Verizon NEBS™ Compliance: Fuel Cell Systems NEBS Test Requirements

Verizon Technical Purchasing Requirements

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1	*01/10/2007*	Reissue	New template format. Original document issued Aug 11, 2004.

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Trademark Acknowledgement – NEBS is a trademark of Telcordia Technologies, Inc.

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1.0 PURPOSE

To better manage network energy, Verizon is deploying alternative energy sources such as stationary fuel cell systems, which produce electricity as a result of electrochemical energy conversion. Typically, these "green" energy sources provide electricity to network equipment and central offices. While these systems pose cost benefit to Verizon they must be assessed for NEBS compliance prior to installation in the network.

As with other products that serve the network, fuel cell systems shall be tested to determine their safety, performance, and reliability characteristics. The supplier shall provide a production sample to a Verizon-approved Independent Testing Laboratory (ITL) for testing and shall furnish the test results to Verizon's NEBS and Quality Assurance team for review. In addition to NEBS testing, fuel cell systems shall comply with all applicable local, state and federal statutes and regulatory requirements prior to general deployment.

2.0 SCOPE

This document defines the NEBS test requirements for stationary fuel cell systems, which may be deployed in Verizon's outside plant network. The "punchlist" of tests contained herein shall be used by equipment suppliers and the Verizon-approved Independent Test Laboratory as the baseline of tests to create the NEBS test plan. In all instances of test planning and test execution, the most recent and accepted versions of the GR standards shall be used.

3.0 REFERENCES

GR-63-CORE	NEBS™ Requirements: Physical Protection
GR-78-CORE	Generic Requirements for the Physical Design and Manufacture of Telecommunications Products and Equipment
GR-1089-CORE	Electromagnetic Compatibility and Electrical Safety - Generic Criteria for Network Telecommunications Equipment
GR-487-CORE	Generic Requirements for Electronic Equipment Cabinets
VZ.NEBS.TE.NPI.2004.015	Telecommunications Carrier Group NEBS Compliance Checklist
SIT.NEBS.RQS.NPI.2004.019	Verizon Communications NEBS Compliance Clarification Document

4.0 ABBREVIATIONS

CO	Central Office
CPE	Customer Premises Equipment
EUT	Equipment Under Test
DOT	Department of Transportation
DOE	Department of Energy
FCC	Federal Communications Commission
FOC	Fiber Optic Component
ITL	Independent Testing Laboratory
NEBS	Network Equipment Building Systems
NEC	National Electrical Code
TCP	Testing Certification Program
TCWP	Testing Certification Witnessing Program

5.0 DEFINITIONS

THIS SECTION INTENTIONALLY LEFT BLANK.

6.0 GENERAL REQUIREMENTS

Test configuration: The Equipment Under Test (EUT) shall be fully configured and performing its designated functions during the application of NEBS testing. All chemical fuels, telecommunication lines, connection hoses, sensors, documentation (installation and operating manuals), mounting and grounding schemes shall be provided to the test laboratory by the supplier prior to test commencement. Because of the volatility of the chemical energy source (i.e., hydrogen, natural gas, etc.), special safety considerations shall be in place before test commencement.

In addition to the specific test requirements listed below, products must comply with GR-78-CORE, *Generic Requirements for the Physical Design and Manufacture of Telecommunications Products and Equipment*. Vendors may self-declare their product's compliance to GR-78-CORE by submitting a completed copy of Appendix B of the Telecommunication Carrier Group Checklist. Current versions of the TCG Compliance Checklist and the Verizon NEBS Clarification document can be found on the Verizon web page (http://www.verizonnebs.com/index.html#chklist). A list of approved Verizon ITLs can be found on the Verizon NEBS Compliance web page, http://www.verizonnebs.com/tcppage.html.

7.0 PASS/FAIL REQUIREMENTS

The EUT shall be configurable as documented in the manufacturer's installation procedures and shall operate reliably over its intended life cycle. The product shall operate as intended during immunity and susceptibility testing (EMI, Operational Temperature and Relative Humidity, Altitude, etc.,) and the test

report shall include failure thresholds, if any, so that proper risk analysis can be made. The product shall meet all defined limits in the NEBS standards and the references listed above. Lines, hoses, clamps and couplers shall be continuously monitored for pressure leaks during fire resistance and seismic testing. Any degradation in pressure during or immediately following the application of these tests shall be considered a failure.

8.0 TEST REQUIREMENTS

GR-63-CORE, NEBS Requirements: Physical Protection; Issue 3, March 2006

Section	Test	Configuration
2	Spatial	Non-functioning unit. Inspection only.
4.1.1.1	Low-Temperature Exposure and Thermal Shock	As configured for shipment
4.1.1.2	High-Temperature Exposure and Thermal Shock	As configured for shipment
4.1.1.3	High Relative Humidity Exposure	As configured for shipment
4.1.2	Operating Temperature and Relative Humidity **(see Note 1)**	Fully functional system
4.1.3	Altitude **(see Note 2)**	Fully functional system
4.5	Airborne Contaminants	Fully functional system

NOTE 1:

The following excerpt is taken from the Verizon NEBS webpage. It explains how to conduct the Operating Temperature and Relative Humidity test of GR-63-CORE with a modification to the temperature profile to address outside plant equipment testing. As expressed in GR-63-CORE, the temperature profile is consistent with that found in the central office environment. By incorporating a wider temperature range, however, outside plant equipment can be tested to an operational temperature and relative humidity cycle consistent with normal operating conditions found in the outside plant.

> The purpose of this memo is to clarify the Operating Temperature/Relative Humidity testing methodology for cabinets used to house electronic equipment in the Outside Plant (OSP). It will also ensure compliance with the requirement limits as specified in GR-487-CORE Generic Requirements for Electronic Equipment Cabinets section 2.2 (Operating Environment).
>
> The current version of GR-487-CORE does not provide a detailed test methodology for performing Operating Temperature/Relative Humidity of cabinets with installed electronic equipment. This omission in the Generic Requirement document causes independent test laboratories (ITLs) and equipment providers to interpret the test methodology (duration/profile) differently. Inconsistently applied test methods become the source of unreliable product testing.
>
> Verizon requires the test methodology specified in GR-63 be used with the temperature and humidity criteria of GR-487-CORE Section 3.26. In order to apply the OSP equipment standards to the central office test methods, note the following:
>
> a) Replace the CO temperature limits in GR-63-CORE with the ambient temperature limits of GR-487, -40 °C to +46 °C, with solar loading applied only at +46 °C or +65 °C for [environmentally

controlled] enclosures without solar loading, as specified in GR-487 section 3.26 requirements. ITLs will report results by including a pictorial representation of the temperature profile.

b) The equipment, in a configuration representing planned deployment, will operate under the above conditions for two consecutive failure-free cycles. ITLs will report results by including how many cycles were run for the equipment to pass.

NOTE 2:

Verizon has reviewed its policy with respect to Altitude testing per GR-63-CORE and now accepts altitude test results using the temperature compensation method for products that have no mechanical sensitivities. Mechanical sensitivities include items such as hard disk drives, sealed relays, fuel cells, or other items that may be mechanically affected by a change in differential pressure.

Verizon will now accept any of the following three methods for demonstrating compliance to the NEBS Altitude Test criteria.

1. The ITL shall follow Option 1 test sequences of Section 5.1.3, using a hypobaric chamber.

2. The ITL shall follow Option 1 test sequences in Section 5.1.3, using the temperature compensation method to simulate lower atmospheric pressures, according to the rule of +1° C per 1000 feet increase in altitude. For example, if a test temperature should be 50° C and test pressure should be 80 kPa, then the temperature compensation method would require exposing the EUT to 56° C.

3. The ITL shall test to Objective O4-11[137], and if the EUT passes, it is considered to meet NEBS criteria R4-8, R4-9, and O4-12. The chamber temperature shall be increased to 61° C (shelf equipment) or 56° C (frame equipment), at a ramp rate of 30° C/hour. After an eight-hour dwell at this temperature, the chamber temperature shall be decreased at a rate of 30° C/hour to ambient temperature. If using this abbreviated form of the Altitude Test, Verizon will accept the test running concurrently with the Operational Temperature and Humidity Test. To integrate these tests, the parameters for the shortened Altitude Test (61° /56° C for 8 hours) will be used during Step 3 of the Operational Temperature and Humidity Test (see Figure 5-4, GR-63). Step 3 must continue to maintain a minimum 12 hour dwell of at least 50°C and no more than 32% RH. However, functional degradation of the EUT during the high temperature extreme will be considered a failure of both tests.

The EUT shall continue to be functional throughout the Altitude Test, regardless of the test method used. Option 2 of section 5.1.3 remains unacceptable to Verizon for altitude testing, as it does not demonstrate conformance to Objective criteria.

Section #	Test	Configuration
2	ESD	Fully functional system
3.2.1	Radiated Emissions (Electric Fields) with Cabinet doors open [tested to cabinet doors closed limit)	Fully functional system
3.2.2	Radiated Emissions - Magnetic Fields	Fully functional system
3.2.3	Conducted Emissions – AC Power Leads (Voltage)	Fully functional system
3.2.4	Conducted Emissions – AC and DC Power & Signal Leads (Current)	Fully functional system
3.2.5	Conducted Emissions – Analog VoiceBand Leads)	Fully functional system
3.3.1	Radiated Immunity (Electric Fields) with Cabinet Doors and Covers Closed	Fully functional system
3.3.2	Radiated Immunity (Electric Fields) with Cabinet Doors and Covers Open	Fully functional system
3.3.3	Conducted Immunity (AC and DC Power Ports and Signal Leads)	Fully functional system
4.2.1	Voltage-Limiting Protectors	Fully functional system
4.2.2	Current-Limiting Protectors	Fully functional system
4.2.3	Fuse Links	Fully functional system
4.3	Lightning Surges – Longitudinal & Metallic	Fully functional system
4.4	AC Power Faults (contact & fault induction from power lines to telecom ports)	Fully functional system
4.5.3	Listing Requirements	Fully functional system
4.5.4	Short Circuit Tests (Telecommunications Port)	Electronics operational only
4.5.7	First-Level Lightning Surge (Telecommunications Port)	Fully functional system
4.5.8	Second-Level Lightning Surge (Telecommunications Port)	Fully functional system
4.5.11	Current-Limiting Protector Tests (Telecommunications Port)	Fully functional system
5	Steady State Power Induction	Fully functional system
7	Electrical Safety Criteria	Fully functional system
9	Bonding and Grounding Inspection	Fully functioning system

GR-487, Issue 2 – March 2000

Section #	Test	Configuration
3.1 - Product Samples	R3-1, R3-2, R3-3	Fully functioning system
3.2 - Product Changes	R3-4	
3.3 - Safety & Reliability Considerations	R3-5, R3-6, R3-7, R3-8, R3-9	Fully functioning system
3.4 - Metallic Materials	CR3-10, R3-11, R3-12	Fully functioning system
3.5 - Polymeric and other Non-Metallic Materials	CR3-13 – Polymetric identification R3-14 - Chemical Exposure R3-15 – Other chemical exposure (NA) R3-16 - Non-Corrosive R3-17 Flammability - Component R3-18 - Flammability -Wiring R3-19 - Flammability -Gasket R3-20 - Flammability Rating R3-21 - Fungus R3-22 - UV Degradation R3-23 - Seal & Gasket Aging R3-24 - Ozone R3-25 - Adhesives Qualities	Full Bill of Material sampling
3.6 – Finish	R3-26, R3-27, R3-28, R3-29, R3-30, R3-31, R3-32, R3-33, R3-34, R3-35	Cabinet only
3.7 - Screens and Filters	R3-36, R3-37, R3-38, R3-39	Cabinet only
3.8 - Door Restraints – Vertical	R3-40, R3-41, R3-42, R3-43, O3-44	Cabinet only
3.9 – Horizontally Hinged Doors	R3-45, R3-46, R3-47, R3-48, R3-49, R3-50, R3-51, R3-52, R3-53, R3-54, CR3-55, R3-56	Cabinet only
3.10 – Lifting Details	R3-57, R3-58, R3-59	Cabinet only
3.11 – Security	R3-60, O3-61, CR3-62, CR3-63, R3-64, CR3-65, R3-66, R3-67, CR3-68, CR3-69	Cabinet only
3.12.1 – Alarms	R3-70, CR3-71, CR3-72, CR3-73, CR3-74, R3-75, CR3-76	Fully functional system
3.12.2 – Engine-Generators	R3-77, R3-78, R3-79, R3-80	If applicable
3.13 – Condensation	R3-81, R3-82	Fully functional system
3.14 – Fans	R3-83, O3-84, O3-85, O3-86, R3-87	Fully functional system

3.15 – Bonding and Grounding	R3-88, R3-89, R3-90, R3-91	Fully functional system
3.16 – AC Power (Commercial and Auxiliary)	R3-92 – CR3-109	If applicable
3.17 – Splicing Compartment	R3-110 – CR3-123	If applicable
3.18 - Electronic Equipment Compartment	R3-124, CR3-125, R3-126	Fully functional system
3.19 – Battery Compartment	R3-127 – R3-138	If applicable
3.20 – Engine-Generator Compartment	R3-139 – R3-152	If applicable
3.21 – Pole Mounted, Aerial Cabinets	R3-153 – R3-156	If applicable
3.22 – Documentation	R3-157 – CR3-159	Fully functional system
3.23 –Marking, Packaging, and Shipment	R3-160 – R3-167	Fully functional system
3.24 – Installation and Maintenance	R3-168 – CR3-184	Fully functional system
3.25 – Quality	R3-185, R3-186	Fully functional system
3.26 – Exposure to High Temperature	R3-187, CR3-188, CR3-189, CR3-190	Fully functional system
3.27 – Thermal Shock	R3-191	Cabinet only, with functioning fans
3.28.1 – Wind Driven Rain	R3-192	Cabinet only, with functioning fans
3.28.2 – Rain Intrusion	O3-193	Cabinet only, with functioning fans
3.28.3 – Lawn Sprinklers	O3-194	Cabinet only, with functioning fans
3.28.4 - Weather Tightness	R3-195	Cabinet only, with functioning fans
3.29 - Acoustic Noise Suppression	R3-196	Fully functional system
3.30 – Wind Resistance	R3-197 (Applies to pole or wall mounted equipment) R3-198	Cabinet only
3.31 – Impact Resistance	R3-199	Cabinet only
3.32 – Firearms Resistance	R3-200 R3-201; NA	Cabinet only
3.33 – Fire Resistance **(see Note 3)**	R3-202	Fully Functional system
3.34 – Corrosion Resistance (3.34.1 - Salt Fog)	R3-203	Cabinet only, with functioning fans
3.34.2 – Temperature Cycling /High Humidity	R3-204	Cabinet only, with functioning fans
3.35.1 – Transportation Shock (per GR-63, sec 5.3.3)	R3-205	Fully functional system
3.35.2 – Transportation Shock (Rail)	CR3-206	Fully functional system

3.35.3 – Transportation Vibration (per GR-63, sec 5.3.3)	R3-207	Fully functional system
3.35.4 – Installation Shock (per GR-63, sec 5.3.2)	R3-208	Fully functional system
3.35.5 – Environmentally Induced Vibration (per GR-63, sec 5.4.2)	CR3-209	Fully functional system
3.35.6 – Earthquake Resistance (per GR-63, sec 4.4.1.2 and 4.4.1.3)	CR3-210	Fully functional system with anchoring mechanism

NOTE 3:
Fuel line pressure shall be continuously monitored during fire resistance and seismic testing. Any degradation in line pressure during or immediately following the application of these tests shall be considered a failure.