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Fred Dacimo
Vice President Operations

January 31, 2008
Indian Point Unit Nos. 2 and 3
NL-08-024

Mr. Andrew Feeney
First Deputy Director
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1220 Washington Avenue
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Albany, New York 12226-2251

Subject: Indian Point Energy Center Alert and Notification System Design Report

Reference: Entergy letter, "New Indian Point Energy Center Alert and Notification System Installation, Testing and Implementation Schedule," Mr. Michael Balduzzi to Ms. Rebecca Thomson, FEMA, dated January 9, 2008

Dear Mr. Feeney:

Enclosed for your review is Section 14.1 of the Indian Point Energy Center (IPEC) Alert and Notification System Design Report. Section 14.1 of the Design Report discusses the concepts of siren signal steadiness, repeatability, and reproducibility. The section includes the results of testing performed in the anechoic chamber at the Georgia Technical Research Institute in Smyrna, Georgia. The testing demonstrated that the ATI sirens for use as the IPEC Alert and Notification System are steady, repeatable, and reproducible in accordance with FEMA guidance. Transmittal of this report is in accordance with the milestone schedule provided by the referenced letter.

Should you have any questions regarding this matter, please contact Mr. Michael J. Slobodien, Director, Emergency Planning, Entergy at (914) 272-3352.

Sincerely yours,

Fred R. Dacimo
Vice President Operations
Indian Point Energy Center

Enclosure: 1. Indian Point Energy Center Alert and Notification System Design Report
Final Section 14.1

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Indian Point Energy Center Alert and Notification System
Design Report Final Section 14.1

14 ACOUSTIC TESTING AND ANALYSIS

14.1 Steady, Repeatable, and Reproducible

This section of the design report addresses the siren output characteristics of steadiness, repeatability, and reproducibility. Set forth below are the definition of each characteristic, how such characteristic was determined, and the documentation of test results. Georgia Tech Research Institute (GTRI) in Smyrna, Georgia established the testing methodology, conducted the testing, and provided the testing results which establish that the new Indian Point Alert and Notification System (ANS) sirens meet all applicable FEMA standards and guidance[1].

Figure 14-1 shows the location of the nine (9) microphone cruciform array in relation to the siren speaker array inside the anechoic chamber. This equipment arrangement is consistent for all of the tests performed by GTRI in the anechoic chamber. The central microphone was aligned with the center of the siren speaker array and data from this microphone were used in test results and analyses.

Steadiness

The definition of siren steadiness is the ability to maintain an alerting signal at a constant sound pressure level and signal frequency as a function of time. The standard for steadiness is $\pm$ 2.0 dBC established by FEMA during the technical meeting held between ENOI and FEMA on November 9, 2007 and is based on the caption to Figure 1 in CPG 1-17[2,3].

The GTRI testing demonstrates that the siren output is steady in accordance with FEMA guidance in CPG 1-17 and as discussed below.

Siren time history curves depict sound pressure level (SPL) versus time. Siren time history curves for four omni-directional sirens are provided in figures 14-2 – 14-5. Each of the nine (9) time history curves associated with individual microphones follows the same pattern but at different sound pressure levels. Time history data recorded from the center microphone (#3) in the array for multiple activations are shown in figures 14-8 through 14-11. The center microphone was selected because it represents the on-axis center of the siren array location. Table 14-1 lists the range of siren sound variation for 28 independent speaker pair tests from four omni-directional sirens.

The GTRI data demonstrate that the omni-directional siren sound output during normal operation, which excludes an initial transient, varies between 0.16 and 0.49 dBC or 0.34 dBC on average over a 3-4 minute time period. Excluding the transient sound pressure level that occurs with signal initiation, the omni-directional sirens demonstrate a steady signal with sound pressure levels varying by less than 0.5 dBC over a 3-4 minute

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[1] Acoustic Testing of Prompt Alert Notification System Sirens from Indian Point Energy Center", Volume 1 Chamber Testing, Georgia Tech Research Institute GTRI Report D5600-Volume 1, Wyle Laboratories Report WR-07-25, Volume 1 dated December 2007

[2] CPG 1-17, Outdoor Warning Systems Guide, Federal Emergency Management Agency, March 1, 1980, page 10

[3] Technical meeting between ENOI and FEMA and consultant, November 9, 2007 documented in ENOI letter January 9, 2008

sounding period. The initial transient sound pressure level reduction of approximately 1.0 dBC over the first 20-24 seconds of siren operation is due to the initial electrical burst from the siren amplifiers. The ANSI S12.14-1992[4] criteria allows for initial transients in accordance with paragraph 6.2.3.1 which states "Observations shall be made over a period of at least 30 seconds after the warning sound source has reached steady operation."

Results of the GTRI tests indicated that the bi-directional siren sound output, excluding the initial transient varied by less than 0.40 dBC over a 3-4 minute sounding period. Figure 14-6 shows the data that demonstrate signal steadiness for the bi-directional siren system.

Based on the GTRI testing data, the steadiness range for both the omni-directional and bi-directional sirens is within 0.5 dBC over a 3-4 minute sounding period and meet the applicable FEMA standards and guidance.

Steady frequency output was measured for the siren activations of both omni-directional and bi-directional sirens at the standard operating frequency of 576 Hz as well as other frequencies including 660, 675, and 780 Hz. Frequency of the siren output was steady to within $\pm$ 1.0 Hz over a 3-4 minute sounding period. Figure 14-7 shows the constancy of frequency during a representative siren sounding.

The independent GTRI testing results demonstrate that both the omni-directional and bi-directional sirens produce a steady alerting tone frequency in accordance with FEMA standards and guidance.

Repeatability

The definition of repeatability is the ability of a siren to produce the same sound level output and tone frequency during multiple activations. The standard for repeatability is $\pm$ 2.0 dBC established by FEMA during the technical meeting held between ENOI and FEMA on November 9, 2007 and is based on the caption to Figure 1 in CPG 1-17, page 10[3].

The GTRI testing demonstrates that the siren output is repeatable as discussed below.

Figures 14-8 through 14-11 show the representative test results of four different omni-directional sirens during several different activations. Data from the central microphone show sound pressure level variation ranging between 0.8 and 1.4 dBC. These data demonstrate that the omni-directional siren system is repeatable within a 1.4 dBC range over a 3-4 minute sounding period. Figure 14-6 shows that the bi-directional siren is repeatable within a 0.6 DBC range over a 3-4 minute sounding period.

In addition, *in situ* outdoor testing performed in the summer of 2007 within the Indian Point EPZ and shown in Figure 14-12 indicates very similar repeatability results for both the omni-directional and bi-directional sirens. The maximum *in situ* outdoor repeatability

[4] American National Standards Institute (ANSI) S12.14-1992, "Methods for the fixed Measurement of the Sound Output of Audible Public Warning Devices installed at Fixed Locations Outdoors"

range for 5 omni-directional siren tests was 1.1 dBC and for the two bi-directional siren tests was 0.3 dBC.

The independent GTRI testing results demonstrate that both the omni-directional and bi-directional sirens are repeatable in accordance with the FEMA standard established by the FEMA staff [3].

Reproducibility

Reproducibility is defined as the ability of a group of sirens to produce acoustic output that is consistent from one siren to another. The standard for reproducibility was established by the FEMA staff at a technical meeting between ENOI and FEMA on November 9, 2007 [3].

The GTRI testing demonstrates that the siren output is reproducible as discussed below.

Reproducibility was demonstrated by comparing the sound pressure level output of different sirens. Figure 14-13 shows anechoic chamber results from twenty-eight (28) sound tests from four different omni-directional sirens with different speaker pairs facing the microphone array. The data demonstrate that the omni-directional siren systems are reproducible to within a $\pm$ 2.0 dBC band. This is further demonstrated by outdoor tests results performed *in situ* within the Indian Point EPZ in the summer of 2007 and shown in Figure 14-14 [5]. Excluding one outlier (siren 213), outdoor *in situ* testing on the remaining 16 sirens measured on axis at 100 feet at siren height had a $\pm$ 2.0 dBC band. Anechoic chamber test results for siren 213 projected to 100 feet are well within the $\pm$ 2.0 dBC range. Additionally, outdoor tests results obtained from siren 213 at GTRI were also within the $\pm$ 2.0 dBC range. These results suggest that the outlying reading for siren 213 shown in Figure 14-14 was due to outdoor environmental effects.

Anechoic chamber and *in situ* outdoor tests described above demonstrate that the omni-directional sirens are reproducible.

Figure 14-6 shows the reproducibility of two bi-directional sirens to be within 1.0 dBC. This reproducibility is further supported by *in situ* outdoor tests whose data are shown in Figure 14-12. The *in situ* outdoor reproducibility test between bi-directional sirens 116 and 120 using the worst case combination is 0.6 dBC. Therefore, the bi-directional sirens are reproducible to within a $\pm$ 2.0 dBC band over a 3-4 minute sounding period.

The independent GTRI testing results demonstrate that both the omni-directional and bi-directional sirens are reproducible in accordance with the standard established by the FEMA staff [3].

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[5] "General Acoustical Analysis of the New Indian Point Siren System – Final Report", August 2007, Blue Ridge Research and Consulting

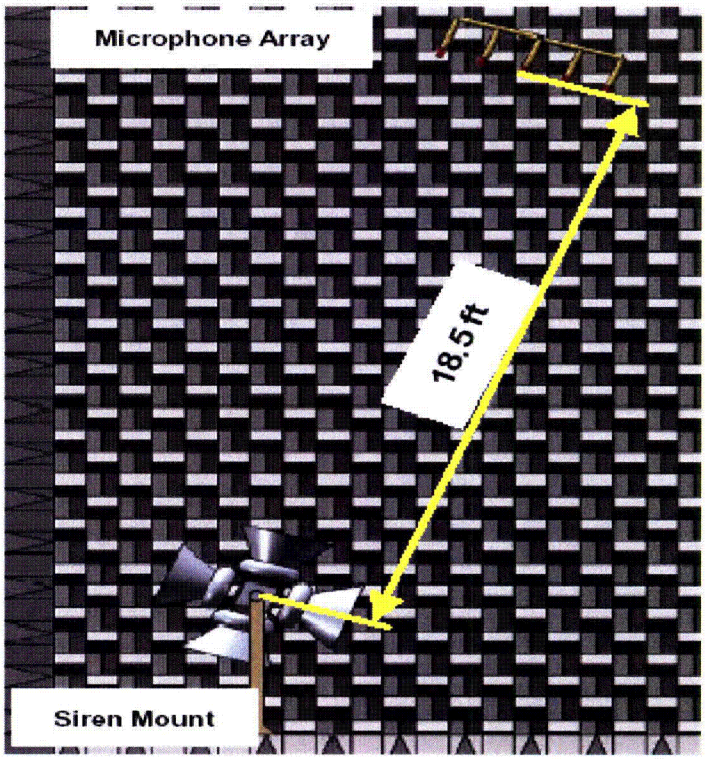

Figure 14-1. Microphone Array in Anechoic Chamber

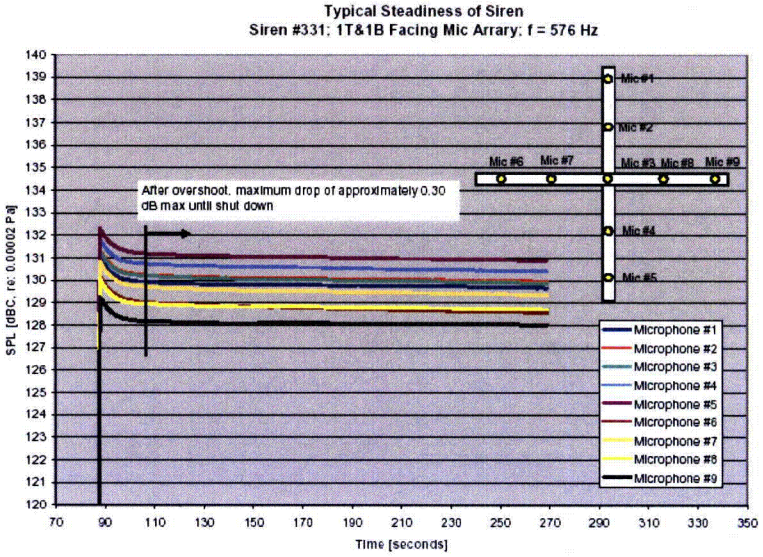

Figure 14-2. Time History of Each SPL for Each Microphone in the Array during the Sounding of Siren 331 f = 576 Hz (Source: GTRI Report D5600 – Vol. 1 Dated 12/07)

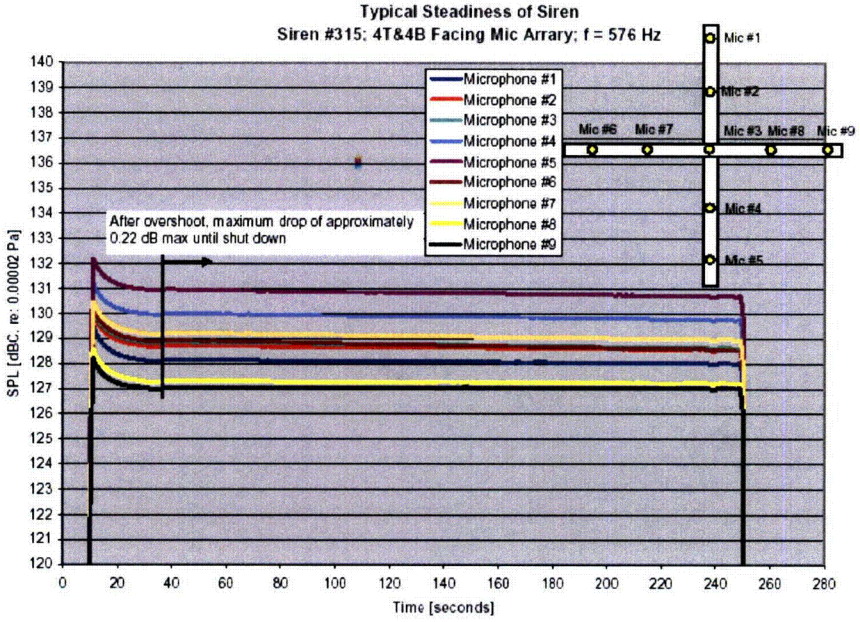

Figure 14-3. Time History of Each SPL for Each Microphone in the Array during the Sounding of Siren 315 f = 576 Hz (Source: GTRI Report D5600 – Vol. 1 Dated 12/07)

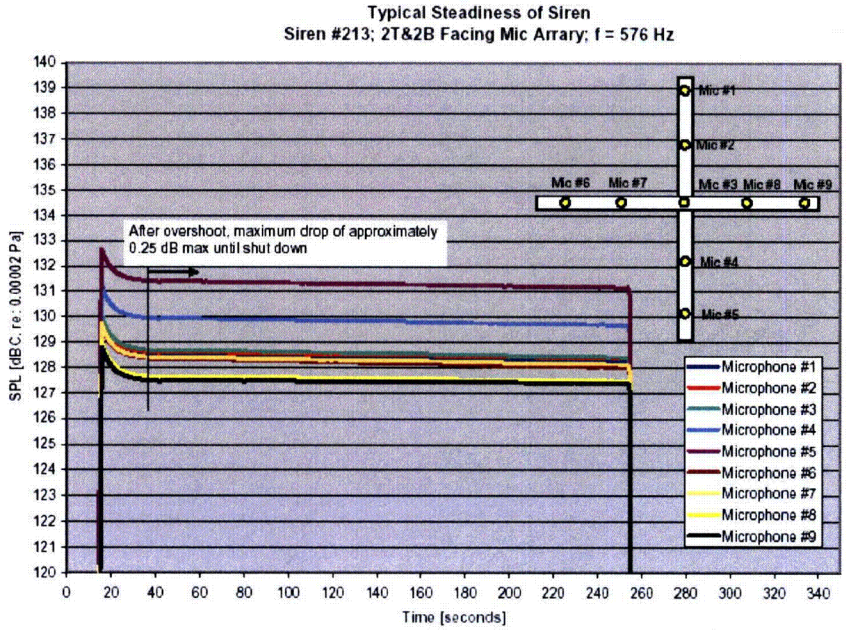

Figure 14-4. Time History of Each SPL for Each Microphone in the Array during the Sounding of Siren 213 f = 576 Hz (Source: GTRI Report D5600 – Vol. 1 Dated 12/07)

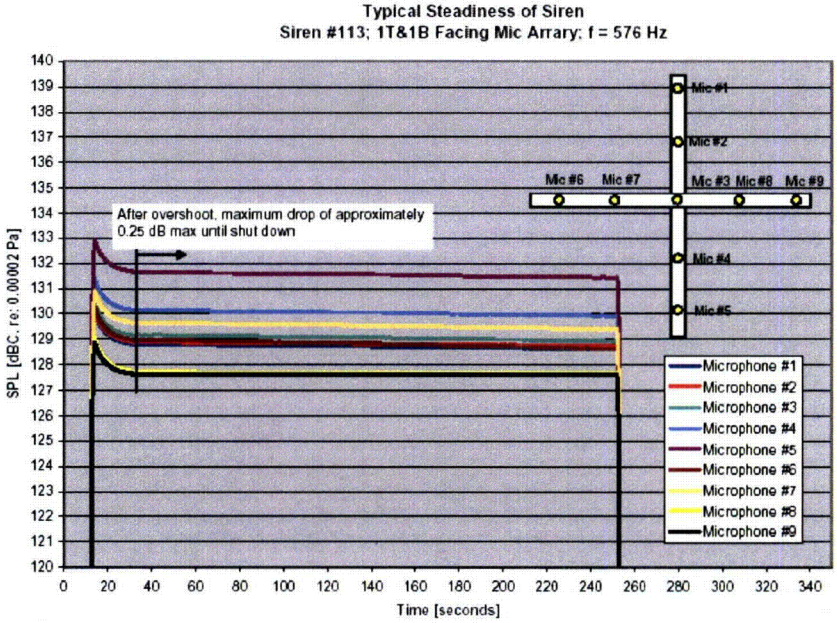

Figure 14-5. Time History of Each SPL for Each Microphone in the Array during the Sounding of Siren 113 f = 576 Hz (Source: GTRI Report D5600 – Vol. 1 Dated 12/07)

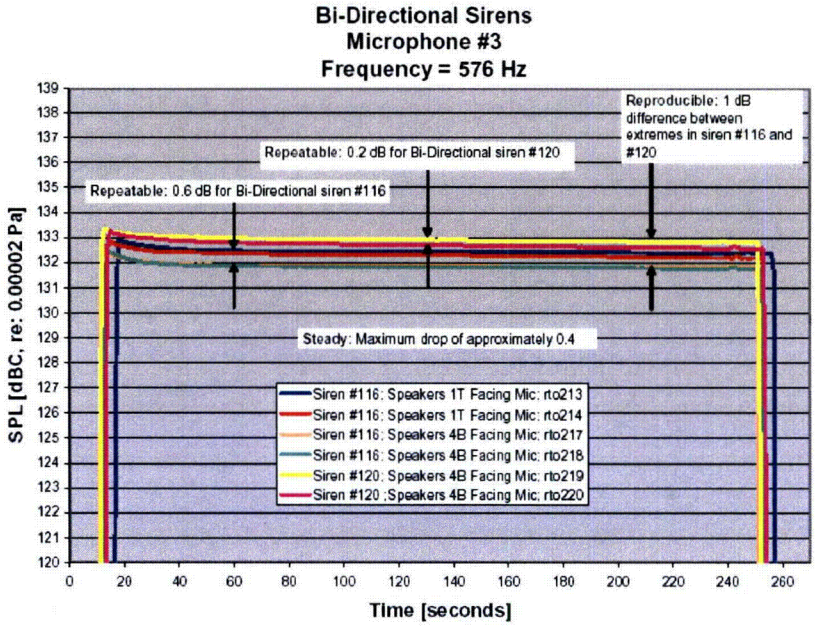

Figure 14-6. Steady, Repeatable, and Reproducible Results from Bi-Directional Sirens (Source: GTRI Report D5600 – Vol. 1 Dated 12/07)

Run Number	Drop in SPL Over Sound Duration (ΔdB)
rto040	0.37
rto045	0.49
rto046	0.35
rto047	0.26
rto063	0.32
rto064	0.43
rto065	0.26
rto069	0.36
rto070	0.42
rto071	0.35
rto074	0.27
rto075	0.35
rto155	0.32
rto157	0.34
rto158	0.34
rto159	0.31
rto165	0.24
rto166	0.30
rto169	0.32
rto170	0.35
rto171	0.39
rto172	0.38
rto197	0.23
rto198	0.16
rto199	0.34
rto200	0.39
rto201	0.37
rto202	0.48
Min	**0.16**
Max	**0.49**
Avg.	**0.34**

Table 14-1. Steadiness of Omni-Directional Siren System Measured at the Center Microphone Location (#3)
(Source: GTRI Report D5600 – Vol. 1 Dated 12/07)

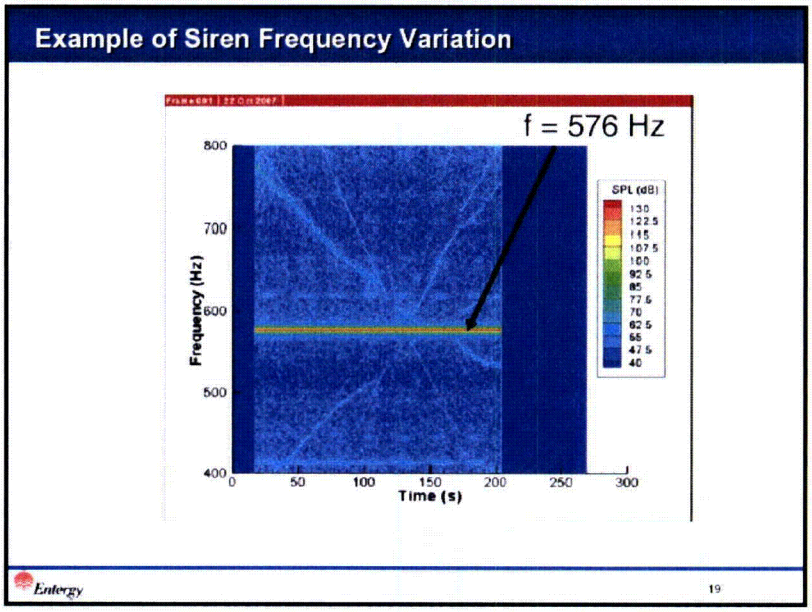

Figure 14-7. Contour Map of Frequency and Time Domain of a Typical Siren Sounding
(Source: GTRI Report D5600 – Vol. 1 Dated 12/07)

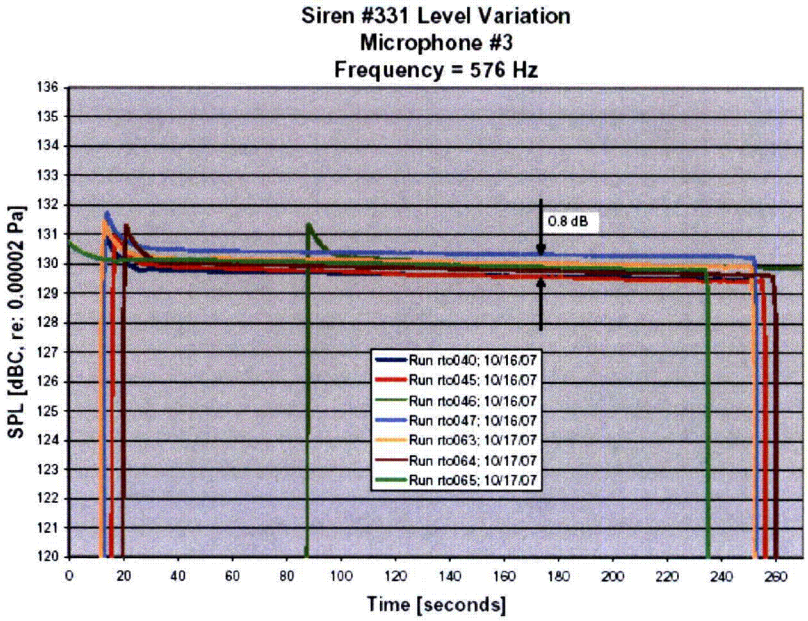

Figure 14-8. Repeatability of Acoustic Measurements on Siren #331;
Microphone #3 Data
(Run 46 Sounding Started After Start of Data Collection)
(Source: GTRI Report D5600 – Vol. 1 Dated 12/07)

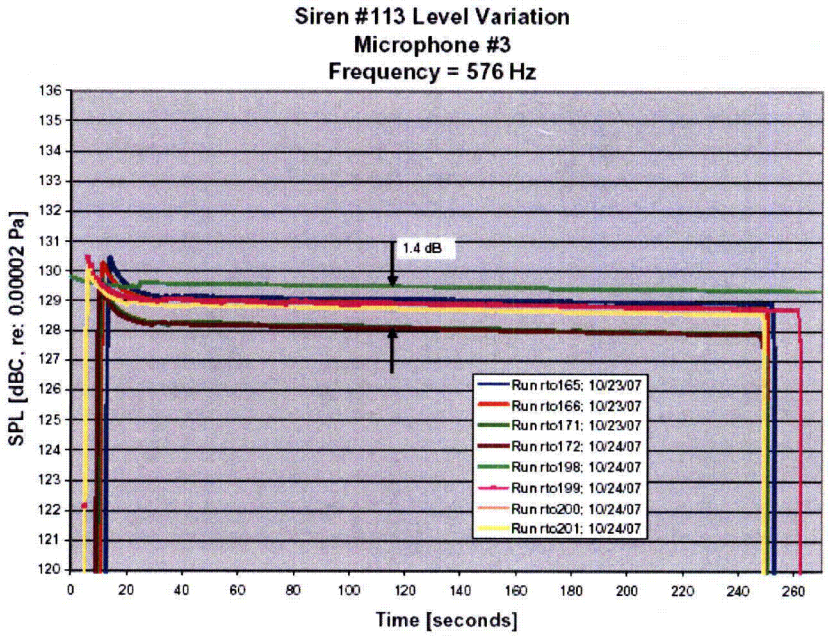

Figure 14-9. Repeatability of Acoustic Measurements on Siren #113; Microphone #3 Data
(Source: GTRI Report D5600 – Vol. 1 Dated 12/07)

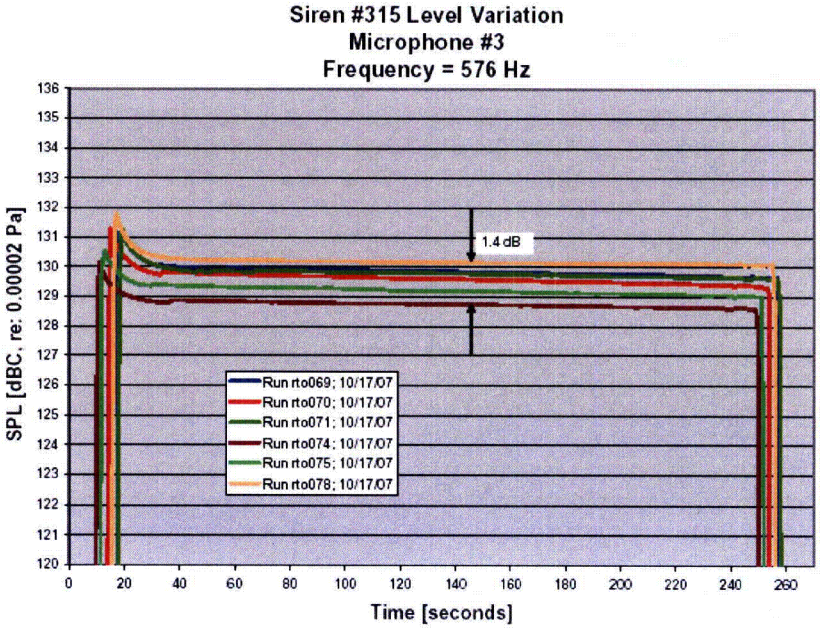

Figure 14-10. Repeatability of Acoustic Measurements on Siren #315; Microphone #3 Data
(Source: GTRI Report D5600 – Vol. 1 Dated 12/07)

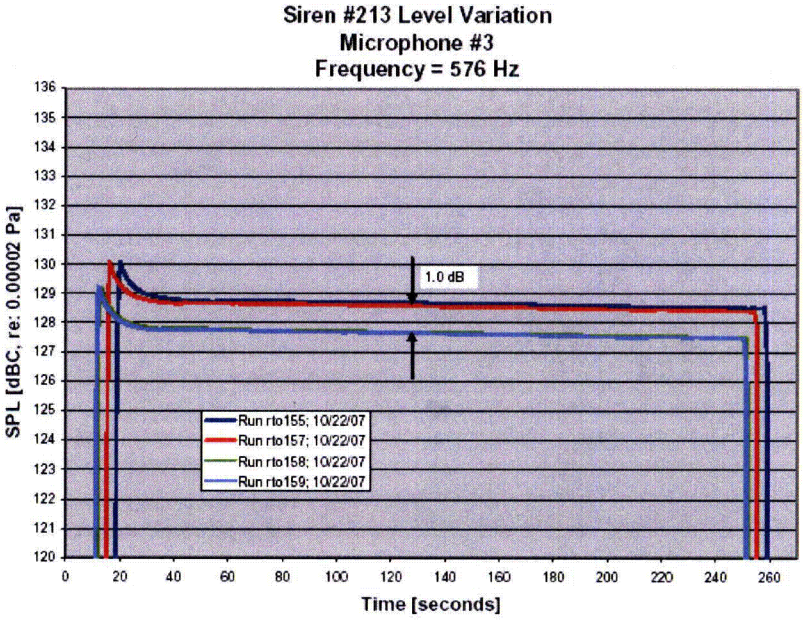

Figure 14-11. Repeatability of Acoustic Measurements on Siren #213; Microphone #3 Data
(Source: GTRI Report D5600 – Vol. 1 Dated 12/07)

Siren Output Repeatability

Siren #	1st Test	2nd Test	3rd Test	4th Test	dBC Range
Omni Sirens					
102	113.9	114.1			**0.2**
213	111.3	111.6	111.1	110.9	**0.7**
369	114.1	113.3			**0.8**
329	113.6	112.6			**1**
336	114.3	113.8	113.2		**1.1**
Bi-Directional Sirens					
116	116.1	115.9			**0.2**
120	115.5	115.8			**0.3**

Note: all measurements in dBC on axis

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Figure 14-12. Outdoor Siren Repeatability Test Results from 2007
(Source: BRRC Final Report Dated 8/07)

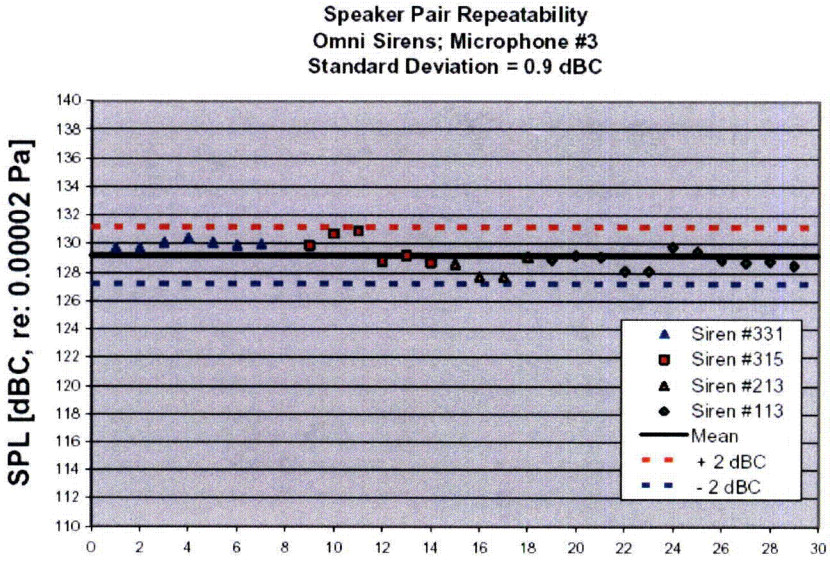

Figure 14-13. Reproducibility of Omni-Directional Sirens
Tested in Anechoic Chamber in 2007
(Source: GTRI Report D5600 – Vol. 1 Dated 12/07)

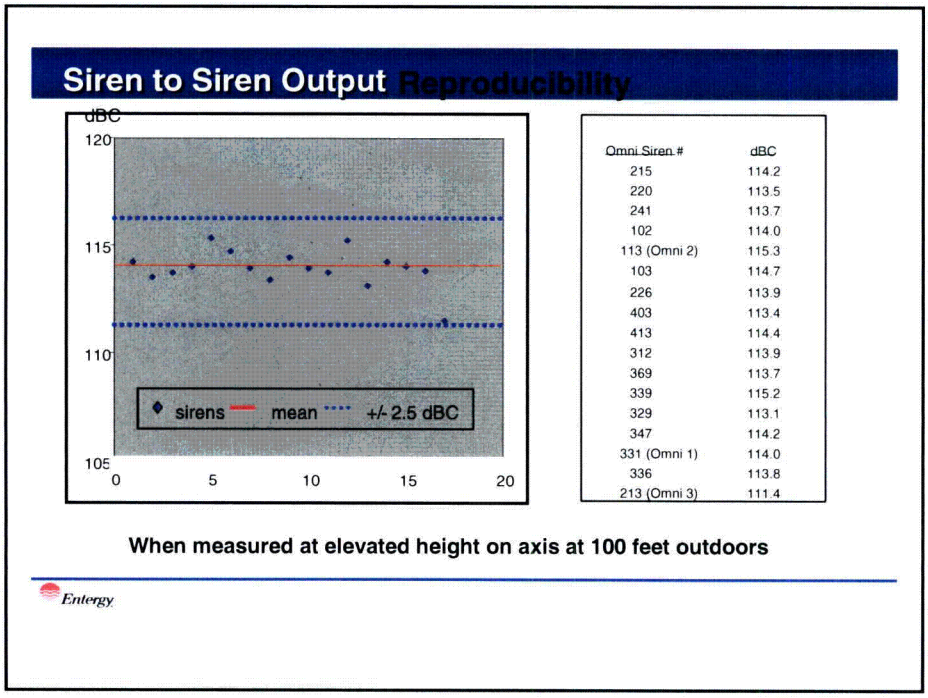

Figure 14-14. Outdoor Siren Reproducibility Test Results from 2007
(Source: BRRC Final Report Dated 8/07)