Alert and

Notification System

for the

Indian Point Energy Center

Entergy Nuclear

July 30, 2008

PREPARED BY:
ENTERGY NUCLEAR
AND
ACOUSTIC TECHNOLOGY, INC.
EAST BOSTON, MASSACHUSETTS

THIS DOCUMENT CONTAINS ~~PROPRIETARY INFORMATION~~ OF ACOUSTIC TECHNOLOGY, INC. (ATI) It is submitted with the express understanding, to which the recipient agrees, that its contents or any part of them will not be duplicated or disclosed to third parties, nor will proprietary information herein be used to or for any other purpose except review and implementation of the design system, with the prior written consent of ATI having been obtained in each instance. "Proprietary information" means information not previously known to the recipient so long as not generally and properly available to the public.

The following sections were revised or added in the July 30, 2008 revision of this report:

- Inside Cover Page (July 30, 2008), Revision 3
- Table of Contents, Revision 3

- Section 1, Revision 2
- Section 8, Revision 3
- Section 11, Revision 3
- Section 14, Revision 3
- Section 22, Revision 2
- Appendix G, Revision 3
- Appendix M

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 SUMMARY

This report describes the Alert and Notification System (ANS) for the Indian Point Energy Center (IPEC) in Buchanan, New York.

The IPEC ANS consists of sirens and broadcasted emergency information with the addition of tone alert radios (TARs) and the NY-Alert system in the future as enhancements to the system. High speed telephone notification is used as a backup in the event of siren failure. This system meets or exceeds the guidelines set forth in the Federal Emergency Management Agency's (FEMA's) regulations, 44 CFR Part 350, Planning Standard E, Appendix 3 of NUREG-0654/FEMA-REP-1, and the Guide for the Evaluation of Alert and Notification Systems for Nuclear Power Plants (FEMA-REP-10).

The siren system described in this report, in conjunction with other elements of the ANS, achieves the design objectives for coverage specified in Appendix 3 of NUREG-0654/ FEMA-REP-1, and FEMA-REP-10 section E.6.2 in that together they meet the following criteria:

> "Capability for providing both an alert signal and informational or instructional message to the population on an area wide basis throughout the 10 mile EPZ, within 15 minutes."
>
> "The initial notification system will assure direct coverage of essentially 100% of the population within 5 miles of the site"
>
> "Special arrangements will be made to assure 100% coverage within 45 minutes of the population who may not have received the initial notification within the entire plume exposure EPZ."

The ANS relies on omni-directional and bi-directional electronic sirens broadcasting an audible sound tone signal at 576 Hertz to alert the public to obtain information. The notification information is provided from commercial broadcast networks that participate in the Emergency Alert System (EAS). As an enhancement, residents in areas of reduced acoustic coverage will be offered TARs. A cost evaluation has determined that TARs provide a more cost effective solution to sirens in low population areas or where a few households require coverage. In a few areas, resistance from local population and governments to installing new sirens has been encountered. TARs therefore have been selected as an interim cost effective method of alert and notification to enhance population coverage up to 100% of the population inside the EPZ until the NY-Alert system becomes fully functional. Details of the NY Alert system will be provided for review and approval when the system is ready for use.

NY-Alert is a mass alerting/notification system maintained by the State of New York's State Emergency Management Office. Phase 1 of NY-Alert currently provides a variety of broadcast including direct e-mail, text messaging to cell phones, blast fax sending, high speed telephone calling, and cable television scrolling. In the future, Phase 2 will include notification using instant messenger technology, cell phone casting, notification using selected EAS broadcasting systems, and transmission of EAS via satellite.

IPEC will provide guidance to these residents on the use and testing of the TARs on an annual basis. These residents will also be advised in writing of the availability and desirability of registration with the NY-Alert system.

The counties located in the Emergency Planning Zone (EPZ) also have arrangements to assure that there is essentially 100% coverage of the population who may not have received the initial siren alert. In the event of a siren failure, backup alerting will be provided by a high speed telephone calling system capable of delivering geographically customized pre-recorded emergency messages. Geographic Information Systems (GIS) were used to define the messaging area for each siren based on the acoustic coverage that would be potentially affected by a failure of that siren.

This report describes the technical features of the siren system including siren features and placement, sound propagation acoustic modeling, control and communications systems, system operation, testing and maintenance, and backup power capabilities.

8 GENERAL SYSTEM OVERVIEW

8.1 Siren System

The number of sirens in each of the four counties within the EPZ is summarized in the table below:

Table 8-1. Number of Sirens by County

County	New System – Number of Sirens
	Total
Westchester	77
Rockland	56
Orange	23
Putnam	16
Total	172

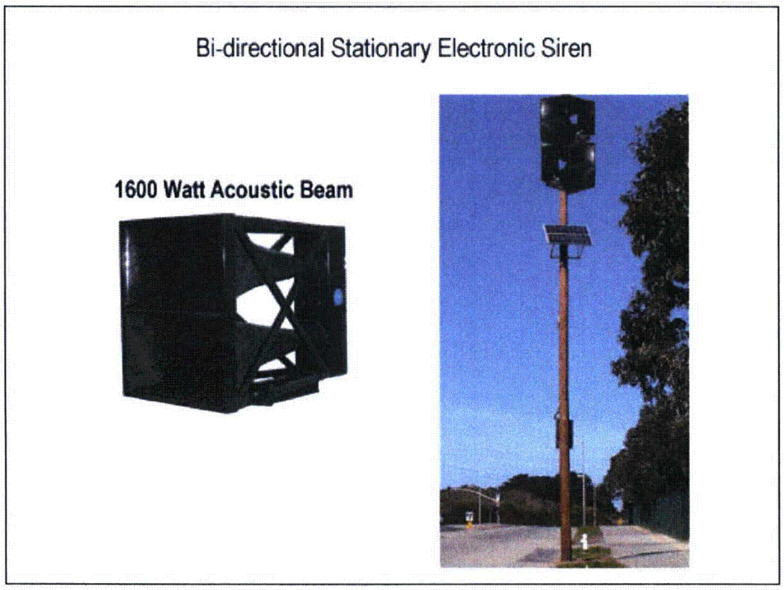
Sirens

Electronic stationary sirens are used in this system. The sirens provide reliable alarm tone notification for warning areas in a community and are capable of voice reproduction when enabled. This omni-directional electronic siren configuration (Figure 8-1) is certified to produce a 360-degree pattern of at least 114 dBC Leq sound pressure (rated at 100 feet on axis at siren height). The bi-directional electronic siren configuration (Figure 8-2) is certified to produce a sound pressure level of at least 114 dBC Leq for each 800 watt beam or 116 dBC Leq for each 1600 watt beam (rated at 100 feet on axis at siren height). The sound pattern from multiple fixed omni-directional sirens is designed to provide a greater added effect by creating an increased sound level exposure at full volume, compared to the previous design that used rotating sirens. Stationary sirens are advantageous since they maintain a constant output level in all directions. The design of the speaker assembly allows the siren to still operate even if some drivers were to fail although there would be a reduction in sound output. The siren units are driven by battery power with sufficient capacity to provide 15 minutes of operation after a 24 hour loss of external power. There are 172 sirens in the Indian Point warning system. Of those, 136 sirens use essentially the same locations as the previous rotating sirens they are replacing, while the remaining 31 are in new locations.

Figure 8-1. Typical Stationary Omni-Directional Siren in New System

One hundred and fifty-seven (157) sirens are omni-directional and fifteen (15) use the bi-directional configuration (Figure 8-2).

Figure 8-2. Typical Stationary Bi-Directional Siren in New System



Siren Station Components

Each omni-directional siren includes the following components:

- Eight Horns (HPSS32), each containing four 100-watt compression drivers
- NEMA 4X Stainless Steel Enclosure with three separate compartments: an upper compartment for the electronics and two lower ventilated compartments for the batteries.
- Siren Amplifier Controller Board
- Auxiliary Amplifier Board
- Wireless Radio
- Wireless Modem
- Temperature-compensated Battery Charger
- On/Off Switch for the Battery Charger
- On/Off Circuit Breakers for Siren Power
- On/Off Circuit Breakers for heater
- Four 12V, Gel Cell Batteries
- Intrusion Switch
- Battery Heater and Thermostat
- Cell Antenna
- Omni-Directional or YAGI (directional) Antenna with low loss coaxial cable

The omni-directional High Power Speaker Station (HPSS32) in the IPEC system utilizes the model TH 300 speaker and is a state-of-the-art electronic siren capable of producing 3200 watts of audio power (400 watts per speaker) and includes all of the above components. It uses advanced microprocessor-based circuitry.

Two different bi-directional configurations are used. In the first configuration, the bi-directional HPSS32 which utilizes the model TH 400 speaker is capable of producing 3200 watts (800 watts per speaker) and also includes all of the above components, except that it uses four speakers (two per direction, configured vertically), each containing two 400-watt compression drivers.

In the second configuration, the bi-directional HPSS32 which is an omni-directional HPSS32 (utilizing the model TH 300 speaker) with two pairs of speakers enabled, is capable of producing 1600 watts (400 watt per speaker), and includes all of the above components, except uses four speakers (two per direction, configured vertically), each containing four 100-watt compression drivers.

The HPSS32 sirens are 24V DC powered sirens using deep cycle gel cell batteries which are trickle charged with an 8 Amp temperature-compensated Battery Charger. Six (6) sirens are solar powered.

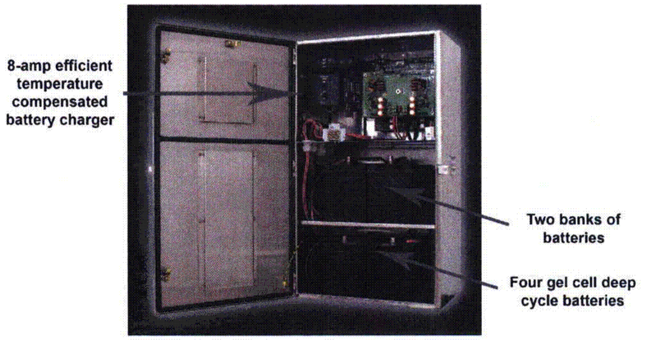
The electronics and batteries are housed in a stainless steel NEMA 4X enclosure (see Figure 8-3) as a standard feature, providing protection from adverse outdoor weather conditions. With AC power available, the battery compartment is heated, thus enabling the batteries to function at full capacity when the outside temperature drops.

The HPSS enclosure (NEMA 4X) contains the ATI Siren Amplifier Controller Board (SAB), which integrates both the microprocessor control and audio amplifier circuitries. It contains a control section, communication section, input/output section, and 1600W amplifier section. The Auxiliary Amplifier Board contains an additional 1600 W amplifier section.

The HPSS enclosure also contains a highly efficient audio amplifier design (up to 95%), resulting in very low heat dissipation during standard operation with lower power requirements, leading to longer battery life.

Figure 8-3. Typical Siren Equipment and Control Enclosure

NEMA 4X Siren Equipment and Control Enclosure



The SAB board is a microprocessor-based board. It has an embedded modem, analog to digital converter, serial port interfaces, and a wireless communication interface. The board is programmed from a regular PC using a special utility program.

The communication section of the board interfaces to an off-the-shelf wireless radio. The radio is used to send and receive wireless messages to and from the control station incorporating Frequency Shift Keying (FSK) data transmission schemes. The board will perform specific activations dependent upon the wireless messages sent by the control station in addition to responding to other types of service messages, (i.e. polling, acknowledgements, and synchronization messages). The board will report to the control station any local faults, such as intrusion, AC and/or charger failures, and low battery conditions.

A redundant communication path using TCP/IP protocol is also available. The siren controller board interfaces to a wireless modem.

The board monitors the battery voltage of the siren internally and the charger voltage. It will enter Power Shutdown Mode if the battery voltage goes below a pre-set value and generates an alarm report.

Control System

The communication control system uses eleven (11) control stations that are designed to have complete control and monitoring capabilities over all sirens in the system. Each control station includes a REACT-4000 Communication Control Unit (CCU), TCP/IP cell modem with an attached computer, LCD monitor, printer, keyboard, track ball, batteries, and uninterruptible power supply, all generally within a rack-mounted enclosure (See Figure 8-5). There are two (2) control stations located at Indian Point Energy Center that control all 172 sirens. There are three (3) control stations located in Westchester County controlling 77 sirens, two (2) control stations located in Putnam County controlling 16 sirens, two (2) control stations located in Orange County controlling 23 sirens, and two (2) control stations located in Rockland County controlling 56 sirens. Table 8-2 lists the locations of the control stations.

Each county has complete activation control and monitoring over the sirens used to alert its county from all control stations located within its county and can monitor the activation of all sirens via the computer display. Each county can also monitor sirens from bordering counties that may affect their county. All counties can also activate other counties' sirens if agreed upon. The two control stations at IPEC can also activate all of the sirens if needed.

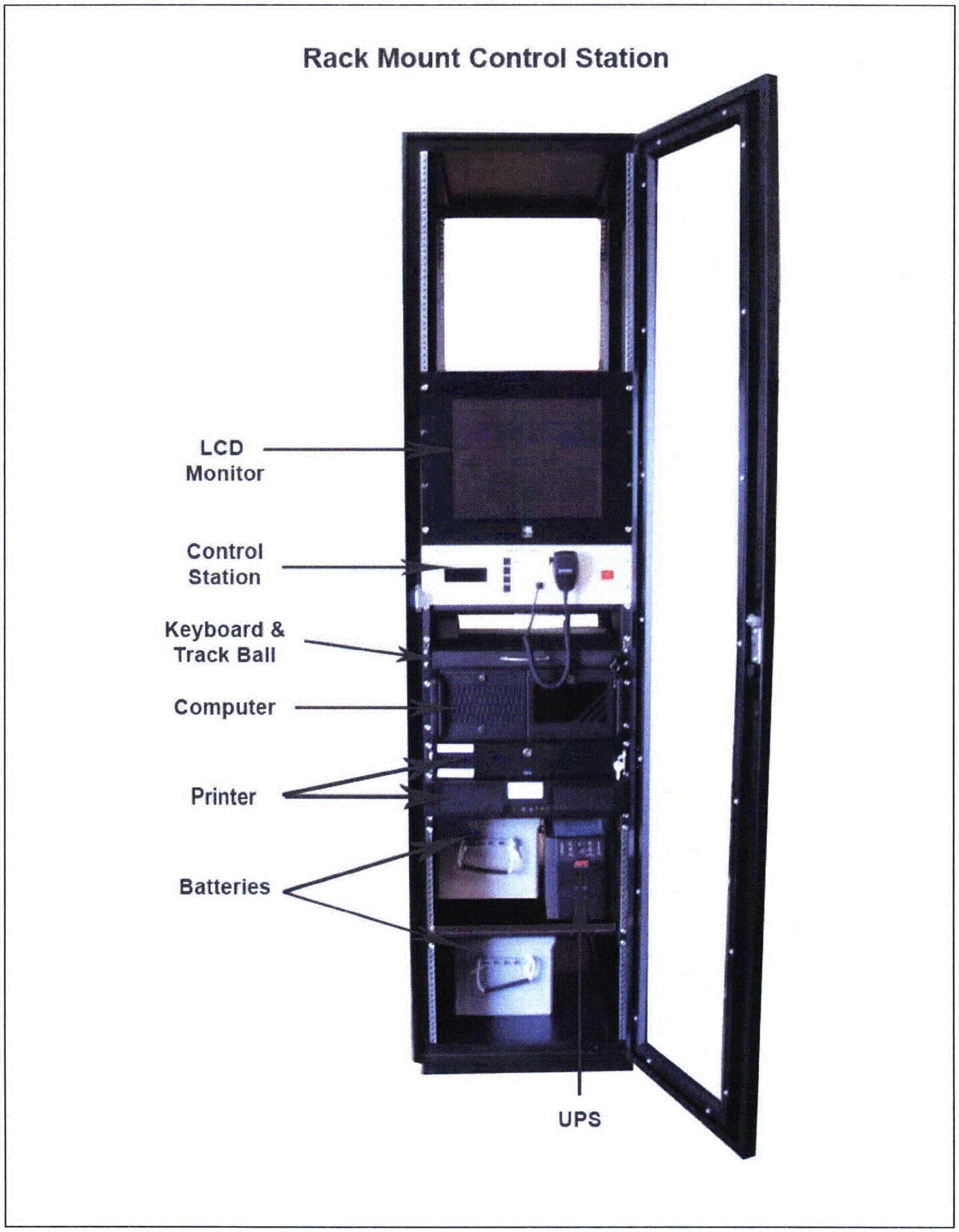
All control stations have battery back-up power capable of providing a minimum of twenty-four (24) hours of operation in case of primary power failure. The system incorporates reliable communication and post activation polling using radio and TCP/IP communication.

Table 8-2. Locations of Siren System Control Stations

Location	Address	Latitude N (Decimal Degrees)*	Longitude W (Decimal Degrees)*
Indian Point Emergency Operations Center (EOF)	Indian Point Energy Center 450 Broadway Buchanan, NY 10511	41.27055555600	-73.95002361100
Indian Point General Service Building (GSB)	Indian Point Energy Center 450 Broadway Buchanan, NY 10511	41.27055555600	-73.95002361100
Westchester Co. EOC	Hudson Valley Traffic Management Center 200 Bradhurst Avenue Hawthorne, NY 10532	41.10700000000	-73.80308333300
Westchester Co. Alternate EOC	Michaelian Office Building 148 Martine Ave. White Plains, NY 10601	41.03091666700	-73.76741666700
Westchester 60 Control	4 Dana Road Valhalla, NY 10595	41.08141666700	-73.81905555600
Rockland Co. EOC	Fire Training Center 35 Fireman's Memorial Drive Pomona, NY 10970	41.17313888900	-74.03666666700
Rockland Co. Warning Point	44 Control Fire Training Center 35 Fireman's Memorial Drive Pomona, NY 10970	41.17313888900	-74.03666666700
Orange Co. EOC	22 Wells Farm Road Goshen, NY 10924	41.40758333300	-74.35550000000
Orange Co. Warning Point	911 Center 22 Wells Farm Road Goshen, NY 10924	41.40758333300	-74.35550000000
Putnam Co. EOC	Putnam County Training & Operations Center 112 Old Route 6 Carmel, NY 10512	41.41027777800	-73.65944444400
Putnam Co. Warning Point	Putnam County Sheriff's Department 3 County Center Carmel, NY 10512	41.42591666700	-73.67597222200

*Latitude/longitude coordinates are referenced to datum GCS WGS 1984.

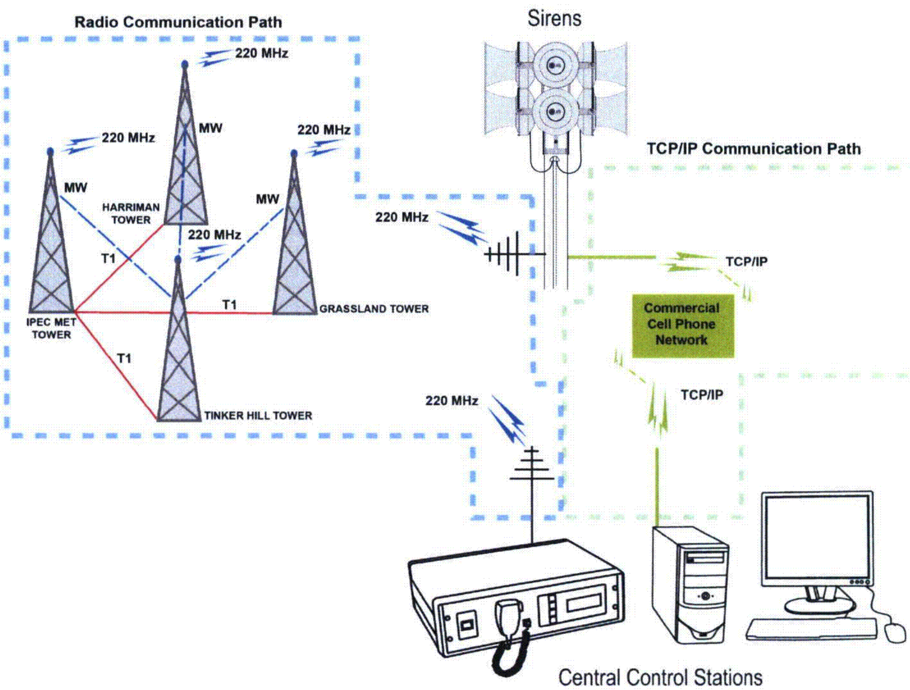
Figure 8-5. Typical Rack Mount Control Station Components



Communication System

There are two separate and distinct communication paths used to convey activation and monitoring messages between the control stations and the remote sirens: dedicated redundant simulcast radio systems and a cellular TCP/IP system. The overall system showing both paths is illustrated in Figure 8-6. The design eliminates single points of siren communication failures since multiple control stations can communicate to every assigned siren by either communication path. To further increase the Radio Frequency (RF) system reliability, all activation transmission messages are sent out multiple times. By sending out multiple redundant activation messages, the probability of all desired sirens activating is increased even in the presence of random radio interference.

Figure 8-6. Typical Communication System



The dedicated simulcast radio system uses redundant transmitters and associated equipment operating in the 220 MHz range to communicate between the control stations, towers and sirens, and it uses either microwave or Telco T1 paths for inter-tower communications. Only one of the redundant simulcast paths is configured to be used at a time to transmit signals. Dual antennas (one for each radio path) are located at each of the four tower sites (IPEC Met Tower, Harriman, Grasslands, and Tinker Hill Towers), and they are used in the communication paths between the control stations, towers, and sirens.

All radio communication equipment used in the microwave communication path (control stations, towers and sirens) has a confirmed battery backup for at least twenty-four (24) hours of operation in case of AC power loss. This same backup is provided for the Telco T1 path with the exception that the commercial carrier has not confirmed a 24-hour backup capability for the Telco T1 lines.

A cellular TCP/IP data network that uses cellular data modems provides redundant communications between all control stations and sirens. Cell modems and antennas are located at all sirens and control stations. Signals are transmitted using commercial carriers, and they seek out appropriate paths between the control stations and sirens. Communications equipment that is physically located at the sirens and control stations use the same backup battery supplies that are used for the radio communications channel. However, the cell modem commercial carrier has not confirmed a 24-hour backup capability on loss of AC power.

By using the simulcast radio system and the cellular modem communications paths concurrently and in a parallel manner for all communications between the control stations and the sirens, a reliable communication system is achieved. Each communication path is designed to achieve reliable delivery of a successful activation message from any control stations.

8.2 Additional Alerting Systems

As an enhancement to the IPEC alert and notification system, Tone Alert Radios (TARs) and NY-ALERT in the future are offered to residents located in the EPZ where acoustic coverage is reduced.

Spatial analysis of the EPZ within 5 miles of IPEC was performed by Visual Risk Technologies to identify locations meeting the following criteria:

- Greater than 2000 people / square mile but do not fall within 70 dBC siren sound coverage and
- Greater than 0 but less than 2000 people / square mile but do not fall within 60 dBC siren sound coverage

The methodology utilized to identify and analyze locations in the 0-5 mile area is contained in Visual Risk Technologies report entitled "Indian Point Energy Center Siren Acoustic Coverage: Areas of Interest" dated July 7, 2008. An additional report to analyze the 5 mile–EPZ area will be issued in the future.

8.2.1 Tone Alert Radios

Description

Tone alert radios are an enhancement to the Indian Point Alert and Notification System. The radios have been distributed to supplement siren alerting for residents in EPZ areas where acoustic coverage is reduced and special facilities in the EPZ.

A commercially available AM/FM radio which activates when EAS messages are broadcast is used in the event of an alerting by the Indian Point EPZ counties. The radios are pre-tuned to a local EAS broadcast station that transmits EAS messages. Upon activation, the EAS station transmits an alerting signal to activate the TARs. The tone alert radios are activated automatically when an Emergency Alert System (EAS) message is broadcast by a commercial radio station in conjunction with siren soundings. The alerting signal is followed by transmission of the pre-recorded EAS message. Activation of all the TARs within the EPZ is essentially instantaneous.

Responsibility for and control of the activation of the system lies with the chief elected officials in the four counties surrounding the Indian Point Site – Westchester, Rockland, Orange and Putnam. Activation of EAS is described in both the Westchester County and Rockland County Radiological Emergency Plans. Both of these documents are referenced in Appendix G. Agreements between the counties acknowledge that Westchester County will be the primary initiator of TARs with Rockland County as the designated backup.

The broadcast station selected for residents is WHUD 100.7 MHz, which has 50,000 watts of power, sufficient to broadcast beyond the 10 mile EPZ assuring communication with each EPZ TAR. Figure 8-7 depicts the WHUD coverage area.

Westchester County performs EAS alerting from its primary EOC and has an auto start diesel/gasoline powered generator backup power supply with greater than 80 hours of operation at full demand. The designated backup facility to Westchester County for EAS alerting is the Rockland County Warning Point and EOC. The WP has a 40 minute battery backup power supply and a diesel driven generator backup power supply. The diesel generator has approximately 7 days of fuel capacity at normal operating load. The EOC has no UPS but after 11 seconds is supplied by backup power from the diesel generator. The radio station uses two specific sites to stay operational (on the air): the studio site and the transmitter site. Each site has a backup power supply to ensure operation for a minimum of 4 days or more in the event of a loss of A/C power. The TARs have a normal A/C supply with battery backup to ensure operability in the event of a local or widespread loss of A/C power. Sufficient battery capacity for 2 days has been demonstrated through testing.

Program Responsibilities

Entergy Nuclear is responsible for the administrative maintenance of the tone alert radio program. These activities typically include:
- Maintaining records of tone alert radios currently distributed by Entergy,
- Providing replacement radios to recipients as requested,
- Ensuring sufficient supplies of replacement radios,
- Identifying facilities that should be offered tone alert radios,
- Surveying tone alert radio holders annually to verify operability of tone alert radios, and to provide instructions on the use of the tone alert radios

IPEC procedure IP-EP-AD12, "Tone Alert Radio Program" provides the details of the tone alert program.

The counties surrounding Indian Point are responsible for:
- Initiating the Alert and Notification System during emergencies,

- Assisting to identify development in the reduced acoustic coverage areas in their jurisdiction that may require tone alert radios, and
- Assisting with obtaining records of special facilities in their jurisdiction that may require tone alert radios.

The ANS is currently activated by the Counties as part of the quarterly Full Volume Alerting Test. The EAS station transmits their alerting signal to activate the Tone Alert Radios consistently with 5 minutes of siren activations. This evolution of TAR activation has also been observed during many FEMA evaluated exercises with successful results.

WHUD Radio Station

The primary station that is used for EAS initial alerting and messages is WHUD Radio in Peekskill, NY. The frequency for this station is 100.7 MHz on the FM commercial broadcast radio band. Residential tone alert radios are tuned to this frequency. WHUD participates in the NYS EAS Plan and the Lower Hudson Valley EAS plan. Both of these documents are referenced in Appendix G. Table 8-3 lists technical information for this radio station.

Figure 8-7. WHUD-FM 100.7 Coverage Map

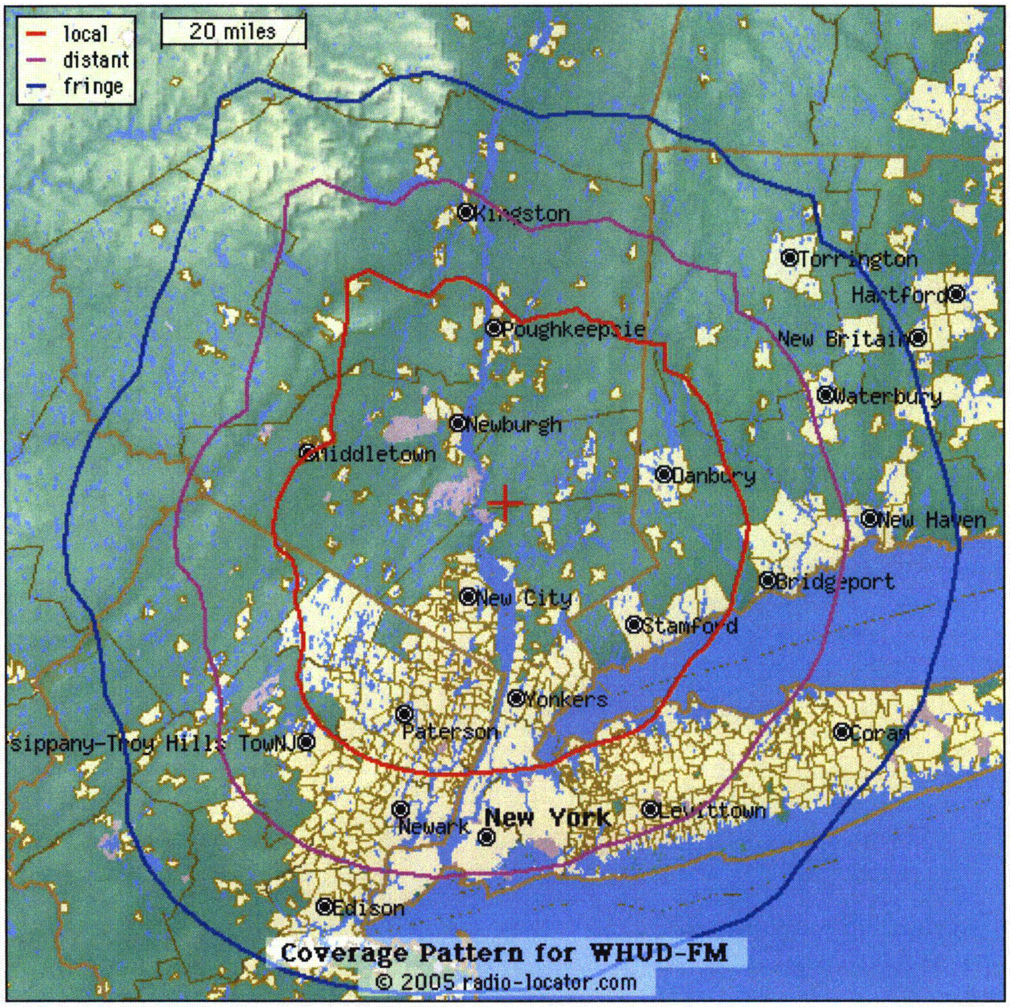


Table 8-3. WHUD-FM 100.7 Technical Info

Station Status	Licensed Class B FM Station
Area of Coverage	See Coverage Map above
Effective Radiated Power	50,000 Watts
Height above Avg. Terrain	152 meters (499 feet)
Height above Ground Level	110 meters (361 feet)
Height above Sea Level	317 meters (1040 feet)
Antenna Pattern	Non-Directional
Transmitter Location	41° 20' 18" N, 73° 53' 41" W

Equipment

The tone alert radios used in this program are the "Emergency Alert Sentinel," manufactured by ASI Industries. Normally, audio output is muted in the energized receiver. When a muted radio receives the broadcast containing the "header code" tones, the radio's audio circuit is turned on. This allows the listener to hear the EAS message.

At the time of shipment or placement, all radios are verified to function properly and written instructions are provided.

The specification sheet for the TAR is included in Appendix F.

Testing of Tone Alert Radios

The opportunity exists to test the operability of ASI tone alert radios on a weekly basis. The insert distributed with the radio provides instructions to monitor the radios for visual indications that the radios have received the FCC-required weekly and monthly EAS tests broadcast by WHUD.

The following is an excerpt from the written operating, testing and maintenance instructions provided with the radios:

OPERATION OF THE EMERGENCY ALERT SENTINEL™

The FCC requires that a weekly test and a monthly test be conducted with the Emergency Alert System (EAS).

- Once a week, at random times and on random days of the week, your local radio station broadcasts an EAS test. The EMERGENCY ALERT SENTINEL™ will respond to this test by solidly lighting the YELLOW weekly test light that will remain on until it is manually reset.

- Once a month, also on a random basis, a special monthly test message will be broadcast. For this monthly test, ***and for any actual alert message***, the EMERGENCY ALERT SENTINEL™ will activate its speaker and the large RED light. At the end of the message, the speaker will turn OFF; leaving the RED light flashing until it is manually reset. This is an indication that your unit has received a monthly test or an actual emergency broadcast.

Placing the switch on the front of the unit in the RESET position and then returning it to the READY position performs a manual reset of the unit.

The RESET position also allows the user to test all lights and the speaker.

The radio insert provides a telephone number to contact Entergy regarding the operation of the radio.

Additionally, a telephone number is provided on each tone alert radio for personnel to call the county emergency management organization.

Providing Households in Affected Areas within the Emergency Planning Zone with Tone Alert Radios

For those areas in which Tone Alert Radios will be utilized, the affected permanent resident households will be contacted to offer one TAR per household at no cost. Recipients of the mailing will be asked to respond by pre-paid return mail. TARs will be provided to those households that respond requesting the device. IPEC will initially and annually provide guidance to each household on the use, maintenance and testing of the TAR. These residents will also be advised of the availability and desirability of registration with the NY-Alert system.

Records will be maintained of the mailings to demonstrate a "best effort" to provide affected households with the tone alert radios.

Entergy maintains an electronic database of all locations where tone alert radios have been placed. Database records are updated as new information becomes available.

Each record includes location and contact information. Records also include annual survey results for each location.

This database is in compliance with requirements of section E.6.2.3 of FEMA-REP-10, *Guide for the Evaluation of Alert and Notification Systems for Nuclear Power Plants.*

Annual Survey

Entergy updates the Tone Alert Radio database by an annual mail survey and reports the results of the survey to the counties. Included with the survey letter are instructions for operating and testing the tone alert radios. These are provided as a reminder for the radio holders.

The survey mailing satisfies the requirements of section E.6.2.3 of FEMA-REP-10, *Guide for the Evaluation of Alert and Notification Systems for Nuclear Power Plants.*

Cost Evaluation: Additional Sirens vs. Tone Alert Radios

An evaluation of costs associated with the use of sirens versus TARs has been performed. The evaluation concludes that in general, TARS are a more cost effective solution in low population areas and where there are few residents requiring coverage. In addition, TARs are an effective alternative in locations where there is opposition to installing sirens. The cost evaluation shows that an area with a population greater than 2250 people is required for a siren to be more cost effective than tone alert radios. The VRT evaluation shows that the most populated area that could be covered by one siren has approximately 250 households, which equates to approximately 750 people.

8.2.2 NY-Alert

In the future, NY-Alert will be used to alert residents located in the EPZ where acoustic coverage is reduced and will replace tone alert radios.

NY-Alert System Description

NY-Alert Phase 1

Phase 1 of the NY-Alert system described below is in place and functional.

NY-Alert is an all hazards alerting and notification system maintained and operated by the New York State Emergency Management Office (NYSEMO). It operates on a continuous basis 24 hours per day every day of the year. It is an internet web-based portal accessible by state and local governments, emergency service agencies, IPEC, and institutions of higher learning for posting alerts and notification information that is then disseminated simultaneously by multiple pathways to defined audiences (local, regional, or state-wide).

NY-Alert utilizes third party infrastructure for message delivery. NY-Alert utilizes the OASIS (Organization for the Advancement of Structured Information Standards) national standard – Common Alert Protocol (CAP) to ensure connectivity with a wide variety of devices. The information transmission protocol is an XML-data based format. The variety of portals and associated infrastructure ensure that all portions of the EPZ are covered by the dissemination methods.

Authorized users including representatives from the counties of Orange, Putnam, Rockland, Westchester, and IPEC are able to create and send messages through an internet portal connection to NY-Alert. Public messages are posted to internet websites (http://www.nyalert.gov) and transmitted to devices such as pagers, land line telephone dialers ("reverse 911"), high speed faxing, SMTP (simple mail transport protocol) e-mail accounts, cell phones via SMS (simple message systems) text messaging, web based RSS (really simple syndication) feeds and are also transmitted to radio and television broadcasters that are part of the voluntary Emergency Alert System (EAS).

The NY-Alert system infrastructure has the capability to store 25 million contacts in its data base. The system is "housed" and activated within two physically separated NYSEMO data centers each of which has 8 hour battery back up power supply and a 7 day fossil fueled electric generator back up power source. The back up power sources activate automatically upon loss of A/C power sources.

NY-Alert has over 5000 telephone dialing lines available; can provide over 50 SMS messages per second, and can support up to 14,000 users concurrently.

NY-Alert Phase 2

Additional alert/notification features will be provided in NY-Alert Phase 2. These features include the following:

- Notification using instant messenger technology
- Cell phone casting in which cell phones within the vicinity of GIS coded cell phone towers is contacted automatically. This does not require registration on the part of the recipient
- Notification using selected satellite radio and navigation systems
- Transmission of EAS via Satellite

Registrants to NY-Alert in phase 2 will be able to use multiple mapping services to geographically code their locations for alerting based on emergency situation locations.

NY-Alert Offering Method

NY-Alert phase 1 is accessible to the members of the public by voluntary registration through the internet at http://www.nyalert.gov. The Indian Point EPZ population will be advised of the availability and desirability of registration with NY-Alert through the following means:

- The periodic emergency information and educational outreach publications prepared and disseminated pursuant to 10 CFR 50.47 (b) (7) will carry a distinct description of NY-Alert and the methods by which individuals can register.
- Periodic print media advertising associated with the mailing of emergency information and educational outreach publications will describe NY-Alert functionality and encourage persons living within the Indian Point EPZ to register.

NY-Alert Maintenance Program

NY-Alert is maintained and operated by the New York State Emergency Management Office (NYSEMO). It is used routinely by its nature to transmit information on low level events such as traffic accidents, road closures, and severe weather. In those ways its functionality is routinely demonstrated so as to meet the requirements described in FEMA REP-10 Section E.6.2.3.

NY-Alert System Details

Details of the NY-Alert system are available from the New York State Emergency Management Office.

11 ACOUSTIC CRITERIA OF SIREN SYSTEM

NUREG-0654 and FEMA-REP-10 indicate that adequate siren sound levels are as follows:

- The expected siren sound pressure level generally exceeds 70 dBC where the population exceeds 2,000 persons per square mile and 60 dBC in other inhabited areas; or
- The expected siren sound pressure level generally exceeds the average measured summer daytime ambient sound pressure levels by 10 dBC (geographical areas with less than 2,000 persons per square mile).

Additionally, Appendix 3 of NUREG 0654 provides the guidance that the notification system will "assure direct coverage of essentially 100% of the population within 5 miles of the site". Following alerting by the siren component of the Alert and Notification System (ANS), the notifications are accomplished by means of the Emergency Alert System (EAS) broadcasts over commercial radio transmissions. The EAS radio broadcast station utilized as part of this system has been selected to ensure that there is essentially 100% direct coverage of the population within the emergency planning zone of the Indian Point Energy Center.

In areas of reduced acoustic coverage within the 10 mile EPZ, essentially 100% alert and notification will be achieved through the use of TARs. TARs are an interim measure until Phase 2 of the NY-Alert system becomes fully functional. Full functionality of the NY-Alert system is targeted for the end of the first quarter of 2009. NY-Alert will enhance population coverage and then become the method of alert and notification for those residents in reduced acoustic coverage areas.

Within the 10 mile EPZ high speed telephone notification is also available for alerting and may be activated by each county located in the EPZ.

Additionally, there is evidence that informal alerting occurs throughout the EPZ in various media forms during an actual event. Ambient sound levels measured in August 2007 indicate that greater than 10 dBC above background is achieved in many areas in the EPZ that contributes to informal alerting.

Inhabited areas are depicted on Map 2 (Appendix K).

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.

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.

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 through 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 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 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.

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 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.

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.

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 ± 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. 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 ± 2.0 dBC band. Anechoic chamber test results for siren 213 projected to 100 feet are well within the ± 2.0 dBC range. Additionally, outdoor tests results obtained from siren 213 at GTRI were also within the ± 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 ± 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.

Figure 14-1. Microphone Array in Anechoic Chamber

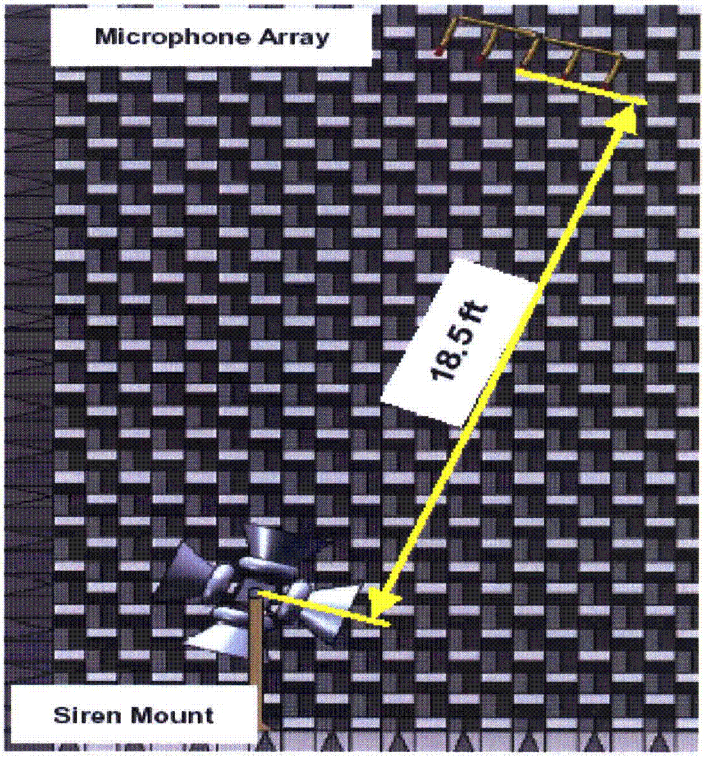


Figure 14-2. Time History of Each SPL for Each Microphone in the Array during the Sounding of Siren 331 f = 576 Hz (Source: GTRI Report D5600 – Vol. 1 Dated 3/08)

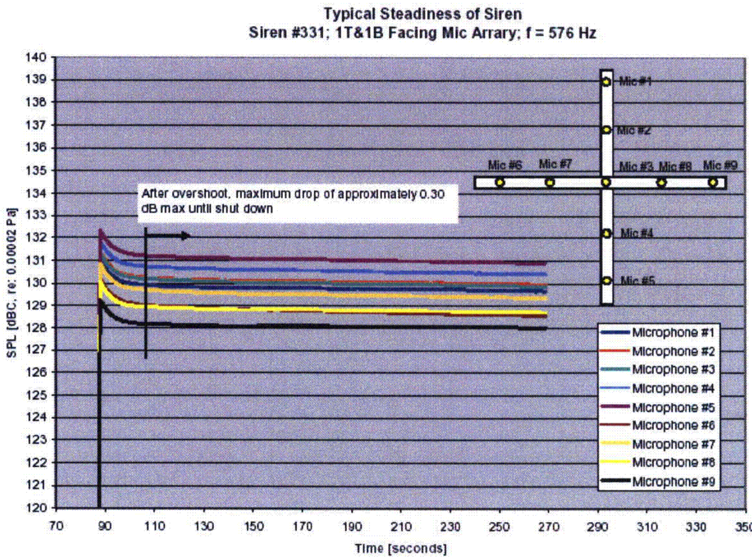


Figure 14-3. Time History of Each SPL for Each Microphone in the Array during the Sounding of Siren 315 f = 576 Hz (Source: GTRI Report D5600 – Vol. 1 Dated 3/08)

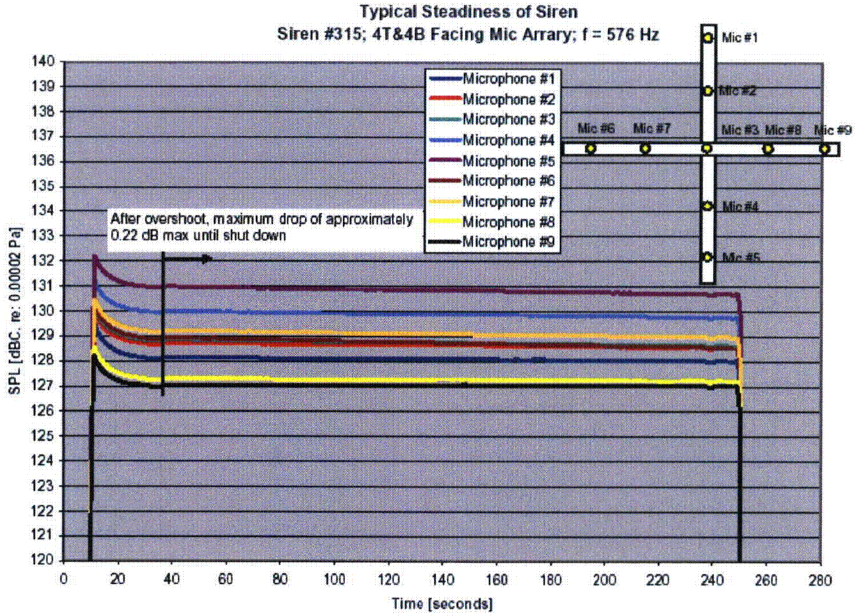


Figure 14-4. Time History of Each SPL for Each Microphone in the Array during the Sounding of Siren 213 f = 576 Hz (Source: GTRI Report D5600 – Vol. 1 Dated 3/08)

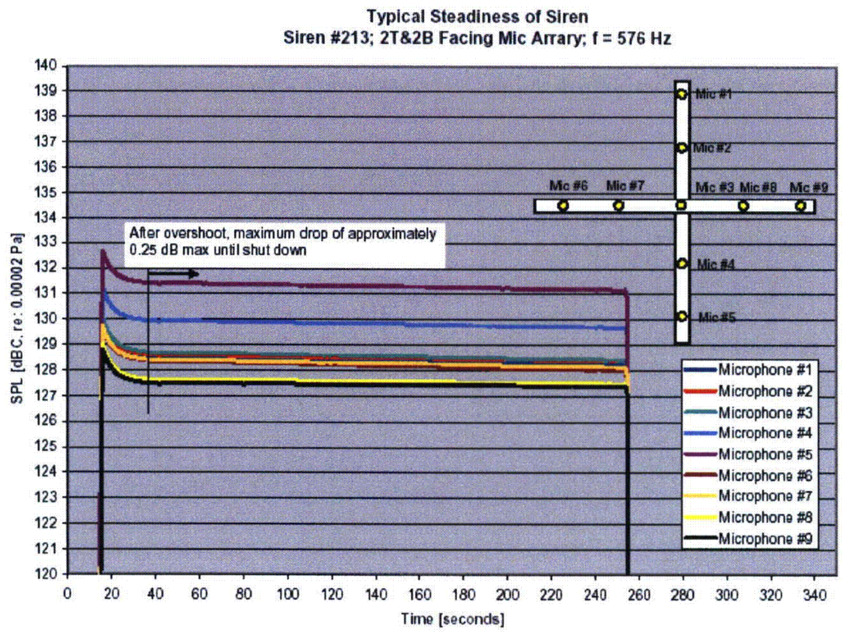


Figure 14-5. Time History of Each SPL for Each Microphone in the Array during the Sounding of Siren 113 f = 576 Hz (Source: GTRI Report D5600 – Vol. 1 Dated 3/08)

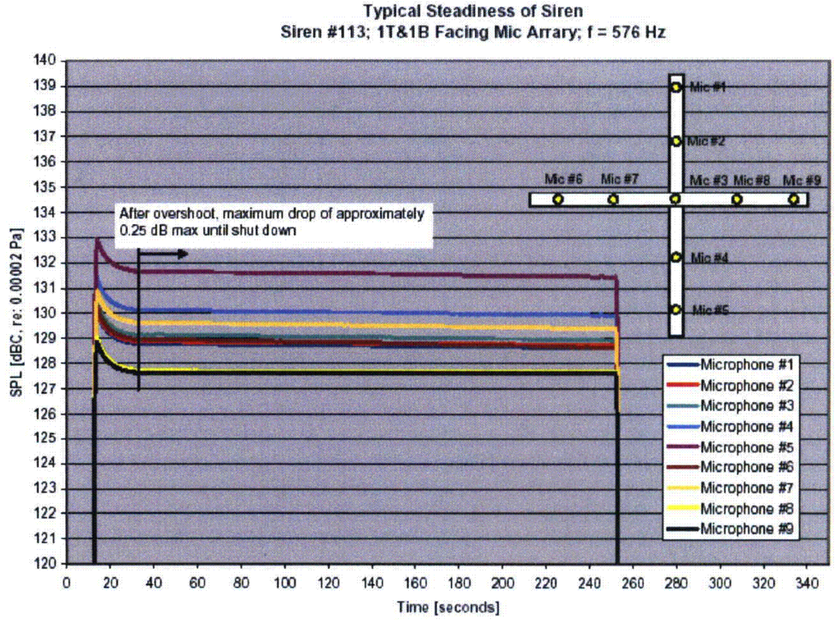


Figure 14-6. Steady, Repeatable, and Reproducible Results from Bi-Directional Sirens (Source: GTRI Report D5600 – Vol. 1 Dated 3/08)

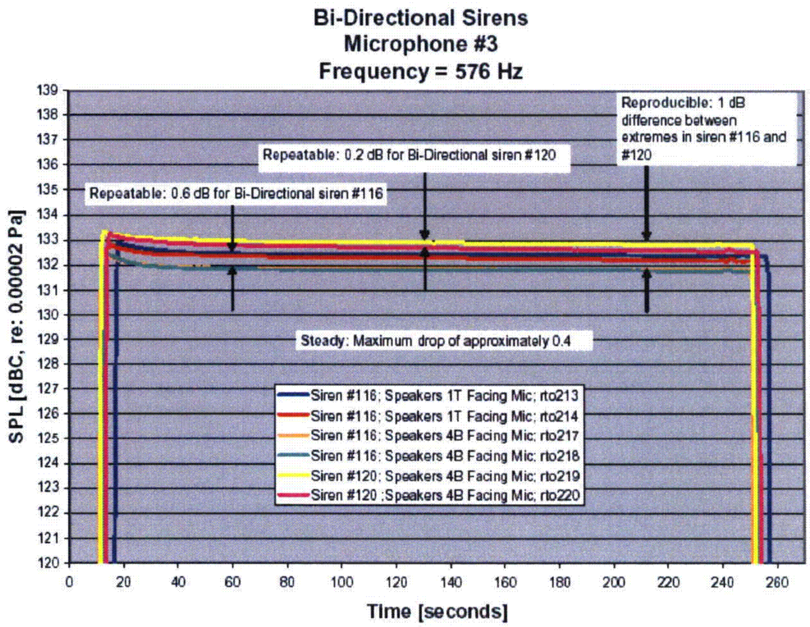


Table 14-1. Steadiness of Omni-Directional Siren System Measured at the Center Microphone Location (#3) (Source: GTRI Report D5600 – Vol. 1 Dated 3/08)

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**

Figure 14-7. Contour Map of Frequency and Time Domain of a Typical Siren Sounding (Source: GTRI Report D5600 – Vol. 1 Dated 3/08)

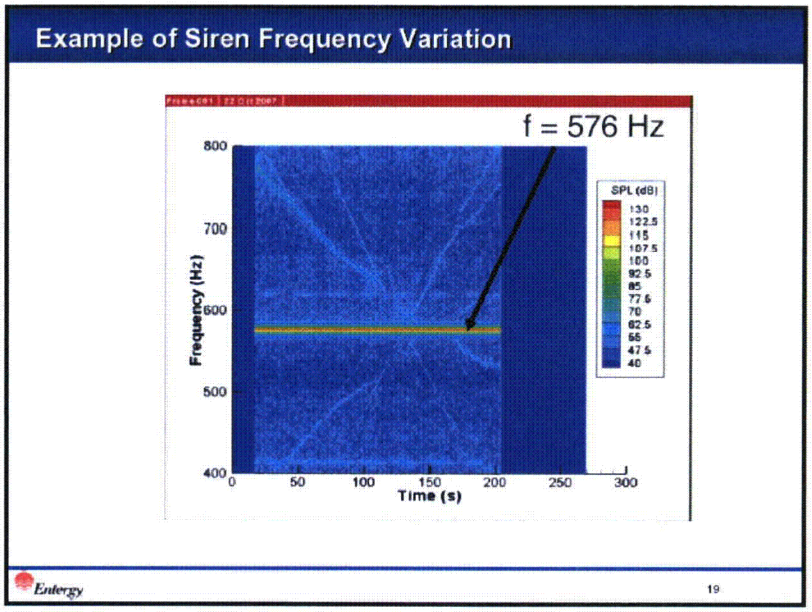


Figure 14-8. Repeatability of Acoustic Measurements on Siren #331; Microphone #3 Data (Run 46 Sounding Started After Start of Data Collection) (Source: GTRI Report D5600 – Vol. 1 Dated 3/08)

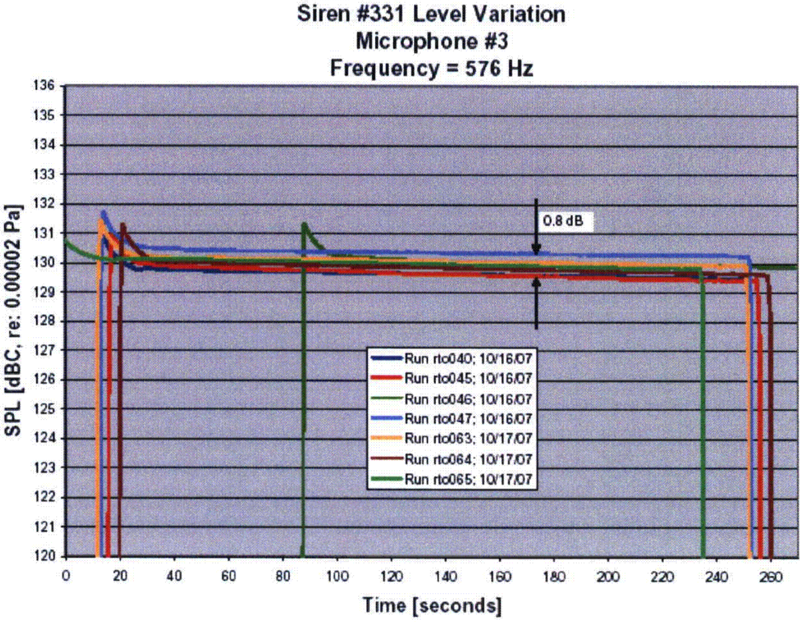


Figure 14-9. Repeatability of Acoustic Measurements on Siren #113; Microphone #3 Data (Source: GTRI Report D5600 – Vol. 1 Dated 3/08)

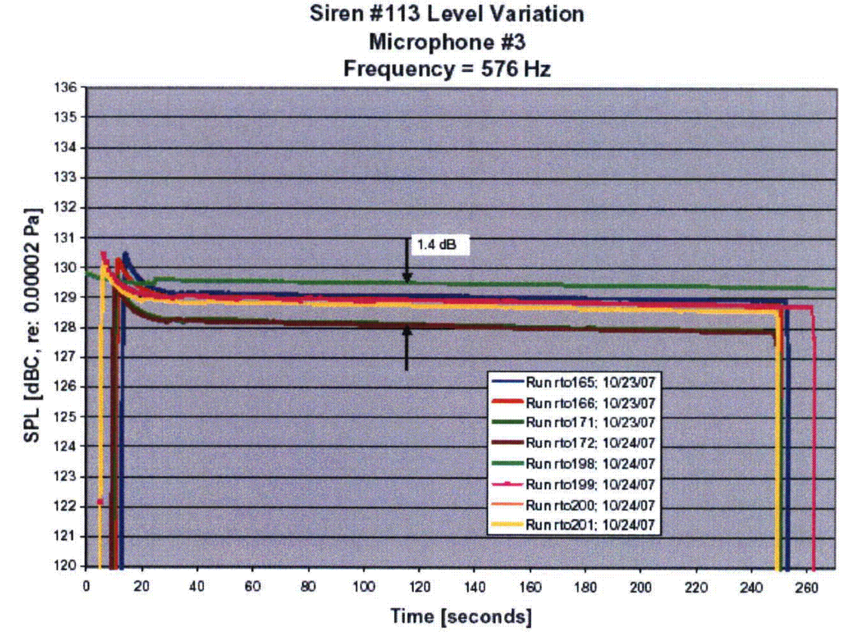


Figure 14-10. Repeatability of Acoustic Measurements on Siren #315; Microphone #3 Data (Source: GTRI Report D5600 – Vol. 1 Dated 3/08)

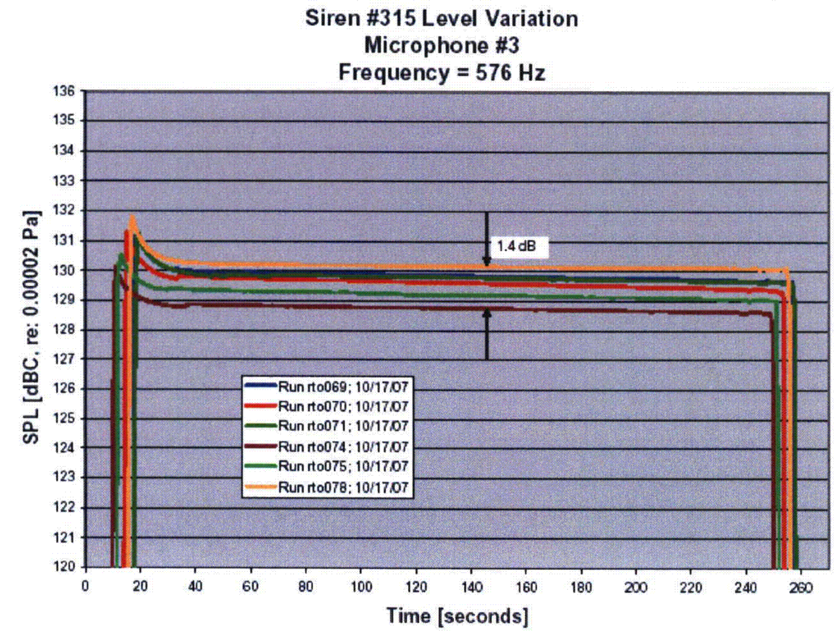


Figure 14-11. Repeatability of Acoustic Measurements on Siren #213; Microphone #3 Data (Source: GTRI Report D5600 – Vol. 1 Dated 3/08)

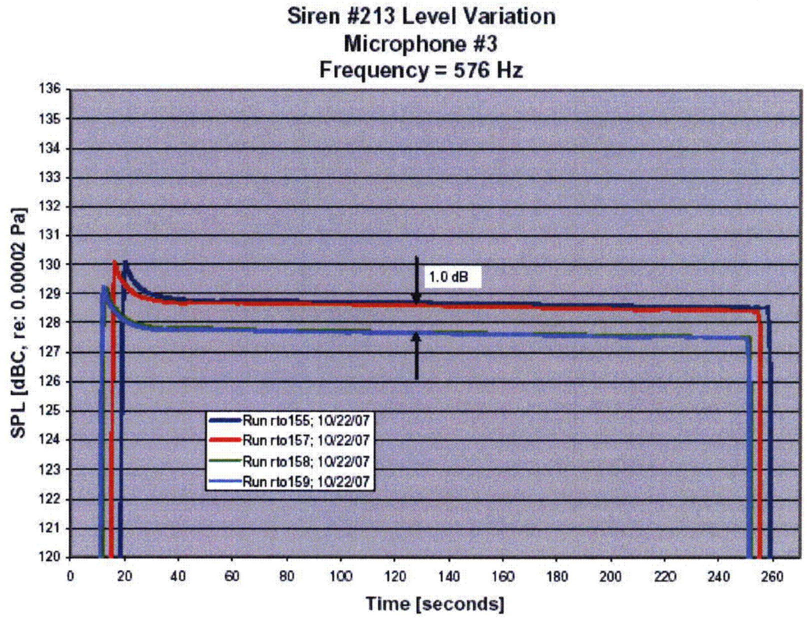


Figure 14-12. Outdoor Siren Repeatability Test Results from 2007 (Source: BRRC Final Report Dated 8/07)

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

Entergy

Figure 14-13. Reproducibility of Omni-Directional Sirens Tested in Anechoic Chamber in 2007 (Source: GTRI Report D5600 – Vol. 1 Dated 3/08)

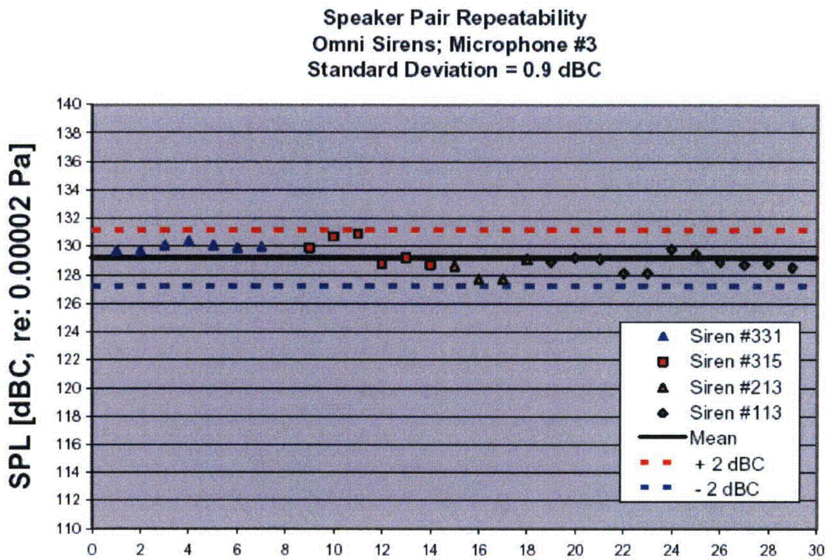
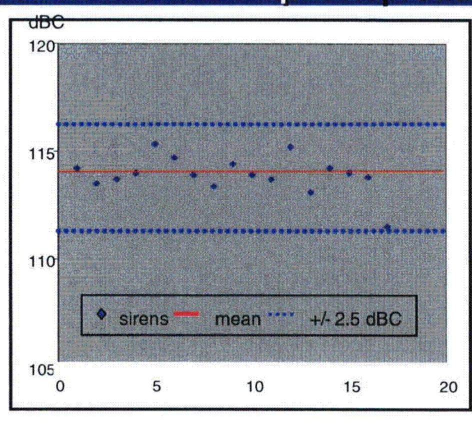


Figure 14-14. Outdoor Siren Reproducibility Test Results from 2007 (Source: BRRC Final Report Dated 8/07)

Siren to Siren Output Reproducibility



Omni Siren #	dBC
215	114.2
220	113.5
241	113.7
102	114.0
113 (Omni 2)	115.3
103	114.7
226	113.9
403	113.4
413	114.4
312	113.9
369	113.7
339	115.2
329	113.1
347	114.2
331 (Omni 1)	114.0
336	113.8
213 (Omni 3)	111.4

When measured at elevated height on axis at 100 feet outdoors

Entergy

14.2 Siren Performance Testing

This section of the design report describes the extensive testing of sirens conducted at the Georgia Tech Research Institute (GTRI) in Smyrna, Georgia. Testing was conducted both within the GTRI anechoic chamber and outside in an open field. The results presented here are provided in more detail in two reports from GTRI.

A total of sixteen (16) Acoustic Technologies, Inc. (ATI) sirens were tested including fourteen omni-directional sirens and two bi-directional sirens. Of these, four of the omni-directional sirens and both of the bi-directional siren speakers and amplifier boards had been installed within the IPEC EPZ and were removed and shipped to GTRI for these tests. The remaining ten omni-directional siren components were acquired new from ATI for these tests.

The ten new sirens were all tested first in the anechoic chamber at GTRI. Then three of these new sirens were selected to be tested outside along with six sirens that had been installed in the EPZ.

Anechoic Chamber Testing

The testing protocol for the anechoic chamber tests followed the same procedure as described in section 14.1. The same cruciform microphone array as shown in Figure 14-1 was used for the measurements. The test plan called for sounding each omni-directional siren with each set of horns facing the microphone array in turn.

The results from these tests show that the new sirens behave similarly to the sirens that were removed from poles and tested in the anechoic chamber (section 14.1). Typical results for these tests are shown in Figure 14-15 which shows selected time histories of soundings for all ten new sirens. Table 14-2 shows the sound pressure level results for the ten new sirens in the chamber.

The sirens were steady, and the results were repeatable from test to test. In addition, the sound pressure level results from the new omni-directional sirens were in close agreement with the results from the previous testing of existing sirens (see Section 14.1).

Table 14-2. Summary of Test Results from Anechoic Chamber Tests of the New Omni-Directional Sirens (Source: GTRI Report D5600 – Vol. 3 Dated 3/08)

Siren #	Orientation	Test #	Mic #3 Leq
N-1	1 up	rbo289	130.0
N-1	1 up	rbo290	129.9
N-1	2 up	rbo291	129.7
N-1	2 up	rbo292	129.7
N-1	3 up	rbo293	129.3
N-1	3 up	rbo294	129.3
N-1	3 up	rbo295	129.6
N-1	4 up	rbo296	129.6
N-2	1 up	rbo254	129.7
N-2	1 up	rbo255	129.5
N-2	2 up	rbo256	128.8
N-2	2 up	rbo257	128.7
N-2	3 up	rbo260	129.4
N-2	3 up	rbo262	128.5
N-2	4 up	rbo263	130.0
N-2	4 up	rbo264	129.9
N-3	1 up	rbo268	129.6
N-3	1 up	rbo269	129.6
N-3	2 up	rbo270	128.9
N-3	2 up	rbo271	128.8
N-3	3 up	rbo272	129.2
N-3	3 up	rbo273	129.2
N-3	4 up	rbo274	129.3
N-3	4 up	rbo275	129.3
N-4	1 up	rbo277	129.2
N-4	1 up	rbo278	129.1
N-4	2 up	rbo279	128.9
N-4	2 up	rbo280	128.8
N-4	3 up	rbo281	129.2
N-4	3 up	rbo282	129.2
N-4	4 up	rbo283	128.7
N-4	4 up	rbo284	128.6
N-4	4 up	rbo288	130.0

Siren #	Orientation	Test #	Mic #3 Leq
N-5	I up	rbo298	129.7
N-5	2 up	rbo299	129.8
N-5	3 up	rbo300	129.6
N-5	4 up	rbo301	129.6
N-6	I up	rbo303	130.5
N-6	2 up	rbo307	129.8
N-6	3 up	rbo309	129.6
N-6	4 up	rbo310	129.4
N-7	I up	rbo312	127.8
N-7	2 up	rbo313	129.8
N-7	3 up	rbo314	129.6
N-7	4 up	rbo315	130.0
N-8	I up	rbo319	129.4
N-8	2 up	rbo320	129.7
N-8	3 up	rbo323	129.9
N-8	4 up	rbo325	129.5
N-9	I up	rbo329	130.0
N-9	2 up	rbo331	130.0
N-9	3 up	rbo332	129.7
N-9	4 up	rbo338	130.2
N-10	1 up	rbo343	130.2
N-10	2 up	rbo344	130.1
N-10	3 up	rbo345	130.2
N-10	4 up	rbo346	129.9
N-10	1 up	rbo348	130.4
N-10	1 up	rbo349	130.3
N-10	1 up	rbo350	130.2

Outdoor Testing

The outdoor tests at GTRI's outdoor testing facility were performed to corroborate the predicted sound pressure level at 100 feet from the anechoic chamber using a steady microphone as well as a moving microphone which followed the ANSI standard S12.14-1992 for the purpose of comparing both values. This testing was augmented with the use of additional microphones at various heights and distances.

The test site was located on the premises of GTRI in Smyrna, Georgia. It is an elongated field (approximately 200 ft by 600 ft in extent) used for radar range testing. Figures 14-16a and 14-

16b show this field from an aerial vantage point and show its location relative to Dobbins AFB and surrounding commercial real estate. The western end of the field was surrounded by trees (mostly pine) at a height of approximately 75 ft or higher. A pole was installed and the sirens were mounted at this end of the field. The opposite end of the field opened up over generally flat terrain. A radar tower stood in this end of the field. The radar tower was approximately 500 feet from the pole, and the field was covered with grass.

Each siren was mounted on top of the 50 foot pole using the same brace that was used in the anechoic chamber tests. The brace was designed so that the entire siren assembly could be rotated on top of the pole to allow testing in all speaker orientations. For the six EPZ sirens, a similar cruciform microphone rig using five microphones, instead of the nine used in the chamber, was used in the field and was mounted 18.5 feet from the sirens. There were two microphones placed at 100 feet from the siren at 50 feet above the ground. One microphone was held steady on the siren axis. The second microphone was scanned in accordance with the methodology recommended in ANSI S12.14-1992. The scanning motion was performed either manually or by using a mechanical rig. For some of these tests there was also a microphone at 200 feet (50 feet off of the ground) and for some of the tests a microphone was placed at 400 feet (50 feet off of the ground). In addition, there were also two microphones placed 5 feet off of the ground at 100 feet, and for some tests, at 200 feet from the siren. Figure 14-17 shows the arrangement of the microphones.

The results from these field tests corroborate the results from the previous anechoic chamber. However, the average of the results from the field test suggests that the sound pressure level of the sirens at 100 feet is closer to 115 to 117 dBC (based on the stationary and moving microphone method outlined in ANSI S12.14-1992). This difference is likely caused by the addition of sound gained from the combination of the direct sound from the siren and the ground reflection. Table 14-3 lists the sound level results from all of the omni-directional siren tests. It should be noted that favorable propagation conditions on the last two days of testing appear to have increased the measured sound on those days.

Table 14-3. Bulk Results from the Testing of the Omni-Directional Sirens (Source: GTRI Report D5600 – Vols. 2 and 3 Dated 3/08)

Date	Siren #	Ambient Temp (F)	Humidity (%)	Stationary Mic Leq @100' (dBC)	Moving Mic Leq @ 100' (dBC)	Moving Mic Max Leq @ 100' (dBC)	Test Condition/ Configuration
11/8/2007	331	61.5	48	114.7	117.9	120.6	1T;1B
"	331	62.6	48	116.3	115.9	119.1	1T;1B
"	331	67.9	48	116.3	115.3	119.1	2T;2B
"	331	59.6	48	116.0	115.4	119.4	3T;3B
"	331	56.3	50	117.3	112.5	118.1	4T;4B
11/9/2007	213	65.2	50	116.5	115.9	116.4	1T;1B
"	213	65.2	50	117.2	115.2	119.0	1T;1B
"	213	62.3	50	118.1	116.5	119.9	2T;2B
"	213	60.7	50	118.3	115.9	120.6	3T;3B
"	213	59.2	50	116.9	116.1	119.0	4T;4B
11/27/2007	315	61.4	45	117.2	116.5	120.0	1T;1B
"	315	57.6	45	115.4	117.7	119.9	2T;2B
"	315	51.5	45	114.8	117.0	119.9	3T;3B
"	315	49.2	45	112.9	116.2	119.5	4T;4B
"	315	55.1	45	114.2	117.3	120.0	1T;1B
"	315	55.2	45	113.6	117.4	120.6	1T;1B
"	113	63.4	50	114.8	115.3	119.5	1T;1B
"	113	63.5	50	114.5	115.5	119.0	2T;2B
"	113	59.2	50	115.4	115.7	118.3	3T;3B
"	113	57.7	50	114.5	115.3	119.7	4T;4B
12/19/2007	N2	49.0	65	114.4	118.7	121.2	1T;1B
"	N2	49.0	65	115.3	118.3	121.2	2T;2B
"	N2	49.0	67	114.3	118.4	121.2	3T;3B
"	N2	49.0	74	113.9	118.1	120.9	4T;4B
"	N3	49.0	75	114.3	117.8	120.1	1T;1B
"	N3	49.0	76	114.7	118.0	121.0	2T;2B
"	N3	48.0	76	114.7	118.1	120.8	3T;3B
"	N3	48.0	76	114.3	118.0	120.7	4T;4B
12/20/2007	N4	48.0	92	115.4	117.1	120.3	4T;4B
"	N4	49.0	90	115.4	117.3	119.9	1T;1B
"	N4	50.0	89	114.8	117.4	120.6	2T;2B
"	N4	50.0	87	113.2	117.4	120.4	3T;3B

As the distance between the microphone and siren increased, the sound became more variable over time. Figure 14-18 shows the results of the testing of siren 331. In this plot, all of the microphones are kept steady, but as the distance between the microphones (receptor) and the siren increases, the variation in recorded sound level also increases. This increase in variation is due to unmeasured changes in the micro-meteorological conditions and is an expected result of outdoor testing.

In addition to the testing of the omni-directional sirens, two bi-directional sirens were tested. The anechoic chamber data agrees well (within 2 dB) with the outdoor data at 18.5 ft and the prediction at 100 feet using a steady microphone. The measurement shows that on average, the bi-directional sirens measured approximately 118 dBC at 100 ft.

Figure 14-15. Representative Time Histories of Anechoic Chamber Data Showing Steadiness of All Ten New Omni-Directional Sirens (Source: GTRI Report D5600 – Vol. 3 Dated 3/08)

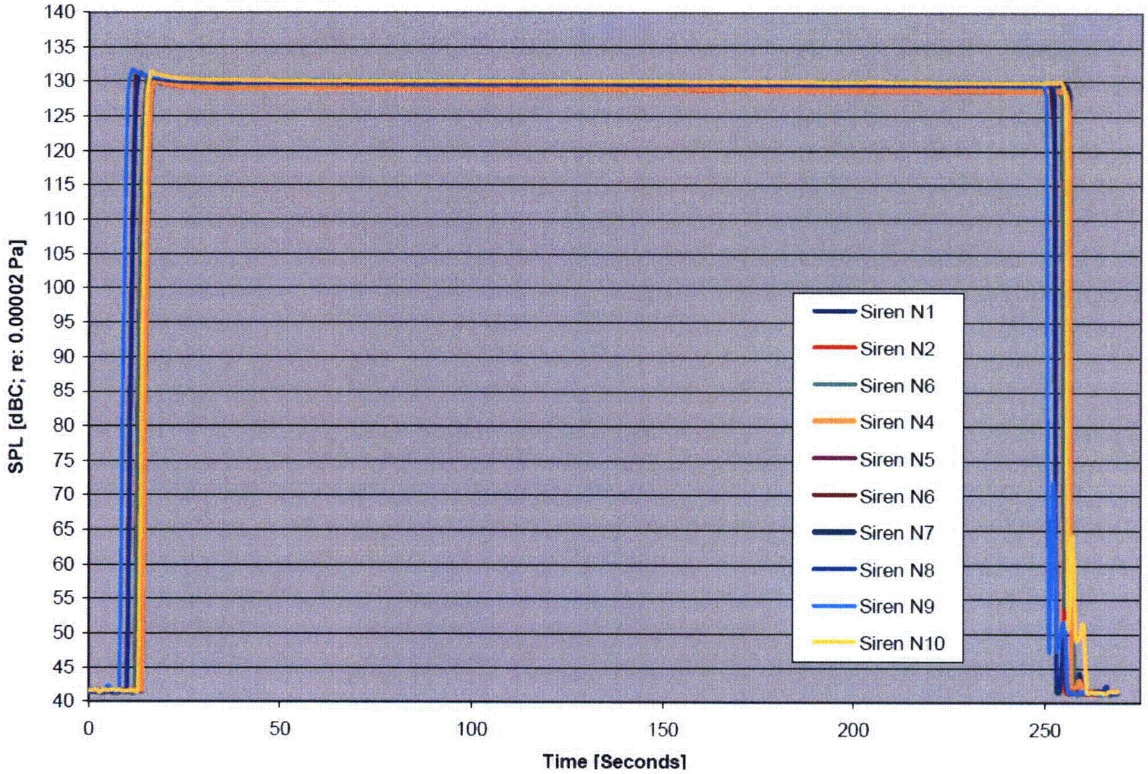


Figure 14-16a. Aerial View of Outdoor GTRI Test Site

Figure 14-16b. Closer Aerial View of Outdoor GTRI Test Site

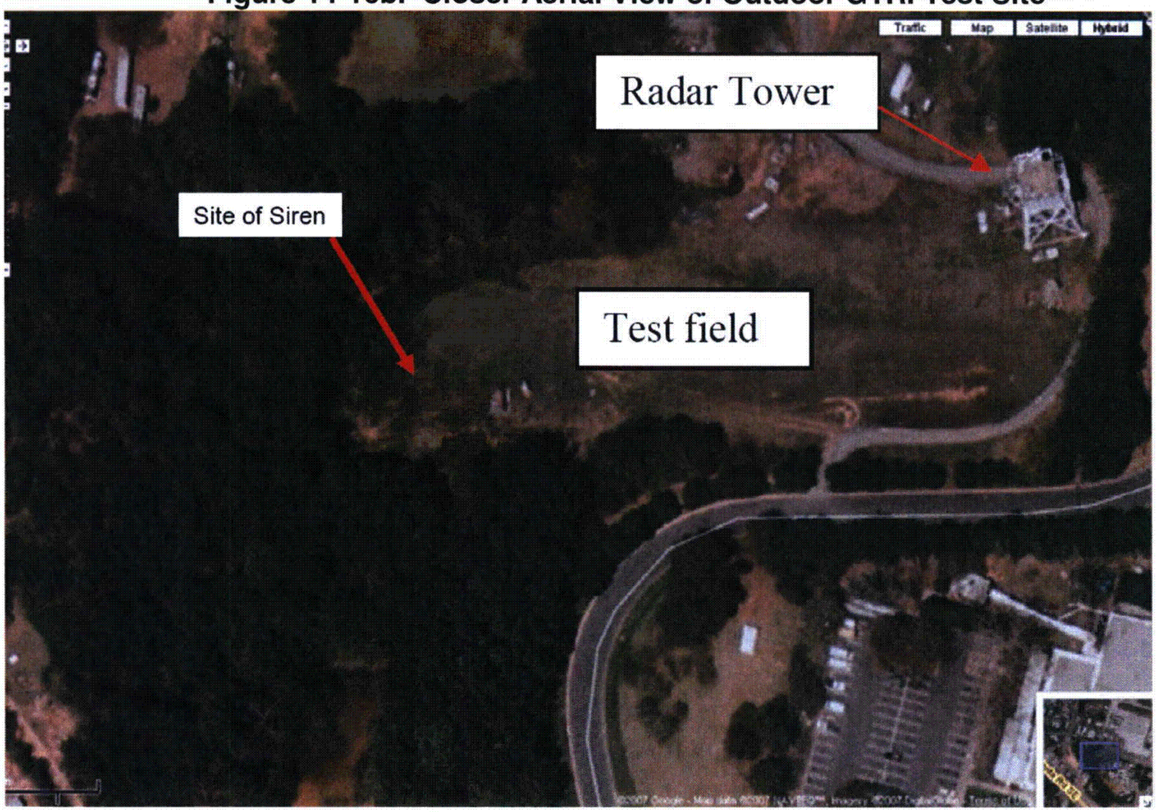


Figure 14-17. Schematic Showing Relative Measurement Locations at the GTRI Outdoor Test Site (Source: GTRI Report D5600 – Vol. 2 Dated 3/08)

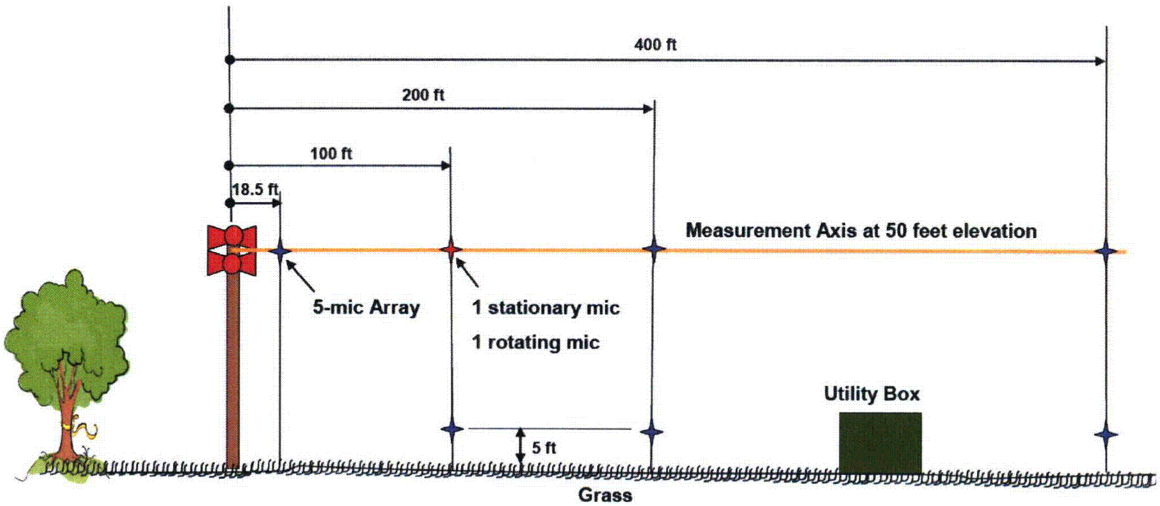
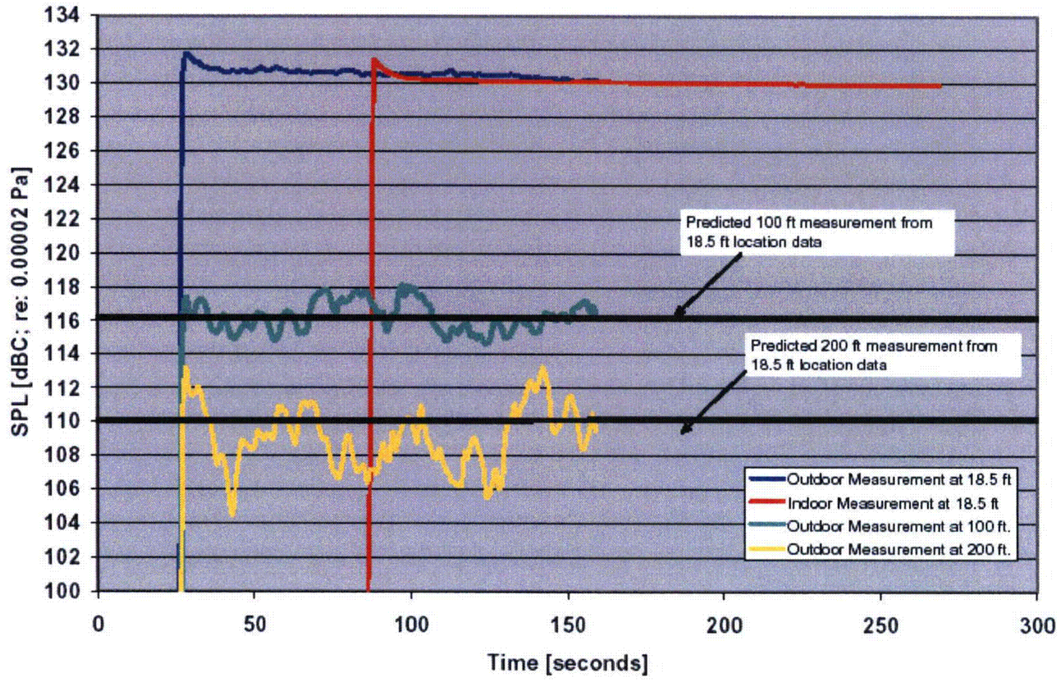


Figure 14-18. Variability in Measured Sound Level with Increases in Measurement Distance (Source: GTRI Report D5600 – Vol. 2 Dated 3/08)



14.3 Acoustic Coverage in the EPZ

The design objective of the installed siren system is to provide full acoustic coverage for the populated sections of the IPEC EPZ in compliance with FEMA guidelines. A siren output of 114 dBC Leq (omni-directional) and 116 dBC Leq (bi-directional) both at 100 ft. on axis at siren elevation was utilized in the sound propagation model, although as explained below this is a conservative approach based on actual measured sound output.

GTRI conducted independent acoustic testing of the IPEC ANS sirens. Six sirens installed in the new system within the IPEC EPZ were removed from their respective poles and delivered to GTRI in addition to ten new sirens. The siren acoustic testing at the GTRI facilities included two separate programs: anechoic chamber testing and open field testing.

Testing of 14 omni-directional and 2 bi-directional sirens in the anechoic chamber resulted in an average of 115 dBC Leq for the omni-directional sirens and an average of 117.3 dBC Leq for the bi-directional sirens both projected at 100 feet. In the field testing at GTRI, results showed up to 2 dBC higher measurements than predicted in the anechoic chamber, with the actual sound pressure levels of 115.2 to 117.4 dBC Leq for the omni-directional and 116.7 to 118.7 dBC Leq for the bi-directional sirens. Furthermore, the Lmax readings in the field, determined after the initial transient response from the sirens, were at least an additional 2 to 3 dBC higher sound pressure level, ranging from 119 to 121 dBC Lmax.

A statistical analysis was performed utilizing 52 independent speaker pair measurements that were taken in the GTRI anechoic chamber. The mean sound pressure level of the sample population was 115 dBC Leq with a standard deviation of 0.5 dBC. Using both a Chi-Squared and a Student T analysis, the minimum siren level output, at the 95% confidence level, for any siren in the total population is 114 dBC Leq for omni-directional sirens. Therefore, to provide sound coverage margin, a conservative siren output level of 114 dBC Leq (omni-directional and 116 dBC Leq (bi-directional) was used in the sound propagation model, notwithstanding the fact that the actual output was measured at higher values.

FEMA-REP-10 specifies that the siren sound pressure level should generally exceed 70 dBC where the population density exceeds 2000 people per square mile in the EPZ. In areas with a population density below 2000 people per square mile the siren sound pressure level should generally exceed 60 dBC.

Population Covered GIS Analysis Methodology (Acoustic Technology, Inc.)

EPZ and 5 Mile Radius

Census 2000 GIS data was acquired at census block level (smallest available).

The GIS layer was classified into three groups: 0 population, population/area values of greater than 0 up to 2000 people per square mile, and population/area values greater than 2000 people per square mile.

This classified census block layer was clipped to the EPZ boundary.
The population in the clipped census block layer was recalculated by calculating the new area for the blocks, dividing the new area by the old area, then using this ratio and multiplying it by

the population value to get the corrected population value for the clipped blocks (caveat: population is assumed to be evenly distributed).

The 70 dBC and 60 dBC siren contours are imported into the GIS and overlaid over the classified clipped census block layer.

The census block layer is then clipped by the 70 dBC contour to create a new layer that contains the areas of the census blocks covered by 70 dBC.

The population in the new layer was recalculated by calculating the new area for the blocks, dividing the new area by the original census block areas, then using this ratio and multiplying it by the original census block population values to get the corrected population value for the new layer.

The total population of the blocks in this layer with population density greater than 2000 people per square mile was calculated. The total population of the blocks in the EPZ and separately for the 5-Mile Radius, with population density greater than 2000 people per square mile was calculated.

The total population of the blocks with population density greater than 2000 people per square mile covered by 70 dBC was divided by the total population of the blocks in the EPZ and separately for the 5-Mile Radius, with population density greater than 2000 people per square mile.

This ratio was used to calculate the percentage of population covered by 70 dBC in areas with population density greater than 2000 people per square mile for both the EPZ and the 5-Mile Radius.

The original census block layer clipped by the EPZ is then clipped by the 60 dBC contour to create a new layer that contains the areas of the census blocks covered by 60 dBC.

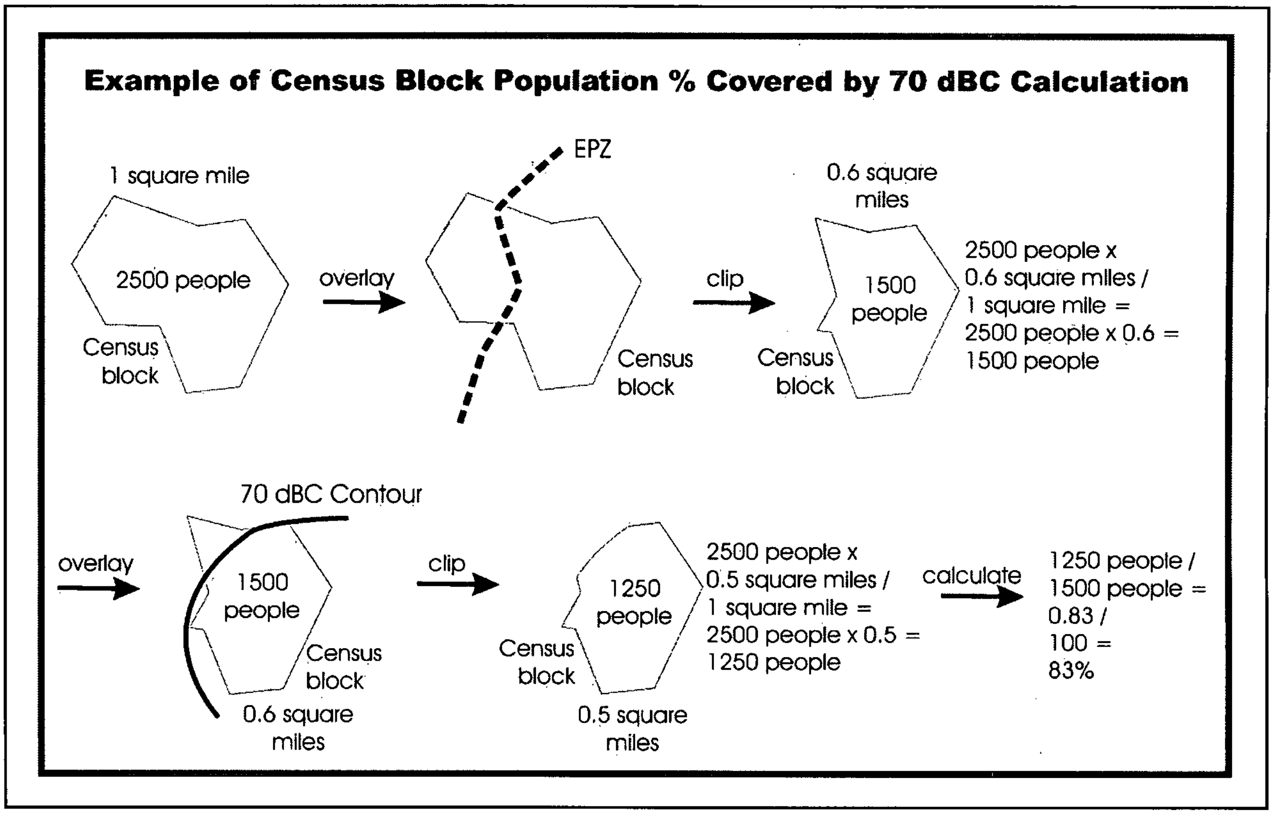
The population in the new layer was recalculated by calculating the new area for the blocks, dividing the new area by the original census block areas, then using this ratio and multiplying it by the original census block population values to get the corrected population value for the new layer.

The total population of the blocks in this layer with population density greater than 0 up to 2000 people per square mile was calculated. The total population of the blocks in the EPZ and separately for the 5-Mile Radius, with population density greater than 0 up to 2000 people per square mile was calculated.

The total population of the blocks with population density greater than 0 up 2000 people per square mile covered by 60 dBC was divided by the total population of the blocks in the EPZ and separately for the 5-Mile Radius, with population density greater than 0 up to 2000 people per square mile.

This ratio was used to calculate the percentage of population covered by 60 dBC in areas with population density greater than 0 up to 2000 people per square mile for both the EPZ and the 5-Mile Radius

Figure 14-19.



5 – EPZ Boundary

The population totals for the 5-mile radius were then subtracted from the population totals for the entire EPZ to calculate population totals and coverage percentages for the 5 – EPZ boundary.

The results are presented in the following table:

Table 14-4. ATI Model Population Coverage

Population of Interest	Boundary	Population	Ratio Covered (%)
All Population	**EPZ**	295,596	**94.8%**
Population in areas >= 2000 people per sq mile	EPZ	201,504	N/A
Population in areas >= 2000 people per sq mile Covered by 70 dBC	EPZ	189,710	94.2%
Population in areas < 2000 people per sq mile	EPZ	94,092	N/A
Population in areas < 2000 people per sq mile Covered by 60 dBC	EPZ	90,549	96.2%
All Population	**5 mile radius**	76,260	**99.2%**
Population in areas >= 2000 people per sq mile	5 mile radius	57,207	N/A
Population in areas >= 2000 people per sq mile Covered by 70 dBC	5 mile radius	56,587	98.9%
Population in areas < 2000 people per sq mile	5 mile radius	19,053	N/A
Population in areas < 2000 people per sq mile Covered by 60 dBC	5 mile radius	19,026	99.9%
All Population	**5 – EPZ boundary**	219,336	**93.3%**
Population in areas >= 2000 people per sq mile	5 – EPZ boundary	144,297	N/A
Population in areas >= 2000 people per sq mile Covered by 70 dBC	5 – EPZ boundary	133,123	92.3%
Population in areas < 2000 people per sq mile	5 – EPZ boundary	75,039	N/A
Population in areas < 2000 people per sq mile Covered by 60 dBC	5 – EPZ boundary	71,523	95.3%

The ATI model demonstrates that the 70 dBC sound output criterion is met in most high population areas requiring 70 dBC coverage. To achieve enhanced alert and notification area coverage, TARs will be offered to residents outside the 70dBC (high population) and 60 dBC (low population) sound coverage areas. Initially residents were selected based on analysis using 2000 US census block data. Further analysis, as described below, showed that some of these high population areas were in fact low population areas and were acceptably covered by greater than 60 dBC and did not need TARs.

Spatial Analysis and Digital Orthoimagery (Visual Risk Technologies, Inc.)

Review of some individual area population densities, resulted in the discovery that the NY State population density map using Census 2000 data may over estimate the population density in some areas. It was determined that it would be prudent to fully analyze the population density for the entire EPZ.

GIS spatial analysis was performed in order to identify Areas of Interest within the 5 mile radius (Volume 1) and 5 – EPZ Boundary (Volume 2) with the following criteria:

- Area greater than 2000 people/ square mile but do not fall within 70 dBC siren sound coverage and
- Greater than 0 but less than 2000 people / square mile but do not fall within 60 dBC siren sound coverage.

The determination as to whether these criteria were met was based on spatially evaluating the 60 dBC and 70 dBC sound pressure level siren coverage contours provided from ATI in conjunction with the US Census block boundaries and their associated population density.

Specifically, a union function was performed; in essence the process creates a set of new polygons whose borders are made up of a combination of census block and siren contour boundaries. Each of these new polygons was attributed with its siren coverage sound pressure level and originating census block identifier. The Area of Interest criteria were then applied and those polygons meeting the criteria were identified as Areas of Interest. Since the Areas of Interest were derived from an evaluation of census block boundaries, no individual Area of Interest polygon will span multiple census blocks but will be a partial or whole topographical representation of the census block from which it was derived.

Utilizing digital orthoimagery (High Resolution Imagery dataset, circa 2007, obtained from NYS Geographic Information Systems Clearinghouse), each Area of Interest was reviewed at a resolution no larger than 1:1,000. Based on this visual inspection of each Area of Interest, the number of apparent housing structures was compiled. In cases where there was the appearance of an apartment/condominium complex, an effort was made to estimate the number of individual housing units within each building structure. The initial product of the orthoimagery review was a count of the estimated number of housing units located within each Area of Interest

The results of these studies for the 0-5 mile radius are documented in Visual Risk Technologies report entitled "Indian Point Energy Center Siren Acoustic Coverage: Areas of Interest Review". An additional report to analyze the 5 mile-EPZ area will be issued in the future although the results have been presented to Entergy and used in the table below. Based on the more detailed and actual population density review performed by VRT, the sound pressure level coverage is actually better than originally predicted by ATI as follows:

All Populations	ATI	VRT
0-5 mile	99.2%	>99.9%
5-EPZ	93.3%	96.7%
EPZ	94.8%	97.5%

In areas were the acoustic coverage is reduced, the residents will be offered Tone Alert Radios and encouraged to register for NY-Alert to enhance alert and notification area coverage in lieu of adding more sirens.

Two population analysis maps are included in Appendix M. The first map is the "Siren Acoustic Coverage Area of Interest Status" map. This map depicts resolution by the analysis described above, of the areas of interest (potential reduced acoustic coverage areas) that are shown in the map in Appendix K. The second map in Appendix M is the "Residential Alerting Method" map. This map depicts the geographical area covered by each alerting mechanism. Both maps show zero population areas and West Point alerting areas.

Ambient Noise Survey

Additionally, Blue Ridge Research and Consulting (BRRC) performed an ambient noise survey in high population density areas in thirteen locations within the EPZ for three consecutive days in August of 2007 to determine the outdoor summer daytime ambient sound level in areas within the EPZ. The daytime (7 AM to 10 PM) noise data from these measurements was used to compute the local ambient noise environment. The exceedance levels of L10, L50, and L90 were computed in the 28^{th} third octave band, centered on 630 Hz. The L90 levels, representative of the ambient background sound levels, ranged from 25 dB to 46 dB. The L50 levels, representative of the average sound conditions, ranged from 28 dB to 59 dB. The L10 levels, representative of the infrequent and transient noise intrusions, ranged from 35 dB to 52 dB. Complete details and results from the survey are provided in Appendix C.

The measured sound pressure levels from the siren full sounding in the far field exceeded the L50 value (which is most representative of average background conditions) by 15 to 30 dBC in the third octave band.

The siren sound level coverage is provided on Map 2. The map indicates areas with 60 dBC and 70 dBC coverage and the population density in the EPZ.

Based on the siren sound level coverage presented in Map 2, the siren system as designed with the enhancement of TARs and NY-Alert, meets or exceeds FEMA-REP-10 guidance for sound pressure levels and population coverage.

14.4 Far Field Measurements Methodology

The purpose of the measurements described herein is to characterize the amplitude of sound produced by the complete siren system around the Indian Point Energy Center. The results from these measurements will be compared with the results from the model developed by ATI to confirm the quality of the prediction reflected in the ATI model.

Equipment

ANSI certified Type 1 Sound Level Meters (SLMs) will be used in the measurements as per ANSI S12.18. Before and after each measurement the calibration of each sound level meter will be checked, and the calibration tone will be recorded for at least 30 seconds. Each sound level meter will be capable of recording noise data at one-second intervals. The SLMs will be set to record the C-Weighted values. The 1 second Leq and the 1 second third octave band data will be recorded wherever possible based on equipment availability. Each SLM microphone will be fitted with a wind screen and will be mounted on a tripod or other suitable firm mounting device at a height of approximately 5 feet above ground level. Each SLM clock will be synchronized with the clock used to initiate the siren test. In addition, meteorological data will be collected including wind speed and direction, temperature and humidity within the EPZ. Multiple locations within the EPZ will be used to collect this data for each full siren test and recorded at the highest possible sample rate.

Measurement Locations

Twenty (20) measurement locations will be selected within the EPZ. Locations of interest will include: areas along the sound contour lines: areas downwind, cross wind or surrounded by sirens; areas of challenging topography; high population density areas and those locations previously identified with potentially lower projected sound levels, where additional sirens were added. Each measurement position should be greater than 50 feet from the nearest reflecting surface such as buildings, boulders, walls, and other obstacles. General guidelines for selecting measurement locations are that the measurements should be greater than 1,000 feet from the nearest siren. The precise location of each measurement location with GPS coordinates will be determined and recorded, together with any additional details about the measurement location. Also locations that have been previously identified as being within the shadow created by a co-located siren should be avoided. Multiple test days will be planned to maximize the opportunity to have the appropriate weather conditions for testing. Test day weather conditions will be factored into the correlation of predicted to measured sound pressure levels.

Measurement Procedure

The SLMs will start recording data approximately 2 minutes or more prior to the full system sounding and will continue to record data for approximately 2 minutes or more after the siren sounding has concluded. The testing personnel should be careful not to make any noise during the period while the SLM is running including the periods prior to and after siren sounding while the SLM is operating.

Each operator of an SLM will be given a data sheet (Figure 14-19) that will be filled out completely. Each data sheet will have all of the information about the test including the date, time, location, SLM serial number, and calibration. In addition, the operator will record the local ambient noise level before and after the siren system sounding. Each operator will note on the data sheet any significant intruding noise sources that occur during the test. This is intermittent noise that is above background. The operator will record the source and time of the intrusion on the data sheet.

Testing will not be conducted if meteorological conditions such as precipitation and elevated wind exist. ANSI S12.18 provides guidelines for appropriate atmospheric conditions. Every effort will be made to collect data under the conditions stated in ANSI S12.18. The determination to take measurements will be made by the Test Director on the day of the test.

Data Analysis

The data from the SLMs will be analyzed to determine the sound level produced during the full siren system activation. The third-octave band with the majority of the siren energy will be identified and used for part of the analysis, including the difference above ambient. Data will be reported by identifying the C-weighted Lmax (maximum 1 second Leq during the test) and the C-weighted L10. In addition, the complete time history of each measurement will be recorded.

Comparison with Modeled Results

The measured metric, C-weighted L10, will be compared to the output from ATI's sound propagation model. Lmax will be reviewed for a more complete understanding of additional margin. For this analysis, the sound level predicted by the model will be compared with the measured L10 at each location. To evaluate the quality of the sound propagation model, the data will be analyzed by a bulk average deviation method as shown in Eq. 1 below.

Any significant outlier will be identified and considered. If there are extenuating circumstances that are identified and justify exclusion, these outliers will be removed from the bulk average calculation. Examples of outlier circumstances include: siren material condition, instrument problems, interfering noise events, etc. An outlier is defined as a measurement greater than 3 standard deviations of the difference in predicted and measured sound pressure level data. Any exclusion will be documented.

(Eq. 1) $$Q = \frac{\sum (P_i - M_i)}{N}$$

Where:

Q is the measure of model quality
P_i is the predicted Leq sound pressure level at the i^{th} location
M_i is the measured Leq sound pressure level at the i^{th} location
N is the total number of measurements

A value for Q of positive 3 dBC or less is indicative of a high level of model quality. Since this is a one-sided test any negative value of Q is acceptable, since that means the measured values are predominately higher than the predicted and thus the model would be conservative.

Figure 14-20.

Indian Point Siren Test Sample Data Sheet

Date:______________________ Time: __________________________

SLM Model: _______________ SLM Serial Number:_____________

Tester's Name:____

Measurement Location: ____

GPS Coordinates:______________________ West ____________________North

Checked Battery? Yes No

Checked Clock? Yes No

Calibration level before test:____________ dBC

30 second calibration tone recorded before test? Yes No

Calibration level after test: ____________ dBC

30 second calibration tone recorded after test? Yes No

Calibrator Model: _____________________ Calibrator SN: ________________

Location Drawing:

Microphone height:_____________ ft.

Taken Photo? Yes No

Meter Recording? Yes No

Weather Station on and wind cover removed? Yes No

Ambient noise level before test: __________ dBC

Maximum level observed during the test: ________________dBC

Ambient noise level after test: ___________ dBC

Notes about test (including noise intrusions):

Tester's Signature: ____

22 CONCLUSION

As a result of the Energy Policy Act of 2005, IPEC elected to install a new ANS system consisting of fixed electronic sirens capable of providing an alert for twenty-four (24) hours after a loss of normal AC power. The battery backup power feature ensures system components operate securely in the event of power failure. The design of the new system also minimizes single points of failure.

The IPEC ANS consists of sirens, and broadcasted emergency information with the addition of tone alert radios (TARs) and the NY-Alert system in the future as enhancements to the system. High speed telephone notification is used as a backup in the event of siren failure. This system meets or exceeds the guidelines set forth in the Federal Emergency Management Agency's (FEMA's) regulations, 44 CFR Part 350, Planning Standard E, Appendix 3 of NUREG-0654/FEMA-REP-1, and the Guide for the Evaluation of Alert and Notification Systems for Nuclear Power Plants (FEMA-REP-10).

The sirens were installed on steel poles which extend pole life and withstand environmental challenges. Additionally, susceptible siren wiring is protected from damage because they are installed within the metal poles.

One hundred and fifty-seven (157) sirens are omni-directional and fifteen (15) use the bi-directional configuration.

The communication control system uses eleven control stations that are designed to have complete control and monitoring capabilities over all sirens in the system.
Each county has complete activation control and monitoring over the sirens used to alert its county from all control stations located within its county and can monitor the activation of all sirens via the computer display. Each county can also monitor sirens from bordering counties that may affect their county. All counties can also activate other counties' sirens if agreed upon. The two control stations at IPEC can also activate all of the sirens if needed.

Twenty-four hour battery capability is provided to meet the siren backup power requirements of the Energy Policy Act. The design includes this capability for each siren, each control station and one of the redundant radio paths at the repeater towers. Twenty-four hour battery capability is also provided for the second redundant radio path and the wireless TCP/IP equipment installed at the sirens, control stations and repeaters, with the exception of the T1 telephone lines and the TCP/IP network, which are maintained by Verizon (Telco).

The system incorporates reliable communication and post activation polling using radio and TCP/IP communication.

There are two separate and distinct communication paths used to convey activation and monitoring messages between the control stations and the remote sirens: dedicated redundant simulcast radio systems and a cellular TCP/IP system. The design eliminates single points of siren communication failures since multiple control stations can communicate to every assigned siren by either communication path.

The communication and control system reliability testing performed in 2007/2008 for the microwave synchronized simulcast radio activation and control mode has demonstrated high reliability (greater than 97%) with a greater than 95% confidence. This activation and control mode has battery power supplies confirmed to provide 24-hour backup power in the event of a loss of normal AC power. Furthermore, the testing has not revealed any unanticipated failure modes.

Acoustic testing at Georgia Tech Research Institute (GTRI) included both anechoic chamber and open field testing. The testing collected data to support the determination of the siren characteristics pertinent to their acoustic performance. The testing demonstrated that the siren output is steady, repeatable, and reproducible.

The siren sound contours of 60 and 70 dBC within the IPEC EPZ were calculated by a computer model developed by ATI. The ATI model demonstrates that the 70 dB sound output criterion is generally met in high population areas requiring 70 dB coverage and the 60 dB sound output criterion is generally met in low population areas requiring 60 dB coverage.

To further confirm the quality of the ATI predictions, acoustic measurements were also taken in the far field. These measurements were compared to the predicted sound pressure levels for these locations. A bulk average deviation method was used to analyze this data. Close alignment was shown between the predicted values and measured values using this bulk average method.

The siren system as designed meets or exceeds FEMA-REP-10 guidance based on the sound contours generated by the ATI acoustic model using 114 dBC as siren output. Modeling indicates that sound coverage meets requirements down to a siren output of 112 dBC. The controlled testing at GTRI showed an average siren output range of 115.2 to 117.4 dBC measured during outdoor testing. This design using a 114 dBC siren output is conservative by up to 5.4 dBC of margin. For areas in the EPZ in which predicted siren sound pressure levels are less that the criteria specified in FEMA-REP-10, the ANS is enhanced by using Tone Alert Radios and NY-Alert in the future which is an all-hazard alerting system operated and maintained by New York State.

Inspections have been performed to verify that the siren system configuration and condition is acceptable prior to declaring system operability. These inspections have ensured a high level of material readiness that will maintained through an ongoing siren maintenance program.

Benefits of the Placing the New System into Service

The newly installed Indian Point Alert and Notification System offers significant improvement over the currently installed system. Table 22-1 provides a summary of these improvements, which include:

Backup Power

The system was designed and installed with backup power for sirens, control and communications systems to meet the requirements of Energy Policy Act of 2005.

Acoustic Coverage

The new system has provides broader acoustic coverage than provided by the existing system. There are 28 new sirens in locations that did not have sirens in of the old system. An additional approximately 60 square miles of the EPZ (and the associated population) are covered by the new system.

Operational Effectiveness

Design features of the new system were developed specifically to address challenges of the old system. Redundant communication paths (simulcast radio and TCP/IP) eliminate single points of failure existing in the old system. The simulcast radio system eliminates the need use siren locations as repeaters and the daisy chain of communications to other sirens.

Each control station (11) is independent and capable of activating all sirens.

Use of electronic sirens eliminates the mechanical components of the old rotational sirens and the associated failures.

The new system also has significant system diagnostic capability which includes control station receipt of unsolicited feedback from sirens on the status of AC and DC power, and communication links.

System polling using TCP/IP protocol has demonstrated up to a 20 minute quicker response from the currently installed system for system activation verification. This will result in more timely response to issues that may impact population alerting.

Additional discussion is provided in Appendix E “Lessons Learned” regarding features of the old system versus the new system.

Table 22-1. **Comparison of New vs. Currently Installed System**

Attribute	New	Currently Installed
Back Up Power	Yes	No
Area – wide coverage	Approx. 60 Sq mi additional	Adequate
Population Coverage • 0-5 mile • EPZ	 >99.9 % 97.5 %	 98.9 % 82.3 %
Single point of failure	Only individual sirens	Several including controls, towers, communication paths
Daisy chain communication	No	Yes
Diagnostics	Many with call out features	Limited
Mechanical components	None	Motor, rotators
Polling speed	8-10 minutes on TCP/IP	30 minutes
Redundancy	Extensive	Limited
Poles	Steel	Wood
Silent test capability	Yes	No
Operator feedback	Unsolicited messages, callouts, computer screen status	Requires printing reports
Communication Pathways	3 paths (microwave coordinated radio, Telco coordinated radio, TCP/IP)	1 path –radio
Failure Mode Effects Analysis	Yes	No

APPENDIX G SUPPORTING DOCUMENTATION/REFERENCES

Code of Federal Regulations, Title 44, Chapter I, Part 350, "Review and Approval of State and Local Radiological Emergency Plans and Preparedness", Planning Standard E

NUREG-0654/FEMA-REP-1, Rev. 1, "Criteria for Preparation and Evaluation of Radiological Emergency response Plans and Preparedness in Support of Nuclear Power Plants", U.S. Nuclear Regulatory Commission/ Federal Emergency Management Agency, November 1980

FEMA-REP-10, "Guide for the Evaluation of Alert and Notification Systems for Nuclear Power Plants", Federal Emergency Management Agency, November 1985

Energy Policy Act of 2005, Public Law 109-58, section 651(b), "Backup Power for Certain Emergency Notification Systems." August 8, 2005

CPG 1-17, "Outdoor Warning Systems Guide", Federal Emergency Management Agency, March 1, 1980

Emergency Alert System (EAS) New York State Plan 2005, NYS EAS Plan Revision 2.01, Effective Date January 1, 2005

Lower Hudson Valley Local Emergency Communications Committee Emergency Alert System Local Plan for: Westchester, Rockland, Orange, and Putnam Counties

Joint Information Center Procedures/Public Education Work Plan, Hawthorne, 1-31-2008

Westchester County Radiological Emergency Plan for the Indian Point Energy Center

Rockland County Radiological Emergency Preparedness Plan

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"

International Organization for Standardization ISO 9613-2:1996, International Standard, "Acoustics – Attenuation of Sound During Propagation Outdoors"

American National Standards Institute (ANSI) S12.18-1994, "Procedures for Outdoor Measurements of Sound Pressure Level"

Entergy Nuclear Northeast "Report on Trees and Tree Trimming at the Indian Point Energy Center (IPEC) Alert Notification Siren Sites, September 24, 2007 to November 17, 2007," Volume I – Putnam and Westchester Counties, November 30, 2007

Entergy Nuclear Northeast "Report on Trees and Tree Trimming at the Indian Point Energy Center (IPEC) Alert Notification Siren Sites, September 24, 2007 to November 17, 2007," Volume II – Orange and Rockland Counties, November 30, 2007

"Acoustic Testing of Prompt Alert Notification System Sirens from Indian Point Energy Center", Volume I Chamber Testing, Georgia Tech Research Institute GTRI Report D5600-Volume I, Wyle Laboratories Report WR-07-25, Volume I, dated 3/08

"Acoustic Testing of Prompt Alert Notification System Sirens from Indian Point Energy Center", Volume II Outdoor Siren Testing, Georgia Tech Research Institute GTRI Report D5600-Volume II, Wyle Laboratories Report WR-07-25, Volume II, dated 3/08

"Acoustic Testing of Prompt Alert Notification System Sirens from Indian Point Energy Center", Volume III New Omni-Directional Siren Output Validation, Georgia Tech Research Institute GTRI Report D5600-Volume III, Wyle Laboratories Report WR-07-25, Volume III, dated 3/08

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

"Indian Point Energy Center Siren System Far Field Acoustic Testing Report, April 2008" Blue Ridge Research and Consulting

"Indian Point Energy Center Siren Acoustic Coverage: Areas of Interest", Visual Risk Technologies, Inc., July 7, 2008

Entergy Nuclear Failure Modes and Effects Analysis (FMEA) of the New Siren System for Indian Point Energy Center, IP-RPT-08-00005, April 2008

MIL-STD-1629, "Procedures for Performing a Failure Mode, Effects and Criticality Analysis", Military Standards and Specifications, November 24, 1980

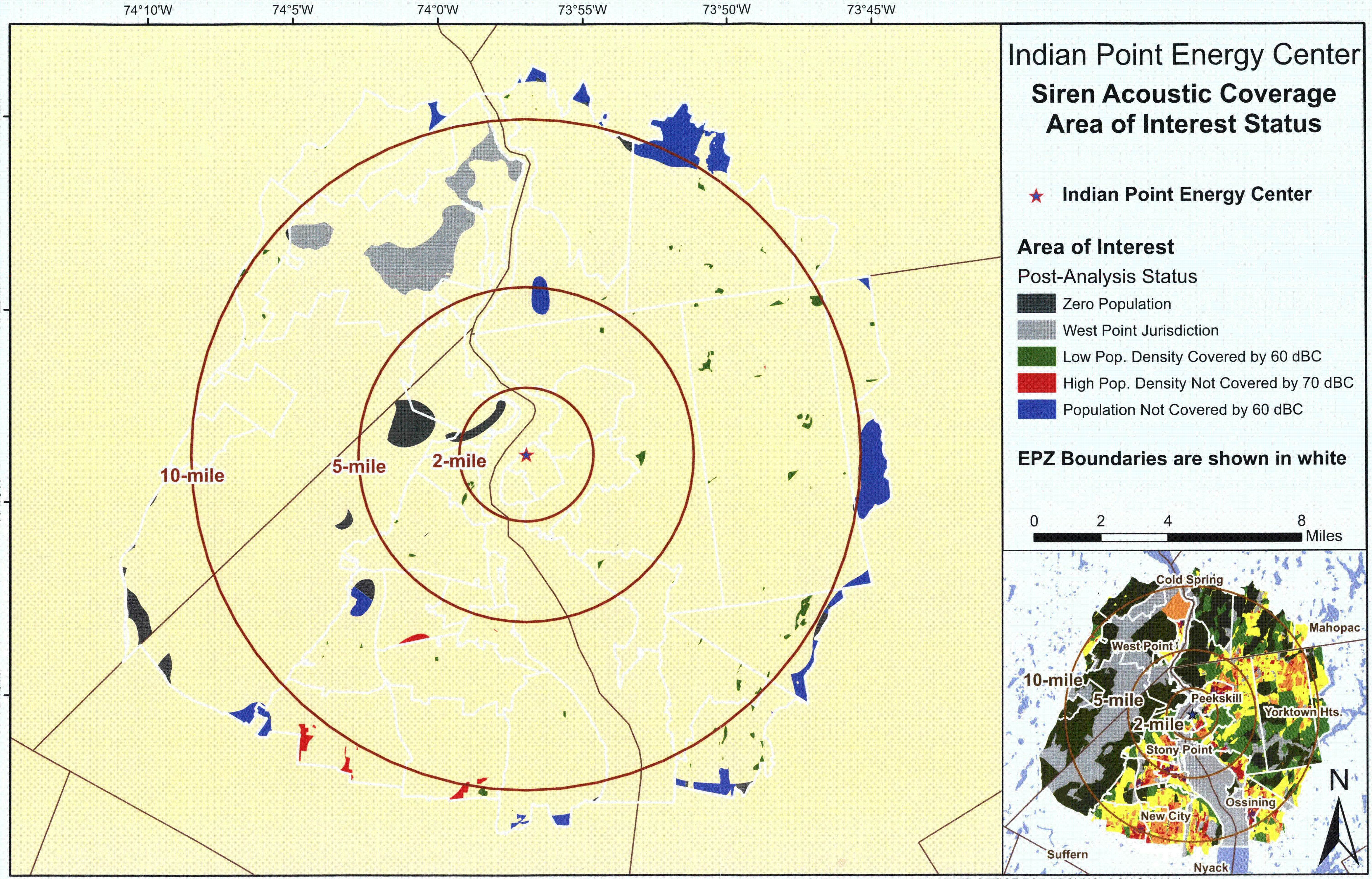
MIL-STD 882, "Safety System Program Requirements", Military Standards and Specifications, July 15, 1969

MIL-HDBK-217F, "Reliability Prediction of Electronic Equipment", US Department of Defense, December 2, 1991

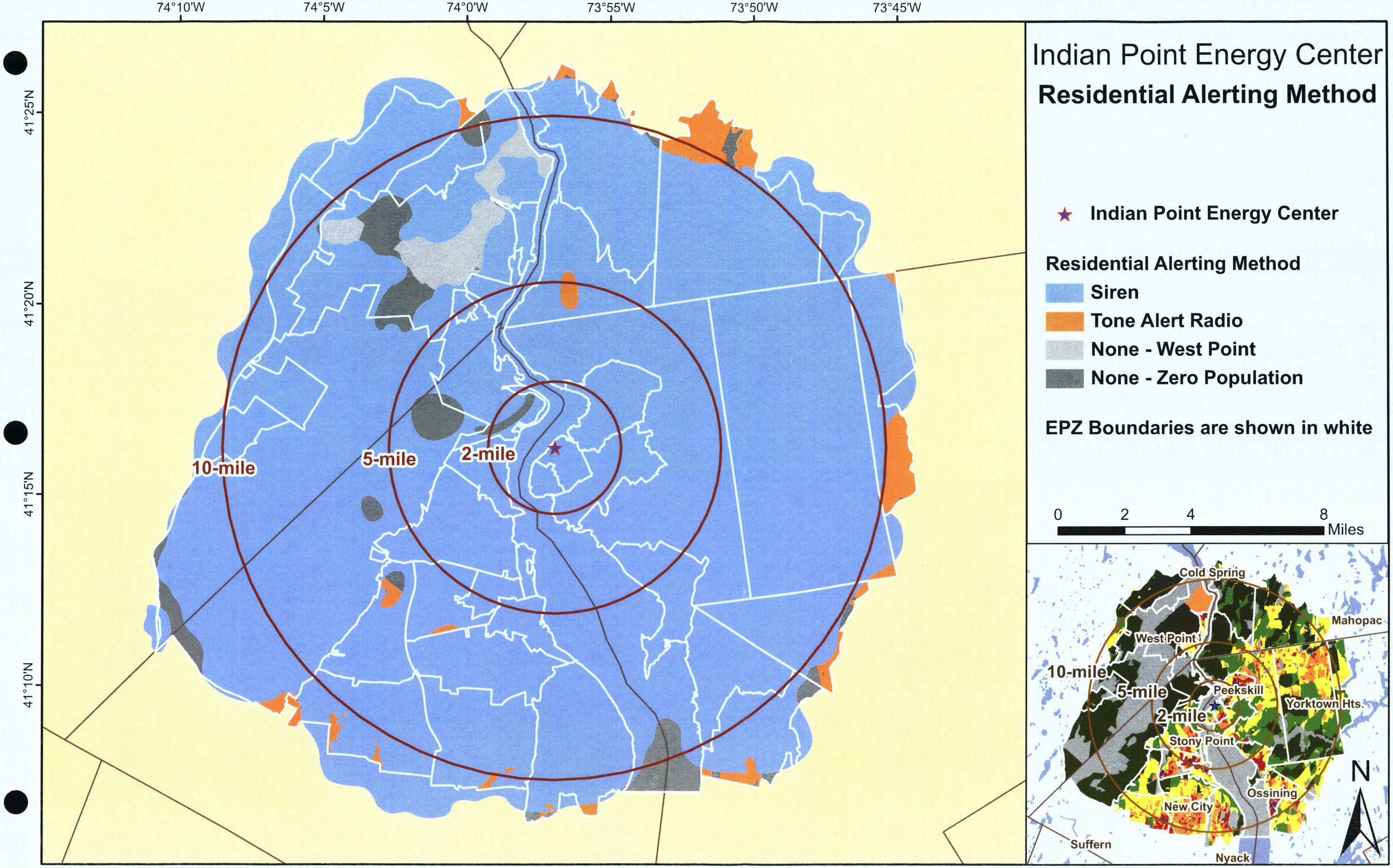
APPENDIX M POPULATION ANALYSIS RESULTS OF SPECIFIC EPZ AREAS (MAPS)

1. Siren Acoustic Coverage Area of Interest Status

2. Residential Alerting Method



© 2008 VISUAL RISK TECHNOLOGIES, INC. BASEMAP INFORMATION © 1984-2008 TELE ATLAS; 2000 CENSUS BLOCK INFORMATION COPYRIGHTED BY NEW YORK STATE OFFICE FOR TECHNOLOGY © (2005)



© 2008 VISUAL RISK TECHNOLOGIES, INC. BASEMAP INFORMATION © 1984-2008 TELE ATLAS; 2000 CENSUS BLOCK INFORMATION COPYRIGHTED BY NEW YORK STATE OFFICE FOR TECHNOLOGY © (2005)