Test Report 21-296
26 December 2001

ELECTROMAGNETIC INTERFERENCE

TEST REPORT

FOR THE

Capstone Turbine Corporation

Micro Turbine Model: C60

PREPARED FOR

Capstone Turbine Corporation
21211 Nordoff St.
Chatsworth, CA 91311

PREPARED BY

Nemko EESI Incorporated
9604 Variel Avenue
Chatsworth, California 91311

RECORD OF CHANGES

REV	DATE	BY	REVISION DESCRIPTION	APPROVED
N/C	12-26-01		Original Issue	

SIGNATURE PAGE

The tests reported herein have been conducted by Nemko EESI, Inc., an independent test laboratory, in accordance with all applicable specifications, procedures and instructions as required by Capstone Turbine Corporation.

Tests Conducted By:

_____

Bryce Elliott, Test Technician Date

_____

Gordon D. Levey, Test Engineer Date

Report Approved for Nemko EESI, Inc. By:

_____

Ricky Hill Date
Laboratory Manager

TABLE OF CONTENTS

RECORD OF CHANGES ..... **II**

SIGNATURE PAGE ..... **III**

TABLE OF CONTENTS ..... **IV**

SUMMARY OF TEST RESULTS ..... **V**

LIST OF ABBREVIATIONS AND ACRONYMS ..... **VI**

ELECTROMAGNETIC INTERFERENCE TEST REPORT **1**

1 INTRODUCTION **1**

1.1 PURPOSE 1
1.2 TEST ITEM DESCRIPTION 1
1.3 UUT PHOTOGRAPH 1
1.4 MANUFACTURER 2
1.5 QUANTITY OF ITEM TESTED 2
1.6 SECURITY CLASSIFICATION 2
1.7 UUT PERFORMANCE MONITOR AND TESTING 2
1.8 DISPOSITION OF TEST ITEM 2

2 APPLICABLE DOCUMENTS **2**

3 TEST APPARATUS **3**

3.1 GENERAL 3
3.2 TEST FACILITY 3

4 INSTRUMENTATION **3**

4.1 INSTRUMENT POWER 3
4.2 CALIBRATION 3
TEST INSTRUMENT 4

5 TEST CONDUCT **5**

5.1.1 ANSI C62.41 IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits and ANSI C62.45 IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits *5*
5.1.2 Requirement *5*
5.1.3 Conduct *5*
5.1.4 Test Log *6*
5.1.5 Test Matrix *7*
5.1.6 Test Results *9*

SUMMARY OF TEST RESULTS

The results of the testing are summarized in the following table.

TEST METHOD	RESULTS SUMMARY
ANSI C62.41 IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits and ANSI C62.45 IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits	Successfully completed. There was no evidence of susceptibility.

LIST OF ABBREVIATIONS AND ACRONYMS

µA	Micro ampere
µs	Micro seconds
µV	Micro volt
ac	alternating current
cm	centimeter
CTC	Current Transformer Cabinet Assembly
dB	Decibel
dc	direct current
EMI	electromagnetic interference
kHz	kilo Hertz
GHz	giga Hertz
ICC	Individual Control Cabinet
Jbox	Junction Box
m	meter
MHz	mega Hertz
MCC	Master Control Cabinet
rms	root mean square
RMS	Remote Maintenance Monitoring Subsystem
SL	Specification Limit
UUT	Unit Under Test
Vac	Volts ac rms
Vdc	Volts dc
Vp	Volts peak
Vp-p	Volts peak to peak
XFMR	Transformer
Z_t	Transfer Impedance

ELECTROMAGNETIC INTERFERENCE TEST REPORT

1 INTRODUCTION

1.1 Purpose

This document describes the Electromagnetic Interference testing of the Capstone Turbine Corporation, Micro Turbine Model: 330, over the period of June 2001 to December 2001.

1.2 Test Item Description

The Test item is as follows:

Micro Turbine Model: C60

The test items are also referred to as the units under test (UUT) or test sample throughout this report.

1.3 UUT Photograph

1.4 Manufacturer

Capstone Turbine Corporation
21211 Nordoff St.
Chatsworth, CA 91311

1.5 Quantity of Item Tested

One.

1.6 Security Classification

Unclassified

1.7 UUT Performance Monitor and Testing

Performance monitoring and testing of the test sample before, during, and after the EMI testing was performed by Capstone Turbine Corporation Representatives.

1.8 Disposition of Test Item

The test item was tested insitu at Capstone Turbine Corporation.

2 APPLICABLE DOCUMENTS

The following specifications and standards, of the issue noted, form a part of this document to the extent specified herein.

ANSI C62.41	IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
ANSI C62.45	IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits

3 TEST APPARATUS

3.1 General

In so far as practical, standard test conditions were maintained during the performance of all tests described herein. Laboratory environmental conditions were as follows:

Temperature:	25 ± 10º C (77º F ± 18º F)
Humidity:	90% or less
Barometric Pressure:	28-32 inches Hg.

3.2 Test Facility

The UUT was tested insitu at Capstone Turbine Corporation, 16605 Stagg St. Van Nuys, CA 91406

4 INSTRUMENTATION

4.1 Instrument Power

480 Vac, 60 Hz, three phase power required for the instrumentation was provide by Capstone Turbine Corporation.

4.2 Calibration

All measurement instruments used in determining compliance with the requirements specified here in, were maintained within a calibration system compliant to ANSI/NCSL Z540-1 and traceable to National Institute for Standards and Technology (NIST). Prior to each test, each instrument used, as applicable, was verified to be within its normal calibration period.

4.3 Test Instrument

Notes:

CAL DATE		MATERIAL # P/N	EQUIP # P/N	S/N	
12/20/01 (COMP)	SURGE NETWORK	KEYE501A	10152470	4500092837	-30
(ECAT CONTRACTOR)	NETWORK UNIT	KEYE103	10152468	4500092837	-10
(RING)	SURGE NETWORK	KEYE503	472		-50
(SURGE)	MAINS COUPLER	4554 KV	473		-70

5 TEST CONDUCT

5.1.1 ANSI C62.41 IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits and ANSI C62.45 IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits

5.1.2 Requirement

The test is intended to demonstrate the compliance of the Equipment Under Test (E.U.T.) to electrical surge on supply lines.

5.1.3 Conduct

Testing was performed using the procedures specified in ANSI C62.41 IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits and ANSI C62.45 IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits. All combinations of the 3 phase 5 wire were performed.

5.1.4 Test Log

TEST LOG

DATE STARTED 12 DEC 2001	CUSTOMER CAPSTONE ENGINEERING	TECHNICIAN (SIGNATURE) BJ Elliott
DATE COMPLETED 18 DEC 2001	SPECIMEN DESCRIPTION MicroTurbine Generator	ENGINEER (SIGNATURE) BJ Elliott
TEMPERATURE (LABORATORY) + 70 ° F	TYPE OF TEST EMC - Power Line Surge Immunity	ENGINEER Bryce Elliott
HUMIDITY (LABORATORY) 54 %	TEST SPECIFICATION ~~EN 61000-4-5~~ ANSI C62.41 / REVISION / PARAGRAPH NUMBER	PAN 21031501
SPECIMEN NUMBER M/N 60	ANSI C62.45	

DATE/TIME	
12 DEC 2001	
1030	SET UP ECAT SURGE EQUIP WITH 232 CONVERTER FOR E500 SURGEWARE PROGRAM.
1140	BEGIN TEST WITH PHASES TO NEUTRAL.
1700	BREAK FOR THE DAY.
13 DEC 01	
0800	CONTINUE TESTING TO NEUTRAL.
1200	BREAK FOR LUNCH.
1300	CONTINUE TEST.
1700	BREAK FOR THE DAY.
14 DEC 01	
0810	CONTINUE TESTING.
1210	BREAK FOR LUNCH
1300	CONTINUE TEST TO NEUTRAL AND PE
1700	BREAK FOR THE DAY.
17 DEC 01	
800	CONTINUE TESTING.
1230	BREAK FOR LUNCH
1330	CONTINUE TESTING
1700	BREAK FOR THE DAY.
18 DEC 01	
0800	CONTINUE TESTING.
1200	BREAK FOR LUNCH
1300	CONTINUE TESTING
1500	COMPLETE EN 61000-4-5 TESTING
	UNIT PASSES ALL REQUIRED SURGE TESTING
	COMBINATIONS OF COUPLING.

5.1.5 Test Matrix

Capstone Turbine Engineering
Model C60 Micro Turbine Generator – Grid Tied Version
Lightning Test, ANSI C62.41 & C62.45
Power: 277/480 VRMS, 60 Hz
Date: 30 June 2001

Common Mode, Combination Wave

Test Lead	+1 kV	-1 kV	+2 kV	- 2kV	+4 kV	-4 kV	+6 kV	-6 kV
L1 to PE	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X
L2 to PE	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X
L3 to PE	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X
N to PE	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X
L1L2 to PE	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X
L2L3 to PE	X X X	X X X	X 2 X	X X X	X X X	X X X	X X X	X X X
L1L3 to PE	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X
L1N to PE	X X X	X X 2	X X X	X 2 X	X X X	X X X	X X X	X X X
L2N to PE	X X X	X X X	2 X X	2 X X	X X X	X X X	X X X	X X X
L3N to PE	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X
L1L2L3 to PE	X X X	X X 2	X X X	X X X	X X X	X X X	X X X	X X X

Capstone Turbine Engineering
Model 60 Turbine Generator
Lightning Test, ANSI C62.41 & C62.45
Power 277/480 Vrms, 60 Hz
Date: 12 Dec 01

Differential Mode, Combination Wave

Test Lead	+1 kV			-1kV			+2 kV			-2 kV			+4 kV			-4 kV			+6 kV			-6 kV		
L1L2 to N	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
		X			X			X			X			X			X			X			X	
	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
L2L3 to N	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
		X			X			X			X			X			X			X			X	
	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
L1L3 to N	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
		X			X			X			X			X			X			X			X	
	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
L1L2L3 to N	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
		X			X			X			X			X			X			X			X	
	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X

Differential Mode, Ring Wave

Test Lead	+1 kV			-1kV			+2 kV			-2 kV			+4 kV			-4 kV			+6 kV			-6 kV		
L1L2 to N	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
		X			X			X			X			X			X			X			X	
	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
L2L3 to N	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
		X			X			X			X			X			X			X			X	
	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
L1L3 to N	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
		X			X			X			X			X			X			X			X	
	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
L1L2L3 to N	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
		X			X			X			X			X			X			X			X	
	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X

Capstone Turbine Engineering
Model 60 Turbine Generator
Lightning Test, ANSI C62.41 & C62.45
Power 277/480 Vrms, 60 Hz
Date: 14 Dec 01

Common Mode, Ring Wave

Test Lead	+1 kV	-1kV	+2 kV	-2 kV	+4 kV	-4 kV	+6 kV	-6 kV
L1L2 to PE	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X
L2L3 to PE	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X
L1L3 to PE	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X
L1N to PE	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X
L2N to PE	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X
L3N to PE	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X
L1L2L3 to PE	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X
L1L2N to PE	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X
L2L3N to PE	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X
L1L3N to PE	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X
L1L2L3N to PE	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X

5.1.6 Test Results

The UUT successfully completed this test.