHWJ2, DISTRIBUTED GENERATION POWER SYSTEMS EQUIPMENT – COMPONENT
QHWJ3, DISTRIBUTED GENERATION POWER SYSTEMS EQUIPMENT – UNLISTED COMPONENT
QHWJ7, DISTRIBUTED GENERATION POWER SYSTEMS EQUIPMENT – CERTIFIED FOR CANADA
QHWJ8, DISTRIBUTED GENERATION POWER SYSTEMS EQUIPMENT – CERTIFIED FOR CANADA – COMPONENT
QIBP, PHOTOVOLTAIC CHARGE CONTROLLERS
QIBP2, PHOTOVOLTAIC CHARGE CONTROLLERS – COMPONENT
QIGU, [DISTRIBUTED GENERATION POWER SYSTEMS EQUIPMENT] PHOTOVOLTAIC MODULES AND PANELS
QIGU2, [DISTRIBUTED GENERATION POWER SYSTEMS EQUIPMENT] PHOTOVOLTAIC MODULES AND PANELS – COMPONENT
QIGU3, [DISTRIBUTED GENERATION POWER SYSTEMS EQUIPMENT] PHOTOVOLTAIC MODULES AND PANELS – UNLISTED COMPONENT
QIGU7, [DISTRIBUTED GENERATION POWER SYSTEMS EQUIPMENT] PHOTOVOLTAIC MODULES AND PANELS – CERTIFIED FOR CANADA
QIGU8, [DISTRIBUTED GENERATION POWER SYSTEMS EQUIPMENT] PHOTOVOLTAIC MODULES AND PANELS – CERTIFIED FOR CANADA – COMPONENT
QIIO, [DISTRIBUTED GENERATION POWER SYSTEMS EQUIPMENT] PHOTOVOLTAIC POWER SYSTEMS ACCESSORY EQUIPMENT
QIIO2, [DISTRIBUTED GENERATION POWER SYSTEMS EQUIPMENT] PHOTOVOLTAIC POWER SYSTEMS ACCESSORY EQUIPMENT – COMPONENT
QIIO3, [DISTRIBUTED GENERATION POWER SYSTEMS EQUIPMENT] PHOTOVOLTAIC POWER SYSTEMS ACCESSORY EQUIPMENT – UNLISTED COMPONENT
QIJL, PHOTOVOLTAIC POWER UNITS
QIKH, [DISTRIBUTED GENERATION POWER SYSTEMS EQUIPMENT – COMPONENT] STATIC INVERTERS AND CONVERTERS FOR USE IN INDEPENDENT POWER SYSTEMS
QIKH2, [DISTRIBUTED GENERATION POWER SYSTEMS EQUIPMENT – COMPONENT] STATIC INVERTERS AND CONVERTERS FOR USE IN INDEPENDENT POWER SYSTEMS – COMPONENT
QIKH7, [DISTRIBUTED GENERATION POWER SYSTEMS EQUIPMENT – COMPONENT] STATIC INVERTERS AND CONVERTERS FOR USE IN INDEPENDENT POWER SYSTEMS – CERTIFIED FOR CANADA
QIKH8, [DISTRIBUTED GENERATION POWER SYSTEMS EQUIPMENT – COMPONENT] STATIC INVERTERS AND CONVERTERS FOR USE IN INDEPENDENT POWER SYSTEMS – CERTIFIED FOR CANADA – COMPONENT

ZGXW, WIND TURBINE GENERATING SYSTEMS
 ZGXW2, WIND TURBINE GENERATING SYSTEMS – COMPONENT
 ZGYW, SMALL WIND TURBINE GENERATING SYSTEMS
 ZGYZ, [WIND TURBINE GENERATING SYSTEMS] LARGE WIND TURBINE GENERATING SYSTEMS
 ZGZJ, [WIND TURBINE GENERATING SYSTEMS] WIND TURBINE GENERATING SYSTEMS
 SUBASSEMBLIES
 ZGZJ2, [WIND TURBINE GENERATING SYSTEMS] WIND TURBINE GENERATING SYSTEMS
 SUBASSEMBLIES – COMPONENT

The individuals shown in the following tables are involved with the investigation of products covered under the subject categories. The Primary Designated Engineer (**shown in UPPERCASE letters**) coordinates the establishment and uniform interpretation of UL requirements applicable to the product categories. The Designated Engineers (**shown in lowercase letters**) work with the Primary Designated Engineer to interpret requirements and maintain standards.

Should you have questions regarding the interpretation of the requirements proposed in this bulletin or any adopted requirements that affect your product, you are encouraged to contact the individual at the office to which you normally submit your products.

CCN	Office/Subsidiary	Responsible Engineer	Extension
FTSR, FTSR2, FTSR3, FTSR7, FTSR8	Northbrook	HARRY RUETSCHLIN	42938
	Mellville	Roland Riegel	22421
	Research Triangle Park	William Moss	11636
	Santa Clara	Gregory Okada	32444

CCN	Office/Subsidiary	Responsible Engineer	Extension
IUXX, IUXX2, IUXX7, IUXX8	Northbrook	LARRY KETTWICH	42484
	Mellville	Steven Bionde	22908
	Research Triangle Park	John Cronin	11662
	Santa Clara	Barry Karnes	32433

CCN	Office/Subsidiary	Responsible Engineer	Extension
IRGN, IRGN2	Northbrook	HARRY JONES	42948
	Mellville	Robert Wozniak	22454
	Research Triangle Park	Travis Hardin	11670
	Santa Clara	David Jordan	63603
	Toronto Canada	M Evans	61329

CCN	Office/Subsidiary	Responsible Engineer	Extension
IRGX	Northbrook	HARRY JONES	42948
	Mellville	Robert Wozniak	22454
	Research Triangle Park	Carl Radcliffe	11678
	Santa Clara	David Jordan	63603
	Toronto Canada	M Evans	61329
	Camas	Eugene Wirth	55606

CCN	Office/Subsidiary	Responsible Engineer	Extension
QHWJ, QHWJ2, QHWJ3, QHWJ7, QHWJ8, QHYZ, QIJL	Northbrook	TIMOTHY ZGONENA	43051
	Santa Clara	Adalberto Margarito	32341

CCN	Office/Subsidiary	Responsible Engineer	Extension
QIBP, QIBP2, QIIO, QIIO2, QIIO3, QIKH, QIKH2, QIKH7, QIKH8	Northbrook	TIMOTHY ZGONENA	43051
	Santa Clara	Adalberto Margarito	32341
	Camas	Jason Halverson	55560

CCN	Office/Subsidiary	Responsible Engineer	Extension
QIGU, QIGU2, QIGU3, QIGU7, QIGU8	Northbrook	STEVEN JOCHUMS	42229

CCN	Office/Subsidiary	Responsible Engineer	Extension
ZGXW, ZGXW2, ZGYW, ZGYZ	Research Triangle Park	WILLIAM COLAVECCHIO	11534

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