



## **Public Meeting on the US-APWR GTG Qualification Testing – DCD Chapter 8**

**Technical Reviewers - Tania Martínez Navedo and  
Robert Fitzpatrick  
Project Manager – Ngola Otto  
Lead Project Manager – Jeff Ciocco  
December 15, 2011**

## **Planned Meeting Attendees**

- MHI
  - Shinji Kawanago, James Curry, Richard Barnes, Hiroshi Shirasawa
- MHI - Kobe Japan
  - Shinji Niida, Shinji Kuichi, Yasutaka Eguchi
- North Carolina
  - Robin Weeks, Hideki Tanaka
- NRC
  - Tania Martinez Navedo, Robert Fitzpatrick, Terry Jackson, Ngola Otto, Jeff Ciocco, Dennis Galvin

# Agenda

- Introductions
- GTG Qualification Testing
  - Item #1: Maintenance Activities Documentation
    - Discussion
  - Item #2: Maintenance Activities during Qualification Testing
    - Discussion
  - Item #3: Reactive Load Bank Failure
    - Discussion
- Parking Lot Items

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## GTG Qualification Testing: Maintenance Activities Documentation

- Regulatory Basis
  - IEEE Std 387
  - RG 1.9
- Applicant's Statement
  - Fuel nozzles cleaned every 50 starts.
- Staff's Request
  - Documentation in MUAP-07024-P
  - Documentation in the DCD
  - ITAAC on verification of GTG qualification
  - Test Procedures

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## GTG Qualification Testing: Maintenance Activities during Qualification Testing

- Regulatory Basis
  - IEEE Std 387
  - RG 1.9
- Staff's Request
  - Applicant determine whether performing these activities was an essential factor for the GTG to successfully complete the qualification tests.

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## GTG Qualification Testing: Reactive Load Bank Failure

- Regulatory Basis
  - IEEE Std 387
  - RG 1.9
- Staff's Request
  - Identification of the reactive load bank failure and subsequent discovery of the portion of the acoustical enclosure roof that had been ingested into the engine's air intake plenum, and whether or not this failure could affect the GTG during operation.
  - Corrective Action(s)
  - Characterization of load bank failure

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# Parking Lot Items

- Questions
- Clarifications
- Action Items / Wrap-up

# REQUEST FOR ADDITIONAL INFORMATION 876-6210 REVISION 3

12/5/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 08.03.01 - AC Power Systems (Onsite)

Application Section: 08.03.01

QUESTIONS for Electrical Engineering Branch (EEB)

08.03.01-43

Question 08.03.01-43

In the response to RAI 818-5872, Question 08.03.01-42, the applicant provided the Qualification Testing Log for the Gas Turbine Generator (GTG) qualification. The log provided in the response indicated the performance of maintenance activities (Fuel Nozzle Cleaning) consisted of removing, cleaning and re-installing the fuel nozzle in each of the two combustion chambers.

The applicant's response also stated the following: The maintenance activity is recommended by the gas turbine engine manufacturer as part of the routine maintenance. This maintenance interval is tied to the number of starts of the gas turbine and is recommended by the manufacturer that the fuel nozzles be cleaned every 50 starts.

IEEE Standard 387-1995, "IEEE Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations," as endorsed in Regulatory Guide 1.9, "Application and testing of Safety-Related Diesel generators in Nuclear Power Plants," states in its Section 6.2.2, "Start and load acceptance tests," Item e.2, the following:

2) Tests performed for verification of a scheduled maintenance procedure required during this series of tests. This maintenance procedure shall be defined prior to conducting the start and load acceptance tests and will then become a part of the normal maintenance schedule after installation.

IEEE Standard 387-1995, "IEEE Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations," as endorsed in Regulatory Guide 1.9, "Application and testing of Safety-Related Diesel generators in Nuclear Power Plants," states in its Section 6.1, "General," the following:

All qualification shall be performed in accordance with a written plan that defines analysis and tests to be performed, parameters to be monitored during tests, test instrumentation, and acceptance criteria for equipment.

- a. Provide information to support that the scheduled maintenance activity conducted was part of the test procedures because this information was not provided in the submitted technical reports, MUAP-07024-P (R2), "Qualification and Test Plan of Class 1E Gas Turbine Generator System", MUAP-10023-P (R3), "Initial Type Test Result of Class 1E GTG System", and Technical Specifications.
- b. Provide details related to the maintenance procedures defined prior to conducting the start and load acceptance tests, and document this maintenance activity in the US-APWR DCD in all appropriate sections where GTG qualification is discussed, as well as in the Qualification Plan Technical Report, MUAP-07024-P (R2).

## REQUEST FOR ADDITIONAL INFORMATION 876-6210 REVISION 3

- c. Add an ITAAC in the DCD, Tier 1, Table 2.6.4-1, "EPS Systems Inspections, Tests, Analyses, and Acceptance Criteria," in order to verify the qualification of the GTGs.
- d. Provide the detailed written plan that defines analysis and tests to be performed, parameters to be monitored during tests, test instrumentation, and acceptance criteria for equipment that was followed during the qualification testing of the GTGs.

### 08.03.01-44

#### Question 08.03.01-44

With regards to the maintenance activities outlined in the response to RAI 818-5872, Question 08.03.01-42, explain whether performing these activities was an essential factor for the GTG to successfully complete the qualification tests.

### 08.03.01-45

#### Question 08.03.01-45

In the response to RAI 818-5872, Question 08.03.01-42, the applicant provided the Qualification Testing Log for the Gas Turbine Generator (GTG) qualification. Such log displayed a failure of the reactive load bank due to a short circuit (Start Test No. 128). The applicant further discussed that the start test was repeated but that an unusual sound was heard by one of the technicians. Upon an inspection following the test, an inspection revealed distortion in the foreign object debris (FOD) screen. The KHI representative stated this was from the sudden application of load during the load bank failure, causing a pulse or pressure wave in the air intake. Upon removal of the right side adapter, it was determined that a portion of the acoustical enclosure roof had been ingested into the engine's air intake plenum, and had deformed an RTD in the air intake. Additionally, some of the perforated surface material of the piece had been bent. It was determined that three narrow portions of the acoustical enclosure roof which should have been welded in place during the fabrication of the enclosure, were not secured; therefore, this allowed the piece to be drawn into the engine plenum. One of the three items was too long to be ingested. The two smaller pieces were secured to prevent further possible displacement. Subsequently, a maintenance start (MS-4) was performed, and the Start and Load acceptance test continued with Start Test No. 129. IEEE Standard 387-1995, "IEEE Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations," as endorsed in Regulatory Guide 1.9, "Application and testing of Safety-Related Diesel generators in Nuclear Power Plants," states in its Section 6.2.2 d)5), "Start and load acceptance tests," the following:

- "If the cause for failure to start or accept load in accordance with the preceding sequence falls under any of the categories listed below, that particular test shall be disregarded, and the test sequence shall be resumed without penalty following identification and correction of the cause for the unsuccessful attempt...
  - 5) Failure of any of the temporary service systems such as dc power source, output circuit breaker, load, interconnecting piping and wiring, and any other temporary setup that will not be a part of the permanent installation.
- a. State whether the applicant identified the cause of the reactive load bank failure, and the subsequent discovery of the portion of the acoustical enclosure roof that had been

## REQUEST FOR ADDITIONAL INFORMATION 876-6210 REVISION 3

ingested into the engine's air intake plenum, and whether or not this failure could affect the GTG during operation.

b. State the corrective action taken in order to preclude this failure from repeating, and whether a design change was done to this effect.

c. Provide information to support the characterization of the load bank failure based on the definition of a failed and successful start and load acceptance tests.

  
**MITSUBISHI HEAVY INDUSTRIES, LTD.**  
16-5, KONAN 2-CHOME, MINATO-KU  
TOKYO, JAPAN

October 7, 2011

Document Control Desk  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

Attention: Mr. Jeffrey A. Ciocco

Docket No. 52-021  
MHI Ref: UAP-HF-11350

**Subject:** MHI's Response to US-APWR DCD RAI No. 818-5872 REVISION 4 (SRP 08.03.01)

**References:** 1) "Request for Additional Information No. 818-5872 Revision 4, SRP Section: 08.03.01, Application Section: 8.3.1," dated (August 30, 2011.).

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Response to Request for Additional Information No. 818-5872, Revision 4."

Enclosed is the responses to one RAI contained within Reference 1.

Please contact Dr. C. Keith Paulson, Senior Technical Manager, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of the submittals. His contact information is below.

Sincerely,



Yoshiaki Ogata,  
General Manager- APWR Promoting Department  
Mitsubishi Heavy Industries, LTD.

Enclosures:

1. Response to Request for Additional Information No. 818-5872 REVISION 4.

DD81  
MRO



CC: J. A. Ciocco  
C. K. Paulson

Contact Information

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Enclosure 1

Docket No. 52-021  
MHI Ref: UAP-HF-11350

UAP-HF-11350  
Docket No. 52-021

Response to Request for Additional Information  
No. 818-5872, Revision 4

October, 2011

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**RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION**

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**10/7/2011**

**US-APWR Design Certification  
Mitsubishi Heavy Industries  
Docket No.52-021**

**RAI NO.:** NO.818-5872 REVISION 4  
**SRP SECTION:** 08.03.01 – AC Power Systems (Onsite)  
**APPLICATION SECTION:** 8.3.1  
**DATE OF RAI ISSUE:** 8/30/2011

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**QUESTION NO. : 08.03.01-42**

During the ACRS Subcommittee Meeting on April 22, 2011, Mr. Richard Barnes of MHI discussed the test sequence for the GTG qualification, as confirmed by the transcripts in page 212, starting in line 19. Specifically, Mr. Barnes affirmed that the qualification testing was stopped every 50 starts to perform maintenance on the injectors, and that maintenance restart was not part of the qualification testing. This particular maintenance activity was not outlined in the Qualification Plan Technical Report, MUAP-07024-P(R2), or the Technical Specifications pertaining to the GTG, therefore:

- a. Explain whether or not this maintenance activity is recommended by the manufacturer, or provide the technical basis to support such activity. Also, document this maintenance activity in the USAPWR DCD in all appropriate sections where GTG qualification is discussed, as well as in the Qualification Plan Technical Report.
- b. Provide the GTG test log for all tests performed during the qualification testing including all stops and maintenance activities performed during the length of each test.

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**ANSWER:**

- a. The maintenance activity is recommended by the gas turbine engine manufacturer as part of the routine maintenance. The activity consists of removing, cleaning and re-installation of the fuel nozzle in each of the two combustion chambers. Cleaning is accomplished by washing the nozzle in a mild detergent and water solution. This maintenance interval is tied to the number of starts of the gas turbine and is recommended by the manufacturer that the fuel nozzles be cleaned every 50 starts. Please note that the removal and re-installation is a simple operation of detaching the fuel line and unscrewing the

nozzle from the combustion chamber, cleaning, and re-installation. The entire interval takes between 30 minutes to one hour to accomplish. Because this normal, routine maintenance activity is addressed in the GTG manufacturer's operations and maintenance manual, it is not necessary to document this maintenance activity in the DCD. This level of detail is inconsistent with other sections of the US-APWR DCD, and the "Qualification Plan Technical Report." The DCD Subsection 8.3.3 contains the requirement to maintain the GTGs in accordance with applicable standards and manufacturer recommendations.

- b. Attachment 1 is a facsimile of the test log. The log indicates a total of 166 starts. In addition to these, other starts were conducted as part of the seismic testing. During the testing, the fuel nozzle was cleaned a total of 3 times. There was no detectable change in the performance of the gas turbine generator between pre- and post-maintenance starts or runs.

**Impact on DCD**

There is no impact on the DCD.

**Impact on R-COLA**

There is no impact on the R-COLA

**Impact on S-COLA**

There is no impact on the S-COLA

**Impact on PRA**

There is no impact on the PRA.

<b>Summary of GTG Engine Start Test Data<sup>1</sup></b>						
<b>Ref. No.</b>	<b>Date of Test</b>	<b>Test Type<sup>2</sup></b>	<b>Start No.</b>	<b>Type of Start (Hot or Cold)</b>	<b>Start Time</b>	<b>Test Successful ?</b>
1	10/27/2010	Initial Start (6.8.2)	1	Cold	N/A	N/A
2	10/28/2010	Control Verifications (6.9)	1	Cold	N/A	N/A
3	10/28/2010	Control Verifications (6.9)	2	Hot	N/A	N/A
4	11/03/2010	Starting Capacity & Start Time (6.10.3)	1	Cold	N/A	N/A
5	11/03/2010	Starting Capacity & Start Time (6.10.3)	2	Hot	N/A	N/A
6	11/03/2010	Starting Capacity & Start Time (6.10.3)	3	Hot	N/A	N/A <sup>3</sup>
7	11/03/2010	Starting Capacity & Start Time (6.10.3)	4	Hot	N/A	N/A <sup>4</sup>
8	11/03/2010	Starting Capacity & Start Time (6.10.3)	5	Hot	N/A	N/A <sup>4</sup>
9	11/04/2010	Start and Load Acceptance Test (6.12)	1	Cold	26.5	Yes
10	11/04/2010	Start and Load Acceptance Test (6.12)	2	Hot	28	Yes
11	11/04/2010	Start and Load Acceptance Test (6.12)	3	Hot	26	Yes
12	11/04/2010	Start and Load Acceptance Test (6.12)	4	Hot	27	Yes
13	11/05/2010	Start and Load Acceptance Test (6.12)	5	Hot	27	Yes
14	11/05/2010	Start and Load Acceptance Test (6.12)	6	Cold	26	Yes
15	11/05/2010	Start and Load Acceptance Test (6.12)	7	Hot	27.5	Yes
16	11/05/2010	Start and Load Acceptance Test (6.12)	8	Hot	28	Yes
17	11/05/2010	Start and Load Acceptance Test (6.12)	9	Hot	28	Yes
18	11/05/2010	Start and Load Acceptance Test (6.12)	10	Hot	28	Yes
19	11/06/2010	Start and Load Acceptance Test (6.12)	11	Cold	26.5	Yes
20	11/06/2010	Start and Load Acceptance Test (6.12)	12	Hot	27.5	Yes
21	11/06/2010	Start and Load Acceptance Test (6.12)	13	Hot	27.5	Yes

Summary of GTG Engine Start Test Data <sup>1</sup>						
Ref. No.	Date of Test	Test Type <sup>2</sup>	Start No.	Type of Start (Hot or Cold)	Start Time	Test Successful ?
22	11/06/2010	Start and Load Acceptance Test (6.12)	14	Hot	28	Yes
23	11/06/2010	Start and Load Acceptance Test (6.12)	15	Hot	28	Yes
24	11/08/2010	Start and Load Acceptance Test (6.12)	16	Cold	26.5	Yes
25	11/08/2010	Start and Load Acceptance Test (6.12)	17	Hot	27	Yes
26	11/08/2010	Start and Load Acceptance Test (6.12)	18	Hot	27.5	Yes
27	11/08/2010	Start and Load Acceptance Test (6.12)	19	Hot	28	Yes
28	11/08/2010	Start and Load Acceptance Test (6.12)	20	Hot	27	Yes
29	11/08/2010	Load Transient Test (6.14.2)	1	Hot	N/A	N/A
30	11/09/2010	Start and Load Acceptance Test (6.12)	21	Cold	26.5	Yes
31	11/09/2010	Start and Load Acceptance Test (6.12)	22	Hot	28	Yes
32	11/09/2010	Start and Load Acceptance Test (6.12)	23	Hot	28	Yes
33	11/09/2010	Start and Load Acceptance Test (6.12)	24	Hot	27	Yes
34	11/09/2010	Start and Load Acceptance Test (6.12)	25	Hot	28.5	Yes
35	11/10/2010	Start and Load Acceptance Test (6.12)	26	Cold	26.5	Yes
36	11/10/2010	Start and Load Acceptance Test (6.12)	27	Hot	27.5	Yes
37	11/10/2010	Start and Load Acceptance Test (6.12)	28	Hot	28	Yes
38	11/10/2010	Start and Load Acceptance Test (6.12)	29	Hot	28	Yes
39	11/10/2010	Start and Load Acceptance Test (6.12)	30	Hot	28	Yes
40	11/10/2010	Start and Load Acceptance Test (6.12)	31	Hot	27	Yes
41	11/10/2010	Start and Load Acceptance Test (6.12)	32	Hot	28	Yes
42	11/10/2010	Start and Load Acceptance Test (6.12)	33	Hot	28.5	Yes
Fuel Nozzle Cleaning						

Summary of GTG Engine Start Test Data <sup>1</sup>						
Ref. No.	Date of Test	Test Type <sup>2</sup>	Start No.	Type of Start (Hot or Cold)	Start Time	Test Successful ?
43	11/11/2010	Maintenance Start	MS-1	N/A	N/A	N/A
44	11/11/2010	Start and Load Acceptance Test (6.12)	34	Hot	26.5	Yes
45	11/11/2010	Start an48d Load Acceptance Test (6.12)	35	Hot	28	Yes
46	11/11/2010	Start an50d Load Acceptance Test (6.12)	36	Hot	28	Yes
47	11/11/2010	Start and Load Acceptance Test (6.12)	37	Hot	28	Yes
48	11/11/2010	Start and Load Acceptance Test (6.12)	38	Hot	28	Yes
49	11/12/2010	Start and Load Acceptance Test (6.12)	39	Cold	26.5	Yes
50	11/12/2010	Start and Load Acceptance Test (6.12)	40	Hot	27.5	Yes
51	11/12/2010	Start and Load Acceptance Test (6.12)	41	Hot	28	Yes
52	11/12/2010	Start and Load Acceptance Test (6.12)	42	Hot	28	Yes
53	11/12/2010	Start and Load Acceptance Test (6.12)	43	Hot	28	Yes
54	11/12/2010	Start and Load Acceptance Test (6.12)	44	Hot	28.5	Yes
55	11/12/2010	Start and Load Acceptance Test (6.12)	45	Hot	27.5	Yes
56	11/12/2010	Start and Load Acceptance Test (6.12)	46	Hot	28	Yes
57	11/12/2010	Start and Load Acceptance Test (6.12)	47	Hot	28.5	Yes
58	11/12/2010	Start and Load Acceptance Test (6.12)	48	Hot	28.5	Yes
59	11/13/2010	Start and Load Acceptance Test (6.12)	49	Cold	26.5	Yes
60	11/13/2010	Start and Load Acceptance Test (6.12)	50	Hot	27.5	Yes
61	11/13/2010	Start and Load Acceptance Test (6.12)	51	Hot	28	Yes
62	11/13/2010	Start and Load Acceptance Test (6.12)	52	Hot	28	Yes
63	11/13/2010	Start and Load Acceptance Test (6.12)	53	Hot	28	Yes

Summary of GTG Engine Start Test Data <sup>1</sup>						
Ref. No.	Date of Test	Test Type <sup>2</sup>	Start No.	Type of Start (Hot or Cold)	Start Time	Test Successful ?
64	11/13/2010	Start and Load Acceptance Test (6.12)	54	Hot	28	Yes
65	11/13/2010	Start and Load Acceptance Test (6.12)	55	Hot	27.5	Yes
66	11/13/2010	Start and Load Acceptance Test (6.12)	56	Hot	28.5	Yes
67	11/15/2010	Start and Load Acceptance Test (6.12)	57	Cold	26.5	Yes
68	11/15/2010	Start and Load Acceptance Test (6.12)	58	Hot	28	Yes
69	11/15/2010	Start and Load Acceptance Test (6.12)	59	Hot	28	Yes
70	11/15/2010	Start and Load Acceptance Test (6.12)	60	Hot	28.5	Yes
71	11/15/2010	Start and Load Acceptance Test (6.12)	61	Hot	28.5	Yes
72	11/15/2010	Start and Load Acceptance Test (6.12)	62	Hot	27.5	Yes
73	11/15/2010	Start and Load Acceptance Test (6.12)	63	Hot	28	Yes
74	11/15/2010	Start and Load Acceptance Test (6.12)	64	Hot	29	Yes
75	11/15/2010	Start and Load Acceptance Test (6.12)	65	Hot	28.5	Yes
76	11/15/2010	Start and Load Acceptance Test (6.12)	66	Hot	29	Yes
77	11/16/2010	Start and Load Acceptance Test (6.12)	67	Cold	26.5	Yes
78	11/16/2010	Start and Load Acceptance Test (6.12)	68	Hot	28.5	Yes
79	11/16/2010	Start and Load Acceptance Test (6.12)	69	Hot	28	Yes
80	11/16/2010	Start and Load Acceptance Test (6.12)	70	Hot	28.5	Yes
81	11/16/2010	Start and Load Acceptance Test (6.12)	71	Hot	28.5	Yes
82	11/16/2010	Start and Load Acceptance Test (6.12)	72	Hot	27	Yes
83	11/16/2010	Start and Load Acceptance Test (6.12)	73	Hot	28.5	Yes
84	11/16/2010	Start and Load Acceptance Test (6.12)	74	Hot	28.5	Yes



Summary of GTG Engine Start Test Data <sup>1</sup>						
Ref. No.	Date of Test	Test Type <sup>2</sup>	Start No.	Type of Start (Hot or Cold)	Start Time	Test Successful ?
85	11/16/2010	Start and Load Acceptance Test (6.12)	75	Hot	29	Yes
86	11/16/2010	Start and Load Acceptance Test (6.12)	76	Hot	29	Yes
87	11/17/2010	Start and Load Acceptance Test (6.12)	77	Cold	26.5	Yes
88	11/17/2010	Start and Load Acceptance Test (6.12)	78	Hot	28	Yes
89	11/17/2010	Start and Load Acceptance Test (6.12)	79	Hot	28	Yes
90	11/17/2010	Start and Load Acceptance Test (6.12)	80	Hot	27	Yes
91	11/17/2010	Start and Load Acceptance Test (6.12)	81	Hot	28.5	Yes
92	11/17/2010	Start and Load Acceptance Test (6.12)	82	Hot	28.5	Yes
93	11/17/2010	Start and Load Acceptance Test (6.12)	83	Hot	28.5	Yes
Fuel Nozzle Cleaning						
94	11/17/2010	Maintenance Start	MS-2	N/A	N/A	N/A
95	11/17/2010	Start and Load Acceptance Test (6.12)	84	Hot	27.75	Yes
96	11/17/2010	Start and Load Acceptance Test (6.12)	85	Hot	28	Yes
97	11/17/2010	Start and Load Acceptance Test (6.12)	86	Hot	27	Yes
98	11/17/2010	Start and Load Acceptance Test (6.12)	87	Hot	28.25	Yes
99	11/17/2010	Start and Load Acceptance Test (6.12)	88	Hot	28.5	Yes
100	11/19/2010	Start and Load Acceptance Test (6.12)	89	Cold	26.5	Yes
101	11/19/2010	Start and Load Acceptance Test (6.12)	90	Hot	28	Yes
102	11/19/2010	Start and Load Acceptance Test (6.12)	91	Hot	28	Yes
103	11/19/2010	Start and Load Acceptance Test (6.12)	92	Hot	28	Yes
104	11/19/2010	Start and Load Acceptance Test (6.12)	93	Hot	28.5	Yes
105	11/19/2010	Start and Load Acceptance Test (6.12)	94	Hot	28.5	Yes

Summary of GTG Engine Start Test Data <sup>1</sup>						
Ref. No.	Date of Test	Test Type <sup>2</sup>	Start No.	Type of Start (Hot or Cold)	Start Time	Test Successful ?
106	11/19/2010	Start and Load Acceptance Test (6.12)	95	Hot	27	Yes
107	11/19/2010	Start and Load Acceptance Test (6.12)	96	Hot	28.5	Yes
108	11/19/2010	Start and Load Acceptance Test (6.12)	97	Hot	28.5	Yes
109	11/19/2010	Start and Load Acceptance Test (6.12)	98	Hot	28.5	Yes
110	11/20/2010	Start and Load Acceptance Test (6.12)	99	Cold	27	Yes
111	11/20/2010	Start and Load Acceptance Test (6.12)	100	Hot	28	Yes
112	11/20/2010	Start and Load Acceptance Test (6.12)	101	Hot	28	Yes
113	11/20/2010	Start and Load Acceptance Test (6.12)	102	Hot	28.5	Yes
114	11/20/2010	Start and Load Acceptance Test (6.12)	103	Hot	28.5	Yes
115	11/20/2010	Start and Load Acceptance Test (6.12)	104	Hot	28.5	Yes
116	11/20/2010	Start and Load Acceptance Test (6.12)	105	Hot	28.5	Yes
117	11/20/2010	Start and Load Acceptance Test (6.12)	106	Hot	28.5	Yes
118	11/22/2010	Start and Load Acceptance Test (6.12)	107	Cold	27	Yes
119	11/22/2010	Start and Load Acceptance Test (6.12)	108	Hot	28	Yes
120	11/22/2010	Start and Load Acceptance Test (6.12)	109	Hot	28	Yes
121	11/22/2010	Start and Load Acceptance Test (6.12)	110	Hot	28	Yes
122	11/22/2010	Start and Load Acceptance Test (6.12)	111	Hot	28	Yes
123	11/22/2010	Start and Load Acceptance Test (6.12)	112	Hot	28	Yes
124	11/22/2010	Start and Load Acceptance Test (6.12)	113	Hot	27	Yes
125	11/22/2010	Start and Load Acceptance Test (6.12)	114	Hot	28.5	Yes
126	11/22/2010	Start and Load Acceptance Test (6.12)	115	Hot	28	Yes

Summary of GTG Engine Start Test Data <sup>1</sup>						
Ref. No.	Date of Test	Test Type <sup>2</sup>	Start No.	Type of Start (Hot or Cold)	Start Time	Test Successful ?
127	11/22/2010	Start and Load Acceptance Test (6.12)	116	Hot	29	Yes
128	11/23/2010	Start and Load Acceptance Test (6.12)	117	Cold	26.5	Yes
129	11/23/2010	Start and Load Acceptance Test (6.12)	118	Hot	28	Yes
130	11/23/2010	Start and Load Acceptance Test (6.12)	119	Hot	28	Yes
131	11/23/2010	Start and Load Acceptance Test (6.12)	120	Hot	29	Yes
132	11/23/2010	Start and Load Acceptance Test (6.12)	121	Hot	28.5	Yes
133	11/23/2010	Start and Load Acceptance Test (6.12)	122	Hot	29	Yes
134	11/23/2010	Start and Load Acceptance Test (6.12)	123	Hot	28	Yes
135	11/23/2010	Start and Load Acceptance Test (6.12)	124	Hot	28.5	Yes
136	11/23/2010	Start and Load Acceptance Test (6.12)	125	Hot	29	Yes
137	11/23/2010	Start and Load Acceptance Test (6.12)	126	Hot	29	Yes
138	11/24/2010	Start and Load Acceptance Test (6.12)	127	Cold	26.5	Yes
139	11/29/2010	Start and Load Acceptance Test (6.12) <sup>6</sup>	128 <sup>6</sup>	ESI Load Bank Failure (Cold Start)	26.5	Note 6
140	11/29/2010	Maintenance Start	MS-3	N/A	N/A	N/A
141	11/29/2010	Start and Load Acceptance Test (6.12) <sup>6</sup>	128 <sup>6</sup>	Hot	27	Note 6
142	11/29/2010	Maintenance Start	MS-4	N/A	N/A	N/A
143	11/29/2010	Start and Load Acceptance Test (6.12)	129	Hot	27	Yes
144	11/30/2010	Start and Load Acceptance Test (6.12)	130	Hot	28	Yes
Fuel Nozzle Cleaning						
145	11/30/2010	Maintenance Start	MS-5	N/A	N/A	N/A

Summary of GTG Engine Start Test Data <sup>1</sup>						
Ref. No.	Date of Test	Test Type <sup>2</sup>	Start No.	Type of Start (Hot or Cold)	Start Time	Test Successful ?
146	12/01/2010	Start and Load Acceptance Test (6.12)	131	Cold	26.5	Yes
147	12/01/2010	Start and Load Acceptance Test (6.12)	132	Hot	28	Yes
148	12/01/2010	Start and Load Acceptance Test (6.12)	133	Hot	28	Yes
149	12/01/2010	Start and Load Acceptance Test (6.12)	134	Hot	28	Yes
150	12/01/2010	Start and Load Acceptance Test (6.12)	135	Hot	28	Yes
151	12/01/2010	Start and Load Acceptance Test (6.12)	136	Hot	28.5	Yes
152	12/01/2010	Start and Load Acceptance Test (6.12)	137	Hot	27.5	Yes
153	12/01/2010	Start and Load Acceptance Test (6.12)	138	Hot	28	Yes
154	12/01/2010	Start and Load Acceptance Test (6.12)	139	Hot	28.5	Yes
155	12/01/2010	Start and Load Acceptance Test (6.12)	140	Hot	28	Yes
156	12/02/2010	Start and Load Acceptance Test (6.12)	141	Cold	26.5	Yes
157	12/02/2010	Start and Load Acceptance Test (6.12)	142	Hot	27.5	Yes
158	12/02/2010	Start and Load Acceptance Test (6.12)	143	Hot	27.5	Yes
159	12/02/2010	Start and Load Acceptance Test (6.12)	144	Hot	28	Yes
160	12/02/2010	Start and Load Acceptance Test (6.12)	145	Hot	27.5	Yes
161	12/02/2010	Start and Load Acceptance Test (6.12)	146	Hot	28	Yes
162	12/02/2010	Start and Load Acceptance Test (6.12)	147	Hot	26.5	Yes
163	12/02/2010	Start and Load Acceptance Test (6.12)	148	Hot	27.5	Yes
164	12/02/2010	Start and Load Acceptance Test (6.12)	149	Hot	28	Yes
165	12/03/2010	Start and Load Acceptance Test (6.12)	150	Cold	26.5	Yes
166	12/04/2010	Margin Test (6.13)	N/A	N/A	N/A	Note 7

Summary of GTG Engine Start Test Data <sup>1</sup>						
Ref. No.	Date of Test	Test Type <sup>2</sup>	Start No.	Type of Start (Hot or Cold)	Start Time	Test Successful ?
167	12/04/2010	Start and Load Acceptance Test (6.12)	151	Cold	26.5	Yes
168	Total Hot Starts:	131				
169	Total Cold Starts:	20				
170	Total Discarded:	5 <sup>b</sup>				
<p><b>NOTES:</b></p> <ol style="list-style-type: none"> <li>This table was developed from actual test data.</li> <li>Type of test or activity that was performed.</li> <li>Committed to three (3) Starting Capacity and Start Time tests, but performed five (5) such tests.</li> <li>Additional Starting Capacity and Start Time tests, performed, but not required. These tests demonstrate the additional excess capacity of the air start system to be capable of greater than the three (3) required starts.</li> <li>The five (5) Maintenance Starts were discarded.</li> <li>Note that Start Test No. 128 is intentionally listed twice. The first start test was terminated when a short circuit occurred in one of the reactive load banks, causing the GTG to shut down due to under-frequency. The failed load bank was Isolated and the GTG inspected. After conducting several purge cycles, in which the engine was barred over but prevented from starting, a maintenance start was performed. Start Test No. 128 was repeated; however near the end of the run, an unusual sound was heard by one of the technicians. Test No. 128 was completed and further inspections were undertaken. The inspection revealed distortion in the foreign object debris (FOD) screen. The KHI representative stated this was from the sudden application of load during the load bank failure, causing a pulse or pressure wave in the air intake. The left side adapter was straightened, but the right side adapter required removal from the engine. Upon removal, it was determined that a portion of the acoustical enclosure roof had been ingested into the engine's air intake plenum, and had deformed an RTD in the air intake. Additionally, some of the perforated surface material of the piece had been bent. It was determined that three narrow portions of the acoustical enclosure roof which should have been welded in place during the fabrication of the enclosure, were not secured; therefore, this allowed the piece to be drawn into the engine plenum. One of the three items was too long to be ingested. The two smaller pieces were secured to prevent further possible displacement. Subsequently, a maintenance start (MS-4) was performed, and the Start and Load acceptance test continued with Start Test No. 129.</li> <li>The Margin tests were conducted after the completion of Start and Load Acceptance Test No. 150, without shutting down the GTG.</li> </ol>						