LA SALLE NUCLEAR POWER STATION
SITE-SPECIFIC OFFSITE RADIOLOGICAL EMERGENCY
PREPAREDNESS ALERT AND NOTIFICATION SYSTEM
QUALITY ASSURANCE VERIFICATION

Prepared for

Federal Emergency Management Agency
Washington, D.C. 20472
Under Contract No. EMW-83-C-1217

May 29, 1985

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Site-Specific Offsite Radiological Emergency
Preparedness Alert And Notification System
Quality Assurance Verification

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Municipality Of Marseilles
Municipality Of Ransom
Municipality Of Seneca
Grundy County
Municipality Of Kinsman
Municipality Of Verona
Livingston County

I. INTRODUCTION

A. Identification

1. Site Information

The La Salle Nuclear Power Station, operated by the Commonwealth Edison Company, utilizes two 1078 MWe (net) General Electric boiling water reactor electric generating units. Unit 1 began commercial operation in 1982; Unit 2, in 1984.[1]

The La Salle Nuclear Power Station is located in Brookfield Township in La Salle County, Illinois. It is located in the northeastern portion of Illinois, approximately 7 miles south-southeast of Marseilles, 5 miles south of the Illinois River, and 6 miles southwest of Seneca.

The land within a 10-mile radius of the La Salle Nuclear Power Station is generally flat with scattered wooded areas and is primarily used for agricultural purposes.

2. Governments Within The 10-Mile Emergency Planning Zone

The emergency planning zone (EPZ) for the La Salle Nuclear Power Station is defined by a 10-mile-radius circle with the La Salle Nuclear Power Station as the center point. The EPZ, located entirely in the State of Illinois, includes portions of La Salle, Grundy, and Livingston Counties. The La Salle and Grundy County line is oriented north-south across the EPZ, approximately 4 miles east of the La Salle Nuclear Power Station. La Salle County, located to the west of this line, occupies the majority of the EPZ. Livingston County extends less than 1 mile into the southern section of the EPZ and contains only a small number of residences. For practical purposes, the portion of Livingston County within the EPZ is treated as an extension of the jurisdiction of La Salle County.

There are six municipalities located within the La Salle Nuclear Power Station EPZ: Grand Ridge, Marseilles, Ransom, and Seneca in La Salle County and Kinsman and Verona in Grundy County. The total 1980 population within these six municipalities was 8409 persons: 4766 persons were located in Marseilles, 2098 persons in Seneca, and less than 700 persons in each of the remaining municipalities. The 1980 population within 5 miles of the La Salle Nuclear Power Station was 729 persons. An additional 3759

persons lived in either rural residences or on farmsteads between 5 miles and 10 miles from the La Salle Nuclear Power Station. The above population figures were obtained from the Illinois Emergency Services and Disaster Agency and Commonwealth Edison Company's "An Off-Site Emergency Plan Alert and Notification Addendum for the La Salle Nuclear Power Station," as supplemented by an operational reliability statement forwarded by FEMA Region V (hereinafter referred to as the Design Report).[2]

Recreational facilities within the La Salle Nuclear Power Station EPZ include a 60-acre park with camping facilities on the southwest shore of the site's cooling lake. This 2058-acre cooling lake is used for recreational boating and fishing. Approximately 6 miles north-northwest of the La Salle Nuclear Power Station is the 510-acre Illini State Park, which is used for camping, boating, picnicking, and fishing. There are no airports, government installations, or correctional facilities within the La Salle Nuclear Power Station EPZ.[2]

B. Scope Of Review

1. Emergency Plans For Offsite Response Organizations

The emergency plans and implementing instructions for jurisdictions within the La Salle Nuclear Power Station EPZ include:

- "The Illinois Plan for Radiological Accidents," Volumes I and III, March 1982.[3]

References 2 and 3 above document the administrative means established for notifying and providing prompt instructions to the public within the La Salle Nuclear Power Station EPZ.

2. Alert And Notification System Design Report

The physical means established for alerting the public within the La Salle Nuclear Power Station EPZ are documented in Sections 2.3, 2.4, and supporting Appendices of the Design Report.

3. FEMA Evaluation Findings

FEMA Region V and the Regional Assistance Committee have evaluated four offsite emergency response exercises for the La Salle Nuclear Power Station:

- FEMA, "Post Exercise Evaluation, State of Illinois and Grundy and La Salle Counties Exercise of the Illinois Plan for Radiological Accidents for La Salle Nuclear Power Plant, December 4, 1980" (No date);[4]

- FEMA, "Final Report, La Salle Nuclear Power Station Full-Scale Exercise, April 14-15, 1982," May 1982;[5]

- FEMA, "Exercise Final Report, La Salle Nuclear Power Station Joint Radiological Emergency Exercise," July 12, 1983;[6] and

- FEMA, "Exercise Report, La Salle Nuclear Power Station, Joint Exercise (Partial Participation), October 10-11, 1984," November 26, 1984; also, revisions of March 26, 1985.[7]

In a letter to the Honorable James R. Thompson, Governor of Illinois, dated June 4, 1982, signed by Lee M. Thomas, FEMA Associate Director, State and Local Programs and Support, the La Salle Nuclear Power Station received FEMA approval under Title 44 of the Code of Federal Regulations, Part 350 (44 CFR 350) conditioned upon verification of the adequacy of the public alert and notification system.[8]

II. FINDINGS FOR EVALUATION CRITERION E.6

The Design Report describing the alert and notification system for the La Salle Nuclear Power Station was reviewed against evaluation criterion E.6 and Appendix 3 of NUREG-0654/FEMA-REP-1, Revision 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants" (hereinafter referred to as NUREG-0654/FEMA-REP-1, Rev. 1). This evaluation criterion states:

> Each organization shall establish administrative and physical means, and the time required for notifying and providing prompt instructions to the public within the plume exposure pathway Emergency Planning Zone. (See Appendix 3.) It shall be the licensee's responsibility to demonstrate that such means exist, regardless of who implements this requirement. It shall be the responsibility of the State and local governments to activate such a system.[9]

The bases for review against this evaluation criterion were the corresponding acceptance criteria of FEMA-43, "Standard Guide for the Evaluation of Alert and Notification Systems for Nuclear Power Plants" (hereinafter referred to as FEMA-43).[10] This quality assurance verification review was performed to make a determination of alert and notification system adequacy prior to conducting a demonstration of this system for the La Salle Nuclear Power Station on December 4, 1984.

Based upon this quality assurance verification review and public survey results, International Energy Associates Limited concludes that the design and implementation of the alert and notification system for the La Salle Nuclear Power Station and its supporting procedures conform sufficiently to the acceptance criteria, as stated in FEMA-43,

for evaluation criterion E.6 of NUREG-0654/FEMA-REP-1, Rev. 1, to support a FEMA finding that the alert and notification system is adequate.

This portion of the quality assurance verification review discusses La Salle Nuclear Power Station's alert and notification system against FEMA-43 acceptance criteria in the following areas: the administrative means of alerting, the physical means of alerting, and the special alerting methods (utilization of institutional alerting systems).

A. Administrative Means Of Alerting (E.6.1, FEMA-43)

The Design Report and the Illinois Plan for Radiological Accidents address those organizations or individuals within the state and local governments who are responsible for alert and notification system activation. The decision logic shown in Figure 1 was developed after a review of the current emergency procedures for the State of Illinois, La Salle County, and Grundy County.

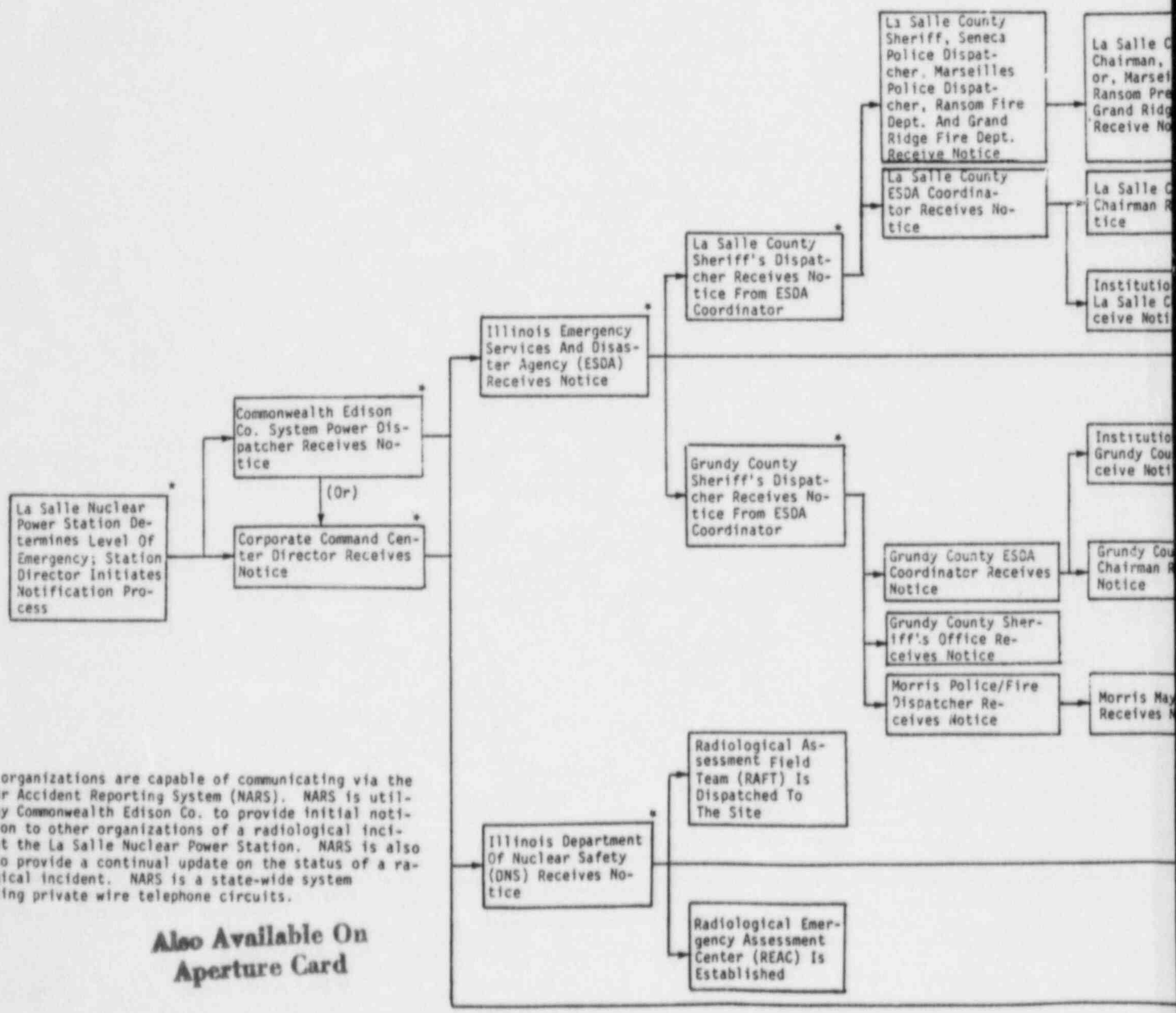
As Figure 1 indicates, these procedures satisfy FEMA-43 acceptance criteria. These current emergency procedures document the responsibilities concerning the alert and notification system activation process from the time a decision is conveyed via the Illinois Emergency Services and Disaster Agency Coordinator to the La Salle County and Grundy County Sheriffs' Dispatchers (who physically activate the sirens).

In the event of a radiological emergency at the La Salle Nuclear Power Station, principal emergency response organizations are notified via the Nuclear Accident Reporting System. The Nuclear Accident Reporting

FIGU

LA SALLE NUCLEAR

ALERT AND NOTIFICATION SYSTEM ACTI

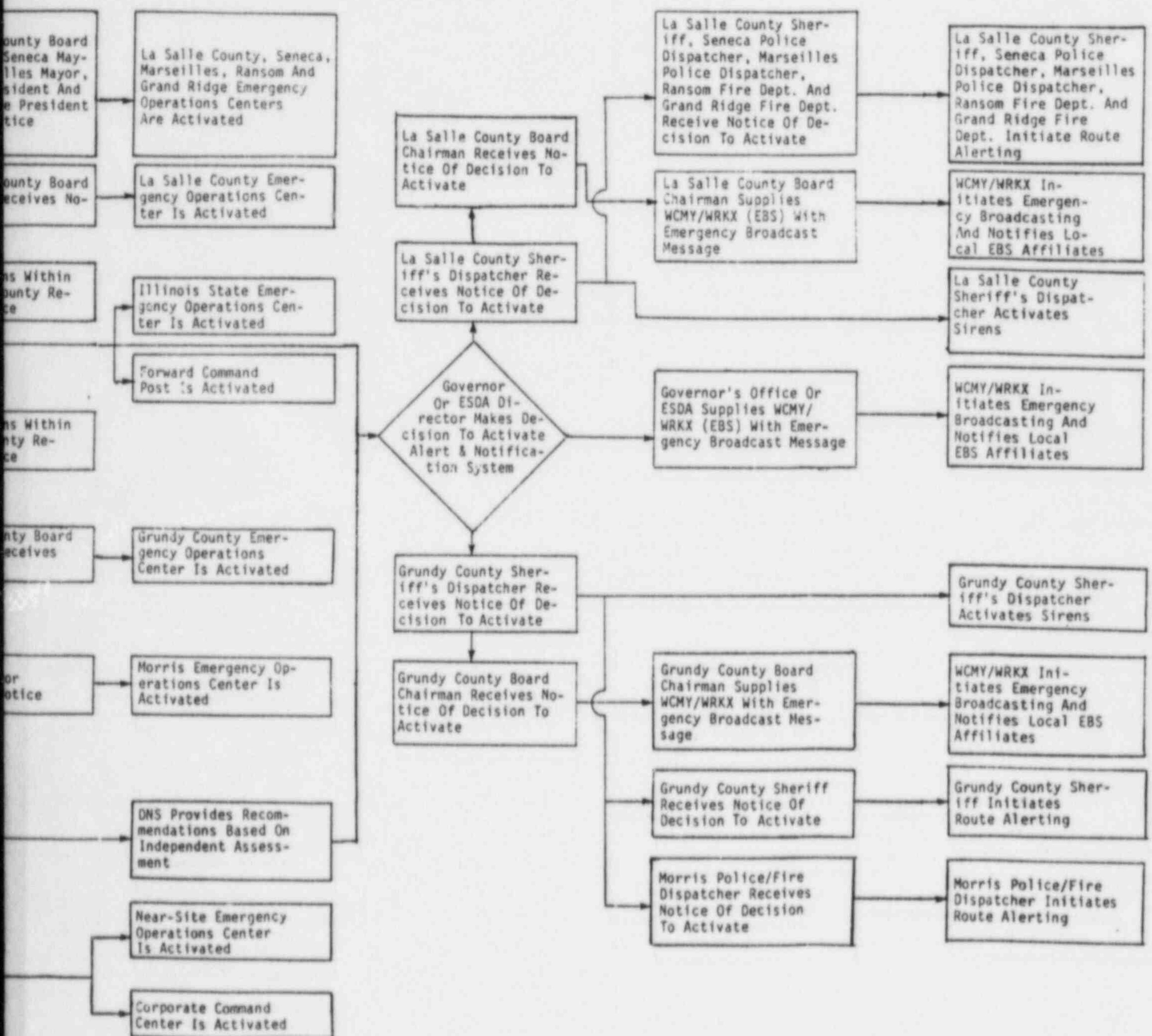


* These organizations are capable of communicating via the Nuclear Accident Reporting System (NARS). NARS is utilized by Commonwealth Edison Co. to provide initial notification to other organizations of a radiological incident at the La Salle Nuclear Power Station. NARS is also used to provide a continual update on the status of a radiological incident. NARS is a state-wide system utilizing private wire telephone circuits.

RE 1

POWER STATION

VATION DECISION/ACTION SEQUENCE DIAGRAM



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System, a state-wide warning system utilizing private wire telephone circuits, is also used by the licensee to provide a continual update on the status of a radiological incident and on recommended protective actions. The Nuclear Accident Reporting System provides the capability to communicate simultaneously among all principal emergency response organizations. The La Salle Nuclear Power Station, Illinois Emergency Services and Disaster Agency, Illinois Department of Nuclear Safety, Grundy County Sheriff, and La Salle County Sheriff utilize the Nuclear Accident Reporting System.

Procedures for the primary Emergency Broadcast System (EBS) station, WCMY, include the recording of EBS messages as dictated by state and local representatives. These recorded messages are then broadcast to the public and are relayed to nearby EBS affiliates. Additionally, all Emergency Operations Centers (EOCs) have the capability to monitor EBS broadcasts.

The aforementioned exercise evaluations and the approval under 44 CFR 350 (see references 4, 5, 6, 7, and 8) demonstrate that the administrative means are in place to provide prompt notification to the general public in the event of an emergency situation at the La Salle Nuclear Power Station.

B. Physical Means Of Alerting (E.6.2, FEMA-43)

The alert and notification system for the La Salle Nuclear Power Station consists of 39 fixed sirens and existing emergency/law enforcement vehicles for route alert and notification. The 39 fixed sirens are utilized primarily within the 0-to-5 mile radius area and also to cover densely populated sections within the

5-to-10 mile radius area. Existing emergency/law enforcement vehicles are utilized to traverse predetermined mobile alert and notification routes within the remaining populated geographical areas of the EPZ.

1. Sirens (E.6.2.1, FEMA-43)

The siren system of the La Salle Nuclear Power Station is comprised of 39 fixed sirens: 22 Federal Signal (FS) Model 1000 Thunderbolt rotational sirens rated at 125 dBC, seven FS STH10 omni-directional sirens rated at 112 dBC, two FS Model 2 omni-directional sirens rated at 98 dBC, and eight FS Local Coverage omni-directional sirens (LCS) rated at 85 dBC. Siren locations, mounting heights, ratings, and estimated ranges are shown in Table 1 of Appendix C of the Design Report. In addition, their locations are also indicated on the Siren Contour Map (Appendix D of the Design Report).

The Design Report, as supplemented by an operational reliability statement forwarded by FEMA Region V, describes the methods by which the siren system's annual reliability is calculated. For the 12-month period from May 1983 through April 1984, the overall siren system reliability level was 94.4%, exceeding the FEMA-43 acceptable value of 90%.

Siren anechoic-chamber measured octave band sound pressure spectra of the sirens (Appendices J and K of the Design Report) were used to verify their rated output at 100 ft. The evaluation of the siren system design calculation procedure was conducted by

verifying and comparing the design calculation procedure (as presented in Section 2.4.2 of the Design Report) with Outdoor Sound Propagation Model (OSPM)[11] results for specific sirens.

The La Salle Nuclear Power Station siren alerting system design follows the 10 dB loss per distance doubled attenuation rate as recommended in NUREG-0654/FEMA-REP-1, Rev. 1, in the absence of intervening topographical features. Kurze's point source barrier attenuation formulation,[12] with a cap of 24 dB maximum, was applied for topographical features that presented barriers. A logarithmic superposition was used when computing the locations of 70 dBC contour lines that were influenced by two sirens. However, no credit was taken for this additive effect when computing 60 dBC contours. These procedures were applied to the system of 39 fixed sirens resulting in the Siren Contour Map contained in Appendix D of the Design Report. The Siren Contour Map also depicted geographical areas with population densities greater than 2000 persons per square mile. Population distributions based on 1980 census data were shown in Table 2.3.1 and Figure 2.3.1 of the Design Report.

The Design Report, in Section 2.4.4, further states that the design objectives were to achieve a minimum of 70 dBC coverage in areas where the population density exceeds 2000 persons per square mile and a minimum of 60 dBC in other populated areas.

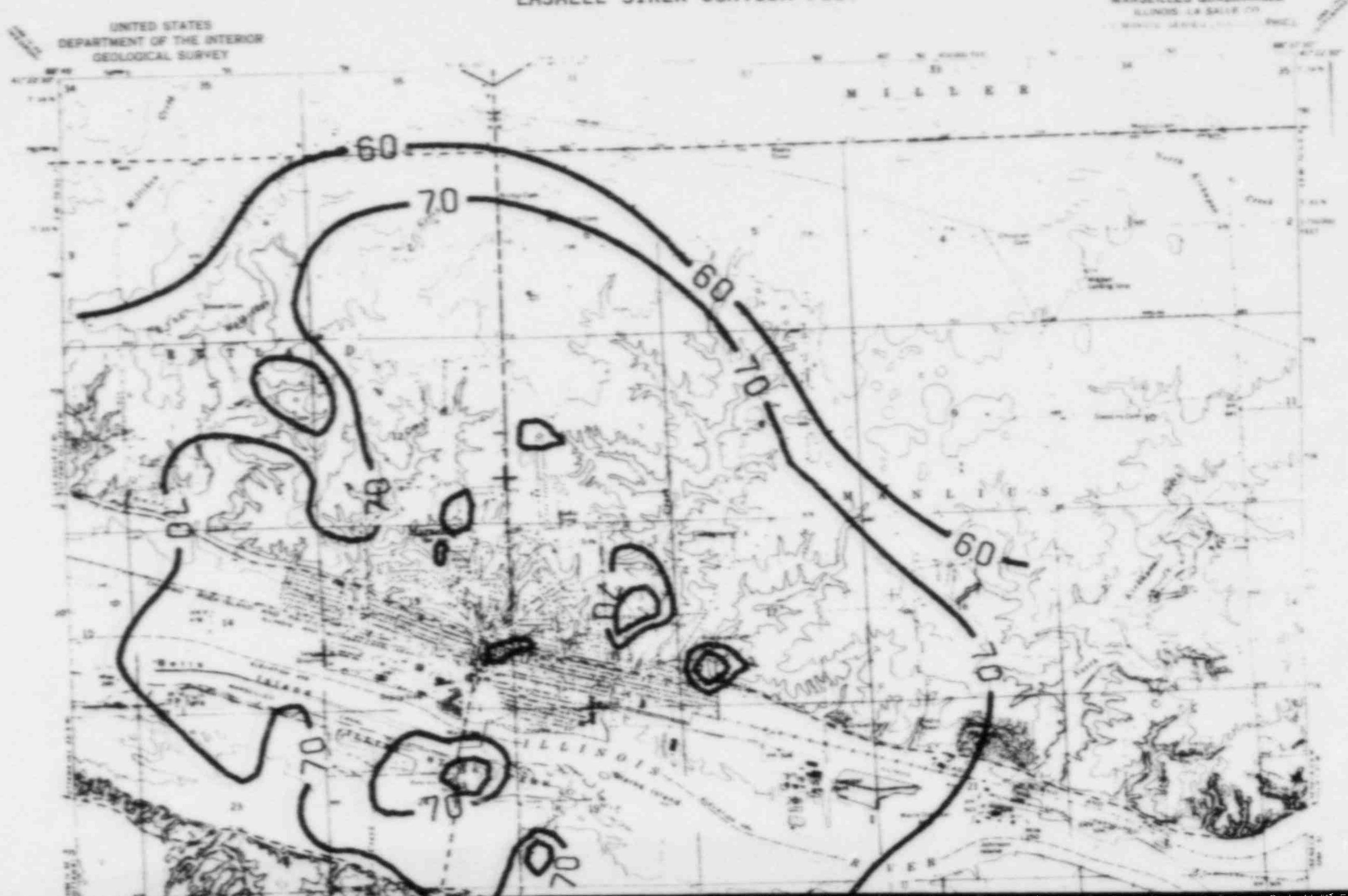
The Design Report states that the La Salle Nuclear Power Station siren alerting system, as depicted in combination with emergency/law enforcement vehicles traversing predetermined mobile alert and notification routes, provides 100% coverage of the EPZ.

This evaluation seeks to ascertain whether the design procedure (with its assumptions) adequately accounts for the site-specific terrain and weather conditions and whether the siren system as designed does indeed meet FEMA-43 acceptance criteria.

Six sirens were selected for this quality assurance verification review. Three FS 1000 sirens (Nos. 1, 3, and 6A), two FS STH10 sirens (Nos. 2 and 13), and one FS LCS (No. 12) were chosen for individual siren range comparisons. The three sirens (Nos. 1, 2, and 3) in Marseilles Township (see Figure 2 of this report) were chosen for superposition siren coverage evaluation. Site average summer daytime weather conditions were derived from over 40 years of Peoria National Oceanic and Atmospheric Administration weather data that was provided by the licensee's consultant. Appendix A contains OSPM topographical profile charts, OSPM topographical input, OSPM sound pressure level input, OSPM meteorological input, and OSPM sound pressure level output for each of the six individual siren runs.

The OSPM results were classified, according to terrain profiles for each siren type, into three categories: hilly, partially hilly, and relatively flat. Regressions of dBC versus the logarithm of distance were performed for the FS 1000 and the FS STH10 sirens over each terrain category with the results depicted in Figures 3 through 8 of this report. The ranges of 70 dBC and 60 dBC as calculated in the Design Report without considering terrain barrier or two-siren additive effects are also shown on the figures and summarized below:

FIGURE 2
LASALLE SIREN CONTOUR PLOT



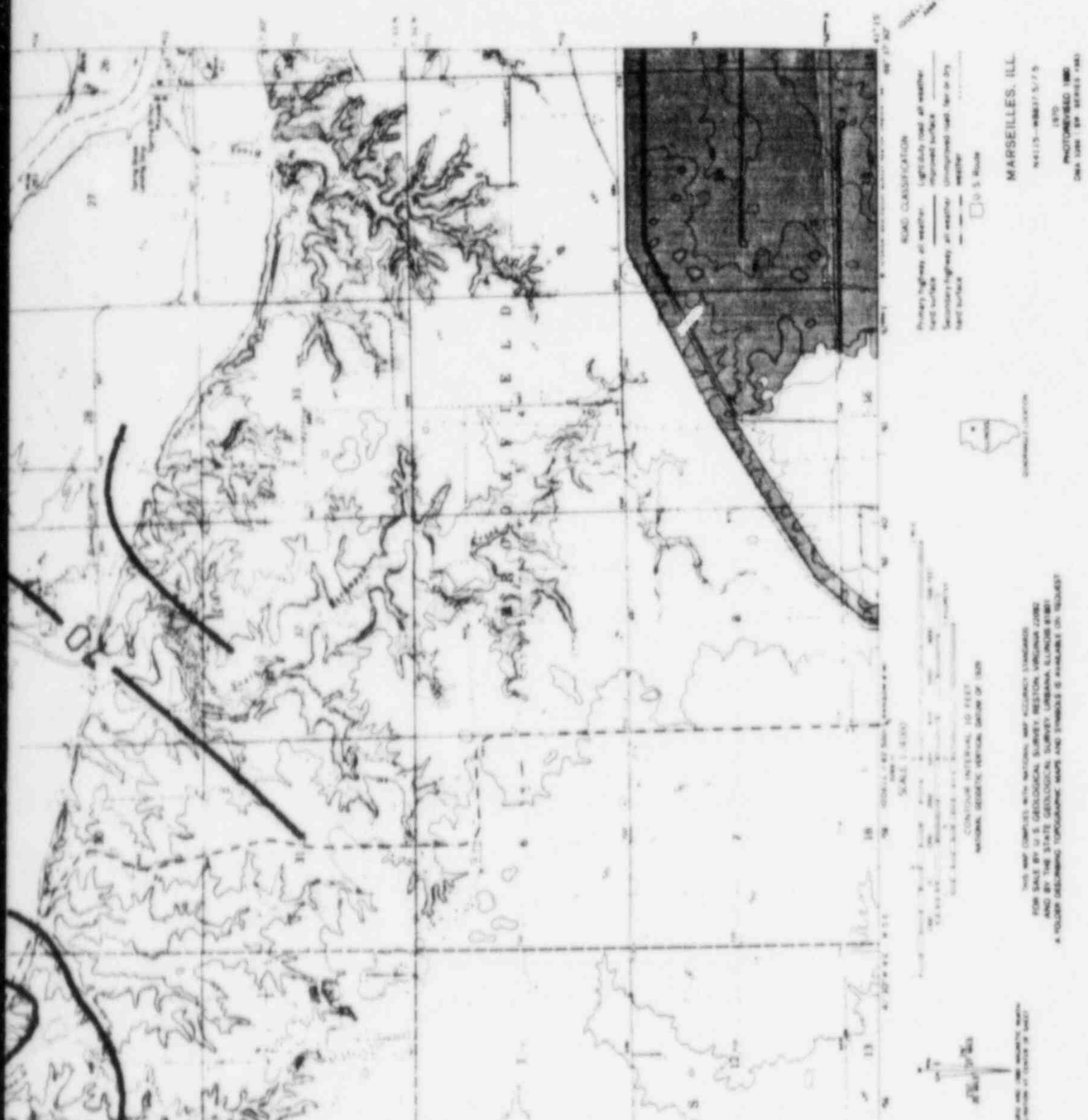


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FIGURE 3

COMPARATIVE OSPM RESULTS, HILLY TERRAIN (FS 1000 SIREN)

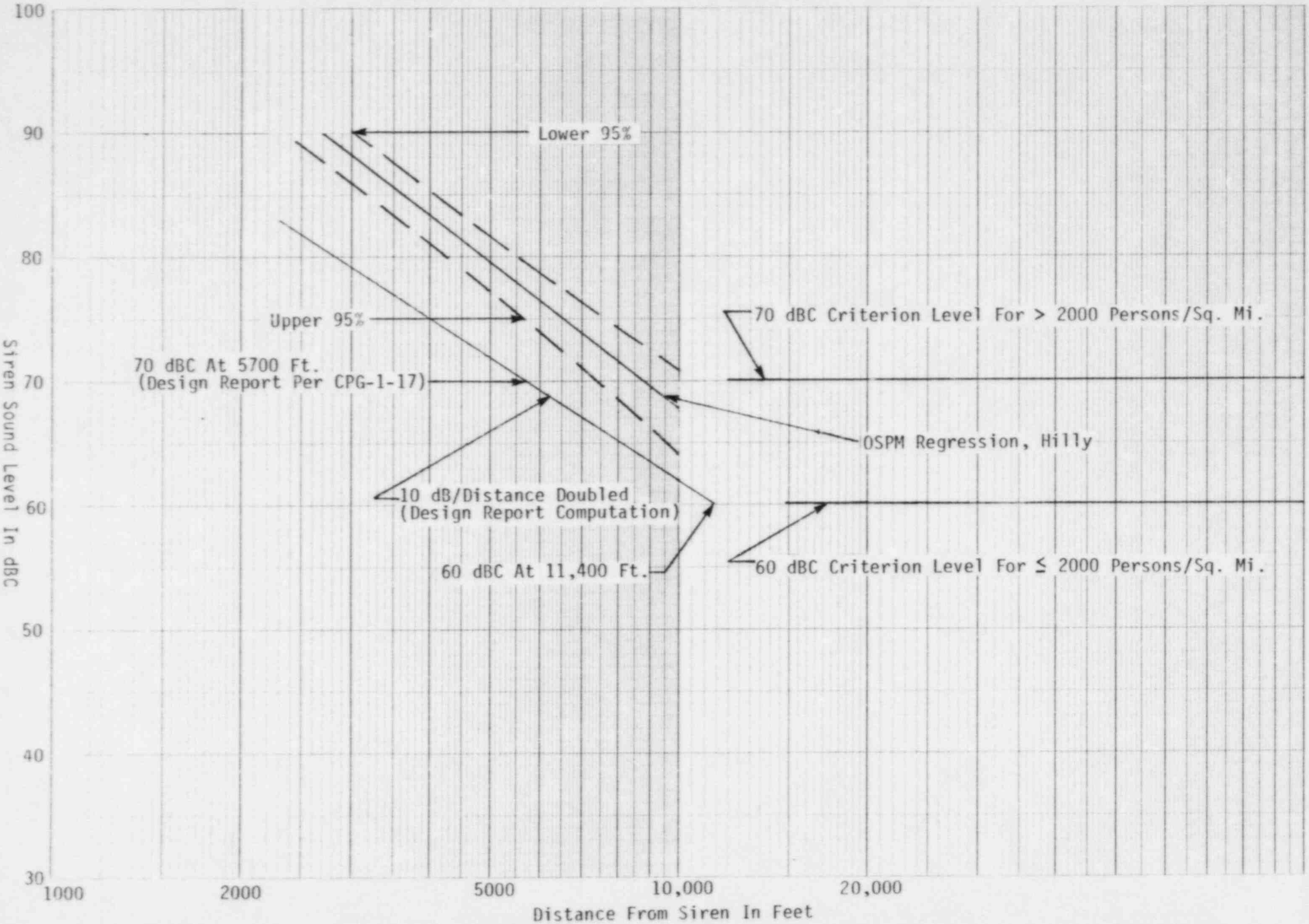


FIGURE 4

COMPARATIVE OSPM RESULTS, PARTIALLY HILLY TERRAIN (FS 1000 SIREN)

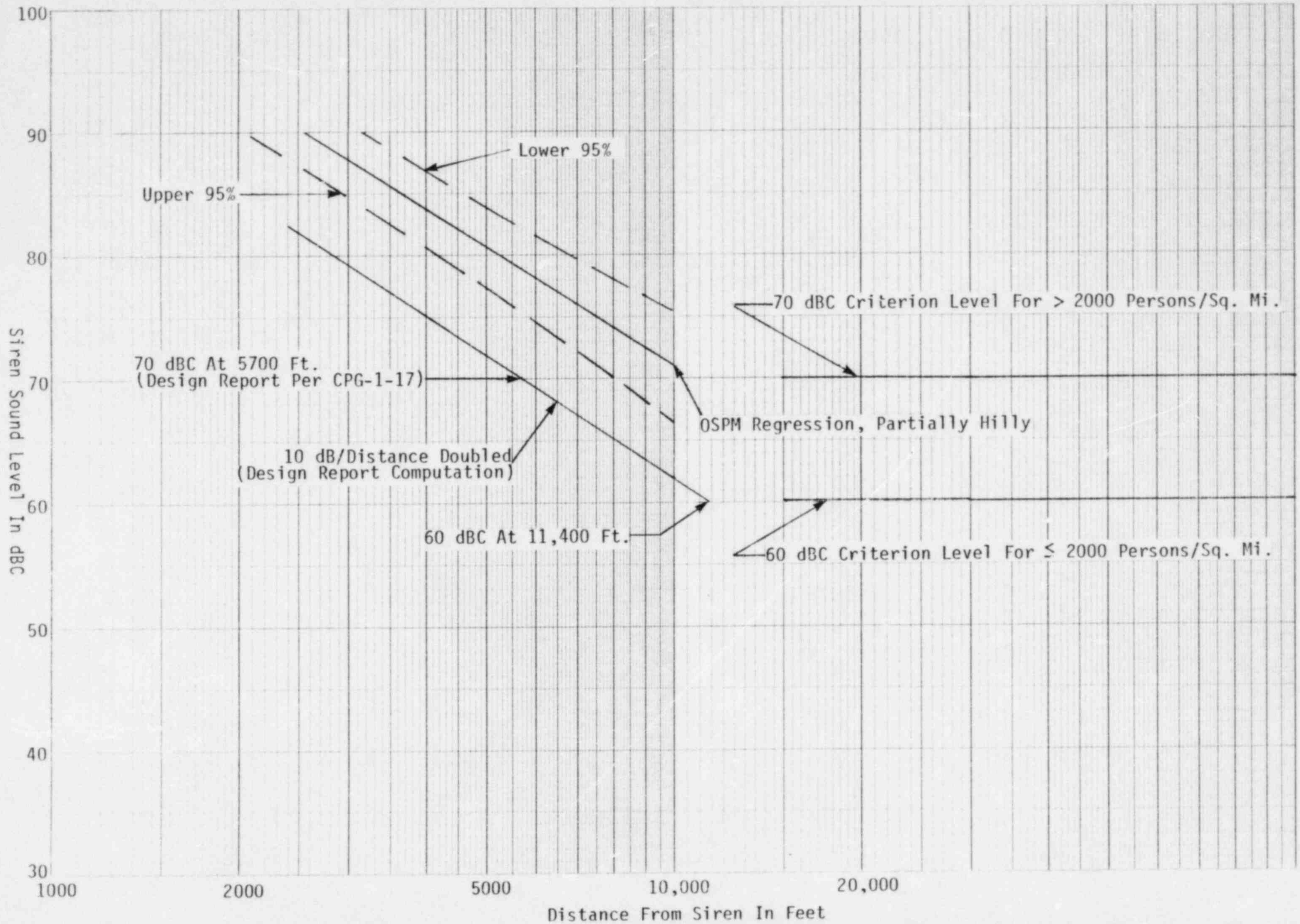


FIGURE 5

COMPARATIVE OSPM RESULTS, RELATIVELY FLAT TERRAIN (FS 1000 SIREN)

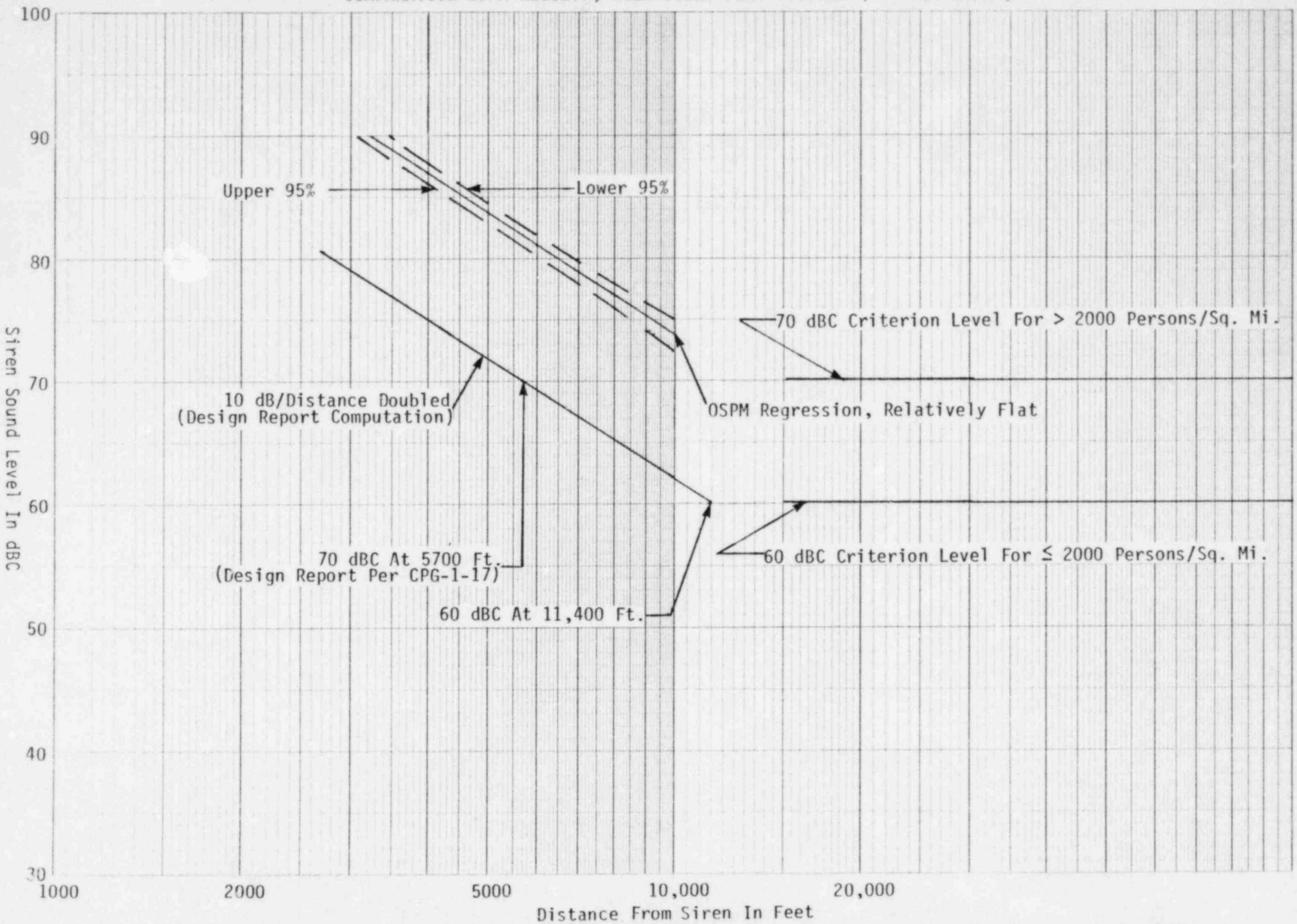


FIGURE 6

COMPARATIVE OSPM RESULTS, HILLY TERRAIN (FS STH10 SIREN)

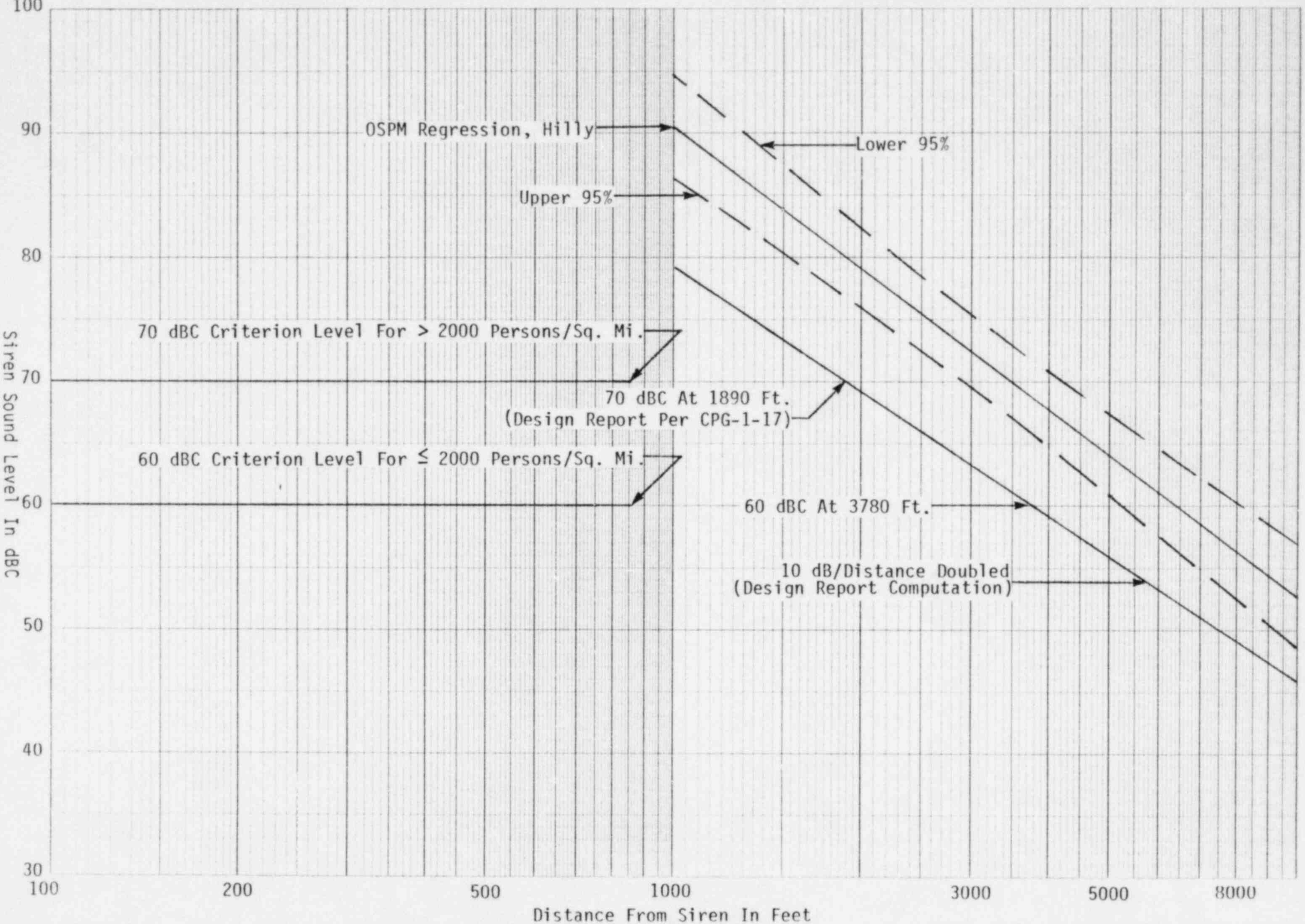


FIGURE 7

COMPARATIVE OSPM RESULTS, PARTIALLY HILLY TERRAIN (FS STH10 SIREN)

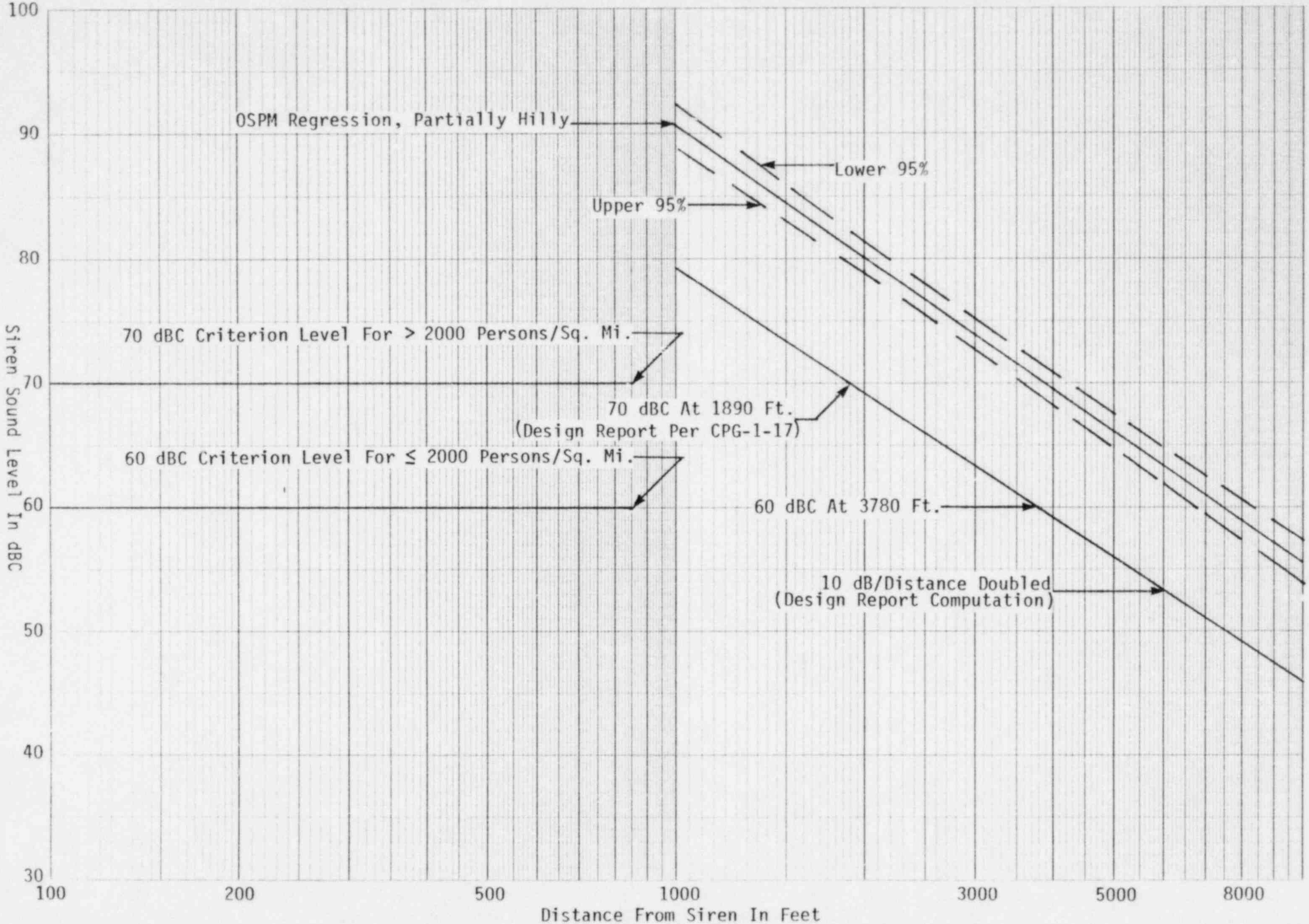
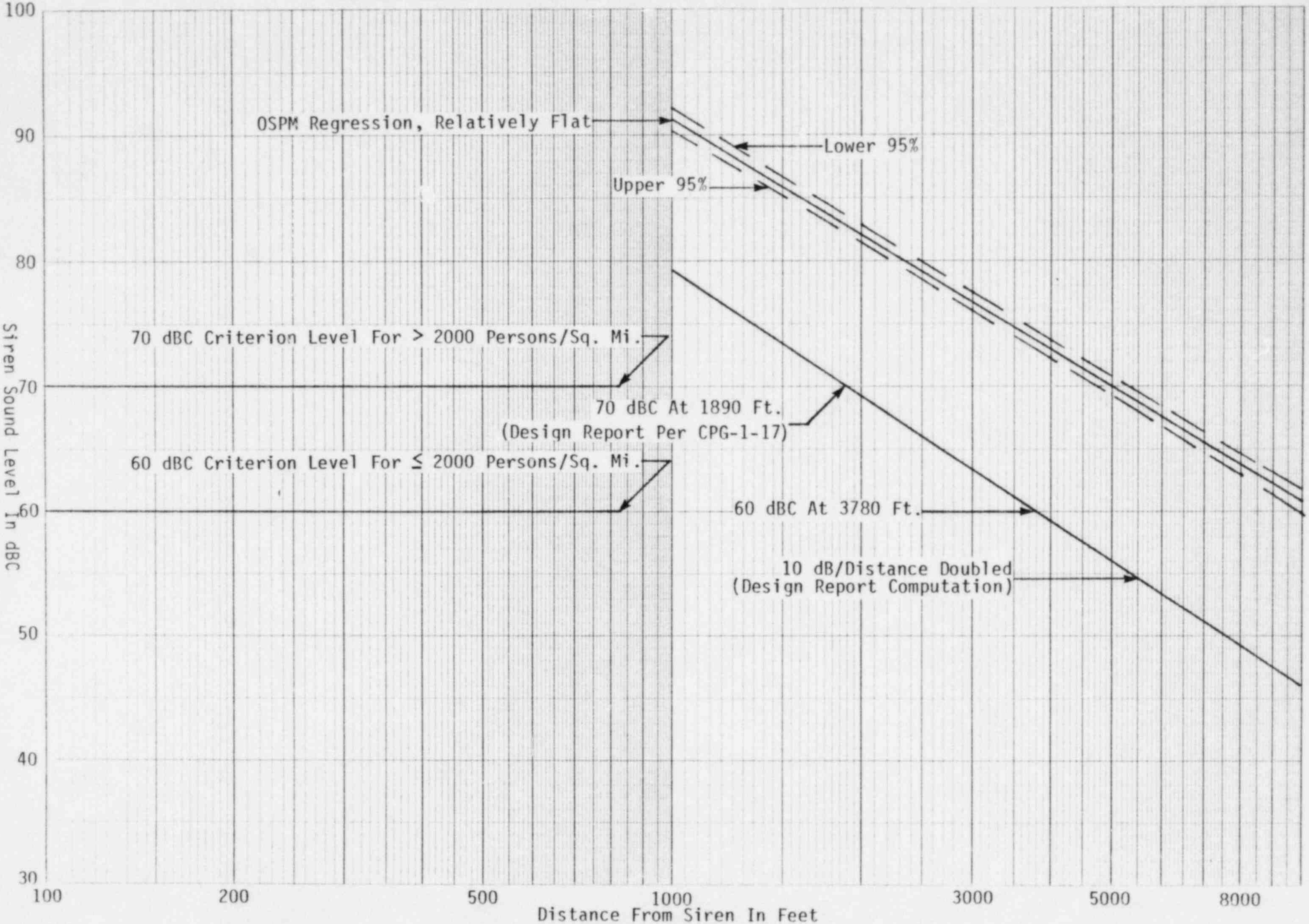


FIGURE 8

COMPARATIVE OSPM RESULTS, RELATIVELY FLAT TERRAIN (FS STH10 SIREN)



Siren Type	70 dBC (ft)	60 dBC (ft)
FS 1000	5700	11,400
FS STH10	1890	3780
FS Model 2	690	1380
FS LCS	-	740

These ranges are conservative over relatively flat terrains, with the conservatism being pronounced for the 70 dBC range estimates. In addition, the range estimates that include the barrier attenuation procedure over partially hilly and hilly terrains adequately account for the site terrain characteristics.

The results of the individual OSPM runs were combined to generate a comprehensive overview of the siren sound pressure levels over the Marseilles area. A logarithmic distance-weighted interpolation was performed on the output results of the three sirens to generate a grid of 44 by 44 dBC values over the entire map area. Each siren's dBC output was interpolated over this grid.

The maximum dBC values at each grid point were then used to compute the siren sound pressure level contours as shown in Figure 2. These contours account for the site-specific topographical and meteorological effects. Comparison of the OSPM predicted 70 dBC contours with the Design Report's 70 dBC contours indicates that the siren coverage (as discussed in the Design Report) in Marseilles is slightly more conservative than those coverages projected by OSPM.

The design procedure results in a reasonable overall estimate of the system coverage, in that it: (1) utilizes the 10 dB loss per distance doubled estimate, (2) utilizes barrier attenuation corrections, and (3) does not take credit for the logarithmically additive effects of omni-directional sirens when computing 60 dBC sound pressure level contours.

Thus, the La Salle Nuclear Power Station siren alerting system is found to meet the specific design requirements of FEMA-43.

2. Special Alerting (E.6.2.4, FEMA-43)

A method of special alerting, route alerting, is employed to alert persons within those geographical areas of the EPZ not covered by the siren system. The route alerting, therefore, is employed in the geographical area within a radius of 5 to 10 miles from the La Salle Nuclear Power Station. This method of special alerting involves emergency/law enforcement vehicles, equipped with public address systems, traversing predetermined mobile alert and notification routes.

Activation of the route alerting system, as indicated in Figure 1, is the responsibility of local organizations. The mobile alert and notification network is designed around the keyhole concept such that the mobile alert and notification routes are centered on and prioritized by the appropriate three downwind sectors of the EPZ. In an accident situation, under the keyhole concept, the downwind sectors have

immediate priority of public alert and notification. The nearest emergency/law enforcement vehicles that support these three sectors are assigned the priority routes within the three sectors by the La Salle County Sheriff's Dispatcher and/or the Grundy County Sheriff's Dispatcher.

These existing special alerting resources are supplemented by mutual aid agreements currently on record with the appropriate state and local emergency response organization. As stated in Section 2.7 of the Design Report, all special alerting routes within the La Salle Nuclear Power Station EPZ can be completed within a 45-minute time span, in accordance with NUREG-0654/FEMA-REP-1, Rev. 1.[9]

Institutional alerting is addressed in Section J of the La Salle County Plan and the Grundy County Plan, both of which are contained within the Illinois Plan for Radiological Accidents.[3] These sections identify special concerns within the two counties and their communities. The following special concerns within each county are identified: schools, hospitals, nursing homes, subdivisions, recreational facilities, industrial complexes, disabled and handicapped citizens, and provisions for notifying the Illinois Commerce Commission in communities and areas that have railroad crossings. Specific responsibilities for notification and specific protective actions for these special concerns have been designated within the La Salle County Plan and the Grundy County Plan.

III. FINDINGS FOR EVALUATION CRITERION N.1

On December 4, 1984, the physical means (sirens and route alerting) used to alert the population within the La Salle Nuclear Power Station EPZ were demonstrated to satisfy the alert and notification aspects of 44 CFR 350.9(a). This demonstration was conducted by using methods specified in Section N.1.(a,b).2 of FEMA-43.[10] The results indicate that this portion of the alert and notification system evaluation conforms to FEMA-43 and NUREG-0654/FEMA-REP-1, Rev. 1.[9]

The December 4, 1984, demonstration of the La Salle Nuclear Power Station siren system consisted of a double activation of all sirens, a route alerting demonstration, and a subsequent telephone survey to estimate the proportion of EPZ households actually alerted. Siren activations were initiated at approximately 10:00 a.m. and 10:08 a.m. (Central Standard Time). All sirens were reported operating during the activations. Route alerting began at 10:00 a.m. (Central Standard Time).

The telephone survey of EPZ residences began at approximately 10:13 a.m. (Central Standard Time) and was completed within one hour and 2 minutes. This survey was conducted by approximately 40 telephone interviewers, each with a separate WATS line and computer terminal.

The universe of households to be surveyed was determined by establishing a 10-mile-radius circle around the latitude and longitude of the plant. The sample incorporated a sorted master list of approximately 2500 households (addresses and telephone numbers) within the established boundary.

Replicated subsamples were developed from this master list. In order to properly account for route alerting, one replicated subsample of households was analyzed in greater detail than is usually required. The size of this subsample was calculated so that:

- It was sufficiently large to support interviewing efforts for as long as possible and to minimize any down time associated with the waiting period between interviewing households in siren coverage areas and the 45 minutes for completion of route alerting, so that interviews in route alerting areas could begin; and

- It was small enough in size to ensure that the total sample was representative of the EPZ (i.e., to ensure that a disproportionate number of interviews were not completed in siren coverage areas simply because interviewing could be started in these areas about 40 minutes earlier).

All households in this systematically drawn subsample were screened by checking their addresses against street maps showing siren coverage areas and route alerting areas. The subsample was sorted into two groups: (1) households that were positively identified as being in siren coverage areas (and therefore could be contacted immediately after activation) and (2) households that either were in route alerting areas or had uncertain geographic locations (such as post office boxes or rural route addresses). In addition, all households in the entire sample that could be positively identified as being outside the EPZ were removed from the sample.

Immediately following the second siren activation, interviews were begun with households in the subsample that had been definitely identified as being in the siren coverage area. Interviews were attempted with all of these households until this group of the subsample was exhausted. Forty-five minutes after route alerting began, interviews started with the group of households in the subsample that were in route alerting areas or that could not be precisely located. Interviews were attempted with all of these households until this group of the subsample was exhausted. As soon as this replicate subsample was exhausted, interviews were begun using the remaining replicate subsamples.

A sufficient number of replicate subsamples were developed from the overall sample to ensure that the required number of telephone calls would be made, i.e., to establish the proportion of households alerted to within a 5% precision at a 95% confidence level. Appendix B of this report describes the method for sizing the sample to achieve this result.

The questionnaire used for the telephone survey is included as Figure 9.

As part of the telephone survey, a total of 302 households within the La Salle Nuclear Power Station EPZ were contacted and their responses were collected in an automated data base. Of this group, 71 respondents stated that they were not alerted. However, before running the final tabulations, addresses of all households interviewed were checked on a street map to validate their locations. Of the 302 addresses, 16 were outside the EPZ. Therefore, data were tabulated on the 286 respondent households located within the EPZ. Respondents at 13 of these households had been away from home at the time of the

FIGURE 9

#2316Q
Chilton Research Services
Radnor, Pennsylvania

Study #8523
December 4, 1984

OMB #3067-0103 (FEMA 9/85)
FEMA NUCLEAR POWER PLANT ALERTING AND NOTIFICATION SYSTEM: PUBLIC TELEPHONE SURVEY

LA SALLE NUCLEAR POWER STATION

Time Dialed ________AM ______PM

Time Began ________AM ______PM

Time Ended ________AM ______PM

Interview #______________ (1-3)

Zip Code ______________ (6-10)

INTERVIEWER: Enter Sample Type ______________ (11)

RECORD BEFORE DIALING - Telephone # ________________________________
(Area Code) (Exchange) (Number) (12-21)

INTRODUCTION:

Hello, my name is ____________________. We're calling households long distance from Chilton Research Services as part of a survey. This survey is sponsored by The Federal Emergency Management Agency (FEMA) of the United States Government.

Your answers are voluntary and will be kept strictly confidential.

1. First of all, is this (REPEAT # DIALED)?

	Yes	1
TERMINATE AND DIAL AGAIN	No	2

2. As you may or may not know, there was a test of the public warning/alert notification system for THE LA SALLE NUCLEAR POWER STATION. Did you, or any other member of this household, hear any type of emergency warning/alert signal from this test today?

22-

CONTINUE	Yes	1
SKIP TO Q. 4A	No	2
CONTINUE	Heard from another source	3
ASK IF ANY OTHER HOUSEHOLD MEMBER IS MORE KNOWLEDGEABLE	Don't Know	8

FIGURE 9 (CONTINUED)

What did you or your household hear? (DO NOT READ. CIRCLE ALL THAT APPLY)

(23-29)

SKIP TO Q. 4	Siren (PROBE FOR TYPE)		
		Large pole-mounted	1
		Police or Fire Vehicle	2
		Don't Know	3
	Neighbor told me		4
	Other family member told me		5
	Other: (SPECIFY) ____________		0
CONTINUE	Don't Know		Y

A. Did you hear . . . (READ LIST. CIRCLE ALL THAT APPLY)

(30-36)

	Large Pole-mounted siren	1
	Police or Fire Vehicle Siren	2
	From a neighbor	4
	From another family member	5
	Or by means of something else (SPECIFY) ____________	6
DO NOT READ	Siren - Don't know type	3
	Don't Know	Y

4. (IF "HEARD EMERGENCY SIGNAL" ASK Q. 4 BELOW; OTHERWISE SKIP TO Q. 4A)

Were you at home or away from home when you were made aware of this emergency test signal?

37-

SKIP TO Q. 5	Home	1
	Away from home	2

4A. (IF "DID NOT HEAR EMERGENCY SIGNAL")

Were you at home around (TIME OF ALERT) today?

38-

Yes	1
No	2
Don't Know	Y

5. Has your household ever received instructions which tell you what to do in the event of a "real" emergency at La Salle Nuclear Power Station? This large booklet with white letters titled "Emergency Information" was mailed to you from Commonwealth Edison in October, 1984. Do you remember receiving this information?

39-

Yes	1
No	2
Don't Know	Y

6. Because we need to determine whether or not you live within the 10 mile Emergency Planning Zone of La Salle, would you please give me this address? (PAUSE FOR ANSWER)

ADDRESS:

____

____

and the nearest intersection (or cross street) to this house.

____

Also, what community is this?

____

On behalf of Chilton Research Services and the Federal Emergency Management Agency, I would like to thank you for your time and for giving us this valuable information.

alerting system demonstration and, therefore, were not included in the alerting analysis. Of the remaining 273 households, 82.0% (224) indicated that they had been alerted during the demonstration. Using the estimated number of households within the EPZ (4510 from reference 2) in the confidence interval expression in Appendix B, an estimated 95% confidence interval that ranges from 77.2% to 86.0% was yielded for the proportion of the total EPZ population alerted. In other words, at the 95% confidence level, between 77.2% and 86.0% of the households within the La Salle Nuclear Power Station EPZ were alerted by the siren and route alerting systems.

The sample of 286 households was also used to estimate the proportion of households within the EPZ that would have stated they received information about what to do in a real emergency at the La Salle Nuclear Power Station. Of these 286 households, 82.2% (235) responded that they had received the information, 16.8% (48) responded that they had not received the information, and 1.0% (3) did not know or refused to state whether they had received the information. Using the approach discussed previously, the following estimates for the entire EPZ population resulted (at the 95% confidence interval):

- Between 77.5% and 86.0% of the households would have reported receiving the information;
- Between 13.0% and 21.4% of the households would have responded that they had not received the information; and
- Between 0.4% and 2.9% of the households would not have known or refused to state whether they had received the information.

In conclusion, no areas of the La Salle Nuclear Power Station siren or route alerting systems were identified as needing enhancements.

IV. FINDINGS FOR EVALUATION CRITERIA E.5, F.1, N.2, N.3, AND N.5

Those aspects of the alert and notification system addressing evaluation criteria E.5, F.1, N.2, N.3, and N.5 of NUREG-0654/FEMA-REP-1, Rev. 1, have been reviewed by FEMA and found to be adequate to provide reasonable assurance that appropriate protective measures can be taken off site in the event of a radiological emergency. This conclusion is documented in a letter to the Honorable James R. Thompson, Governor of Illinois, dated June 4, 1982, signed by Lee M. Thomas, FEMA Associate Director, State and Local Programs and Support.[8] In this letter, the La Salle Nuclear Power Station received FEMA approval under 44 CFR 350, conditioned on an ultimate approval and verification of the public alert and notification system as called for in NUREG-0654/FEMA-REP-1, Rev. 1.

REFERENCE LIST

1. Nuclear News. 1984. "World list of nuclear power plants." Vol. 27, No. 10. August 1984.

2. Illinois Emergency Services and Disaster Agency and Commonwealth Edison Company. 1984. "An off-site emergency plan alert and notification addendum for the La Salle Nuclear Power Station." April 1984. Also: "La Salle Nuclear Power Station Siren System Operational Reliability Determination." FEMA Region V. August 13, 1984.

3. State of Illinois. 1982. "The Illinois plan for radiological accidents." Volumes I and III. March 1982.

4. Federal Emergency Management Agency. 1980. "Post exercise evaluation, State of Illinois and Grundy and La Salle Counties exercise of the Illinois Plan for Radiological Accidents for La Salle Nuclear Power Plant, December 4, 1980." (No date).

5. Federal Emergency Management Agency. 1982. "Final report, La Salle Nuclear Power Station full-scale exercise, April 14-15, 1982." May 1982.

6. Federal Emergency Management Agency. 1983. "Exercise final report, La Salle Nuclear Power Station joint radiological emergency exercise, July 12, 1983."

7. Federal Emergency Management Agency. 1985. "Exercise report, La Salle Nuclear Power Station, joint exercise (partial participation), October 10-11, 1984." November 26, 1984, as revised March 26, 1985.

8. Federal Emergency Management Agency. 1982. Letter to the Honorable James R. Thompson, Governor of Illinois, from Lee M. Thomas, Associate Director, State and Local Programs and Support. June 4, 1982.

9. Nuclear Regulatory Commission and Federal Emergency Management Agency. 1980. "Criteria for preparation and evaluation of radiological emergency response plans and preparedness in support of nuclear power plants." NUREG-0654/FEMA-REP-1. Revision 1. November 1980.

10. Federal Emergency Management Agency. 1983. "Standard guide for the evaluation of alert and notification systems for nuclear power plants." FEMA-43. September 1983.

11. International Energy Associates Limited. 1983. "Analysis of siren system pilot test." IEAL-333. November 2, 1983.

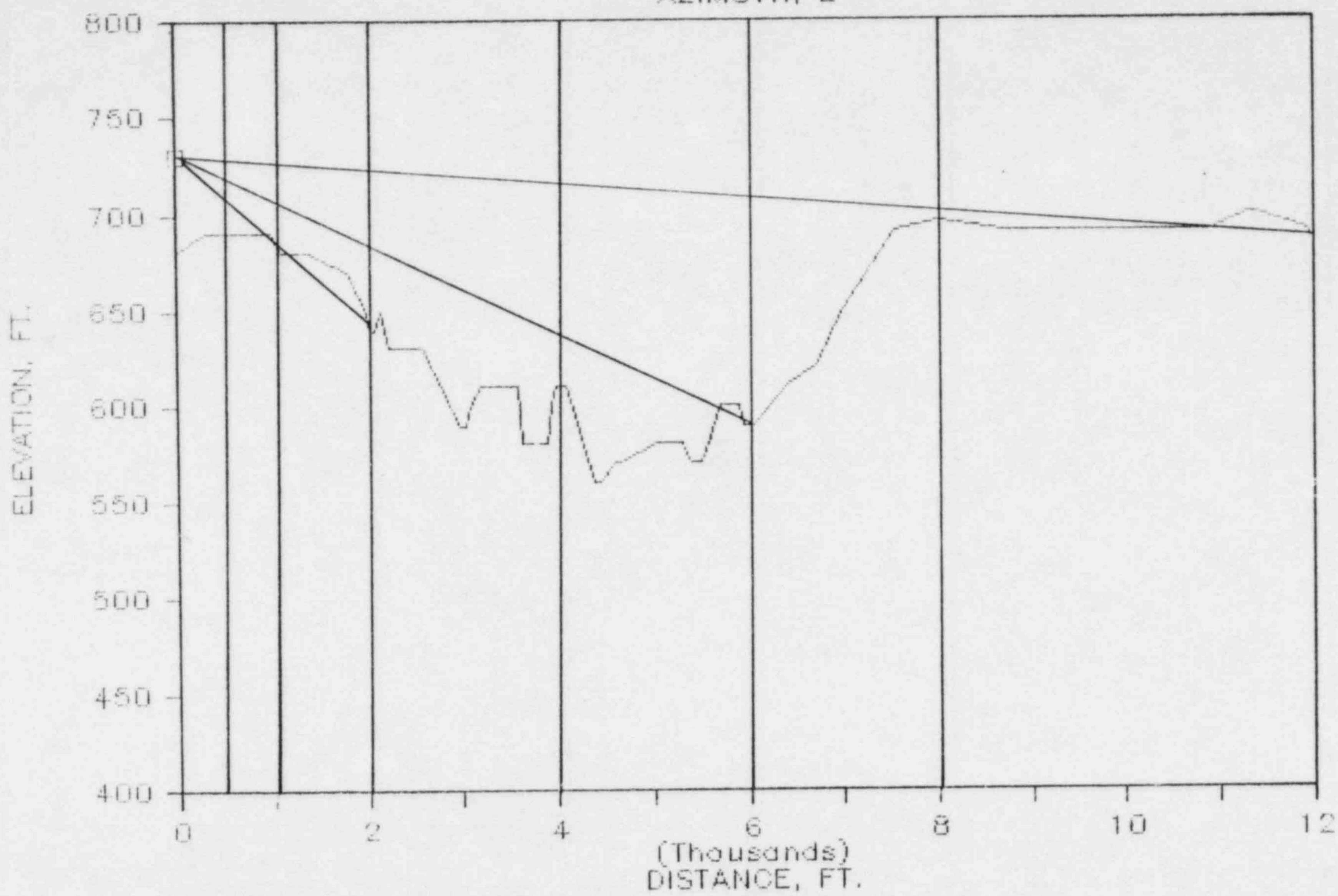
12. Beranek, Leo L., et al. 1971. "Noise and vibration control." McGraw-Hill, Inc. 1971.

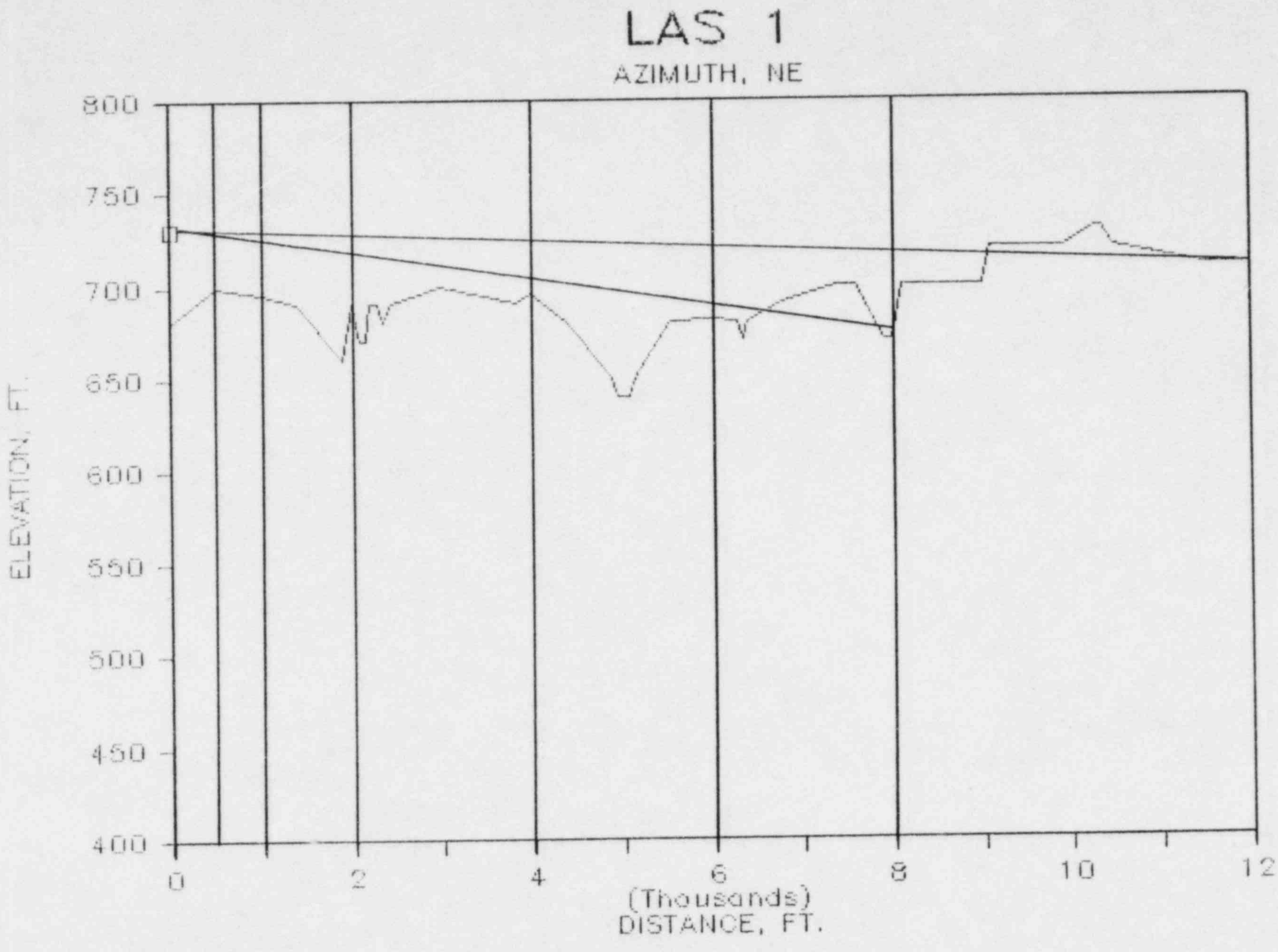
APPENDIX A

OSPM Topographical Profile Charts
OSPM Topographical Input Data
OSPM Siren Sound Pressure Level Input Data
OSPM Meteorological Input Data
OSPM Siren Sound Pressure Level Output Data

LAS 1

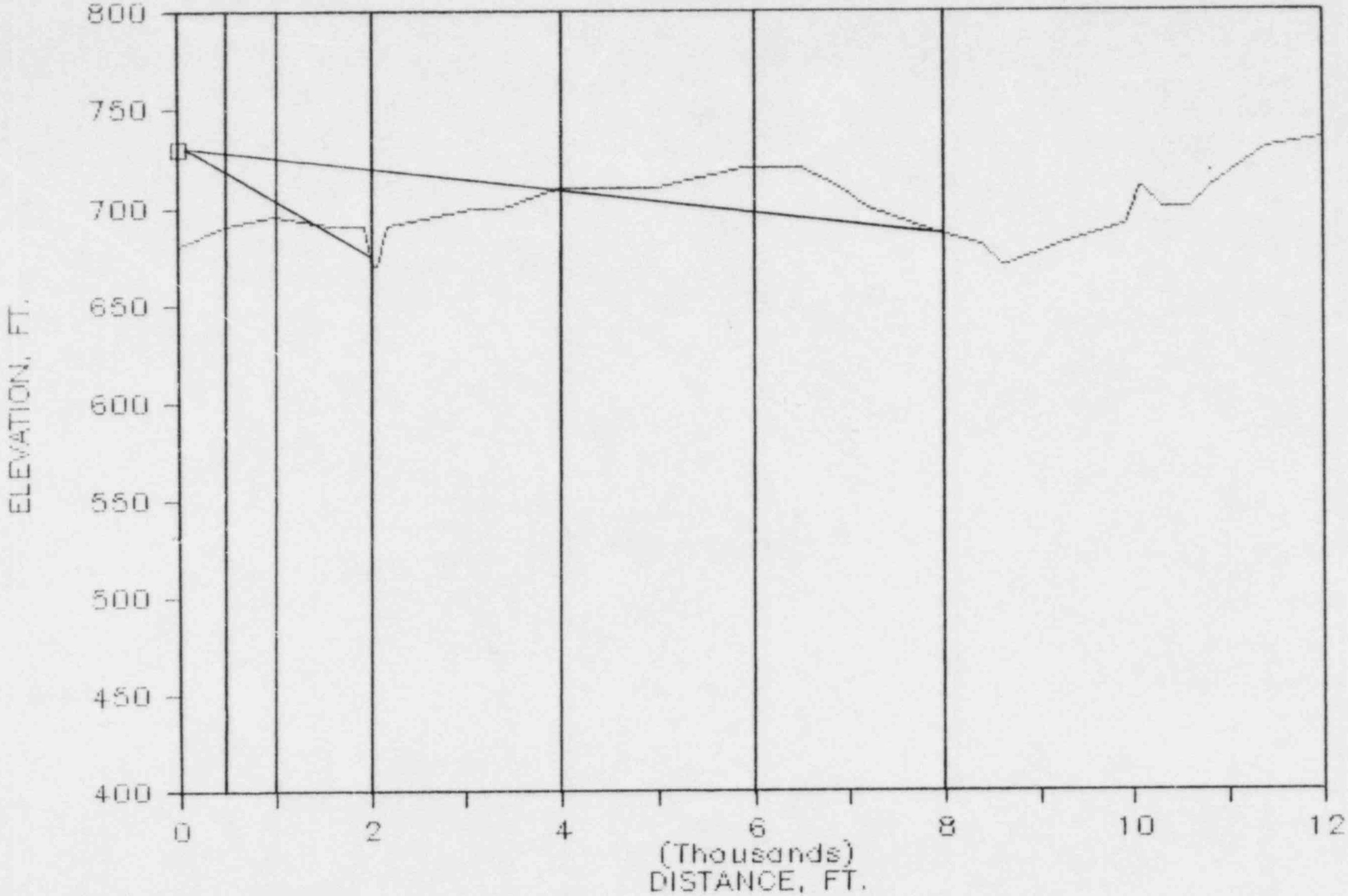
AZIMUTH, E

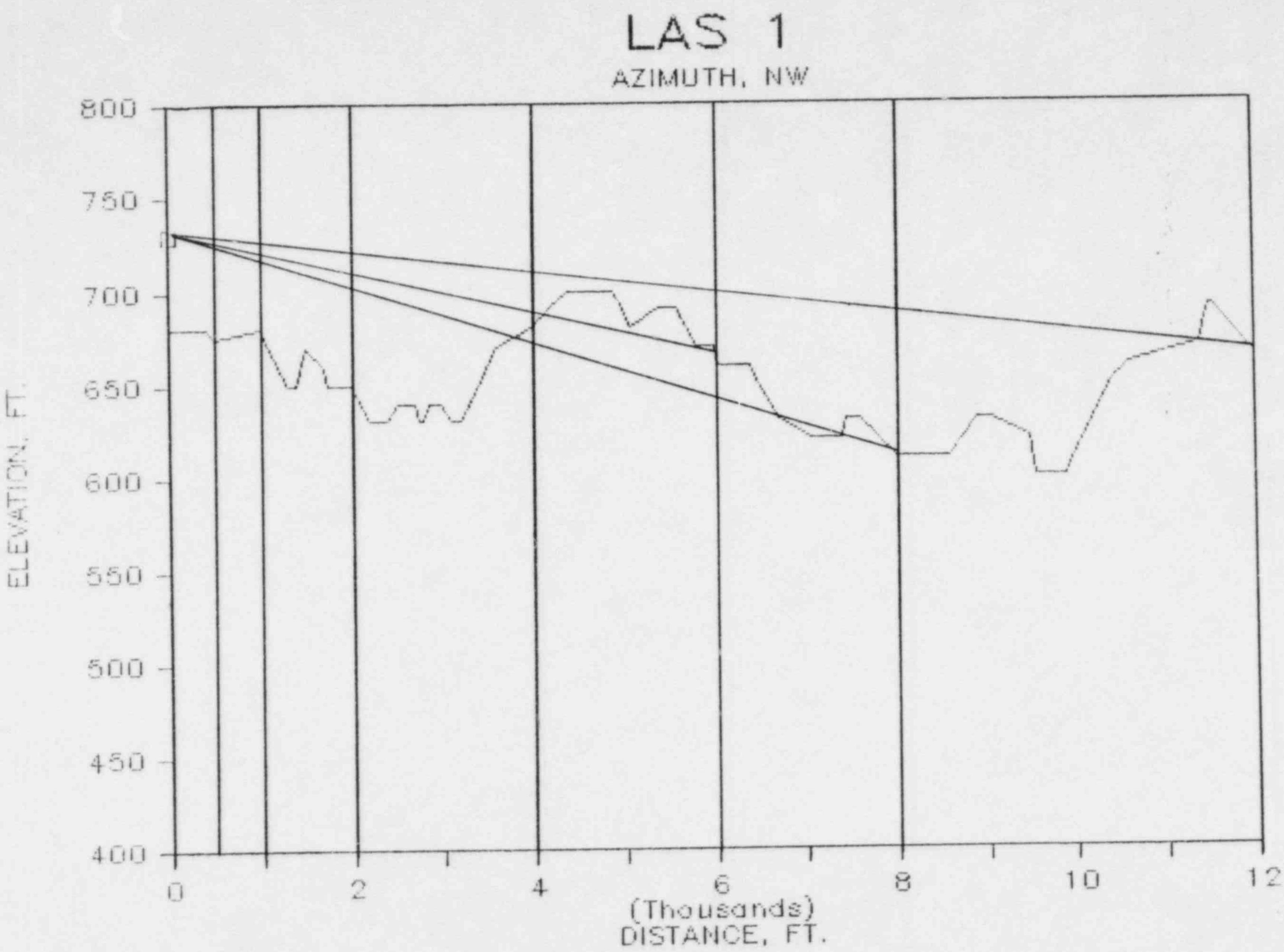



LAS 1
AZIMUTH, NE
800
750
700
650
600
550
500
450
400
ELEVATION, FT.
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT.

LAS 1

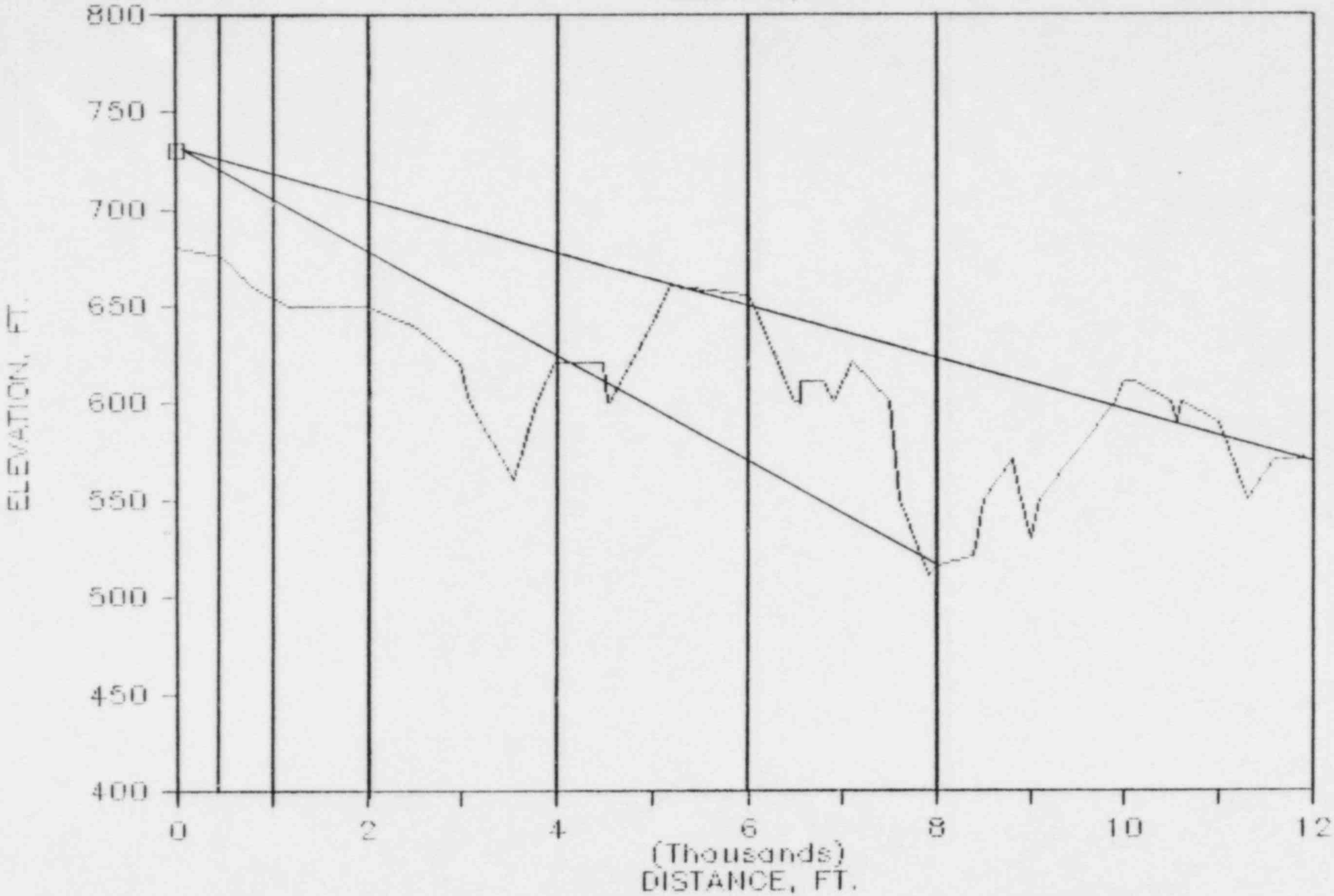
AZIMUTH, N

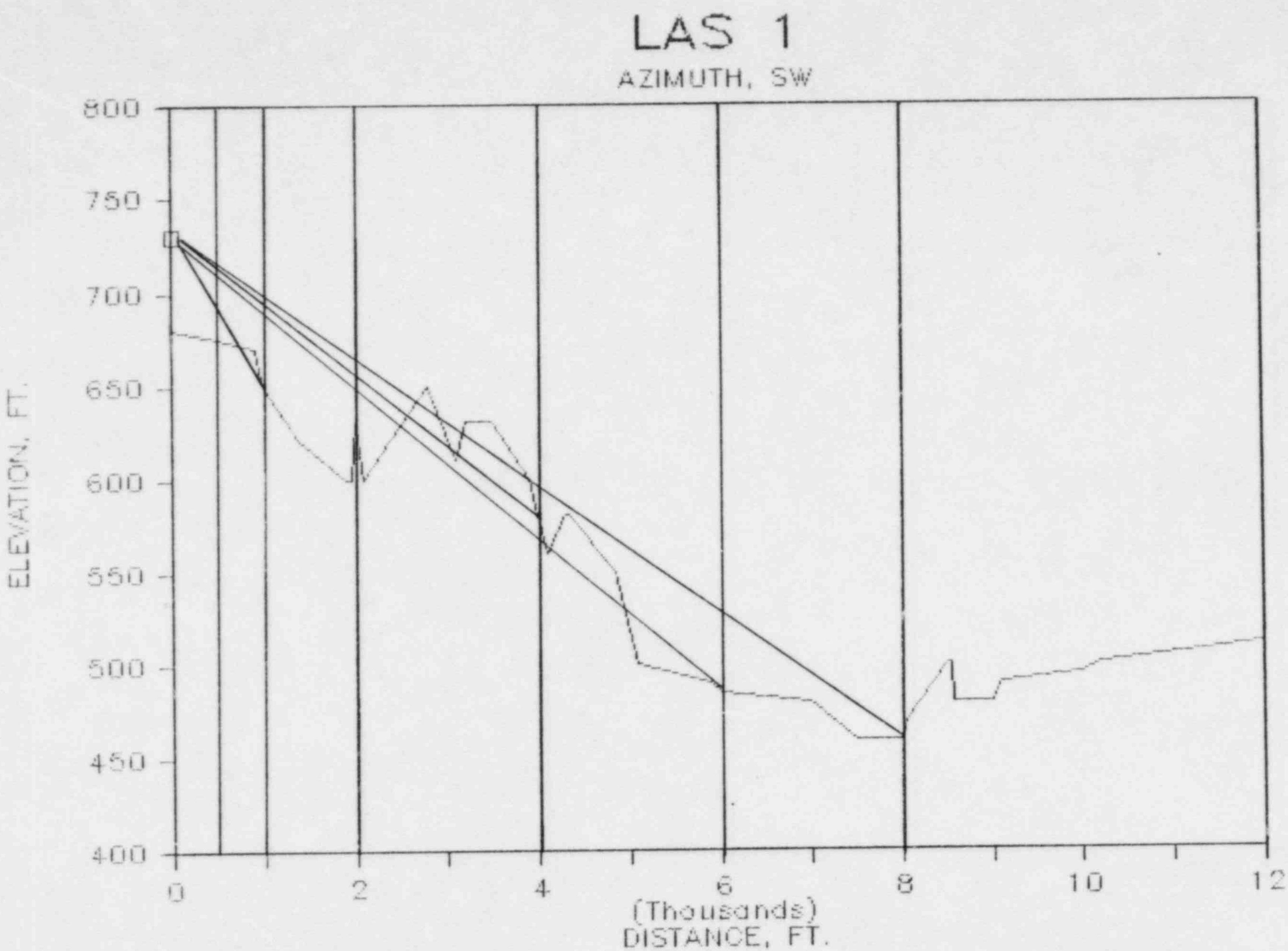



LAS 1
AZIMUTH, NW
ELEVATION, FT.
800
750
700
650
600
550
500
450
400
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT.

LAS 1

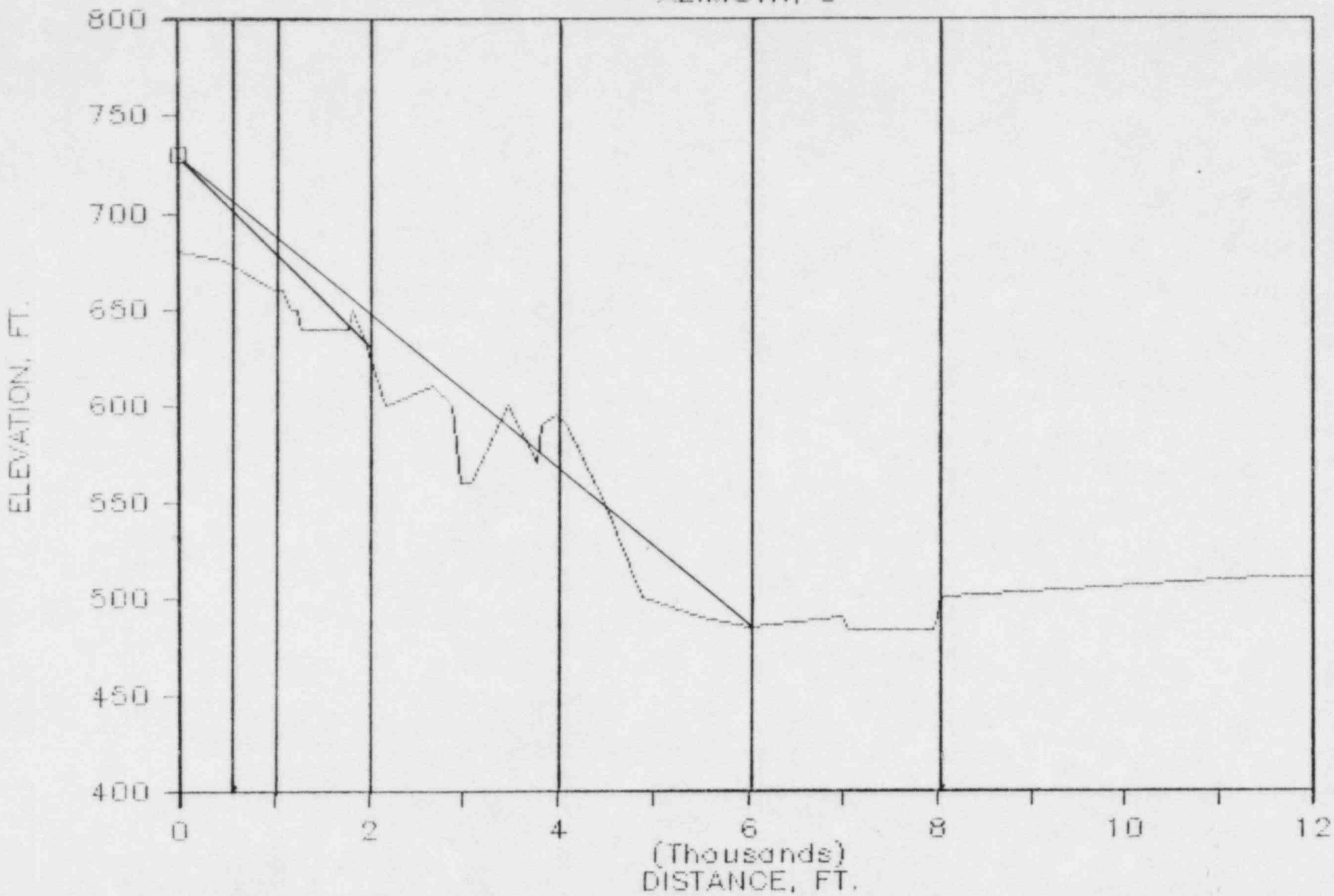
AZIMUTH, W

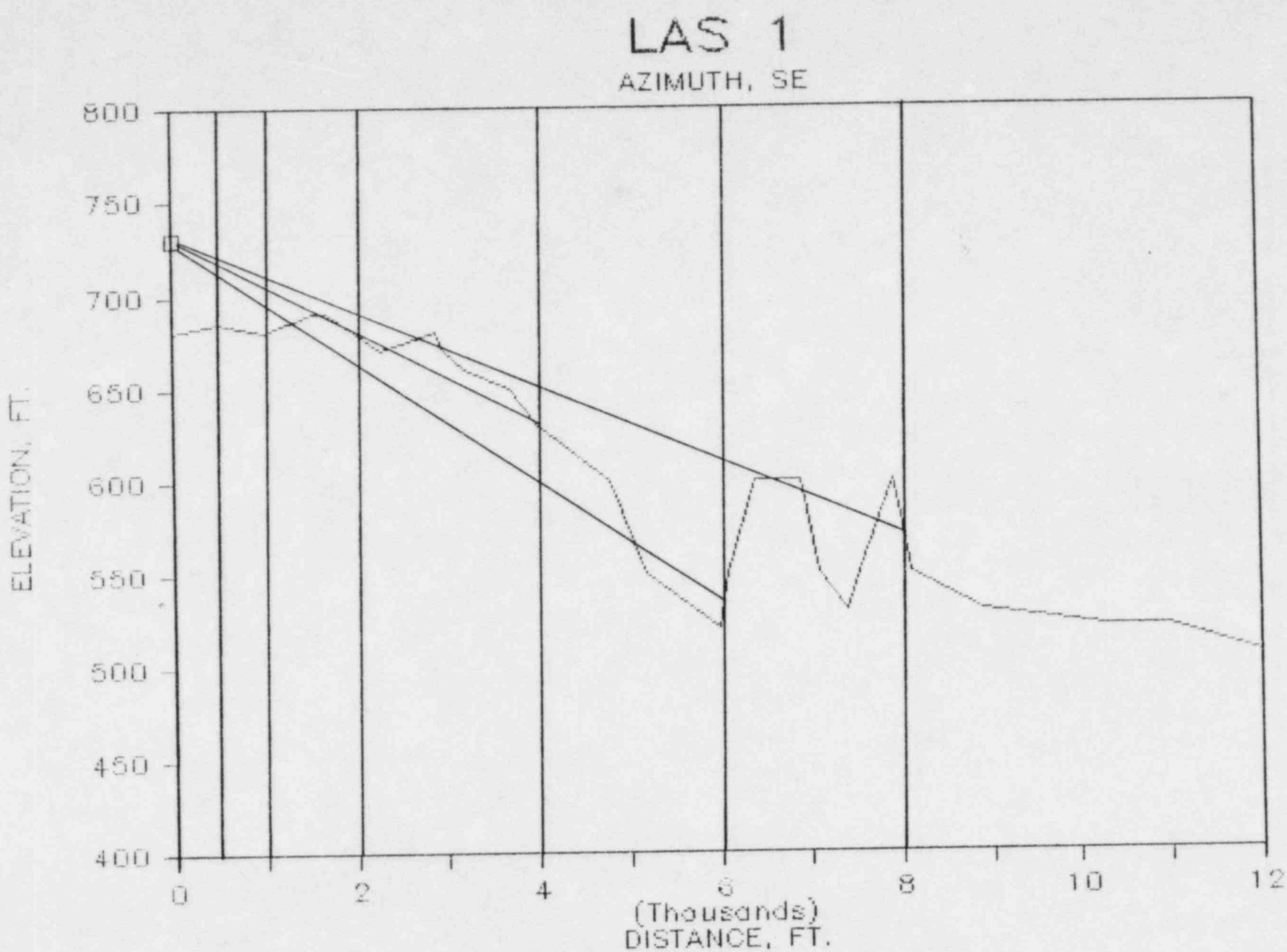



LAS 1
AZIMUTH, SW
800
750
700
650
600
550
500
450
400
ELEVATION, FT.
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT.

LAS 1

AZIMUTH, S




LAS 1
AZIMUTH, SE
ELEVATION, FT.
800
750
700
650
600
550
500
450
400
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT.

COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #1
SOURCE-RECEIVER TOPOGRAPHICAL INPUTS

· ALL BEARINGS ARE WITH RESPECT TO THE NORTH MEASURING CLOCKWISE

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
1	500.	90.00	700.00	SOFT	0.	NO	0.	0.
2	1000.	90.00	695.00	SOFT	0.	NO	0.	0.
3	2000.	90.00	690.00	SOFT	0.	NO	0.	0.
4	4000.	90.00	695.00	SOFT	0.	NO	0.	0.
5	6000.	90.00	682.00	SOFT	0.	NO	0.	0.
6	8000.	90.00	670.00	SOFT	0.	YES	5900.	600.
7	12000.	90.00	710.00	SOFT	0.	YES	11450.	715.
8	500.	45.00	690.00	SOFT	0.	NO	0.	0.
9	1000.	45.00	695.00	SOFT	0.	NO	0.	0.
10	2000.	45.00	680.00	SOFT	0.	YES	7600.	700.
11	4000.	45.00	710.00	SOFT	0.	NO	0.	0.
12	6000.	45.00	720.00	SOFT	0.	NO	0.	0.
13	8000.	45.00	685.00	SOFT	0.	YES	10400.	730.
14	12000.	45.00	735.00	SOFT	0.	NO	0.	0.
15	500.	0.0	675.00	SOFT	0.	NO	0.	0.
16	1000.	0.0	680.00	SOFT	0.	NO	0.	0.
17	2000.	0.0	650.00	SOFT	0.	NO	0.	0.
18	4000.	0.0	680.00	SOFT	0.	NO	0.	0.
19	6000.	0.0	670.00	SOFT	0.	YES	1950.	690.
20	8000.	0.0	610.00	SOFT	0.	YES	6500.	720.
21	12000.	0.0	665.00	SOFT	0.	YES	4950.	700.
22	500.	315.00	675.00	SOFT	0.	NO	0.	0.
23	1000.	315.00	655.00	SOFT	0.	NO	0.	0.
24	2000.	315.00	650.00	SOFT	0.	NO	0.	0.
25	4000.	315.00	620.00	SOFT	0.	NO	0.	0.
26	6000.	315.00	655.00	SOFT	0.	NO	0.	0.
27	8000.	315.00	515.00	SOFT	0.	YES	4950.	700.
28	12000.	315.00	570.00	SOFT	0.	YES	4950.	700.
30	1000.	270.00	650.00	SOFT	0.	YES	6000.	655.
31	2000.	270.00	630.00	SOFT	0.	NO	0.	0.
32	4000.	270.00	580.00	SOFT	0.	YES	6000.	655.
33	6000.	270.00	485.00	SOFT	0.	YES	900.	670.
34	8000.	270.00	459.00	SOFT	0.	YES	3500.	640.
35	12000.	270.00	510.00	SOFT	0.	NO	0.	0.
36	500.	225.00	675.00	SOFT	0.	NO	0.	0.

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
37	1000.	225.00	660.00	SOFT	0.	NO	0.	0.
38	2000.	225.00	630.00	SOFT	0.	YES	3500.	640.
39	4000.	225.00	595.00	SOFT	0.	NO	0.	0.
40	6000.	225.00	485.00	SOFT	0.	YES	3500.	640.
41	8000.	225.00	490.00	HARD	0.	NO	0.	0.
42	12000.	225.00	510.00	SOFT	0.	NO	0.	0.
43	500.	180.00	685.00	SOFT	0.	NO	0.	0.
44	1000.	180.00	680.00	SOFT	0.	NO	0.	0.
45	2000.	180.00	680.00	SOFT	0.	NO	0.	0.
46	4000.	180.00	630.00	SOFT	0.	YES	1800.	650.
47	6000.	180.00	520.00	SOFT	0.	YES	4000.	595.
48	8000.	180.00	580.00	SOFT	0.	YES	2900.	680.
49	12000.	180.00	505.00	SOFT	0.	YES	2900.	680.
50	500.	135.00	0.0	NO	0.	1800	0.	0.
51	1000.	135.00	0.0	NO	0.	670.	0.	0.
52	2000.	135.00	0.0	YES	0.		0.	0.
53	4000.	135.00	0.0	NO	0.		0.	0.
54	6000.	135.00	0.0	YES	0.		0.	0.
55	8000.	135.00	0.0	NO	0.		0.	0.
56	12000.	135.00	0.0	YES	0.		0.	0.

COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #1
NOISE SOURCE POWER LEVEL INPUT

INDEX	SOURCE	DBA	DBC	31.5	63	125	250	500	1000	2000	4000	8000 (HZ)
1	LASALLE	165.9	167.9	0.0	0.0	0.0	0.0	167.0	158.0	157.0	150.0	148.0

XO= 0.0 YO= 0.0 ZO= 730.0 HEIGHT ABOVE GROUND= 50.0

COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #1
METEOROLOGICAL INPUT CONDITIONS

H1= 10.06 METERS H2= 100.58 METERS

YEAR	SEASON	MONTH	DATE	HOUR	WIND DIRECTION	WIND SPEED(MPS) H1	WIND SPEED(MPS) H2	TEMPERATURE(C) H1	TEMPERATURE(C) H2	RELATIVE HUMIDITY	BAROMETRIC PRESSURE(MM OF HG)
1983	3	7	1	12	180.0	3.7	5.2	25.0	24.4	70.0	744.0

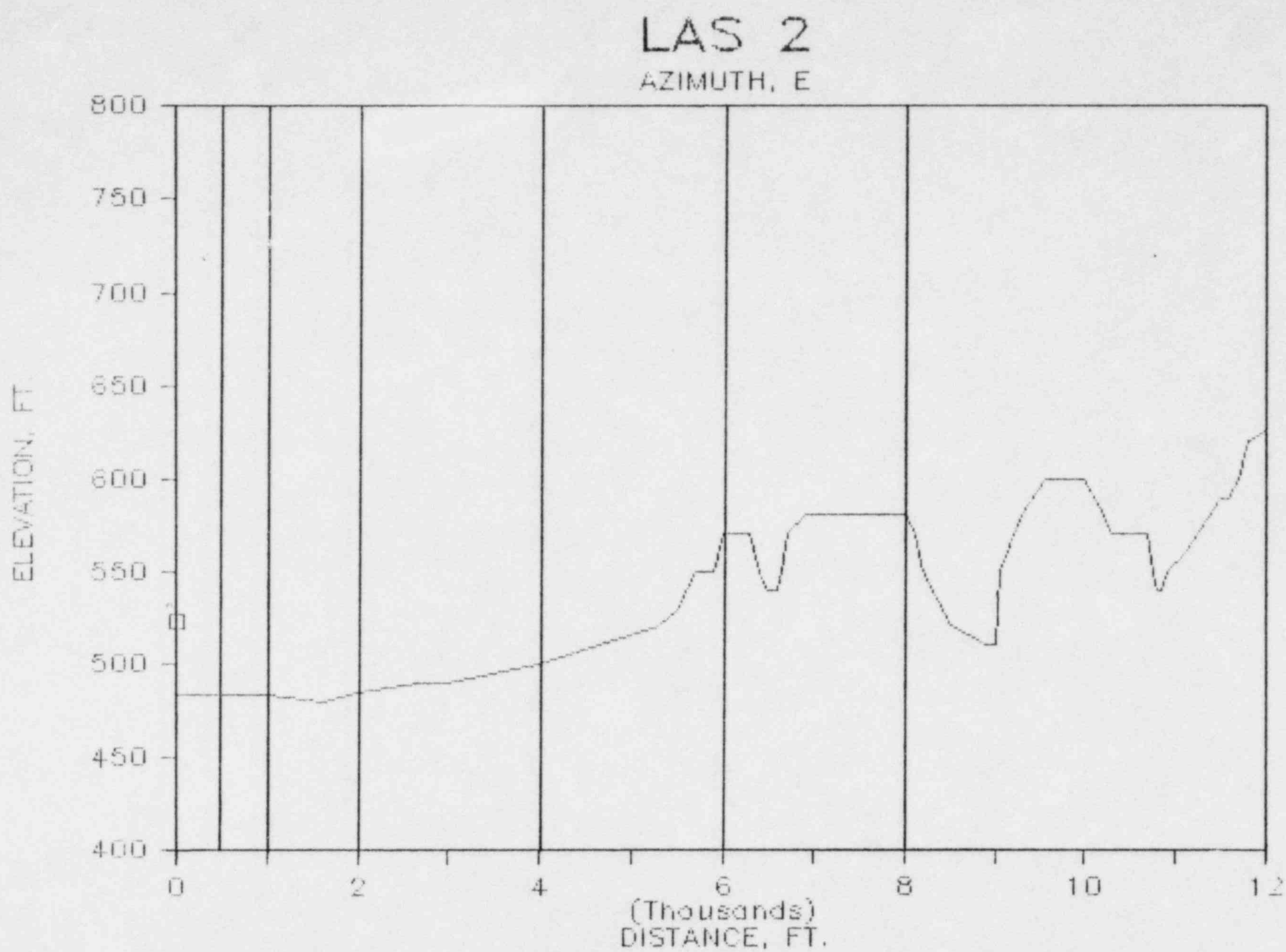
COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #1

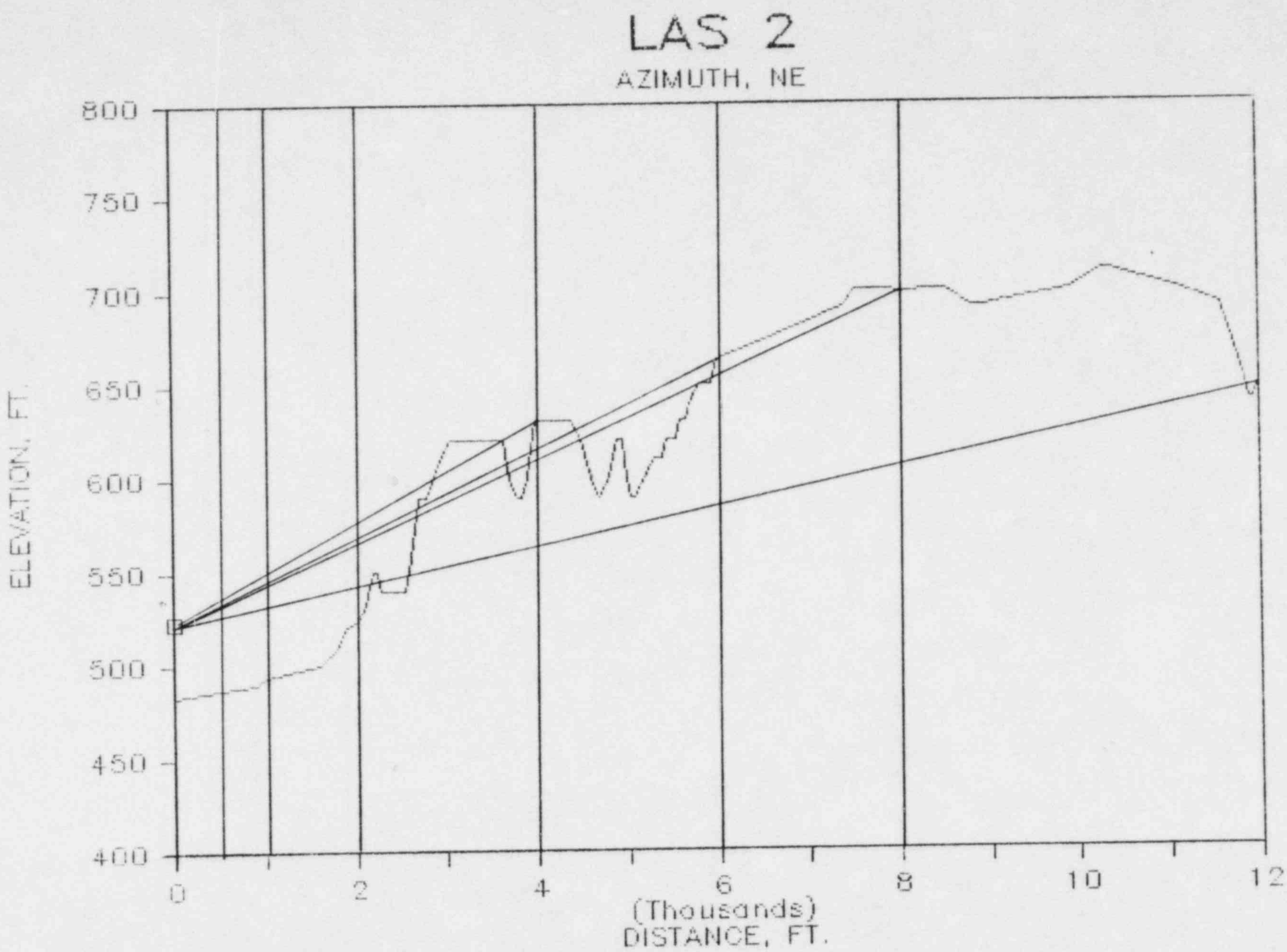
SIREN SOUND LEVELS IN DBC

UNDER MET CONDITION 1

DISTANCE IN FEET

AZIMUTH	500.	1000.	2000.	4000.	6000.	8000.	12000.
E	116.	106.	98.	91.	88.	70.	72.
NE	116.	106.	73.	91.	88.	59.	77.
N	116.	107.	98.	91.	81.	69.	72.
NW	116.	108.	98.	91.	88.	70.	70.
W	116.	83.	99.	66.	80.	77.	77.
SW	116.	108.	74.	91.	72.	75.	62.
S	116.	107.	98.	82.	78.	71.	58.
SE	85.	82.	76.	68.	58.	50.	37.

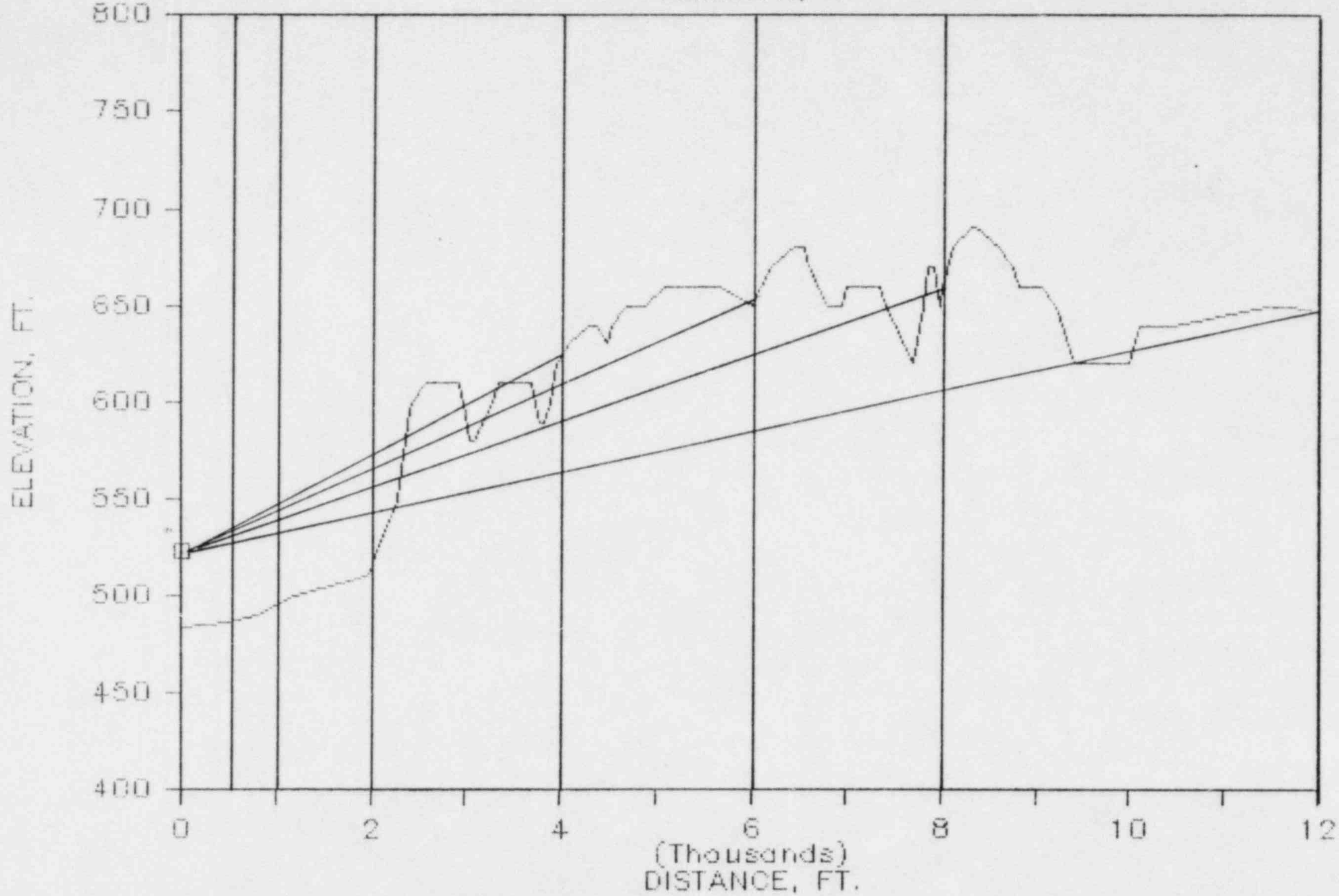

LAS 2
AZIMUTH, E
800
750
700
650
600
550
500
450
400
ELEVATION, FT
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT.

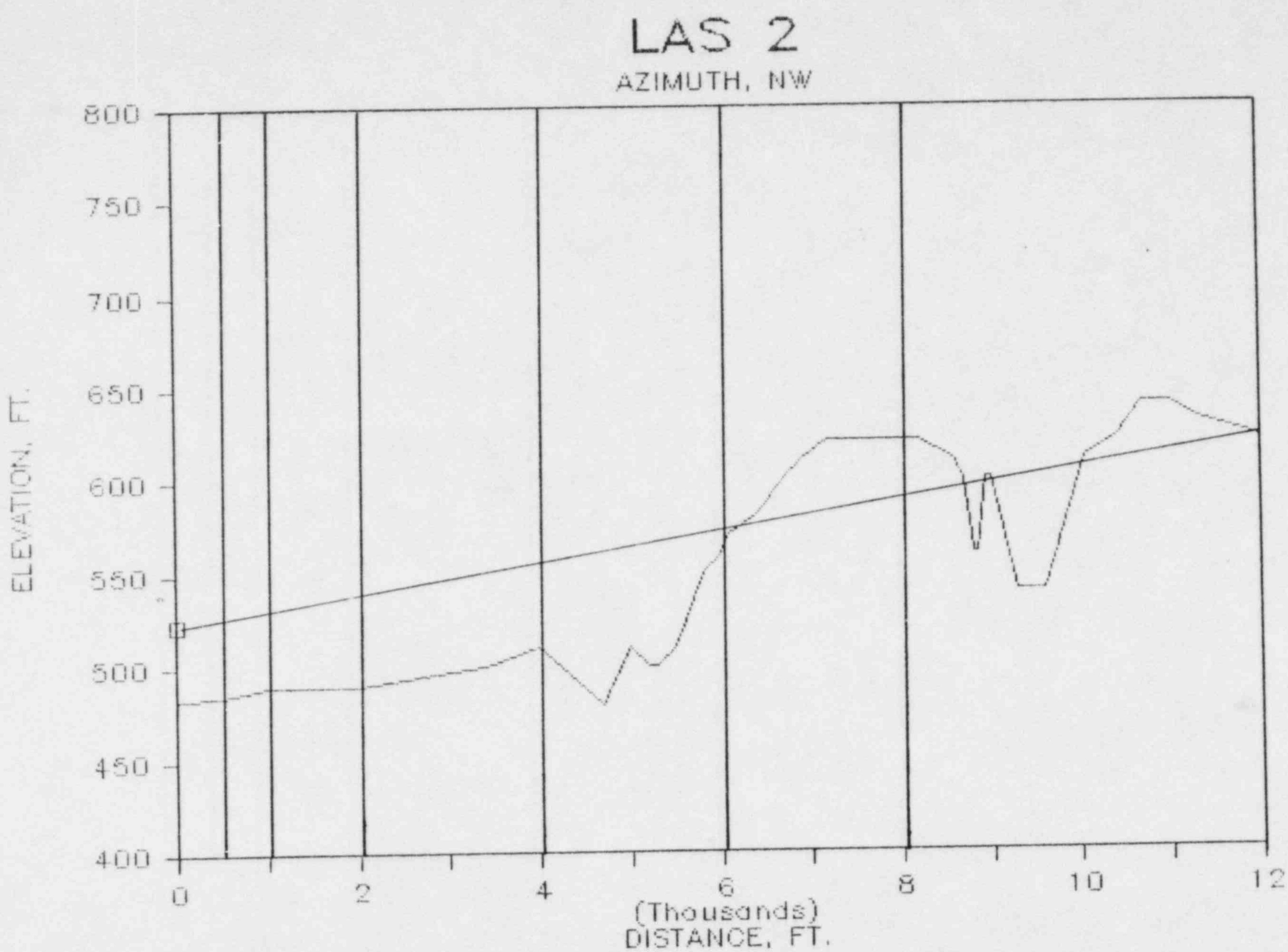


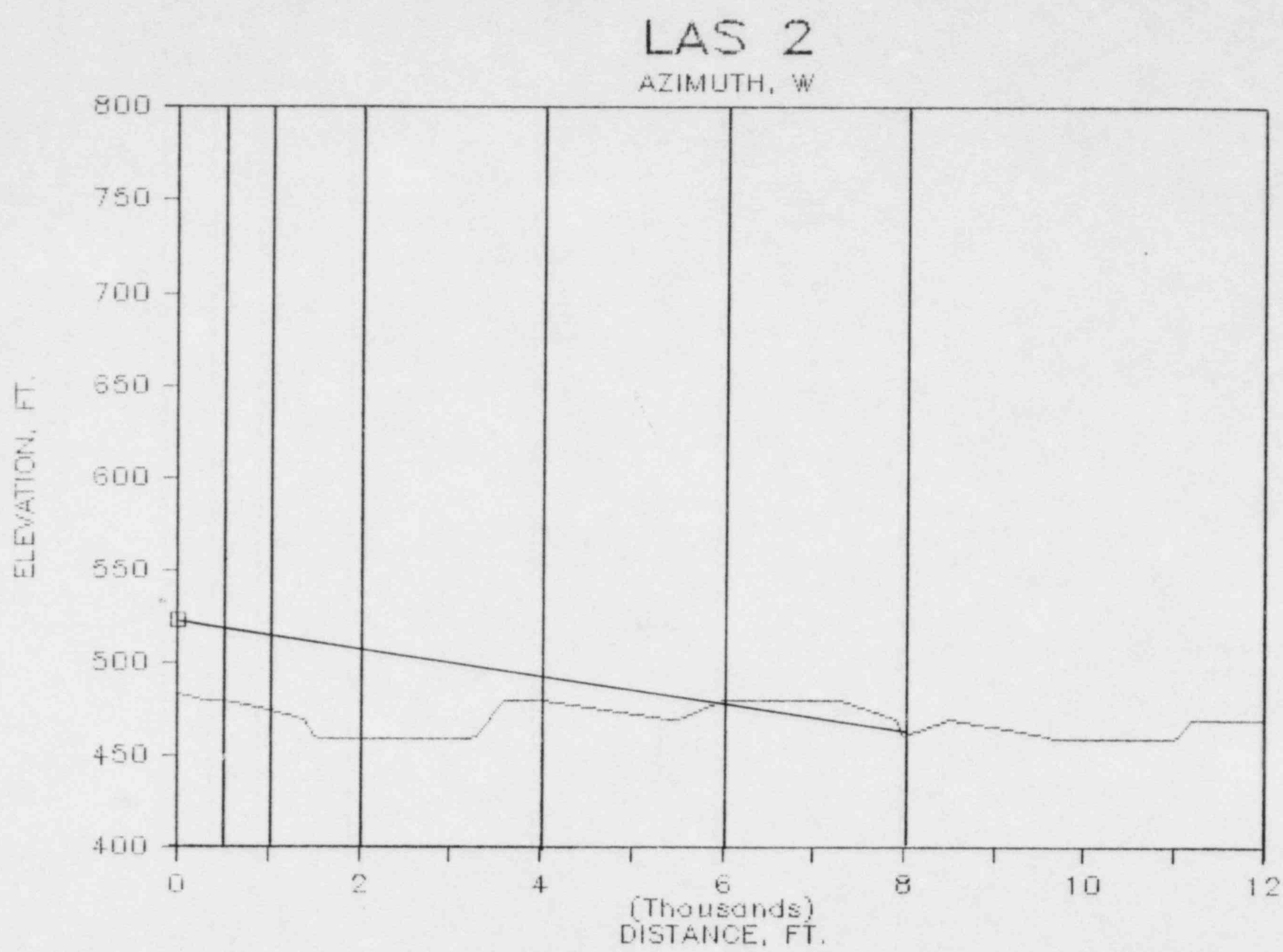
LAS 2
AZIMUTH, NE
ELEVATION, FT.
800
750
700
650
600
550
500
450
400
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT.

LAS 2

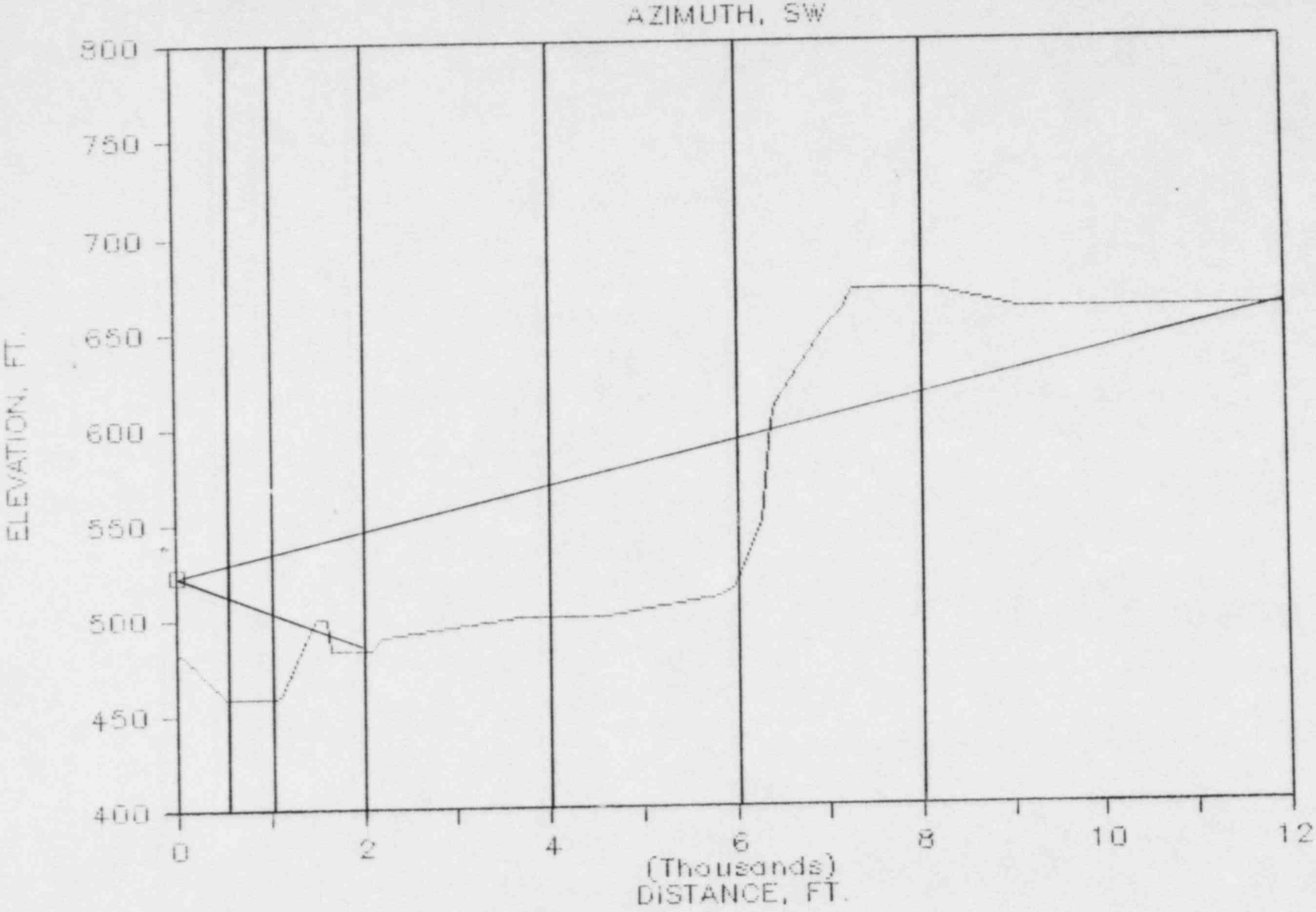
AZIMUTH, N




LAS 2
AZIMUTH, NW
ELEVATION, FT.
800
750
700
650
600
550
500
450
400
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT.

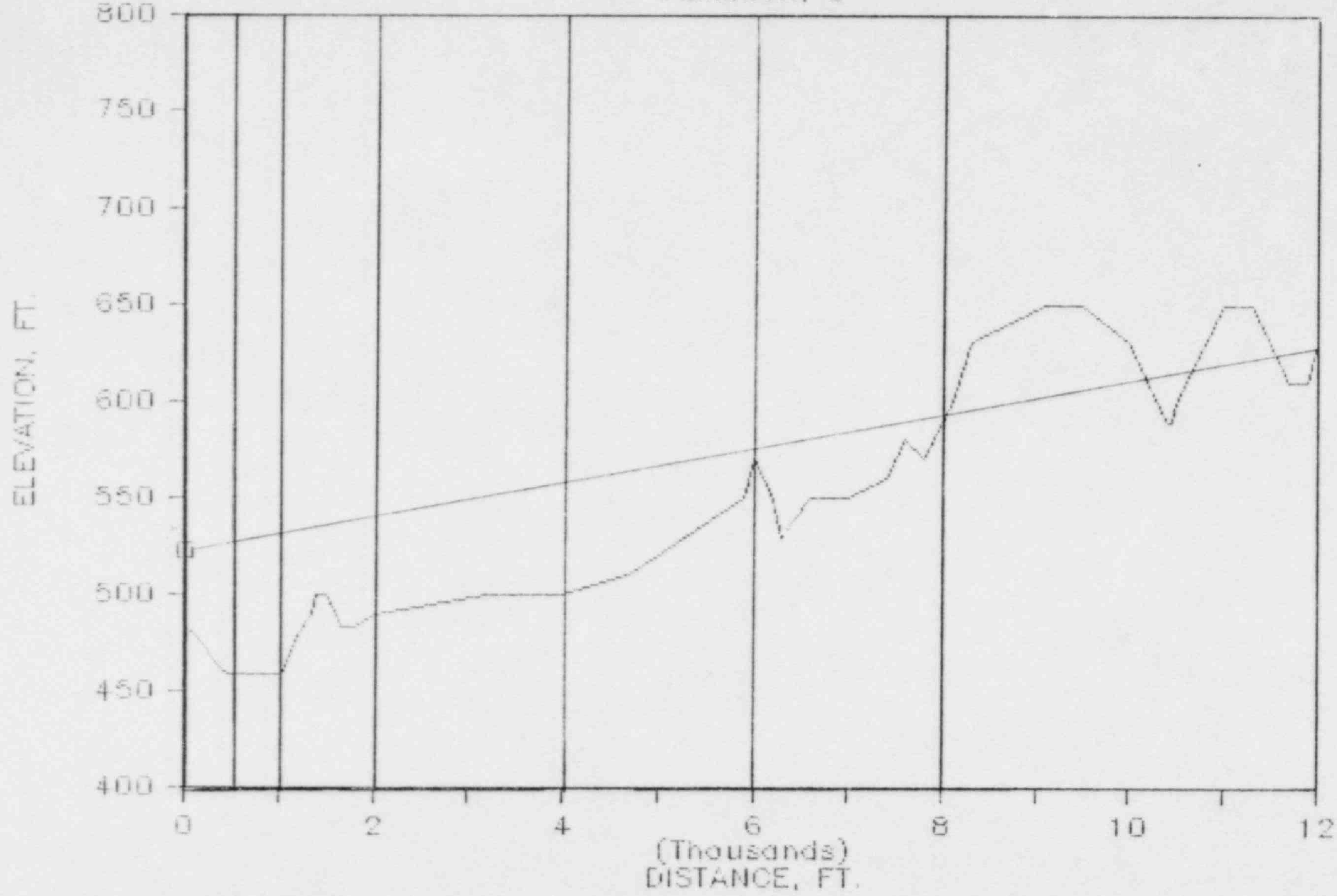

LAS 2
AZIMUTH, W
800
750
700
650
600
550
500
450
400
ELEVATION, FT.
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT.

LAS 2


AZIMUTH, SW
ELEVATION, FT.
800
750
700
650
600
550
500
450
400
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT.

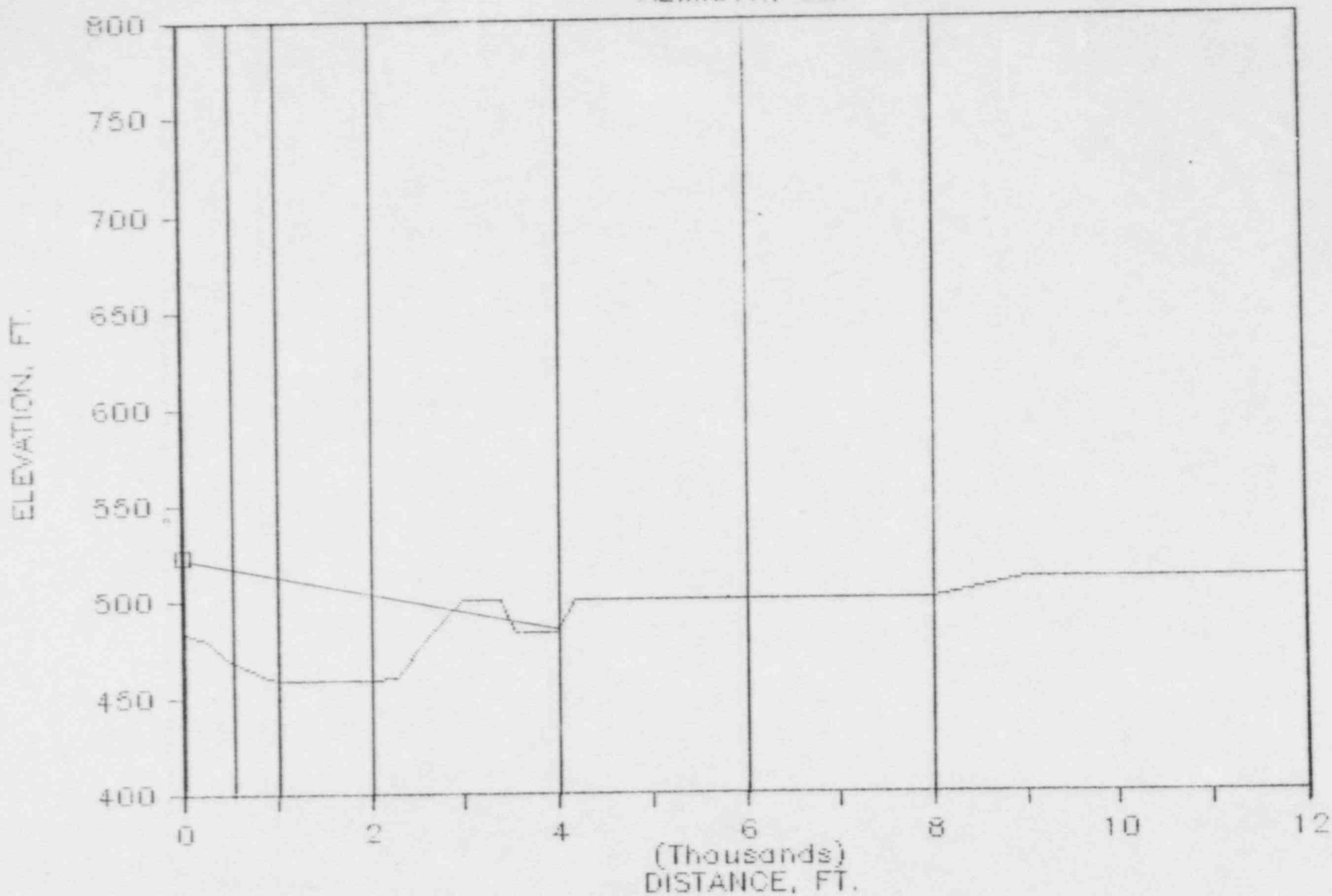
LAS 2

AZIMUTH, S



LAS 2

AZIMUTH, SE



COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #2
SOURCE-RECEIVER TOPOGRAPHICAL INPUTS

ALL BEARINGS ARE WITH RESPECT TO THE NORTH MEASURING CLOCKWISE

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
1	500.	90.00	487.00	SOFT	0.	NO	0.	0.
2	1000.	90.00	487.00	SOFT	0.	NO	0.	0.
3	2000.	90.00	485.00	SOFT	0.	NO	0.	0.
4	4000.	90.00	500.00	SOFT	0.	NO	0.	0.
5	6000.	90.00	570.00	SOFT	0.	NO	0.	0.
6	8000.	90.00	580.00	SOFT	0.	NO	0.	0.
7	12000.	90.00	625.00	SOFT	0.	NO	0.	0.
8	500.	45.00	487.00	SOFT	0.	NO	0.	0.
9	1000.	45.00	493.00	SOFT	0.	NO	0.	0.
10	2000.	45.00	523.00	SOFT	0.	NO	0.	0.
11	4000.	45.00	630.00	SOFT	0.	YES	2500.	620.
12	6000.	45.00	663.00	SOFT	0.	YES	2500.	620.
13	8000.	45.00	698.00	SOFT	0.	YES	2500.	620.
14	12000.	45.00	648.00	SOFT	0.	YES	2500.	620.
15	500.	0.0	486.00	SOFT	0.	NO	0.	0.
16	1000.	0.0	495.00	SOFT	0.	NO	0.	0.
17	2000.	0.0	513.00	SOFT	0.	NO	0.	0.
18	4000.	0.0	622.00	SOFT	0.	YES	2900.	610.
19	6000.	0.0	650.00	SOFT	0.	YES	2900.	610.
20	8000.	0.0	660.00	SOFT	0.	YES	2900.	610.
21	12000.	0.0	647.00	SOFT	0.	YES	2900.	610.
22	500.	315.00	485.00	SOFT	0.	NO	0.	0.
23	1000.	315.00	490.00	SOFT	0.	NO	0.	0.
24	2000.	315.00	490.00	SOFT	0.	NO	0.	0.
25	4000.	315.00	510.00	SOFT	0.	NO	0.	0.
26	6000.	315.00	600.00	SOFT	0.	NO	0.	0.
27	8000.	315.00	620.00	SOFT	0.	NO	0.	0.
28	12000.	315.00	620.00	SOFT	0.	YES	8200.	620.
29	500.	270.00	480.00	SOFT	0.	NO	0.	0.
30	1000.	270.00	475.00	SOFT	0.	NO	0.	0.
31	2000.	270.00	459.00	SOFT	0.	NO	0.	0.
32	4000.	270.00	480.00	SOFT	0.	NO	0.	0.
33	6000.	270.00	480.00	SOFT	0.	NO	0.	0.
34	8000.	270.00	460.00	SOFT	0.	YES	7300.	475.
35	12000.	270.00	470.00	SOFT	0.	NO	0.	0.
36	500.	225.00	460.00	SOFT	0.	NO	0.	0.

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
37	1000.	225.00	459.00	HARD	0.	NO	0.	0.
38	2000.	225.00	484.00	SOFT	0.	YES	1600.	500.
39	4000.	225.00	500.00	SOFT	0.	NO	0.	0.
40	6000.	225.00	515.00	SOFT	0.	NO	0.	0.
41	8000.	225.00	670.00	SOFT	0.	NO	0.	0.
42	12000.	225.00	660.00	SOFT	0.	YES	8200.	670.
43	500.	180.00	459.00	SOFT	0.	NO	0.	0.
44	1000.	180.00	459.00	HARD	0.	NO	0.	0.
45	2000.	180.00	490.00	SOFT	0.	NO	0.	0.
46	4000.	180.00	500.00	SOFT	0.	NO	0.	0.
47	6000.	180.00	570.00	SOFT	0.	NO	0.	0.
48	8000.	180.00	590.00	SOFT	0.	NO	0.	0.
49	12000.	180.00	630.00	SOFT	0.	YES	9500.	645.
50	500.	135.00	570.00	SOFT	0.	NO	0.	0.
51	1000.	135.00	459.00	SOFT	0.	NO	0.	0.
52	2000.	135.00	459.00	HARD	0.	NO	0.	0.
53	4000.	135.00	484.00	SOFT	0.	YES	3400.	500.
54	6000.	135.00	500.00	SOFT	0.	NO	0.	0.
55	8000.	135.00	510.00	SOFT	0.	NO	0.	0.
56	12000.	135.00	510.00	SOFT	0.	NO	0.	0.

COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #2
NOISE SOURCE POWER LEVEL INPUT

INDEX	SOURCE	DBA	DBC	31.5	63	125	250	500	1000	2000	4000	8000 (HZ)
1	SIREN 2-STH10	151.6	152.9	0.0	0.0	0.0	0.0	151.0	146.0	143.0	140.0	138.0

XO= 0.0 YO= 0.0 ZO= 523.00 HEIGHT ABOVE GROUND= 40.00

COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #2
METEOROLOGICAL INPUT CONDITIONS

H1= 10.06 METERS H2= 100.58 METERS

					WIND	WIND SPEED(MPS)		TEMPERATURE(C)		RELATIVE	BAROMETRIC
YEAR	SEASON	MONTH	DATE	HOUR	DIRECTION	H1	H2	H1	H2	HUMIDITY	PRESSURE(MM OF HG)
1983	S	7	1	12	180.0	3.7	5.2	25.0	24.4	70.0	744.0

COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #2

SIREN SOUND LEVELS IN DBC

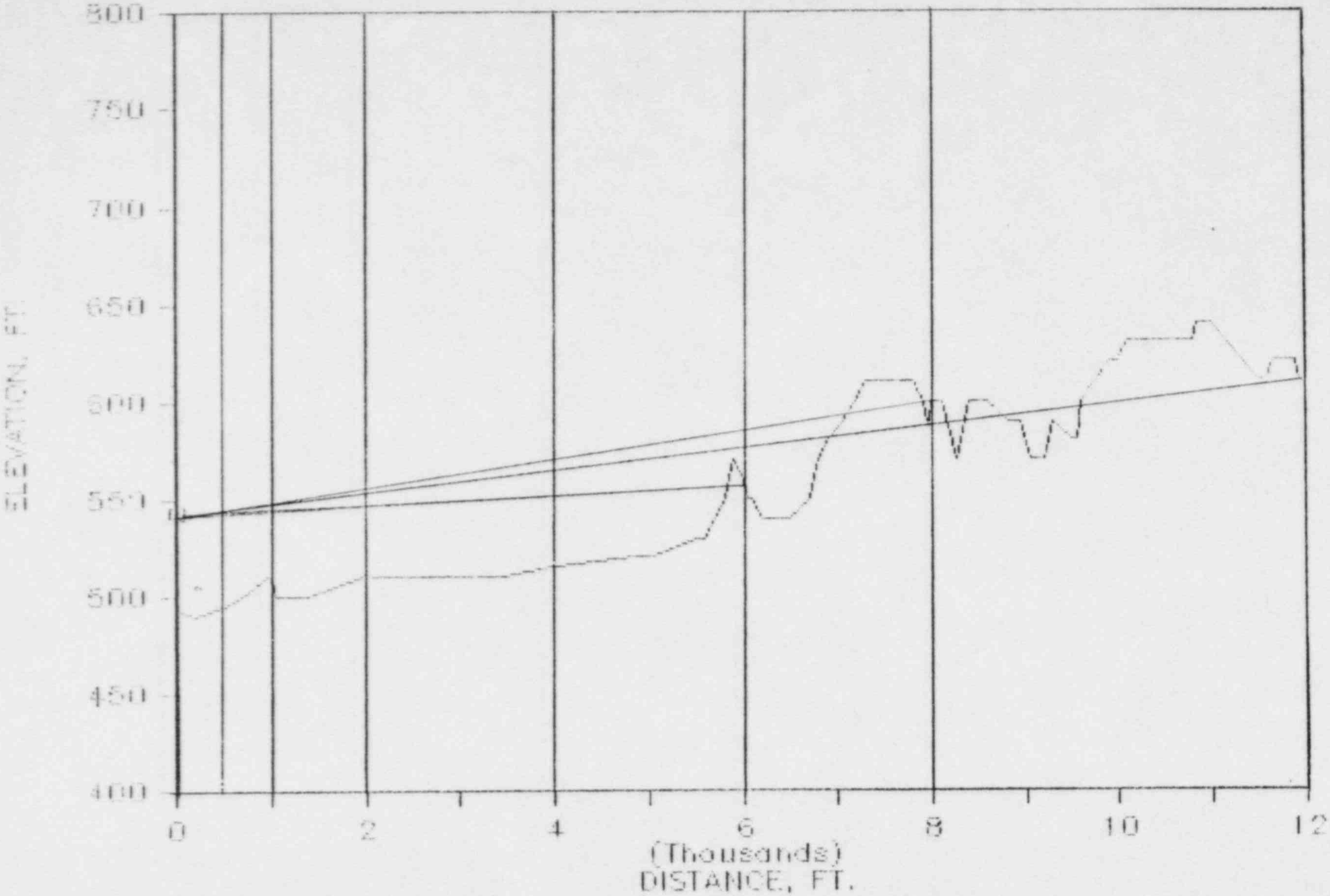
UNDER MET CONDITION 1

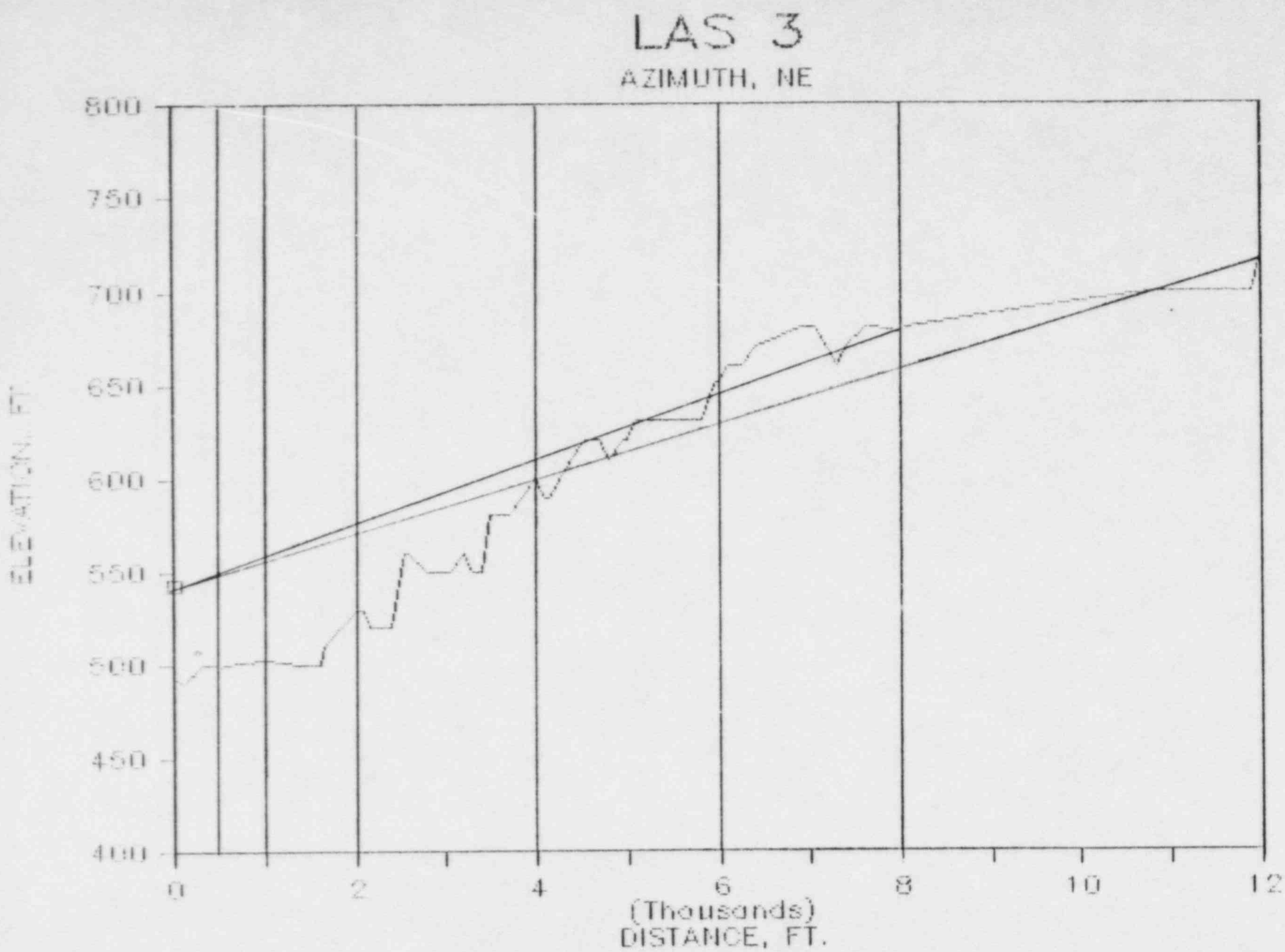
DISTANCE IN FEET

AZIMUTH	500.	1000.	2000.	4000.	6000.	8000.	12000.
E	100.	91.	81.	73.	69.	66.	61.
NE	100.	91.	81.	64.	60.	57.	49.
N	100.	91.	81.	67.	62.	58.	51.
NW	100.	91.	91.	73.	69.	66.	54.
W	100.	91.	81.	73.	69.	61.	61.
SW	100.	94.	75.	71.	64.	66.	52.
S	100.	94.	81.	72.	69.	66.	53.
SE	100.	92.	86.	65.	61.	57.	46.

LAS 3

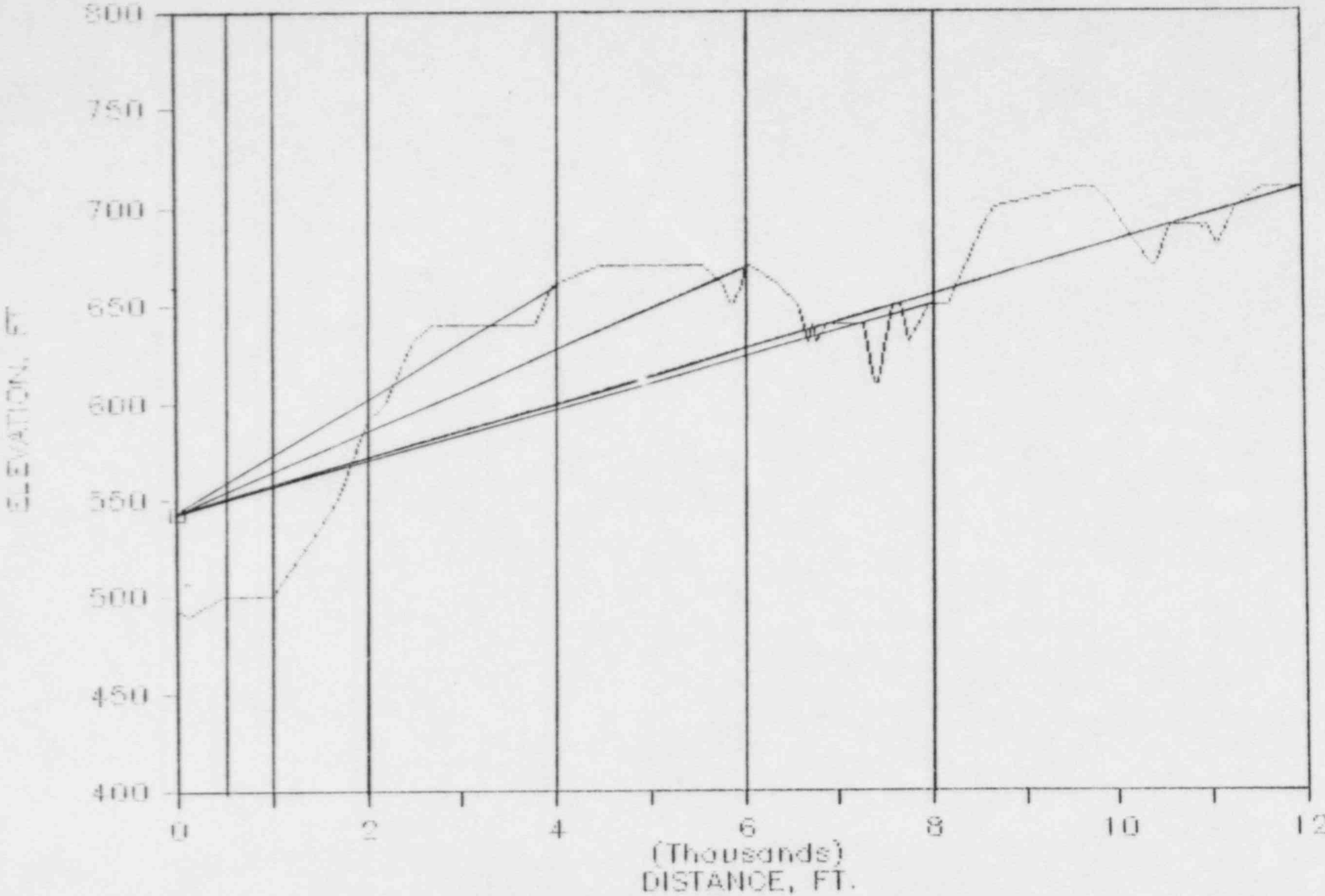
AZIMUTH, E

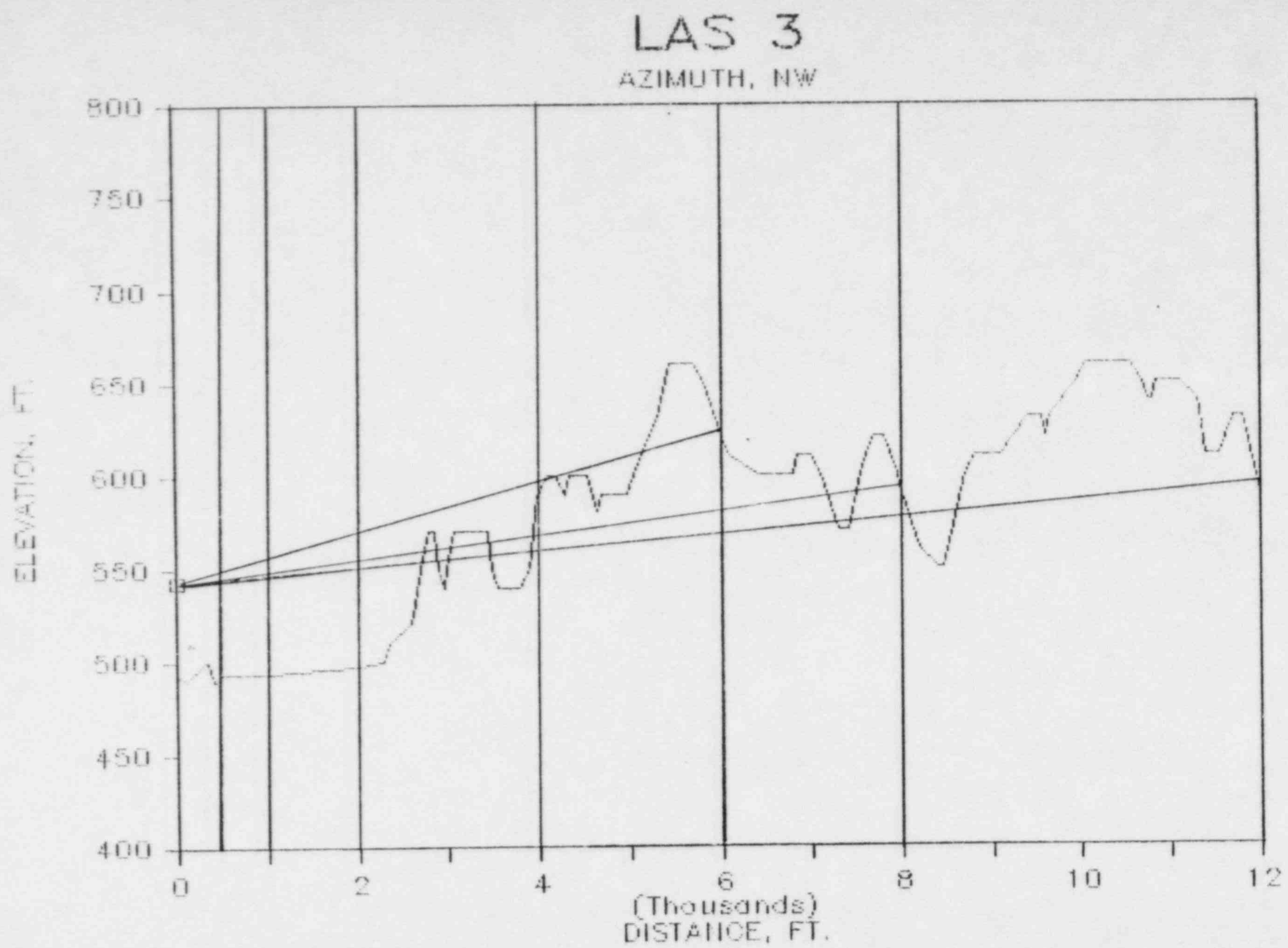



LAS 3
AZIMUTH, NE
ELEVATION, FT
800
750
700
650
600
550
500
450
400
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT.

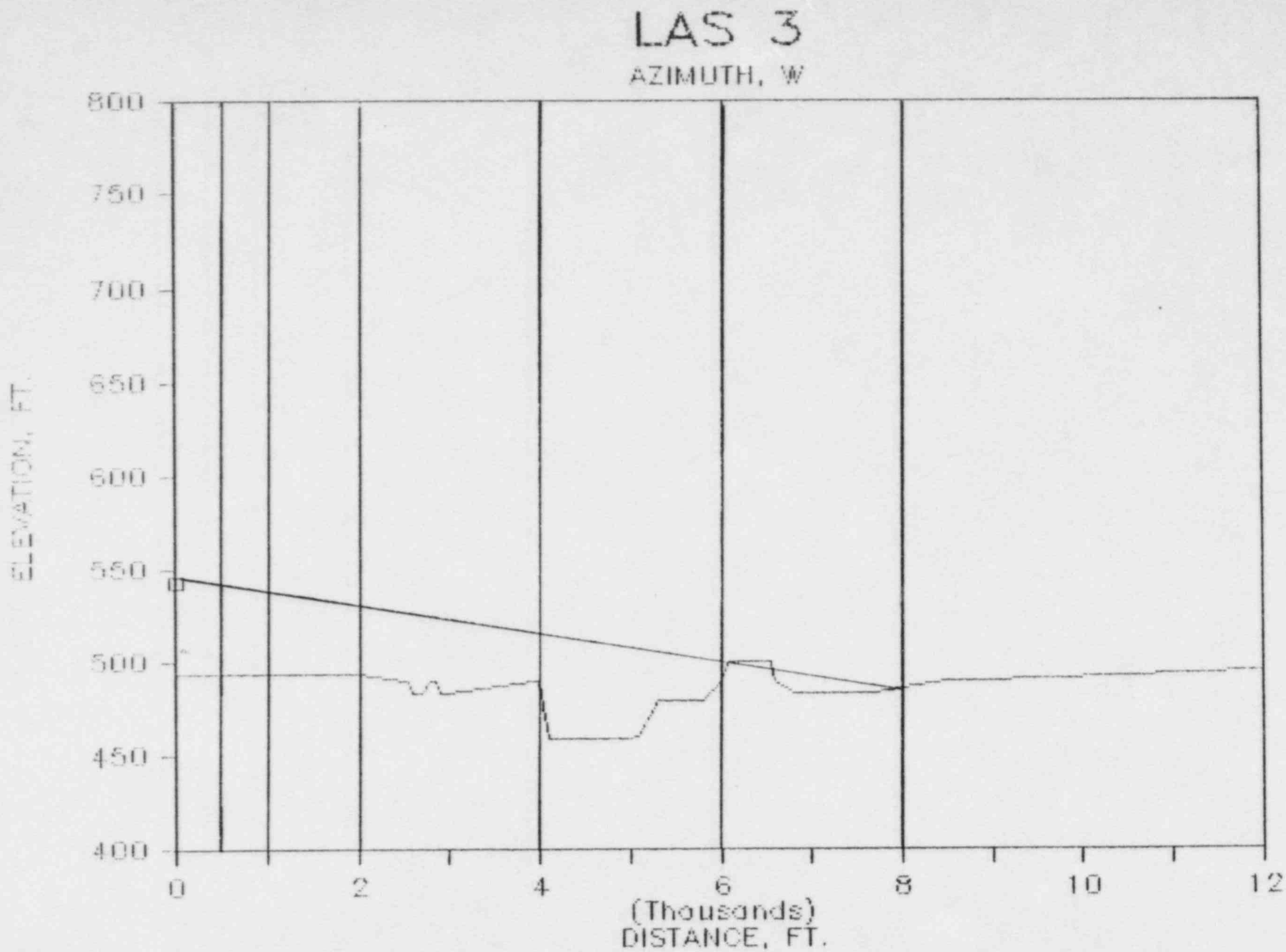
LAS 3

AZIMUTH, N



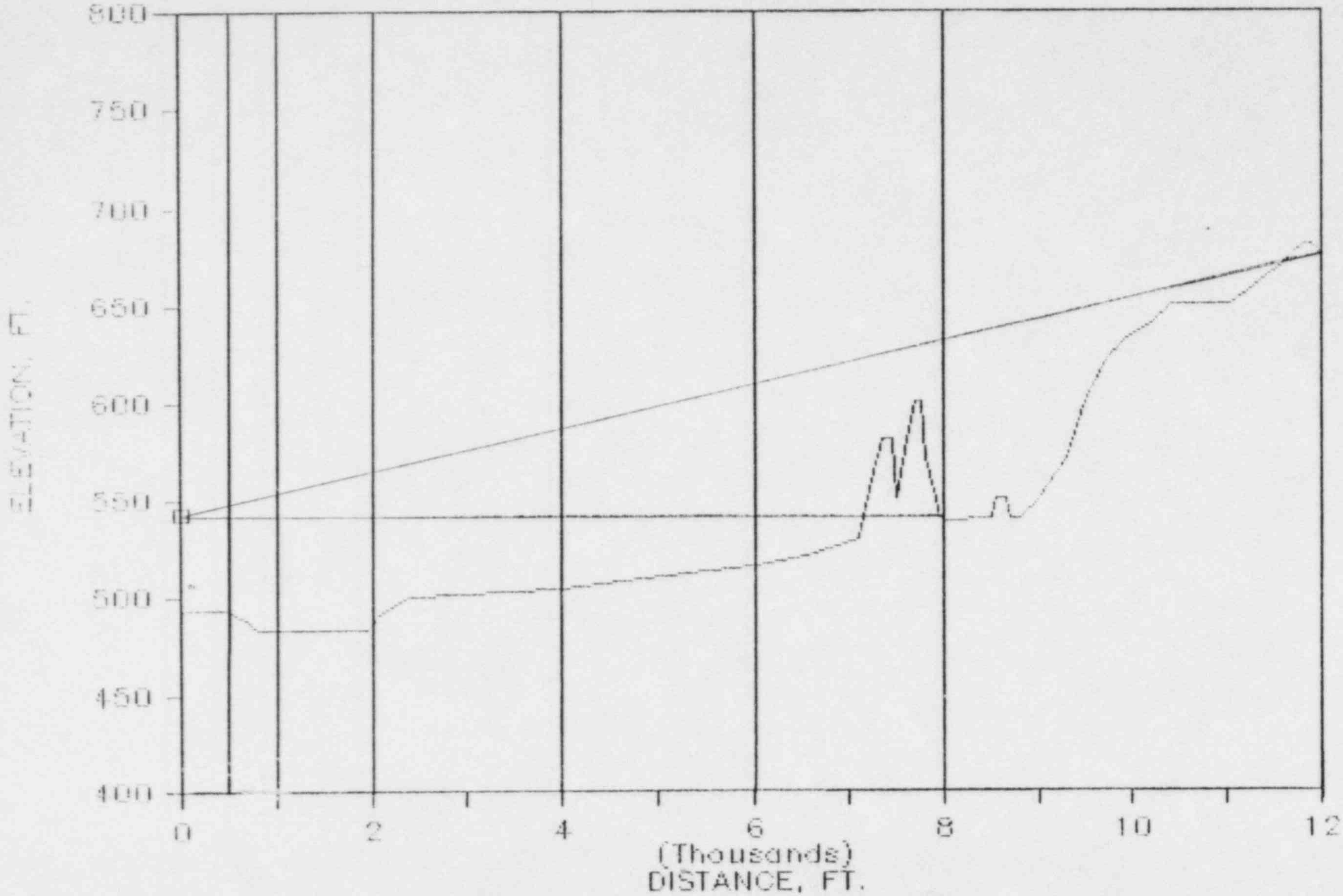


LAS 3
AZIMUTH, NW
ELEVATION, FT.
800
750
700
650
600
550
500
450
400
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT.


LAS 3
AZIMUTH, W
800
750
700
650
600
550
500
450
400
ELEVATION, FT.
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT.

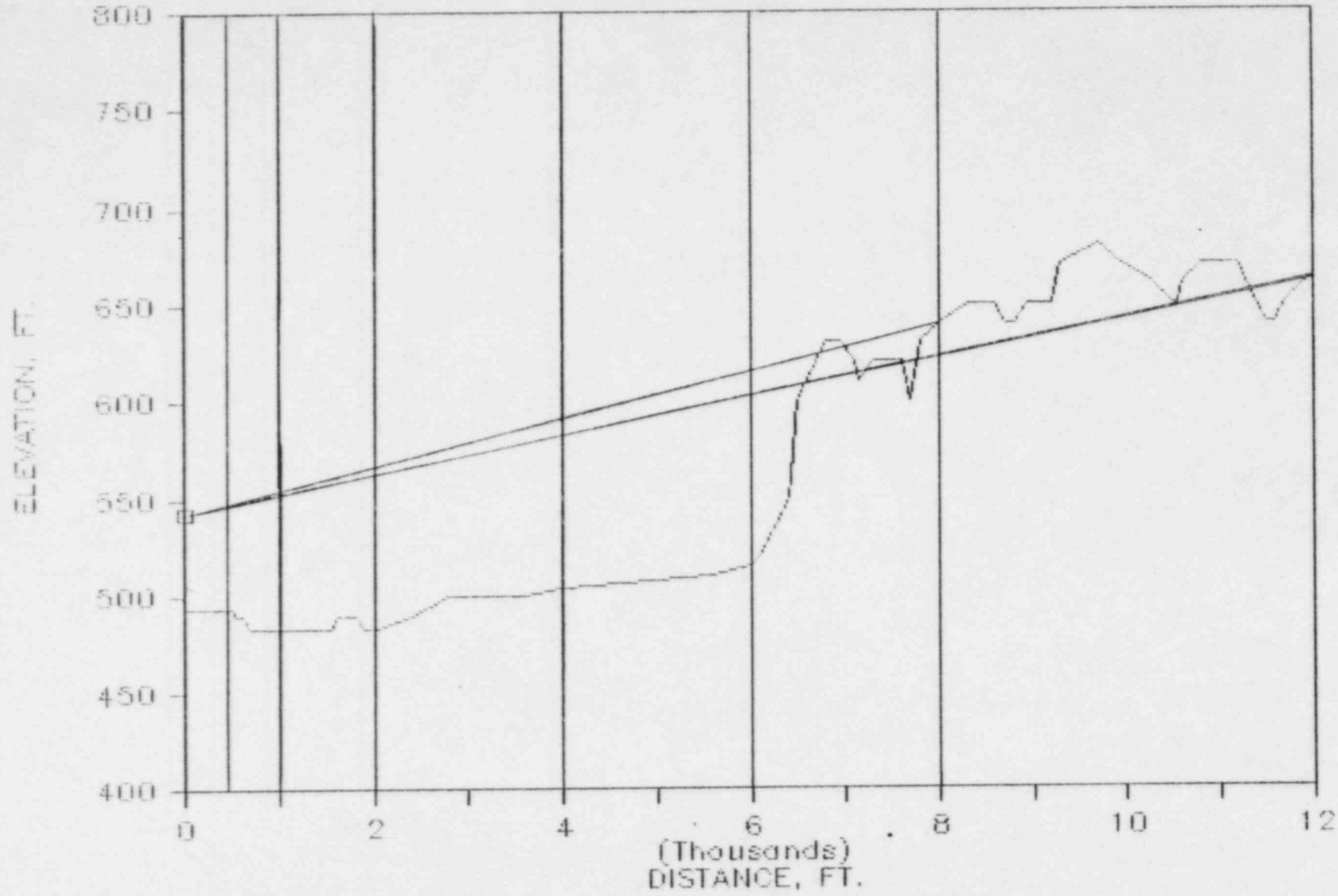
LAS 3

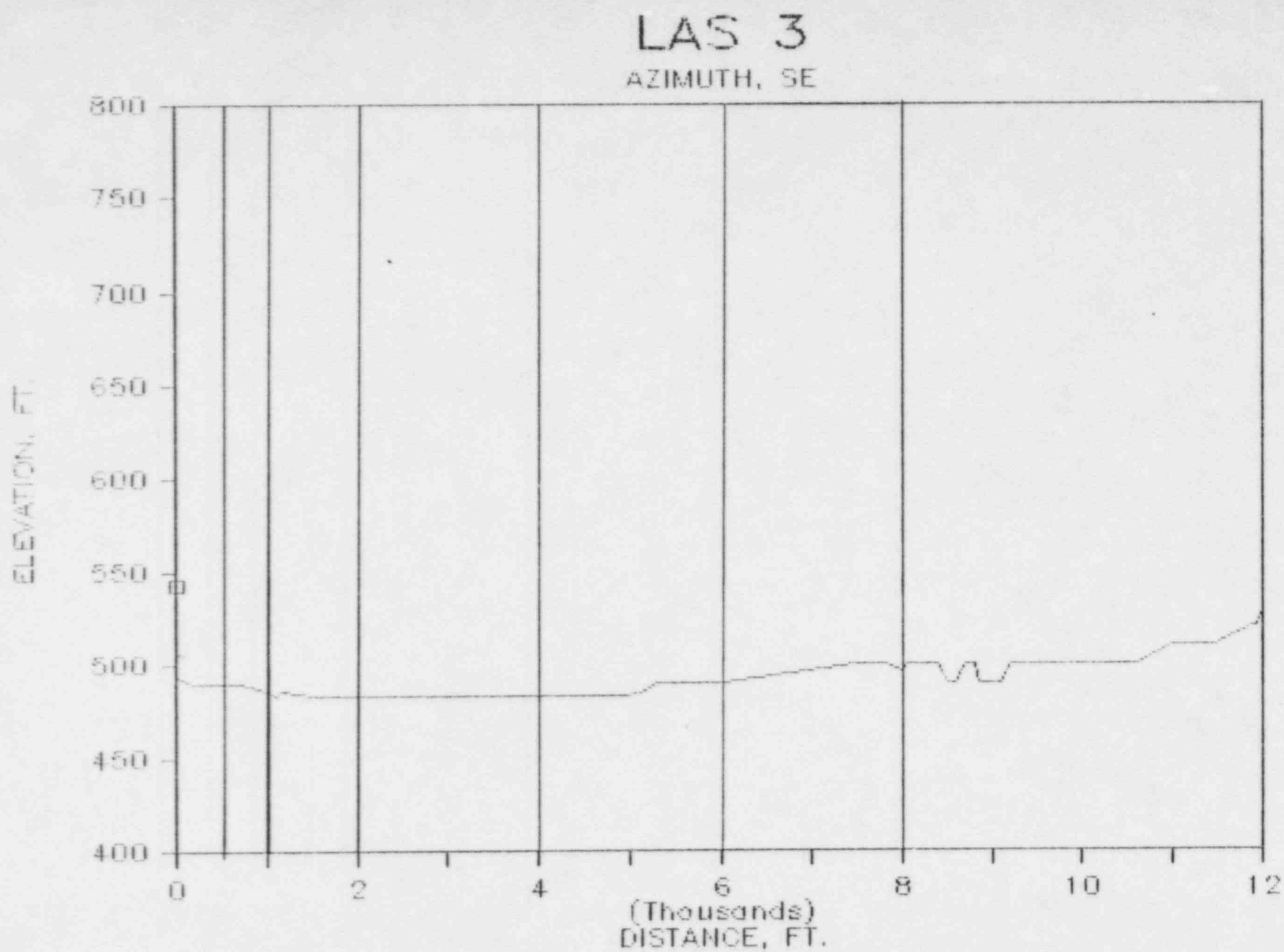
AZIMUTH, SW



LAS 3

AZIMUTH, S




LAS 3
AZIMUTH, SE
ELEVATION, FT.
800
750
700
650
600
550
500
450
400
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT.

COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #3
SOURCE-RECEIVER TOPOGRAPHICAL INPUTS

ALL BEARINGS ARE WITH RESPECT TO THE NORTH MEASURING CLOCKWISE

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
1	500.	90.00	495.00	SOFT	0.	NO	0.	0.
2	1000.	90.00	510.00	SOFT	0.	NO	0.	0.
3	2000.	90.00	512.00	SOFT	0.	NO	0.	0.
4	4000.	90.00	515.00	SOFT	0.	NO	0.	0.
5	6000.	90.00	550.00	SOFT	0.	YES	5900.	575.
6	8000.	90.00	600.00	SOFT	0.	YES	7850.	610.
7	12000.	90.00	608.00	SOFT	0.	YES	7850.	610.
8	500.	45.00	498.00	SOFT	0.	NO	0.	0.
9	1000.	45.00	503.00	SOFT	0.	NO	0.	0.
10	2000.	45.00	530.00	SOFT	0.	NO	0.	0.
11	4000.	45.00	600.00	SOFT	0.	NO	0.	0.
12	6000.	45.00	652.00	SOFT	0.	NO	0.	0.
13	8000.	45.00	678.00	SOFT	0.	YES	7100.	680.
14	12000.	45.00	720.00	SOFT	0.	YES	7100.	680.
15	500.	0.0	500.00	SOFT	0.	NO	0.	0.
16	1000.	0.0	500.00	SOFT	0.	NO	0.	0.
17	2000.	0.0	590.00	SOFT	0.	NO	0.	0.
18	4000.	0.0	660.00	SOFT	0.	YES	3800.	640.
19	6000.	0.0	660.00	SOFT	0.	YES	3800.	640.
20	8000.	0.0	650.00	SOFT	0.	YES	3800.	640.
21	12000.	0.0	710.00	SOFT	0.	YES	3800.	640.
22	500.	315.00	493.00	SOFT	0.	NO	0.	0.
23	1000.	315.00	493.00	SOFT	0.	NO	0.	0.
24	2000.	315.00	497.00	SOFT	0.	NO	0.	0.
25	4000.	315.00	590.00	SOFT	0.	NO	0.	0.
26	6000.	315.00	620.00	SOFT	0.	YES	5700.	660.
27	8000.	315.00	590.00	SOFT	0.	YES	5700.	660.
28	12000.	315.00	590.00	SOFT	0.	YES	5700.	660.
29	500.	270.00	493.00	SOFT	0.	NO	0.	0.
30	1000.	270.00	493.00	SOFT	0.	NO	0.	0.
31	2000.	270.00	493.00	SOFT	0.	NO	0.	0.
32	4000.	270.00	490.00	SOFT	0.	NO	0.	0.
33	6000.	270.00	490.00	HARD	0.	NO	0.	0.
34	8000.	270.00	486.00	SOFT	0.	YES	8000.	500.
35	12000.	270.00	495.00	SOFT	0.	NO	0.	0.
36	500.	225.00	493.00	SOFT	0.	NO	0.	0.

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
37	1000.	225.00	484.00	SOFT	0.	NO	0.	0.
38	2000.	225.00	486.00	HARD	0.	NO	0.	0.
39	4000.	225.00	504.00	SOFT	0.	NO	0.	0.
40	6000.	225.00	515.00	SOFT	0.	NO	0.	0.
41	8000.	225.00	538.00	SOFT	0.	YES	7700.	600.
42	12000.	225.00	675.00	SOFT	0.	YES	11900.	675.
43	500.	180.00	493.00	SOFT	0.	NO	0.	0.
44	1000.	180.00	484.00	SOFT	0.	NO	0.	0.
45	2000.	180.00	484.00	SOFT	0.	NO	0.	0.
46	4000.	180.00	504.00	SOFT	0.	NO	0.	0.
47	6000.	180.00	515.00	SOFT	0.	NO	0.	0.
48	8000.	180.00	640.00	SOFT	0.	YES	7000.	630.
49	12000.	180.00	662.00	SOFT	0.	YES	9800.	690.
50	500.	135.00	490.00	SOFT	0.	NO	0.	0.
51	1000.	135.00	486.00	SOFT	0.	NO	0.	0.
52	2000.	135.00	484.00	HARD	0.	NO	0.	0.
53	4000.	135.00	484.00	HARD	0.	NO	0.	0.
54	6000.	135.00	490.00	SOFT	0.	NO	0.	0.
55	8000.	135.00	496.00	SOFT	0.	NO	0.	0.
56	12000.	135.00	530.00	SOFT	0.	NO	0.	0.

COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #3
NOISE SOURCE POWER LEVEL INPUT

INDEX	SOURCE	DBA	DBC	31.5	63	125	250	500	1000	2000	4000	8000 (HZ)
1	SIREN 3-1000A	165.9	167.9	0.0	0.0	0.0	0.0	167.0	158.0	157.0	150.0	148.0

XO= 0.0 YO= 0.0 ZO= 543.00 HEIGHT ABOVE GROUND= 50.00

COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #3
METEOROLOGICAL INPUT CONDITIONS

H1= 10.06 METERS H2= 100.58 METERS

YEAR	SEASON	MONTH	DATE	HOUR	WIND DIRECTION	WIND SPEED(MPS) H1	WIND SPEED(MPS) H2	TEMPERATURE(C) H1	TEMPERATURE(C) H2	RELATIVE HUMIDITY	BAROMETRIC PRESSURE(MM OF HG)
1983	S	7	1	12	180.0	3.7	5.2	25.0	24.4	70.0	744.0

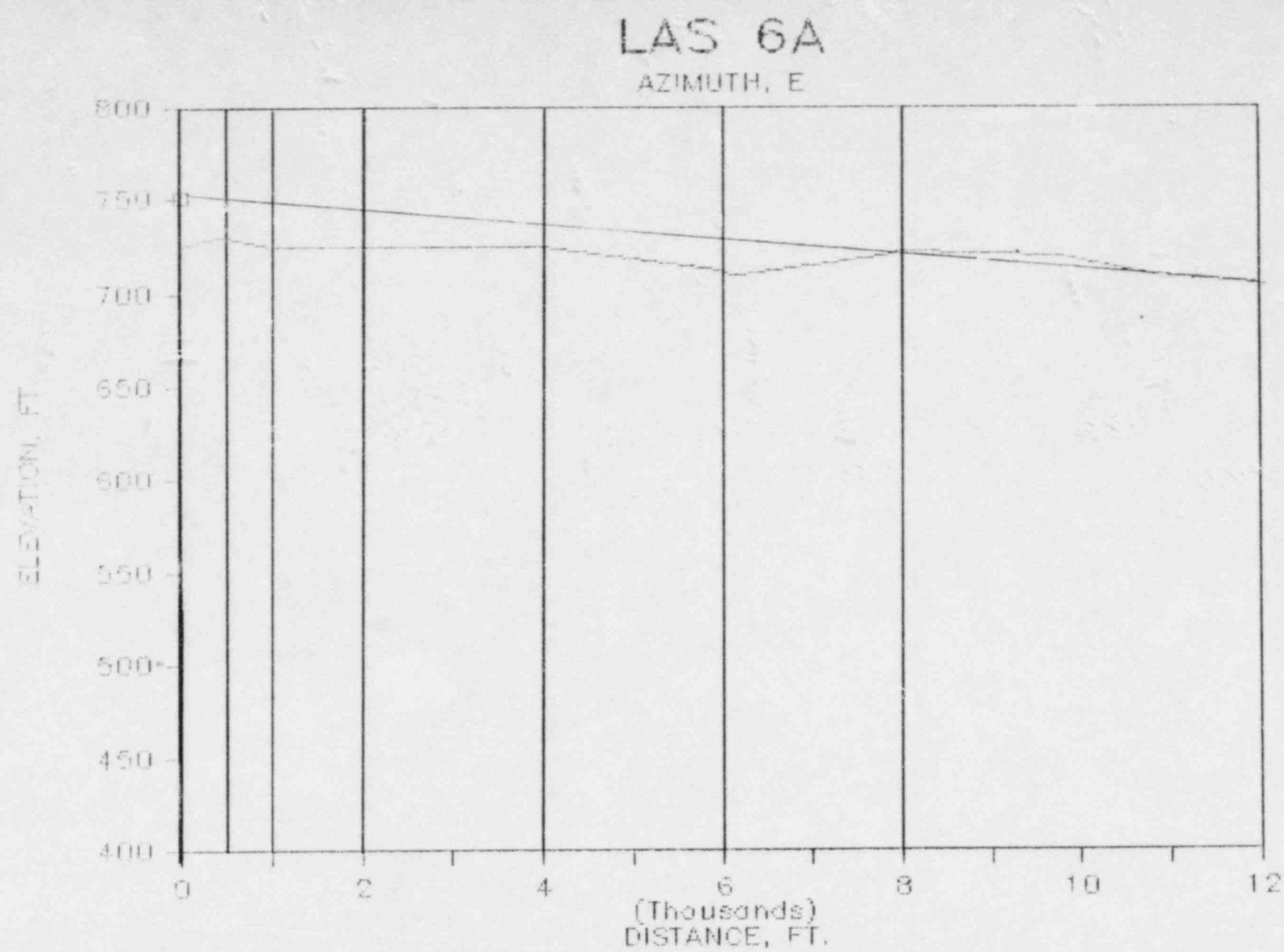
COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #3

SIREN SOUND LEVELS IN DBC

UNDER MET CONDITION 1

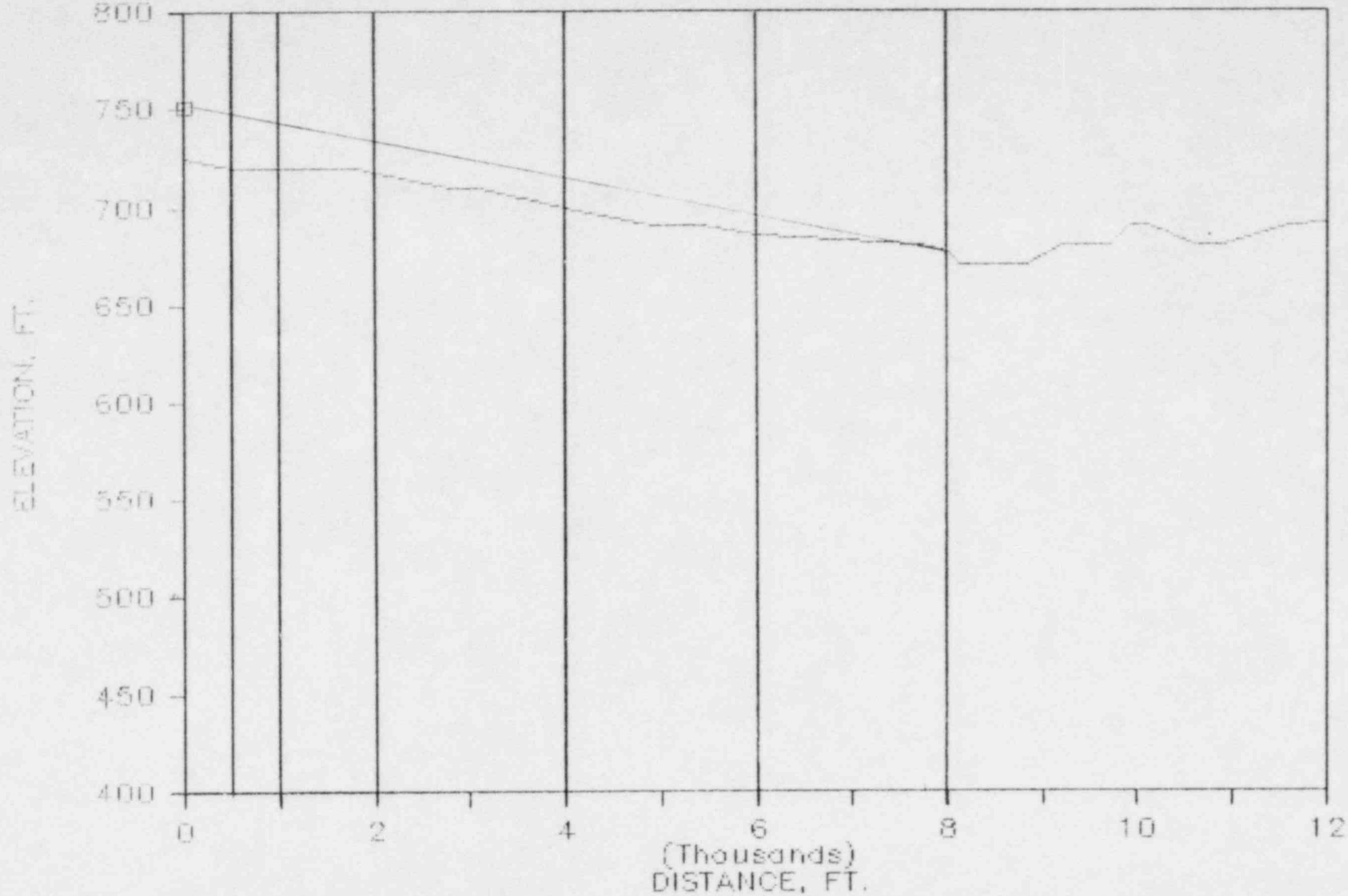
DISTANCE IN FEET

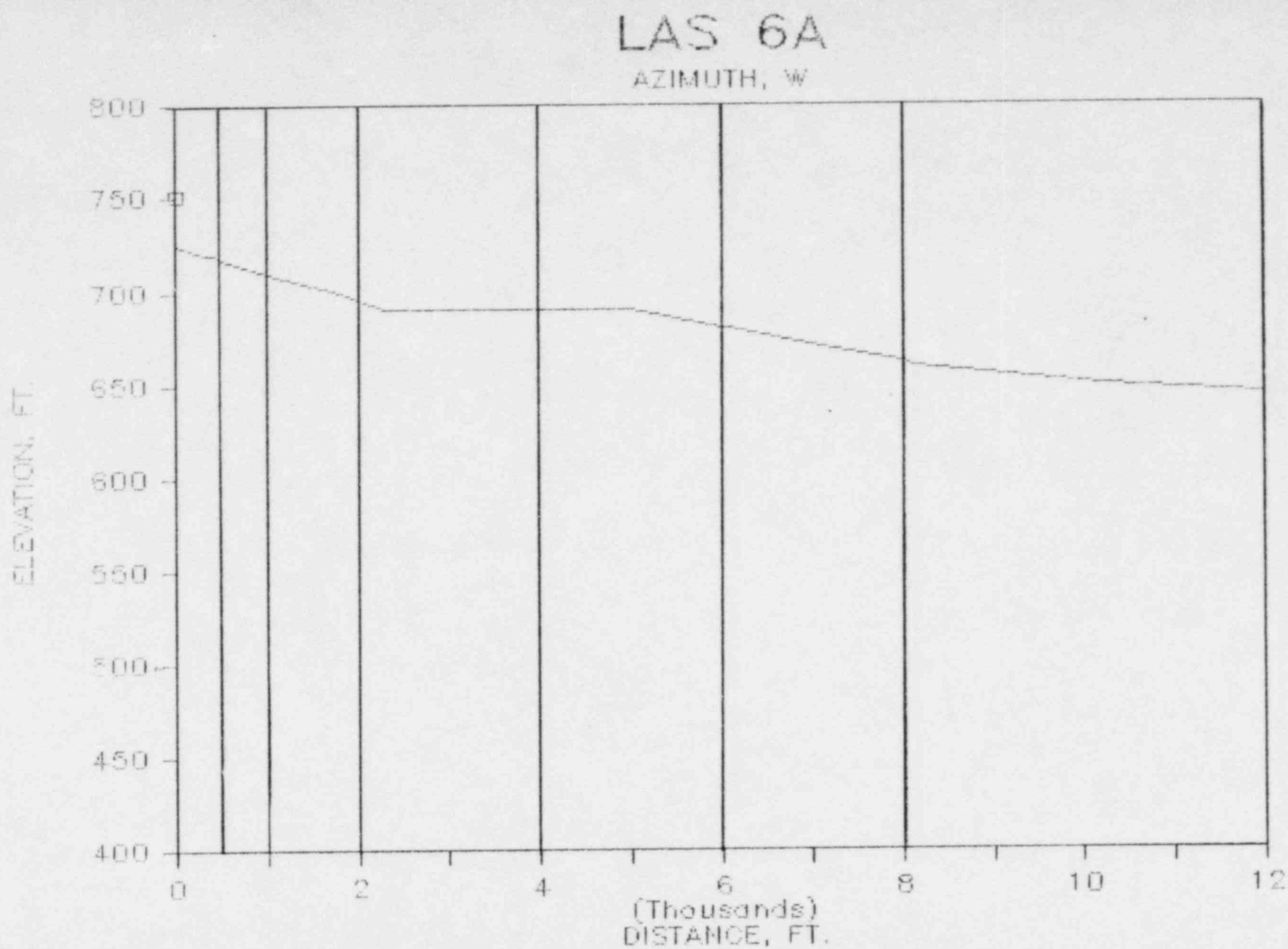
AZIMUTH	500.	1000.	2000.	4000.	6000.	8000.	12000.
E	116.	106.	98.	91.	73.	76.	71.
NE	116.	106.	98.	91.	88.	77.	70.
N	116.	107.	98.	83.	81.	75.	69.
NW	116.	107.	98.	91.	72.	71.	65.
W	116.	107.	98.	91.	89.	63.	77.
SW	116.	107.	102.	91.	82.	62.	72.
S	116.	107.	98.	91.	83.	79.	67.
SE	116.	107.	102.	94.	82.	75.	64.


LAS 6A
AZIMUTH, E
800
750
700
650
600
550
500
450
400
ELEVATION, FT
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT.

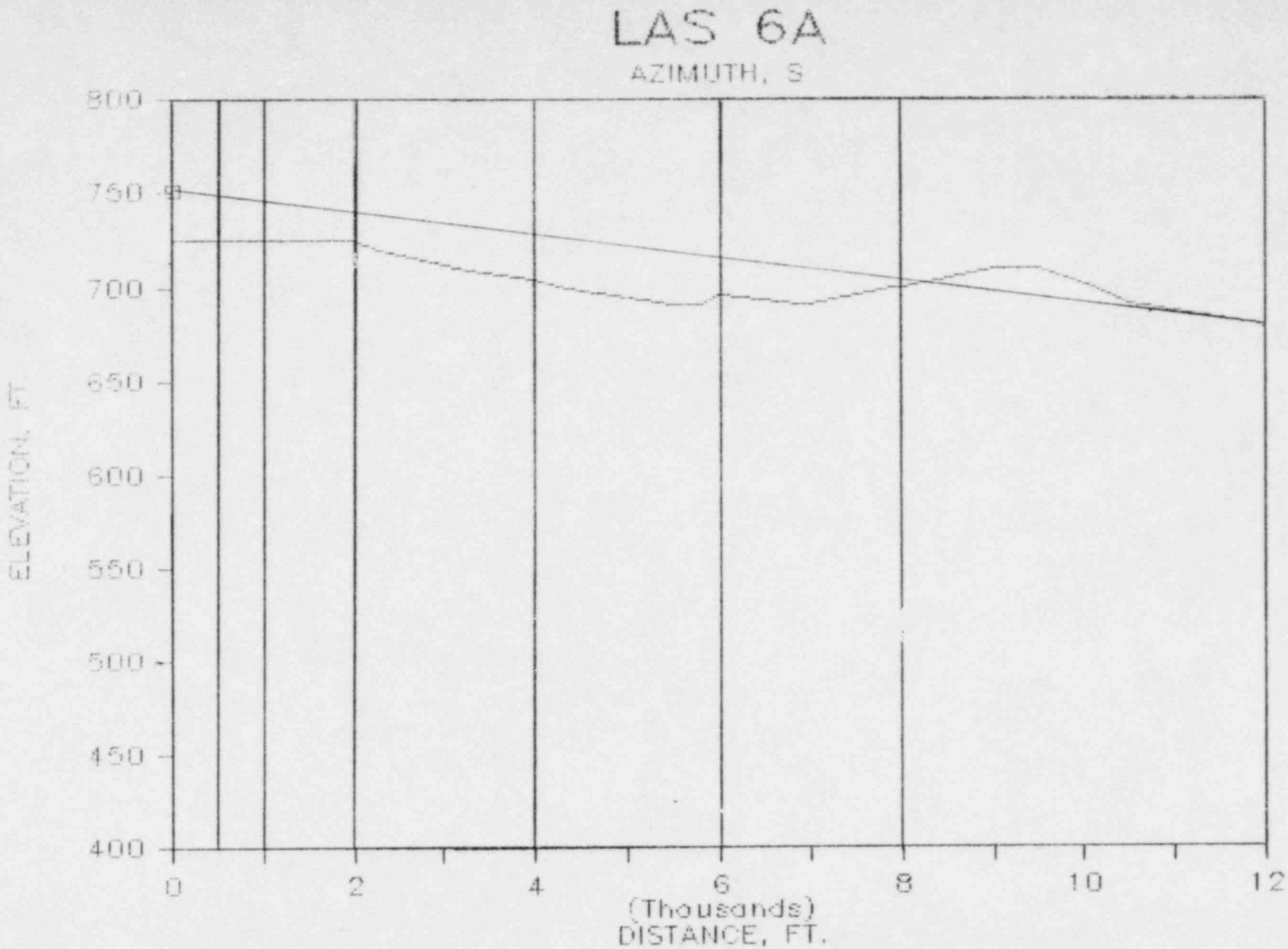
LAS 6A

AZIMUTH, N





LAS 6A
AZIMUTH, W
800
750
700
650
600
550
500
450
400
ELEVATION, FT
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT.


LAS 6A
AZIMUTH, S
ELEVATION, FT
800
750
700
650
600
550
500
450
400
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT.

COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #6A
SOURCE-RECEIVER TOPOGRAPHICAL INPUTS

ALL BEARINGS ARE WITH RESPECT TO THE NORTH MEASURING CLOCKWISE

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
1	500.	90.00	730.00	SOFT	0.	NO	0.	0.
2	1000.	90.00	725.00	SOFT	0.	NO	0.	0.
3	2000.	90.00	725.00	SOFT	0.	NO	0.	0.
4	4000.	90.00	725.00	SOFT	0.	NO	0.	0.
5	6000.	90.00	712.00	SOFT	0.	NO	0.	0.
6	8000.	90.00	722.00	SOFT	0.	NO	0.	0.
7	12000.	90.00	705.00	SOFT	0.	YES	7300.	720.
8	500.	0.0	720.00	SOFT	0.	NO	0.	0.
9	1000.	0.0	720.00	SOFT	0.	NO	0.	0.
10	2000.	0.0	717.00	SOFT	0.	NO	0.	0.
11	4000.	0.0	700.00	SOFT	0.	NO	0.	0.
12	6000.	0.0	685.00	SOFT	0.	NO	0.	0.
13	8000.	0.0	677.00	SOFT	0.	YES	7800.	680.
14	12000.	0.0	692.00	SOFT	0.	NO	0.	0.
15	500.	270.00	718.00	SOFT	0.	NO	0.	0.
16	1000.	270.00	710.00	SOFT	0.	NO	0.	0.
17	2000.	270.00	695.00	SOFT	0.	NO	0.	0.
18	4000.	270.00	690.00	SOFT	0.	NO	0.	0.
19	6000.	270.00	680.00	SOFT	0.	NO	0.	0.
20	8000.	270.00	662.00	SOFT	0.	NO	0.	0.
21	12000.	270.00	645.00	SOFT	0.	NO	0.	0.
22	500.	180.00	725.00	SOFT	0.	NO	0.	0.
23	1000.	180.00	725.00	SOFT	0.	NO	0.	0.
24	2000.	180.00	725.00	SOFT	0.	NO	0.	0.
25	4000.	180.00	705.00	SOFT	0.	NO	0.	0.
26	6000.	180.00	695.00	SOFT	0.	NO	0.	0.
27	8000.	180.00	700.00	SOFT	0.	NO	0.	0.
28	12000.	180.00	677.00	SOFT	0.	YES	9500.	710.

COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #6A
NOISE SOURCE POWER LEVEL INPUT

INDEX	SOURCE	DBA	DBC	31.5	63	125	250	500	1000	2000	4000	8000 (HZ)
1	SIREN 6A-1000A	165.9	167.9	0.0	0.0	0.0	0.0	167.0	158.0	157.0	150.0	148.0

XO= 0.0 YO= 0.0 ZO= 751.00 HEIGHT ABOVE GROUND= 26.00

COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #6A
METEOROLOGICAL INPUT CONDITIONS

H1= 10.06 METERS H2= 100.58 METERS

YEAR	SEASON	MONTH	DATE	HOUR	WIND DIRECTION	WIND SPEED(MPS) H1	WIND SPEED(MPS) H2	TEMPERATURE(C) H1	TEMPERATURE(C) H2	RELATIVE HUMIDITY	BAROMETRIC PRESSURE(MM OF HG)
1983	S	7	1	12	180.0	3.7	5.2	25.0	24.4	70.0	744.0

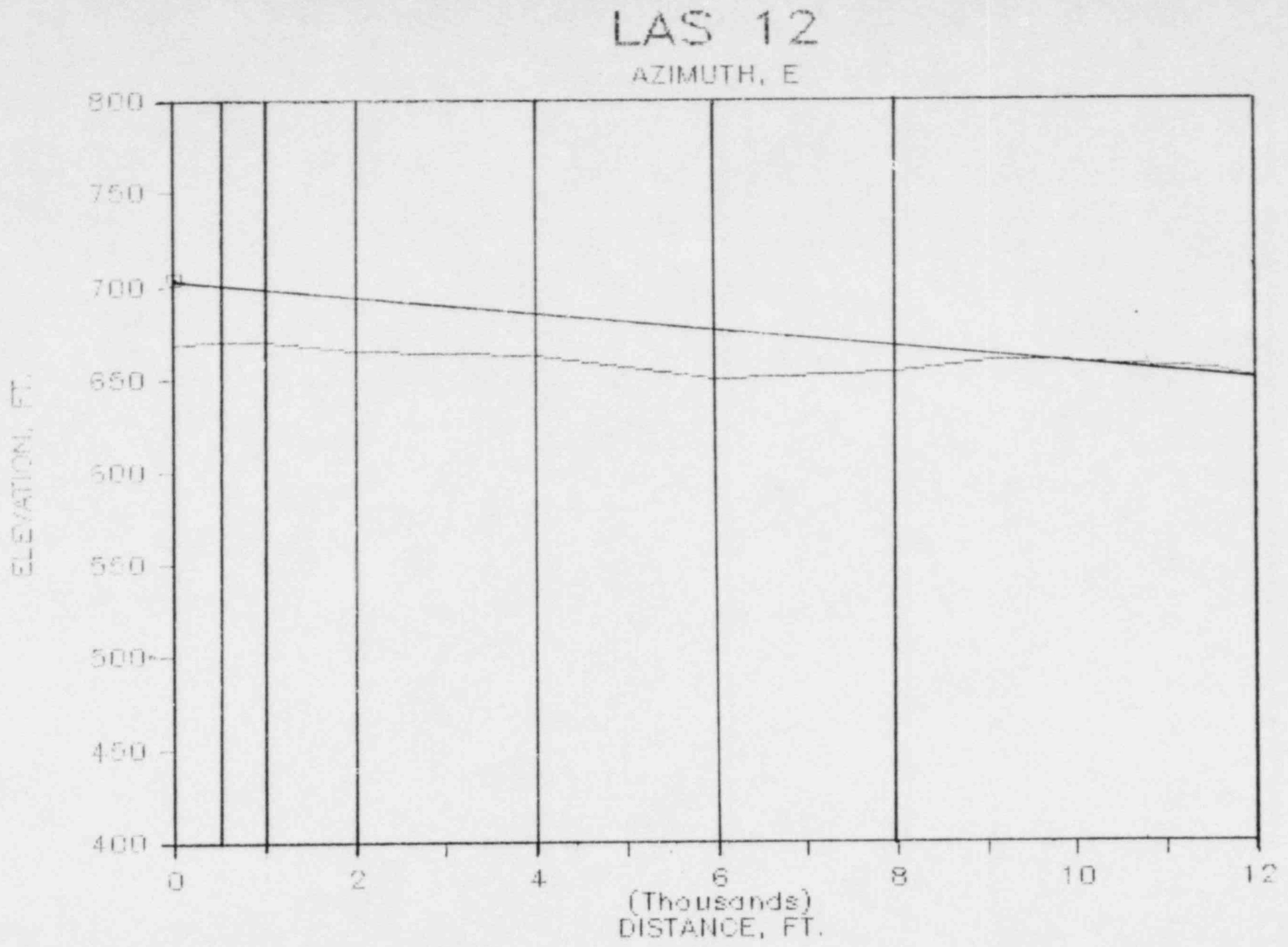
COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #6A

SIREN SOUND LEVELS IN DBC

UNDER MET CONDITION 1

DISTANCE IN FEET

AZIMUTH	500.	1000.	2000.	4000.	6000.	8000.	12000.
E	115.	105.	94.	84.	80.	77.	73.
N	116.	105.	94.	84.	80.	73.	73.
W	116.	105.	94.	84.	80.	77.	73.
S	116.	105.	94.	80.	70.	63.	48.


LAS 12
AZIMUTH, E
800
750
700
650
600
550
500
450
400
ELEVATION, FT.
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT.

COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #12
SOURCE-RECEIVER TOPOGRAPHICAL INPUTS

ALL BEARINGS ARE WITH RESPECT TO THE NORTH MEASURING CLOCKWISE

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
1	500.	90.00	670.00	SOFT	0.	NO	0.	0.
2	1000.	90.00	670.00	SOFT	0.	NO	0.	0.
3	2000.	90.00	665.00	SOFT	0.	NO	0.	0.
4	4000.	90.00	662.00	SOFT	0.	NO	0.	0.
5	6000.	90.00	650.00	SOFT	0.	NO	0.	0.
6	8000.	90.00	653.00	SOFT	0.	NO	0.	0.
7	12000.	90.00	650.00	SOFT	0.	YES	10800.	655.

COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #12
NOISE SOURCE POWER LEVEL INPUT

INDEX	SOURCE	DBA	DBC	31.5	63	125	250	500	1000	2000	4000	8000 (HZ)
1	SIREN 12-LCS1	136.6	135.7	0.0	0.0	0.0	0.0	0.0	131.0	134.0	111.0	114.0

XO= 0.0 YO= 0.0 ZO= 704.00 HEIGHT ABOVE GROUND= 35.00

COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #12
METEOROLOGICAL INPUT CONDITIONS

H1= 10.06 METERS H2= 100.58 METERS

YEAR	SEASON	MONTH	DATE	HOUR	WIND DIRECTION	WIND SPEED(MPS) H1	WIND SPEED(MPS) H2	TEMPERATURE(C) H1	TEMPERATURE(C) H2	RELATIVE HUMIDITY	BAROMETRIC PRESSURE(MM OF HG)
1983	S	7	1	12	180.0	3.7	5.2	25.0	24.4	70.0	744.0

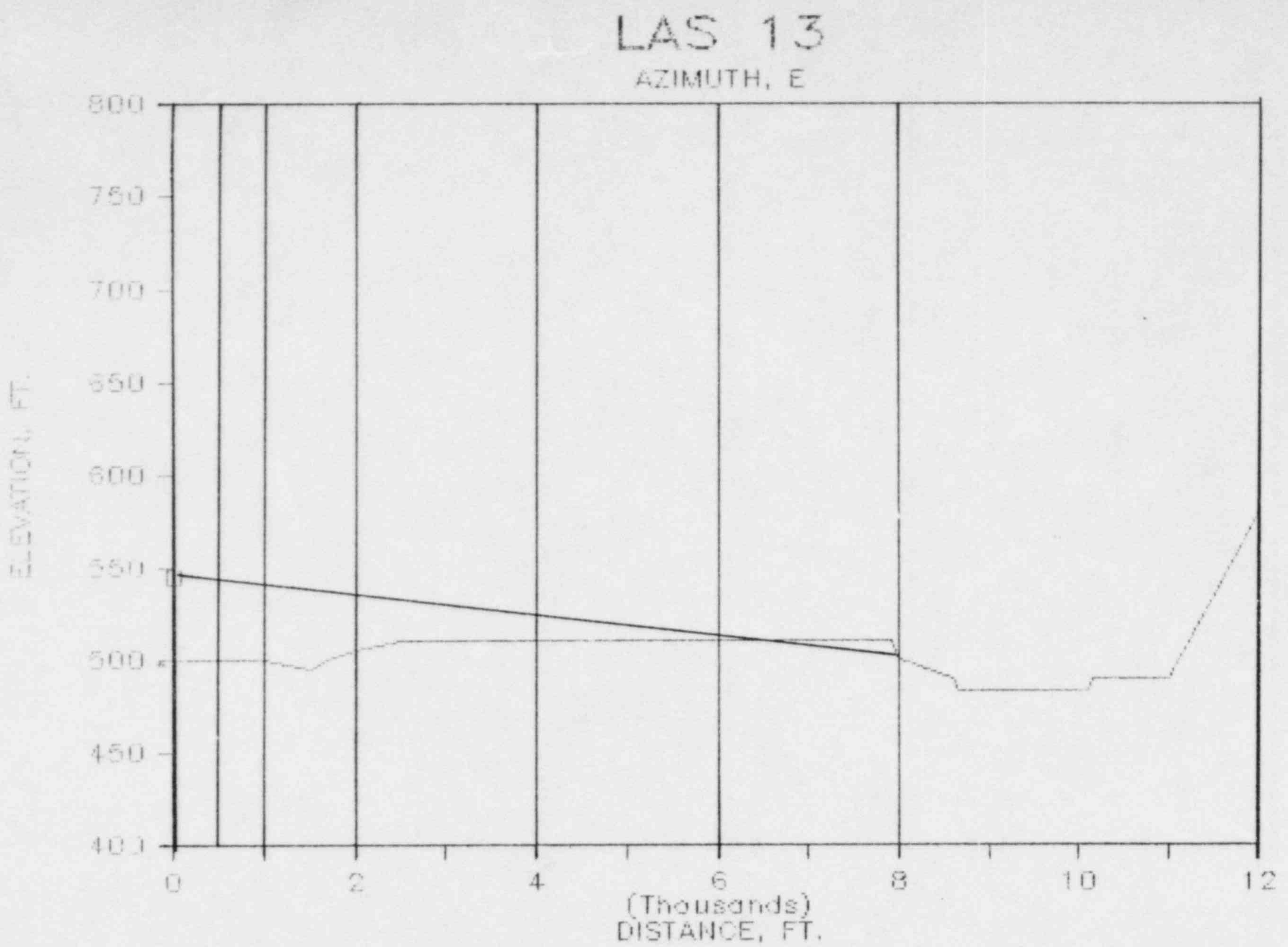
COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #12

SIREN SOUND LEVELS IN DBC

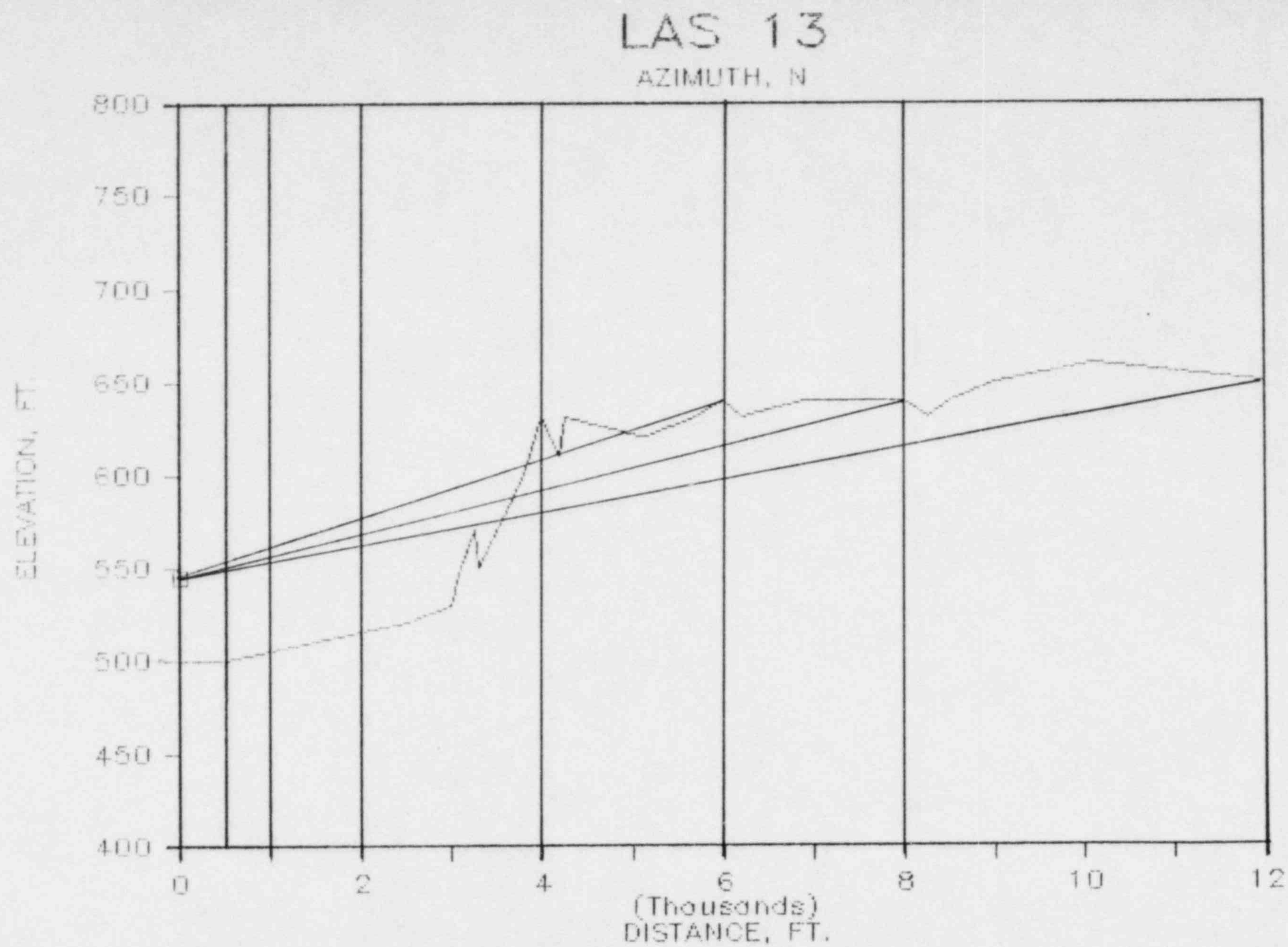
UNDER MET CONDITION 1

DISTANCE IN FEET

AZIMUTH	500.	1000.	2000.	4000.	6000.	8000.	12000.
E	82.	74.	62.	46.	35.	29.	21.



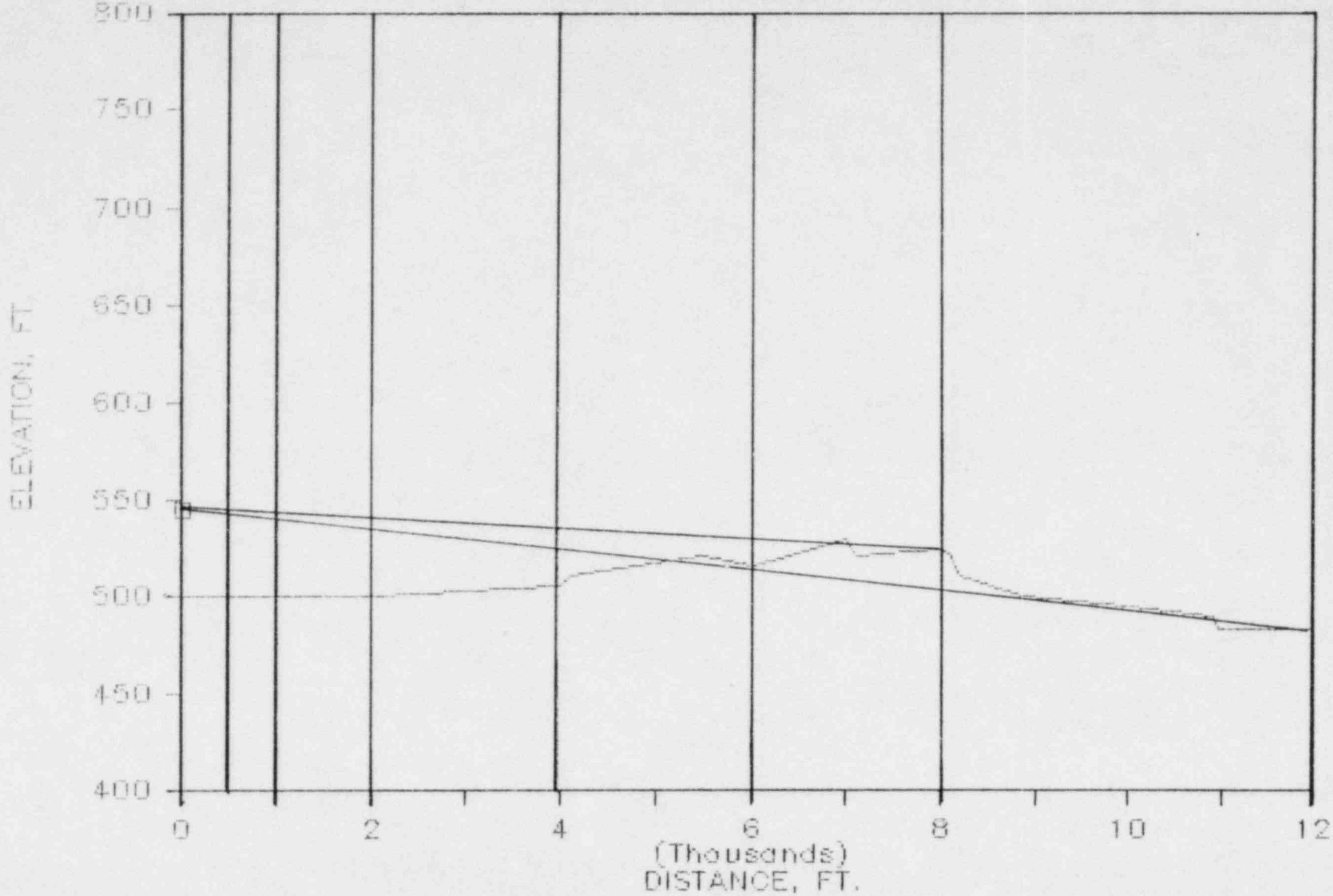
LAS 13
AZIMUTH, E
ELEVATION, FT.
800
750
700
650
600
550
500
450
400
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT.

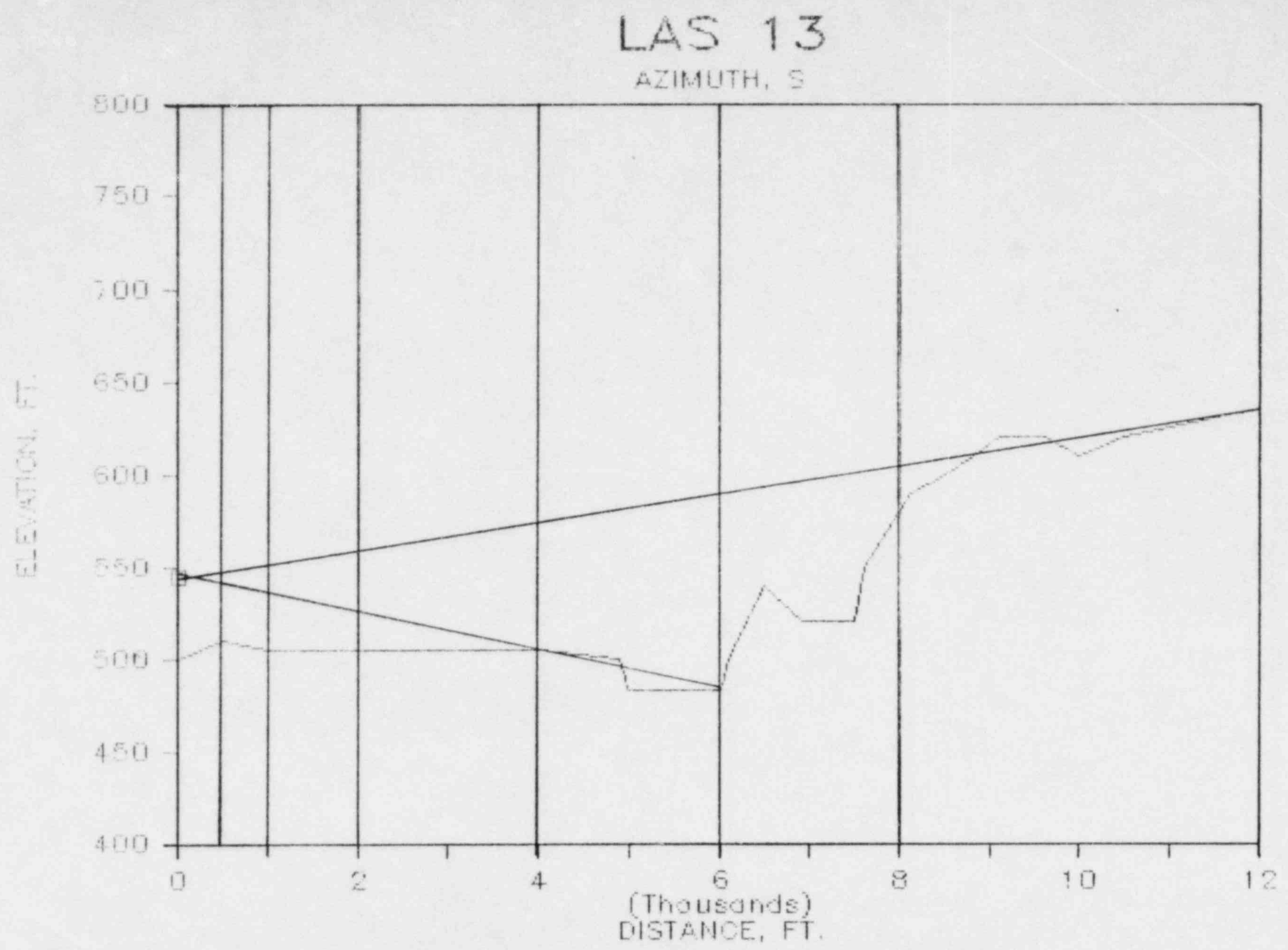


LAS 13
AZIMUTH, N
ELEVATION, FT.
800
750
700
650
600
550
500
450
400
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT.

LAS 13

AZIMUTH, W





LAS 13
AZIMUTH, S
ELEVATION, FT.
800
750
700
650
600
550
500
450
400
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT.

COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #13
SOURCE-RECEIVER TOPOGRAPHICAL INPUTS

ALL BEARINGS ARE WITH RESPECT TO THE NORTH MEASURING CLOCKWISE

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
1	500.	90.00	500.00	SOFT	0.	NO	0.	0.
2	1000.	90.00	500.00	SOFT	0.	NO	0.	0.
3	2000.	90.00	505.00	SOFT	0.	NO	0.	0.
4	4000.	90.00	510.00	SOFT	0.	NO	0.	0.
5	6000.	90.00	510.00	SOFT	0.	NO	0.	0.
6	8000.	90.00	500.00	SOFT	0.	YES	7900.	510.
7	12000.	90.00	580.00	SOFT	0.	NO	0.	0.
8	500.	0.0	500.00	SOFT	0.	NO	0.	0.
9	1000.	0.0	495.00	SOFT	0.	NO	0.	0.
10	2000.	0.0	515.00	SOFT	0.	NO	0.	0.
11	4000.	0.0	630.00	SOFT	0.	YES	4000.	630.
12	6000.	0.0	640.00	SOFT	0.	YES	4000.	630.
13	8000.	0.0	640.00	SOFT	0.	YES	4000.	630.
14	12000.	0.0	650.00	SOFT	0.	YES	7000.	530.
15	500.	270.00	500.00	SOFT	0.	NO	0.	0.
16	1000.	270.00	500.00	SOFT	0.	NO	0.	0.
17	2000.	270.00	500.00	SOFT	0.	NO	0.	0.
18	4000.	270.00	505.00	SOFT	0.	NO	0.	0.
19	6000.	270.00	515.00	SOFT	0.	NO	0.	0.
20	8000.	270.00	525.00	SOFT	0.	YES	7000.	530.
21	12000.	270.00	484.00	HARD	0.	YES	4900.	500.
22	500.	180.00	510.00	SOFT	0.	NO	0.	0.
23	1000.	180.00	505.00	SOFT	0.	NO	0.	0.
24	2000.	180.00	505.00	SOFT	0.	NO	0.	0.
25	4000.	180.00	505.00	SOFT	0.	NO	0.	0.
26	6000.	180.00	484.00	SOFT	0.	YES	9600.	600.
27	8000.	180.00	580.00	SOFT	0.	NO	0.	0.
28	12000.	180.00	635.00	SOFT	0.	YES	9600.	600.

COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #13
NOISE SOURCE POWER LEVEL INPUT

INDEX	SOURCE	DBA	DBC	31.5	63	125	250	500	1000	2000	4000	8000 (HZ)
1	SIREN 13-STH10	151.6	152.9	0.0	0.0	0.0	0.0	151.0	146.0	143.0	140.0	138.0

XO= 0.0 YO= 0.0 ZO= 545.00 HEIGHT ABOVE GROUND= 45.00

COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #13
METEOROLOGICAL INPUT CONDITIONS

H1= 10.06 METERS H2= 100.58 METERS

YEAR	SEASON	MONTH	DATE	HOUR	WIND DIRECTION	WIND SPEED(MPS) H1	H2	TEMPERATURE(C) H1	H2	RELATIVE HUMIDITY	BAROMETRIC PRESSURE(MM OF HG)
1983	S	7	1	12	180.0	3.7	5.2	25.0	24.4	70.0	744.0

COMMONWEALTH EDISON COMPANY
LASALLE ANS SIREN #13

SIREN SOUND LEVELS IN DBC

UNDER MET CONDITION 1

DISTANCE IN FEET

AZIMUTH	500.	1000.	2000.	4000.	6000.	8000.	12000.
E	100.	91.	82.	74.	70.	59.	61.
N	100.	92.	82.	69.	64.	60.	50.
W	100.	91.	82.	74.	70.	63.	55.
S	100.	91.	82.	74.	40.	67.	55.

APPENDIX B

Sample Size Determination

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SAMPLE SIZE DETERMINATION

The number of households that need to be surveyed is determined based upon the need to obtain a sample size sufficient to obtain a 95% confidence interval with precision (half-width) of 0.05 for the estimate of the porportion alerted. The exact number of households to be surveyed can be derived from the following statistical considerations. For relatively large sample sizes ($n \geq 30$), taken without replacement from a population (N), the sampling distribution for proportions (e.g., the proportion of the population alerted) is nearly a normal distribution, the mean of which is the proportion (p) of the population alerted and the variance of which is

$$p(1 - p)/n \left(\frac{N - n}{N - 1}\right)$$

If P is the observed sample proportion, then for a particular confidence level with confidence coefficient Z_C,

$$(P - p)^2 \leq Z_c^2\ p(1 - p)/n \left(\frac{N - n}{N - 1}\right)$$

Thus, for this confidence level, the actual proportion of the population alerted satisfies the following inequalities:

$$\frac{P + \frac{Z_c^2}{2n}\left(\frac{N - n}{N - 1}\right) - Z_c\sqrt{\frac{P(1 - P)}{n}\left(\frac{N - n}{N - 1}\right) + \frac{Z_c^2}{4n^2}\left(\frac{N - n}{N - 1}\right)^2}}{1 + \frac{Z_c^2}{n}\left(\frac{N - n}{N - 1}\right)} \leq p \text{ and}$$

$$p \le \frac{P + \frac{Z_c^2}{2n}\left(\frac{N-n}{N-1}\right) + Z_c\sqrt{\frac{P(1-P)}{n}\left(\frac{N-n}{N-1}\right) + \frac{Z_c^2}{4n^2}\left(\frac{N-n}{N-1}\right)^2}}{1 + \frac{Z_c^2}{n}\left(\frac{N-n}{N-1}\right)}$$

Thus, the precision (W) is simply given by

$$W = \frac{Z_c\sqrt{\frac{P(1-P)}{n}\left(\frac{N-n}{N-1}\right) + \frac{Z_c^2}{4n^2}\left(\frac{N-n}{N-1}\right)^2}}{1 + \frac{Z_c^2}{n}\left(\frac{N-n}{N-1}\right)}$$

This equation can be solved to determine the sample size (n) required to yield a given precision (W) with a given observed sample proportion (P) as follows:

$$n = \frac{\frac{Z_c^2}{2W^2}\left[P(1-P) - 2W^2 + \sqrt{W^2\left[1 - 4P(1-P)\right] + P^2(1-P)^2}\right]}{1 + \frac{Z_c^2}{2W^2N}\left[P(1-P) - 2W^2\left(1 + \frac{1}{Z_c^2}\right) + \sqrt{W^2\left[1 - 4P(1-P)\right] + P^2(1-P)^2}\right]}$$

Although this expression for n can be used directly, it is customary to make several approximations. First, since the term in N in the denominator (the finite population term) is positive definite for all reasonable values of W ($0 < W < 0.5$), omitting this term will result in an approximation to n that is slightly larger than its true value. This is an acceptable practice in sizing the sample since a larger sample gives greater precision.

A second approximation that can be made is to neglect the terms in W^2 within the bracket in the numerator. Analysis demonstrates that this underestimates n when $P < 1/2 - 1/4 \sqrt{2 + 8W^2}$ or $P > 1/2 + 1/4 \sqrt{2 + 8W^2}$ and overestimates n for P between those two values. For the case of interest (a 95% confidence interval with precision of 0.05), this approximation provides an overestimation of n when a sample size greater than 191 is required. Since the sampling plan calls for a minimum sample size of 250, regardless of the value of P, this approximation is acceptable because it also yields an estimate of n larger than the true value. Therefore, for the purposes of the pilot test and subsequent surveys, the following approximate equation can be used to determine whether a sample size larger than 250 is required:

$$n = \frac{Z_c^2}{W^2} P(1 - P)$$

or using 1.96 for Z_c and 0.05 for W,

$$n = 1536.64 P(1 - P)$$

Data from the pilot test can be used to illustrate the effects of these approximations. In the pilot test, the population of tone alert households from which the sample was to be drawn (N) was approximately 4500 and the observed proportion alerted (P) was 0.675. This yields 311 as the exact result for n. Neglecting the finite population term yields an estimate of 334 for n, and the simplified final approximation estimates n as 338. Thus, the final simplified approximation overestimates the required sample size by 27 in this case.

SOURCE: International Energy Associates Limited. "Analysis of Tone Alert Pilot Test." IEAL-321. September 27, 1983.