

official

SEP 06 1988

Georgia Power Company  
ATTN: Mr. W. G. Hairston, III  
Senior Vice President -  
Nuclear Operations  
P. O. Box 4E45  
Atlanta, GA 30302

Gentlemen:

SUBJECT: FEMA ANALYSIS OF THE PROMPT ALERT AND NOTIFICATION SYSTEM FOR THE  
VOGTLE ELECTRIC GENERATING PLANT

Enclosed are copies of correspondence received from FEMA documenting their analysis of the prompt alert and notification system for the Vogtle Electric Generating Plant which was conducted on July 14, 1987. As described in the enclosure, FEMA has determined that the alert and notification system installed around the Vogtle Electric Generating Plant satisfies the requirements of NUREG-0654/FEMA-REP-1, Revision 1, and FEMA-REP-10. Therefore, according to FEMA, the caveats on the alert and notification system contained in the Title 44 CFR, Part 350 approval for the States of Georgia and South Carolina dated June 9, 1987, are now removed. We encourage you to continue to work closely with the States and counties within the 10-mile EPZ in testing and maintaining the prompt alert and notification system.

Sincerely,

*Original signed  
by C. Hasey  
for*

Douglas W. Collins, Chief  
Emergency Preparedness and  
Radiological Protection Branch  
Division of Radiation Safety  
and Safeguards

Enclosure:  
FEMA Analysis of the Prompt Alert and  
Notification System for the Vogtle  
Electric Generating Plant

cc w/encl: (See page 2)

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PDR ADOCK 05000424  
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cc w/encl:

- R. P. McDonald, Executive Vice  
President, Nuclear Operations
- P. D. Rice, Vice President, Project  
Director
- C. W. Hayes, Vogtle Quality  
Assurance Manager
- G. Bockhold, Jr., General Manager,  
Nuclear Operations
- J. P. Kane, Manager Licensing  
and Engineering
- J. A. Bailey, Project Licensing  
Manager
- P. W. Churchill, Esq., Shaw,  
Pittman, Potts and Trowbridge
- D. Kirkland, III, Counsel,  
Office of the Consumer's Utility  
Council
- D. Feig, Georgians Against  
Nuclear Energy  
State of Georgia

bcc w/encl:

- E. Reis, OGC
- J. Hopkins, NRR
- M. Sinkule, RII
- DRS, Technical Assistant
- NRC Resident Inspector
- Document Control Desk
- W. D. Travers, NRR
- J. C. Heard, FEMA RIV

RII  
AGooden  
9/1/88

RII  
TDecker  
9/ /88

RII  
MSinkule  
9/5/88  
Cef

VOGTLE ELECTRIC GENERATING PLANT  
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 21, 1988

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May 31, 1988

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Vogtle Electric Generating Plant  
Site-Specific Offsite Radiological Emergency  
Preparedness Alert And Notification System  
Quality Assurance Verification

State Of Georgia

Burke County

State of South Carolina

Aiken County  
Allendale County  
Barnwell County

I. INTRODUCTION

A. Identification

1. Site Information

The Vogtle Electric Generating Plant is located on the southwest bank of the Savannah River, approximately 25 miles southeast of the city of Augusta, Georgia (1980 census population 47,532 persons). The Savannah River forms the boundary between the states of Georgia and South Carolina. The plant is situated approximately 15 miles north-northwest of the City of Waynesboro (1980 population 5,760 persons) in the eastern portion of Burke County, Georgia.<sup>1,2</sup>

The area surrounding the Vogtle Electric Generating Plant is essentially a flat tableland cut by the Savannah River and its tributary creek valleys. The

flood plain of the Savannah River is approximately 2 miles wide and runs from northwest to southeast at an elevation of 80 to 90 feet above mean sea level. The tableland on both sides of the river ranges in elevation from 200 to 300 feet above mean sea level. The tributary creek valleys, some with fairly steep sides, cut between the elevation of the tableland and that of the flood plain.<sup>1</sup>

The Savannah River flood plain and the broader creek valleys are marshland and are entirely uninhabited; a few hunters and fishermen use these areas. The narrower creek valleys are densely wooded and almost entirely uninhabited, with only an occasional church or residence located on roads that drop below the tableland.

Residences, businesses, and economic activity within 10 miles of the Vogtle Electric Generating Plant are located almost entirely on the tableland. On the Georgia side of the river these include the Vogtle Electric Generating Plant, scattered farms and woodlands, residences, churches, and a few commercial establishments. On the South Carolina side there are just three land holdings:

- . A portion of the U.S. Department of Energy's Savannah River Plant (SRP) in Aiken and Barnwell counties. The SRP contains no residences, and access to the Plant by the public is tightly controlled.
- . A portion of the Cowden Plantation in Aiken County. This portion of the plantation contains no residences, and access is restricted to employees and visitors (hunters) admitted and controlled by the owner.

- . A portion of the Creek Plantation in Allendale and Barnwell counties. This portion of the plantation contains eleven residences for employees of the plantation. Two public roads traverse the Creek Plantation: South Carolina Route 125 which provides access to the SRP, and Steel Creek Landing Road which goes to a public boat landing on the Savannah River. A church is located on Route 125 just outside the gate of the SRP.<sup>1</sup>

Agricultural activities in the area consist of crop production of commodities such as corn, soybeans, and winter and summer grains. Recreational activities available to the public are limited primarily to fishing at selected sites on the Savannah River and hunting. SRP officials allow deer hunting in limited sectors of the property from October to December. Commercial traffic on the Savannah River is composed of barges and tugboats moving up and down the river channel between the cities of Augusta and Savannah.<sup>3,4</sup>

## 2. Governments Within The 10-Mile Emergency Planning Zone

The emergency planning zone (EPZ) for the Vogtle Electric Generating Plant is defined by an irregular shape approximating a 10-mile-radius circle with the plant as the center point. The Georgia portion of the EPZ lies entirely within Burke County. The South Carolina portion of the EPZ includes areas in Aiken, Allendale, and Barnwell counties. A small area in Richmond County, Georgia located between 9 and 10 miles from the Vogtle Electric Generating Plant has been excluded from the EPZ. This area (approximately 1.8 square miles) is a swampy uninhabited area near the Savannah River. The Vogtle Electric Generating



Plant EPZ is located entirely within the states of Georgia and South Carolina and Burke, Aiken, Allendale, and Barnwell counties.<sup>4</sup>

A count of all residences (permanent homes and trailers) located within the Vogtle Electric Generating Plant EPZ in November 1985 yielded a total of 1,871 residences.<sup>1</sup> Reference 3 of this report projected the 1987 resident population within 10 miles of the plant at 2,669 persons.<sup>3</sup> The small Township of Gerard, Georgia is located approximately 7 miles south of the plant. As the majority of the South Carolina portion of the EPZ is occupied by the SRP, the only permanent South Carolina residences (11) within the EPZ lie in a small portion of Barnwell County.<sup>5</sup>

There are no areas within the Vogtle Electric Generating Plant 10-mile EPZ where population density exceeds 2,000 persons per square mile.<sup>1</sup>

## B. Scope Of Review

### 1. Emergency Plans For Offsite Response Organizations

The Georgia Power Company's report, "Public Alert and Notification Systems for Alvin W. Vogtle Electric Generating Plant"<sup>1</sup> describes the public alert and notification system evaluated in this quality assurance verification review. State and local emergency response plans and implementing instructions applicable to this review are included in the:

- . State of Georgia, "Radiological Emergency Plan, Annex D, Plant Vogtle," February 1986;<sup>4</sup>
- . Burke County, "Burke County Emergency Management Agency Radiological Emergency Plan," February 1986.<sup>13</sup>
- . State of South Carolina, "South Carolina Radiological Emergency Response Plan, Part 7, Vogtle Electric Generating Plant Site Specific Radiological Emergency Response Plan," January 1986;<sup>5</sup>
- . Aiken County, "Aiken County Emergency Operations Plan," April 1986;<sup>6</sup>
- . Allendale County, "Allendale County Emergency Operations Plan," July 1982;<sup>7</sup> and
- . Barnwell County, "Barnwell County Emergency Operations Plan," March 1986.<sup>8</sup>

References 1, 4, 5, 6, 7, and 8 document the administrative means established for notifying and providing prompt instructions to the public within the Vogtle Electric Generating Plant EPZ.

## 2. Alert And Notification System Design Report

The physical means established for alerting the public within the Vogtle Electric Generating Plant EPZ are documented in the following:

- . State of Georgia, letter from Billy J. Clack, Executive Director, Georgia Emergency Management Agency, Department of Defense, to Glenn C. Woodard, Jr., Chief, Natural and Technological Hazards Division, Federal Emergency Management Agency, Region IV, dated July 16, 1986, enclosing one copy of "Public Alert and Notification Systems for the Alvin W. Vogtle Electric Generating Plant," dated July 1986. (This letter and its corresponding enclosure are hereinafter referred to as the Design Report.)<sup>1</sup>

### 3. FEMA Evaluation Findings

The Federal Emergency Management Agency (FEMA) Region IV and the Regional Assistance Committee have evaluated the following offsite emergency preparedness exercise for the Vogtle Electric Generating Plant:

- . FEMA, "Radiological Emergency Preparedness Exercise Report, April 30 - May 1, 1986 Exercise," September 19, 1986.<sup>9</sup>

In addition, the Vogtle Electric Generating Plant received 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, as documented in the:

- . Letter to the Honorable Joe F. Harris, Governor of Georgia, signed by Julius W. Becton, Jr., Director, the Federal Emergency Management Agency, dated June 9, 1987.<sup>14</sup>
- . Letter to Victor Stello, Jr., Executive Director for Operations, U.S. Nuclear Regulatory Commission, signed by Dave McLoughlin, Deputy Associate Director, State and Local Programs and Support, the Federal Emergency Management Agency, dated June 9, 1987.<sup>15</sup>
- . Letter to the Honorable Carroll Campbell, Jr., Governor of South Carolina, signed by Julius W. Becton, Jr., Director, the Federal Emergency Management Agency, dated June 9, 1987.<sup>16</sup>
- . Memorandum For: Spence Perry, General Counsel, U.S. Nuclear Regulatory Commission, From: Dave McLoughlin, Deputy Associate Director, State and Local Programs and Support, the Federal Emergency Management Agency, Dated June 9, 1987.<sup>17</sup>

## II. FINDINGS FOR EVALUATION CRITERION E.6

The Design Report describing the alert and notification system for the Vogtle Electric Generating Plant 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.<sup>10</sup>

The bases for review against this evaluation criterion were the corresponding acceptance criteria of FEMA-REP-10, "Guide for the Evaluation of Alert and Notification Systems for Nuclear Power Plants"<sup>11</sup> (hereinafter referred to as FEMA-REP-10). This quality assurance verification review was performed to make a determination of alert and notification system adequacy prior to conducting a demonstration of the Vogtle Electric Generating Plant system on July 14, 1987.

Based upon this quality assurance verification review, International Energy Associates Limited concluded that the design and implementation of the alert and notification system for the Vogtle Electric Generating Plant and its supporting procedures conformed sufficiently to the acceptance criteria, as stated in FEMA-REP-10, 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.

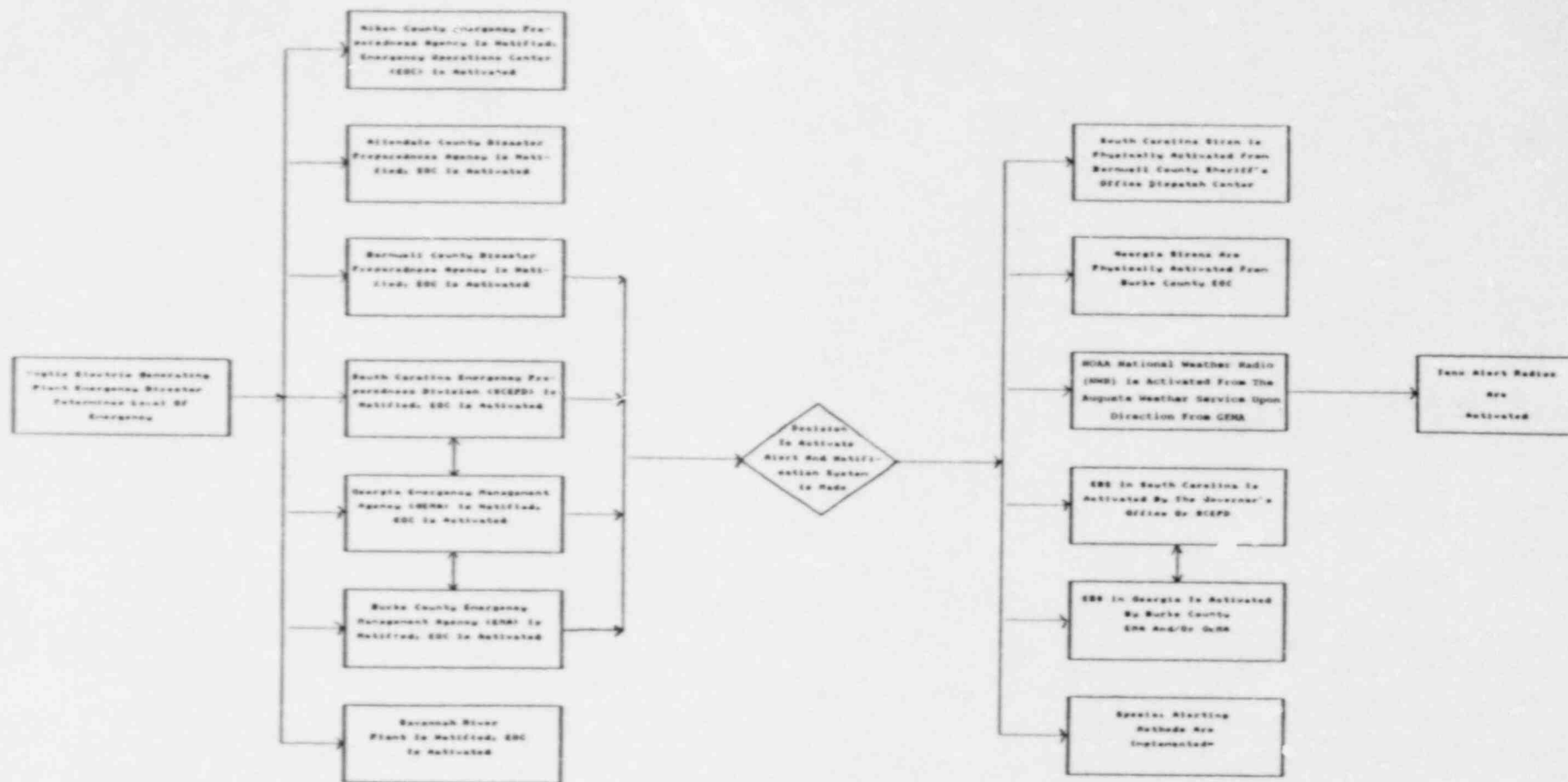
This portion of the quality assurance verification review evaluates the Vogtle Electric Generating Plant's alert and notification system against FEMA-REP-10 acceptance criteria in the following areas: the administrative means of alerting, the physical means of alerting, and the special alerting methods.

A. Administrative Means Of Alerting (E.6.1, FEMA-REP-10)

The Design Report specifies those organizations or individuals within the state and local governments who are responsible for recommending alert and notification system activation for the Vogtle Electric Generating Plant. The decision logic shown in Figure 1 of this report was developed after a review of the current emergency procedures and implementing instructions for the Vogtle Electric Generating Plant, the States of Georgia and South Carolina, and Burke, Aiken, Allendale and Barnwell Counties.

Current emergency procedures document the responsibilities concerning the alert and notification system activation process from the time the emergency message is conveyed from the Vogtle Electric Generating Plant control room to the state and county warning points and to the state and county officials who are responsible for making the decision to activate the public alert and notification system. As Figure 1 indicates, these procedures satisfy FEMA-REP-10 acceptance criteria.

FIGURE 1  
 UOGLTE ELECTRIC GENERATING PLANT  
 ALERT AND NOTIFICATION SYSTEMS ACTIVATION  
 DECISION/ACTION SEQUENCE DIAGRAM



\*Supplemental alerting methods include river alerting, emergency vehicle alerting, outdoor warning signs and institutional alerting.

In the event of an incident at the Vogtle Electric Generating Plant, emergency information is disseminated and requests for assistance made via the Emergency Notification Network (ENN), a dedicated ringdown telephone system connecting the Vogtle Electric Generating Plant with the state and county warning points and the Savannah River Plant (SRP). The Administrative Decision Line (ADL) is a dedicated telephone line connecting the plant with the Georgia and South Carolina emergency operations centers (EOCs). The purpose of the ADL is to provide a separate means of discussion for activation of the alert and notification systems and protective action decision-making. Backup communication systems include commercial telephone and state and local radio systems.

Initial determination of an emergency classification which may require protective actions is made by the Emergency Director at the Vogtle Electric Generating Plant. The Emergency Director initiates the notification process by contacting the Georgia Emergency Management Agency (GEMA), the South Carolina Emergency Preparedness Division (SCEPD), the Burke, Aiken, Allendale, and Barnwell County warning points, and the SRP EOC simultaneously via the ENN. All notification points are manned 24 hours per day, 7 days per week, and have backup power available. Responsibility for alerting and notifying the public lies with the appropriate offsite civil authorities; specifically, GEMA for anywhere within the State of Georgia; Burke County Emergency Management Agency for Burke County, Georgia; SCEPD for South Carolina; the County Emergency Preparedness Agency for Aiken County, South Carolina; the county disaster preparedness agencies for Allendale and Barnwell Counties, South Carolina; and the SRP.

The State emergency management agencies (specifically, GEMA in Georgia and the SCEPD in South Carolina) have the authority to recommend siren system activation. In Georgia, GEMA will instruct the Burke County Emergency Management Director to activate the sirens. Physical activation of these sirens is by remote control from the Burke County EOC. In South Carolina, the SCEPD will instruct the Barnwell County Sheriff's Office Dispatcher to activate the siren in South Carolina, also remotely controlled. All siren control points are manned 24 hours per day and are equipped with emergency generators in the event of a power failure.

GEMA and SCEPD will coordinate siren activation along with the coordination of NOAA and EBS radio messages. GEMA, upon coordination and agreement of the NOAA message with South Carolina, requests the Augusta Weather Service to activate the NWR system. A coordinated EBS message will be transmitted by both states to their respective EBS input stations. In Georgia, radio stations WBRO (AM), WYFA (FM), and WBBQ (FM) are the central contact points; in South Carolina, the central contact stations are WAKN, WJES, and WTCB.

In Georgia, the Burke County Emergency Management Agency is responsible for activation of the EBS; GEMA may also activate the EBS in Georgia. In South Carolina, the Governor's Office is responsible for activation of the EBS; the SCEPD and Aiken, Allendale and Barnwell Counties can also activate the EBS in South Carolina if necessary.

A FEMA exercise evaluation (reference 9 of this report) has demonstrated that the administrative mechanisms are in place to provide prompt notification of the general public in the event of an emergency at the Vogtle Electric Generating Plant.



B. Physical Means of Alerting (E.6.2, FEMA-REP-10)

As described in the Design Report, the physical means of alerting for the Vogtle Electric Generating Plant consist of two independent alerting systems: fixed siren units and a weather warning radio system. The Design Report states that fixed sirens will provide a minimum of 60 dBC design coverage for all residences within the EPZ. In addition, weather warning radios have been provided for all residences, businesses, and public buildings within the EPZ. Therefore, the residences are covered by a redundant alerting capability.

1. Sirens (E.6.2.1, FEMA-REP-10)

The Vogtle Electric Generating Plant siren alerting system, as submitted in the Design Report, was evaluated in accordance with the design evaluation methodology detailed in "Analysis of Sire System Pilot Test."<sup>12</sup>

Routine siren testing procedures and operability for the Vogtle Electric Generating Plant siren alerting system have been reviewed and determined to satisfy FEMA-REP-10 operability requirements.

The siren system as analyzed consists of 47 rotating electronic WS-3000 sirens with public address capability manufactured by Whelen Engineering Company, Inc.

Anechoic-chamber measured octave band sound pressure spectrums supplied by the siren manufacturer were used to verify the rated output of the WS-3000 sirens to be 123 dBC at 100 ft.

The evaluation of the siren system design calculation procedure was conducted by:

- . Verifying the design calculation procedure as presented in Section 2.4.2 of the Design Report against the 10 dB loss per distance doubled attenuation rate in the absence of special conditions; and
- . Ascertaining the adequacy of the design procedure in the presence of site-specific topographical and meteorological conditions through comparison of the design procedure with the Outdoor Sound Propagation Model (OSPM).<sup>12</sup>

The Vogtle Electric Generating Plant siren alerting system design follows the 10 dB loss per distance doubled attenuation rate as recommended in NUREG-0654/FEMA-REP-1, Rev.1, for situations in which special conditions are absent. There are no areas of the EPZ with a population density greater than 2,000 persons per square mile, and a minimum of 60 dBC siren coverage is provided to all residences within the EPZ.

This quality assurance verification review seeks to ascertain whether this design procedure, namely the 10 dB loss per distance doubled attenuation rate, adequately accounts for the site-specific terrain and weather conditions and whether the siren alerting system (as designed) does indeed meet the FEMA-REP-10 acceptance criteria.

Eleven sirens, depicted on the U.S. Geological Survey's Shell Bluff Landing quadrangle map (see Figure 2 of this report), were selected for this quality assurance verification review. This selection is representative of the site-specific topographical conditions around the more populated area within the Vogtle Electric Generating Plant EPZ.

Surface weather parameters, representative of site prevailing summer daytime conditions, were used in the OSPM calculations. Appendix A of this report contains OSPM topographical profile charts, OSPM topographical input, OSPM siren sound pressure level input, OSPM meteorological input, and OSPM siren sound pressure level output for each of the 11 individual siren runs.

To compare the ranging estimates of OSPM with the design procedure for the sirens analyzed, the output dBC levels along each azimuth of the 11 sirens were classified into three terrain categories: flat terrain (generally unobstructed line-of-sight); partially hilly terrain (very slightly obstructed line-of-sight); and hilly terrain (obstructed line-of-site). Regressions of dBC versus the logarithm of distance were performed for the sirens over these categories.

The OSPM regression results of the siren sound pressure levels are presented in Figures 3 through 5 of this report. Also depicted is the 60 dBC range as calculated by the licensee using the 10 dB loss per distance doubled attenuation rate with no barriers. The following table summarizes the estimated effective ranges of 70 dBC and 60 dBC over the various terrain classifications:

<u>Siren Type</u>	<u>Procedure</u>	<u>Terrain</u>	<u>Range in ft to</u>	
			<u>70 dBC</u>	<u>60 dBC</u>
WS-3000	Licensee OSPM	No Barriers	- -	7,880
		Flat	3,225	5,650
		Partially Hilly	2,950	5,000
		Hilly	2,600	4,300
	10 dBC Rule	No Barriers	3,900	7,800

FIGURE 3

COMPARATIVE OSPM RESULTS, RELATIVELY FLAT TERRAIN (WS-3000 SIREN)

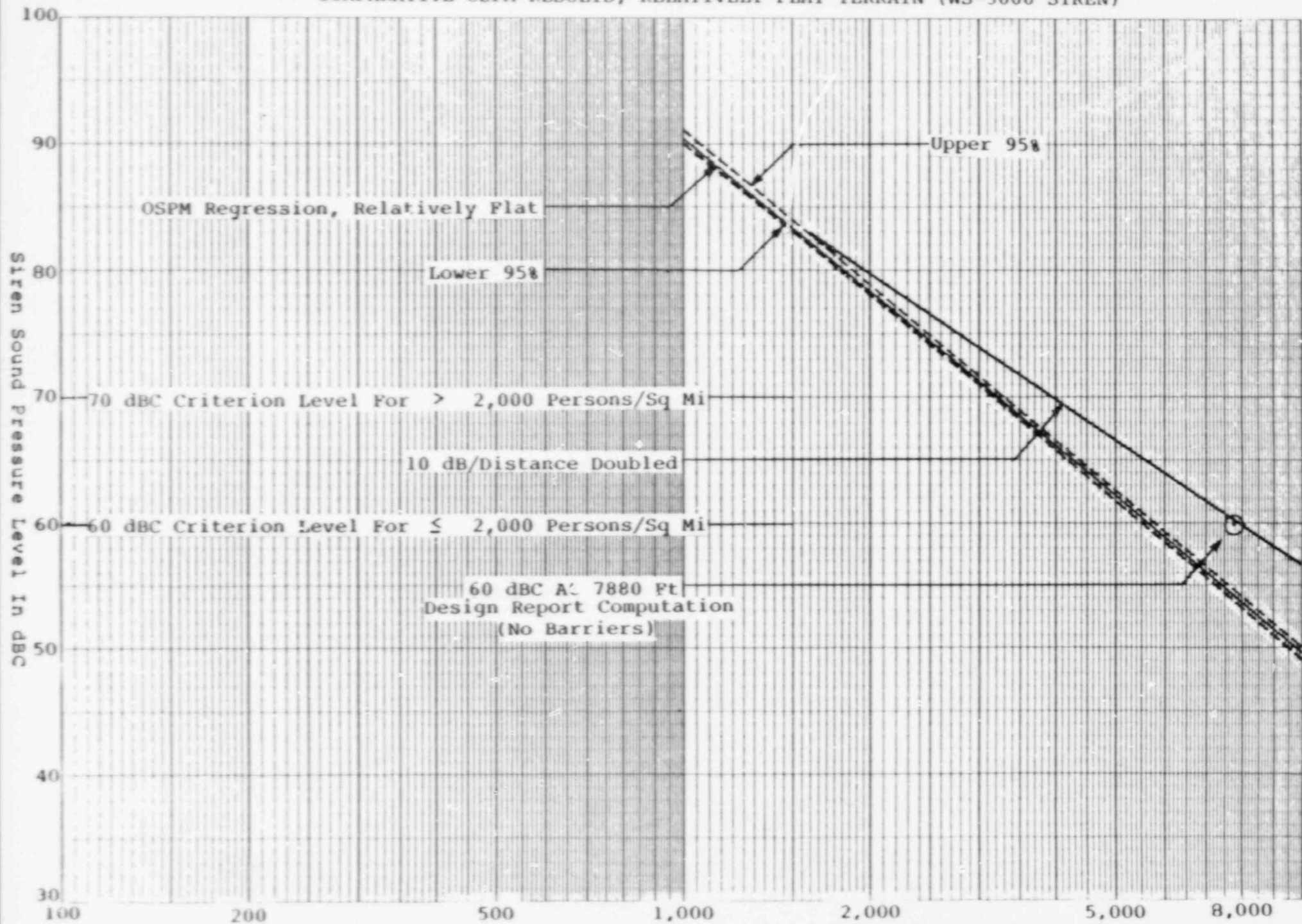


FIGURE 4

COMPARATIVE OSPM RESULTS, PARTIALLY HILLY TERRAIN (WS-3000 SIREN)

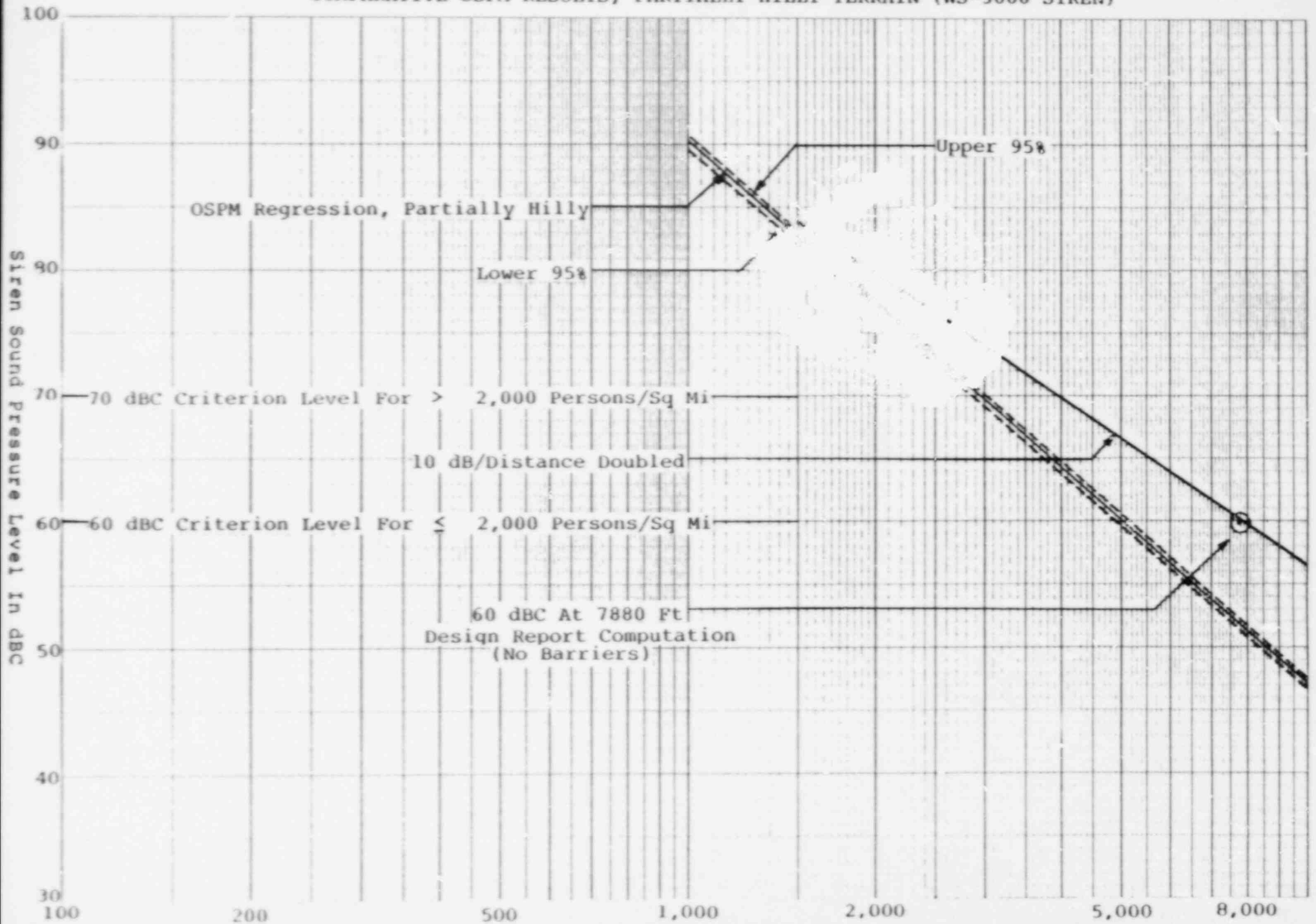
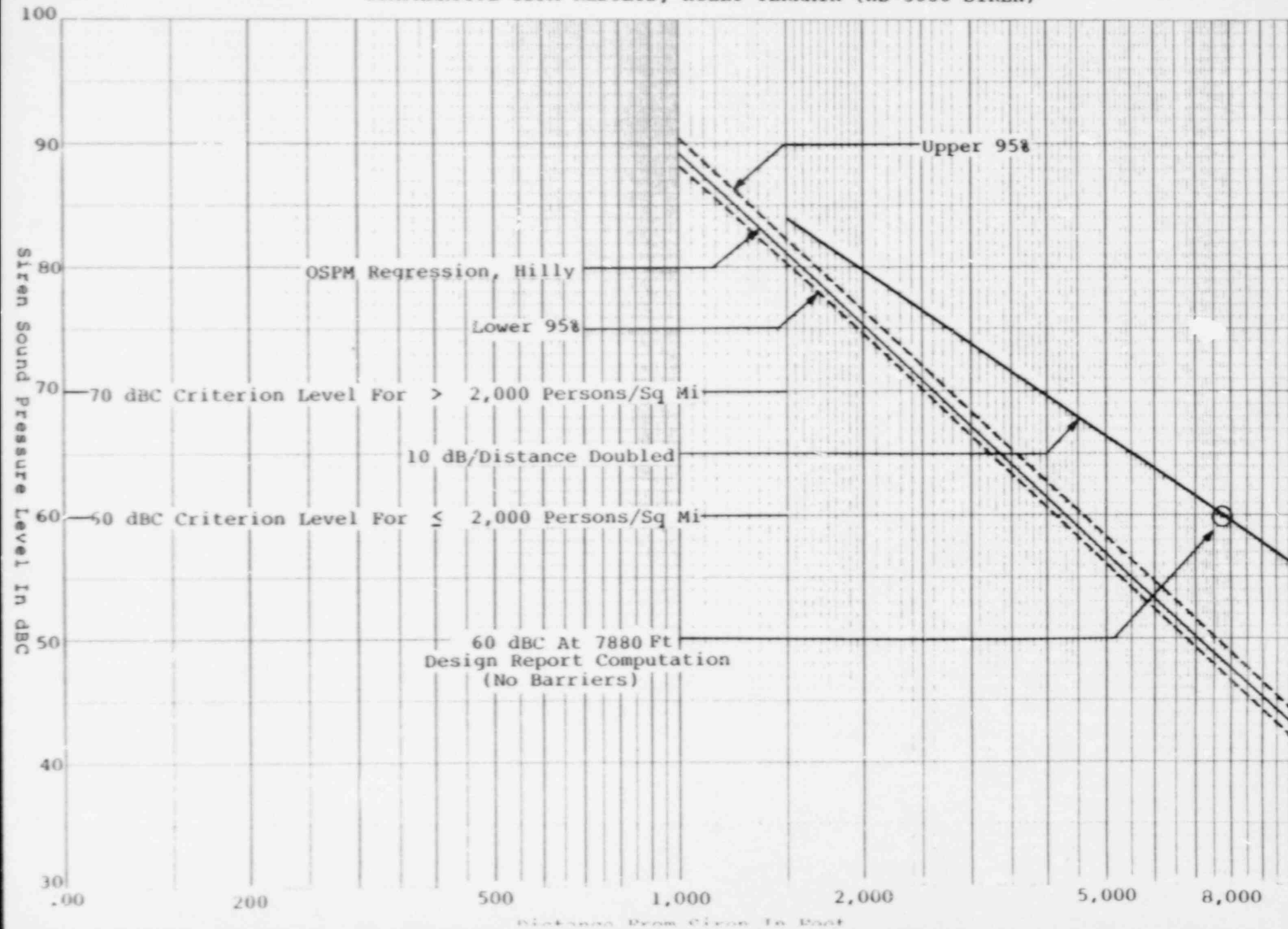


FIGURE 5

COMPARATIVE OSPM RESULTS, HILLY TERRAIN (WS-3000 SIREN)



Some general observations can be made concerning the siren range comparisons. The 60 dBC and 70 dBC ranges estimated by the licensee are liberal compared to OSPM results over all terrain categories. The licensee's estimated 60 dBC range and the ranges estimated by the 10 dB rule for the WS-3000 sirens are liberal compared to OSPM results. This is due primarily to the higher operating frequencies of the WS-3000 sirens which incur substantially higher attenuations through atmospheric absorption than lower operating frequencies as considered in the 10 dBC Rule.

To assess the overall adequacy of the design on an area basis, for each siren located on the U.S. Geological Survey's Shell Bluff Landing quadrangle map (Figure 2 of this report), the area coverages of 60 dBC and 70 dBC were numerically integrated and averaged. The results are as follows:

AVERAGE AREA  
(In Square Miles)

<u>Siren Type</u>	<u>70 dBC</u>	<u>60 dBC</u>
WS-3000	.79	3.21

Using these results, the following average effective radii are derived:

EFFECTIVE RADIUS  
(In ft)

<u>Siren Type</u>	<u>70 dBC</u>	<u>60 dBC</u>
WS-3000	2,654	5,341

These derived radii confirm that on the average, the Design Report siren ranges are very liberal when siren operating characteristics and site terrain and weather conditions are taken into account.

The results of the individual OSPM runs were combined to generate a comprehensive overview of the siren sound pressure levels in the Shell Bluff Landing quadrangle as depicted in Figure 2 of this report. A surface interpolation and contouring program utilizing the output results of the 11 sirens was used to generate the sound pressure level contours shown in Figure 2. These siren contours account for site-specific topographical and meteorological effects.

Comparisons of the OSPM-predicted 60 d3C and 70 dBC contours, with the contours in Figure 10 of the Design Report, indicate that the coverage of the sirens as calculated in the Design Report is slightly liberal.

In conclusion, the Vogtle Electric Generating Plant siren alerting system in conjunction with the weather warning radio system is found to meet the specific design requirements of FEMA-REP-10.

## 2. Tone Alert Radios (E.6.2.3., FEMA-43)

The second portion of the primary alert and notification system for the Vogtle Electric Generating Plant consists of a National Oceanic and Atmospheric Administration (NOAA) weather warning radio system. These tone alert weather radio receivers are Model BCWN manufactured by Bearcat and are distributed to all residences, businesses and public buildings within the EPZ. These



single-channel receivers are tuned to a NOAA weather radio transmitter located at the Vogtle Electric Generating Plant. The transmitter operates continuously providing weather information.

The tone alert weather radio receivers operate from AC house current, but contain a battery which automatically supplies power in the event of a power failure. The receivers can be activated at any time by the user in order to listen to routine weather reports, which are transmitted continuously. The receivers normally operate in a muted but ready mode producing no audio output. A red light on the front panel indicates that the receiver is energized and ready for activation. When a special alerting tone (1050 Hz) is detected, the red light begins to blink and a loud beeping tone is produced. This is followed by a voice message on the nature of the emergency. The receiver remains activated until manually reset.

FEMA has developed guidelines as described in FEMA-REP-10 that should be followed to maintain an effective and continual alert and notification program utilizing tone alert receivers. These guidelines are as follows:

- . Tone alert radios should be offered to the public in geographical areas (where needed) and a "best-effort" attempt must be made to place the radios. A record system (register) containing an accurate list of addresses (names are optional) must be maintained for those geographical areas using the tone alert radios. The addresses of residents refusing tone alert radios should also be noted.
- . A maintenance program offering operating checks should be available at least annually to all residences in geographical areas using the tone alert radios. This maintenance program and the register program (mentioned above) may be integrated.

- . Tests offering the public a means to self-test its receivers are desired at least monthly. However, a final determination of testing frequency rests with appropriate local government officials. These test results need not be monitored.
- . Written guidance should accompany the tone alert radio. These instructions should address, where applicable, a tone alert radio's:
  - General usage;
  - Self-testing frequency and method;
  - Suggested location (to facilitate efficient monitoring);
  - Maintenance program; and
  - Telephone numbers for repair or replacements.
- . As a reminder, this written guidance should be provided annually to each tone alert radio recipient. This portion of the tone alert program may also be integrated with the register and maintenance programs (mentioned above).
- . A determination should be made that the broadcast medium for initiating the tone alert signal has adequate availability (24 hours a day, 7 days a week), signal strength, and signal quality.<sup>11</sup>

Radio and television stations, in cooperation with governments, have formed a network to provide emergency information and instructions to the general public. This network, called the Emergency Broadcast System (EBS), operates on a pyramid structure. This allows an authorized activator to contact one specific station. The station in turn relays the information to all other EBS stations in a given geographic area. Radio Stations WBRO (AM), WYFA (FM) and WBBQ (FM) (CPCS-1) are the central contact points for entry into the local EBS for Georgia. In South Carolina, the key contact stations are WAKN, WJES and WTCB.

In Georgia, the Burke County Emergency Management Agency (EMA) is responsible for activation of the EBS, as well as for the activation of the outdoor siren system in that county. In South Carolina, the Governor's Office is responsible for activation of the EBS. The Georgia Emergency Management Agency (GEMA) may also activate the EBS in Georgia. The Emergency Preparedness Division of the Adjutant General of South Carolina (SCEPD), and Aiken, Allendale and Barnwell Counties in South Carolina can also activate the EBS in South Carolina if necessary.

Arrangements have been made with the local radio stations to broadcast emergency information and instructions as provided by local or State authorities. Similar arrangements have been made with Augusta commercial television stations. Each of these radio and television stations is a member of EBS. The stations are as follows:

WBBQ-FM	104.3	Augusta
WBBQ-AM	1340	Augusta
WBRO-AM	1310	Waynesboro
WYFA-FM	100.9	Waynesboro
WGUS-FM	102.3	Augusta
WGUS-AM	1380	No. Augusta
WNEZ-FM	99.3	Aiken
WAKN-AM	990	Aiken
WTCB-FM	106.7	Orangeburg
WBAW-AM	740	Farnwell
TV Channels	6, 12, 26	Augusta

The NWR receivers produce a loud alerting tone when activated. This is followed by broadcasts of emergency information. NWR can be used for follow-up public information as well as for the initial alert. This supplements the use of the EBS for this purpose, and compensates for the fact that most commercial broadcast

stations in the EPZ do not normally operate 24 hours per day. (All commercial stations have agreed to come on the air in the event of an emergency at Vogtle.) Attachment 1 of the Design Report contains letters of agreement between GEMA and NOAA and between NOAA and the Georgia Power Company.

The transmitters for the NWR are physically located at the Vogtle Electric Generating Plant. One is always in use; the other is always in "hot-standby." Should the primary transmitter fail, the one on hot-standby is automatically switched on. (NWS, Augusta, normally switches transmitters weekly to ensure that both are operable.) When the transmitters switch, an automatic alarm appears in the Georgia Power Company Communications Control Center in Atlanta. Furthermore, the transmissions are monitored continuously at the Vogtle Electric Generating Plant Security Office so that any failure can be investigated and repairs made if necessary.

There is an emergency generator at the transmitter site that automatically provides power in the event of a local power failure.

The audio modulation signal for the transmission originates at a tape console in the NWS weather station in Augusta Georgia. This normally consists of routine weather information recorded on a series of tape loops which are updated from time to time. In the event of an emergency, a special emergency message tape is prepared, the 1050 Hz alert tone is transmitted for about 10 seconds, and the emergency message tape is played. Audio modulation is carried from NWS Augusta to the

Vogtle transmitter site over two independent channels. Both audio channels are monitored by a VOX (Voice Operated Switch) system at the Vogtle transmitter site. Should audio be lost on the channel in use, the other channel is automatically switched to the operating transmitter. If this happens, an alarm is activated at the Vogtle Electric Generating Plant Security Office and at the Georgia Power Company Communications Control Center in Atlanta.

The Design Report states that tone alert receiver distribution within the Vogtle EPZ was conducted in late 1986. Each receiver was personally delivered and demonstrated by a member of the Georgia Power Company distribution crew along with an instruction booklet. A personal explanation and demonstration of the tone alert receiver was also provided for each recipient. All radios were tested immediately before they were handed out.

Georgia Power Company maintains and updates a detailed, computerized register of the names, addresses, and location of all tone alert receiver holders. The register will be kept up to date as residents move into and out of the EPZ.

In order to monitor the movement of residents into and out of the Vogtle Electric Generating Plant EPZ, Georgia Power Company receives monthly lists, provided by rural electric cooperatives, of all electricity service connections and disconnections made within the EPZ. Each new resident is contacted by Georgia Power Company personnel and is offered a tone alert receiver. An attempt is made to recover receivers from residents moving out of the EPZ as indicated by an electrical disconnection.

An information packet and replacement batteries are mailed annually to all receiver holders. These packets include information on the purpose and use of the receivers, their suggested placement within buildings, maintenance procedures, and locations and telephone numbers for free radio service (if needed). Georgia Power Company maintains a repair and replacement service at its district office in Waynesboro, Georgia. The annual information packet is also an attempt by Georgia Power Company to locate persons needing special assistance (e.g., the disabled or handicapped and those persons with language disabilities) so that special measures can be taken to notify and assist them in the event of an emergency.

The tone alert weather radio receivers are tested weekly (around noon on Wednesday) unless severe weather threatens.

The public warning system developed for the Vogtle Electric Generating Plant, as described in the Design Report, meets the intent of FEMA-REP-10 guidelines for tone alert receiver systems.

### 3. Special Alerting (E.6.2.4., FEMA-REP-10)

A number of means have been established to supplement the siren and NOAA tone alert receiver systems for alerting the public within the Vogtle EPZ. Both Georgia and South Carolina utilize the Emergency Broadcast System (EBS) to provide emergency information and instructions to the general public via designated radio and television stations. ~

Burke County Emergency Management Agency and Georgia Department of Natural Resources Law Enforcement Division vehicles, in coordination with the South Carolina Department of Wildlife, will move through wooded areas near boat landings, and boats will travel portions of the Savannah River in the affected areas to warn transients. The U.S. Coast Guard will close the river to water traffic at points outside the EPZ.

General emergency information brochures for Georgia and South Carolina will be distributed annually to all residents within the EPZ. The brochures will also be provided in adequate numbers to all establishments used by transients within the plume exposure EPZ such as churches, stores, and motels. In addition, brochures will be provided at convenient points for distribution to those who enter the EPZ for business or recreation, such as at the Augusta Office of the Agricultural Conservation and Stabilization Service for non-resident farmers, the Seaboard Coast Line Railroad for transient train crews, and hunting clubs for members. The brochures will also solicit identification of anyone needing special assistance (the disabled or handicapped and those with language disabilities) so that special measures can be taken to notify and to assist such individuals in the event of an emergency at the Vogtle Electric Generating Plant.

Outdoor warning signs will be posted at all public parks, boat-launching ramps and other recreational areas within the plume exposure EPZ. Notices will also be placed in or near public telephone booths,

and all local telephone directories will include a notice. Signs, notices, and brochure supplies will be checked periodically and replaced or replenished when necessary.

Institutional Alerting (E.6.2.4.2, FEMA-REP-10)

The Savannah River Plant (SRP) is located within the EPZ and will be notified immediately of an emergency at Vogtle Electric Generating Plant via the ENN. In the event of a serious emergency, the Savannah River Plant is closed to non-essential employees and the public. Registered deer hunters on SRP property will be evacuated using established hunting procedures. These emergency procedures are explained to hunters each day prior to the hunt by the SRP Hunt Coordinator and hunt stations are assigned for accountability purposes. The EOC notifies the Hunt Coordinator of an evacuation order by radio. The coordinator arranges for buses to pick up the hunters. Each transient entering the area is given an orientation card describing protective actions in case of an emergency. The Security Contractor dispatches vehicles with sirens and public address systems to notify transients of an evacuation order. Confirmation of a successful evacuation is obtained when the last sportsman has signed out on the log.

Managers of the Cowden and Creek Plantations will be notified of an emergency by sirens and/or the NWR system. Both plantation owners have agreed to make timely notifications to people on their property. Both plantations also have drive-through alerting capabilities, and Barnwell County EMA officials can provide additional drive-throughs if requested.



Use of Police/Emergency Vehicles (E.6.2.4.6, FEMA-REP-10)

Local governmental agencies can provide drive-through alerting using emergency vehicles equipped with sirens and loudspeakers. Handicapped residents and others with special needs are being asked to register with local EMA officials, and will be alerted by door-to-door contact or by telephone, as appropriate for the individual.

### III. FINDINGS FOR EVALUATION CRITERION N.1

On July 14, 1987, the physical means (sirens and tone alert radios) used to alert the population within the Vogtle Electric Generating Plant EPZ were demonstrated to satisfy the alert and notification aspects of 44 CFR 350.9(a). This demonstration was conducted by using the methods specified in section N.1.(a,b).2 of FEMA-REP-10.<sup>11</sup> The results indicate that this portion of the alert and notification system evaluation conforms to FEMA-REP-10 and NUREG-0654/FEMA-REP-1, Rev.1.<sup>10</sup>

The July 14, 1987, demonstration of the Vogtle Electric Generating Plant alerting system consisted of a single activation of all tone alert radios, two activations of the siren system and a subsequent telephone survey to estimate the proportion of EPZ households actually alerted. The first siren activation was initiated at approximately 12:02 p.m. EDT (Eastern Daylight Time) and continued for approximately three minutes. The second activation of the sirens occurred at approximately 12:07 p.m. EDT. Sirens B-17, D-36, and SC-1 were reported as not operating during the demonstration. All other sirens were reported operating during both activations. Tone alert radios were activated at approximately 12:00 p.m. EDT.

The telephone survey of EPZ residences began at approximately 12:07 p.m. EDT and was completed within two hours. This survey was conducted by 33 telephone interviewers, each with a separate WATS line and computer terminal.

The universe of households to be surveyed was determined by establishing a polygon that contained the entire EPZ around the latitude and longitude of the station. The

sample incorporated a sorted master list of approximately 2,500 households (addresses and telephone numbers) within the established boundary. These were then checked, to the extent possible based upon the addresses, to verify that they were not outside the EPZ.

A sufficient number of replicated 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 used for sizing the sample to achieve this result.

The questionnaire used the telephone survey is included as Figure 6 of this report.

As part of the telephone survey, 372 households within the Vogtle Electric Generating Plant EPZ were contacted and the responses were collected in an automated data base. Of this group, 157 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 original 372 addresses, 118 were found to lie outside of the EPZ. Therefore, data were tabulated on 254 respondent households that were located within the EPZ.

Respondents at 30 of these 254 households were away from that telephoned location ("away from home") at the time of the alerting demonstration and, therefore, were also not included in the alerting analysis. The location of 39 households, where individuals were home during the demonstration but were not alerted, was checked to

#3643Q  
 Chilton Research Services  
 Radnor, Pennsylvania

Draft #2  
 Study #7091  
 July, 1987

OMB #3067-0103 (FEMA 9/86)  
FEMA NUCLEAR POWER PLANT ALERTING  
AND NOTIFICATION SYSTEM: PUBLIC TELEPHONE  
SURVEY

VOGTLE

Time Began \_\_\_\_\_ AM \_\_\_\_\_ PM Interview # \_\_\_\_\_  
 (1-5)  
 Time Ended \_\_\_\_\_ AM \_\_\_\_\_ PM Zip Code \_\_\_\_\_  
 (6-10)  
 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 in cooperation with Georgia Power Company and your state and local governments.

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 emergency notification system for Vogtle Electric Generating Plant. Did you, or any other member of this household, hear any type of emergency 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

3. What type of emergency signal did you hear? (DO NOT READ. CIRCLE ALL THAT APPLY) (23-25)

SKIP TO Q. 4	Siren	1
	Vogtle NOAA weather radio/ (Tone alert radio)	2
	Neighbor told me	3
	Other family member told me	4
	Other (SPECIFY) _____ _____ _____	9
CONTINUE	Don't Know	Y

3A. Did you hear . . . (READ LIST. CIRCLE ALL THAT APPLY) (30-32)

	A siren	1
	Vogtle NOAA weather radio/ (A tone alert radio)	2
	From a neighbor	3
	From another family member	4
	Or by means of something else (SPECIFY) _____ _____ _____	9
DO NOT READ	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 heard or were made aware of this emergency signal?

37-

SKIP TO Q. 5	Home	1
	Away from home	2

4A. (IF "DID NOT HEAR EMERGENCY SIGNAL") Were you at home around noon today?

38-

Yes	1
No	2
Don't Know	Y

4B. Has your household ever been issued a Vogtle NOAA weather radio?

39-

IF RESPONDENT WAS NOT HOME SKIP TO Q. 5, OTHERWISE ASK Q. 4C	Yes	1
	No	2
	Don't Know	Y
SKIP TO Q. 5		

4C. Was it turned on at approximately noon today?

40-

Yes	1
No	2
Don't Know	Y

5. Has your household ever received information which tells you what to do in the event of a "real" emergency at the Vogtle Electric Generating Plant. This blue brochure entitled "Safety Information" was mailed to you from Georgia Power Company. Do you remember receiving this information?

41-

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 the Vogtle Electric Generating Plant, 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.

determine whether the household was in the acoustical coverage of the sirens that failed to operate. Two of these households were verified as being in the sole coverage of the three sirens that failed to operate. Therefore, these two households were also excluded from the alerting analysis. Of the remaining 222 households (those households located within the EPZ, not located within the coverage area of the failed sirens and with individuals at that location, or "home" during the Vogtle Electric Generating Plant demonstration), 83.3% (185) indicated that they had been alerted during the demonstration. Using the estimated number of households within the EPZ (1,871 from reference 1) in the confidence interval expression in Appendix B, and estimated 95% confidence interval that ranges from 78.3% to 87.4% is yielded for the proportion of the total EPZ population alerted. In other words, at the 95% confidence level, between 78.3% and 87.4% of the households within the Vogtle Electric Generating Plant EPZ would have stated that they were alerted by the siren and tone alert radio systems.

The sample of 254 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 Vogtle Electric Generating Plant. Of these 254 households, 68.9% (175) responded that they had received the information, 28.0% (71) responded that they had not received the information, and 3.1% (8) did not know 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 63.4% and 73.9% of the households would have reported receiving the information;

- . Between 23.1% and 33.3% of the households would have responded that they had not received the information; and
- . Between 1.7% and 5.8% of the households would not have known whether they had received the information.

In conclusion, no areas of the Vogtle Electric Generating Plant siren or tone alert radio 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 offsite in the event of a radiological emergency. These results are documented in FEMA's "Radiological Emergency Preparedness Exercise Report Conducted April 30 - May 1, 1986 for the Vogtle Electric Generating Plant, " dated September 19, 1986<sup>9</sup> and in letters to: the Honorable Joe F. Harris, Governor of Georgia, signed by Julius W. Becton, Jr., Director, the Federal Emergency Management Agency, dated June 9, 1987;<sup>14</sup> Victor Stello, Jr., Executive Director for Operations, U.S. Nuclear Regulatory Commission, signed by Dave McLoughlin, Deputy Associate Director, State and Local Programs and Support, the Federal Emergency Management Agency, dated June 9, 1987;<sup>15</sup> the Honorable Carroll Campbell, Jr., Governor of South Carolina, signed by Julius W. Becton, Jr., Director, the Federal Emergency Management Agency, dated June 9, 1987;<sup>16</sup> and a Memorandum for Spence Perry, General Counsel, U.S. Nuclear Regulatory Commission, from Dave McLoughlin, Deputy Associate Director, State and Local Programs and Support, the Federal Emergency Management Agency, dated June 9, 1987.<sup>17</sup> In these letters, the Vogtle Electric Generating Plant 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.

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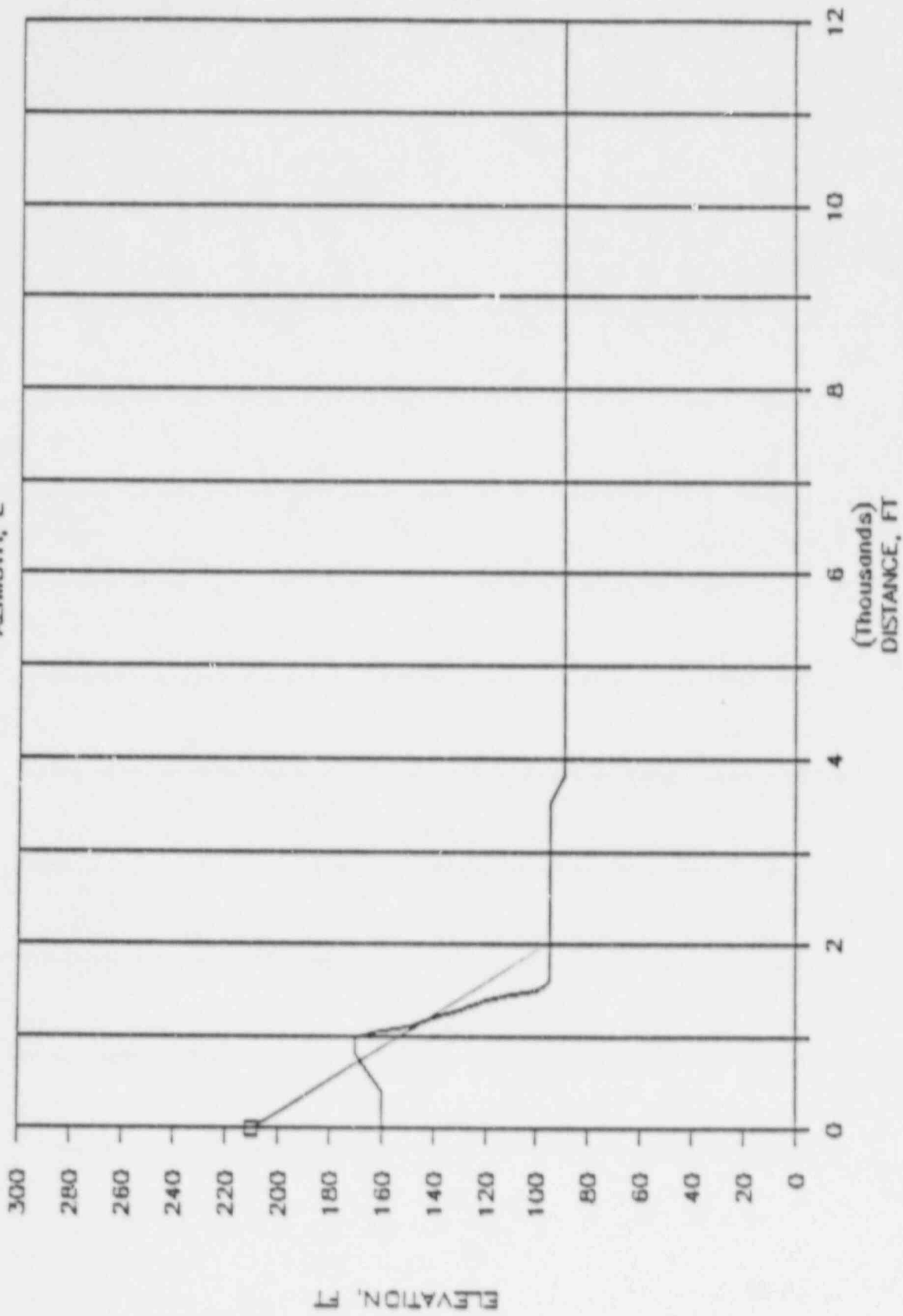
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17. Federal Emergency Management Agency. 1987. Memorandum For: Spence Perry, General Counsel, U.S. Nuclear Regulatory Commission, From: Dave McLoughlin, Deputy Associate Director, State and Local Programs and Support, the Federal Emergency Management Agency. June 9, 1987.

APPENDIX A

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

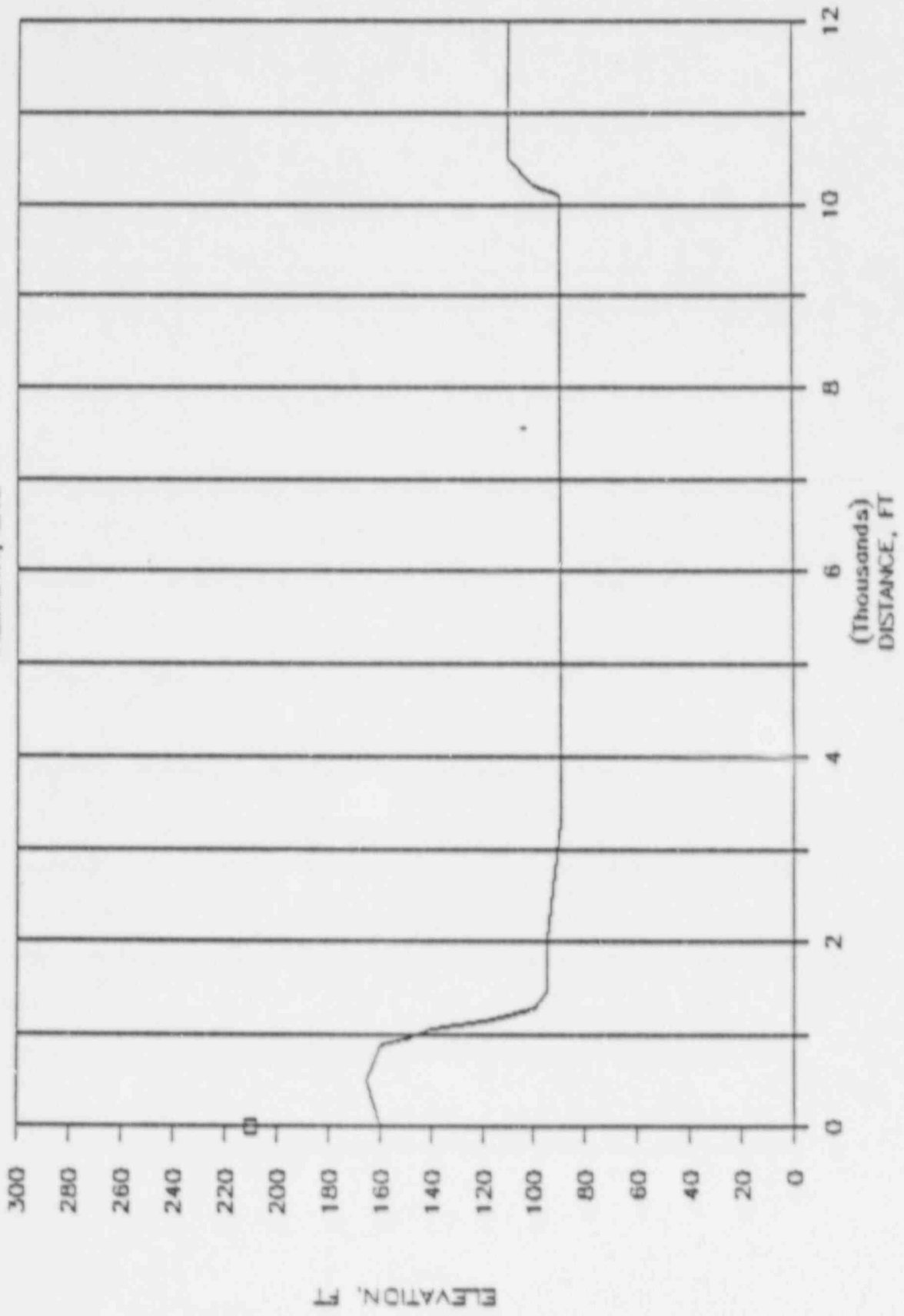
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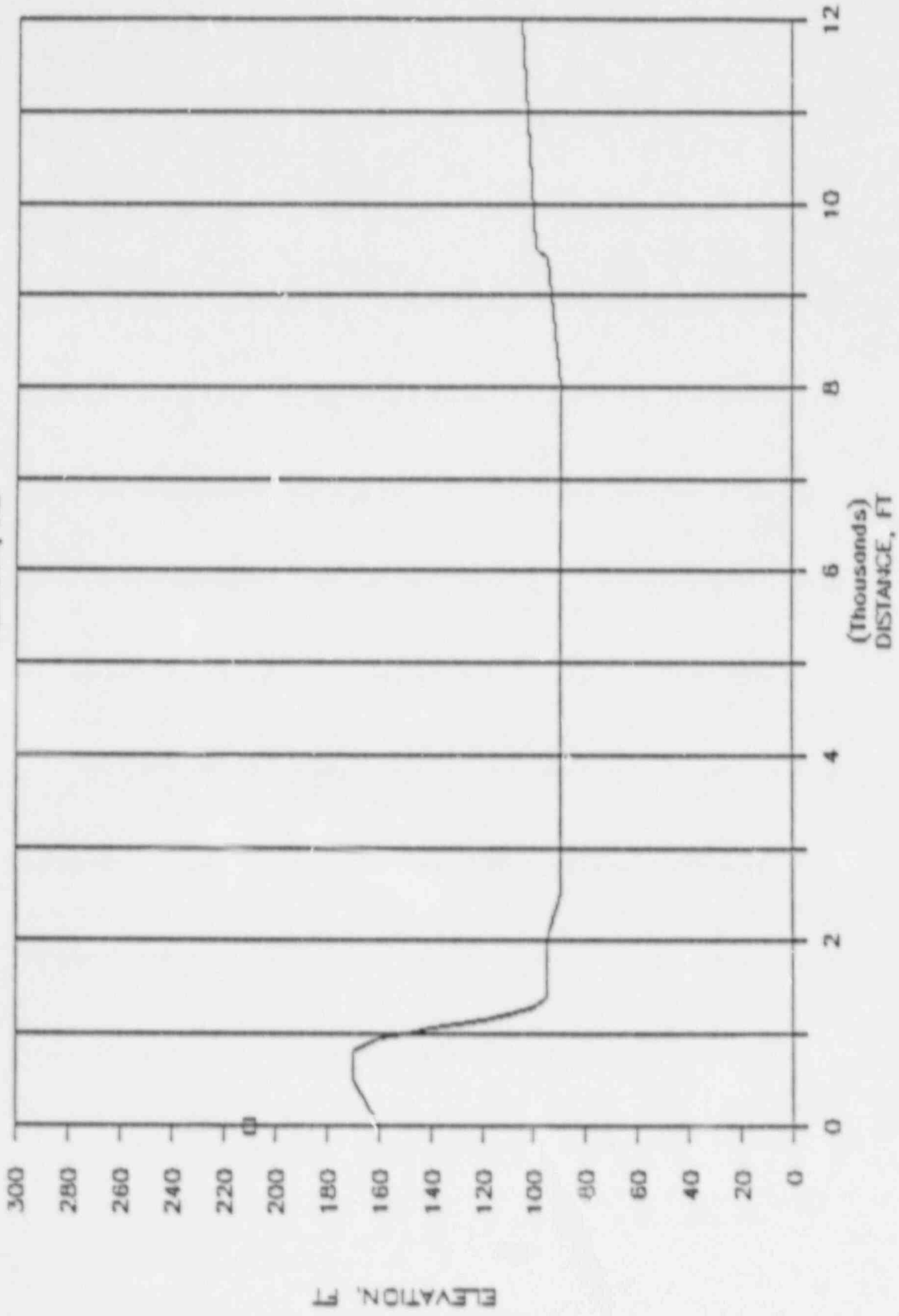
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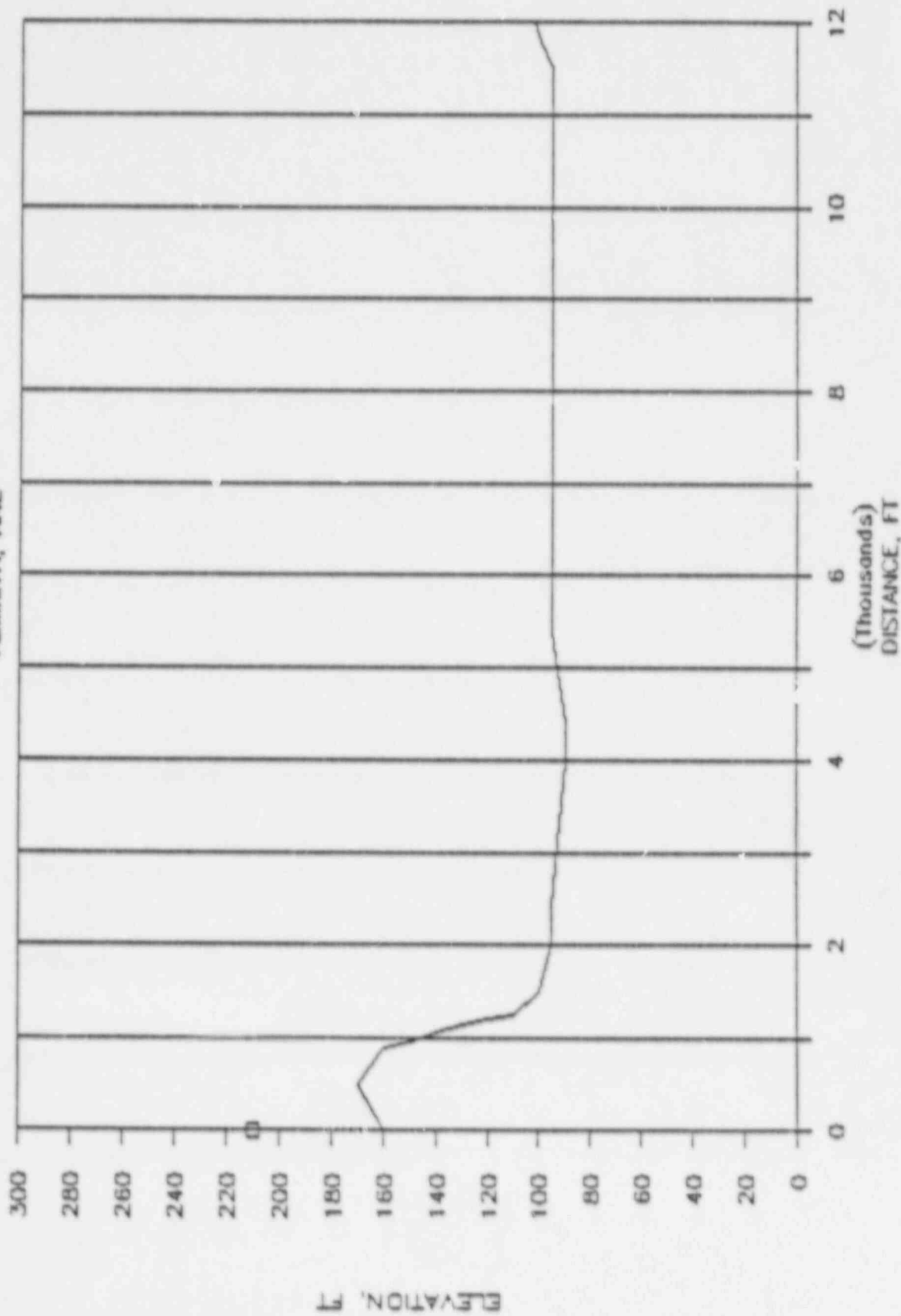
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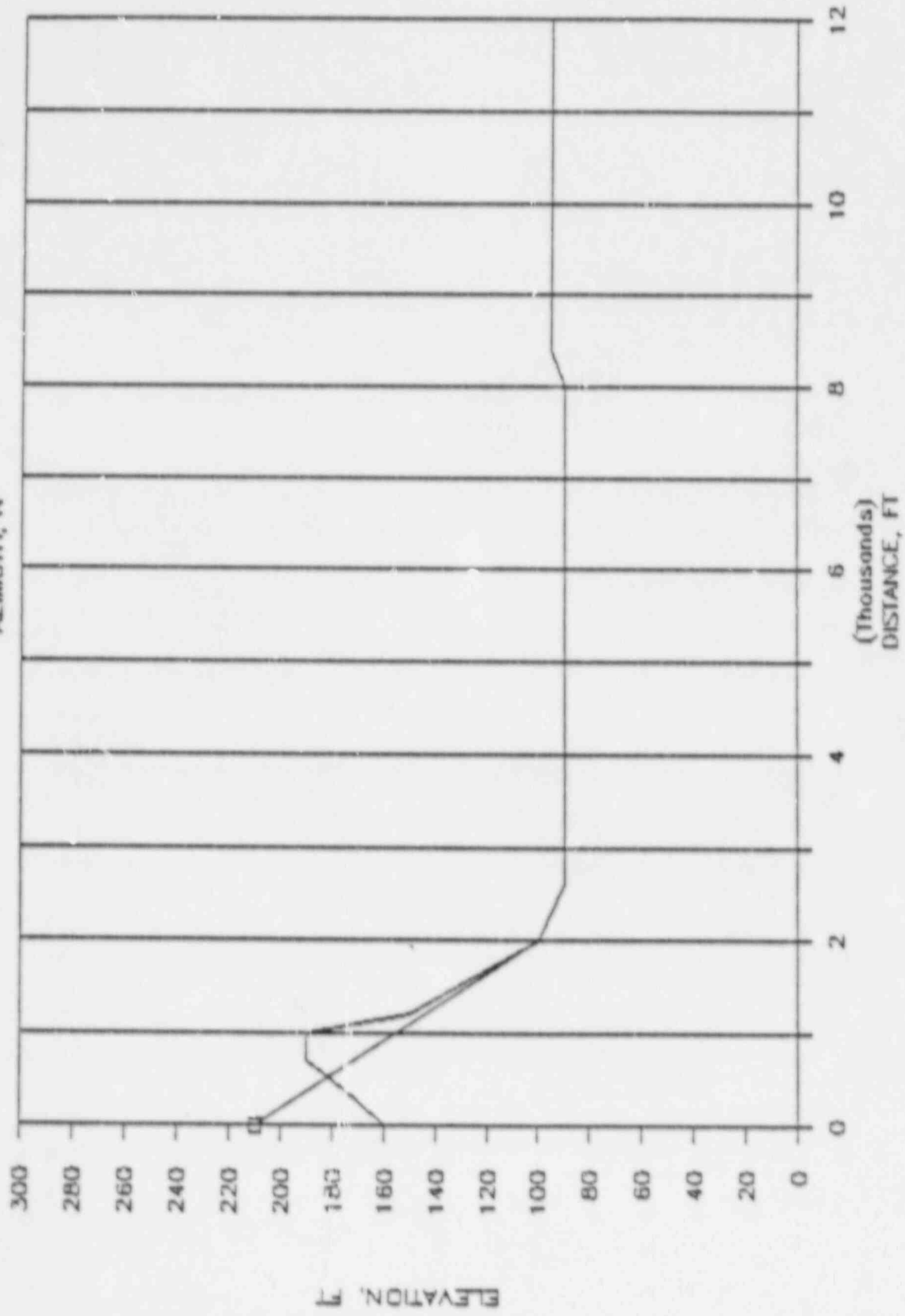
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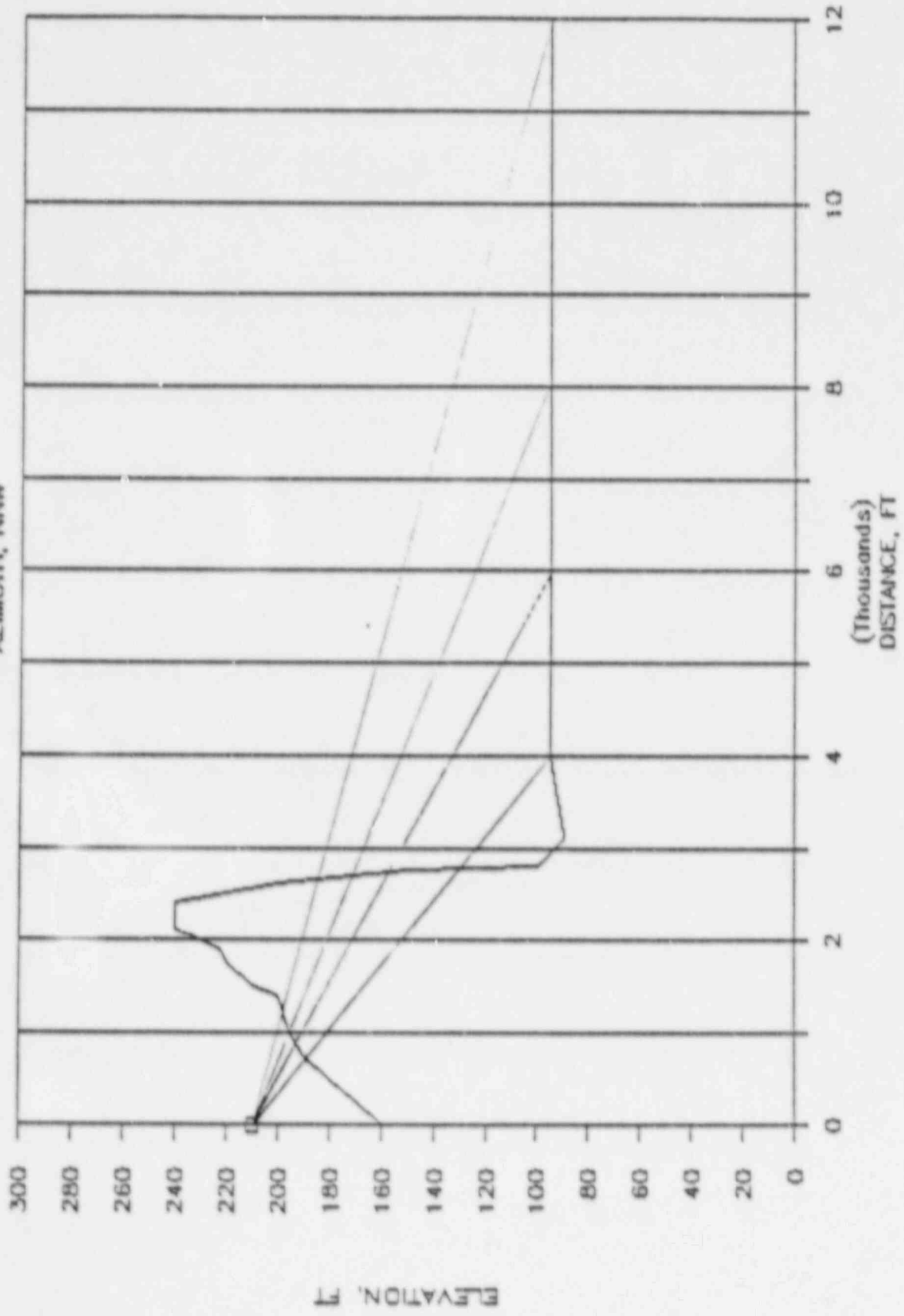
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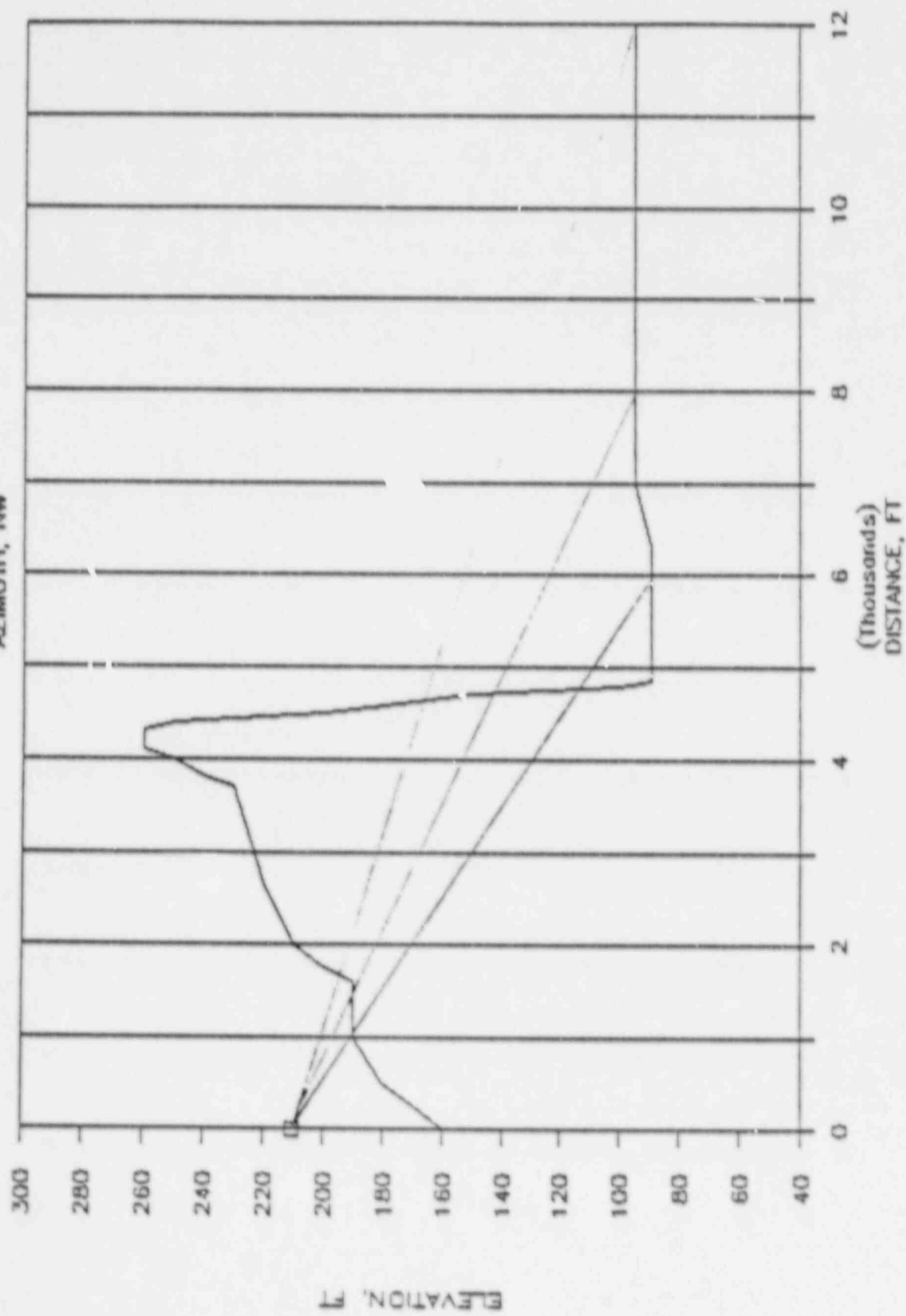
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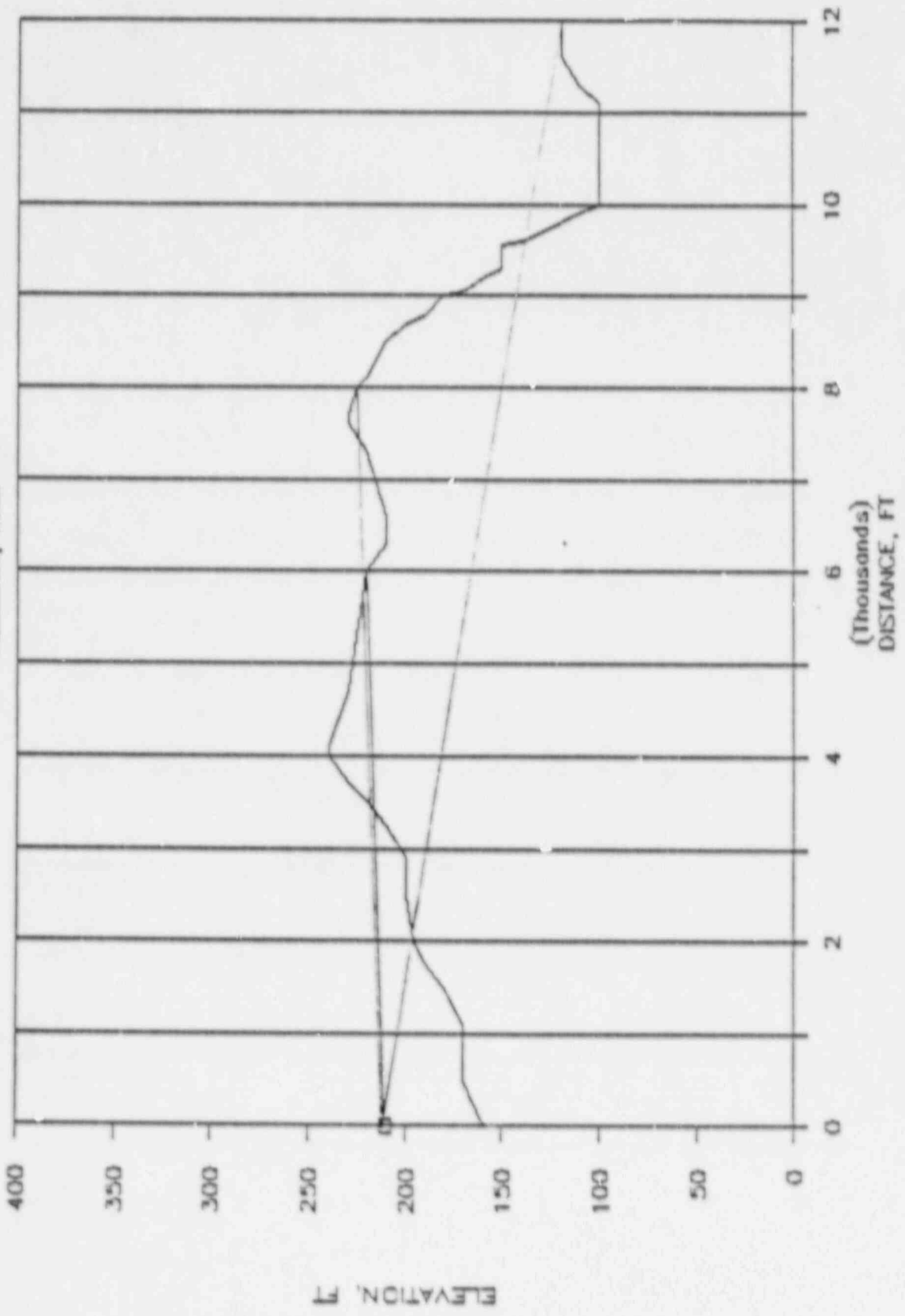
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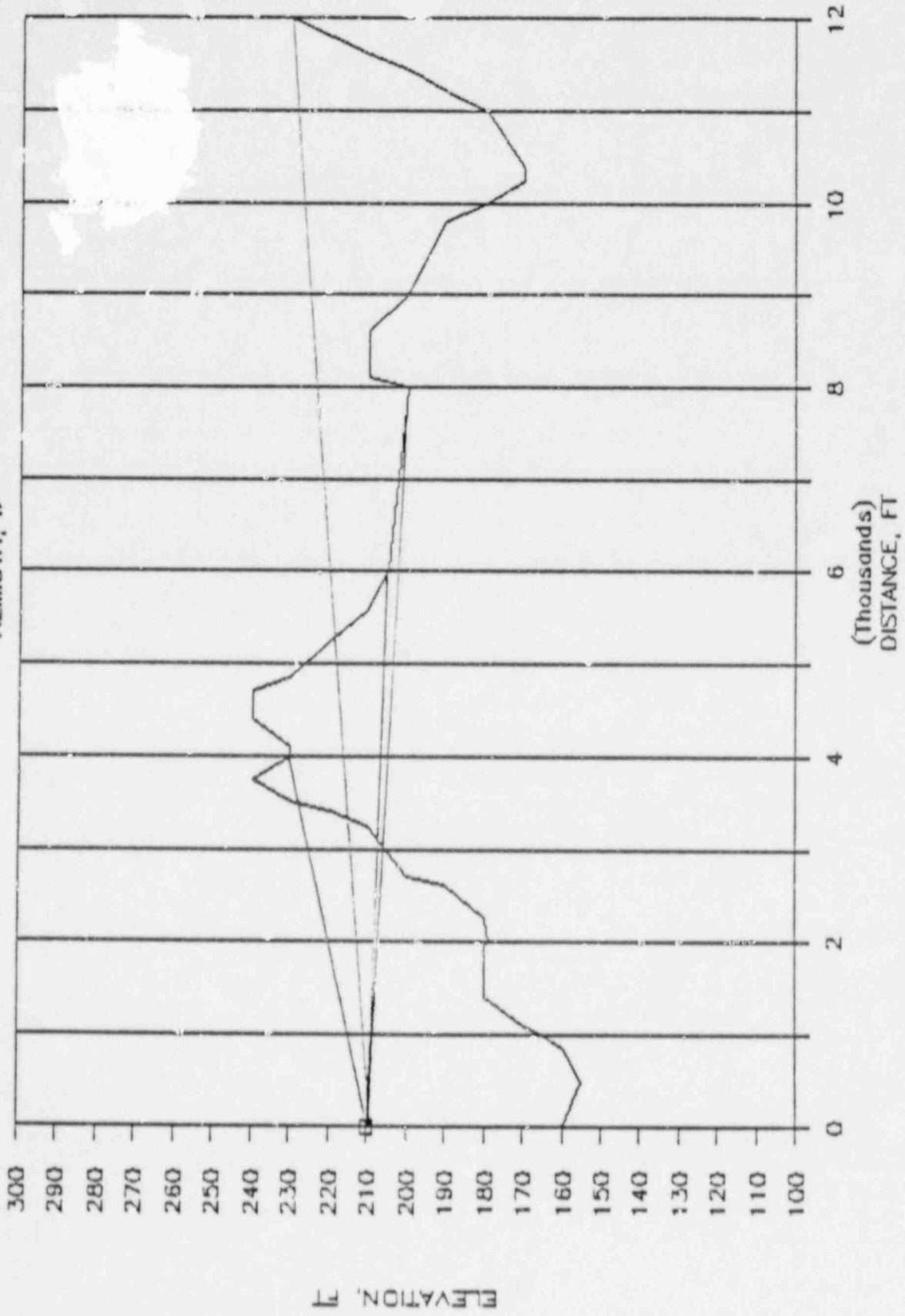
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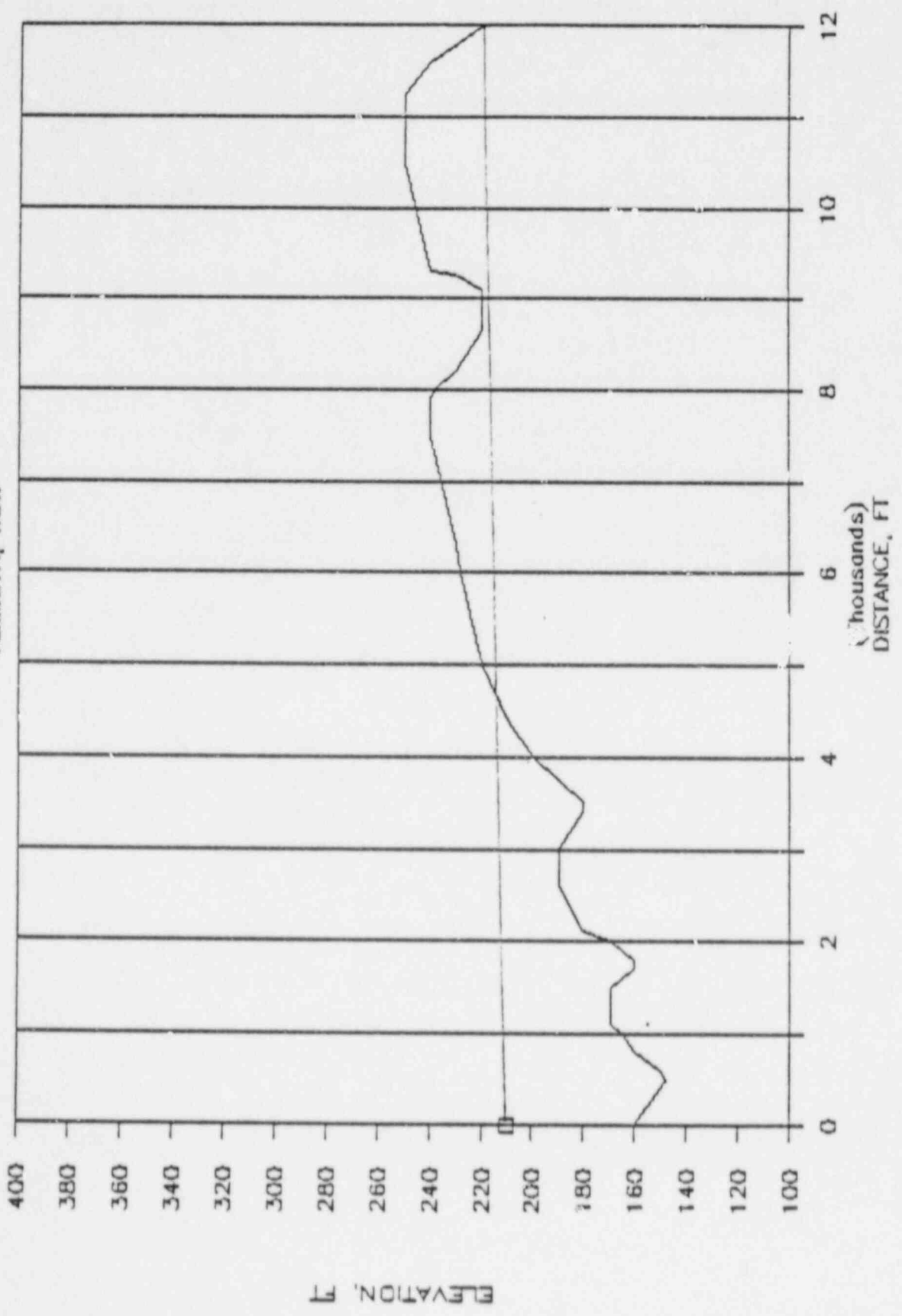
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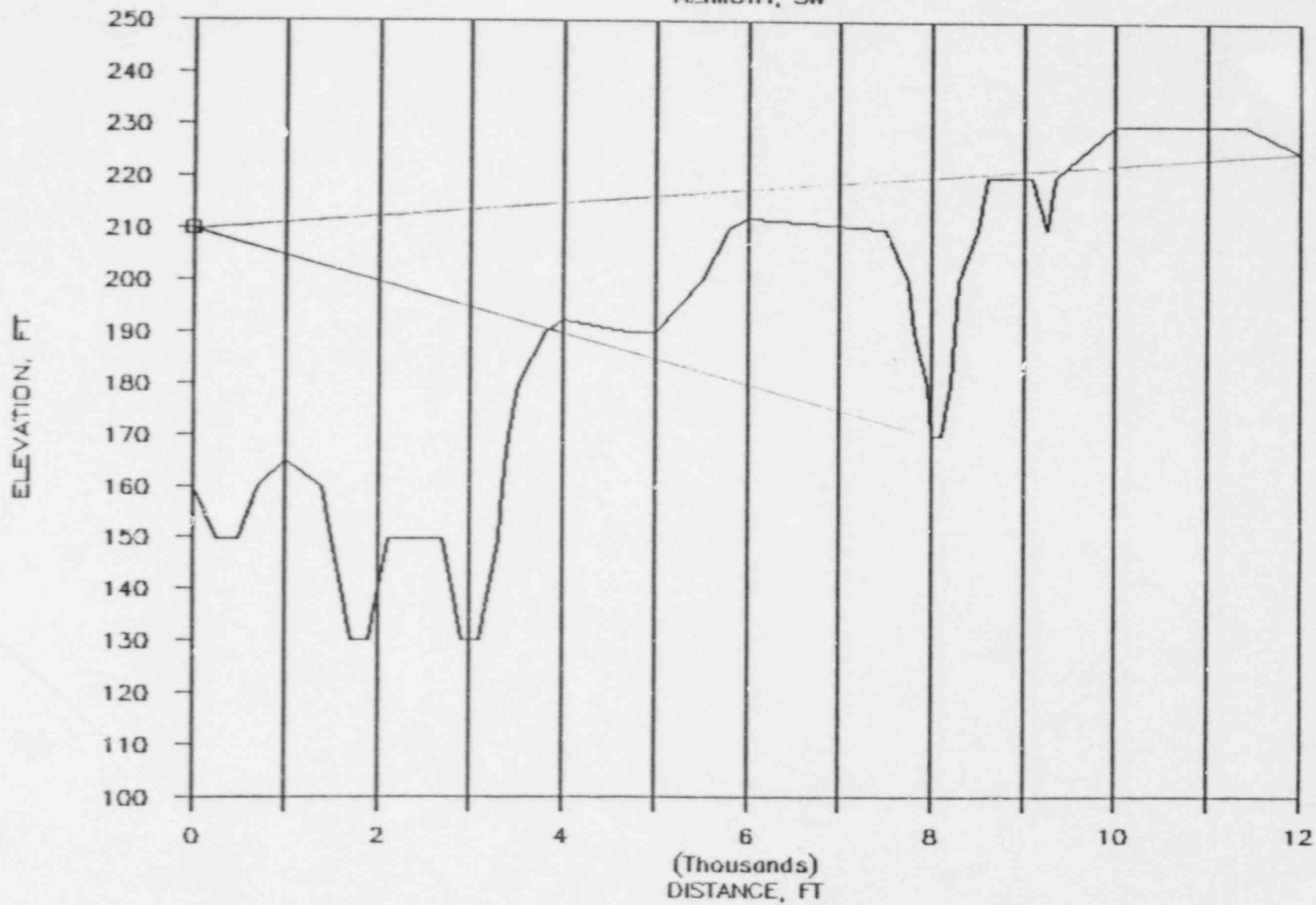
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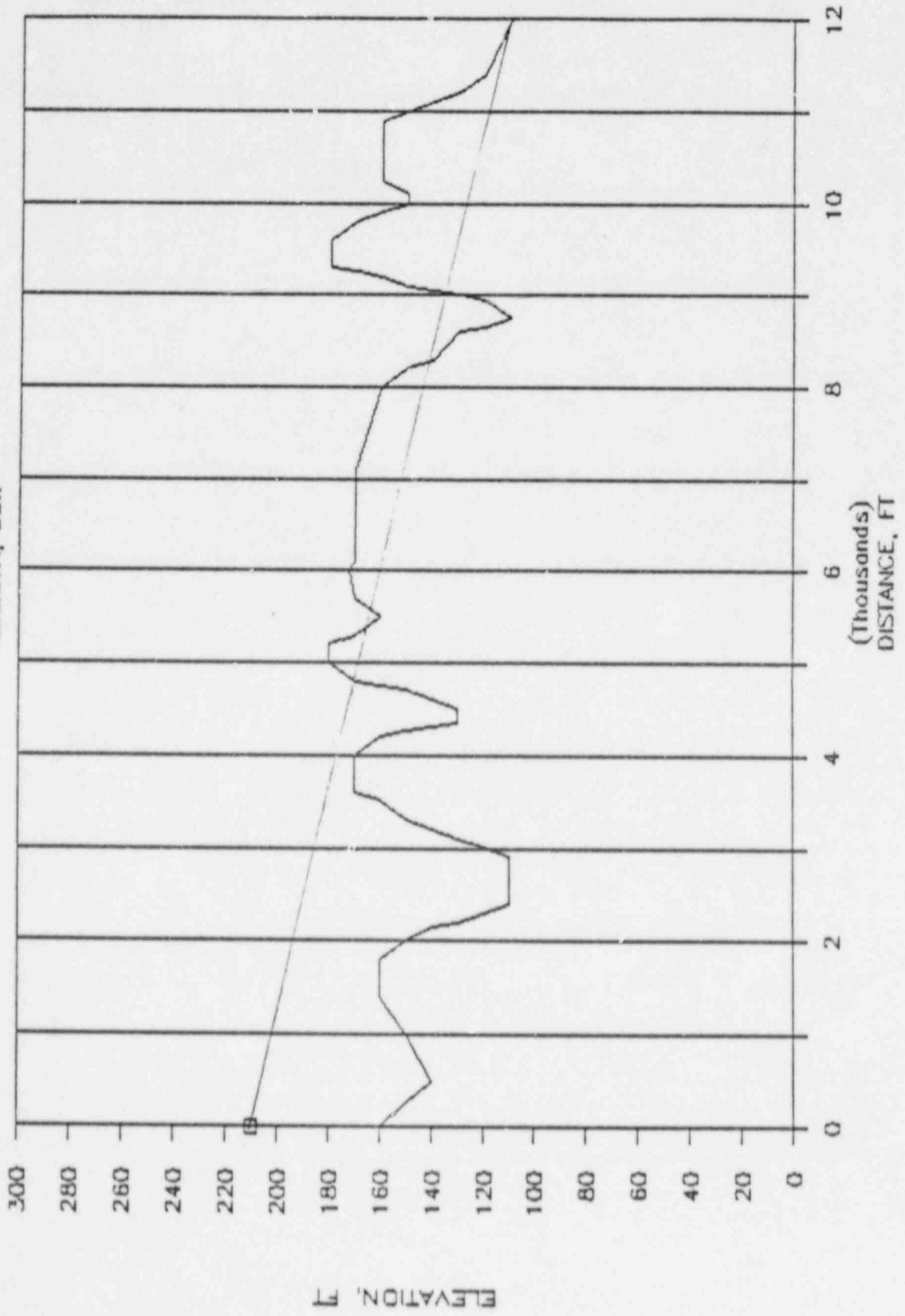
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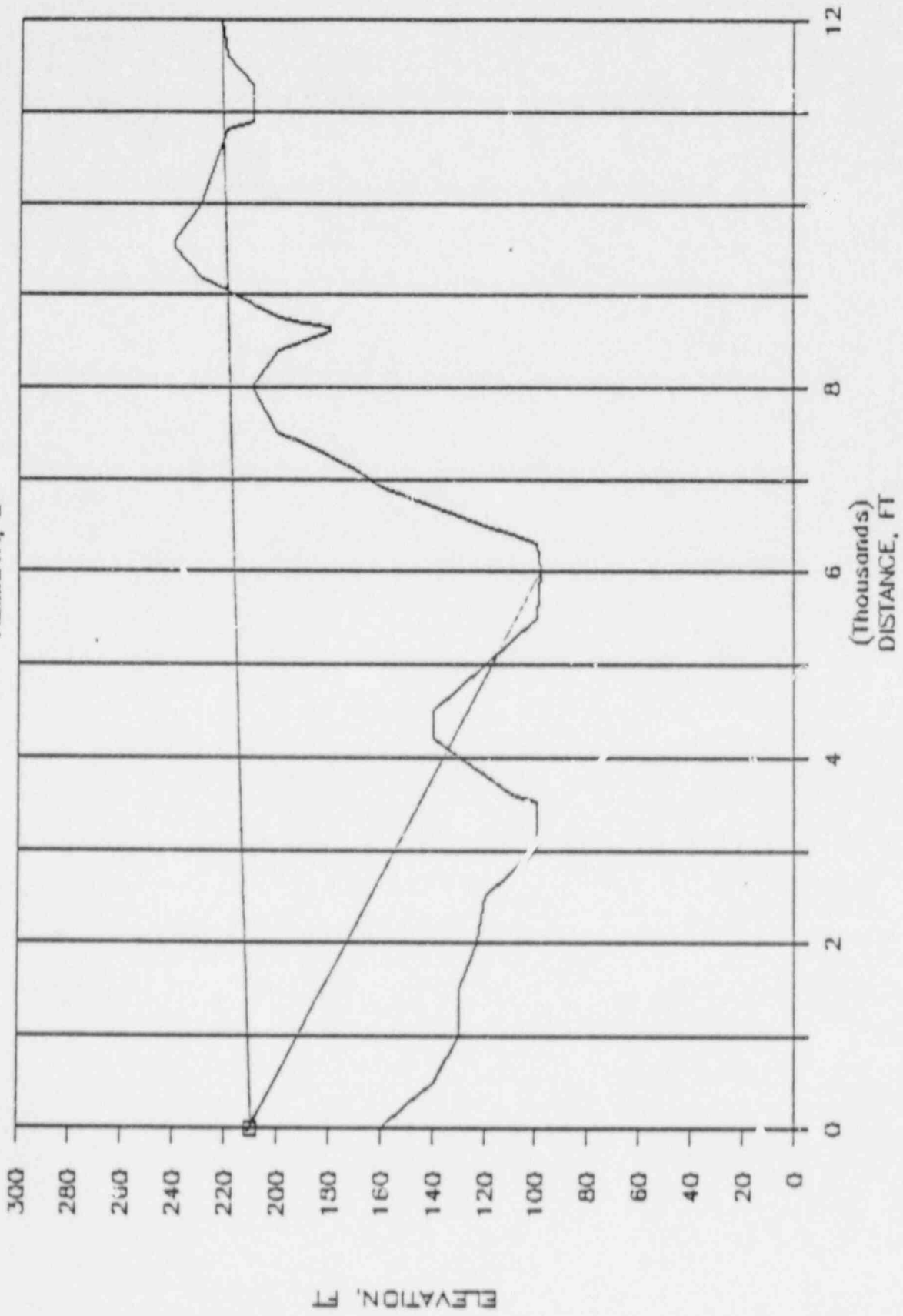
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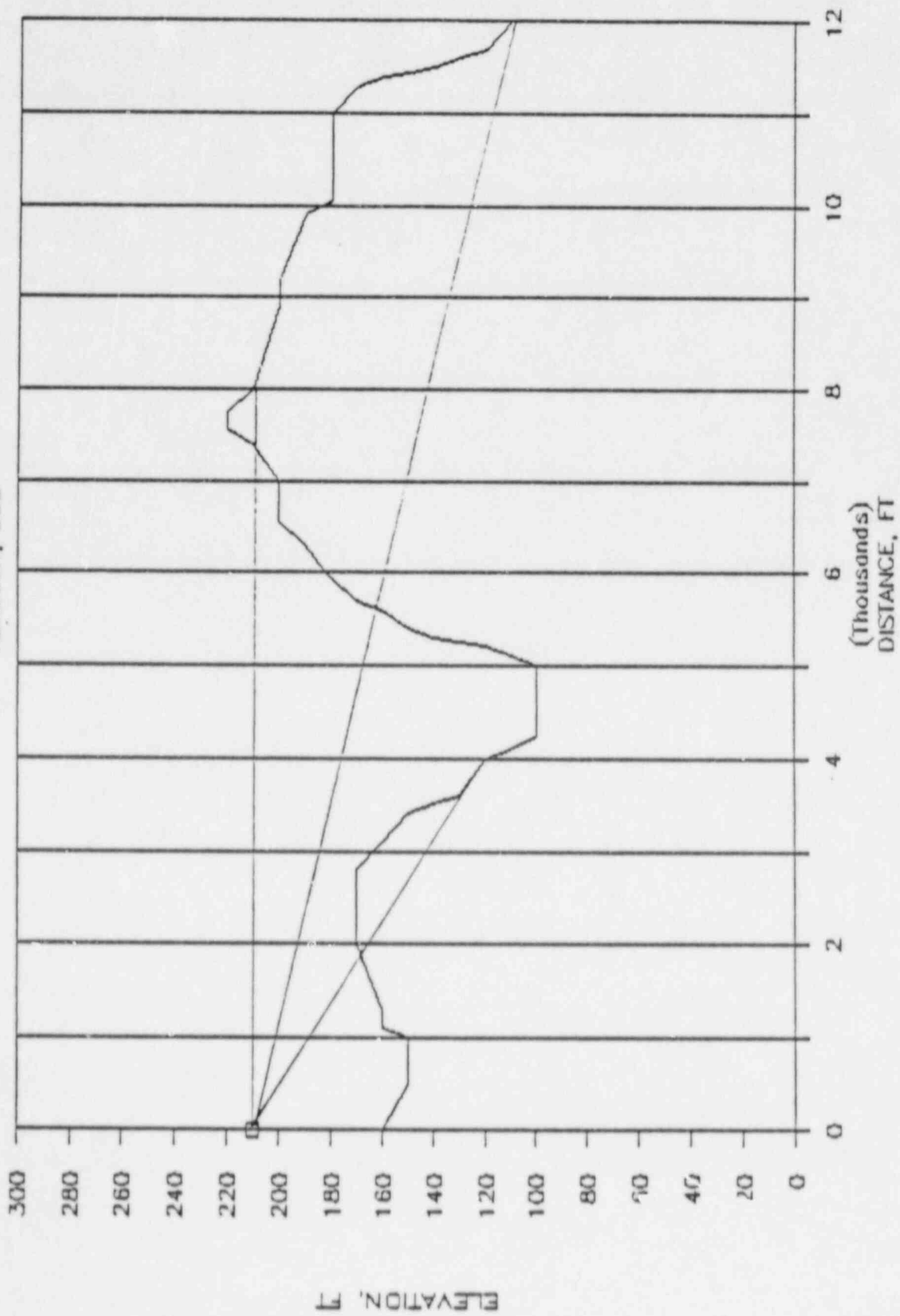
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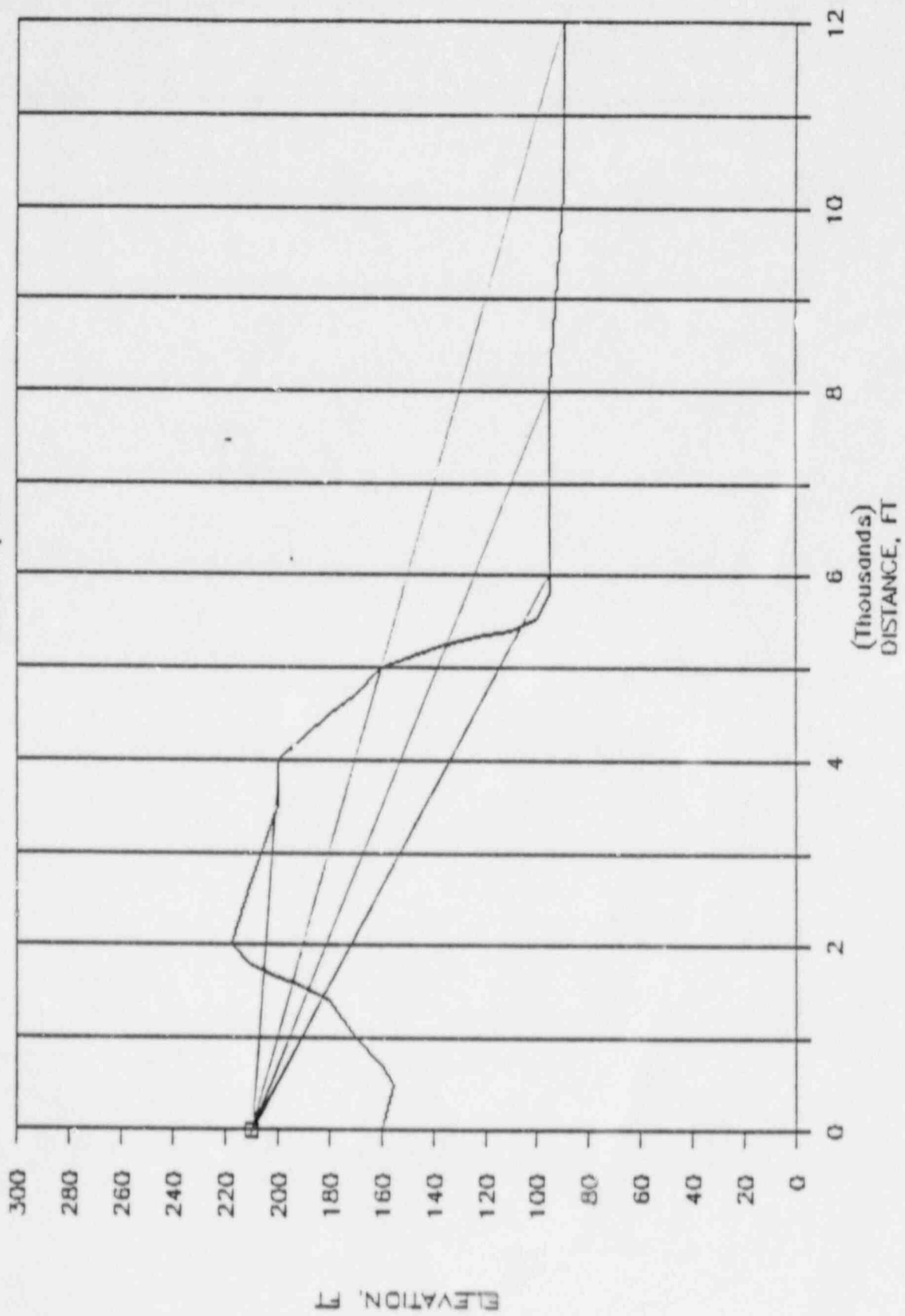
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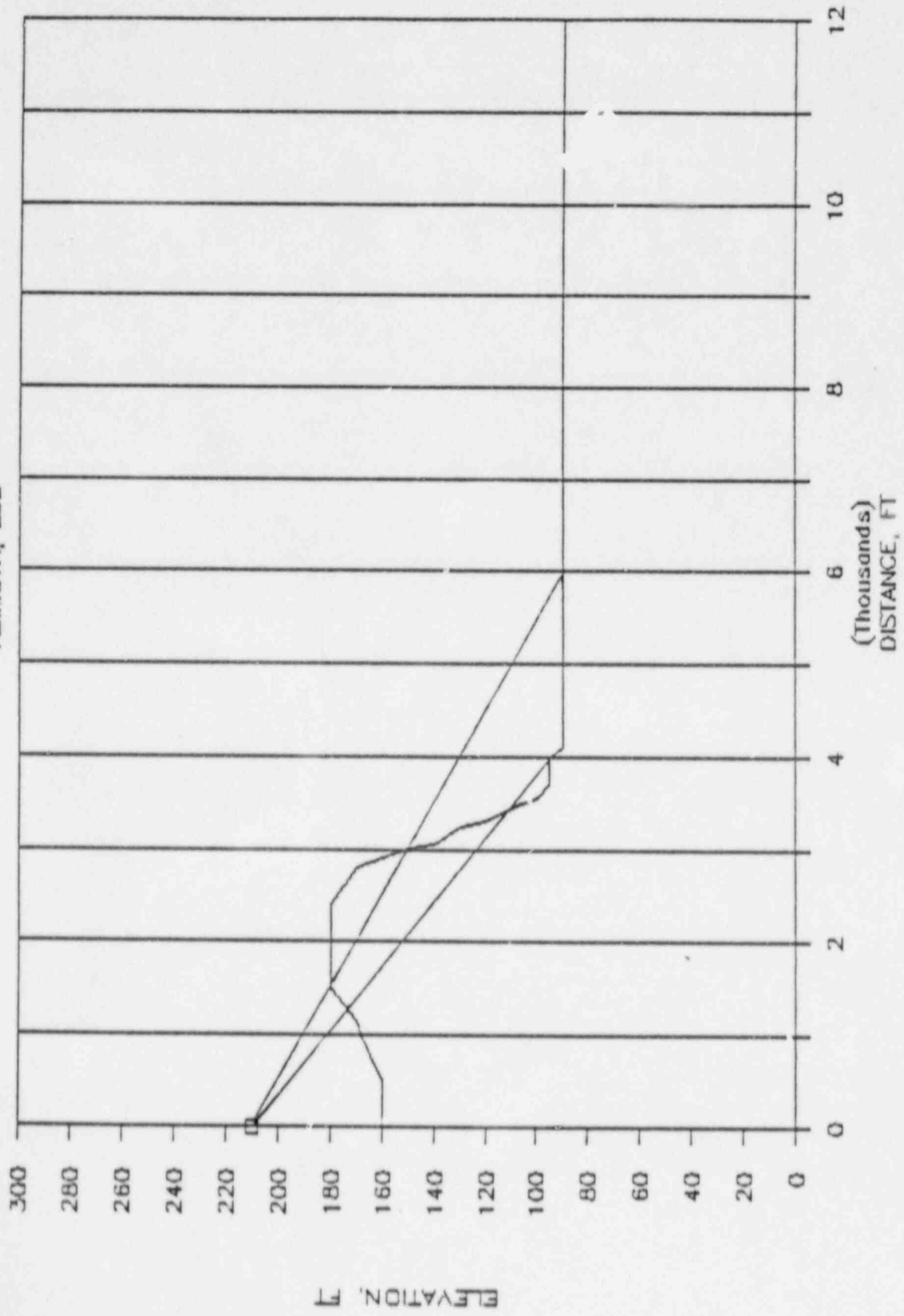
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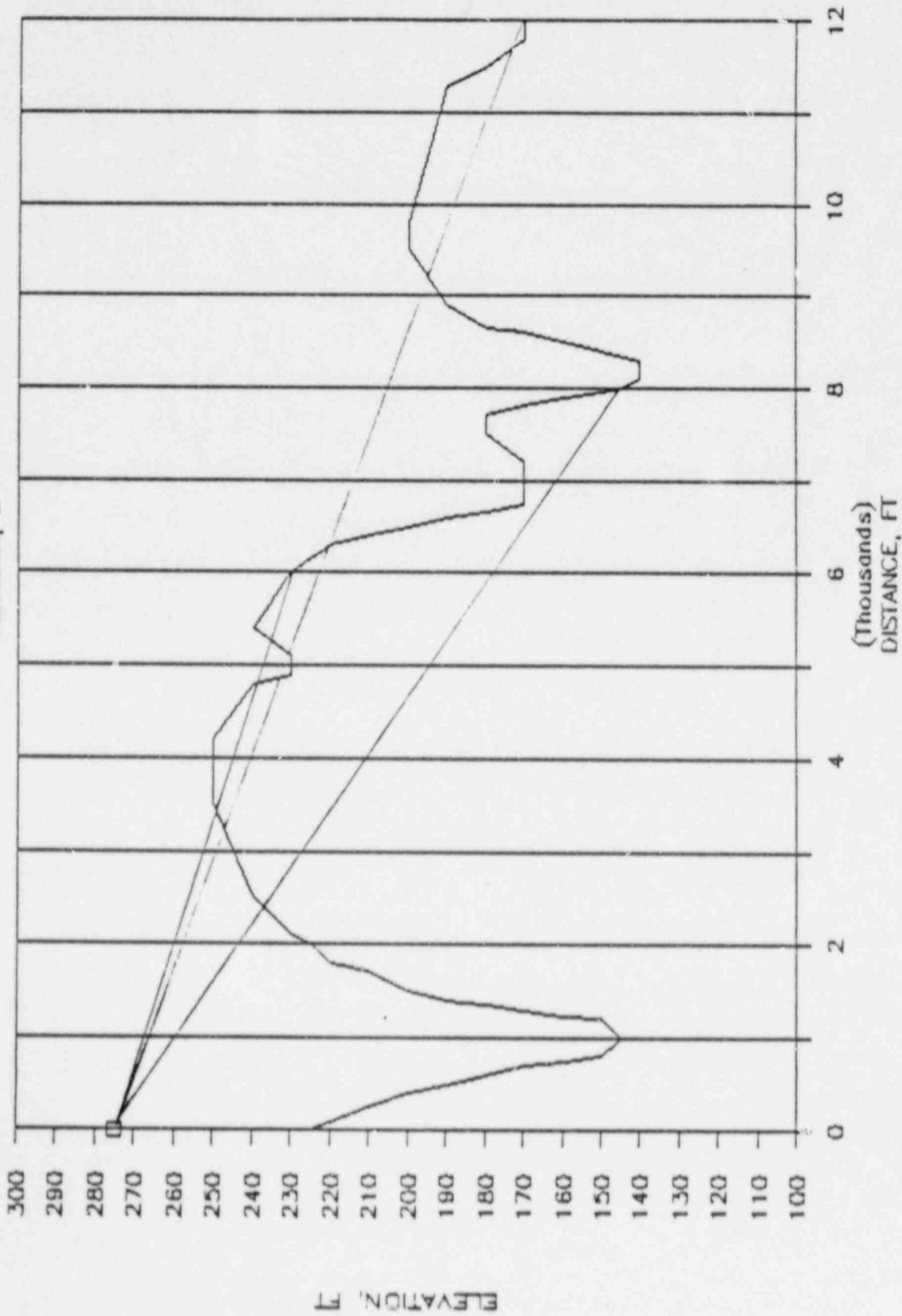
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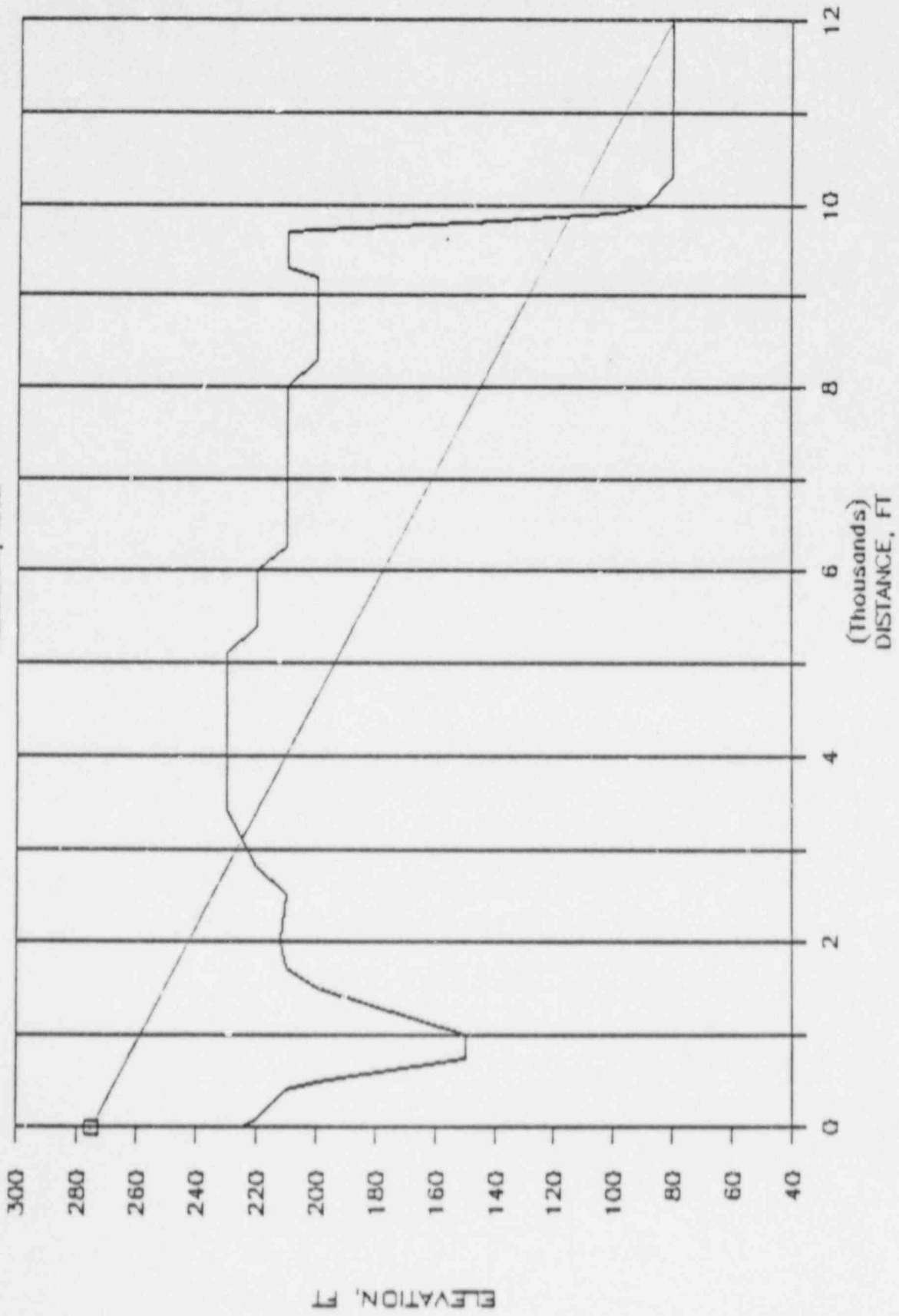
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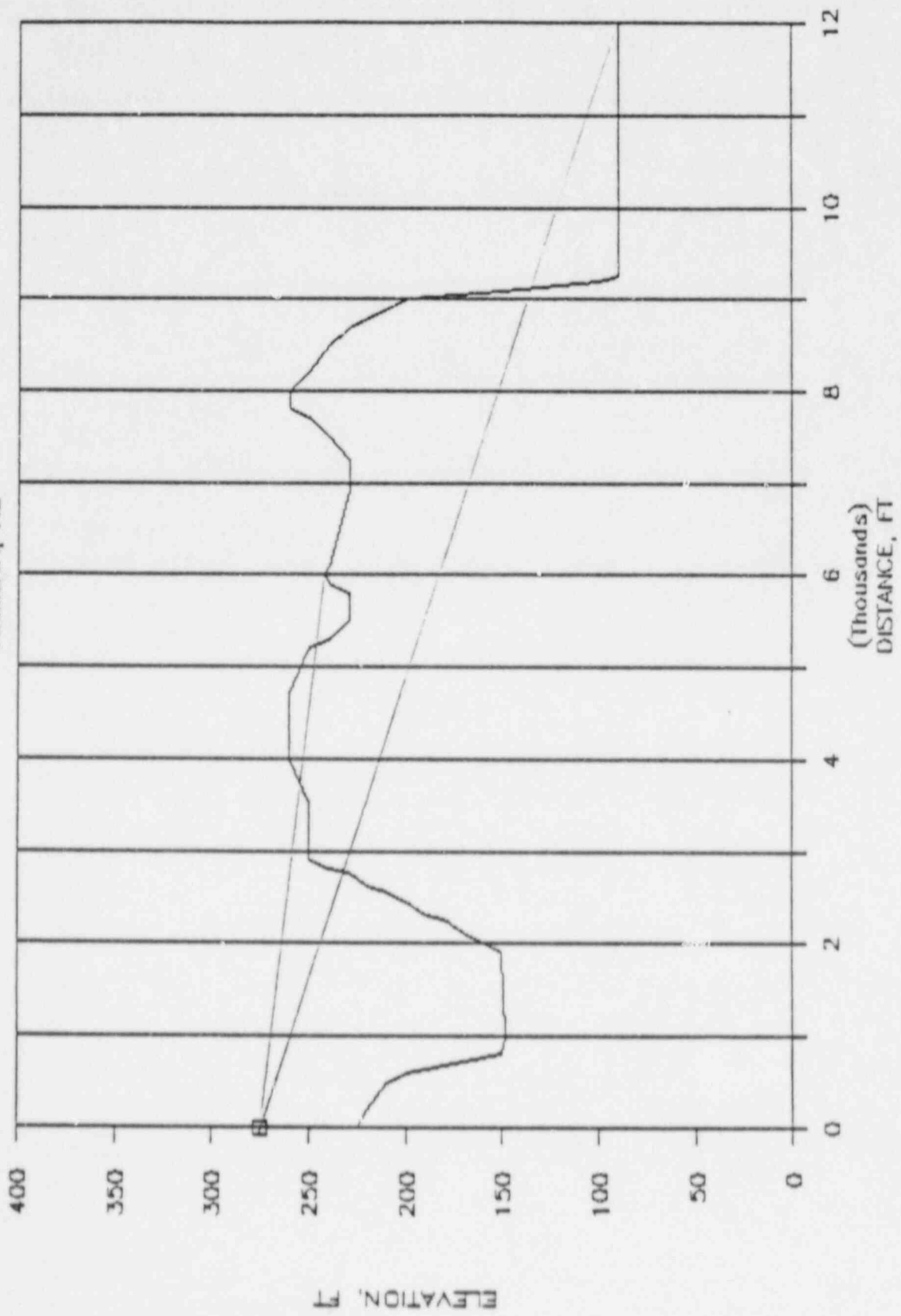
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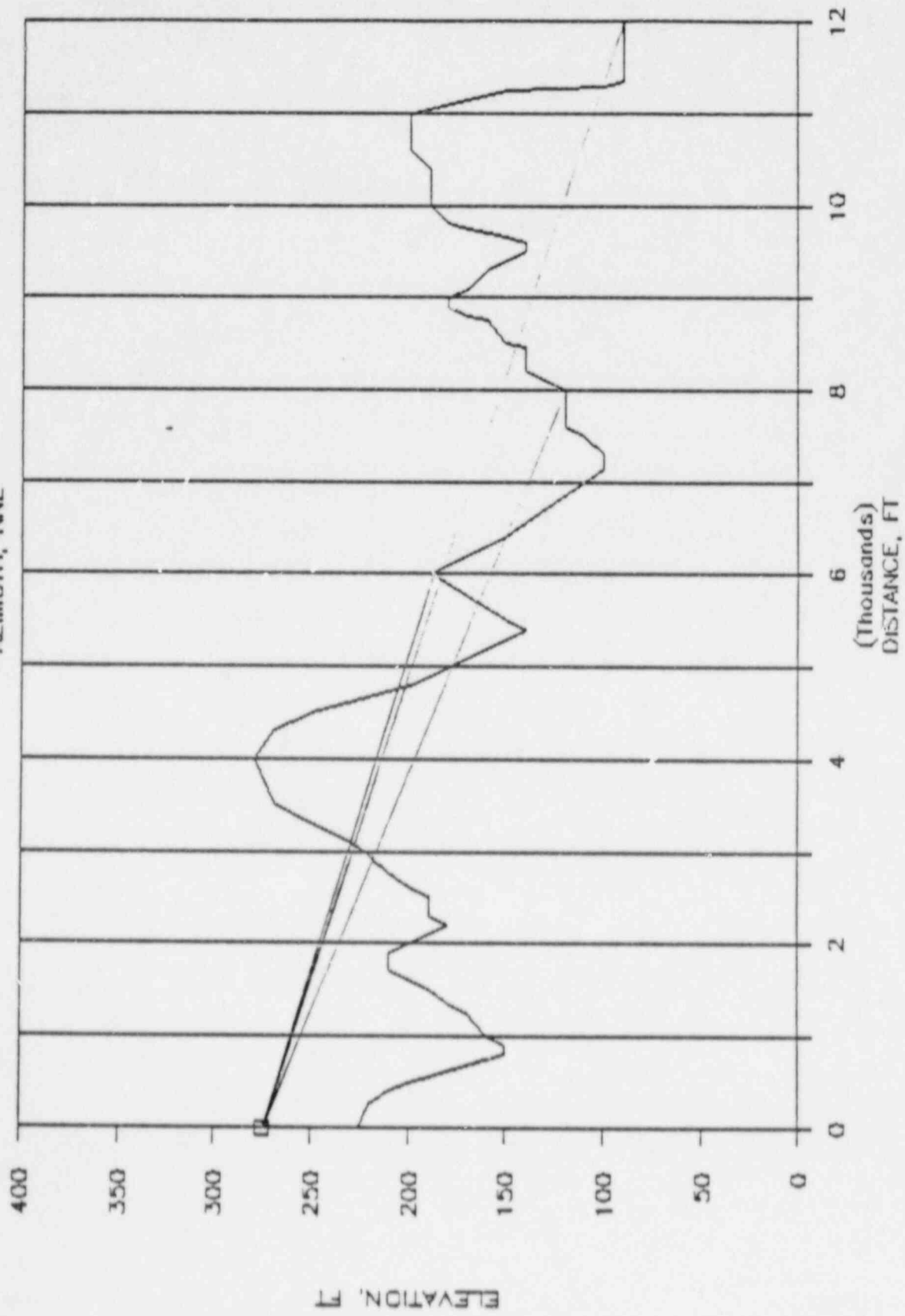
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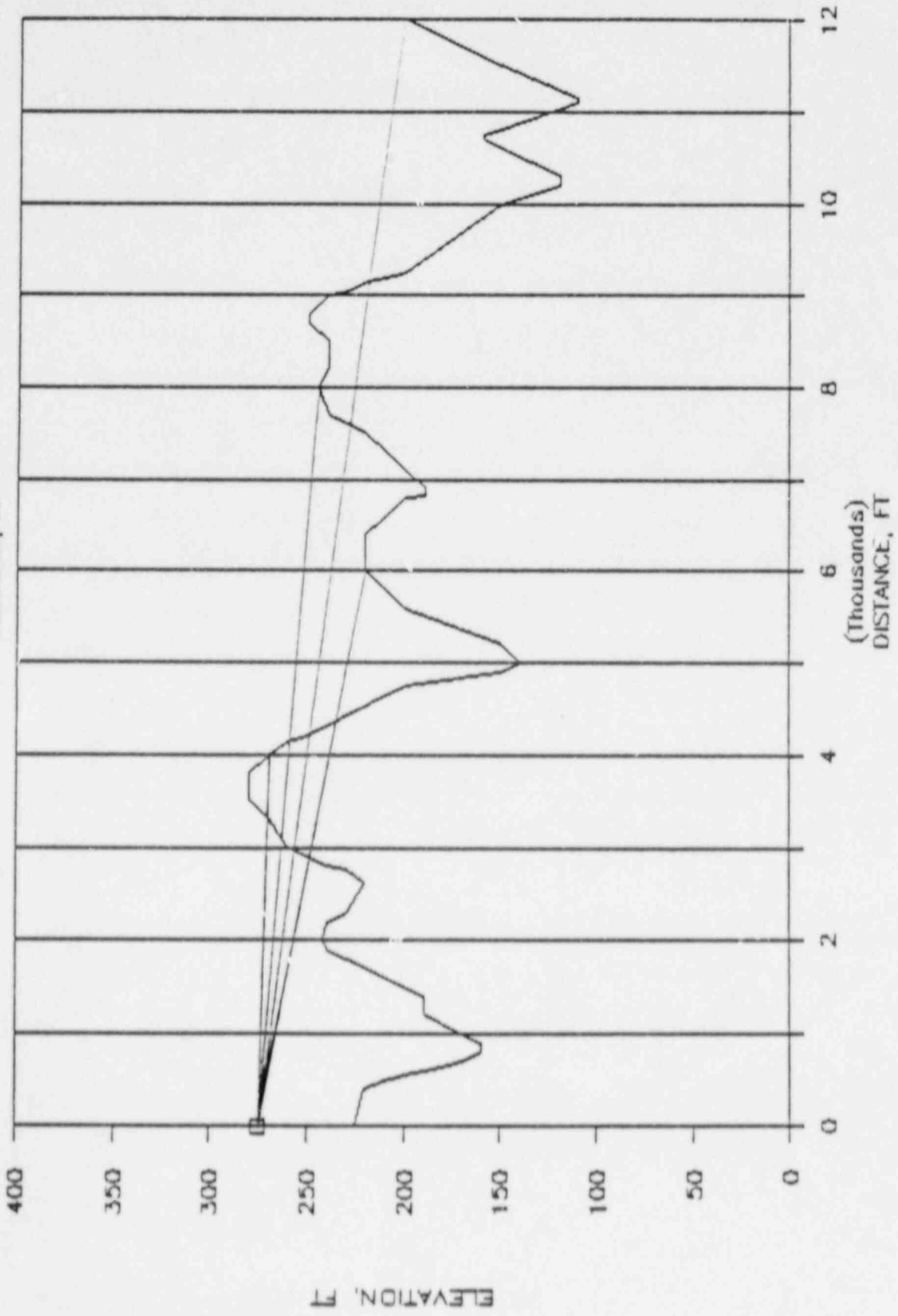
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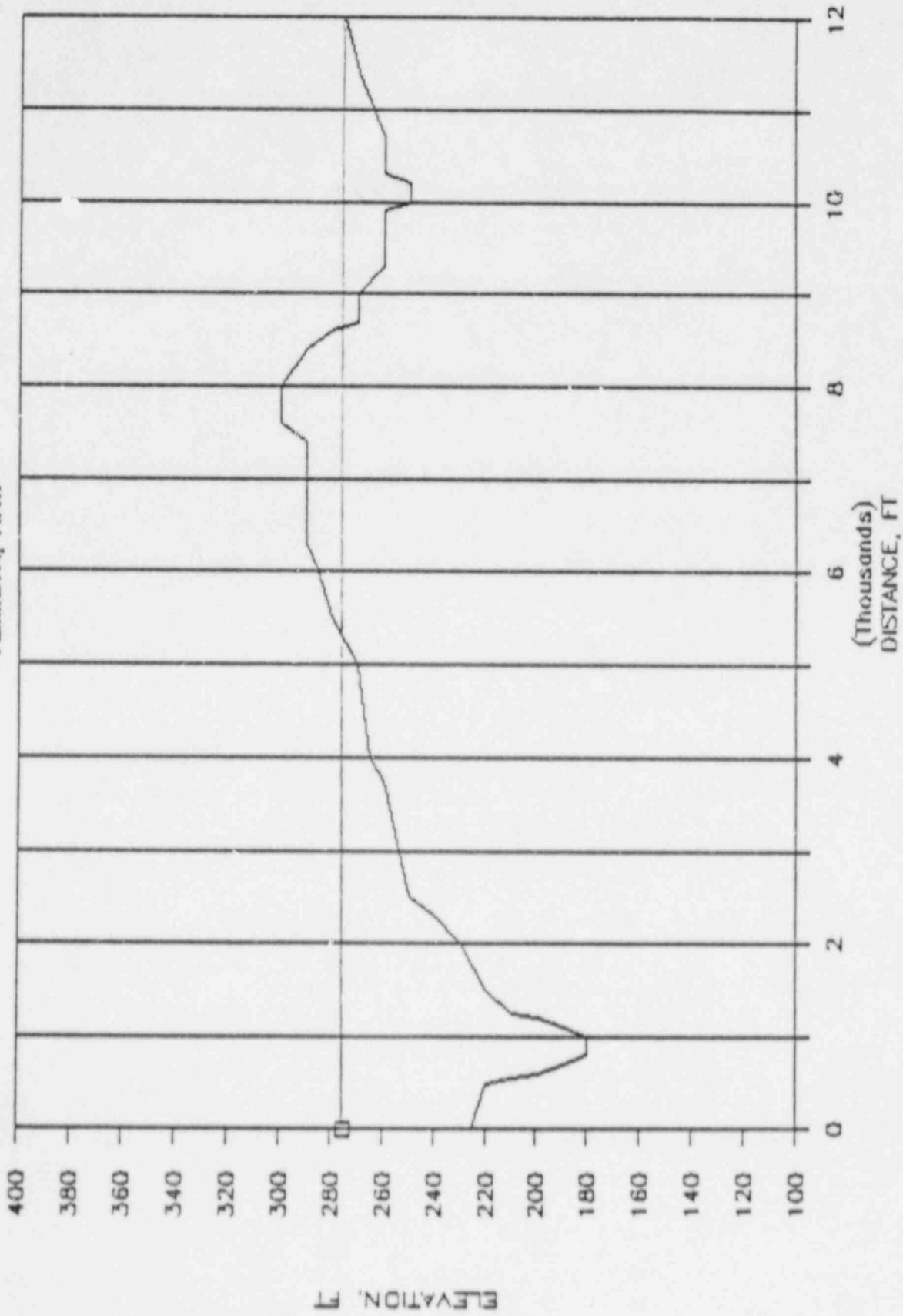
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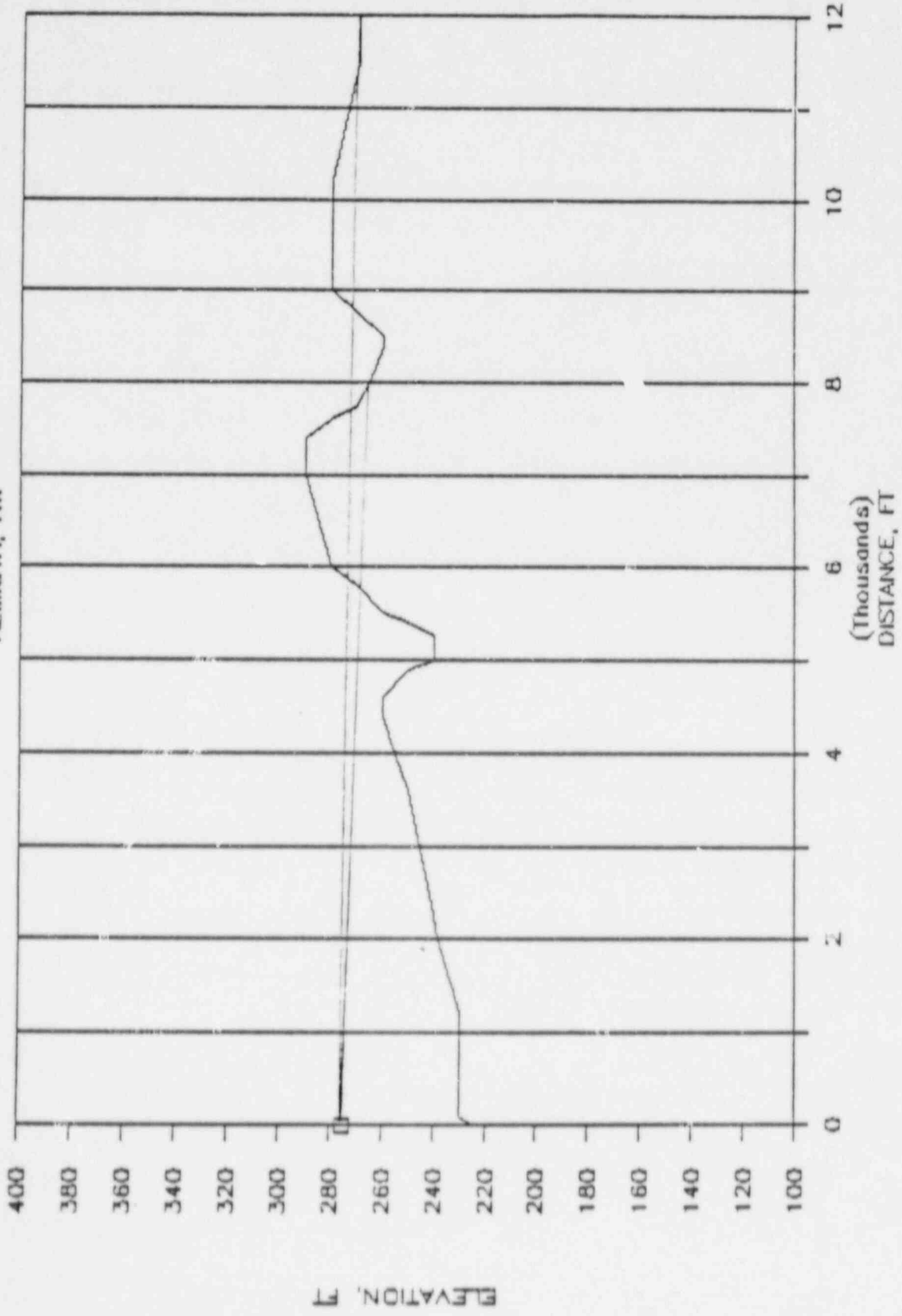
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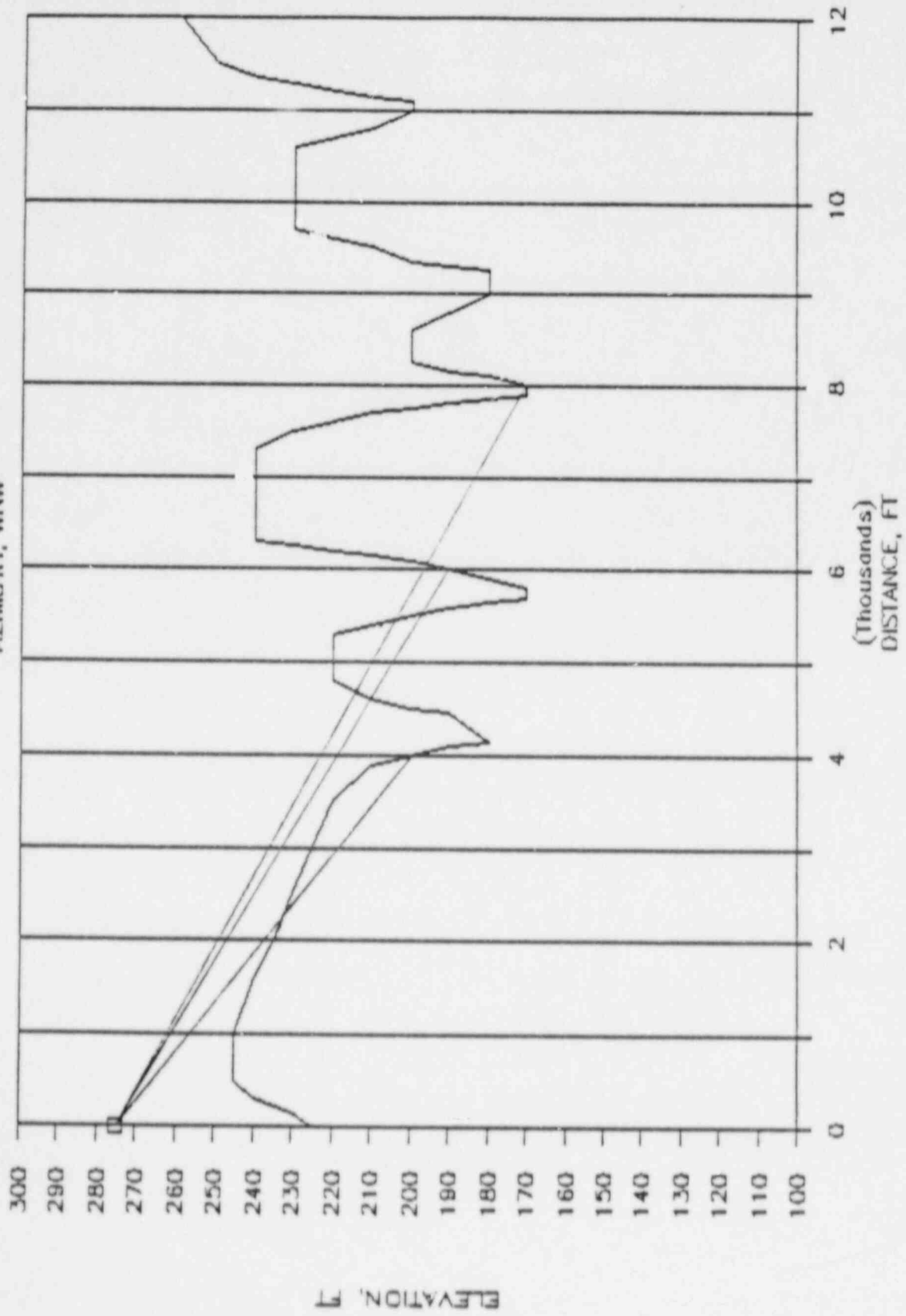
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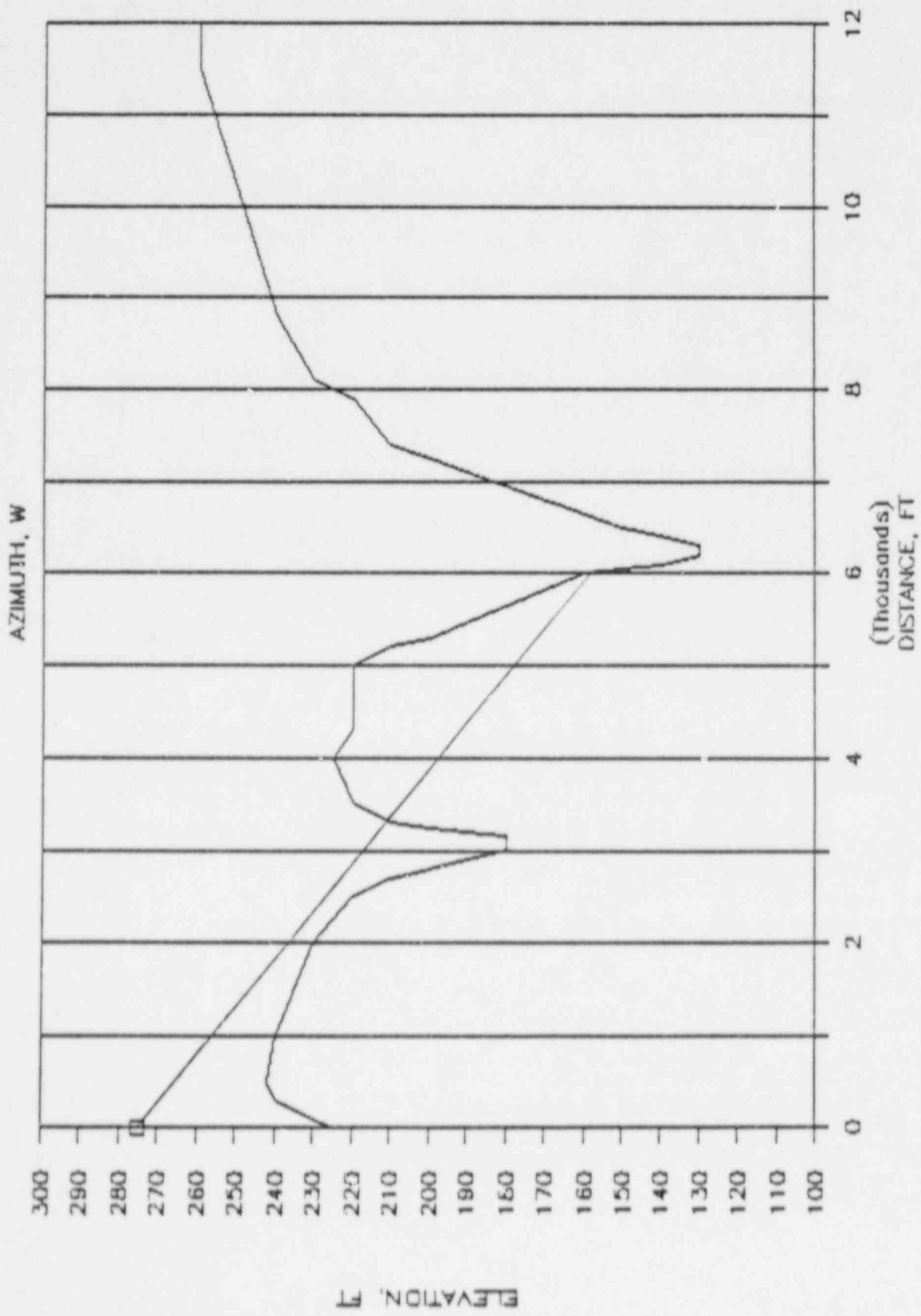


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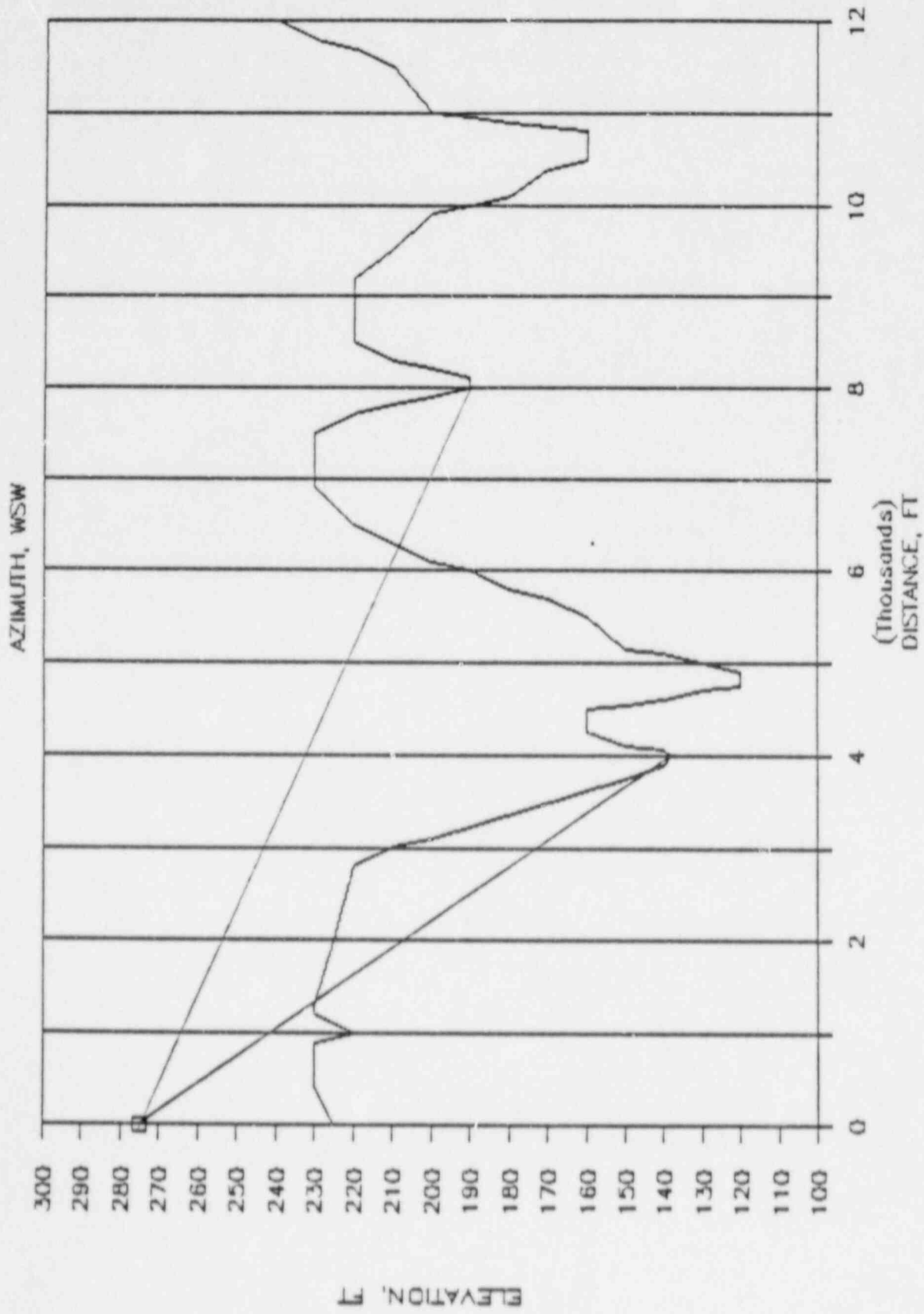
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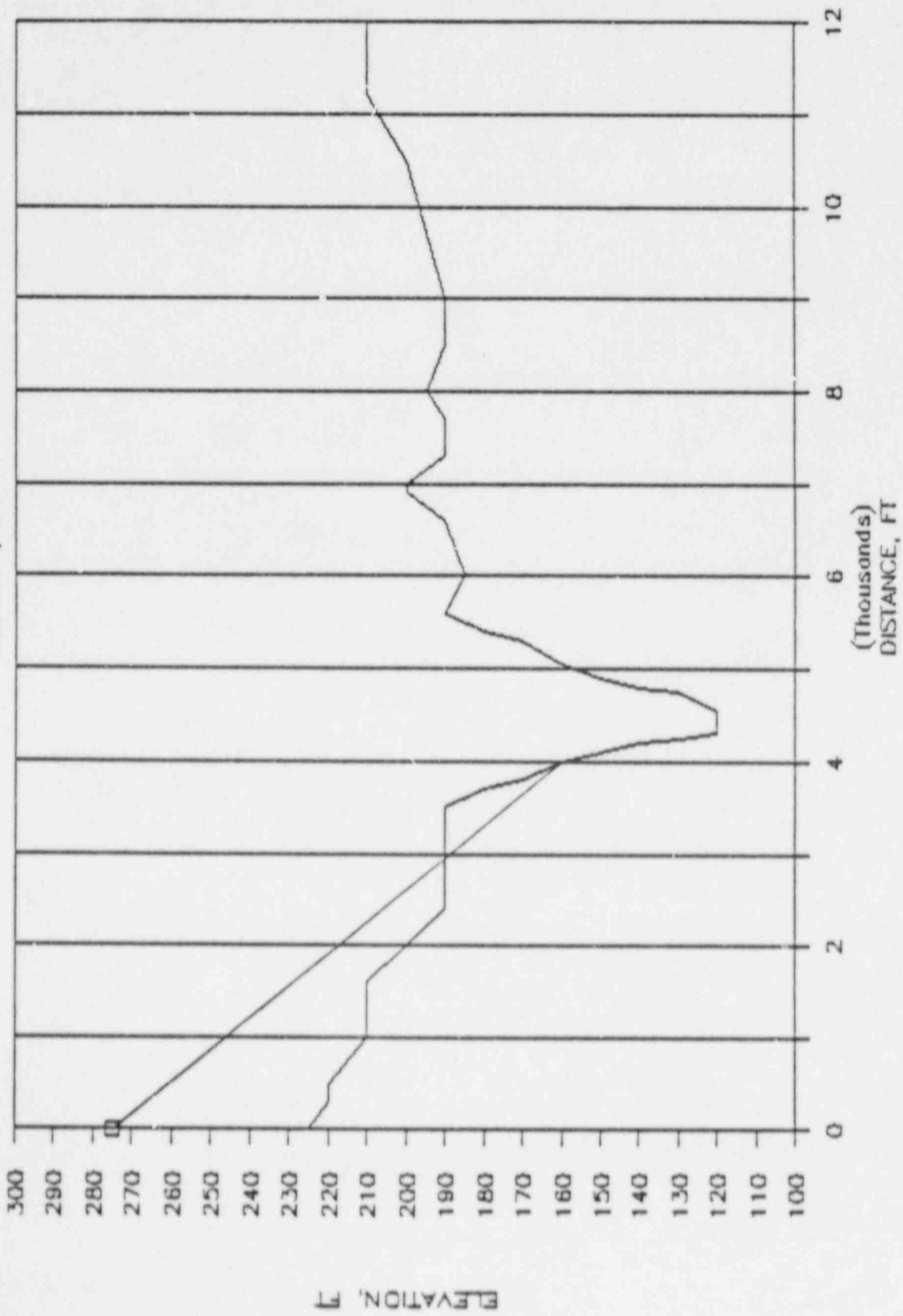


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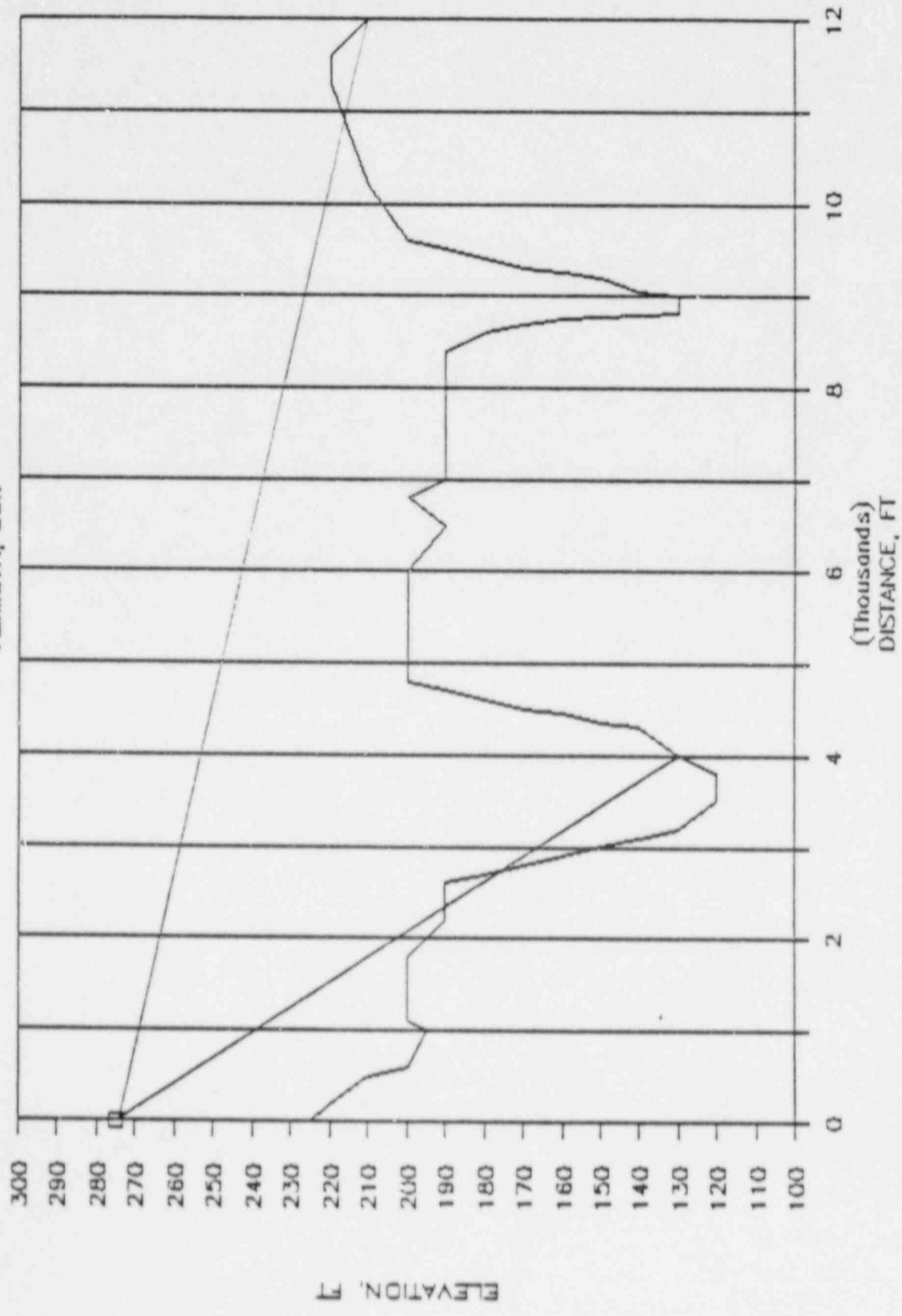
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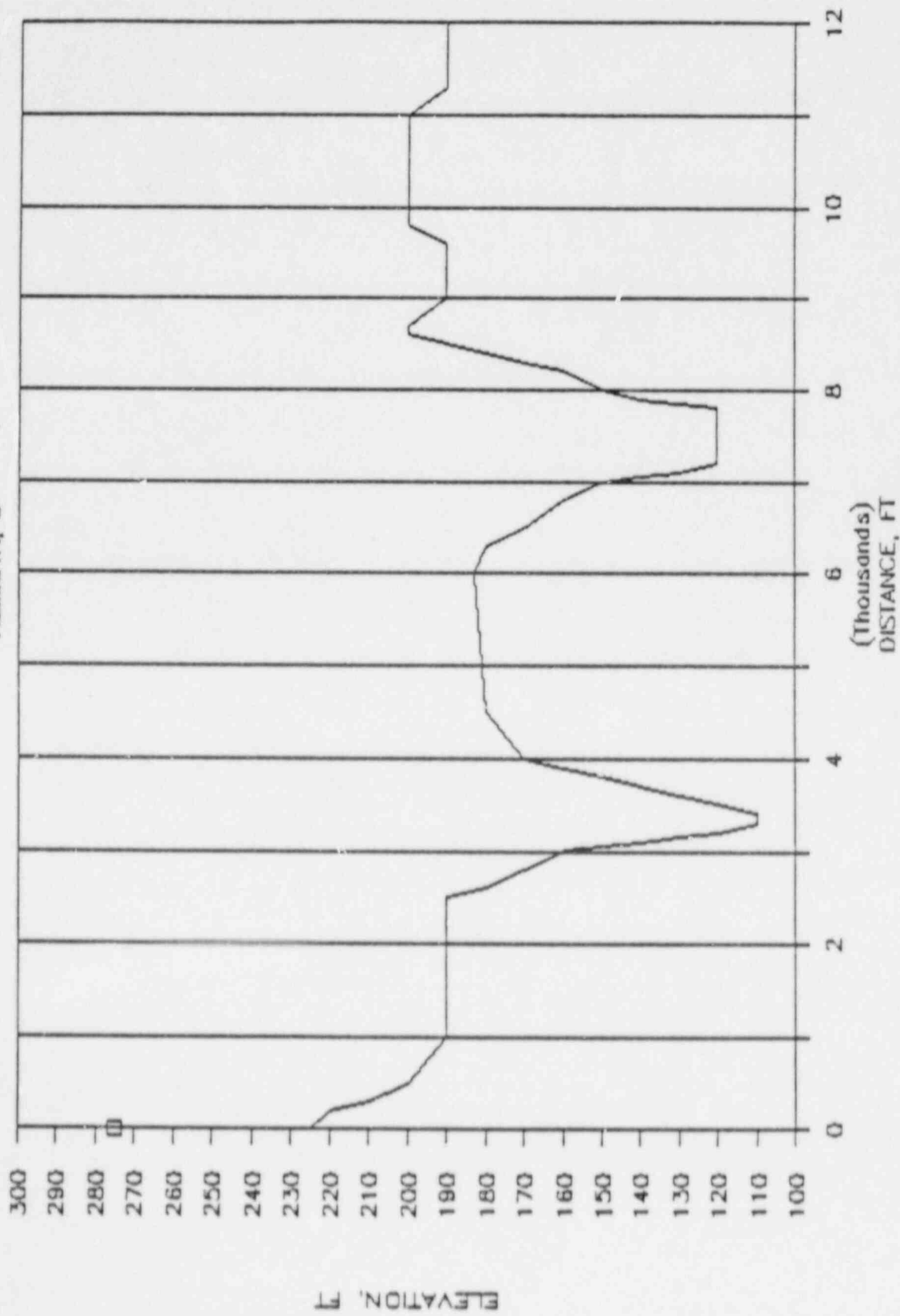
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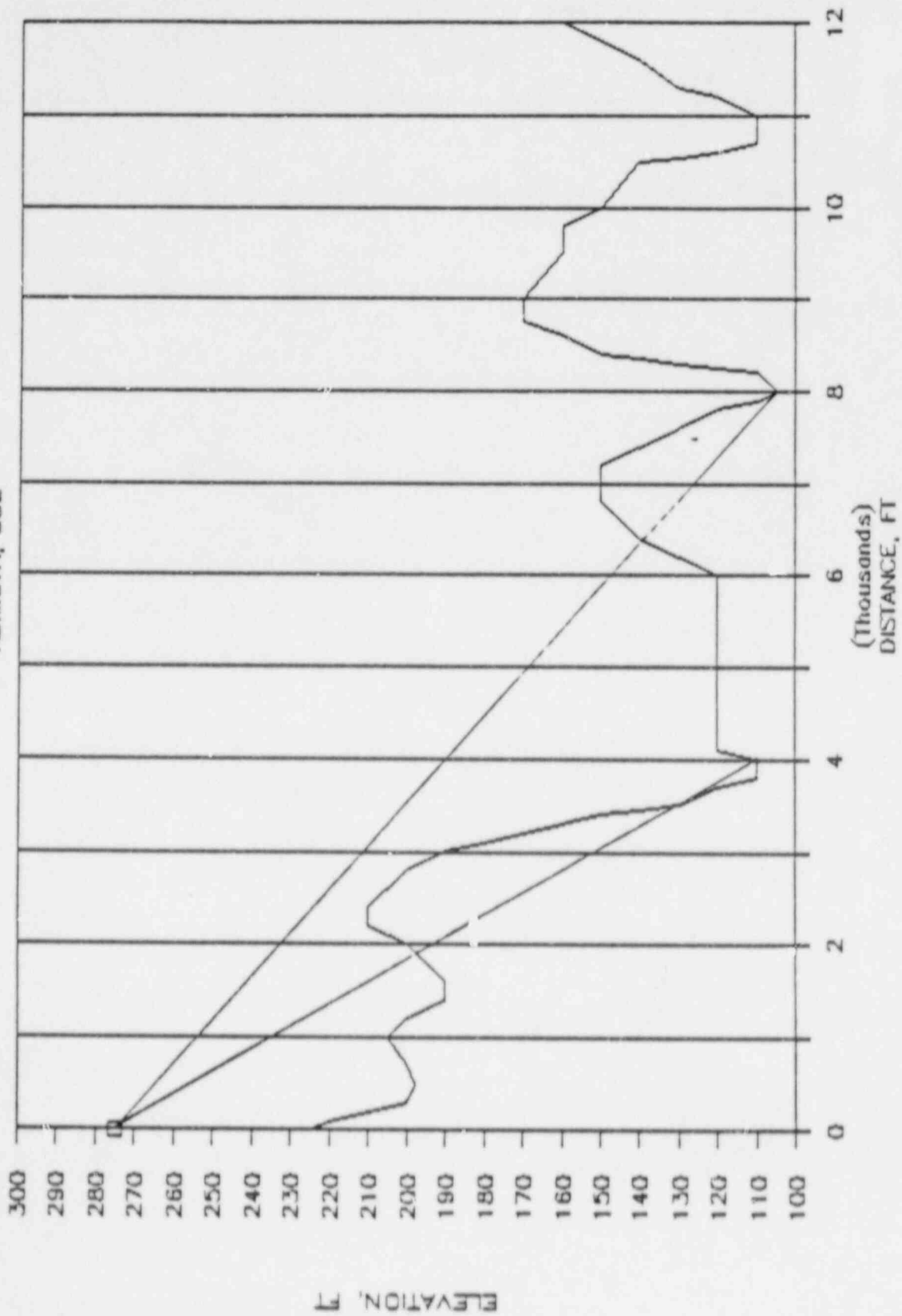
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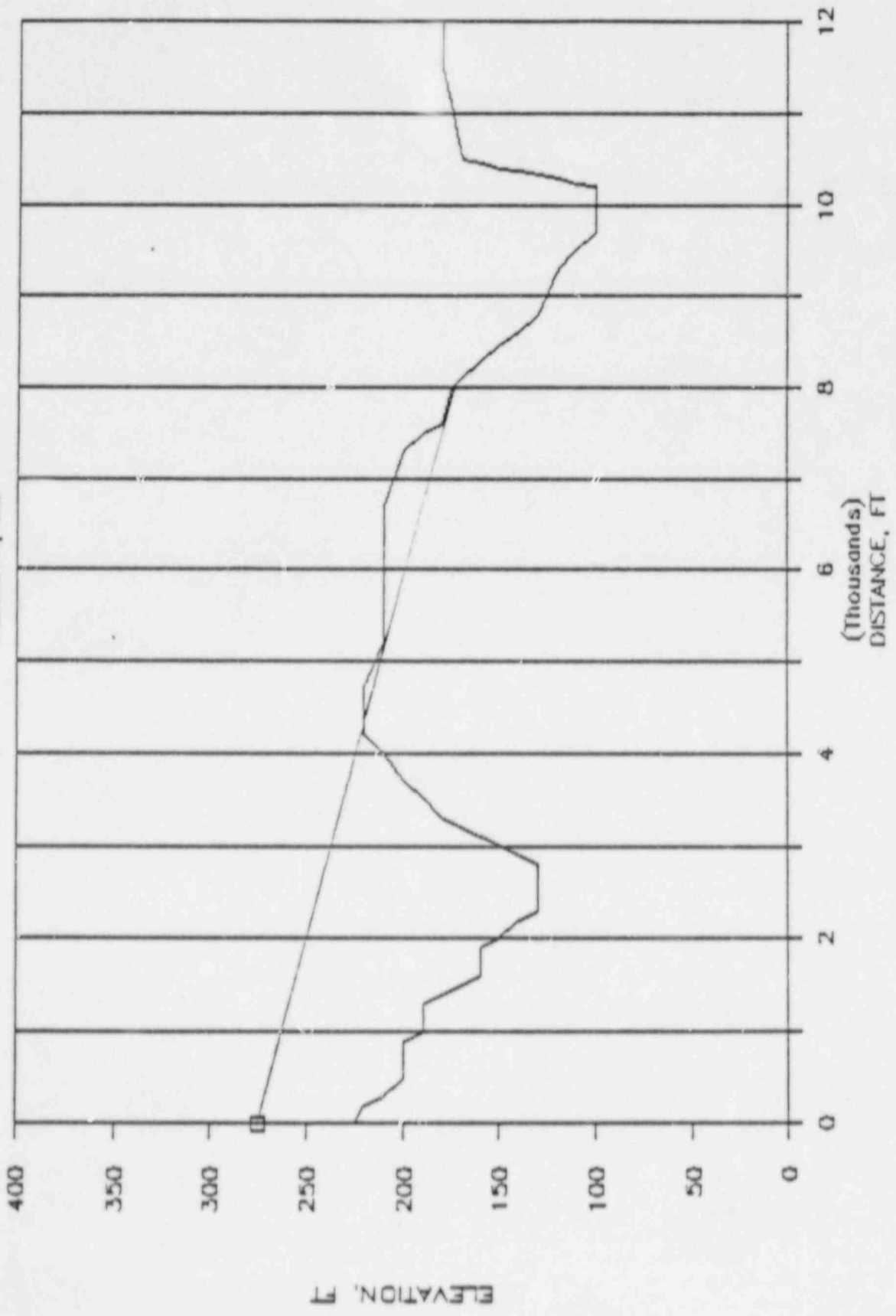
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AZIMUTH, SSE

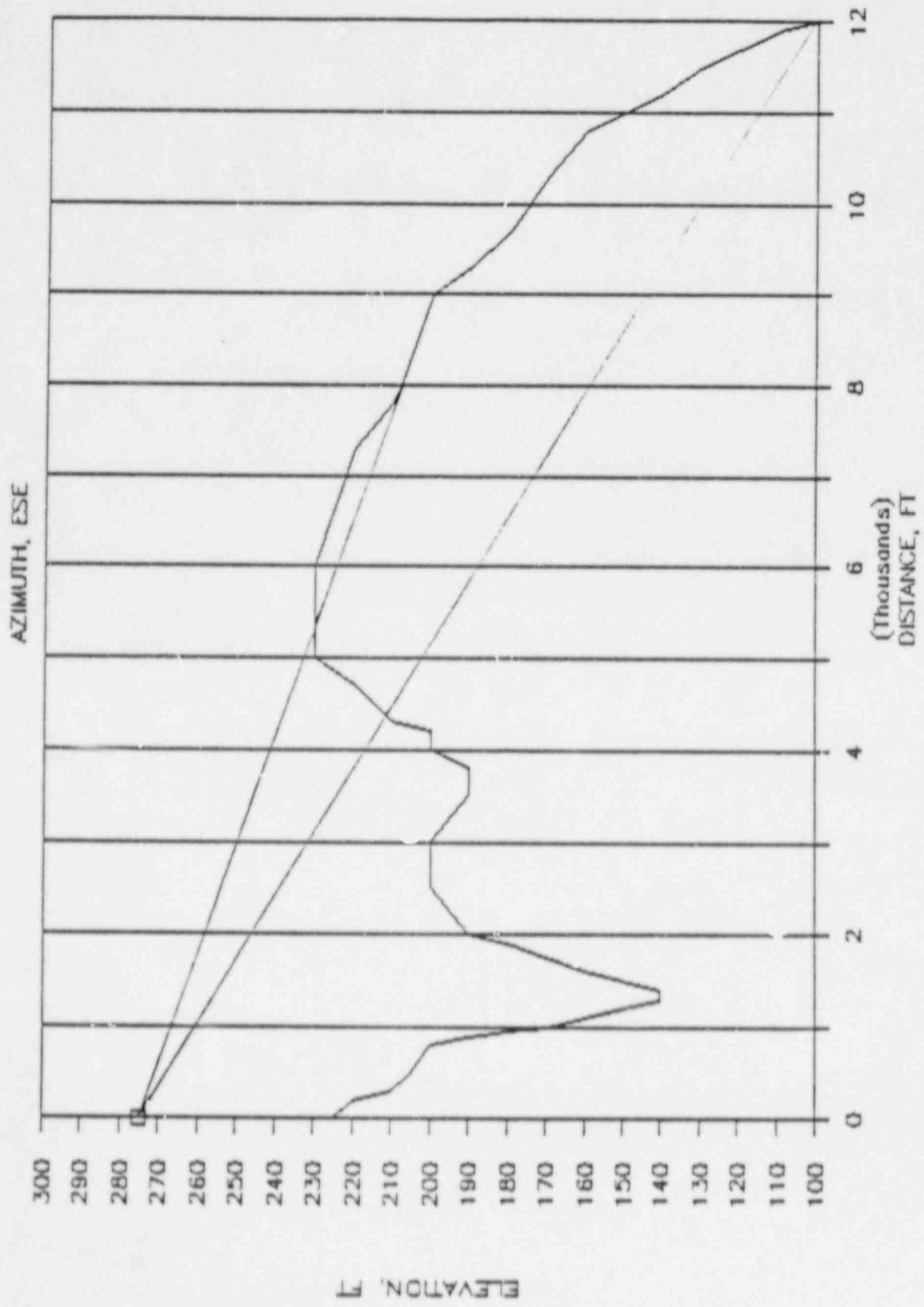


# VOGTLE B20

AZIMUTH, SE

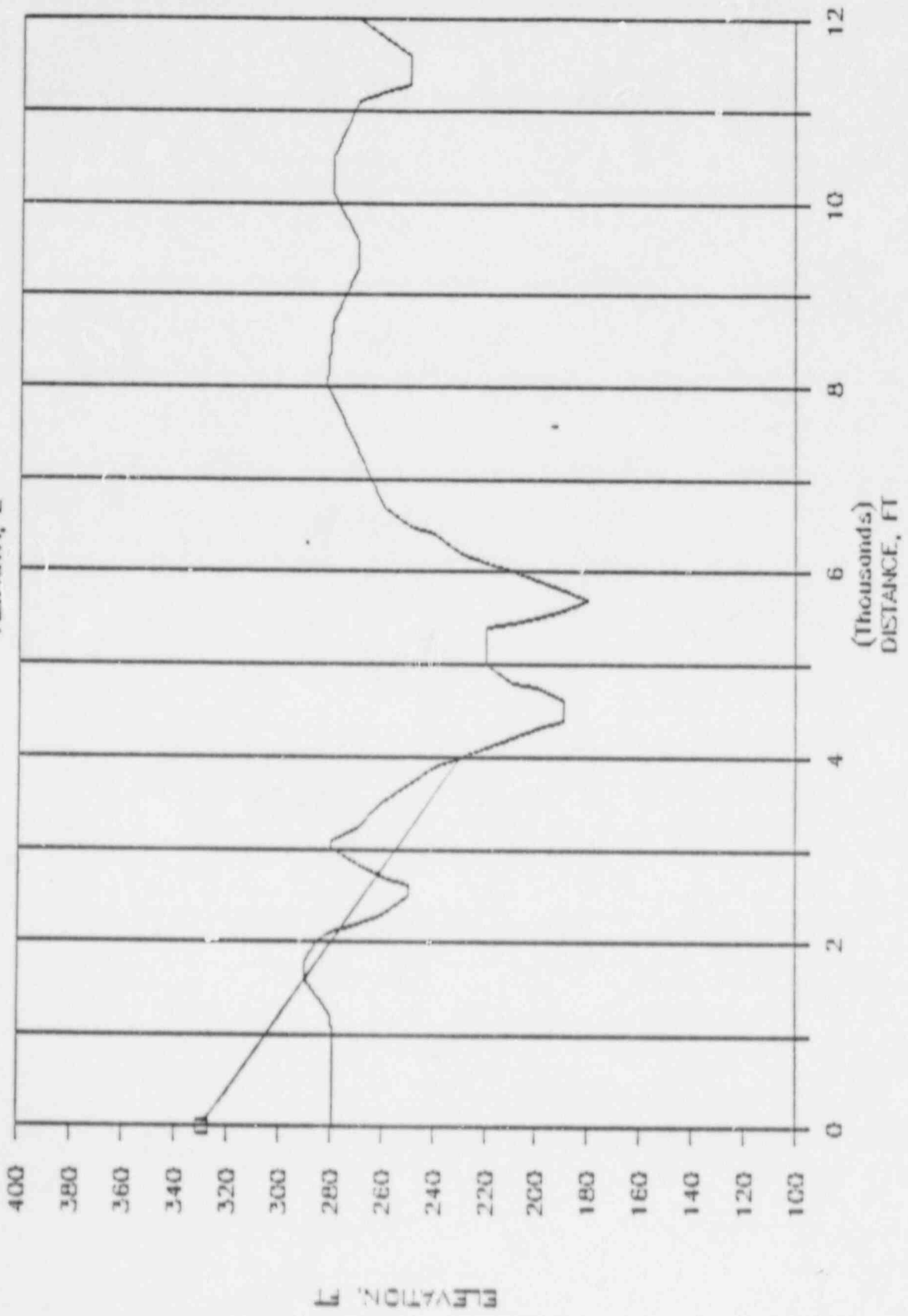


# VOGTLE B20



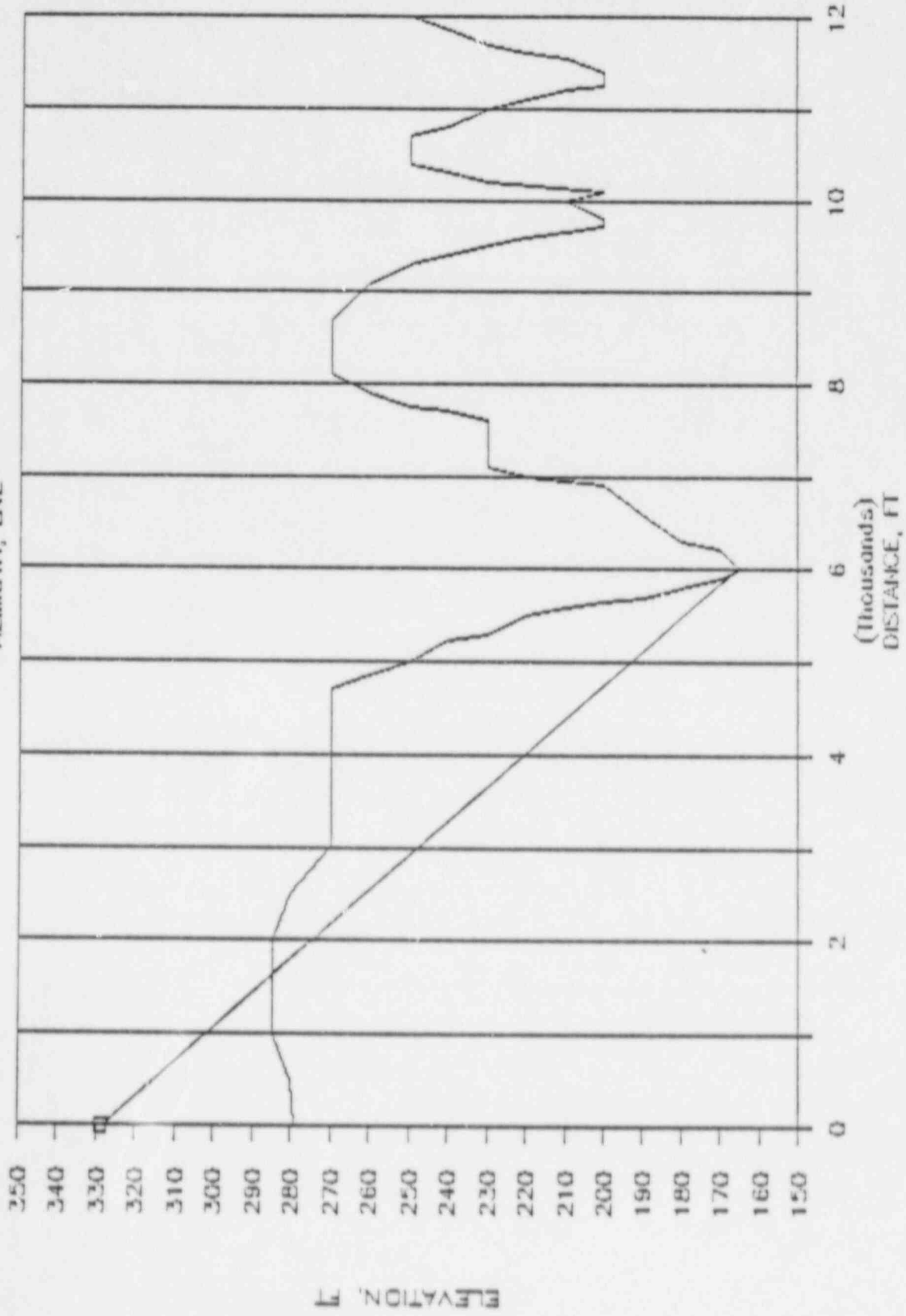
# VOGTLE B15

AZIMUTH, E



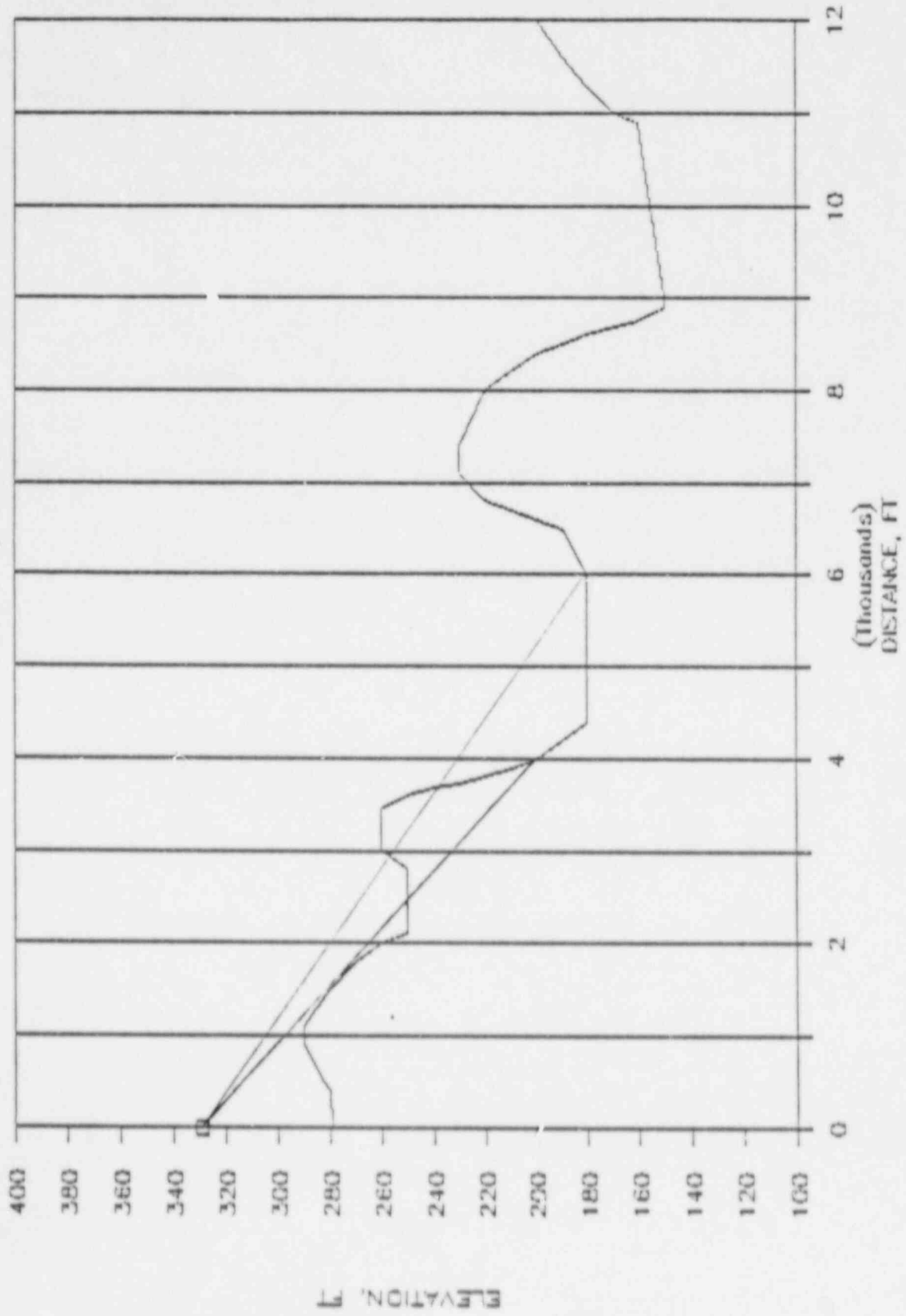
# VOGTLE B15

AZIMUTH, ENR



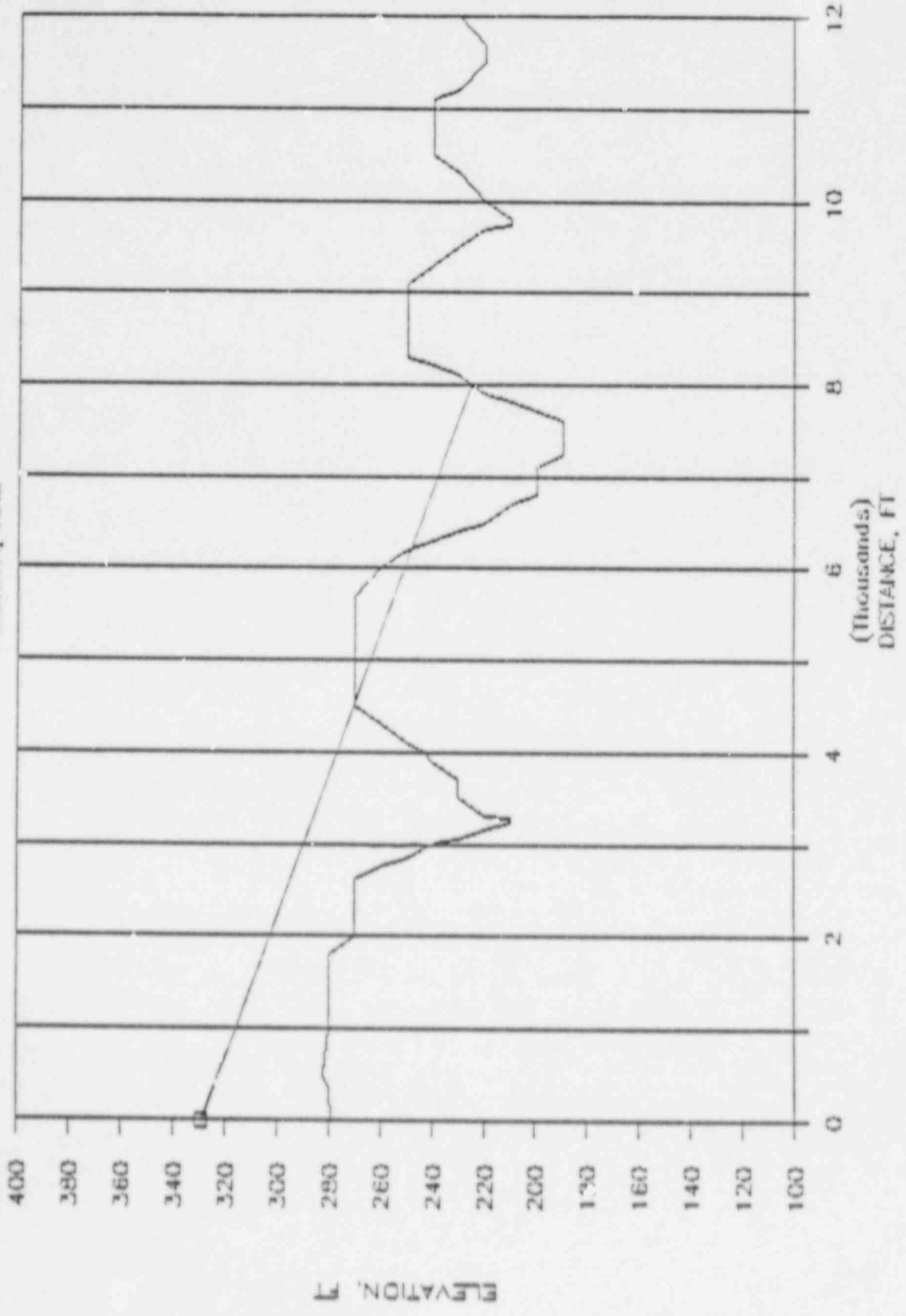
# VOGTLE B15

AZIMUTH, NE



# VOGTLE B15

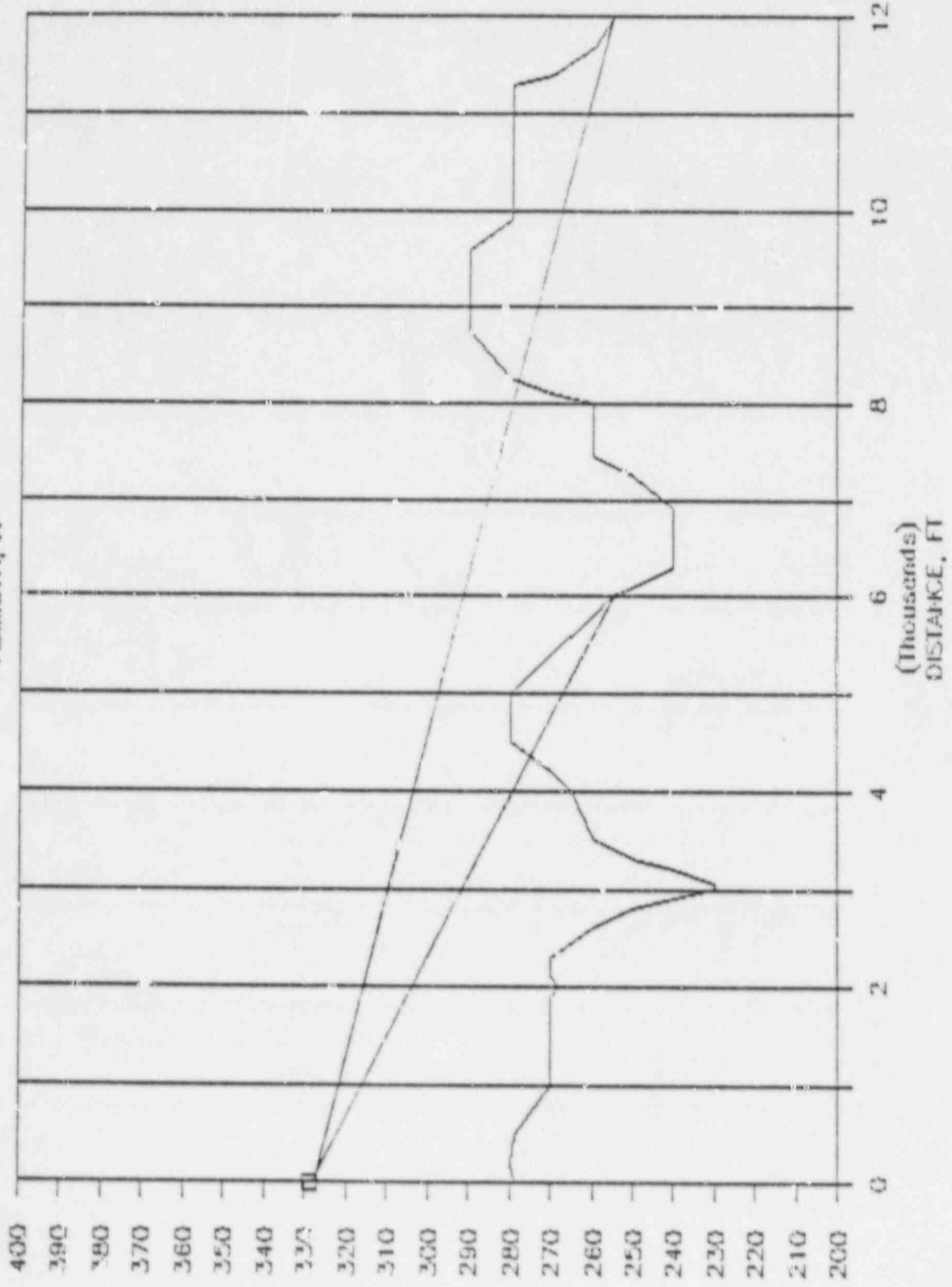
AZIMUTH, NNE





# VOGTLE B15

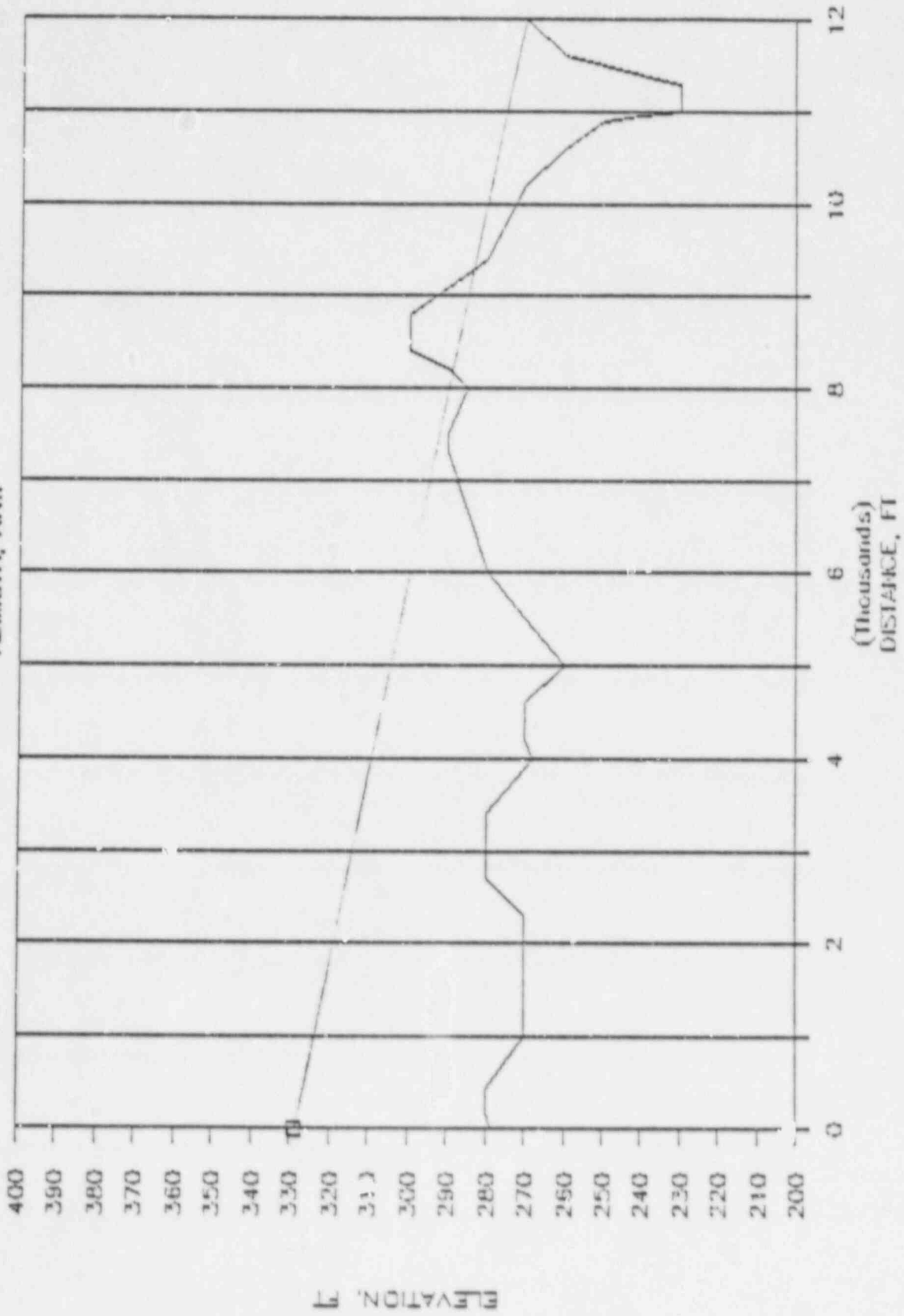
AZIMUTH, N



EVAPORATION

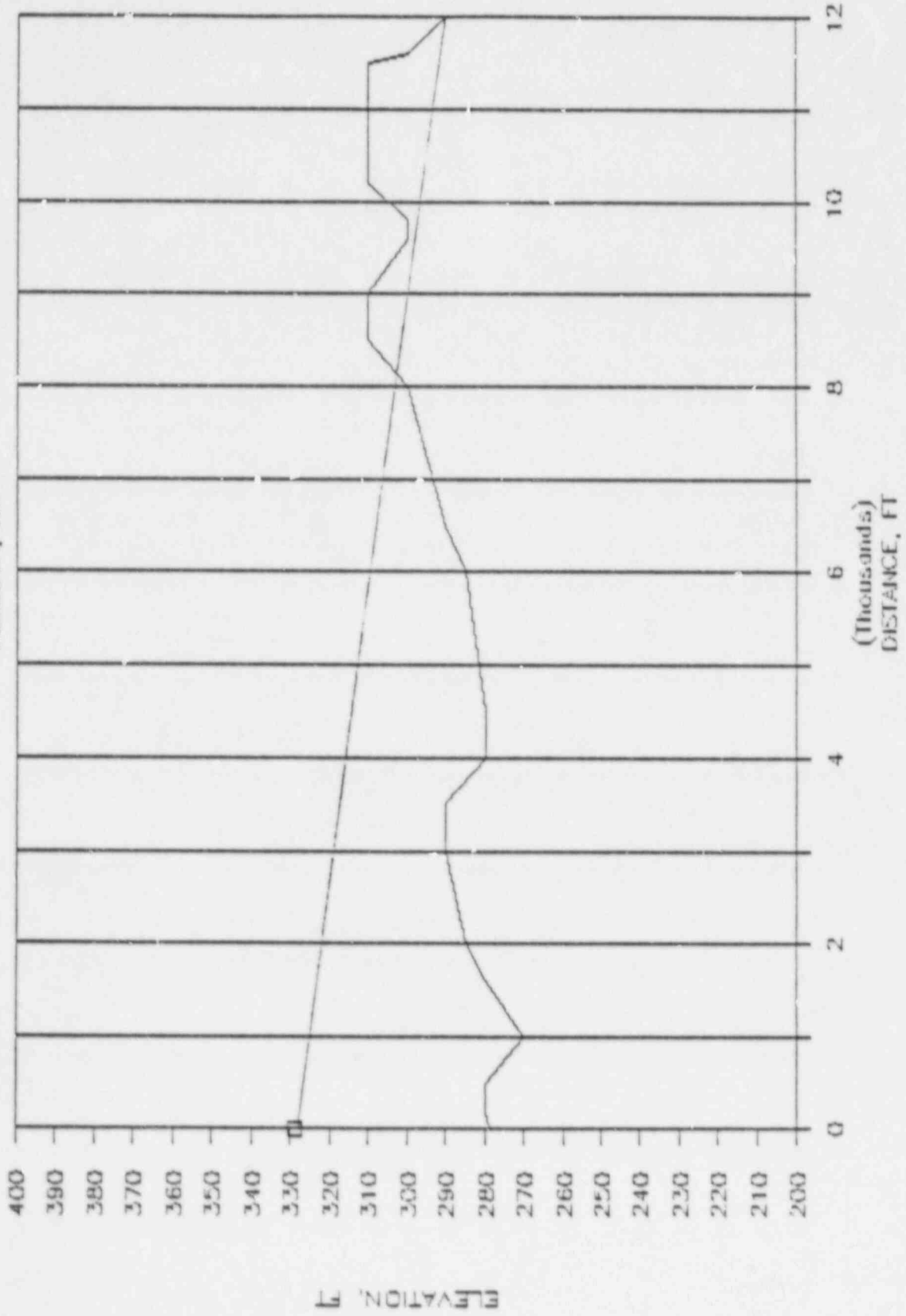
# VOGTLE B15

AZIMUTH, NNW



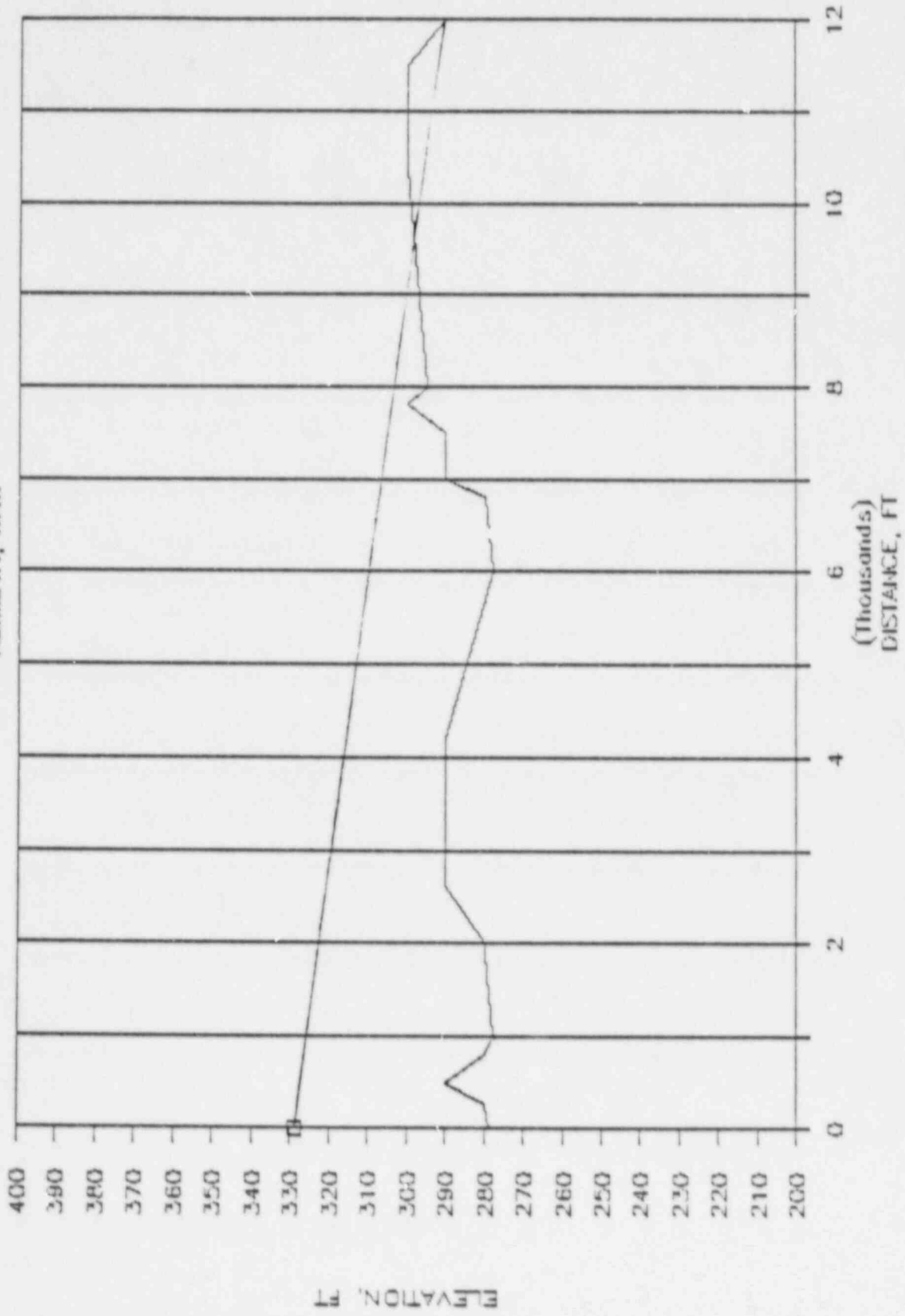
# VOGTLE B15

AZIMUTH, NW



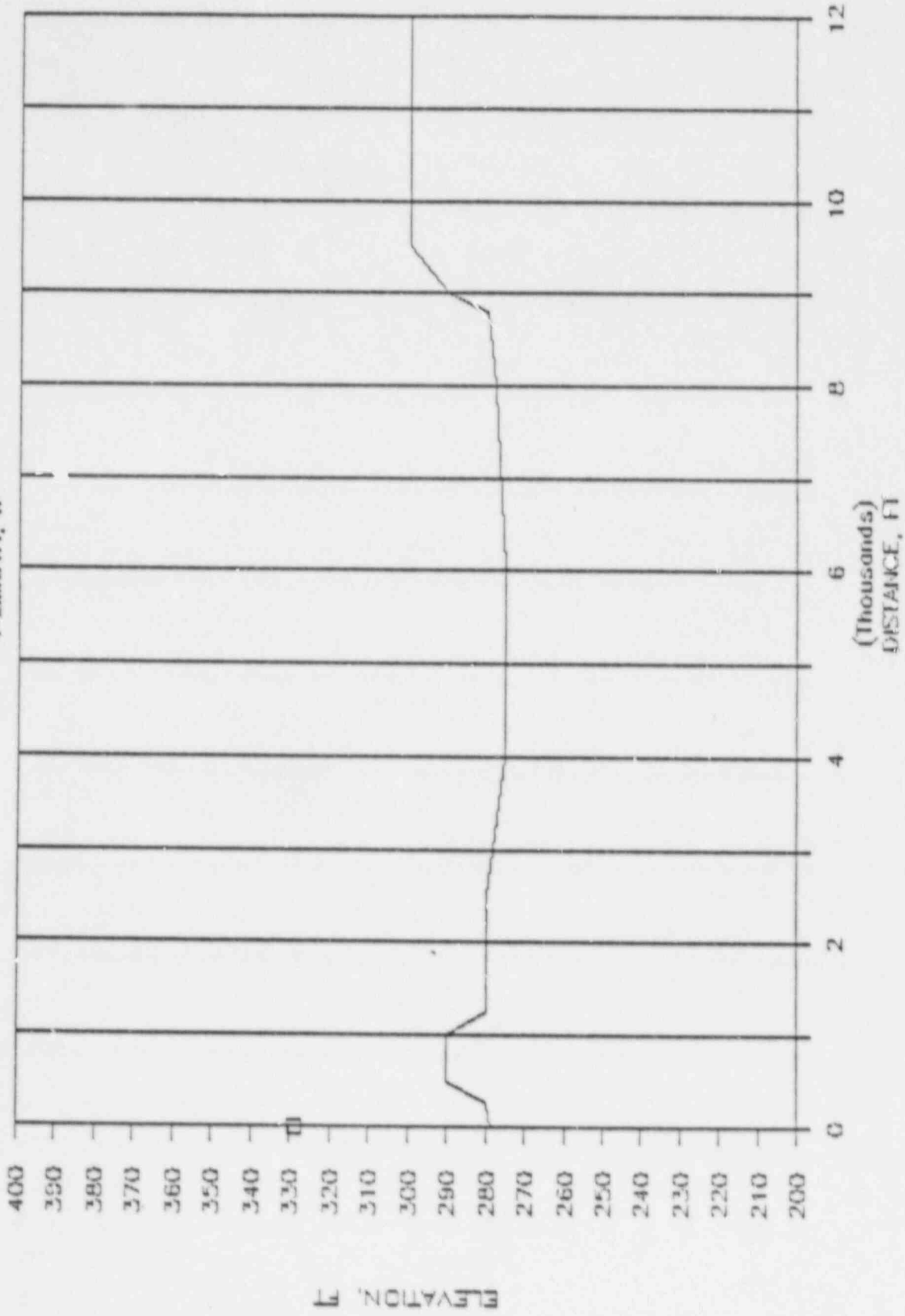
# VOGTLE B15

AZIMUTH, WNW



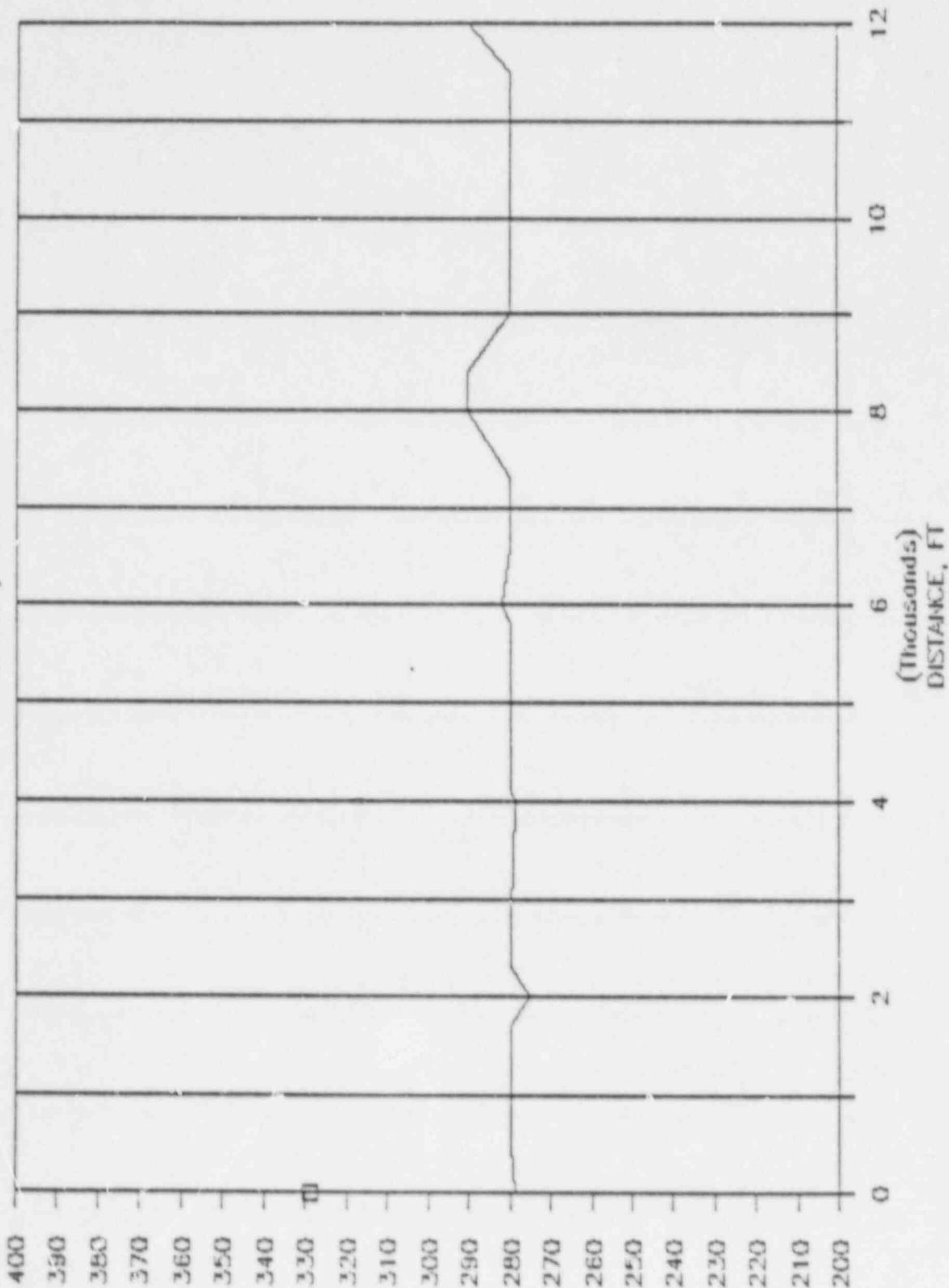
# VOGTLE B15

AZIMUTH, W



# VOGTLE B15

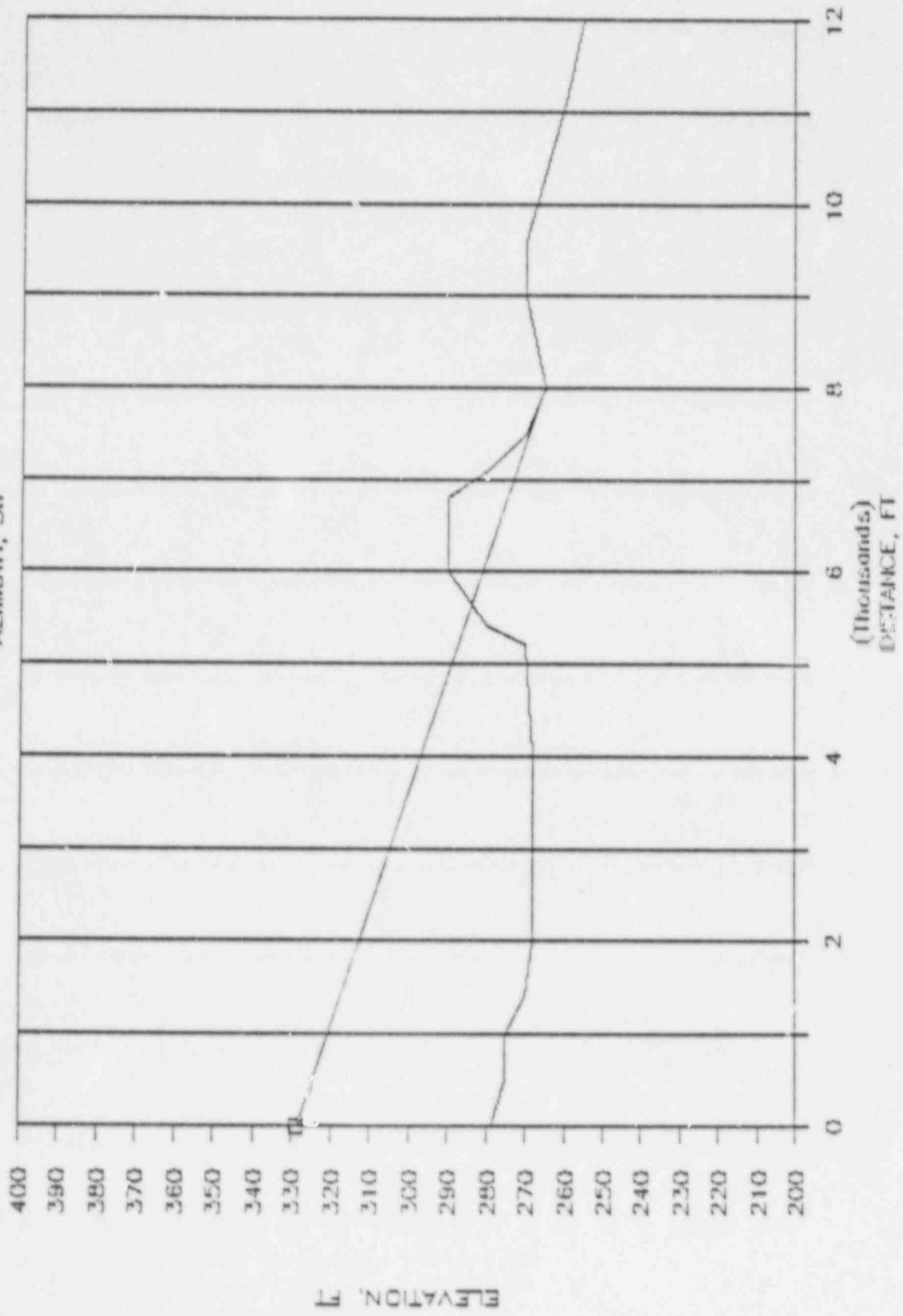
AZIMUTH, WSW



ELEVATION, FT

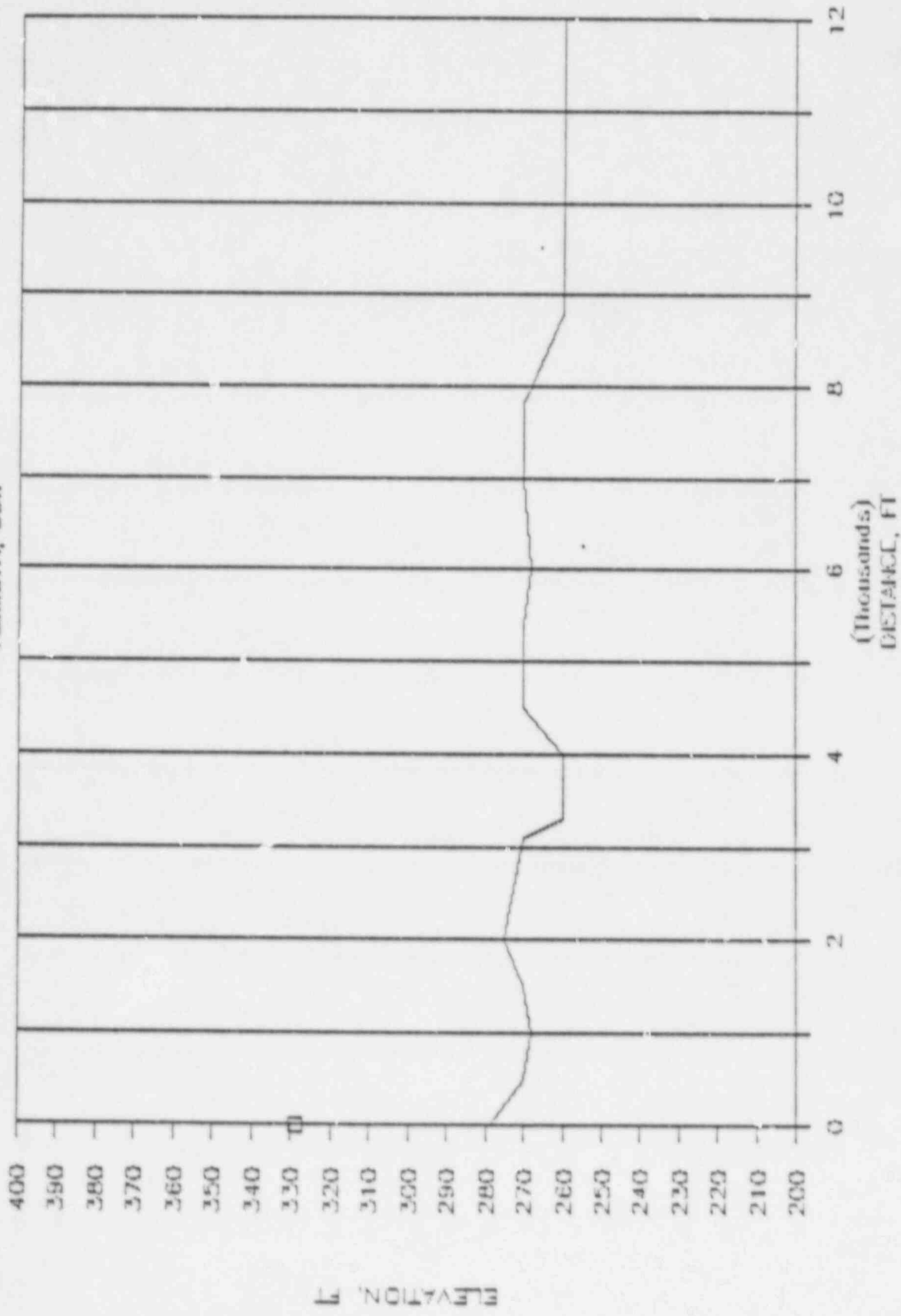
# VOGTLE B15

AZIMUTH, SW



# VOGTLE B15

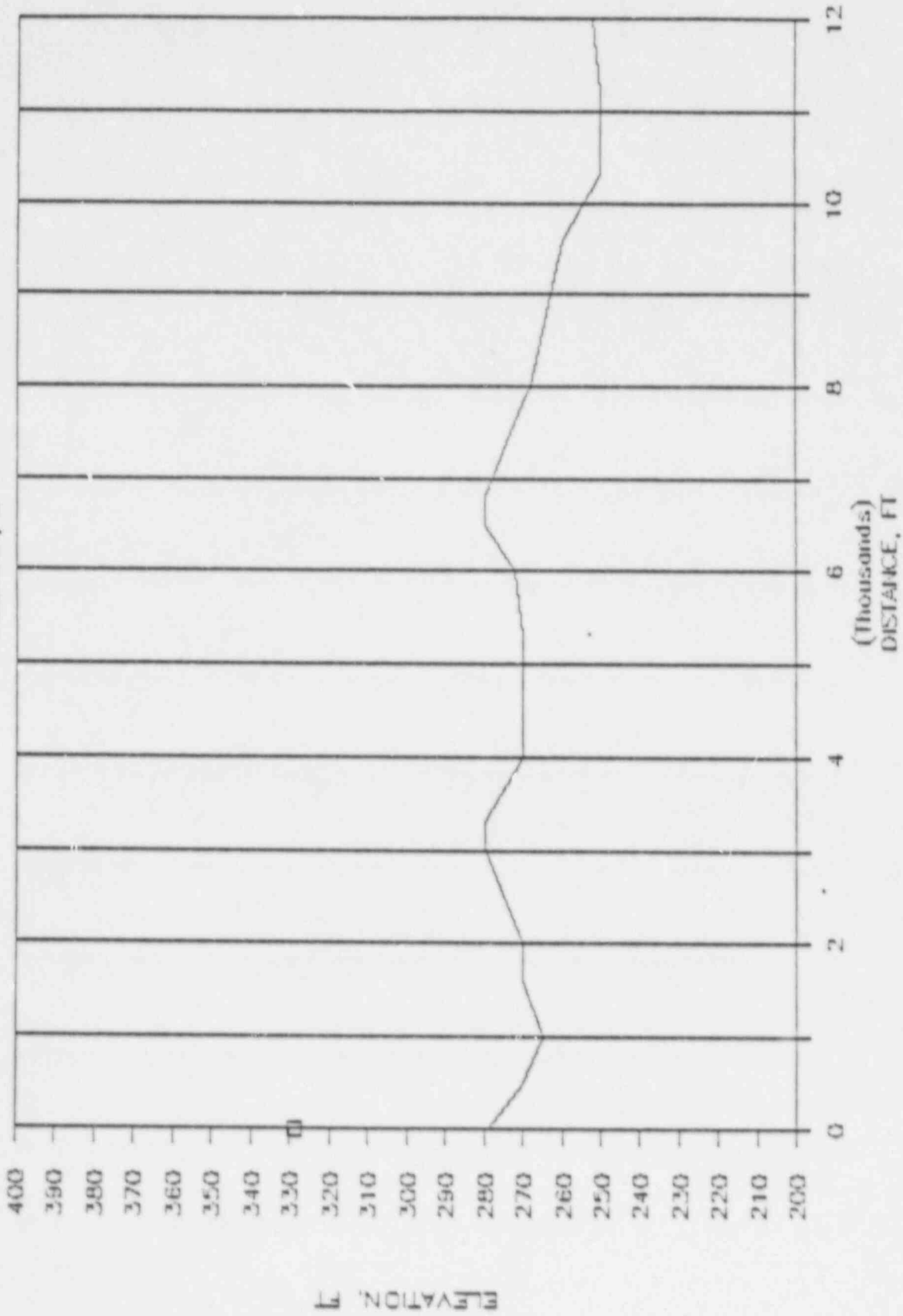
AZIMUTH, SSW





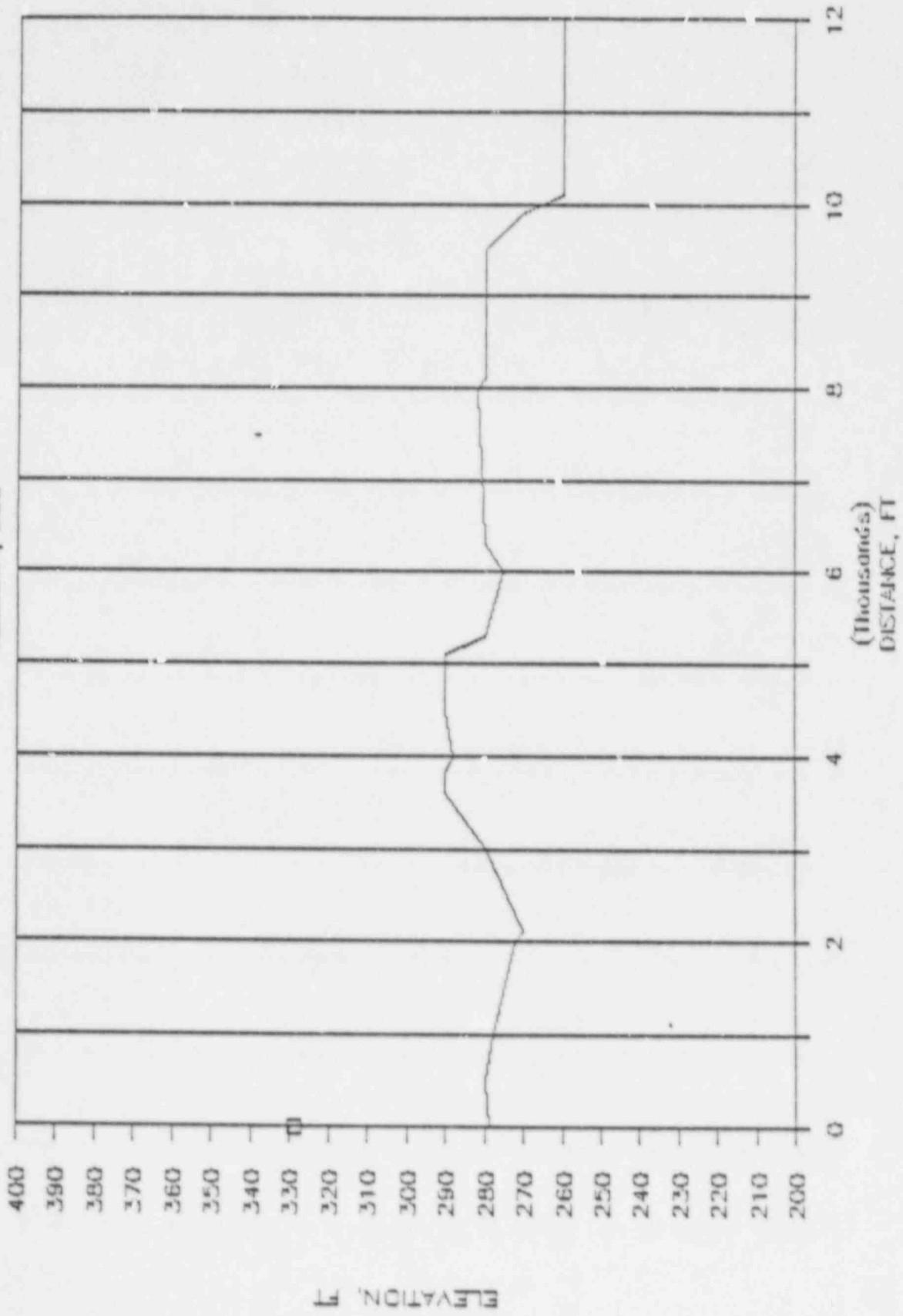
# VOGTLE B15

AZIMUTH, S



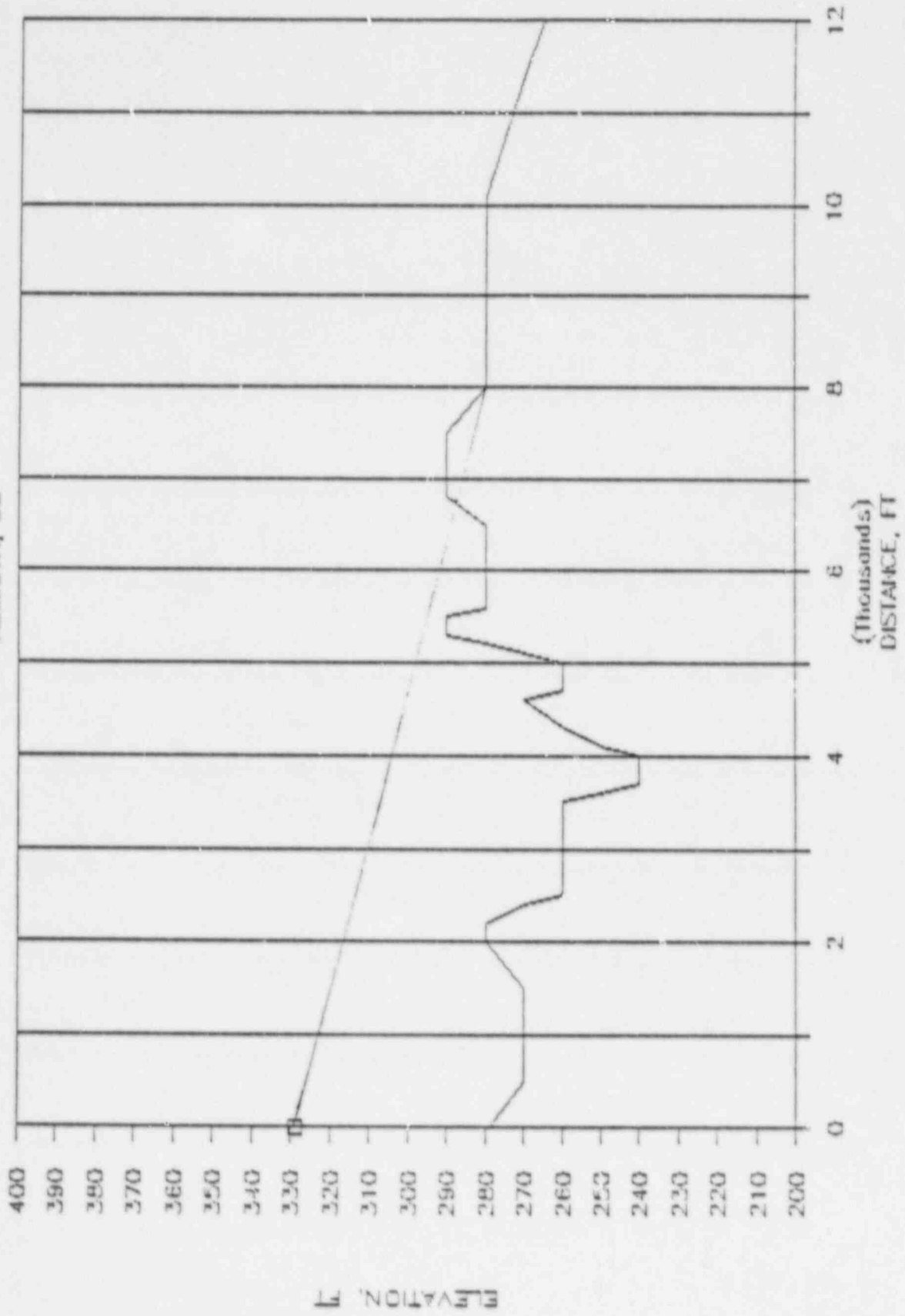
# VOGTLE B15

AZIMUTH, SSE



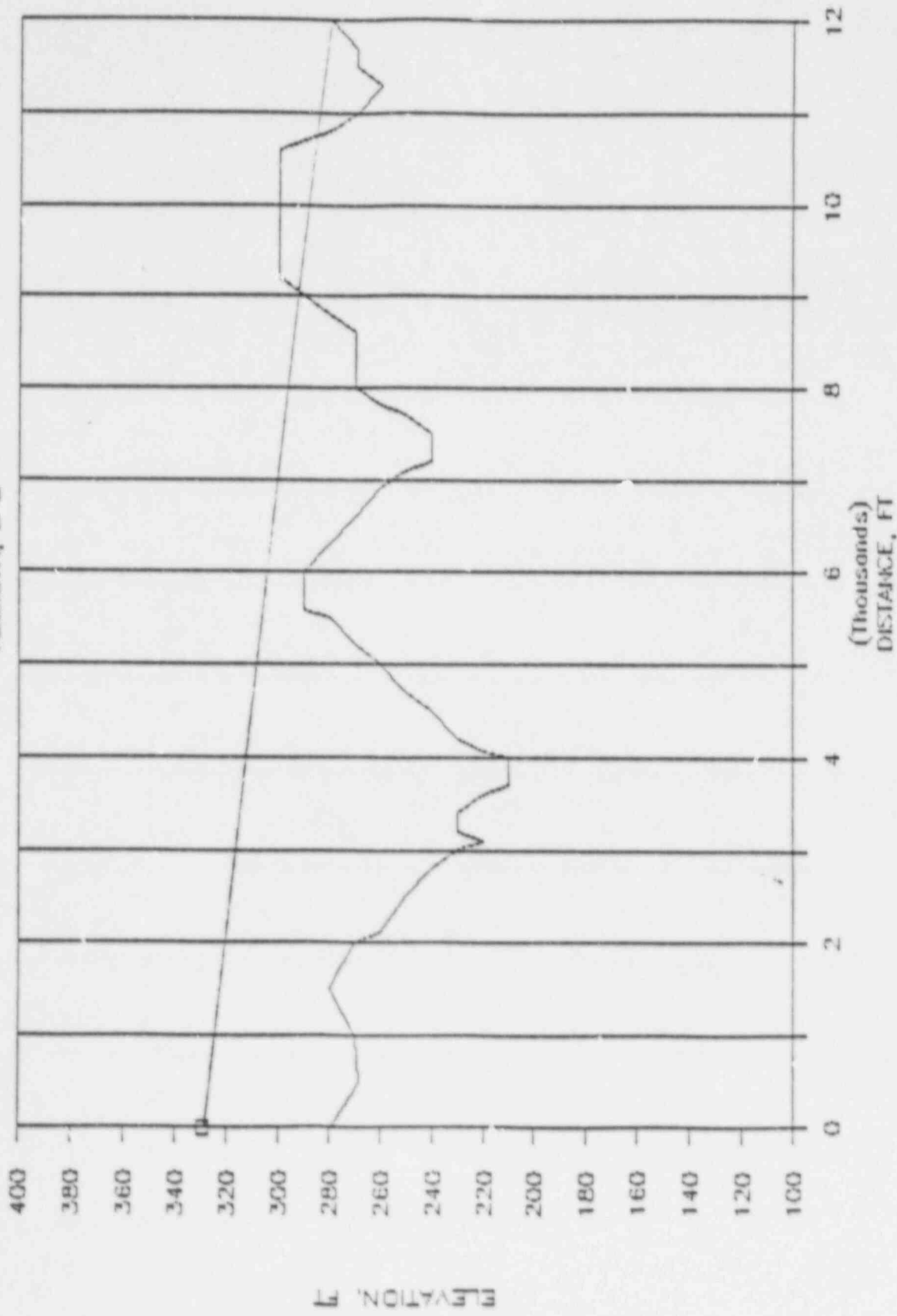
# VOGTLE B15

AZIMUTH, SE



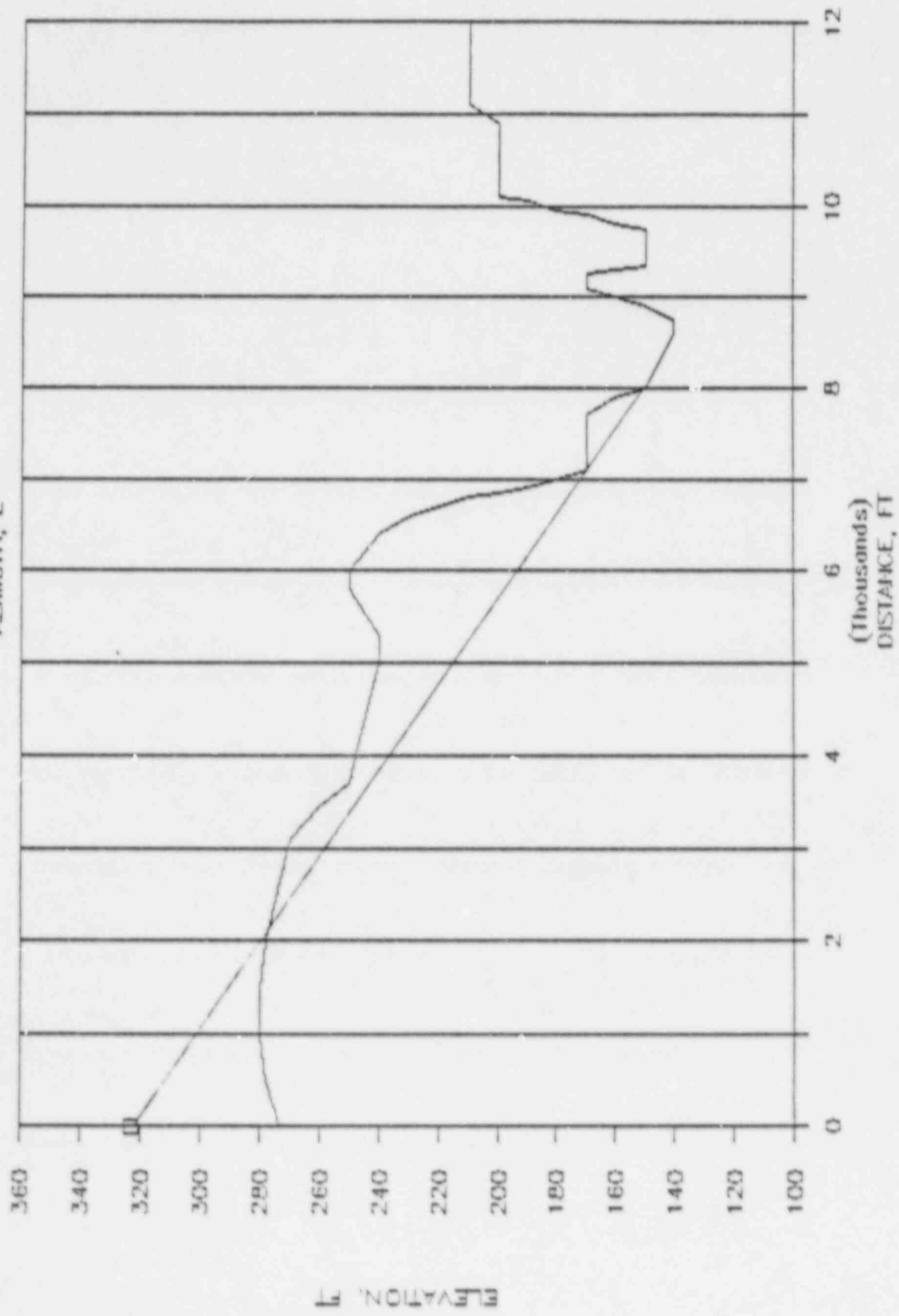
# VOGTLE B15

AZIMUTH, ESE



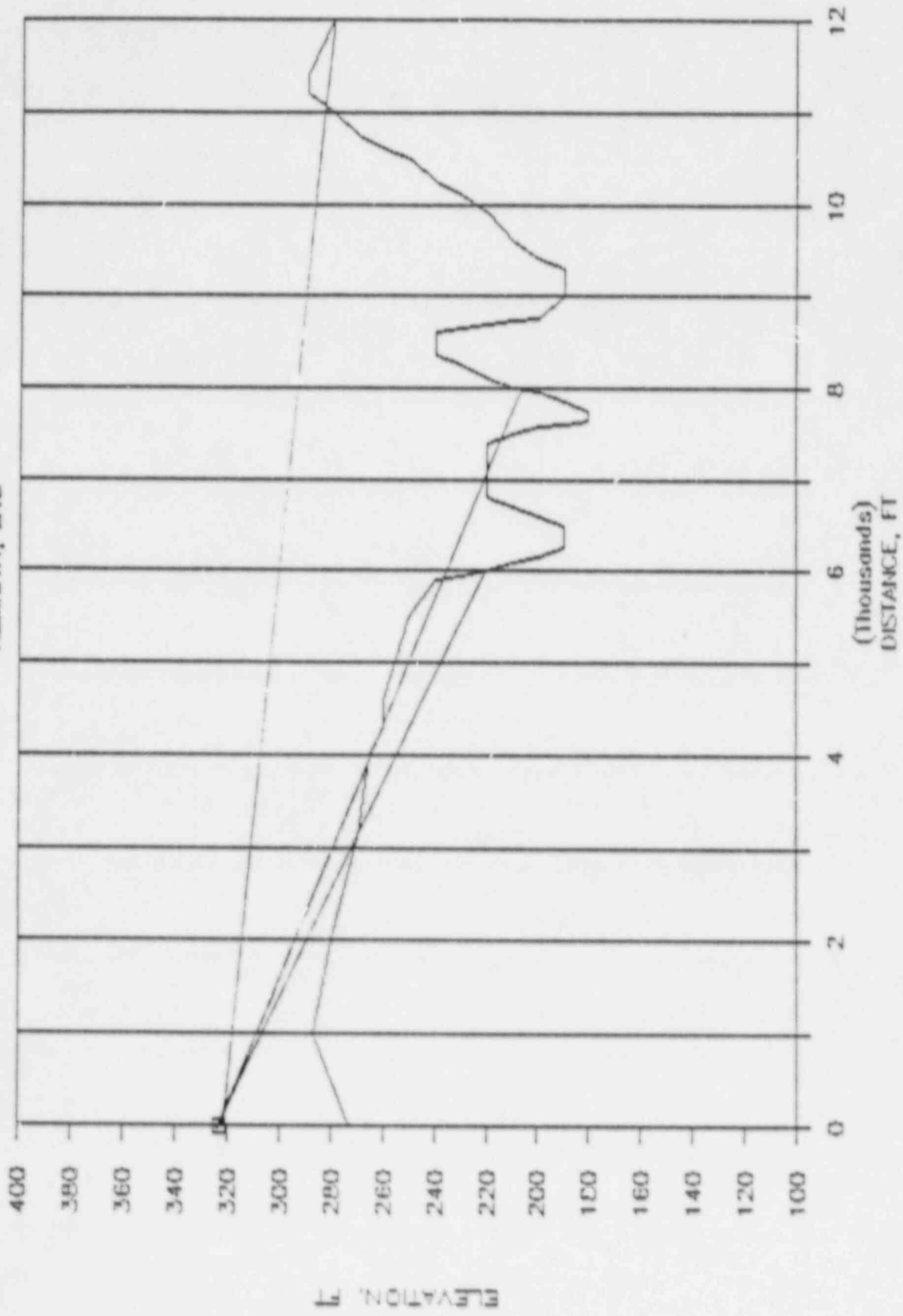
# VOGTLE B14

AZIMUTH, E



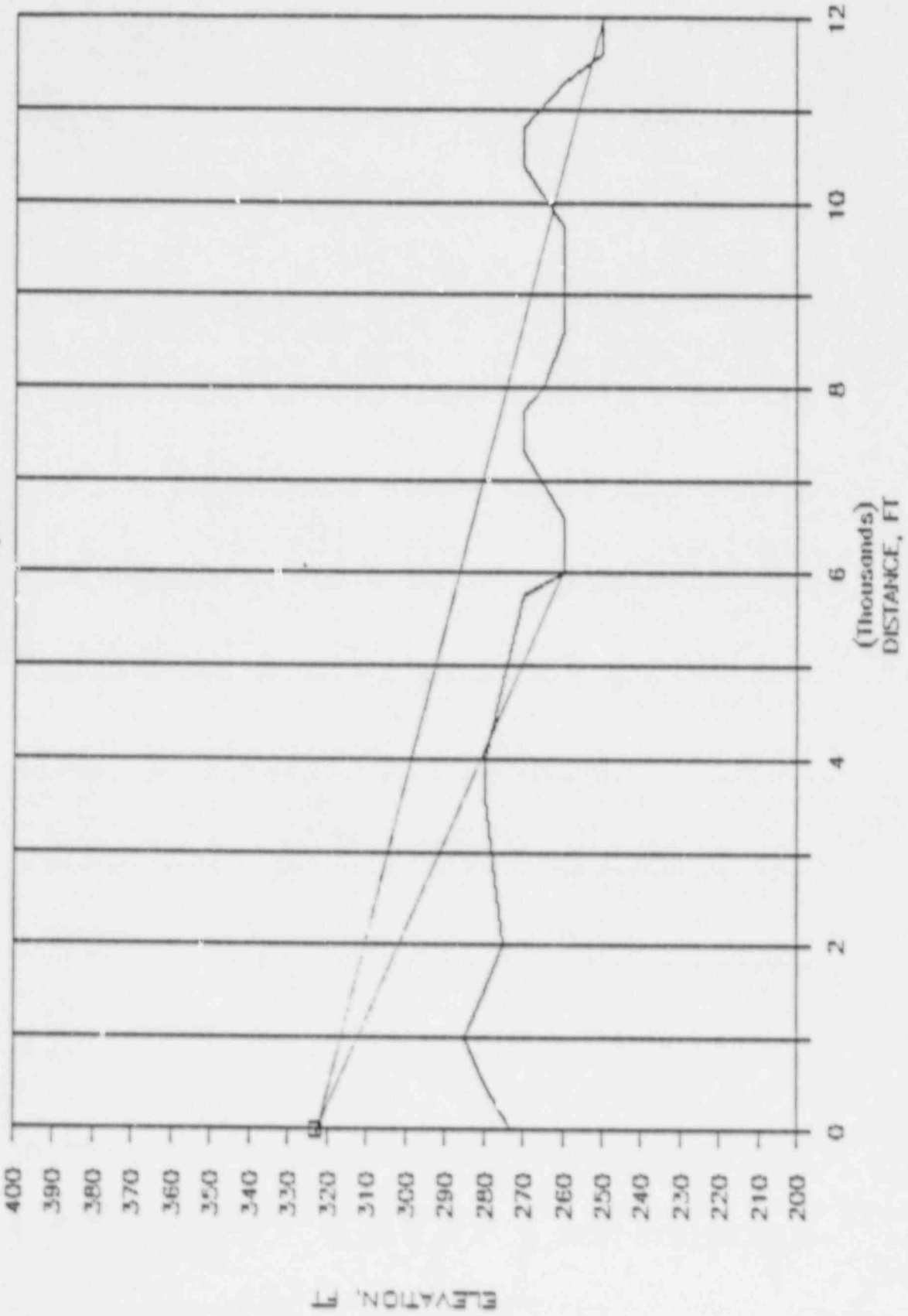
# VOGTLE B14

AZIMUTH, BNE



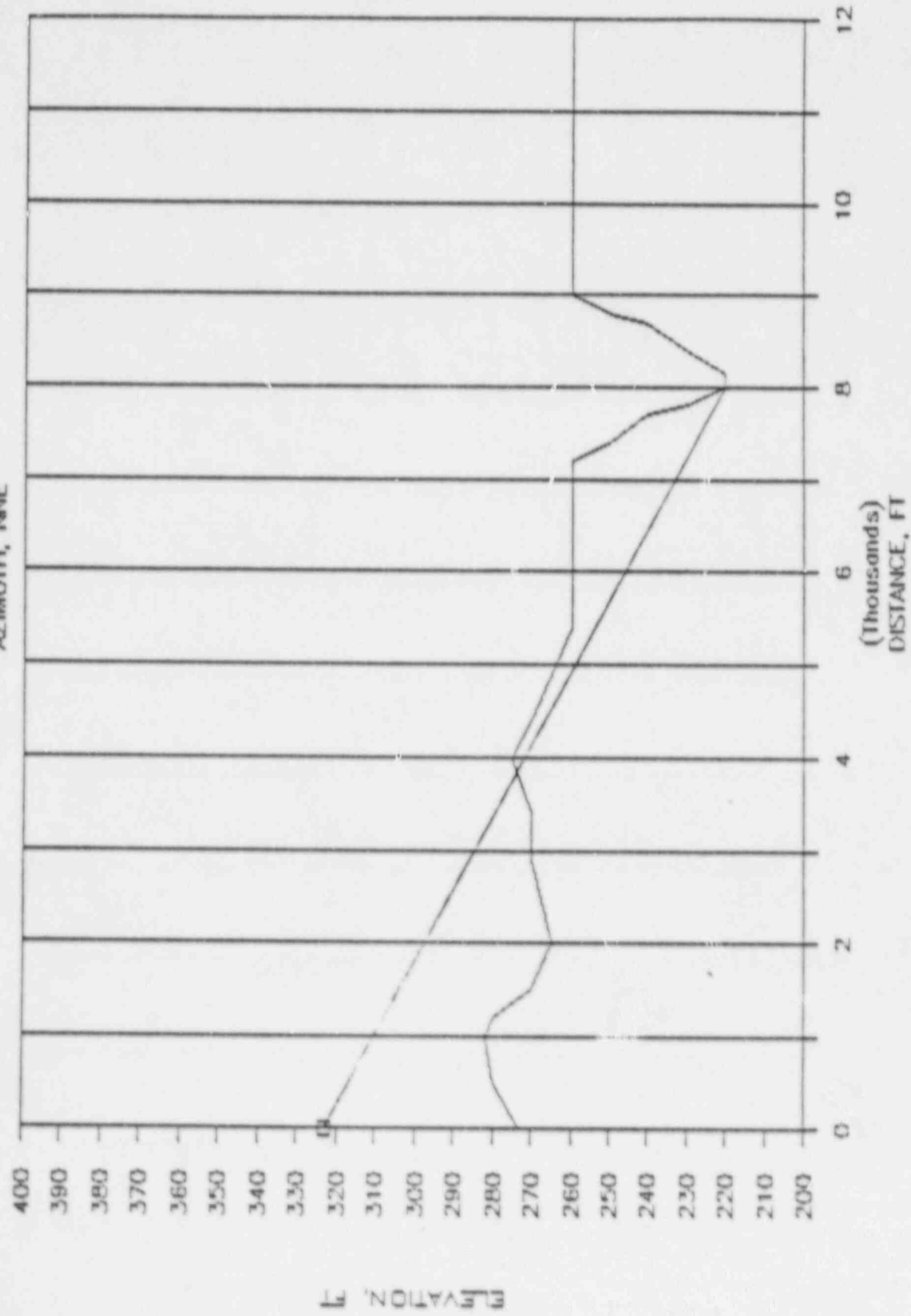
# VOGTLE B14

AZIMUTH, NE



# VOGTLE B14

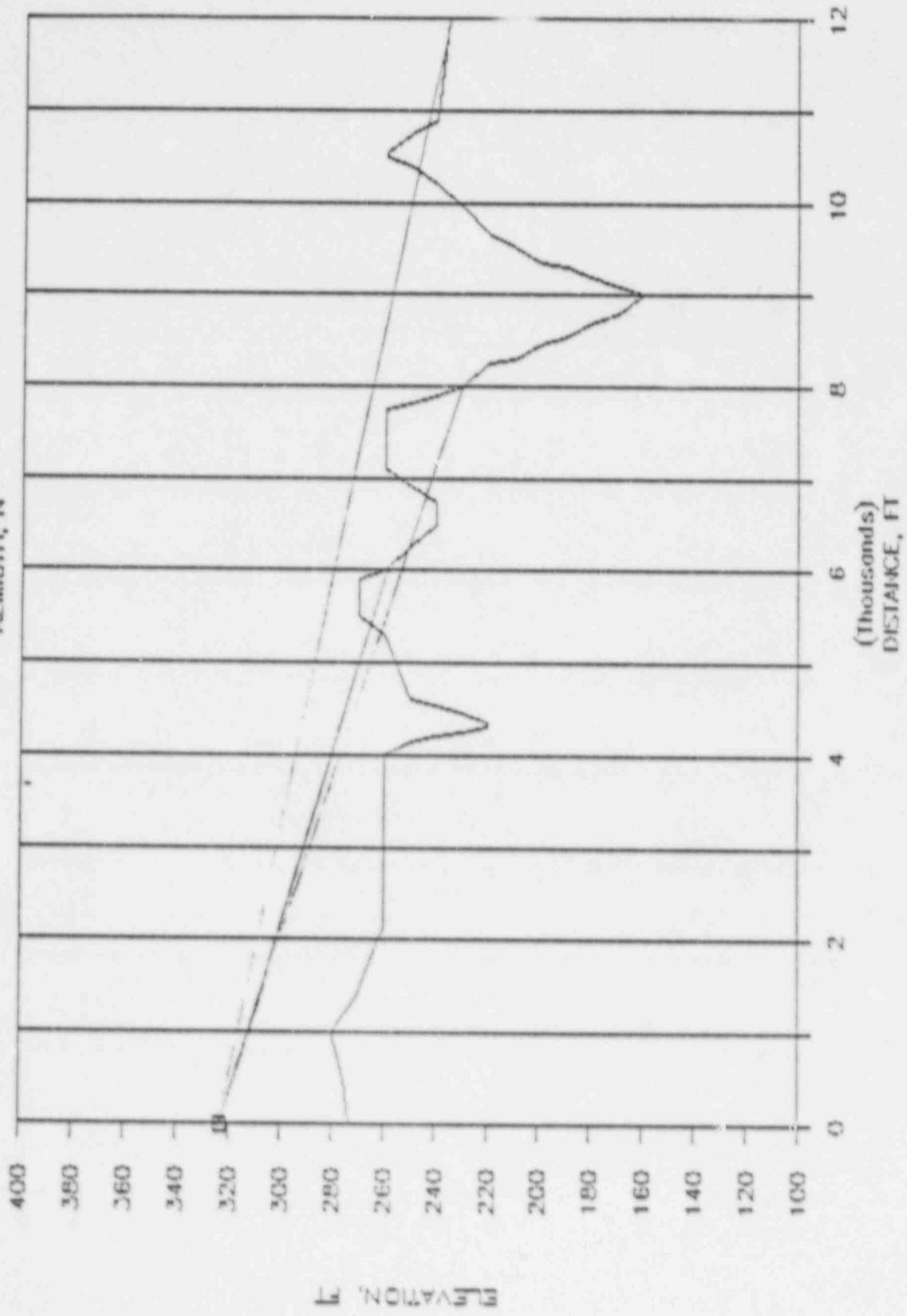
AZIMUTH, NNE





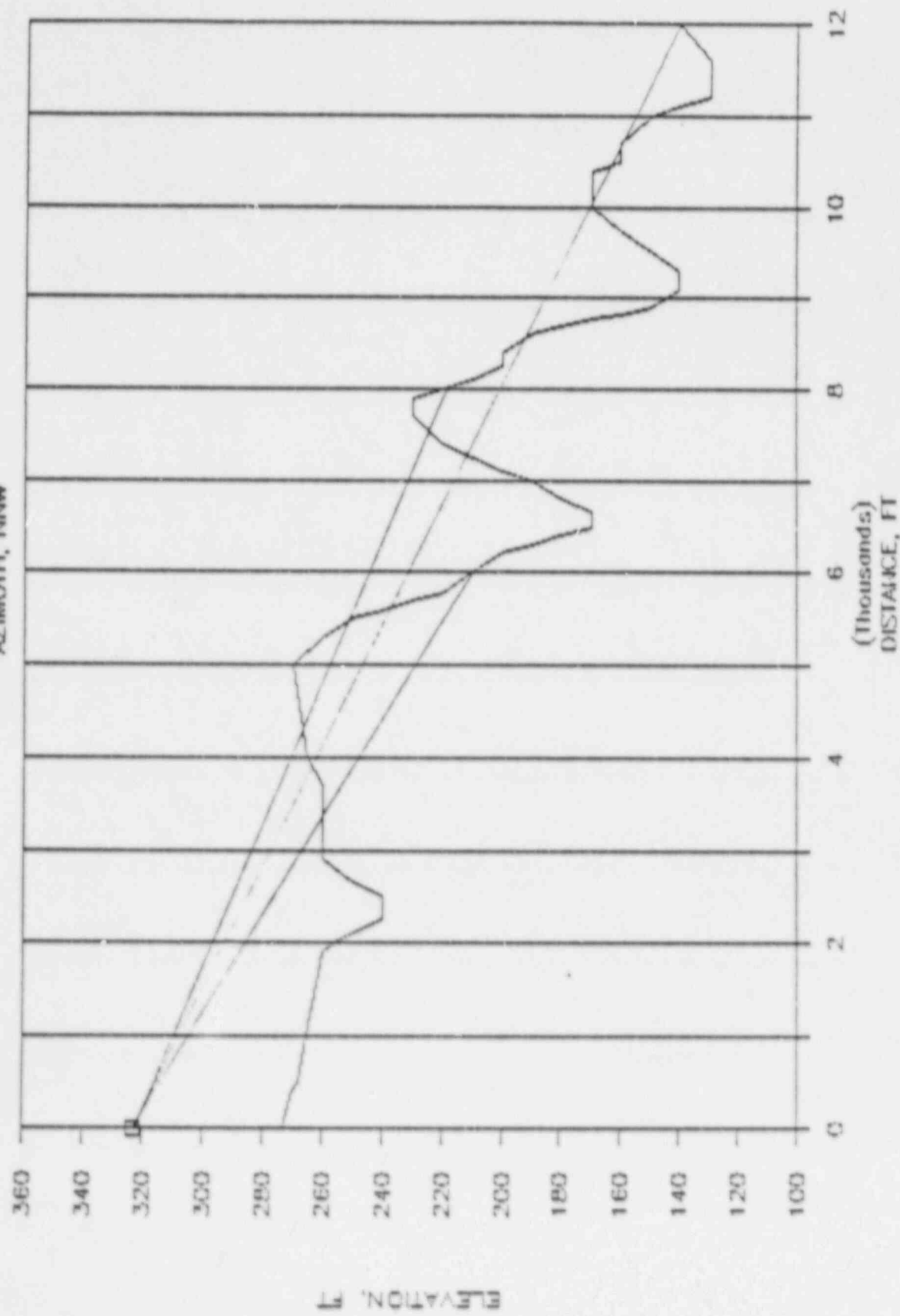
# VOGTLE B14

AZIMUTH, N



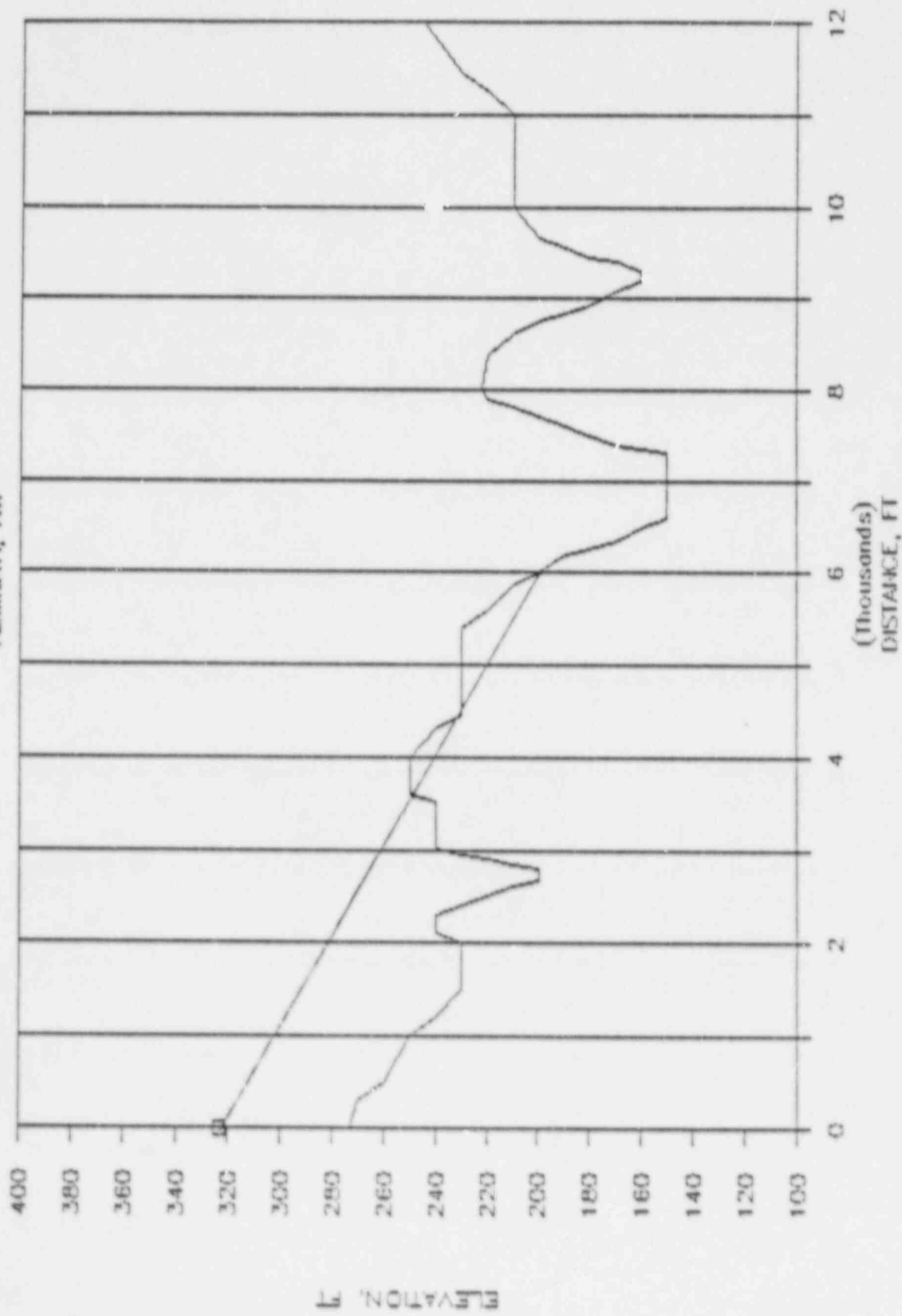
# VOGTLE B14

AZIMUTH, NNW



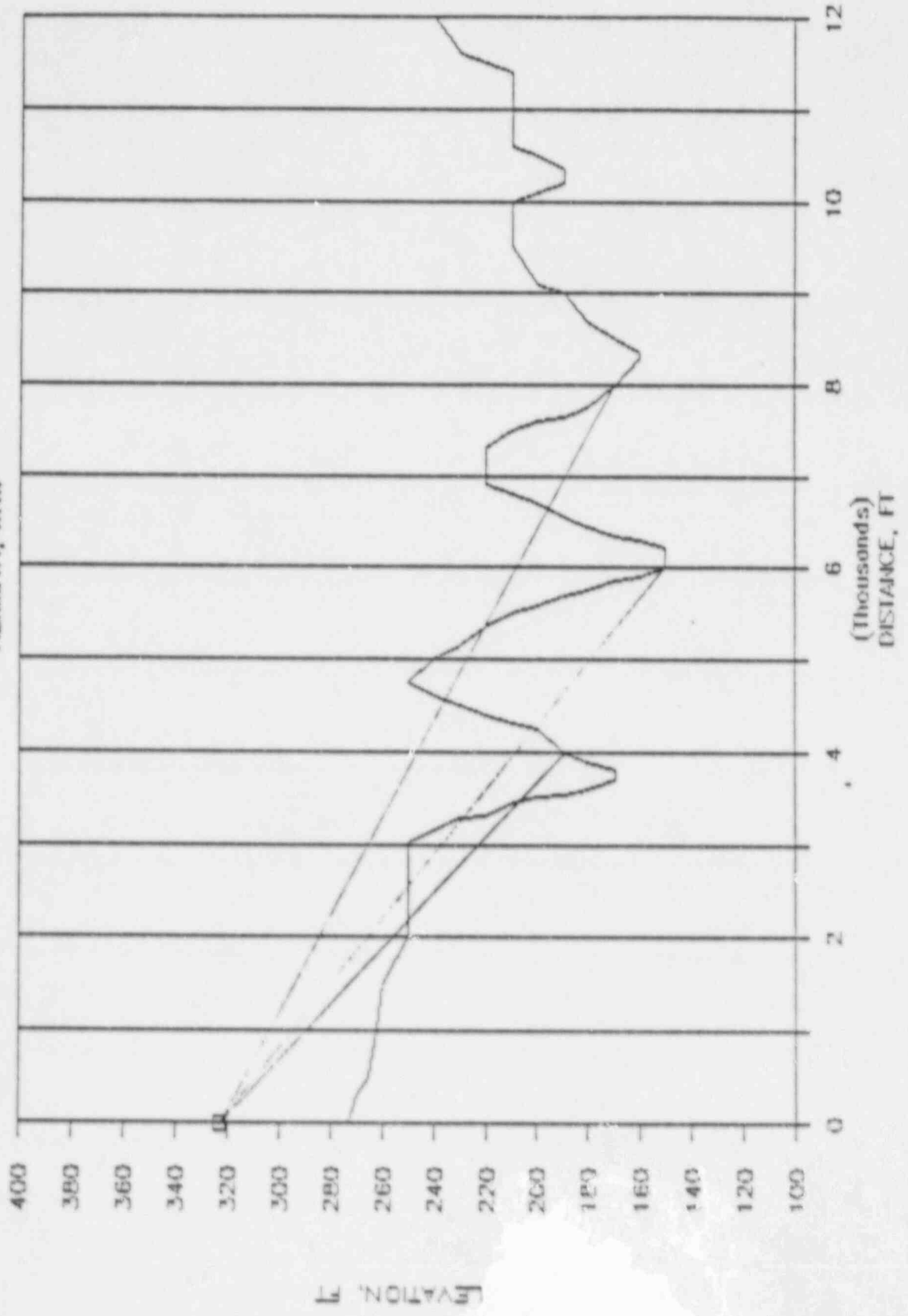
# VOGTLE B14

AZIMUTH, NW



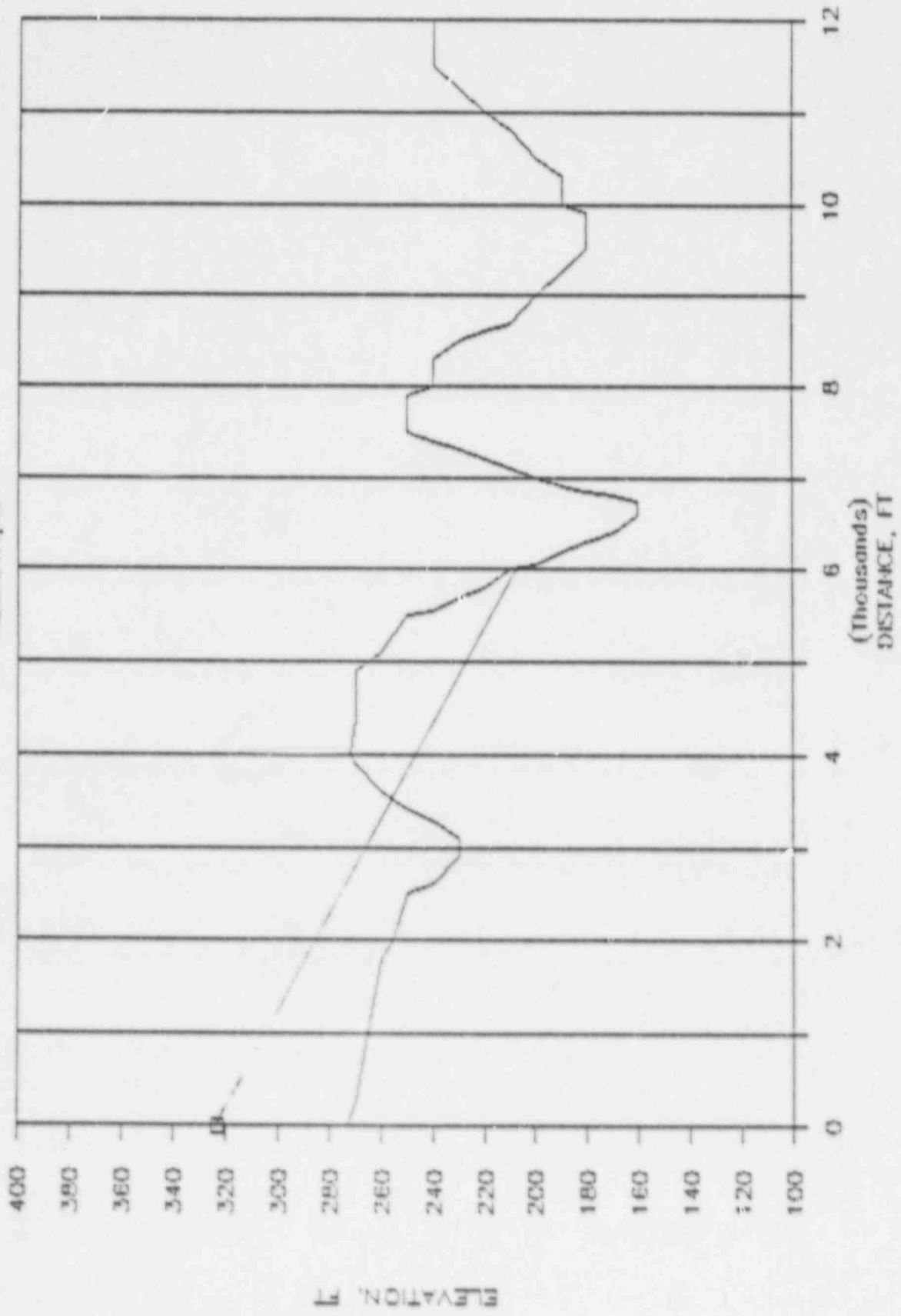
# VOGTLE B14

AZIMUTH, WNW



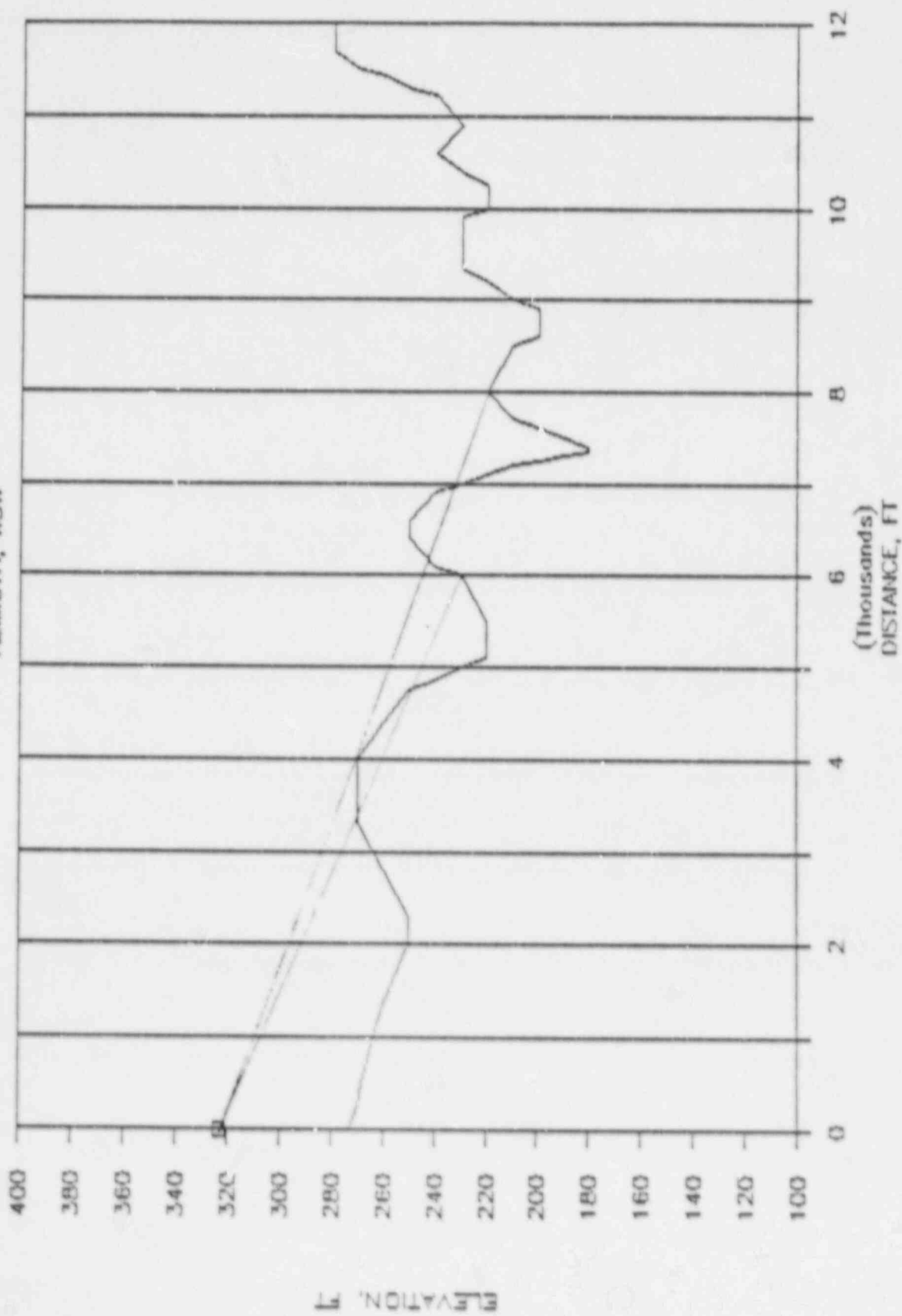
# VOGTLE B14

AZIMUTH, W



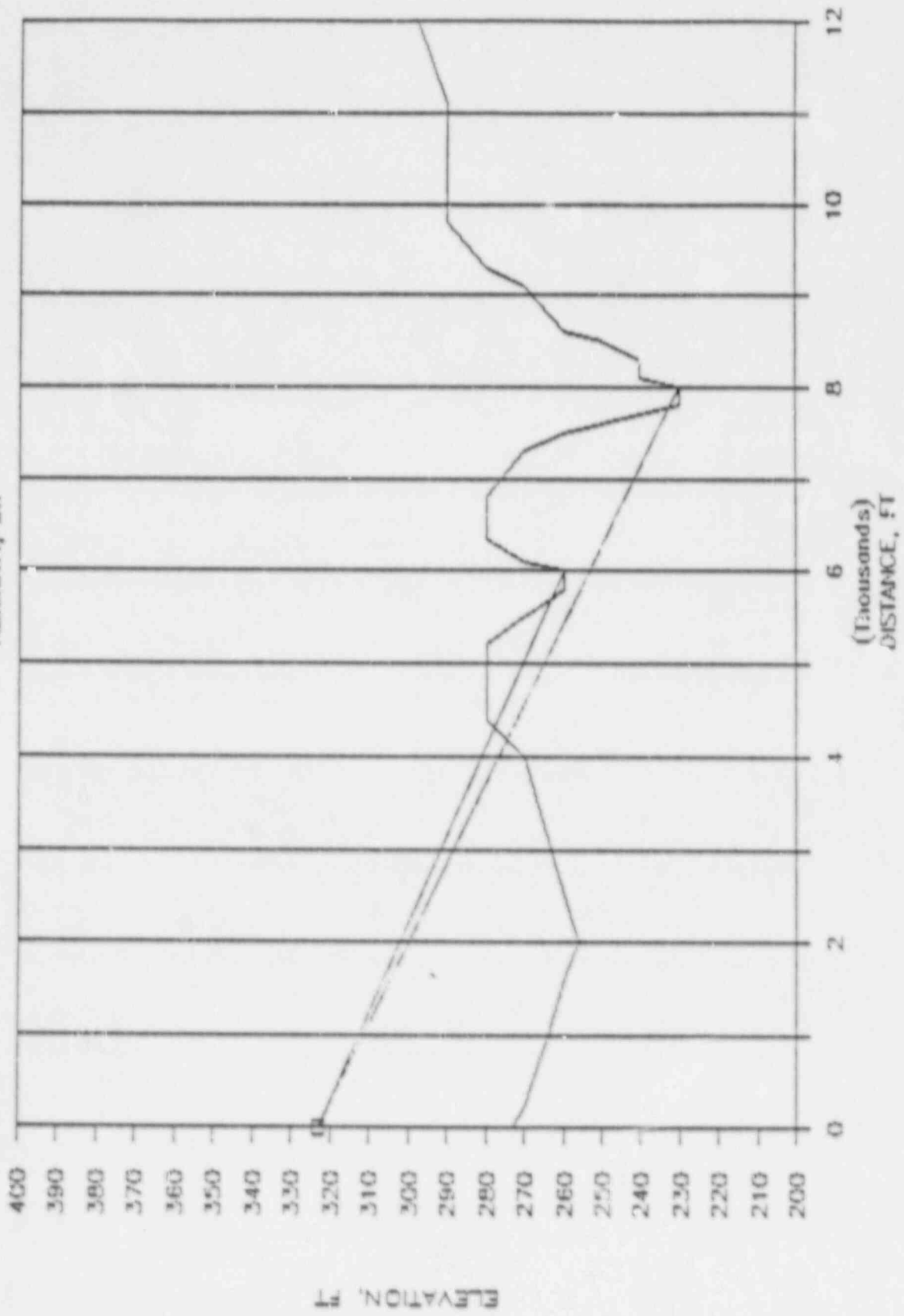
# VOGTLE B14

AZIMUTH, WSW



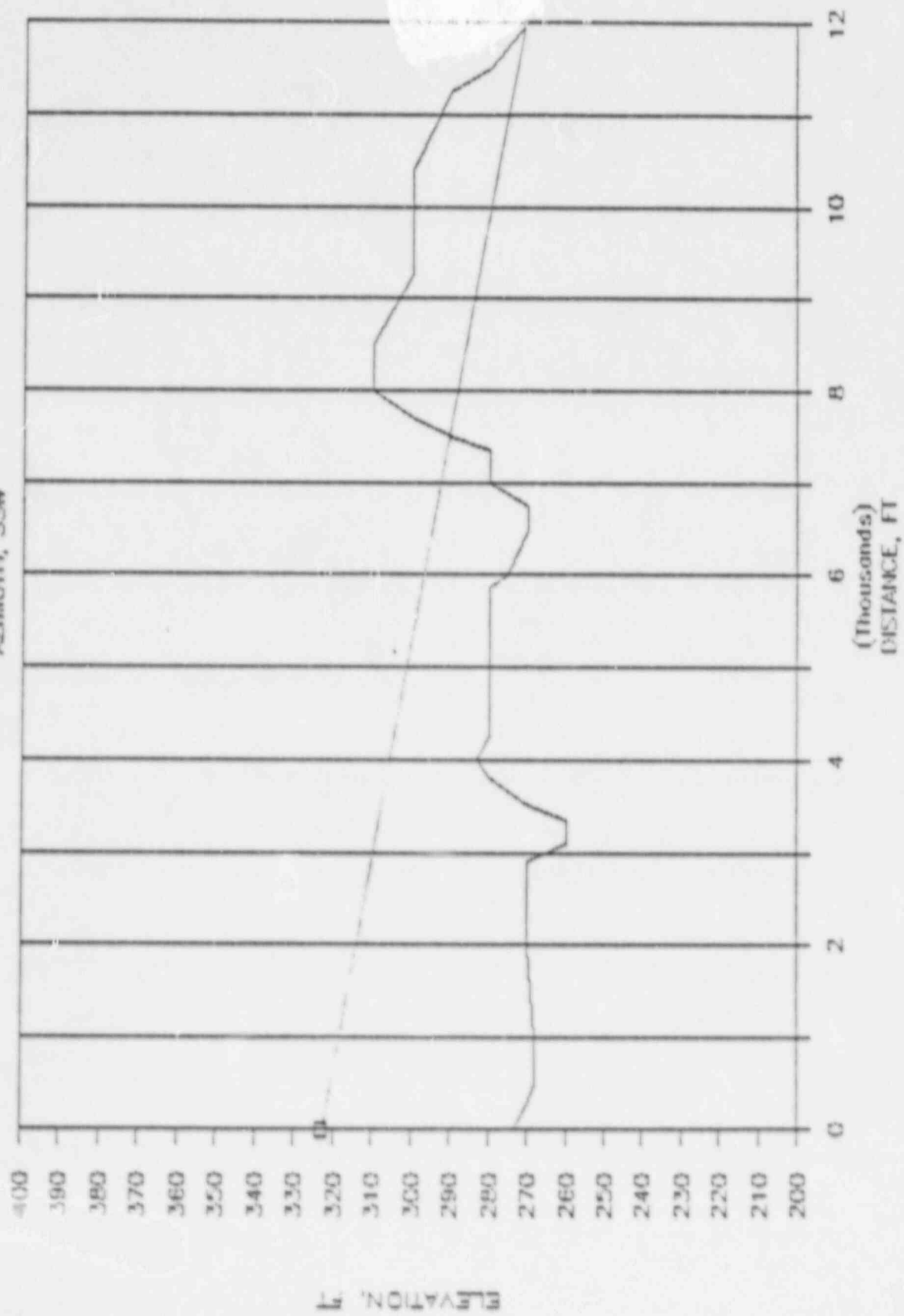
# VOGTLE B14

AZIMUTH, SW



# VOGTLE B14

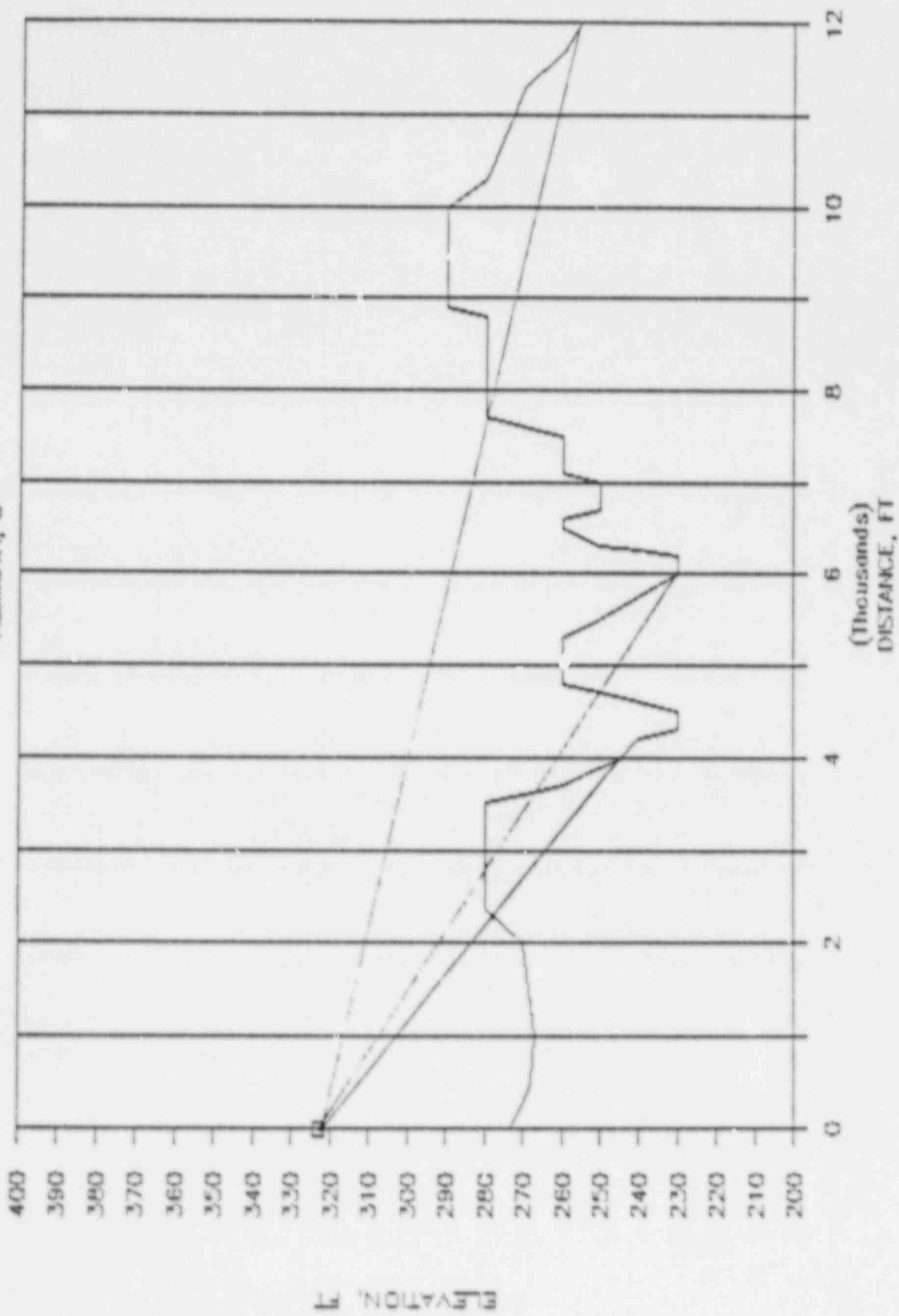
AZIMUTH, SSW





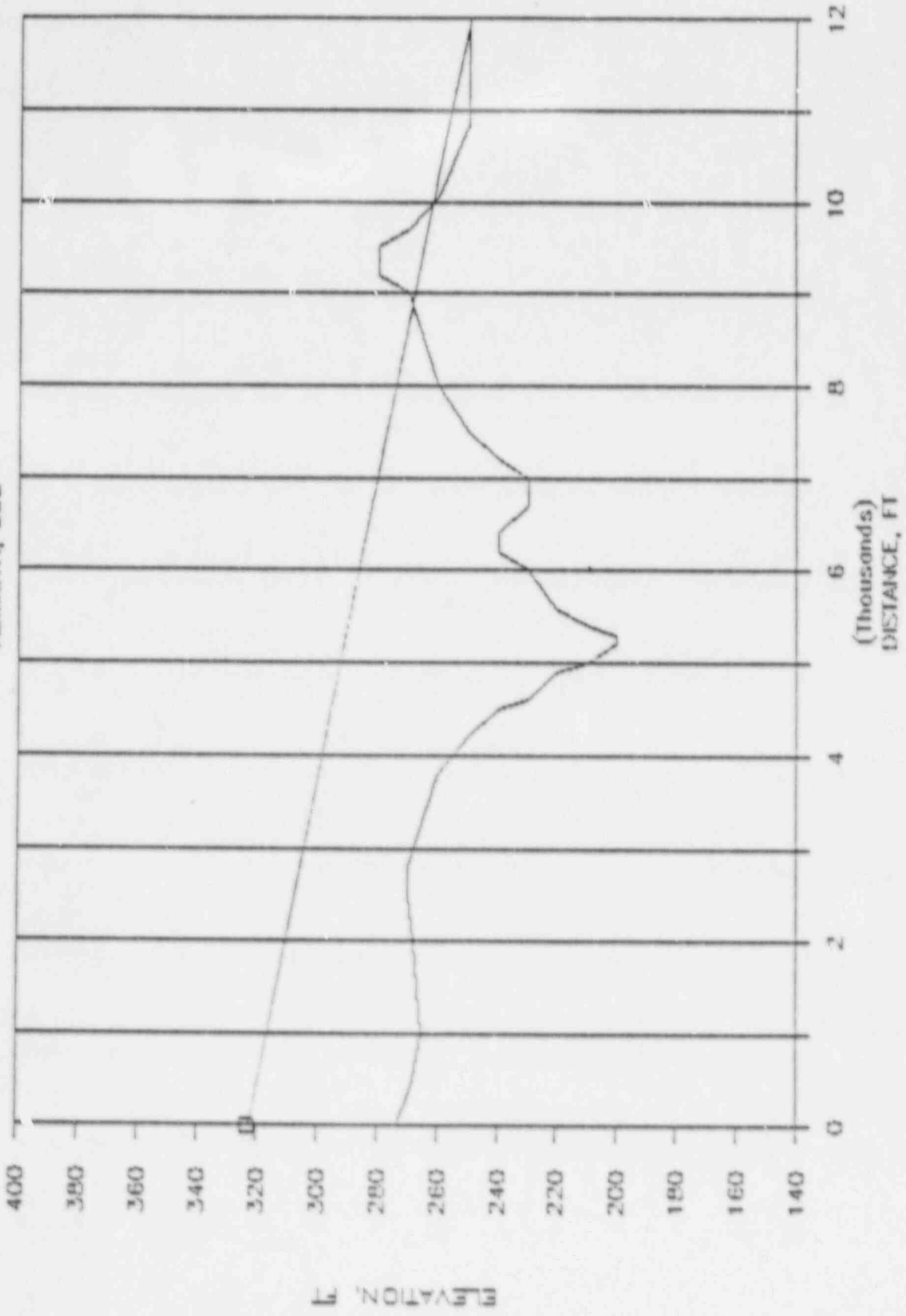
# VOGTLE B14

AZIMUTH, S



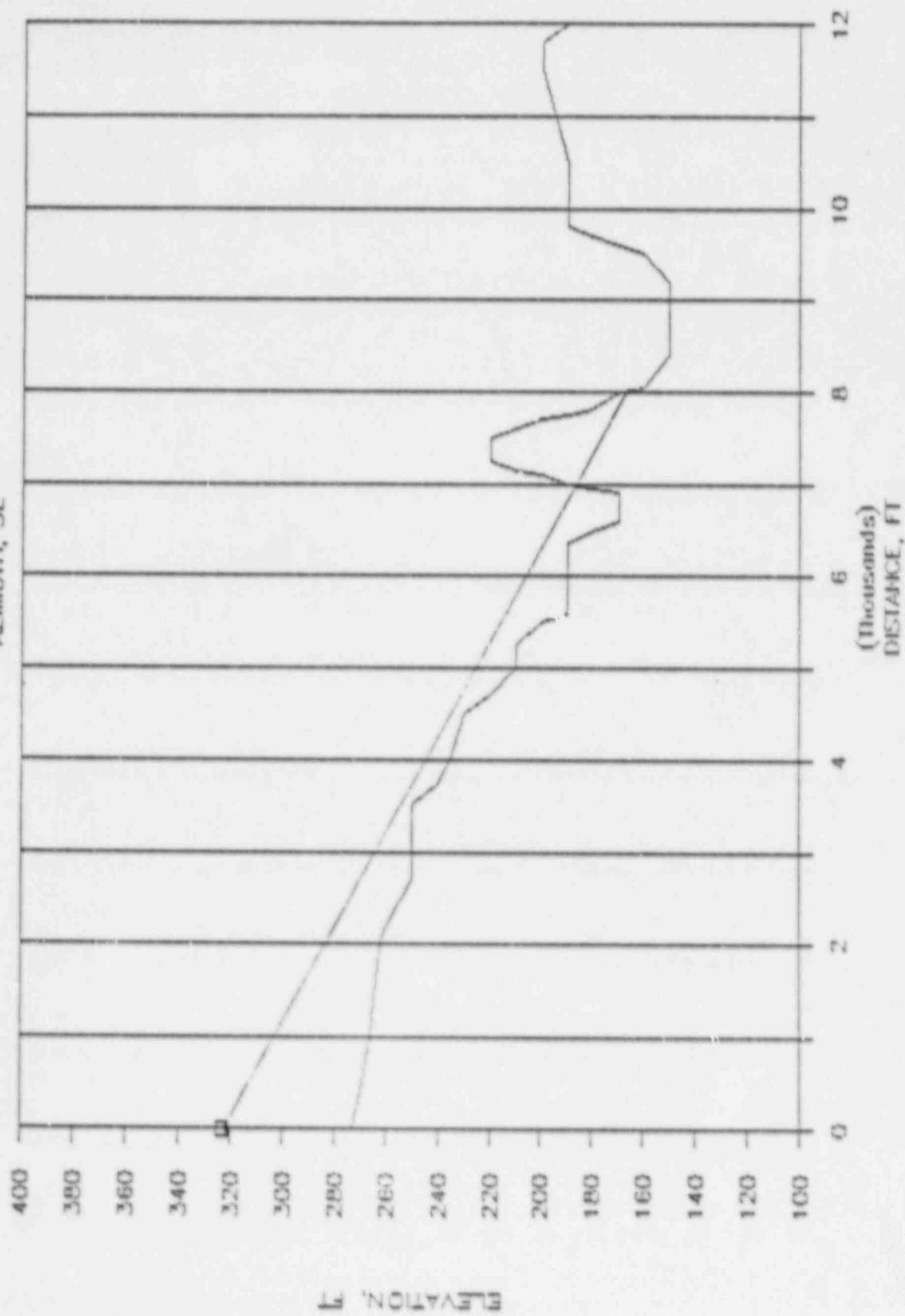
# VOGTLE B14

AZIMUTH, SSE



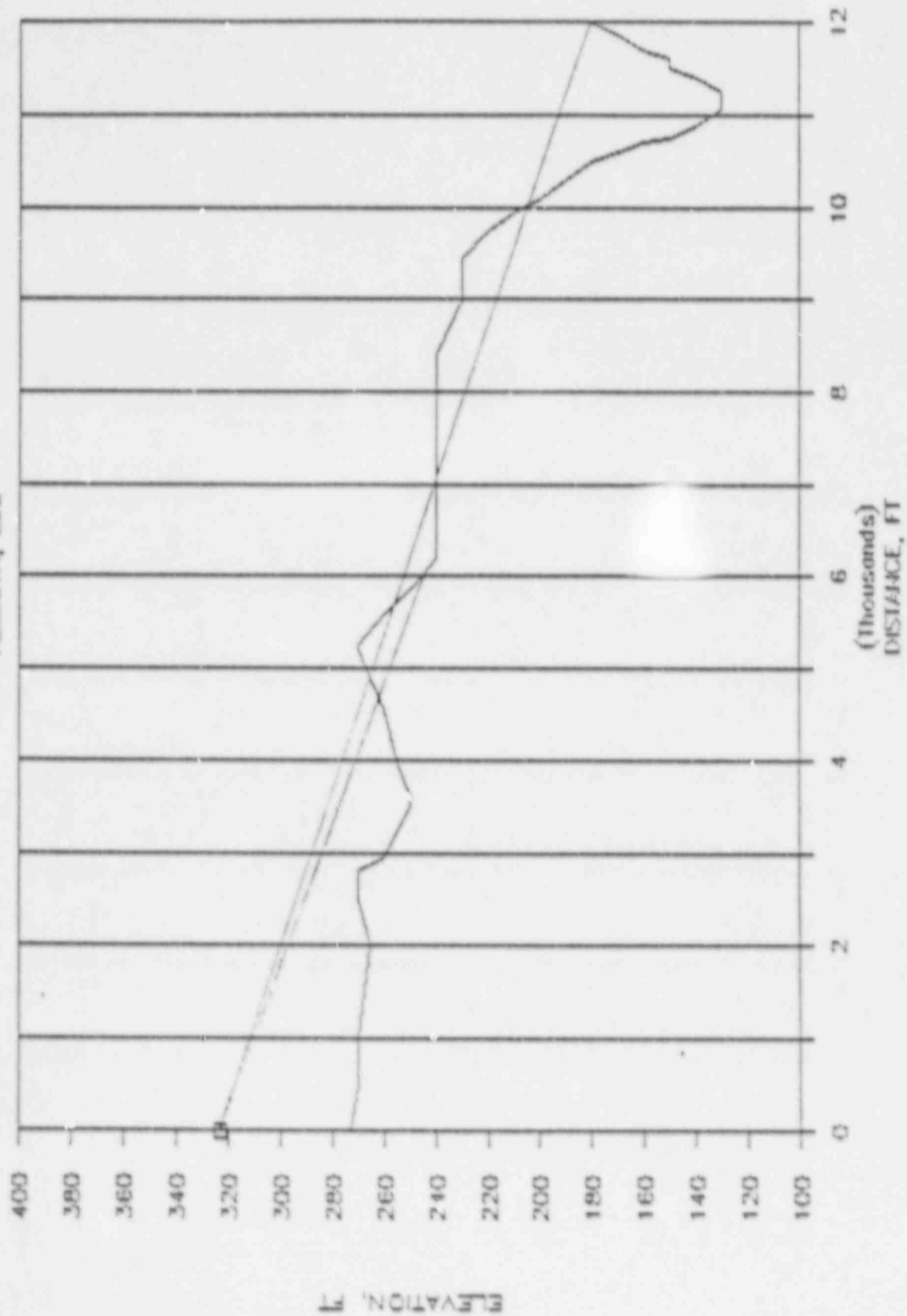
# VOGTLE B14

AZIMUTH, SE



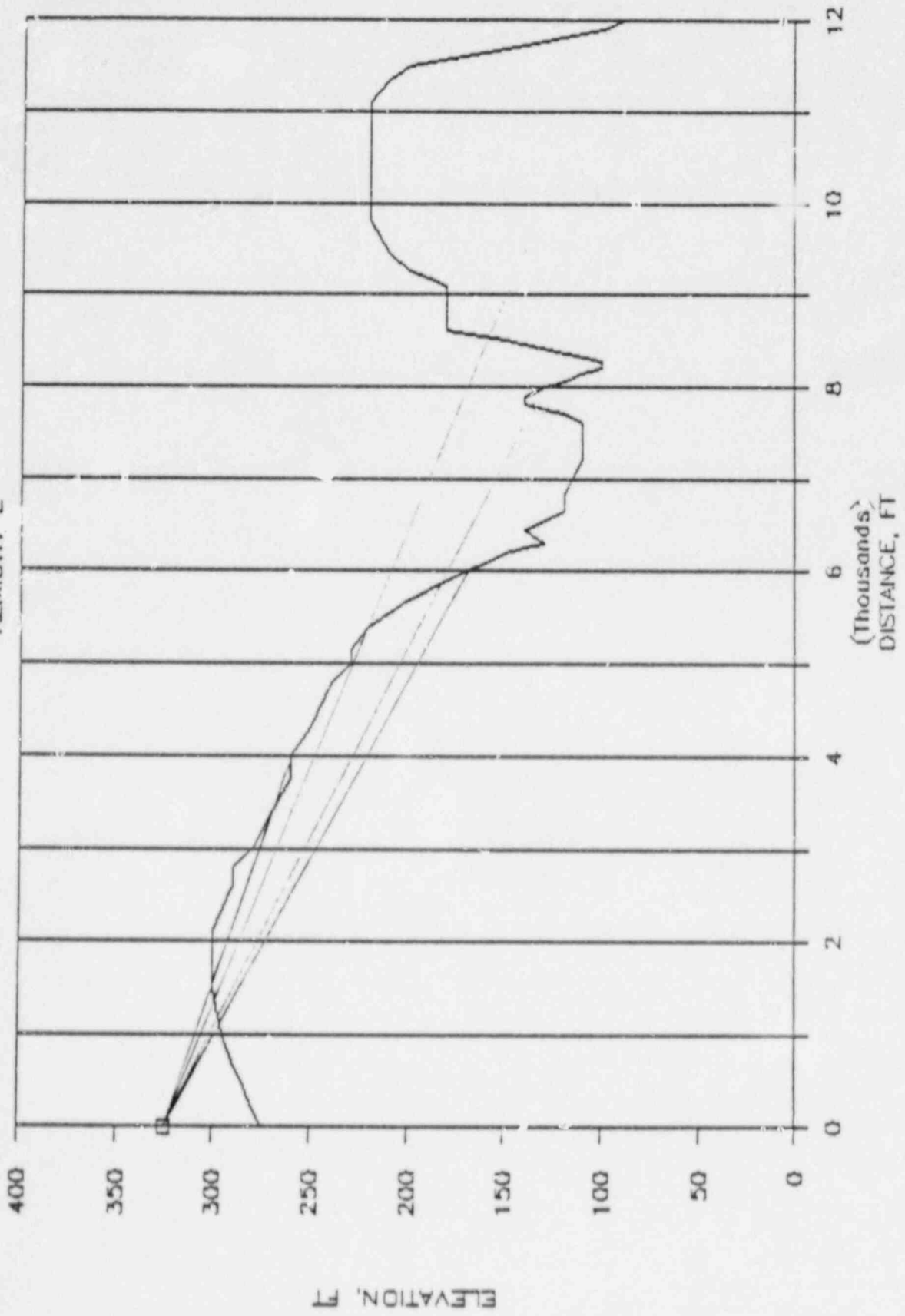
# VOGTLE B14

AZIMUTH, ESE



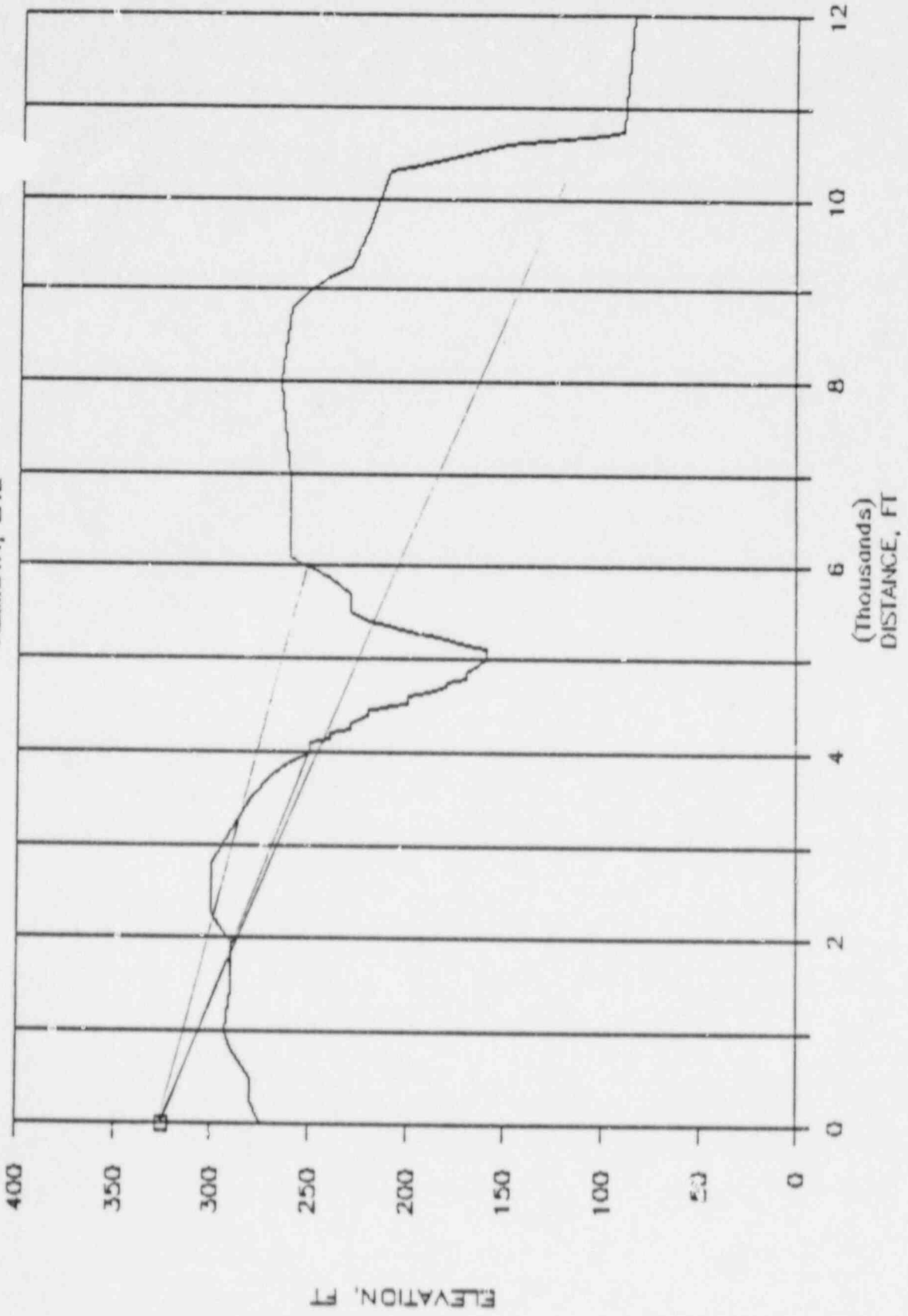
# VOCTLE B13

AZIMUTH E



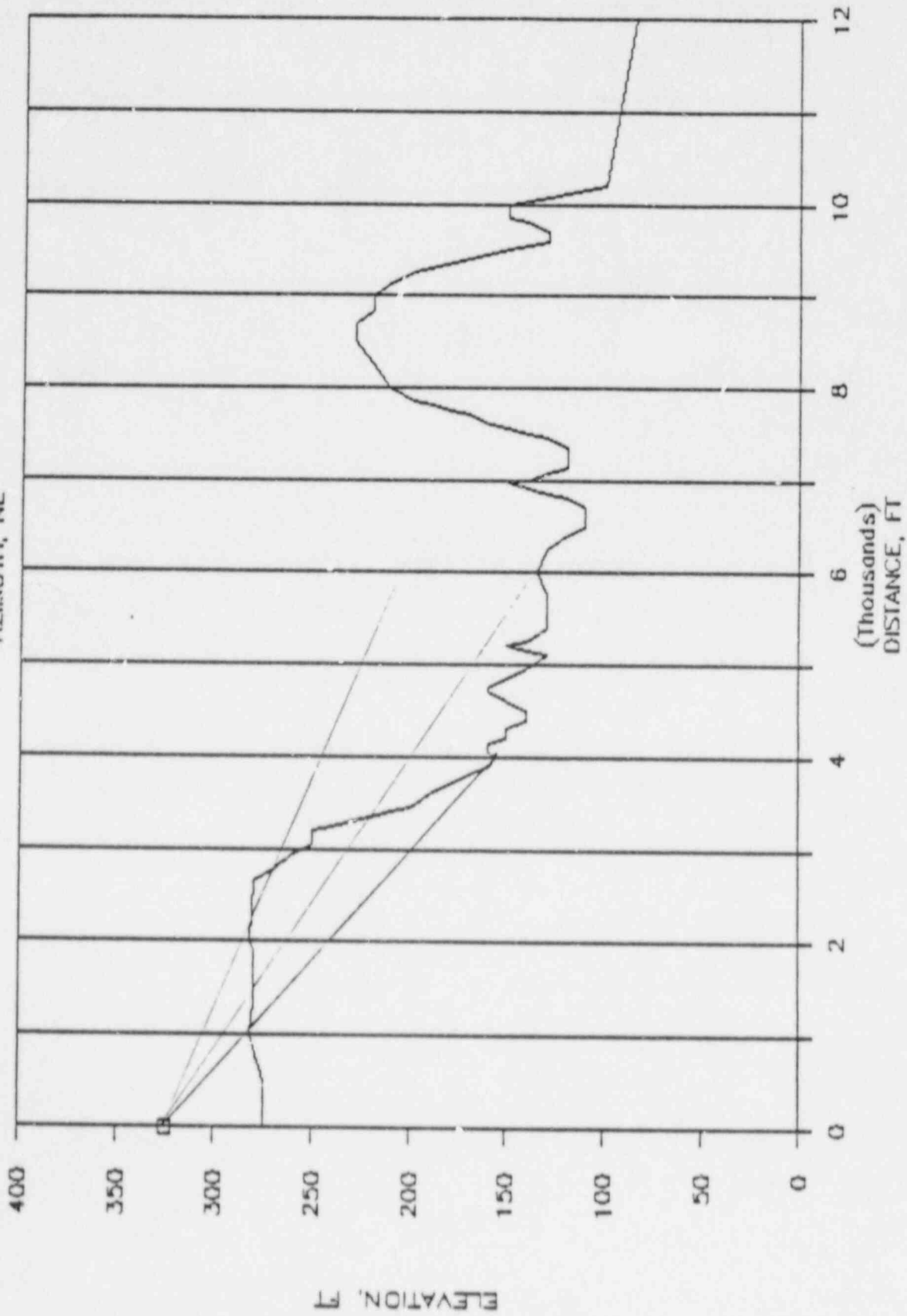
# VOGTLE B13

AZIMUTH, ENE



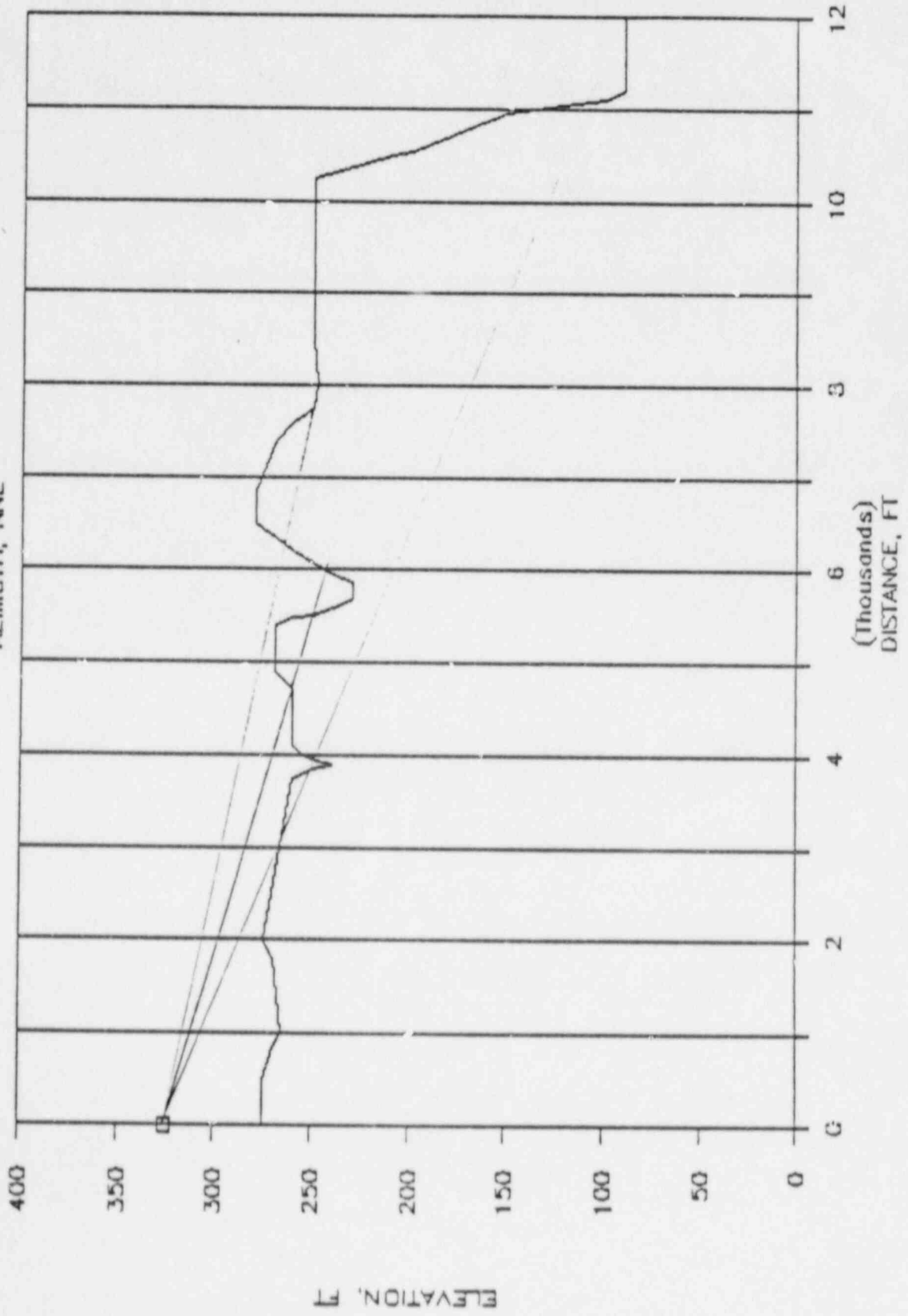
# VOGTLE B13

AZIMUTH, NE



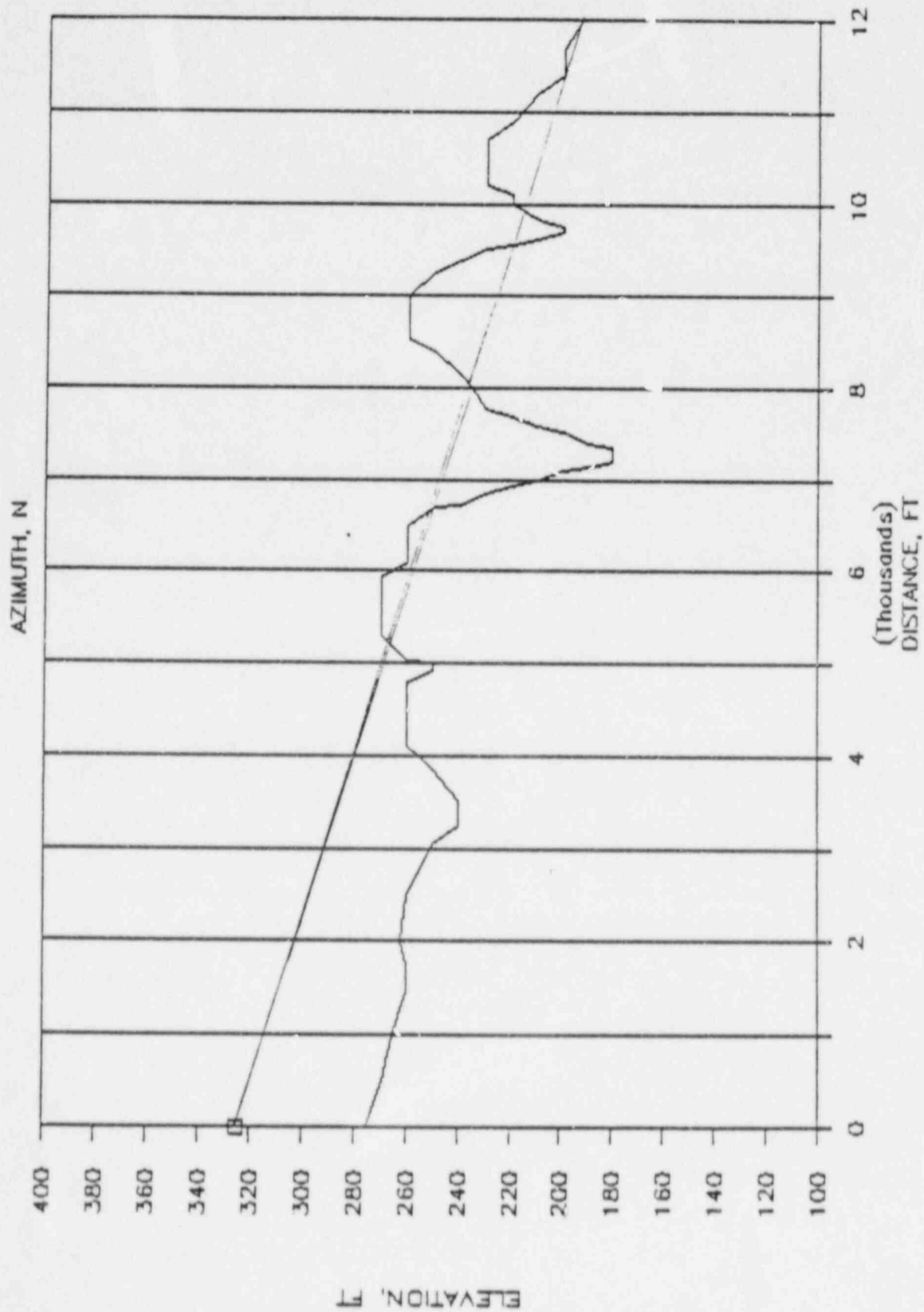
# VOGTLE B13

AZIMUTH, NNE



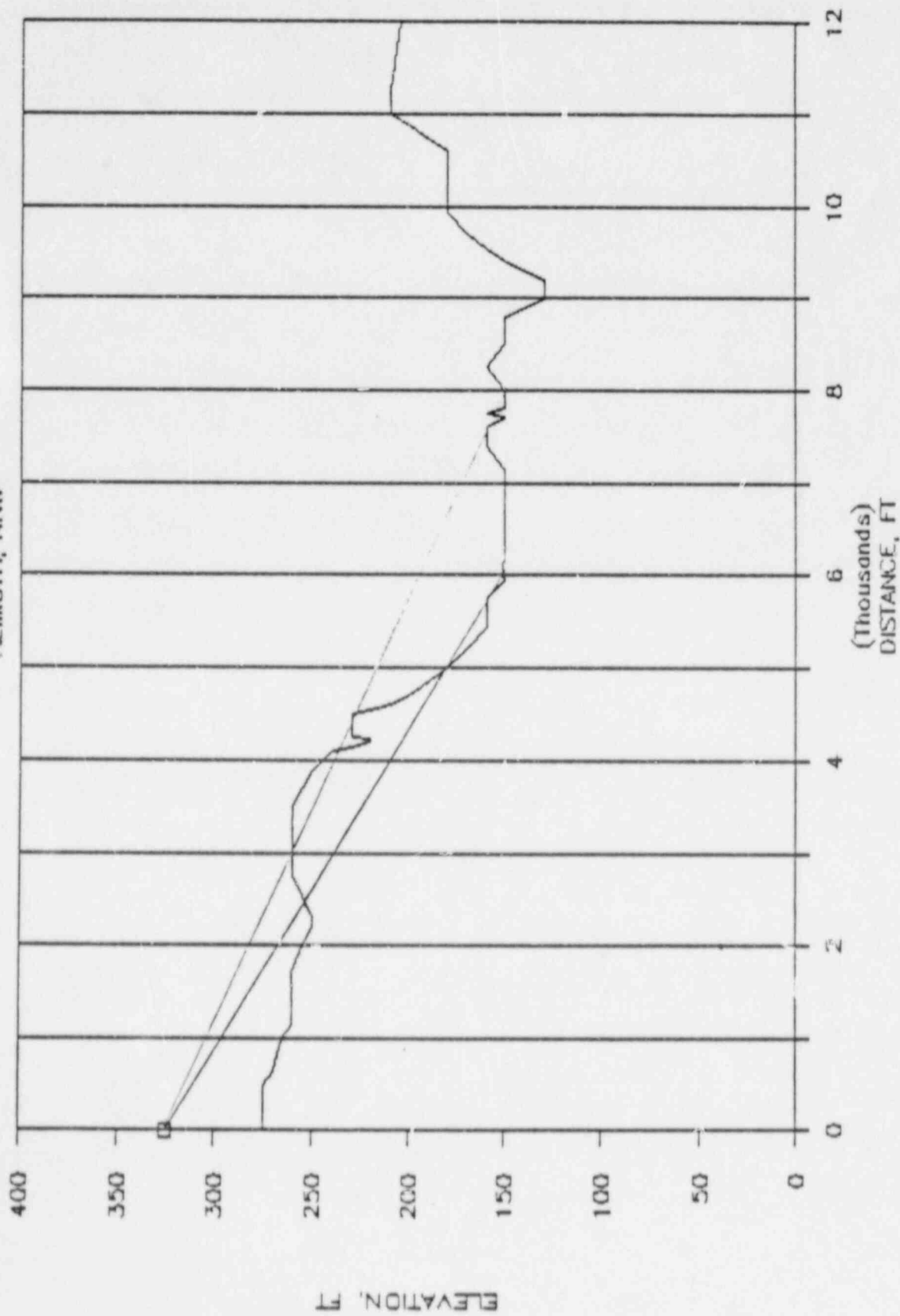


# VOGTLE B13



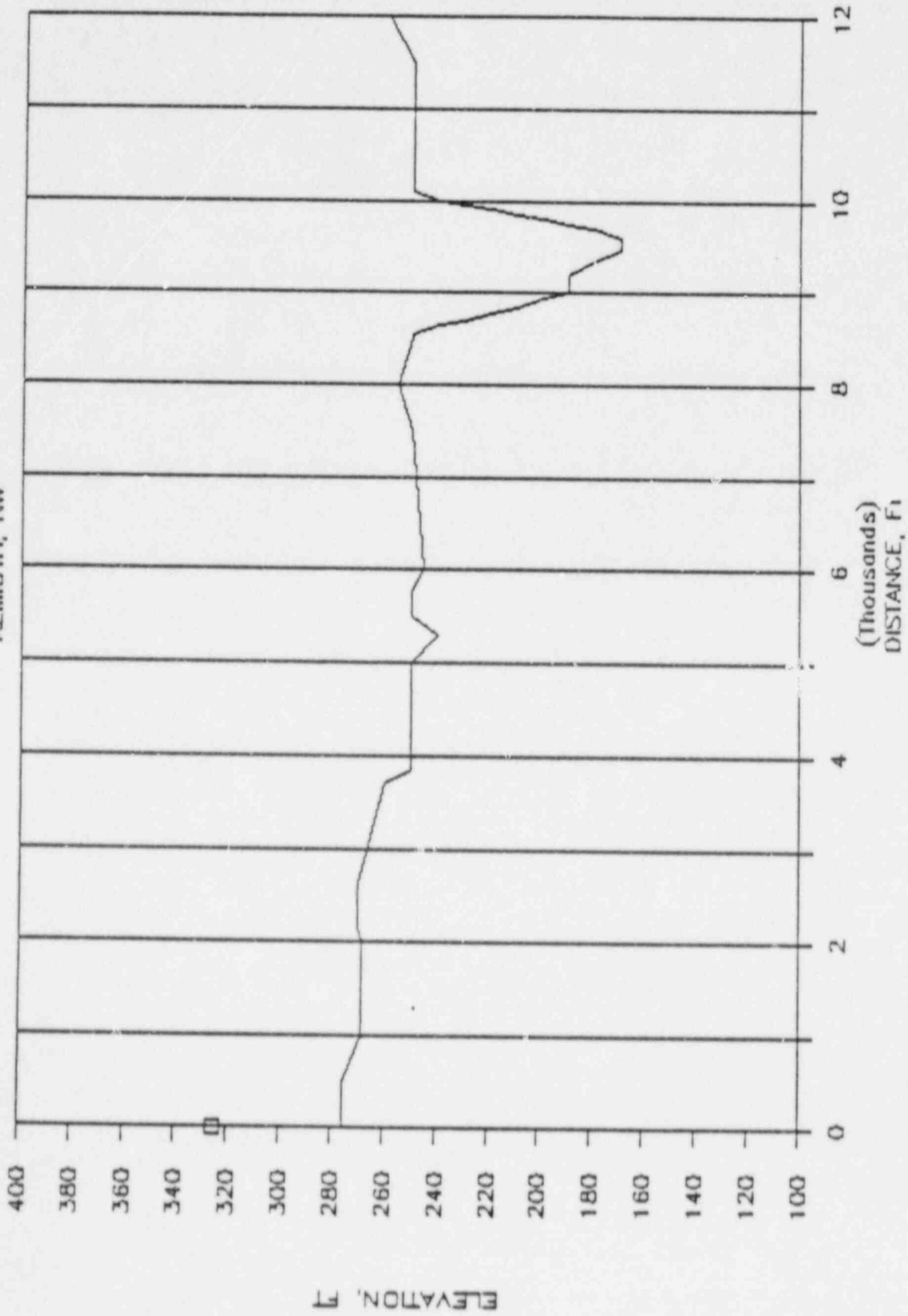
# VOGTLE B13

AZIMUTH, NNW



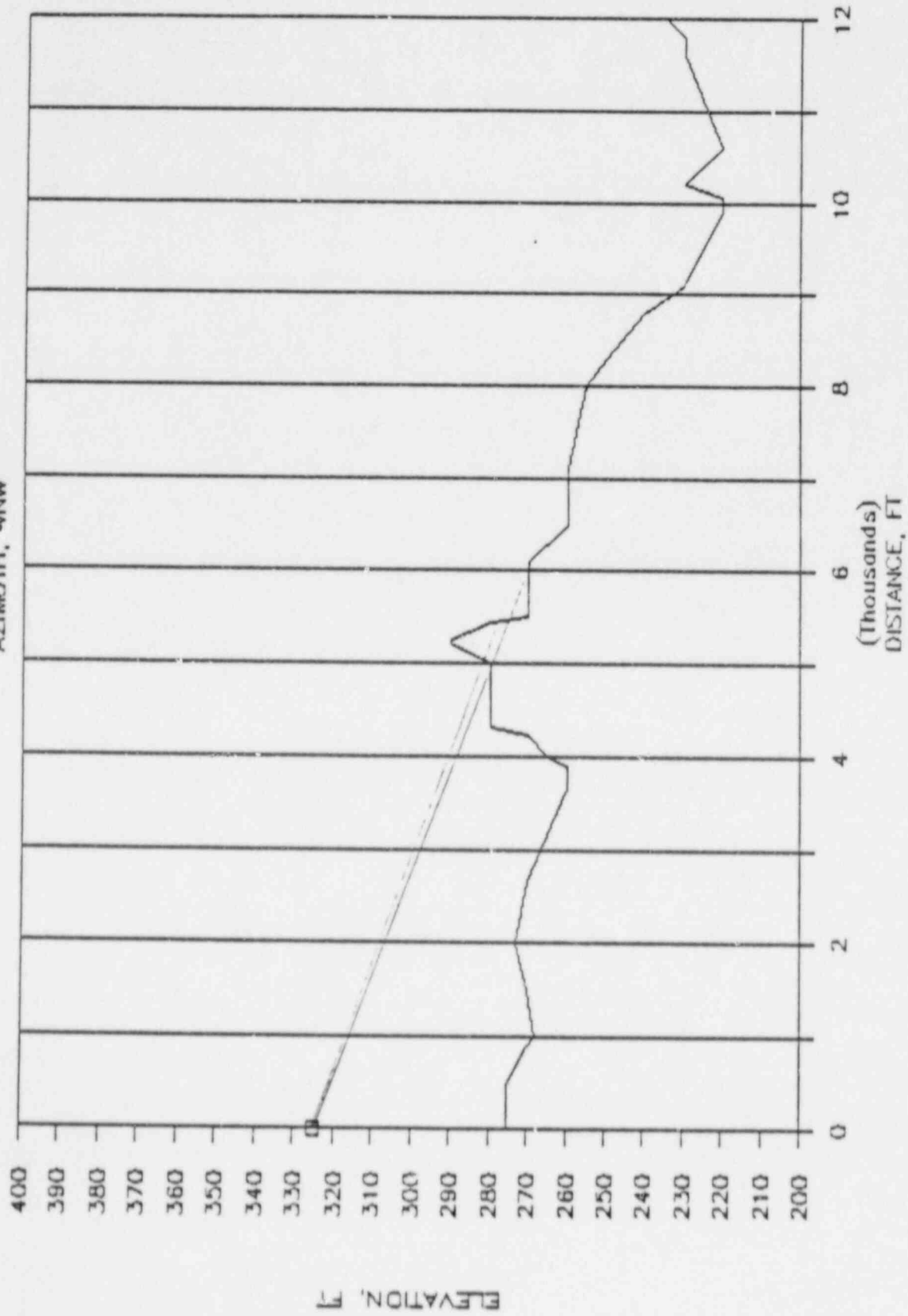
# VOGTLE B13

AZIMUTH, NW



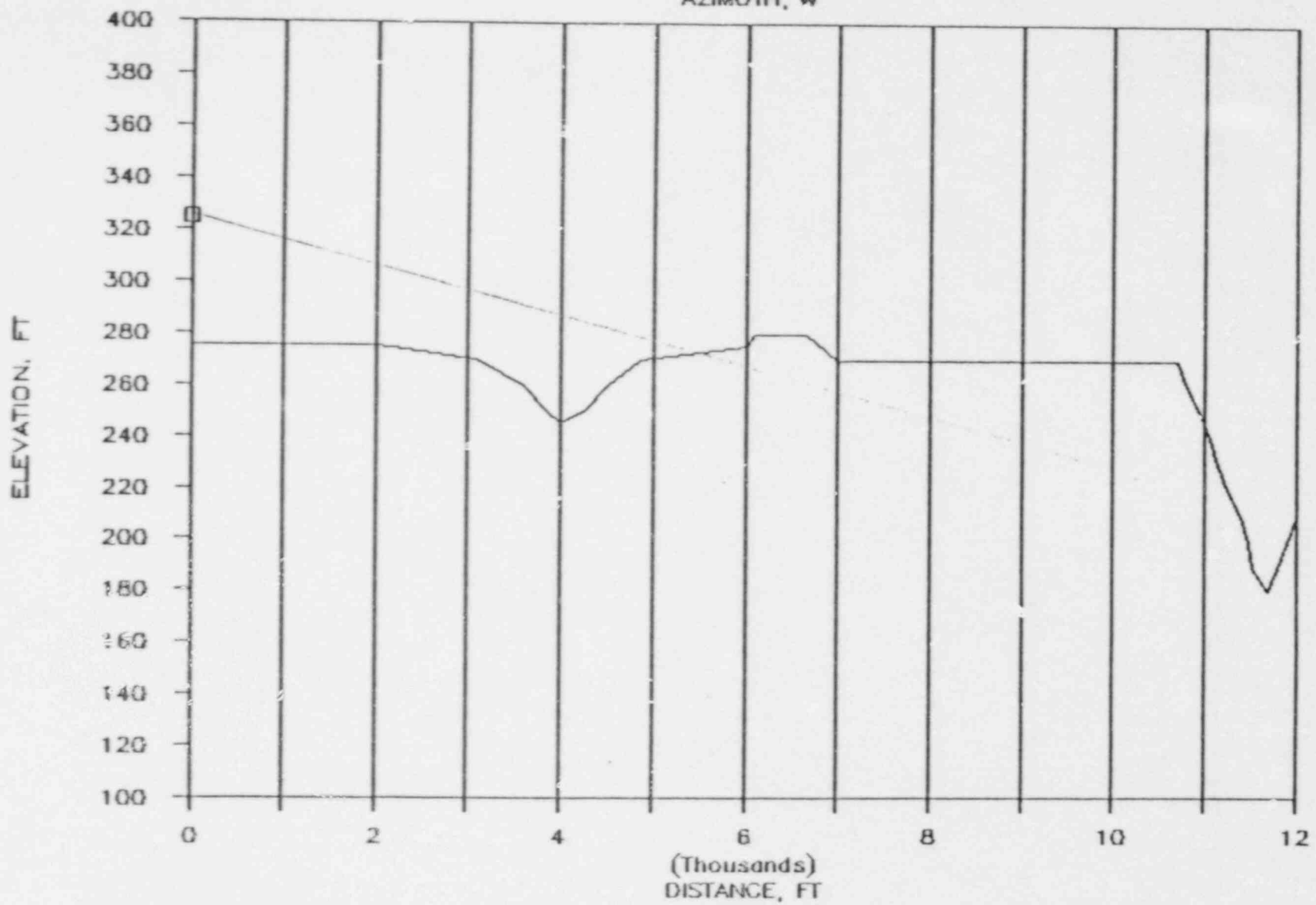
# VOCTLE B13

AZIMUTH, WNW

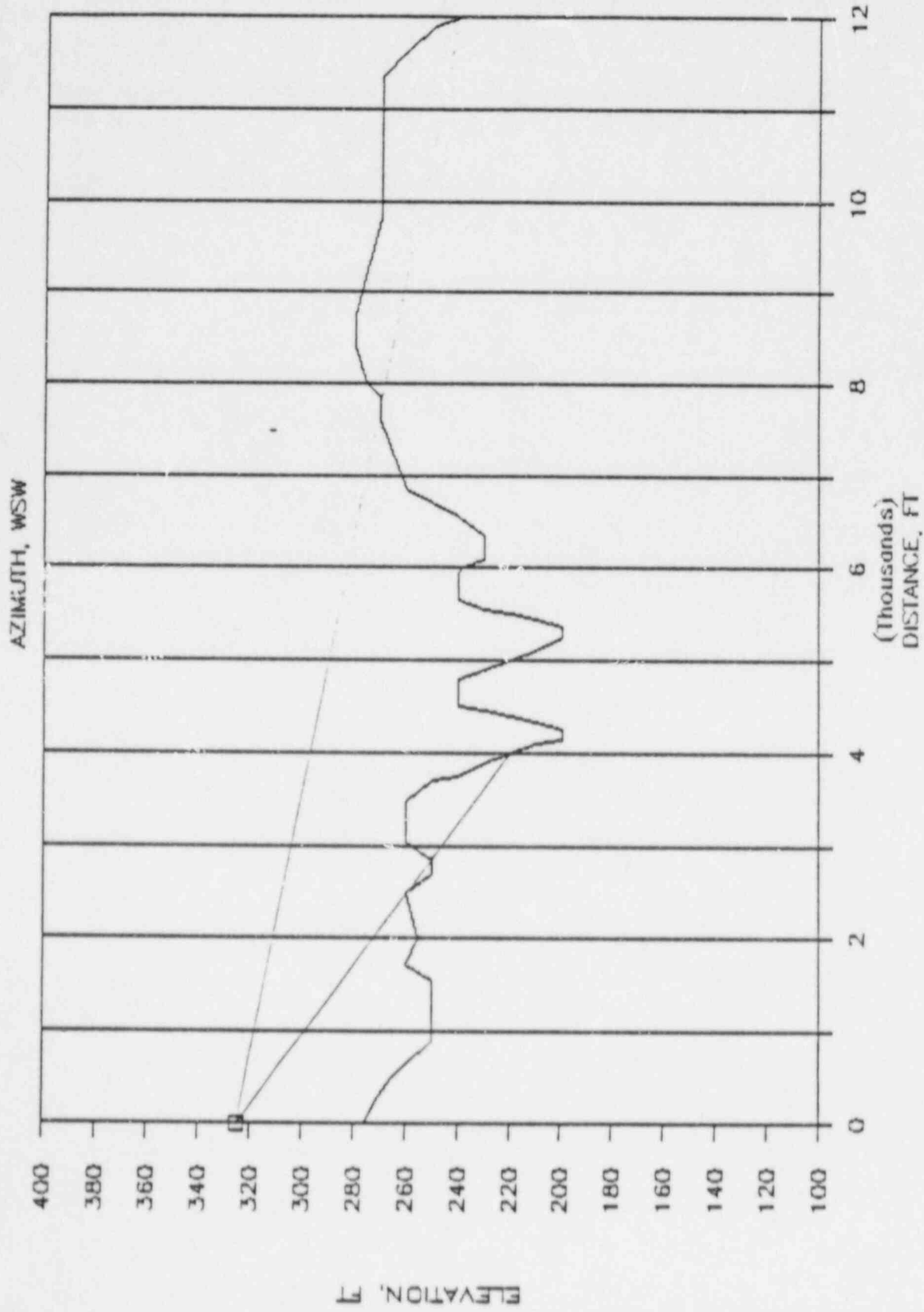


# VOGTLE B13

AZIMUTH, W

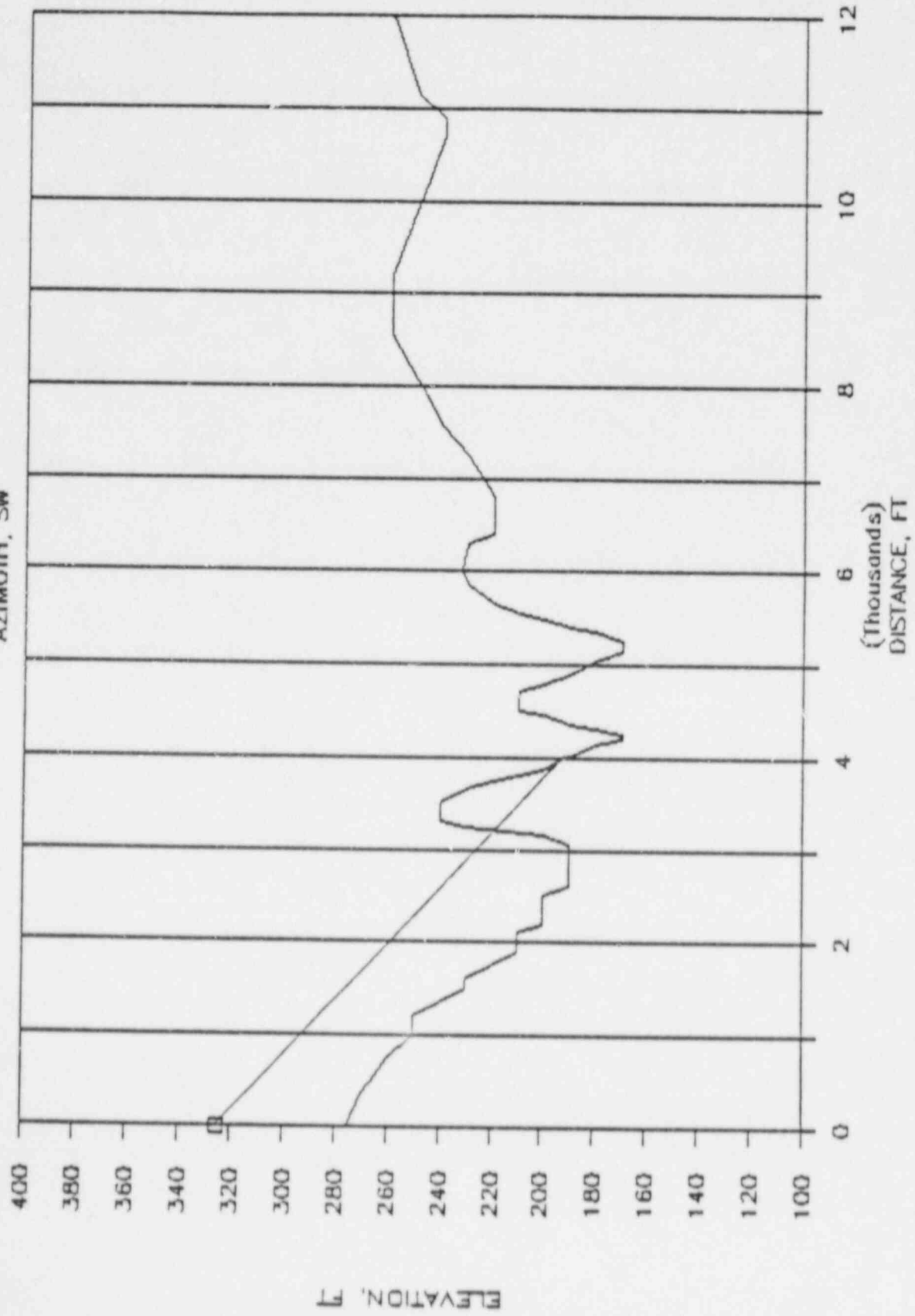


# VOGTLE B13



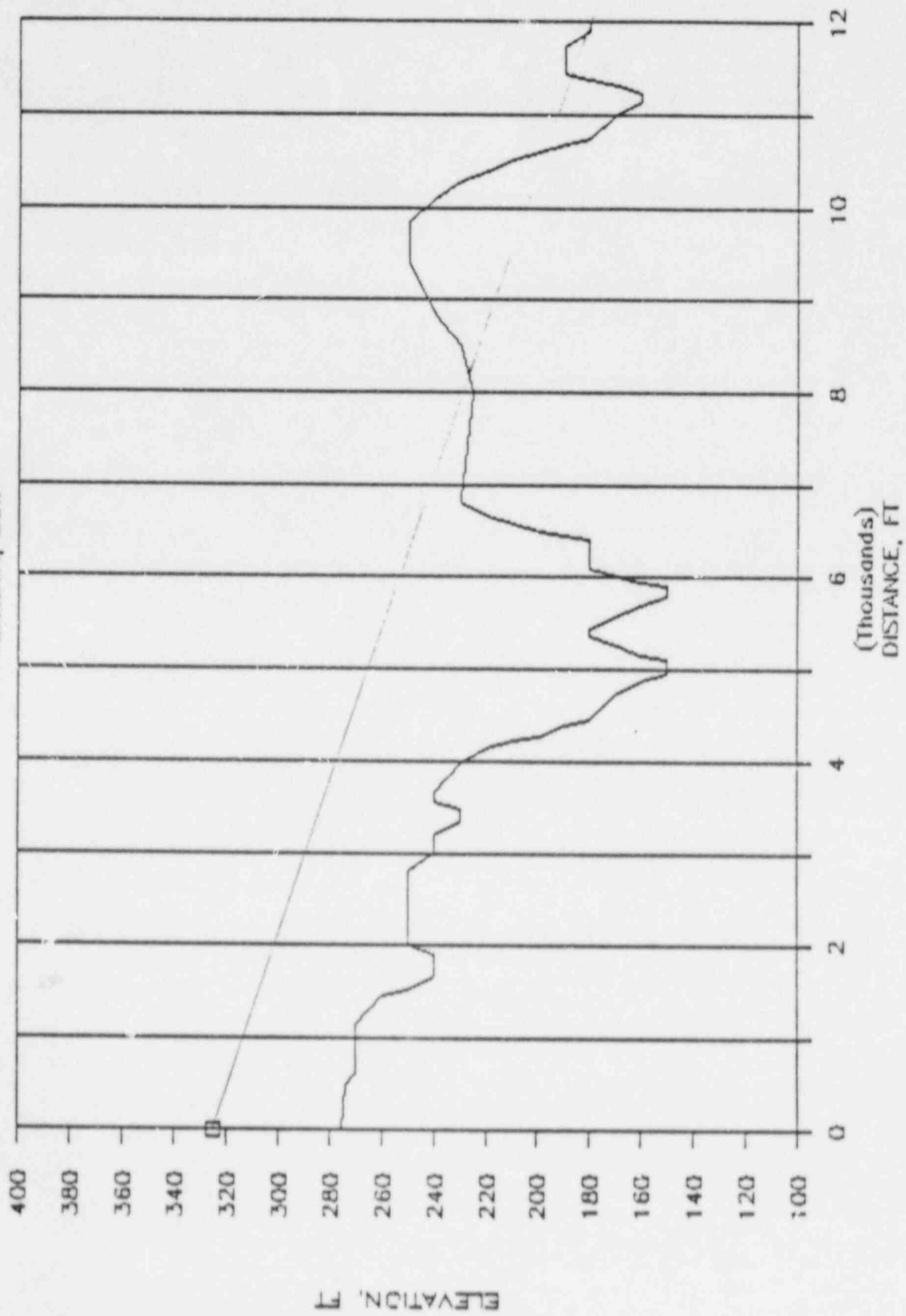
# VOGILE B13

AZIMUTH, SW



# VOCTLE B13

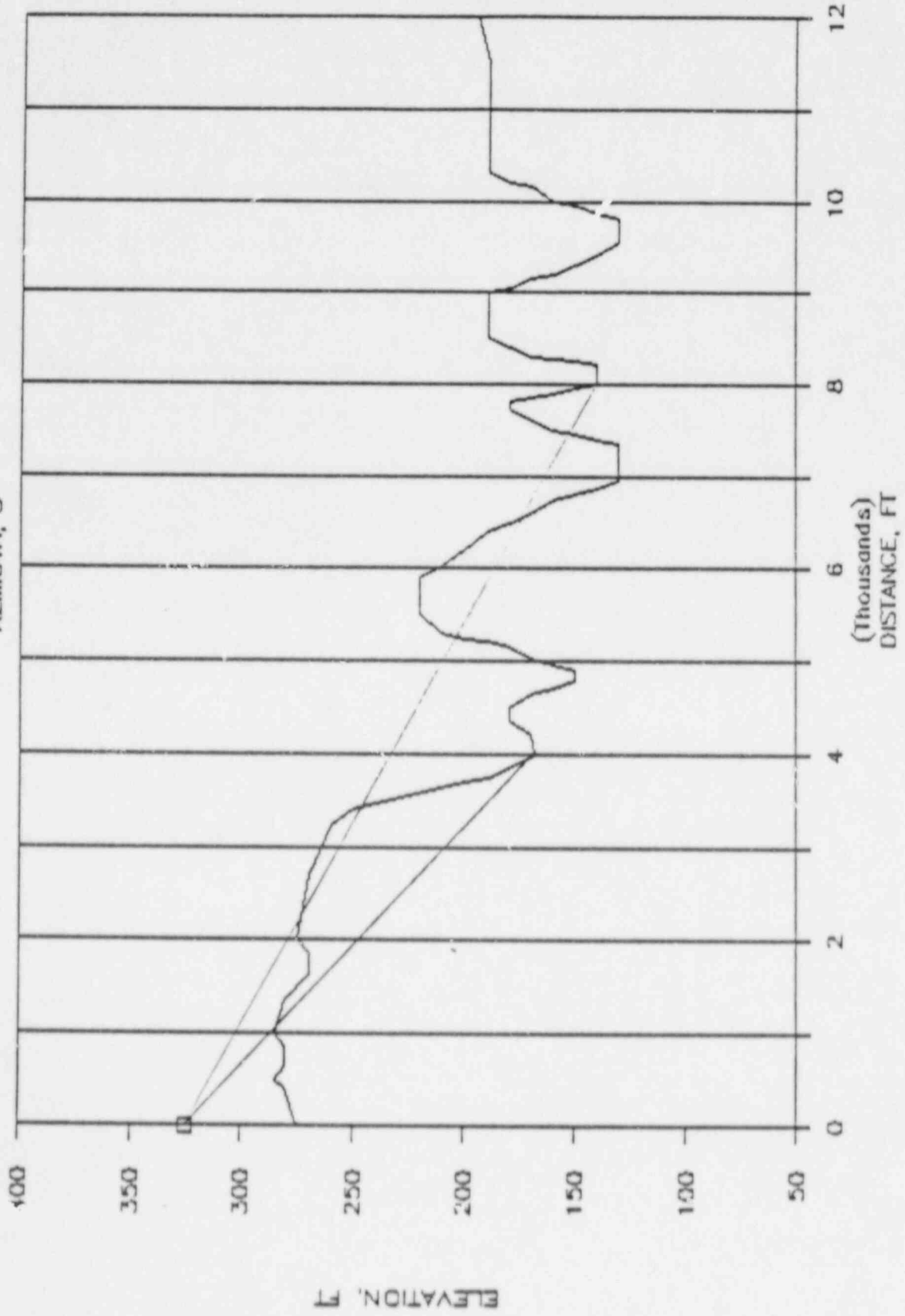
AZIMUTH, SSW





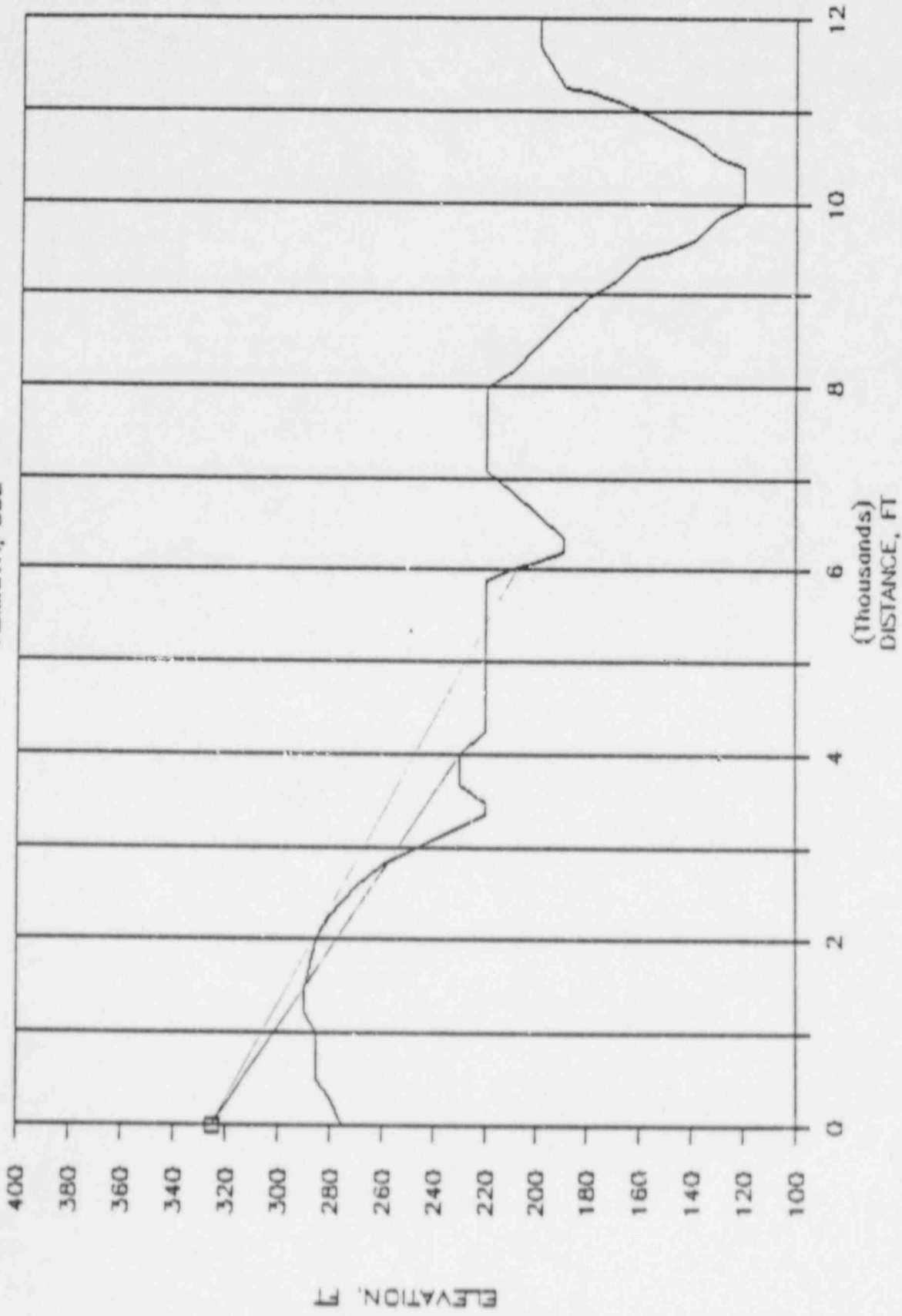
# VOGTLE B13

AZIMUTH, S



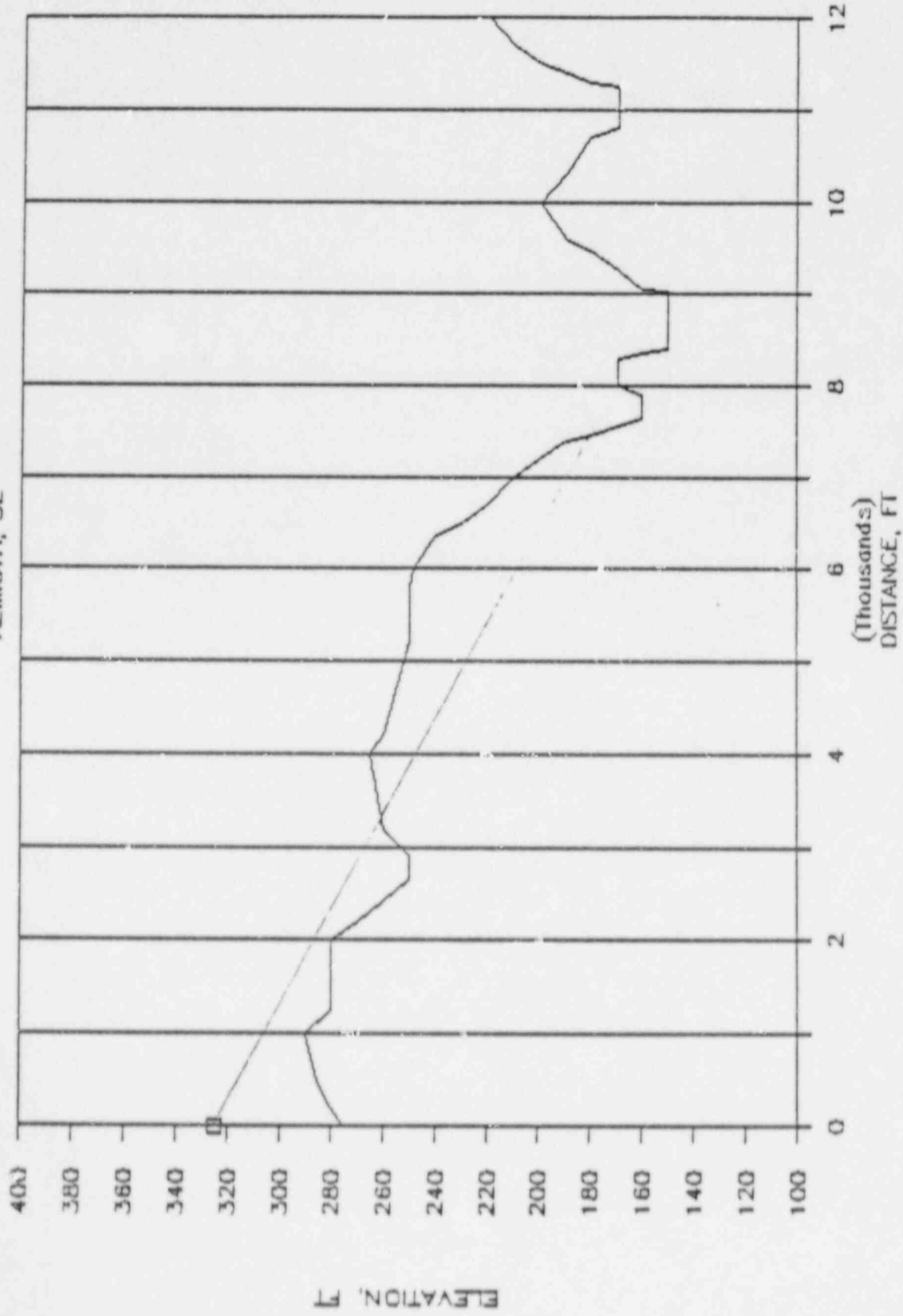
# VOCTLE B13

AZIMUTH, SSE

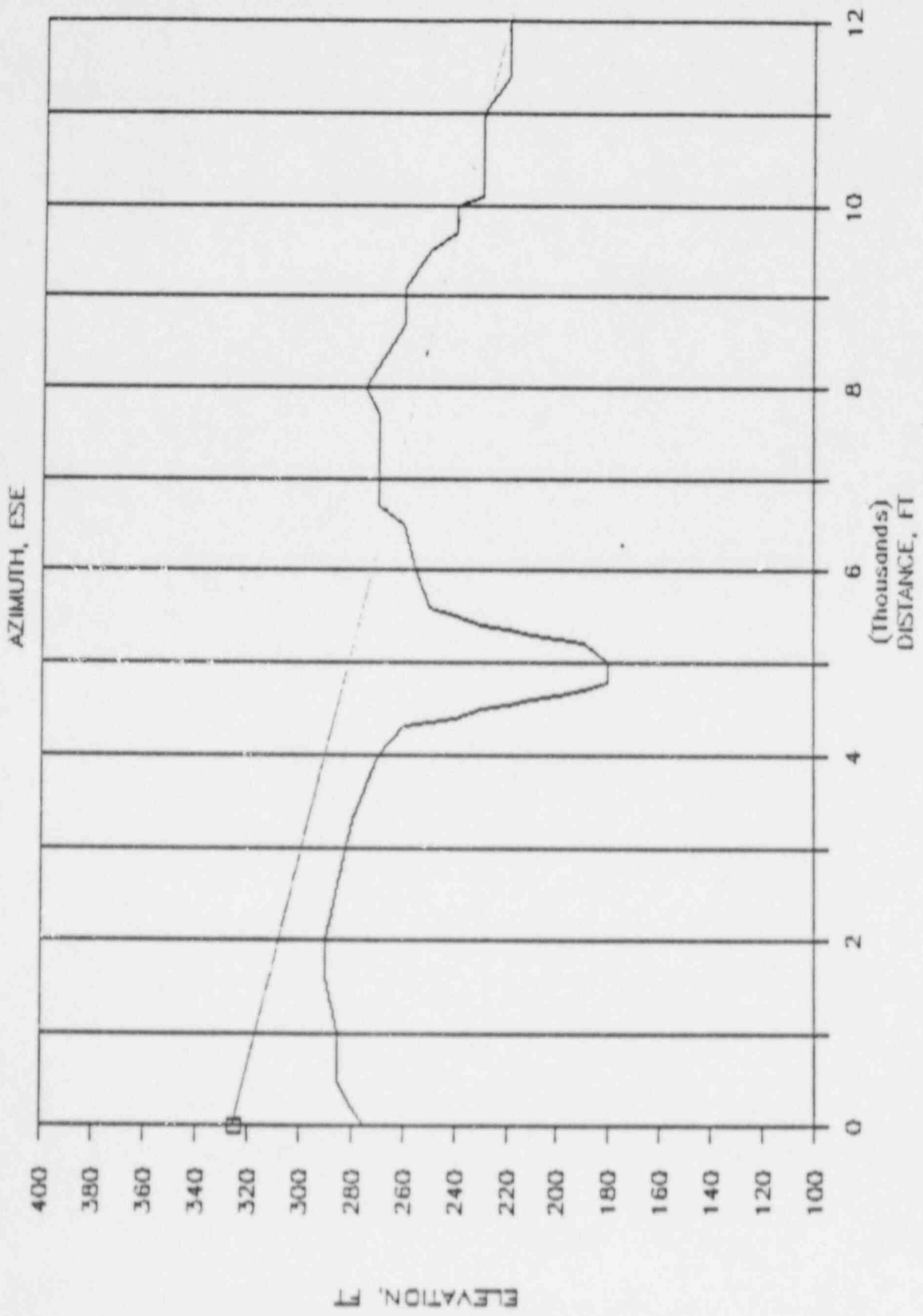


# VOGTLE B13

AZIMUTH, SE

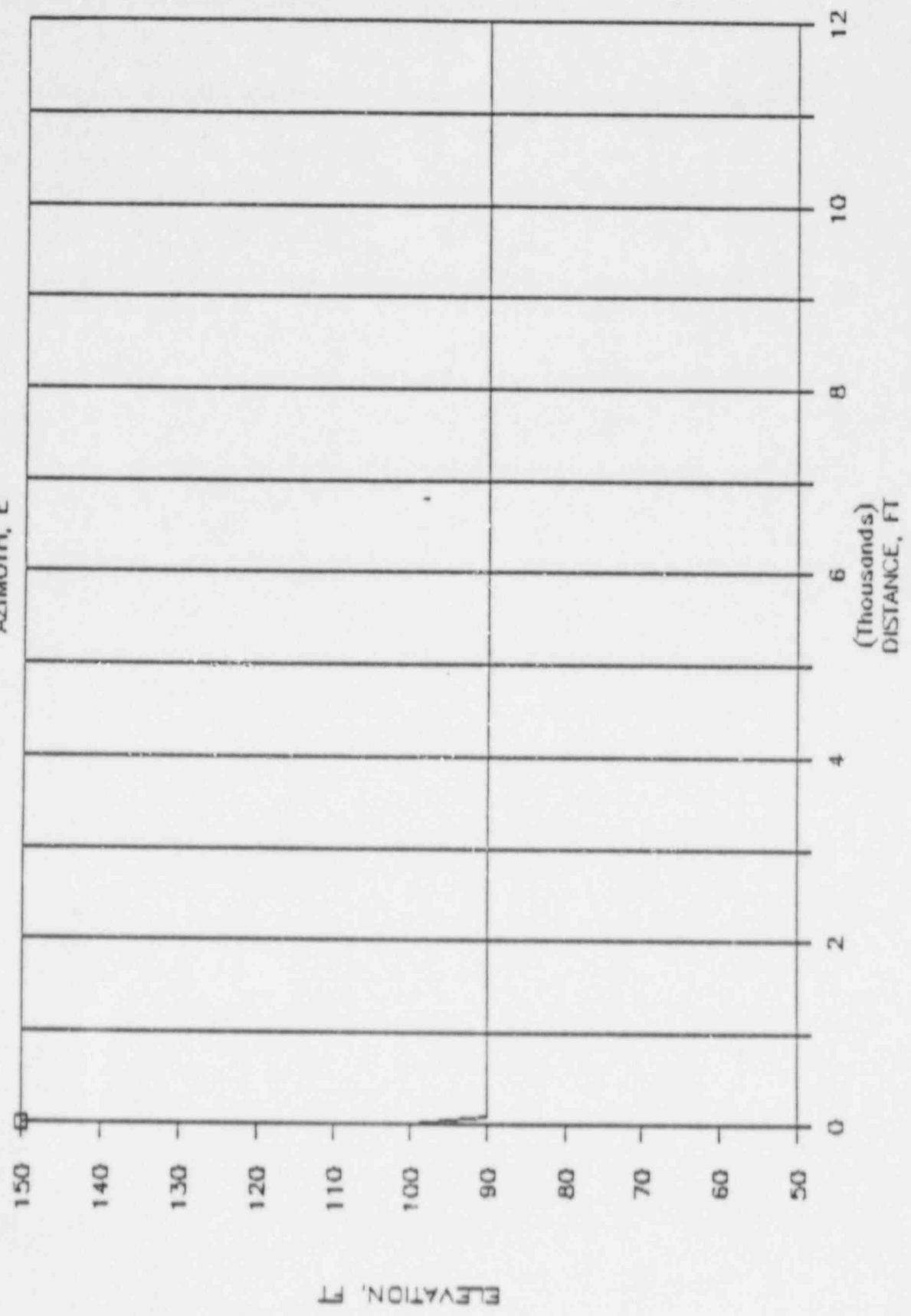


# VOGTLE B13



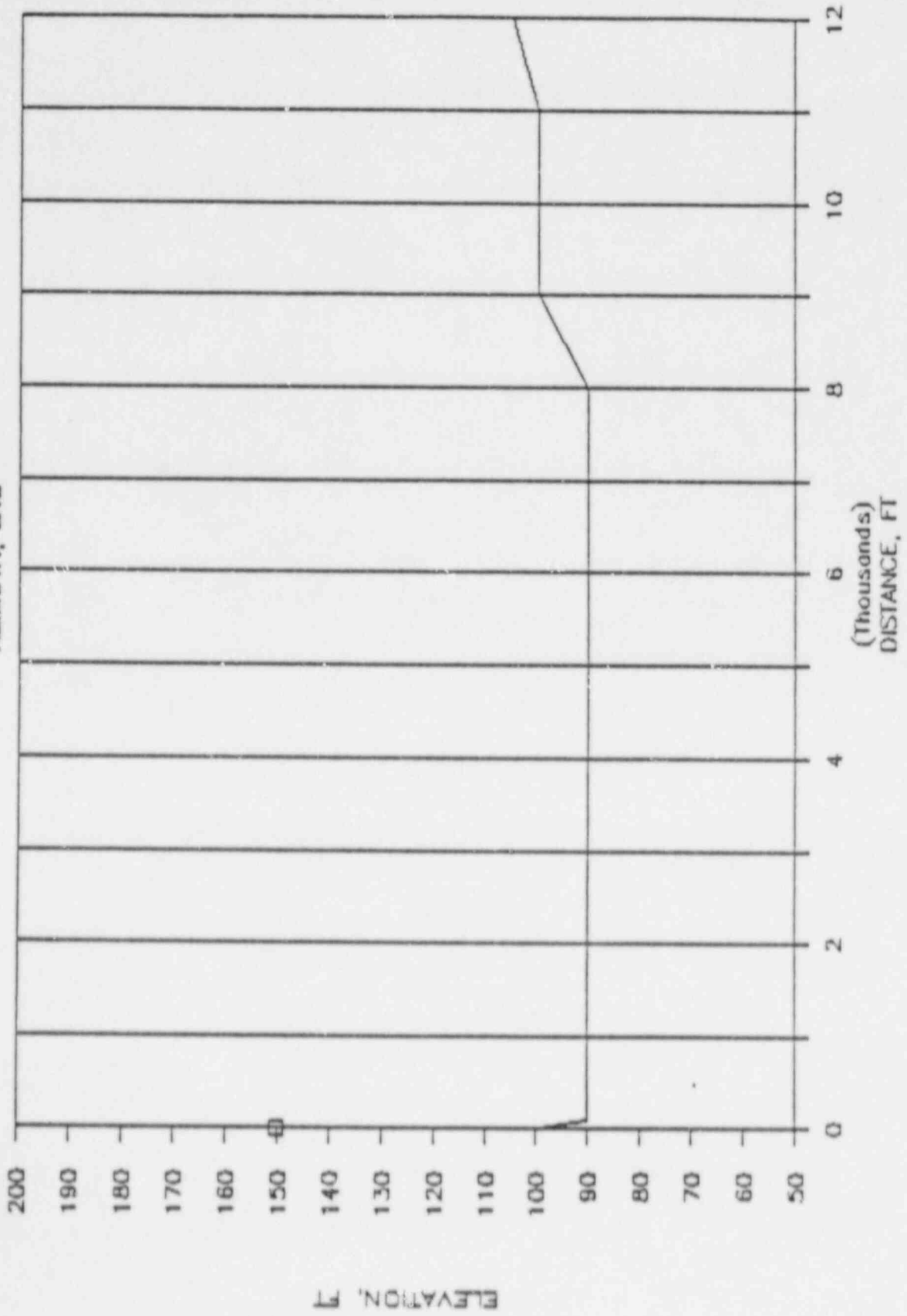
# VOGTLE B12

AZIMUTH, E



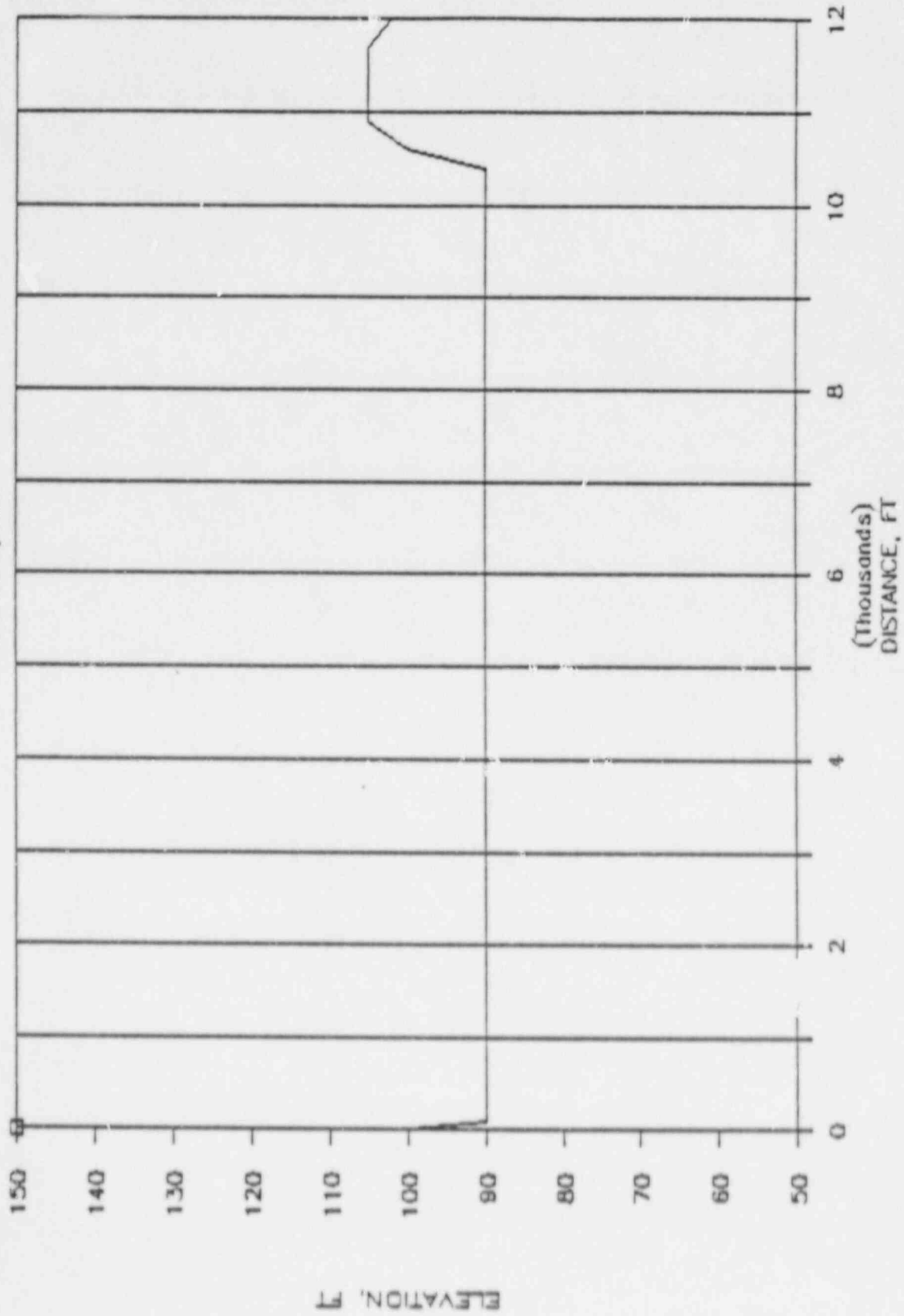
# VOGTLE B12

AZIMUTH, ENR



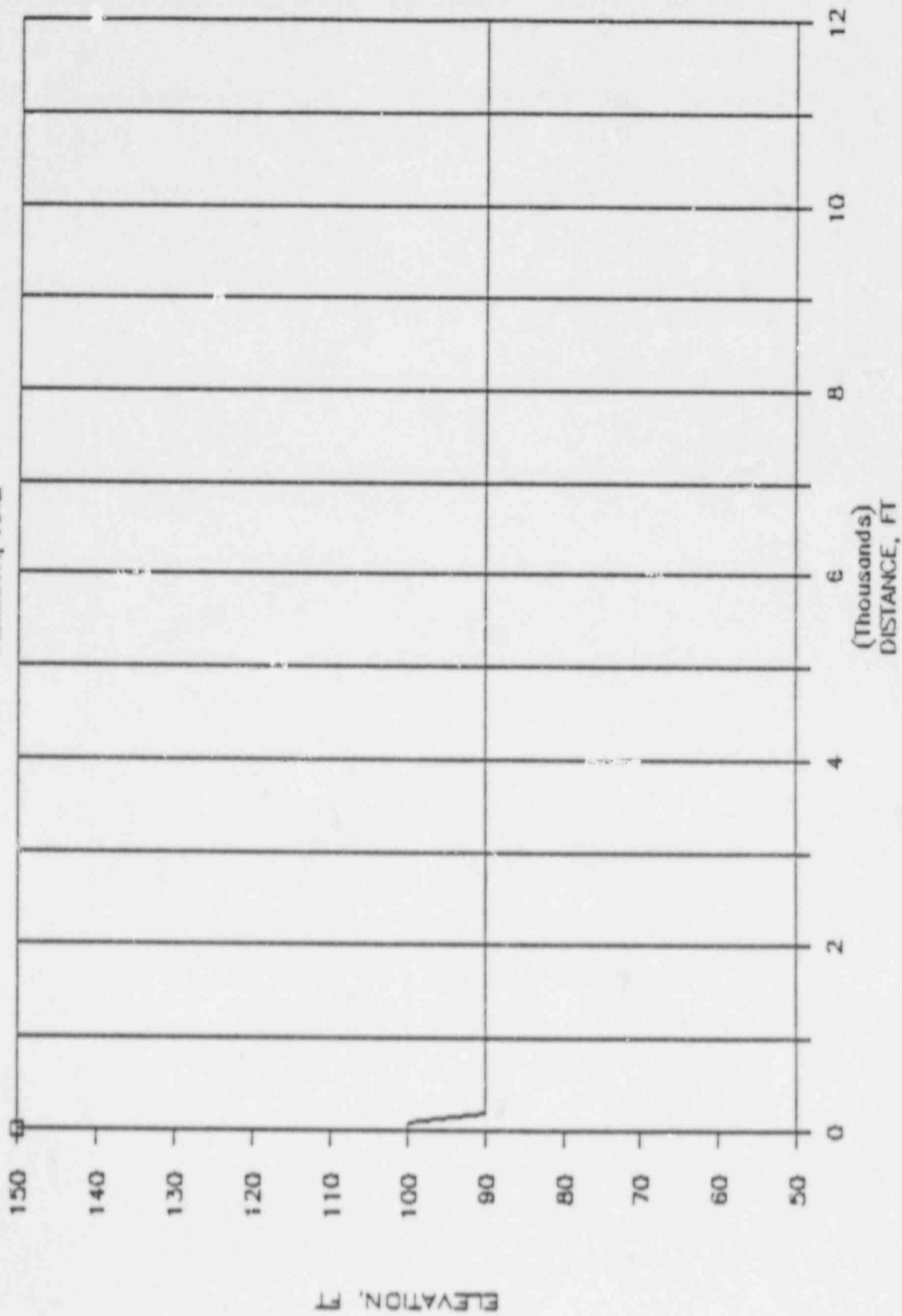
# VOGTLE B12

AZIMUTH, NE



# VOGTLE B12

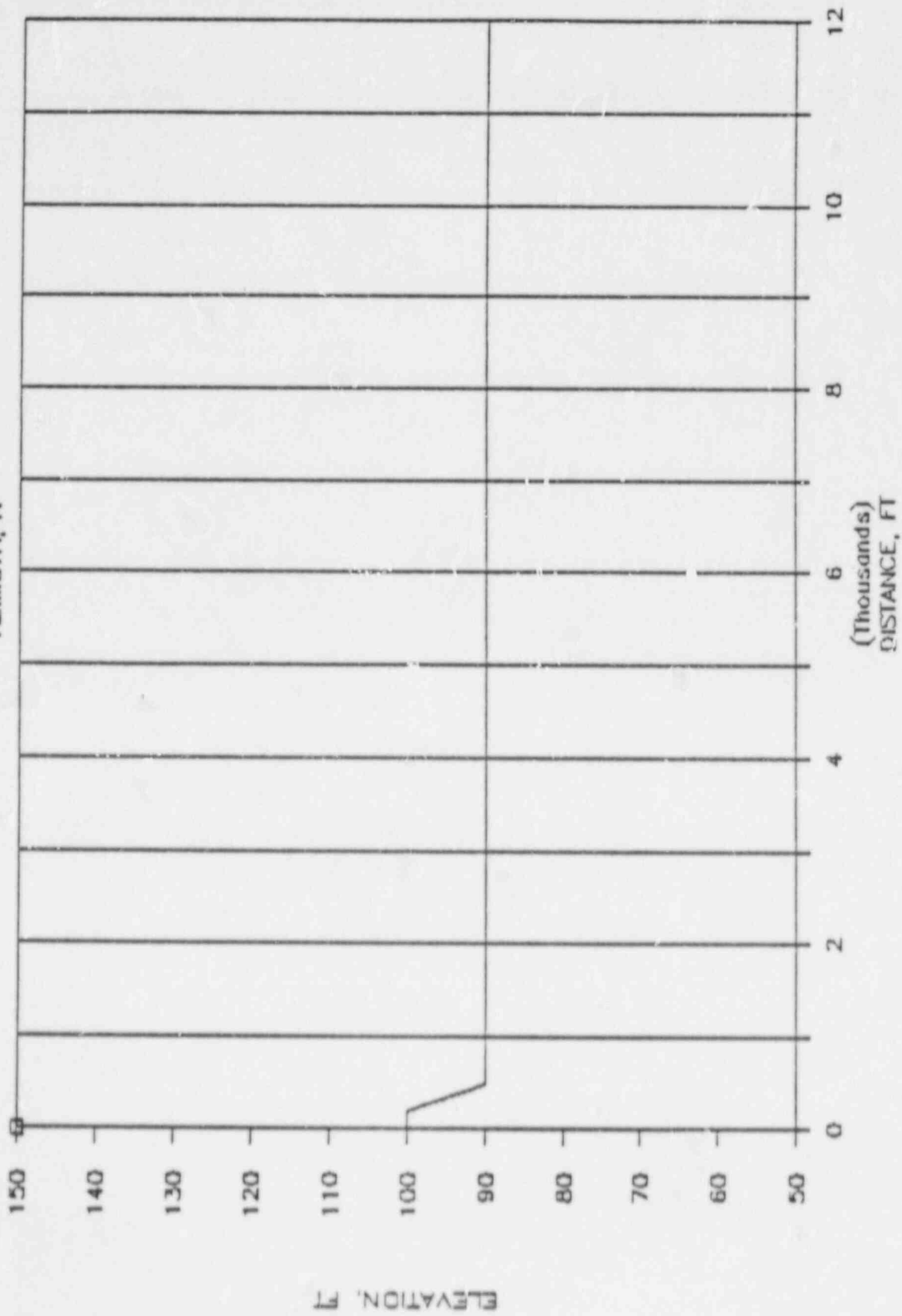
AZIMUTH, NNE





# VOGTLE B12

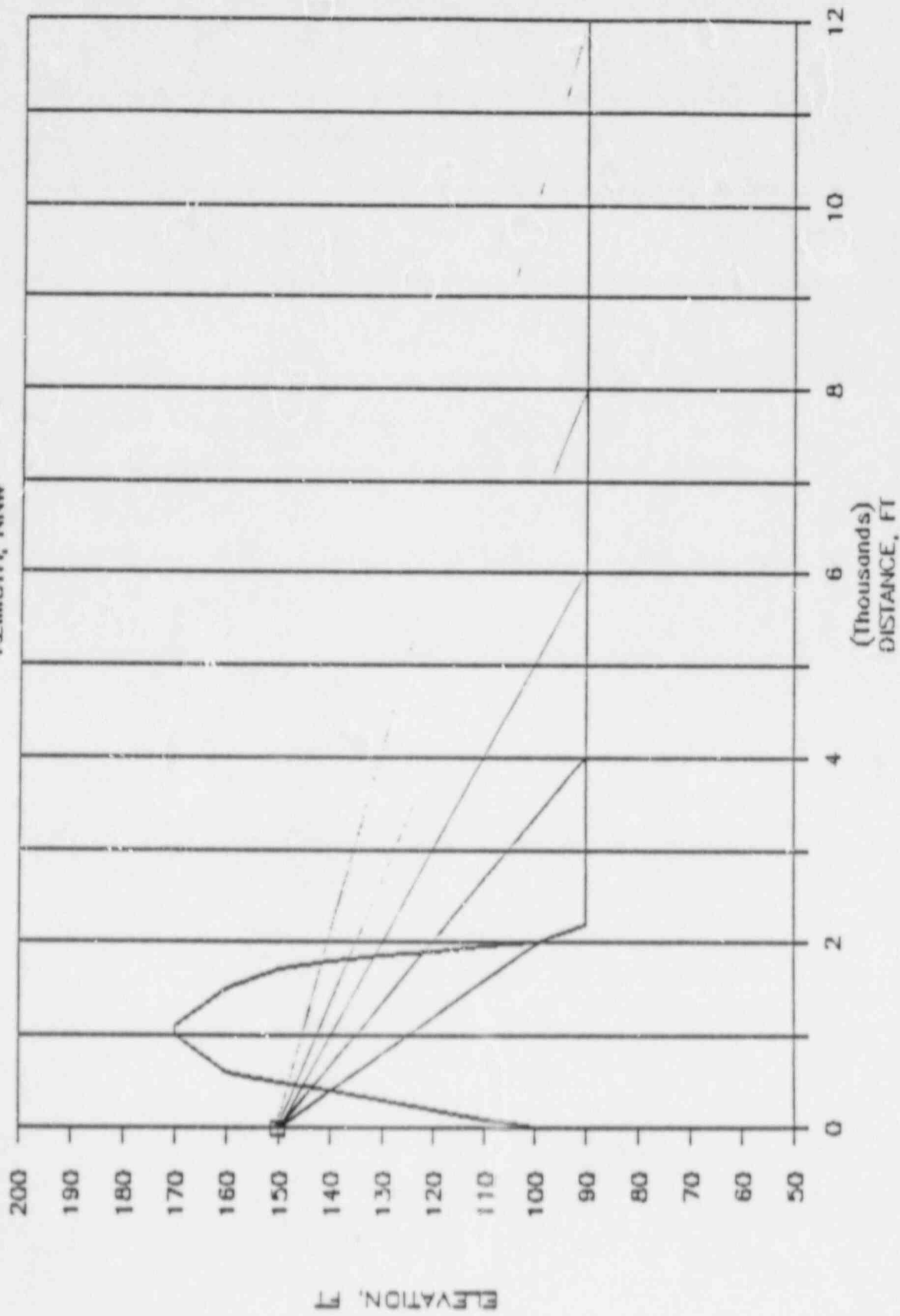
AZIMUTH, N



ELEVATION, FT

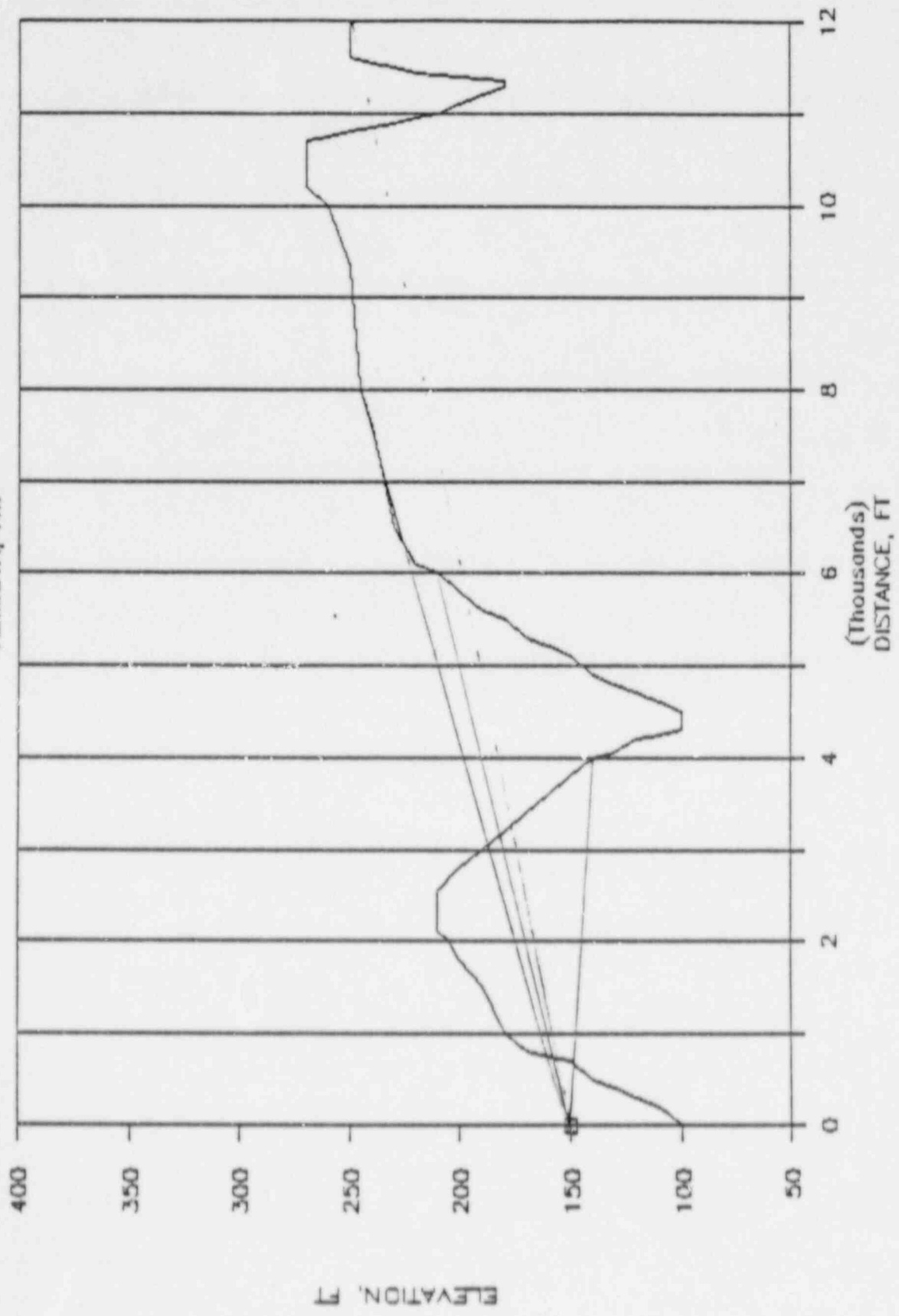
# VOGTLE B12

AZIMUTH, NNW



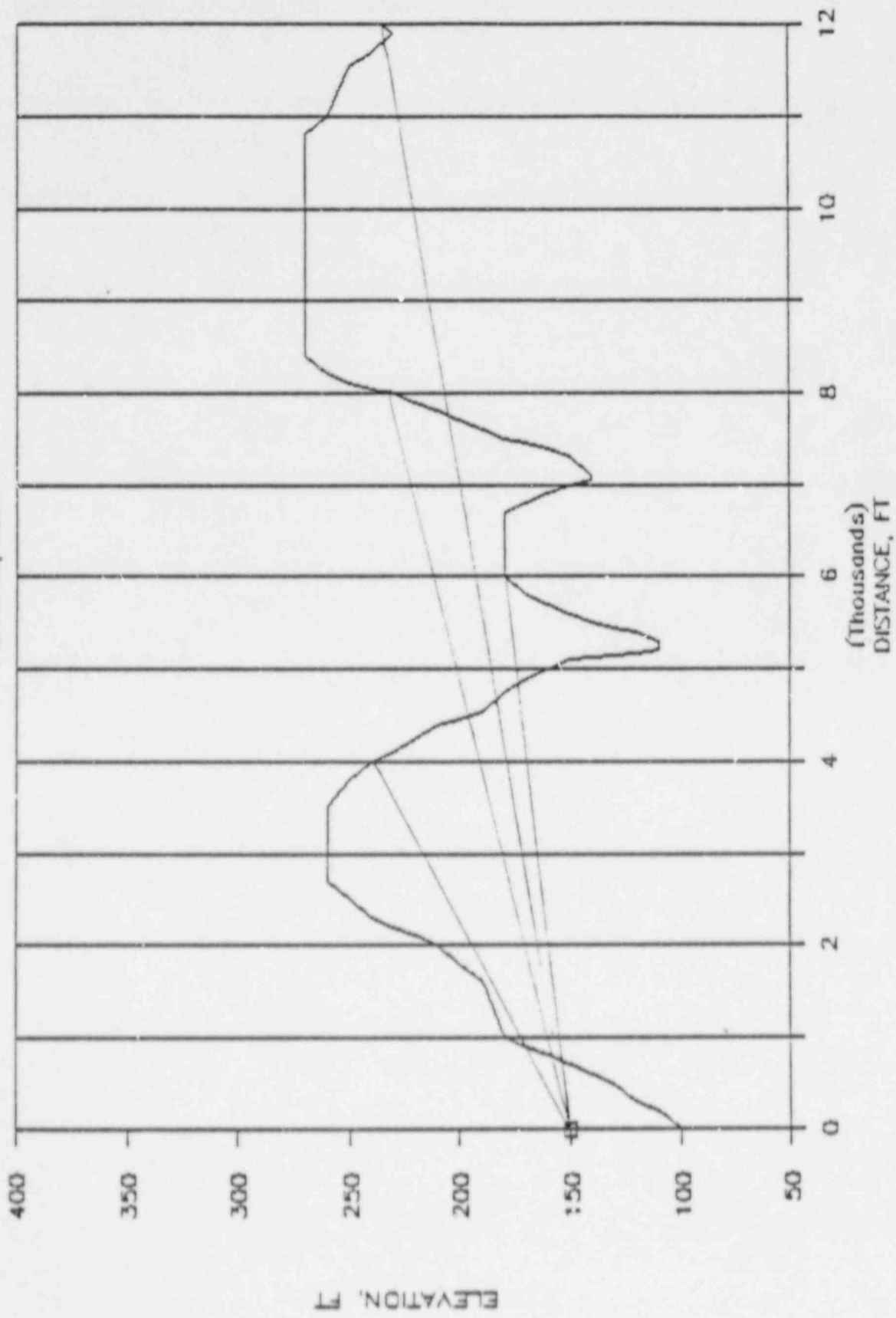
# VOGTLE B12

AZIMUTH, NW



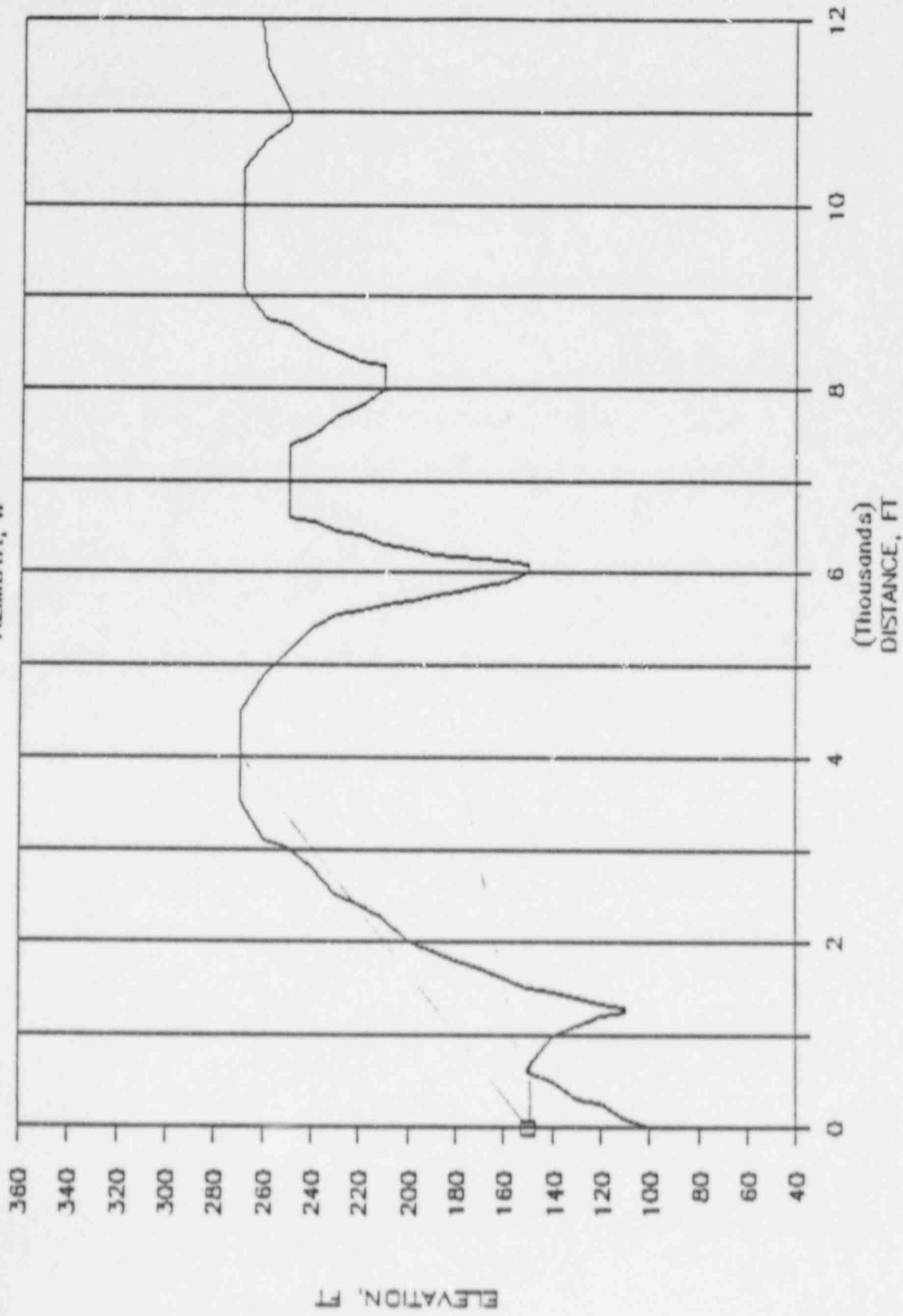
# VOGTLE B12

AZIMUTH, WNW



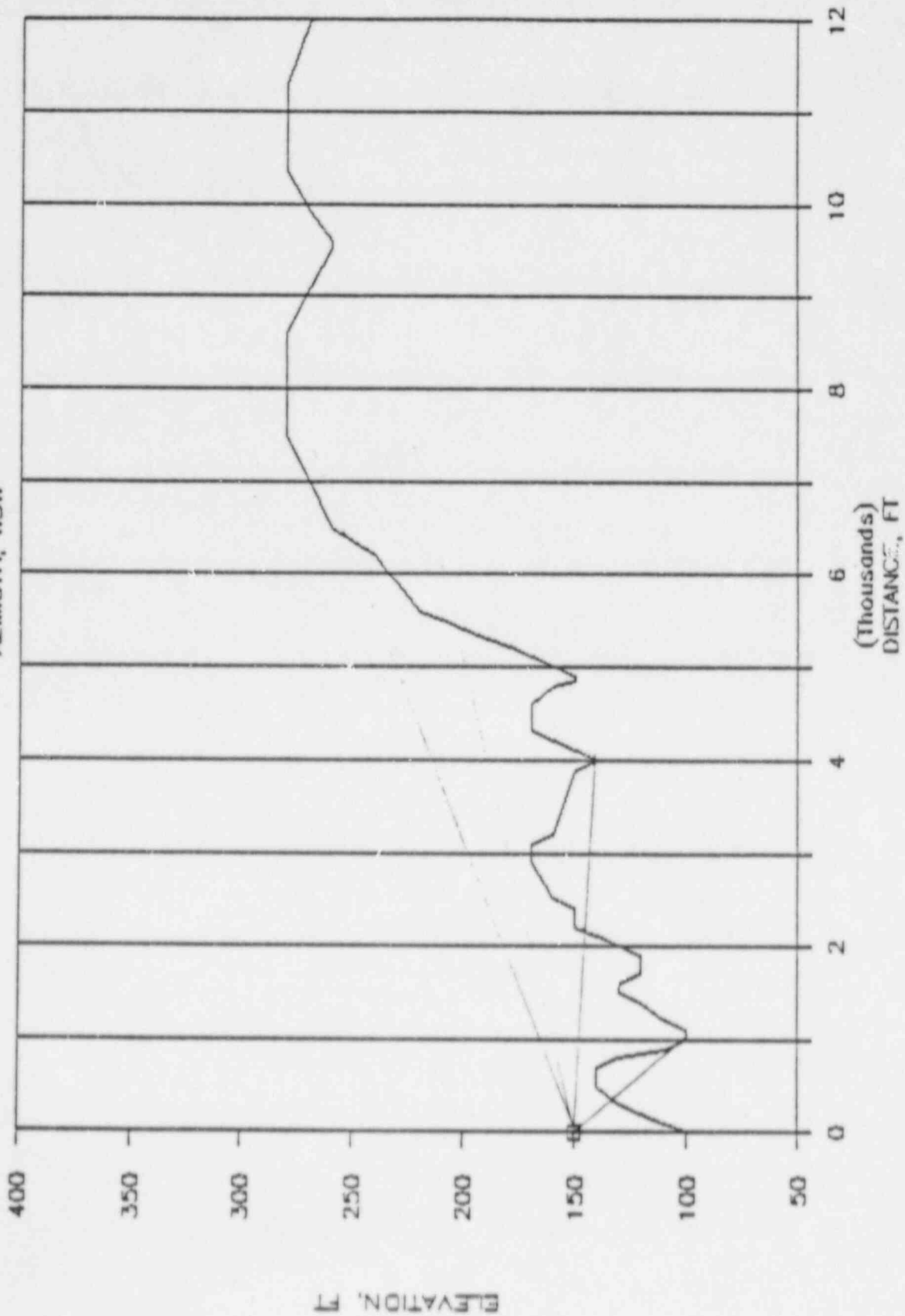
# VOGTLE B12

AZIMUTH, W



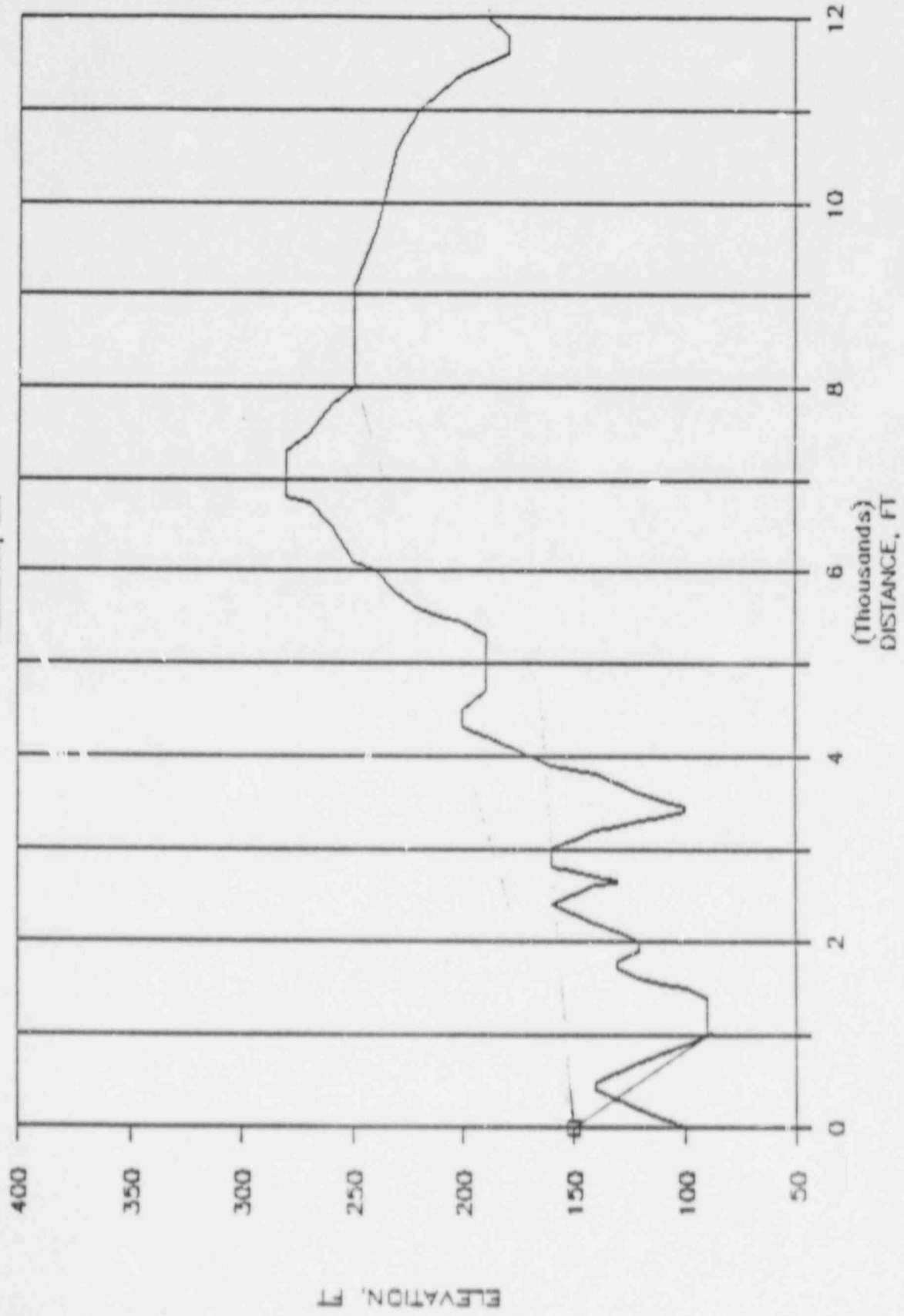
# VOGTLE B12

AZIMUTH, WSW



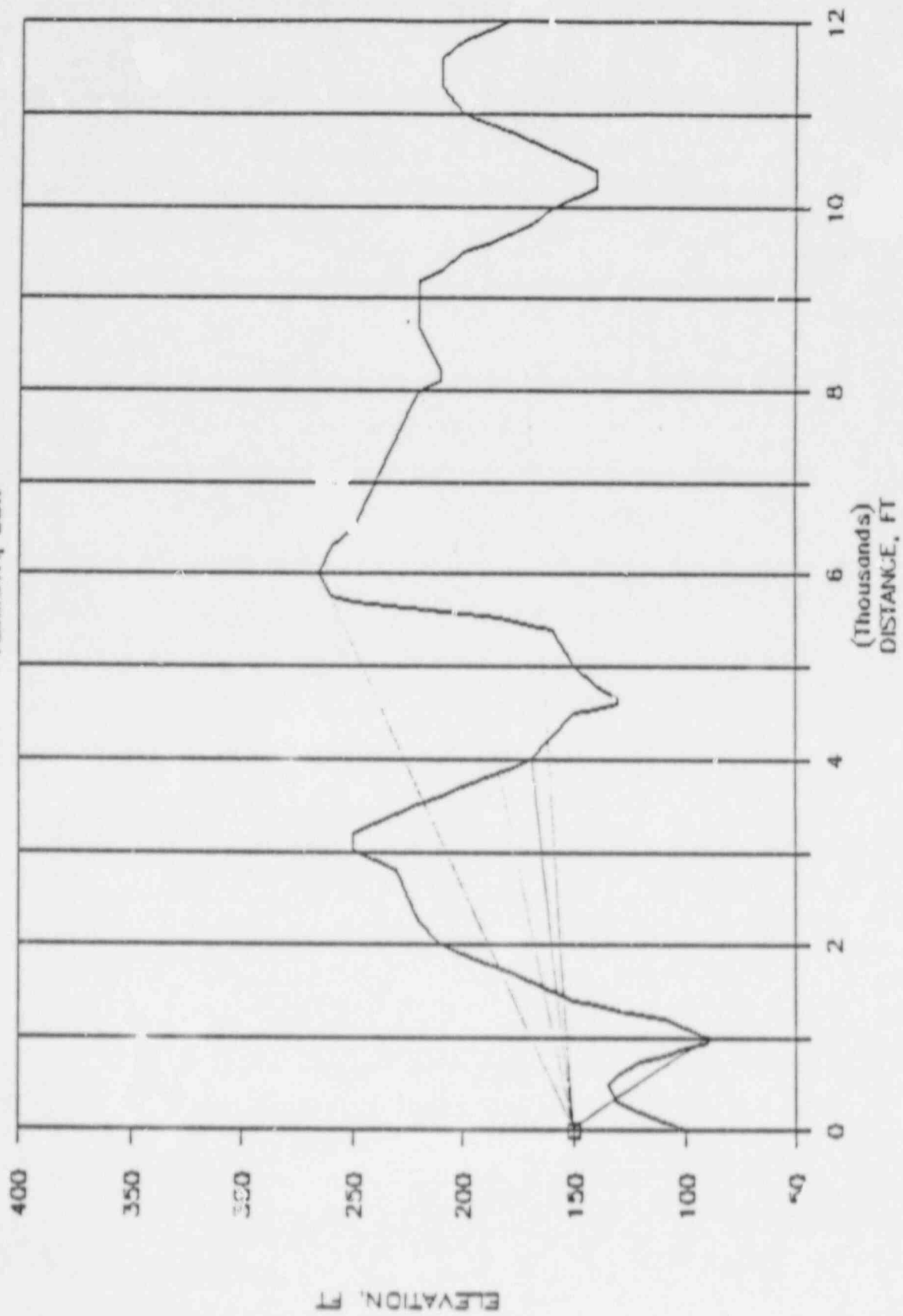
# VOGTLE B12

AZIMUTH, SW



# VOGTLE B12

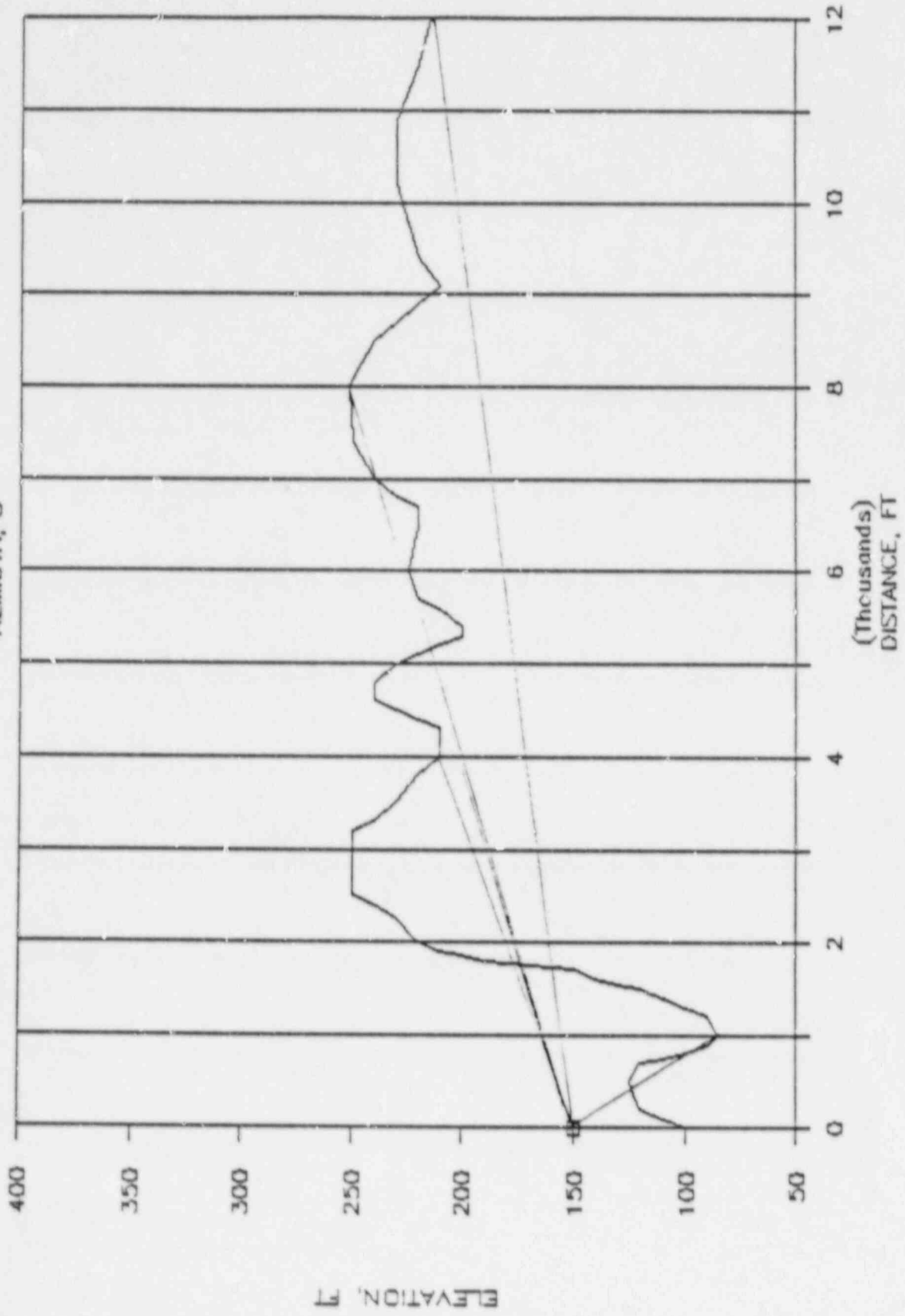
AZIMUTH, SSW





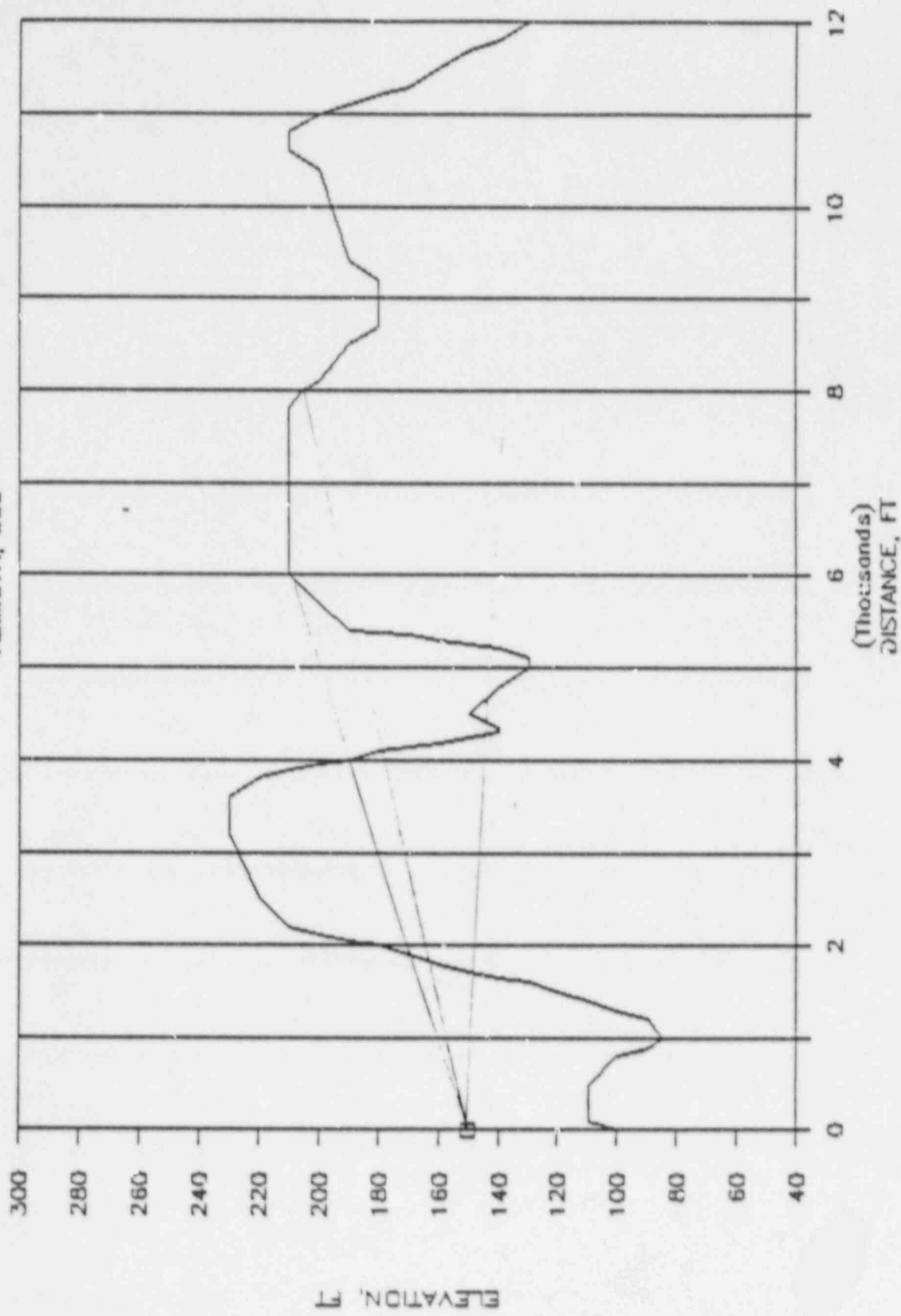
# VOGTLE B12

AZIMUTH, S



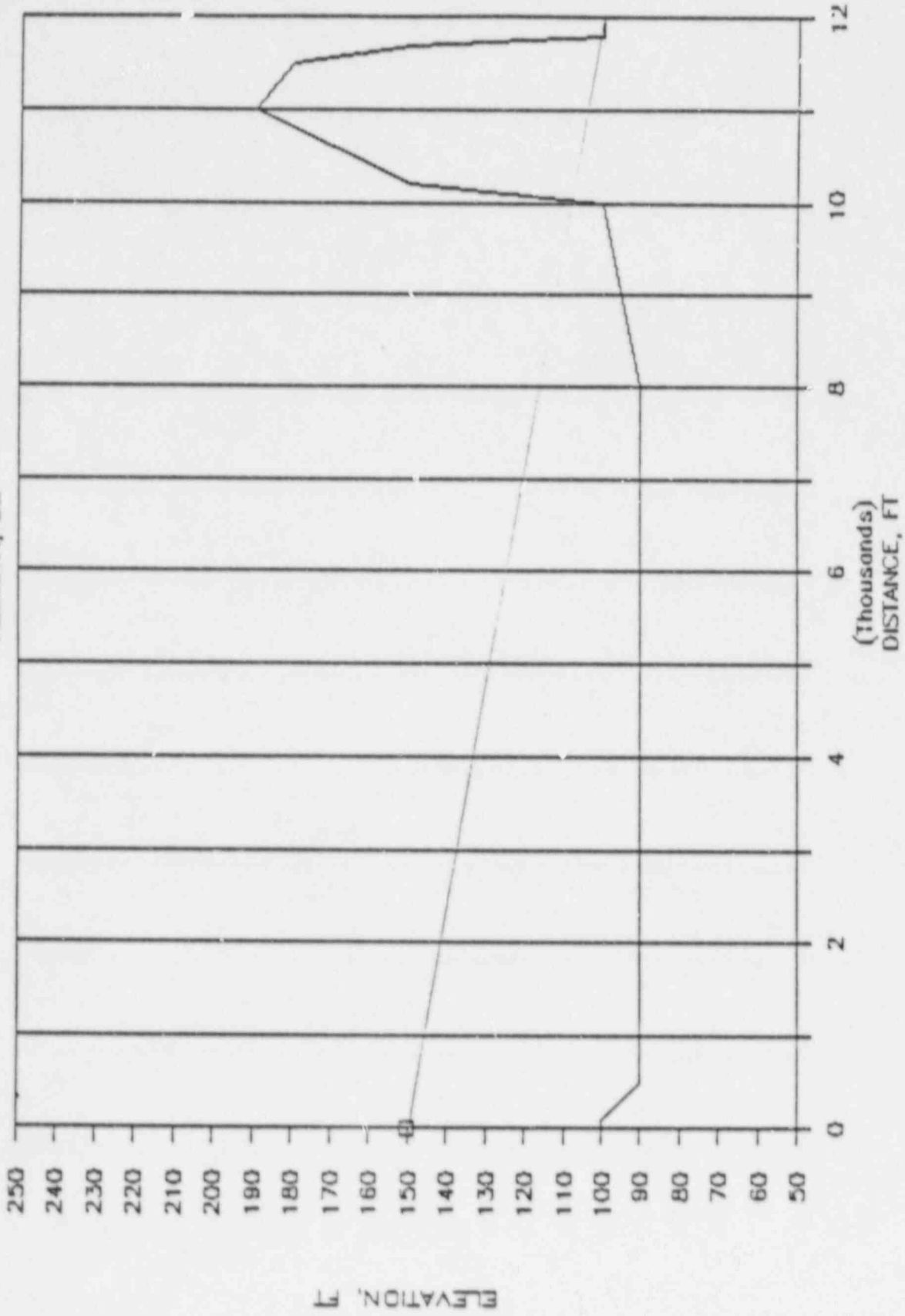
# VOGTLE B12

AZIMUTH, SSE



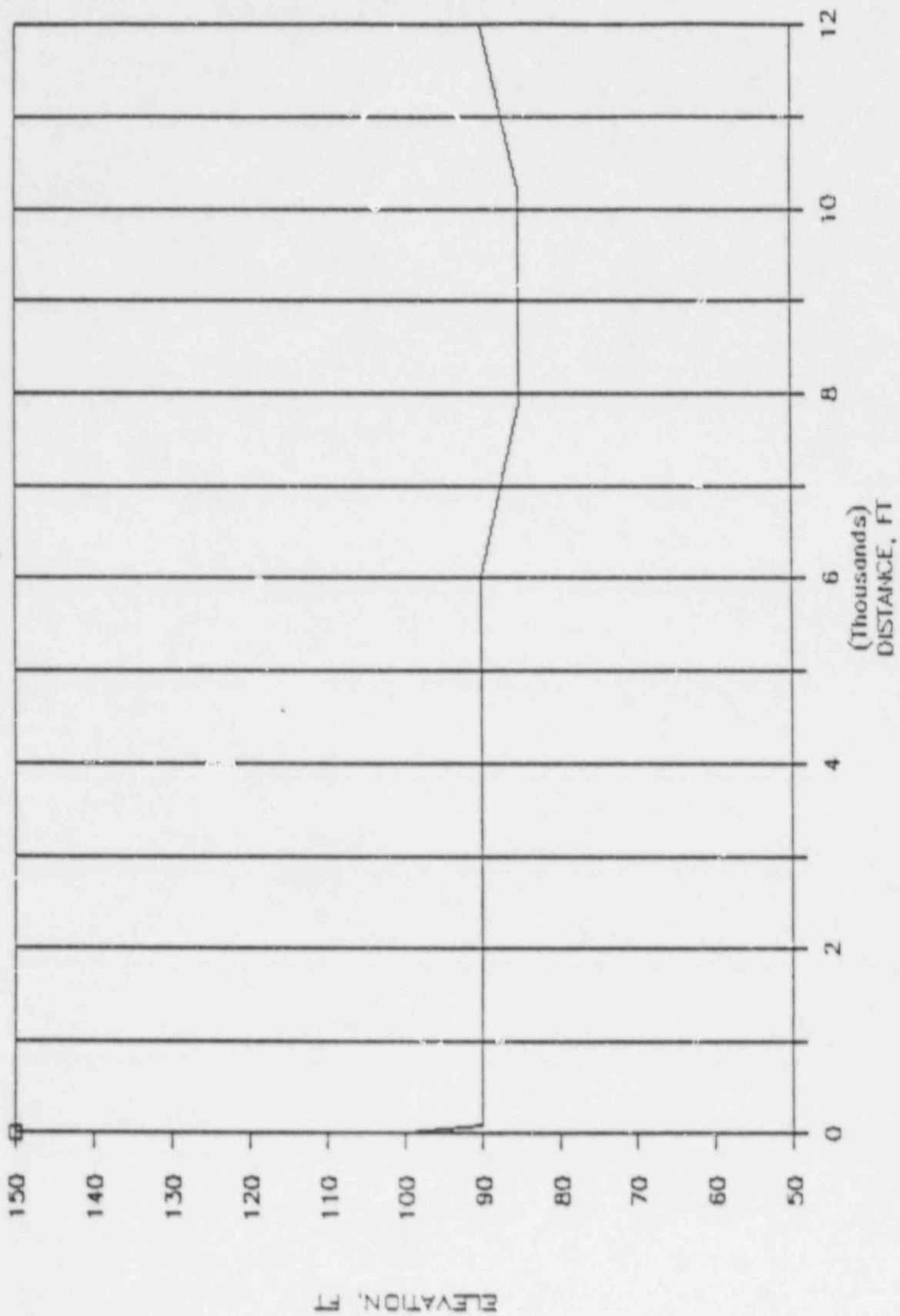
# VOGTLE B12

AZIMUTH, SE



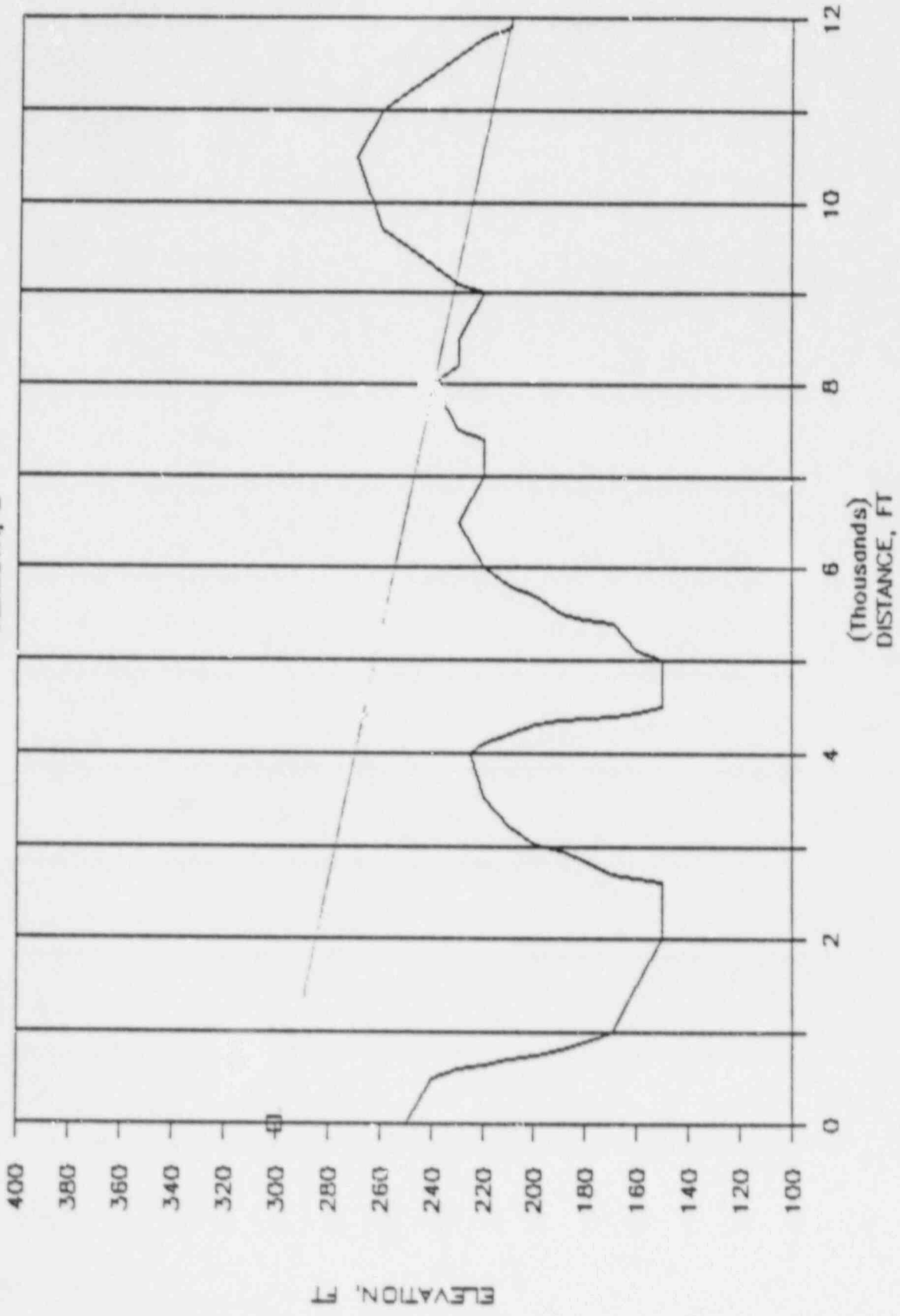
# VOGTLE B12

AZIMUTH, ESE



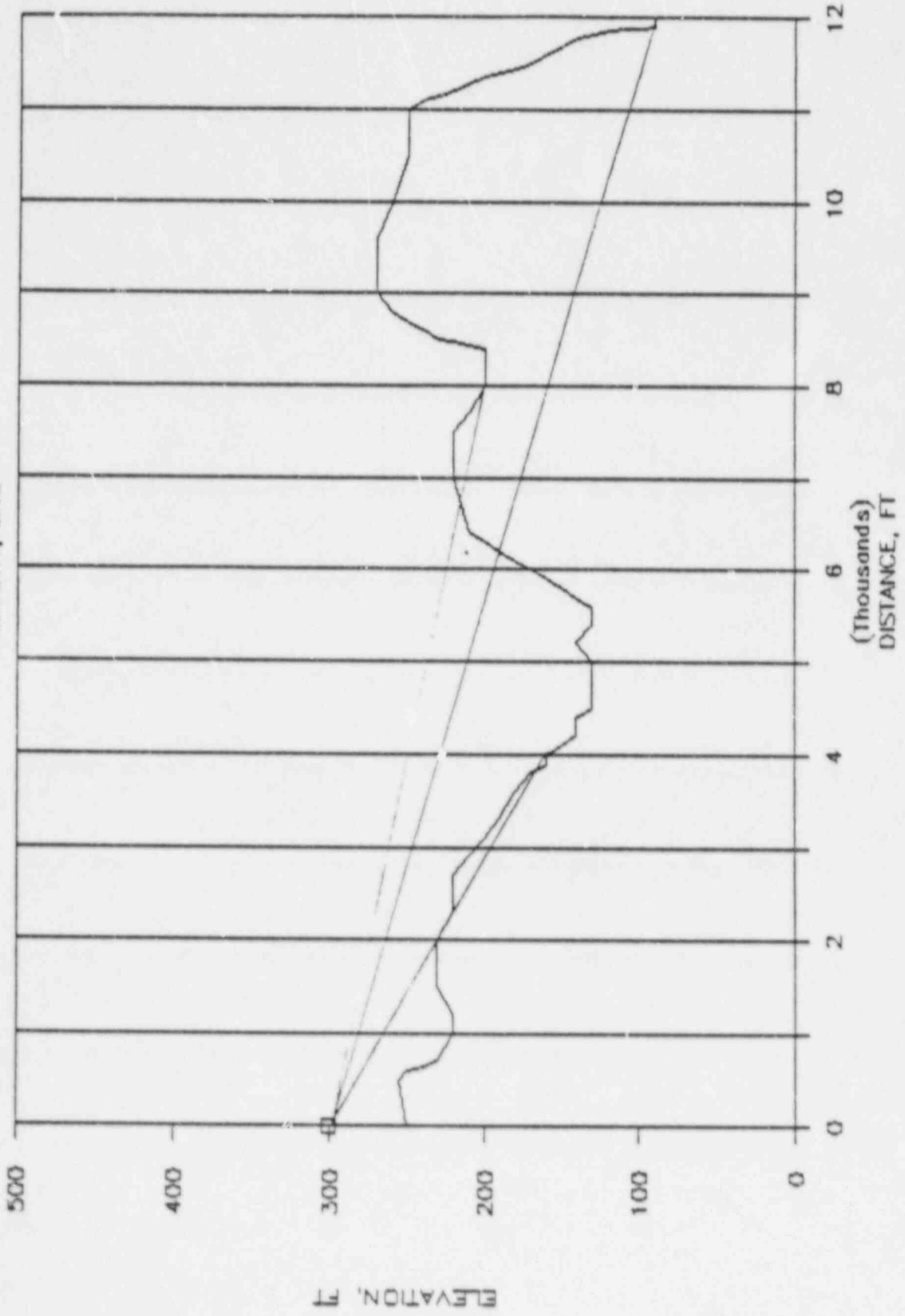
# VOGTLE B11

AZIMUTH, E



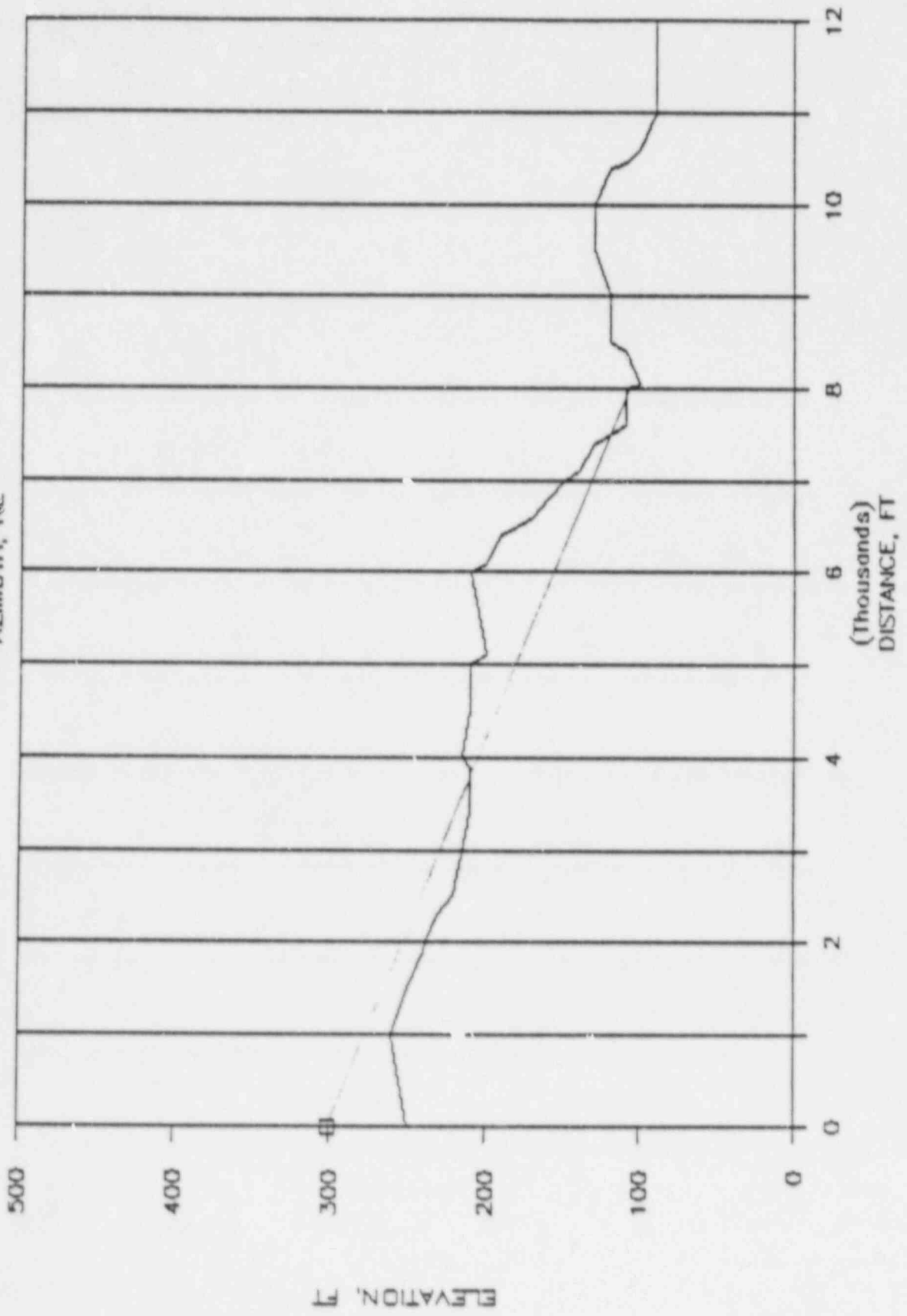
# VOGTLE B11

AZIMUTH, ENE



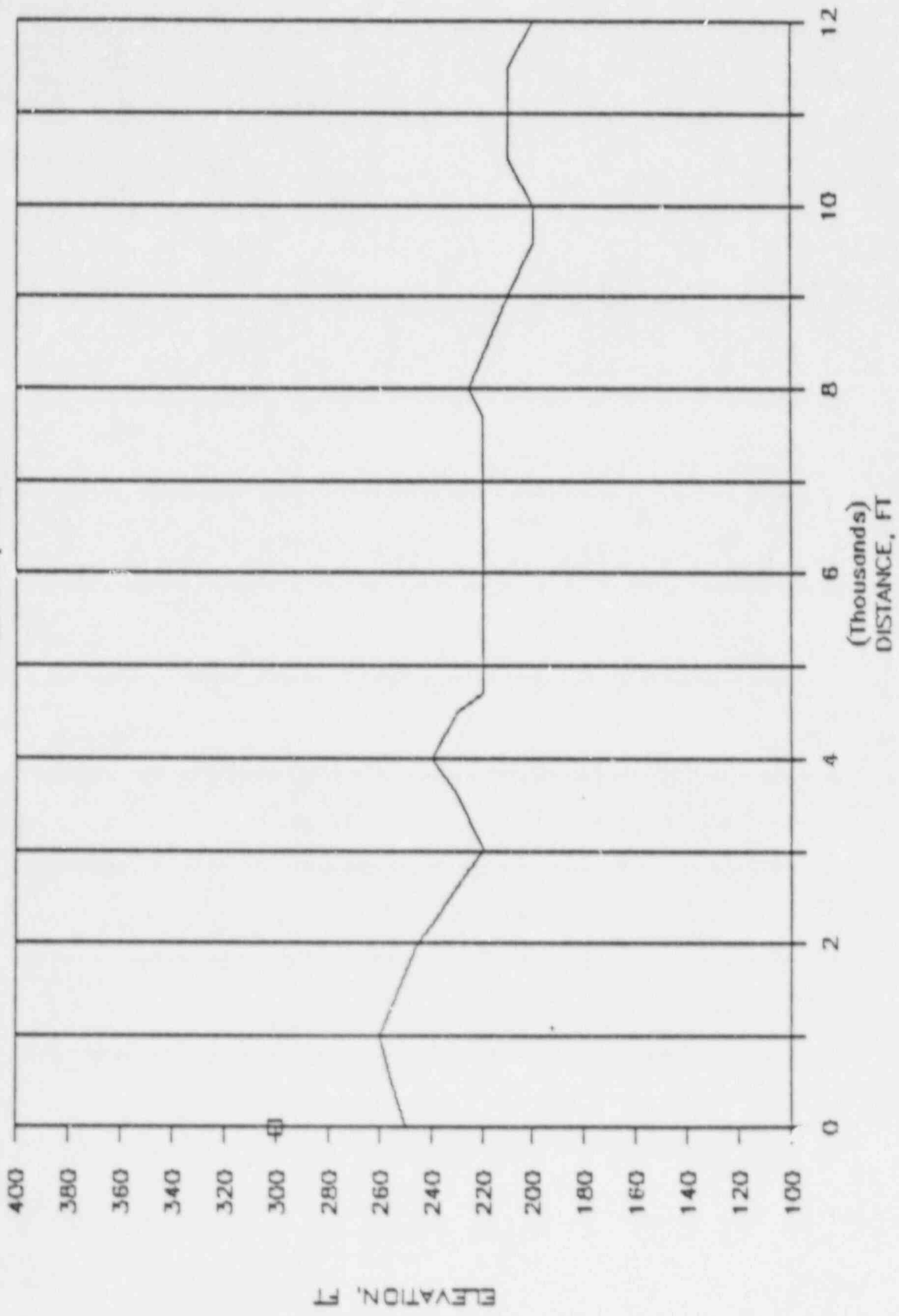
# VOGTLE B11

AZIMUTH, NE



# VOGTLE B11

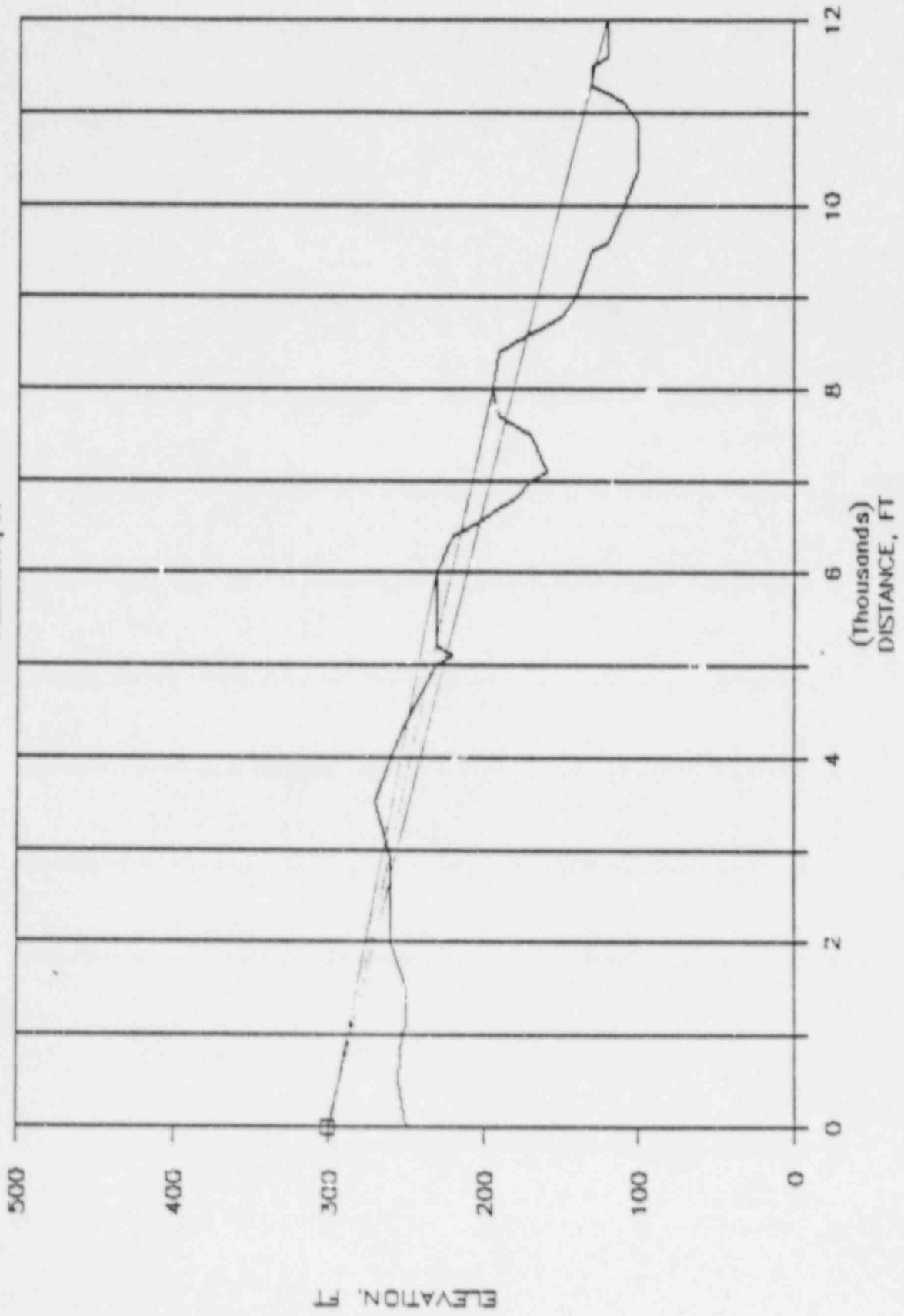
AZIMUTH, NNE





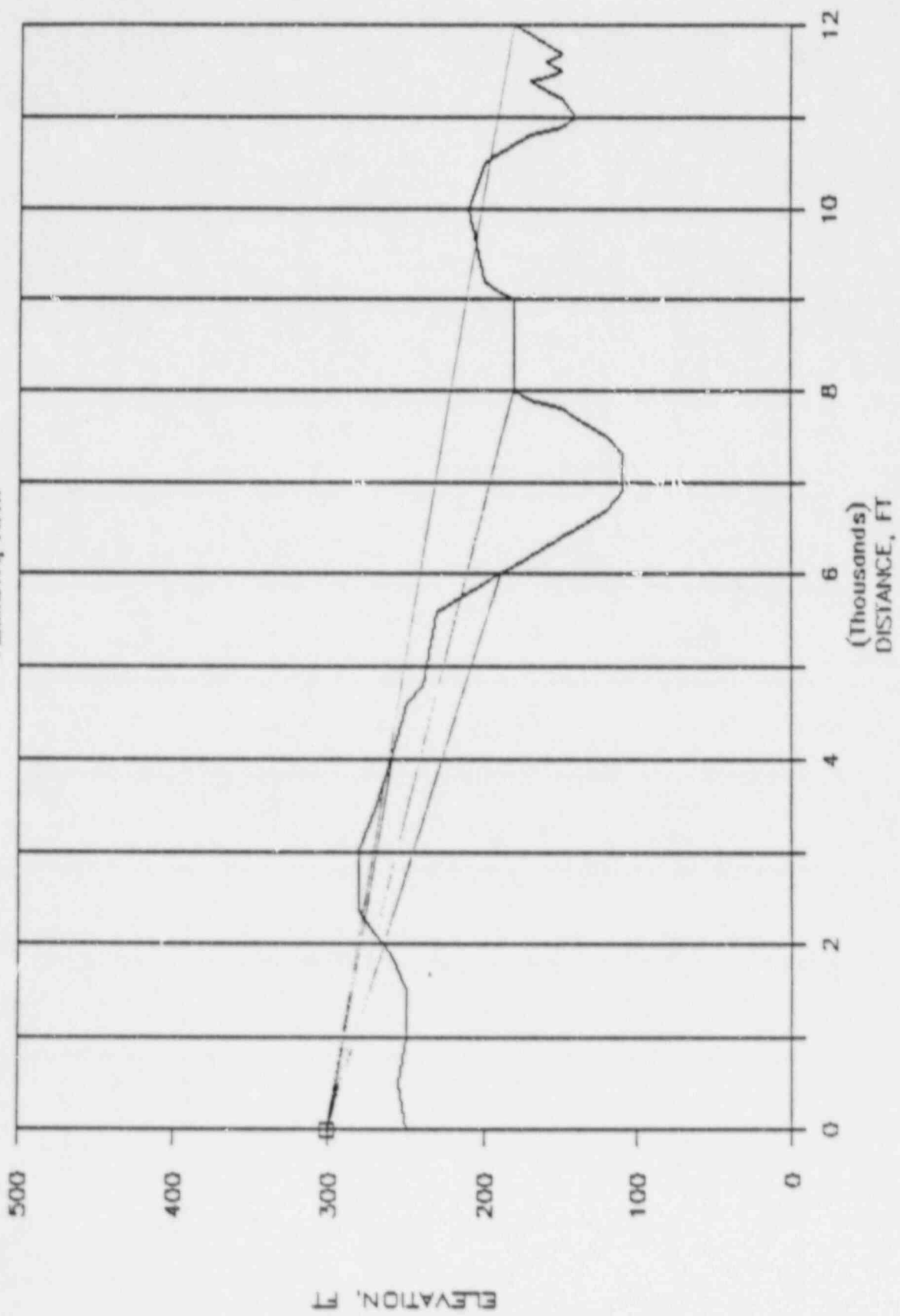
# VOGTLE B11

AZIMUTH, N



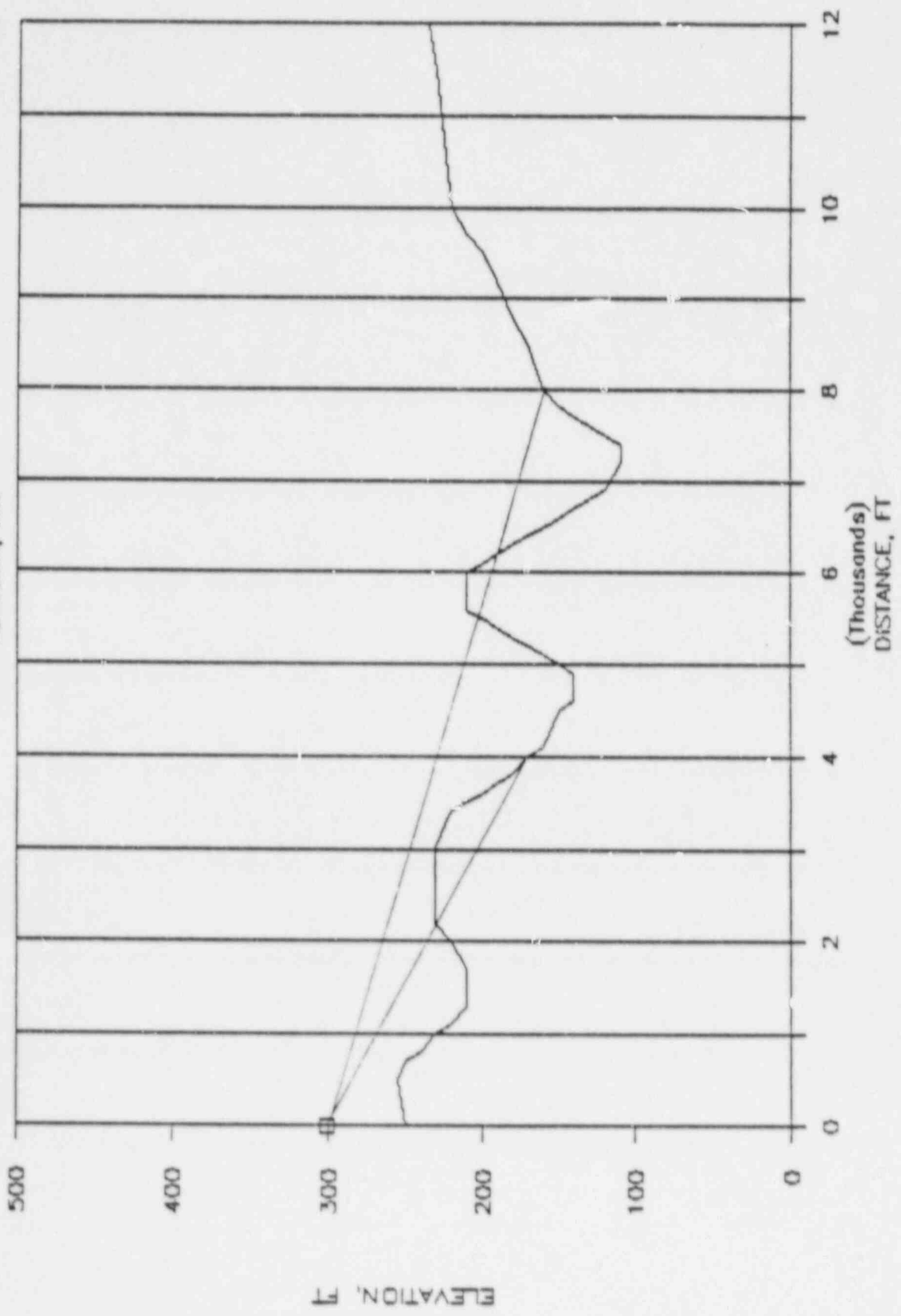
# VOGTLE B11

AZIMUTH, NNW



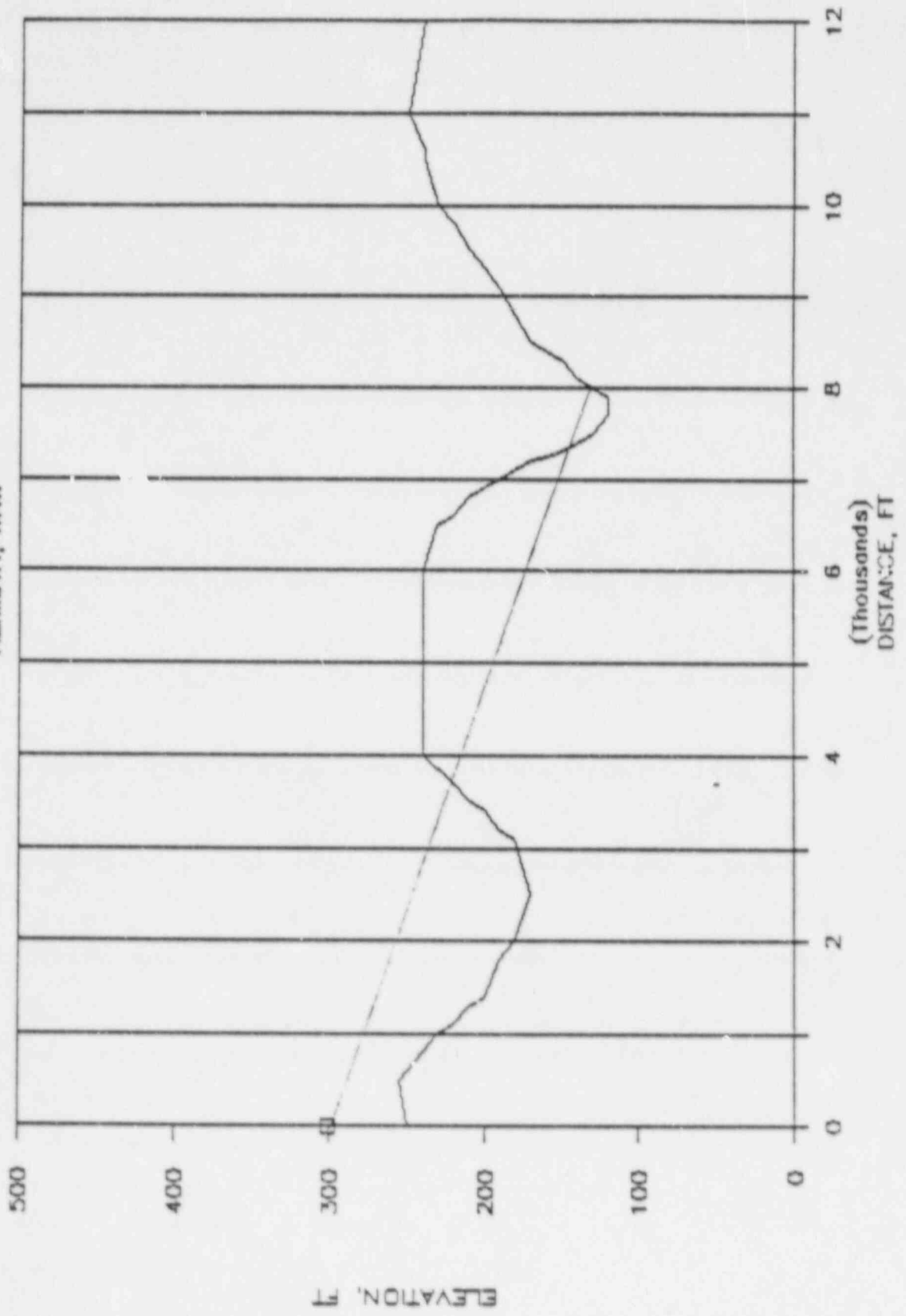
# VOGTLE B11

AZIMUTH, NW



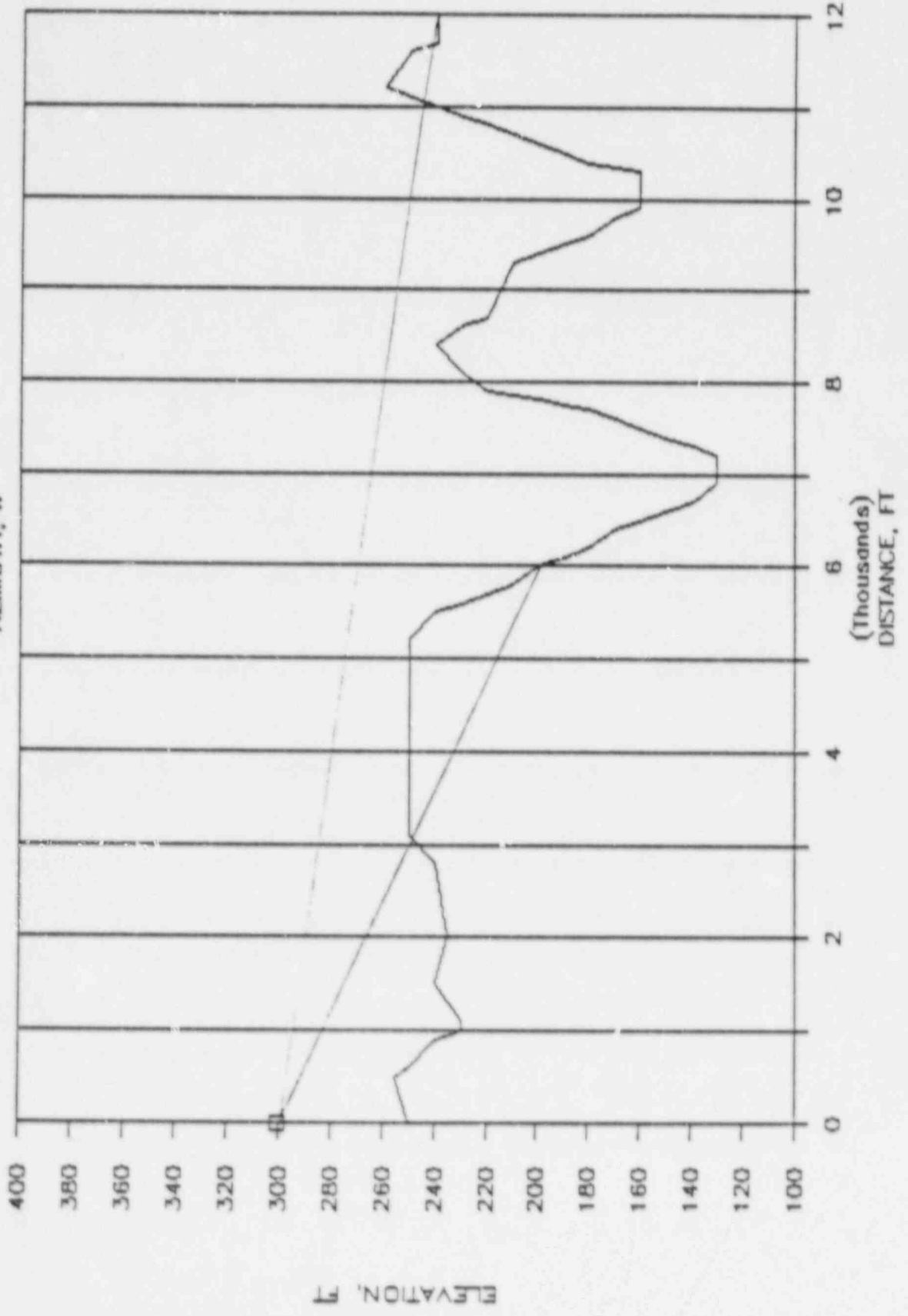
# VOGTLE B11

AZIMUTH, WNW



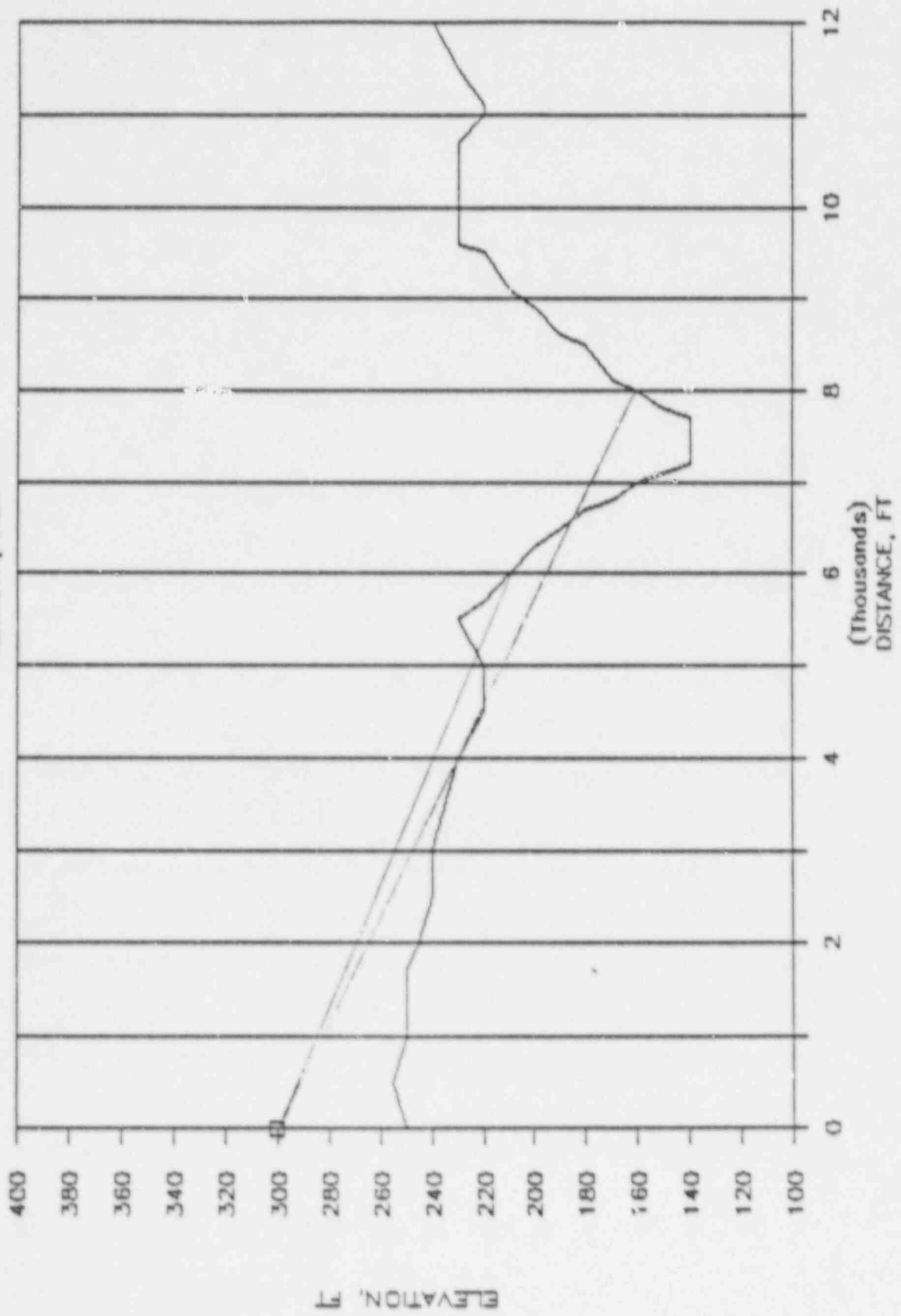
# VOGTLE B11

AZIMUTH, W



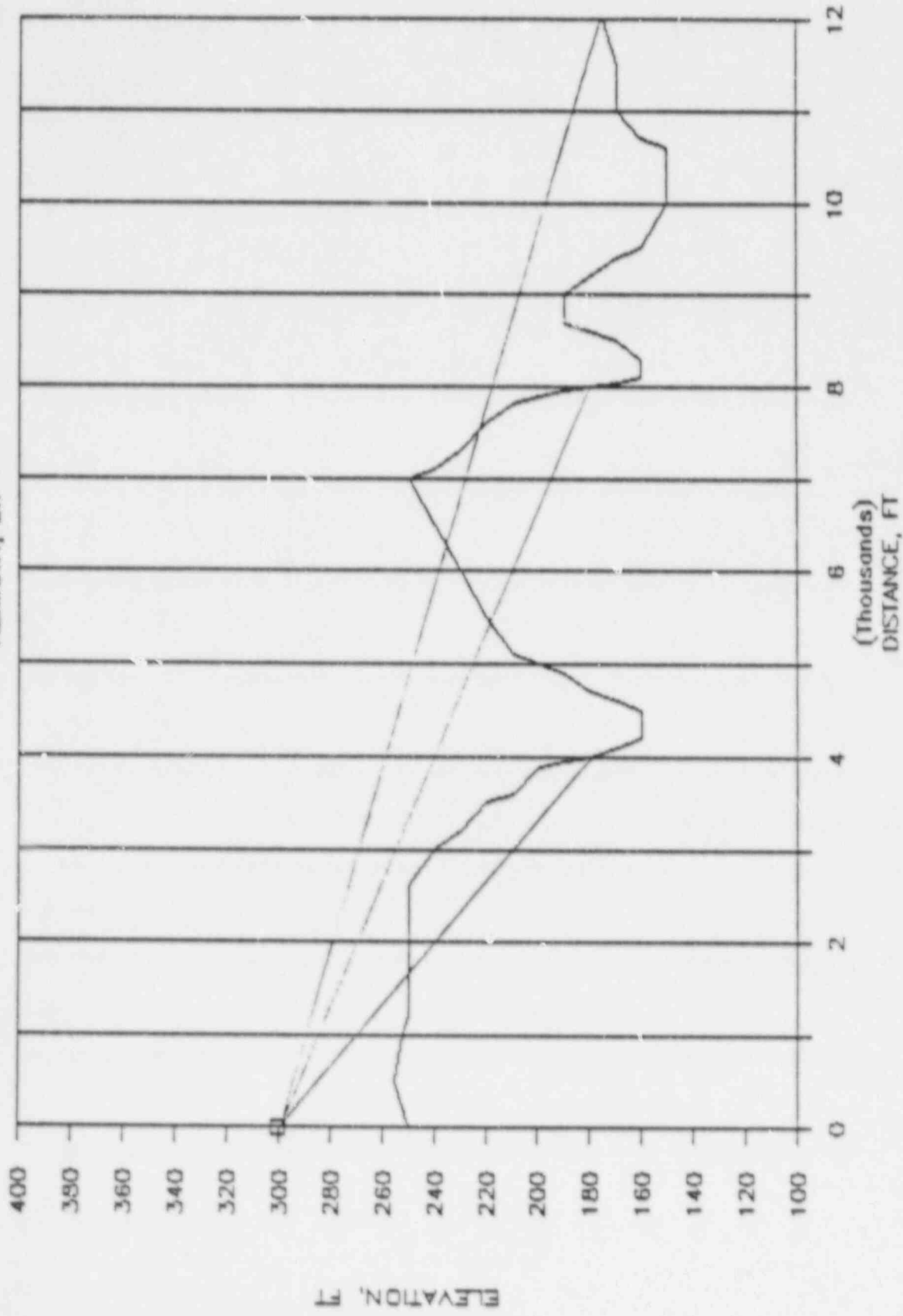
# VOGTLE B11

AZIMUTH, WSW



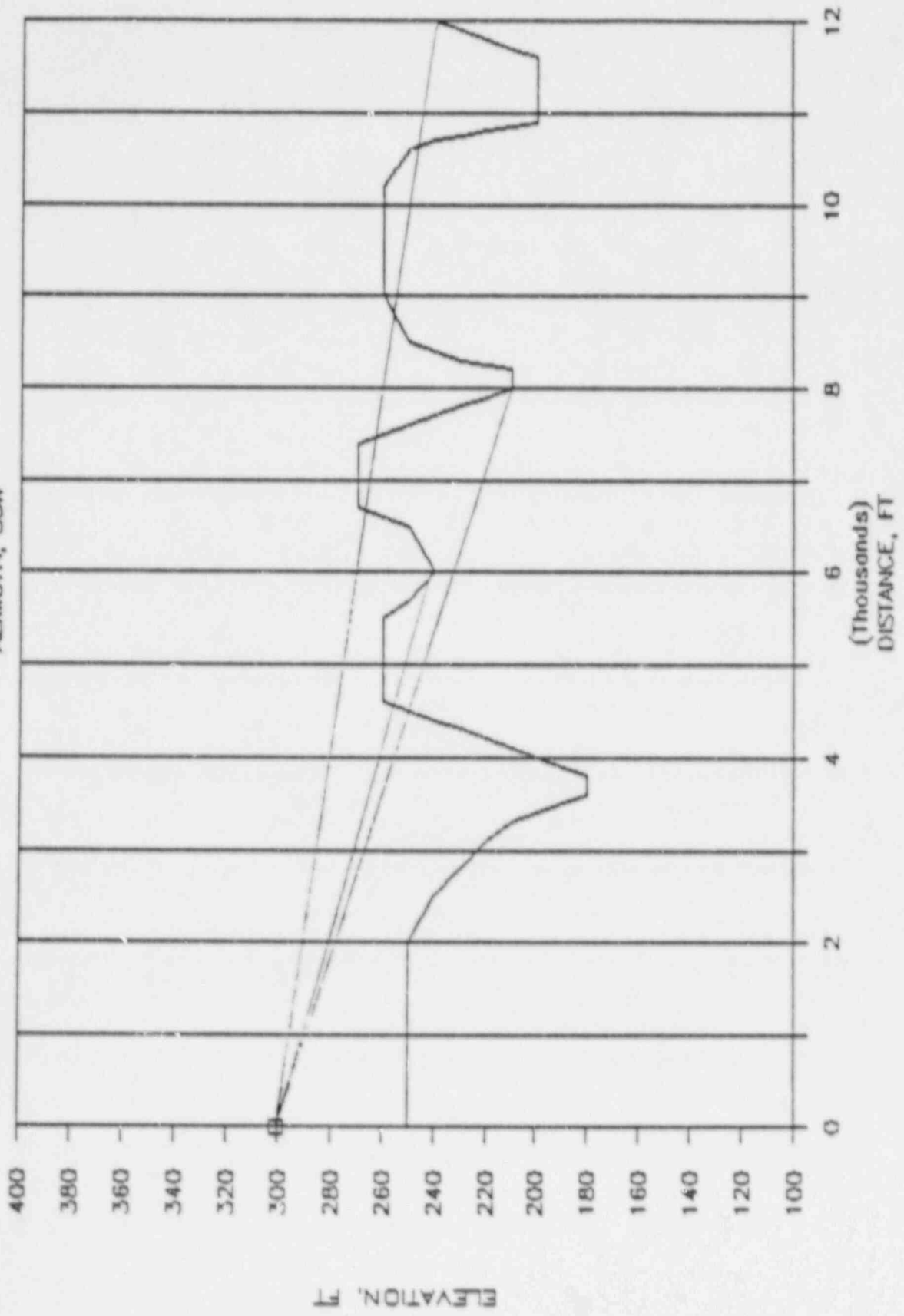
# VOGTLE B11

AZIMUTH, SW



# VOGTLE B11

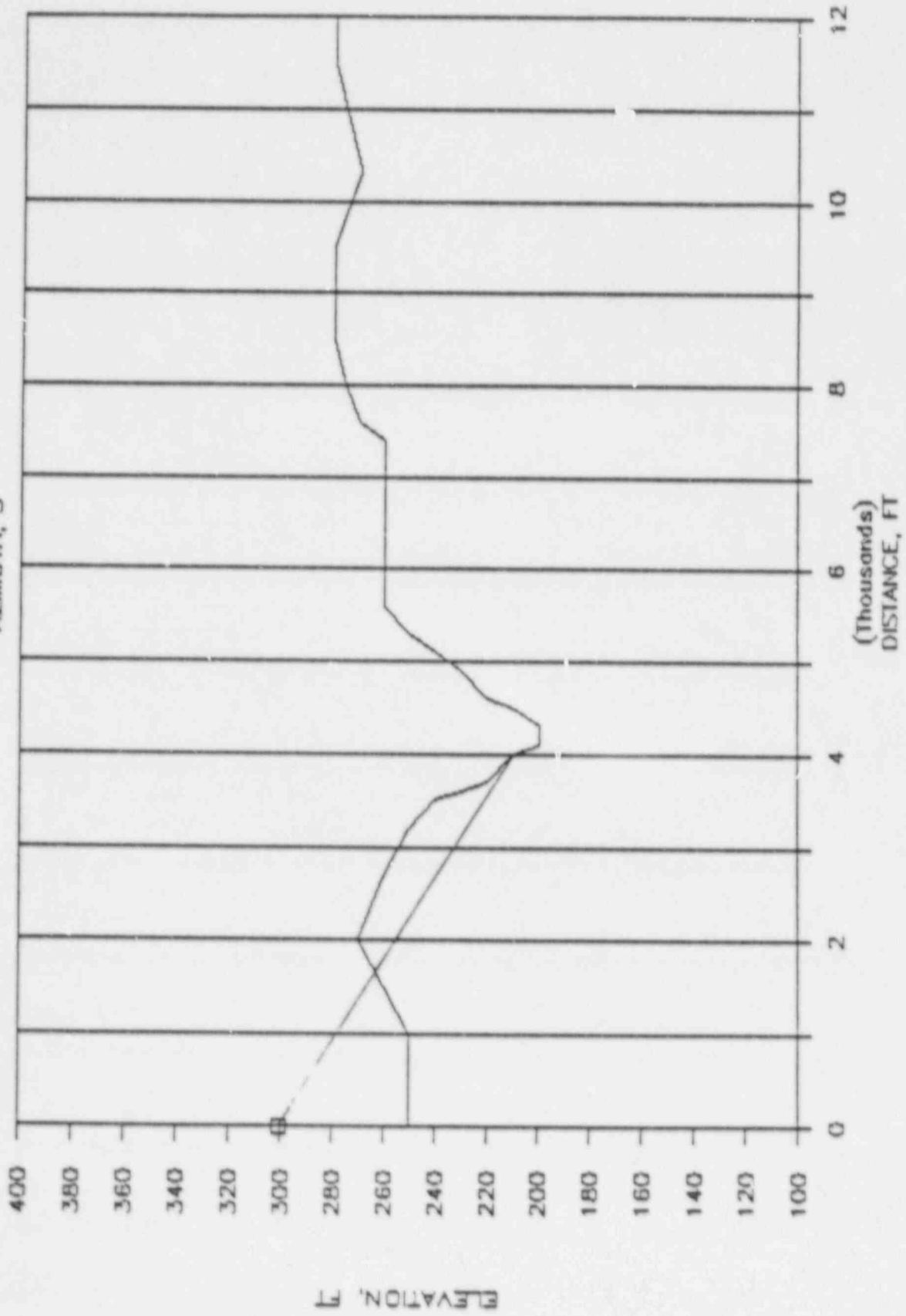
AZIMUTH, SSW





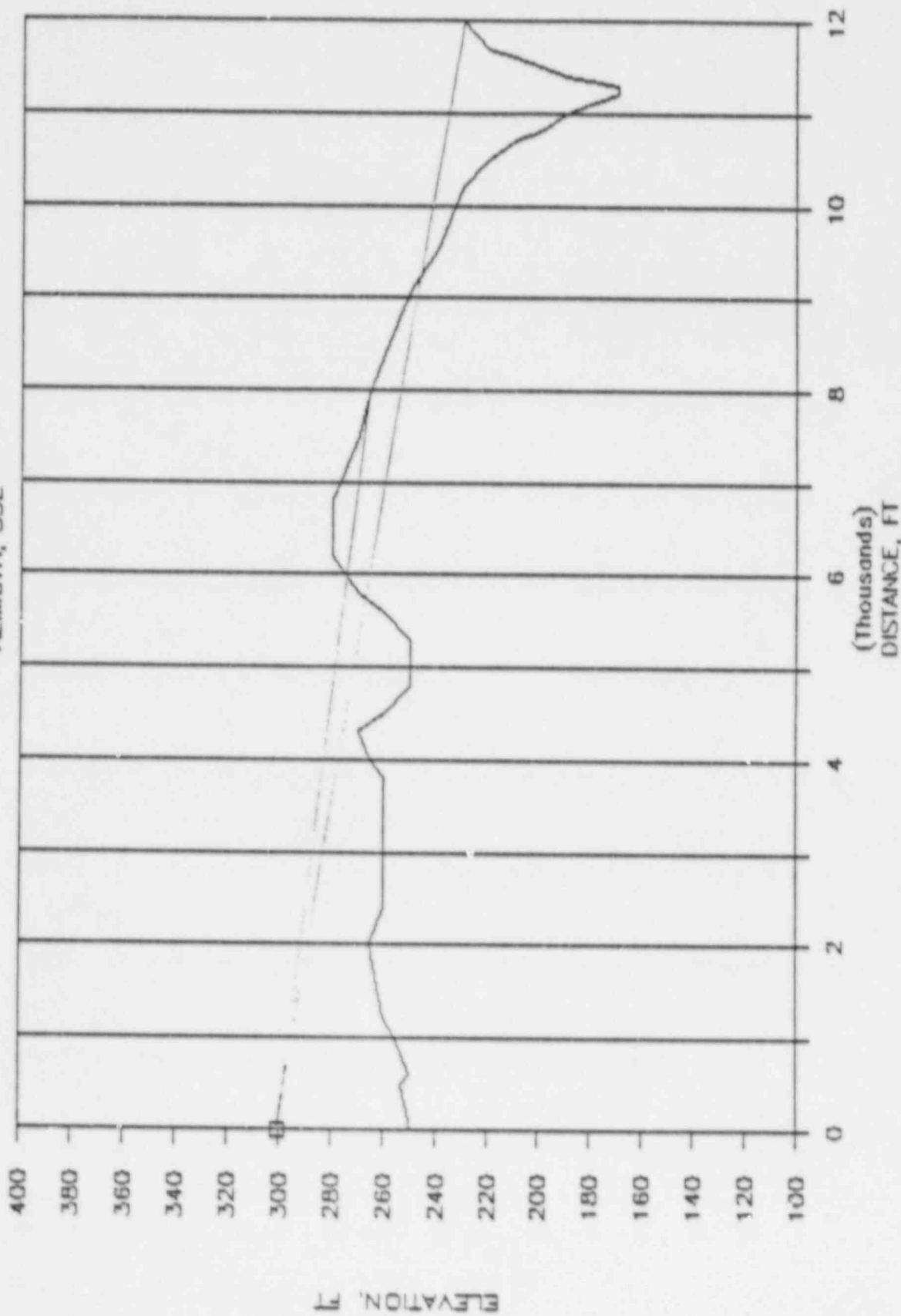
# VOGTLE B11

AZIMUTH, S



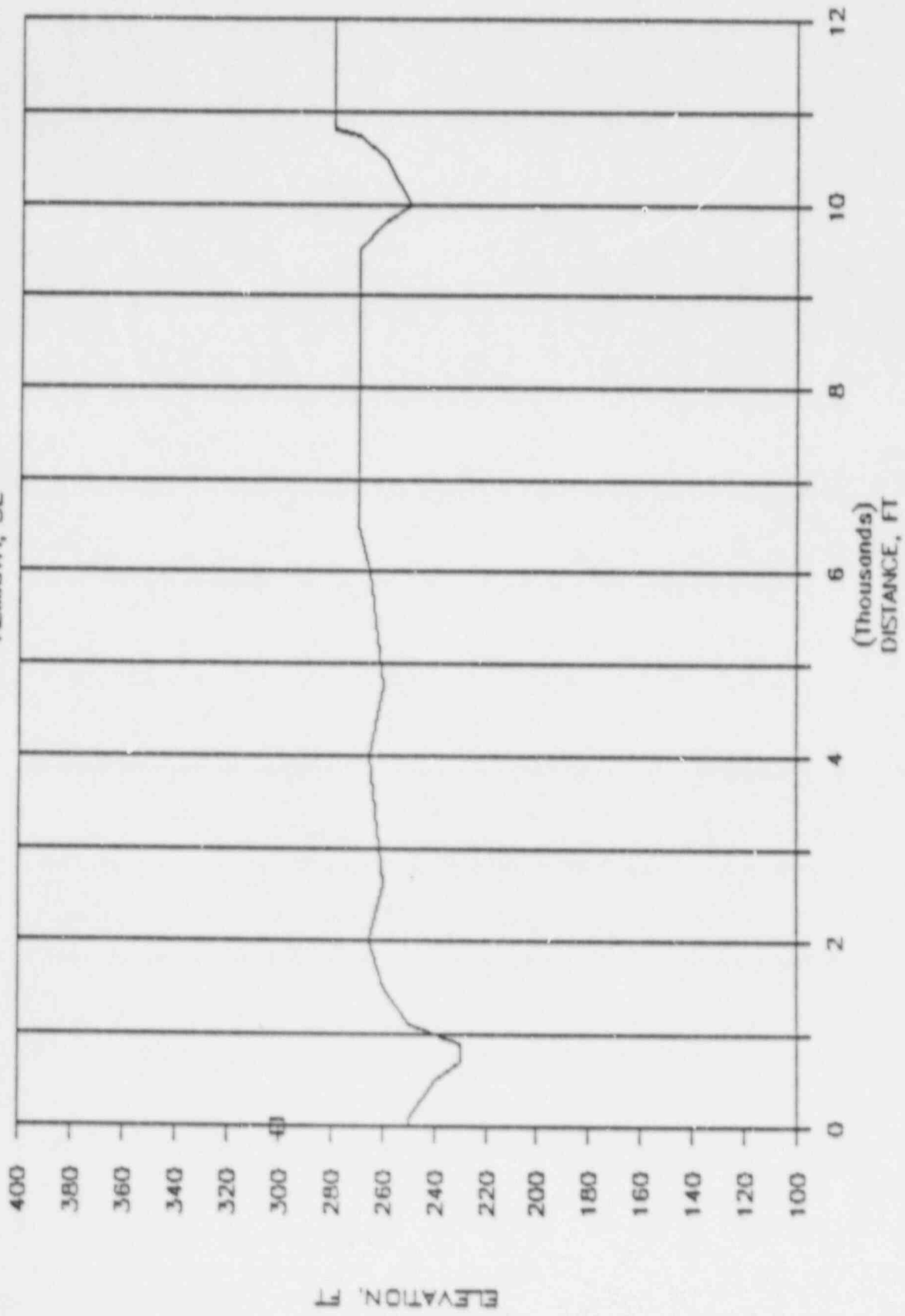
# VOGTLE B11

AZIMUTH, SSE



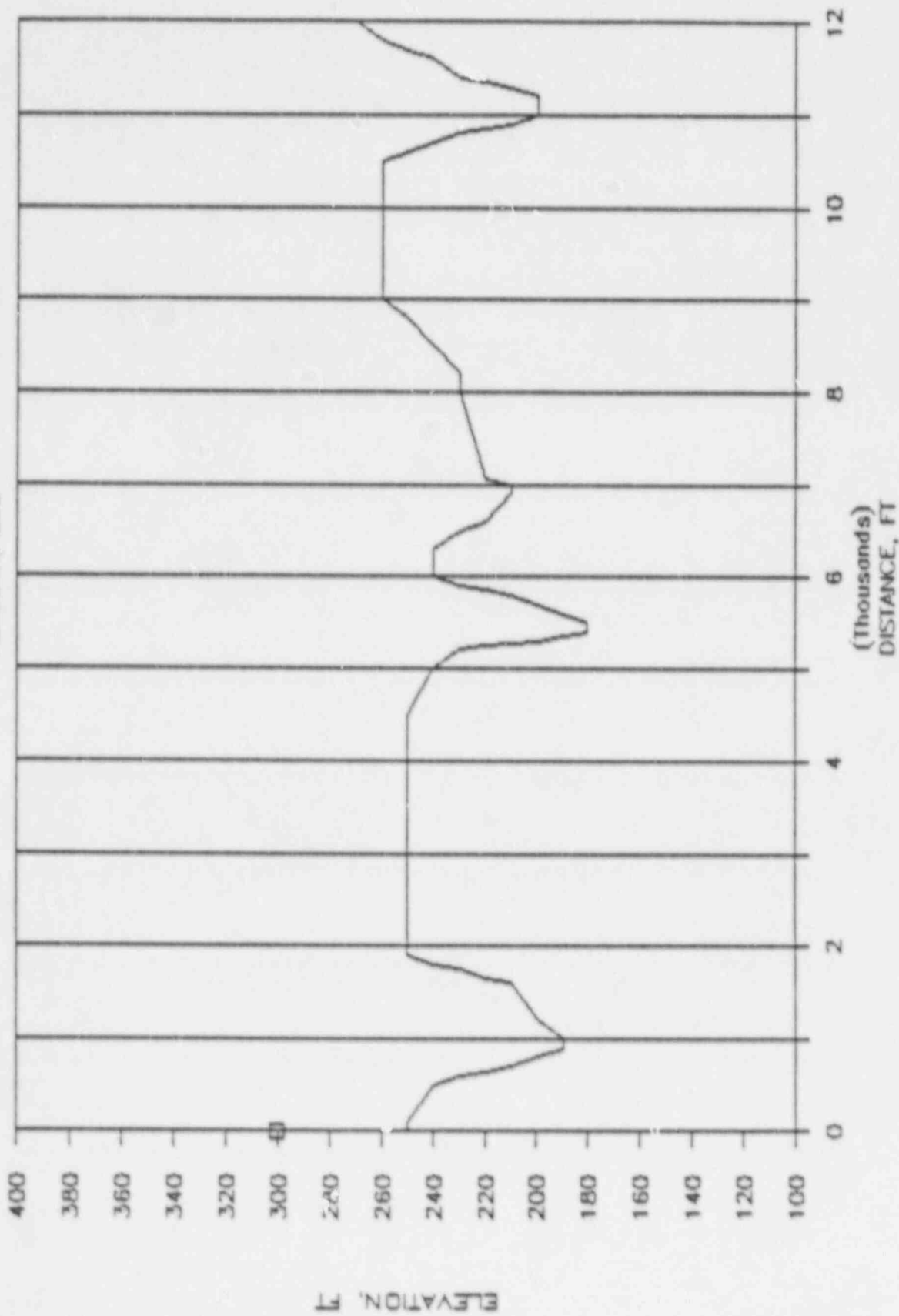
# VOGTLE B11

AZIMUTH, SE



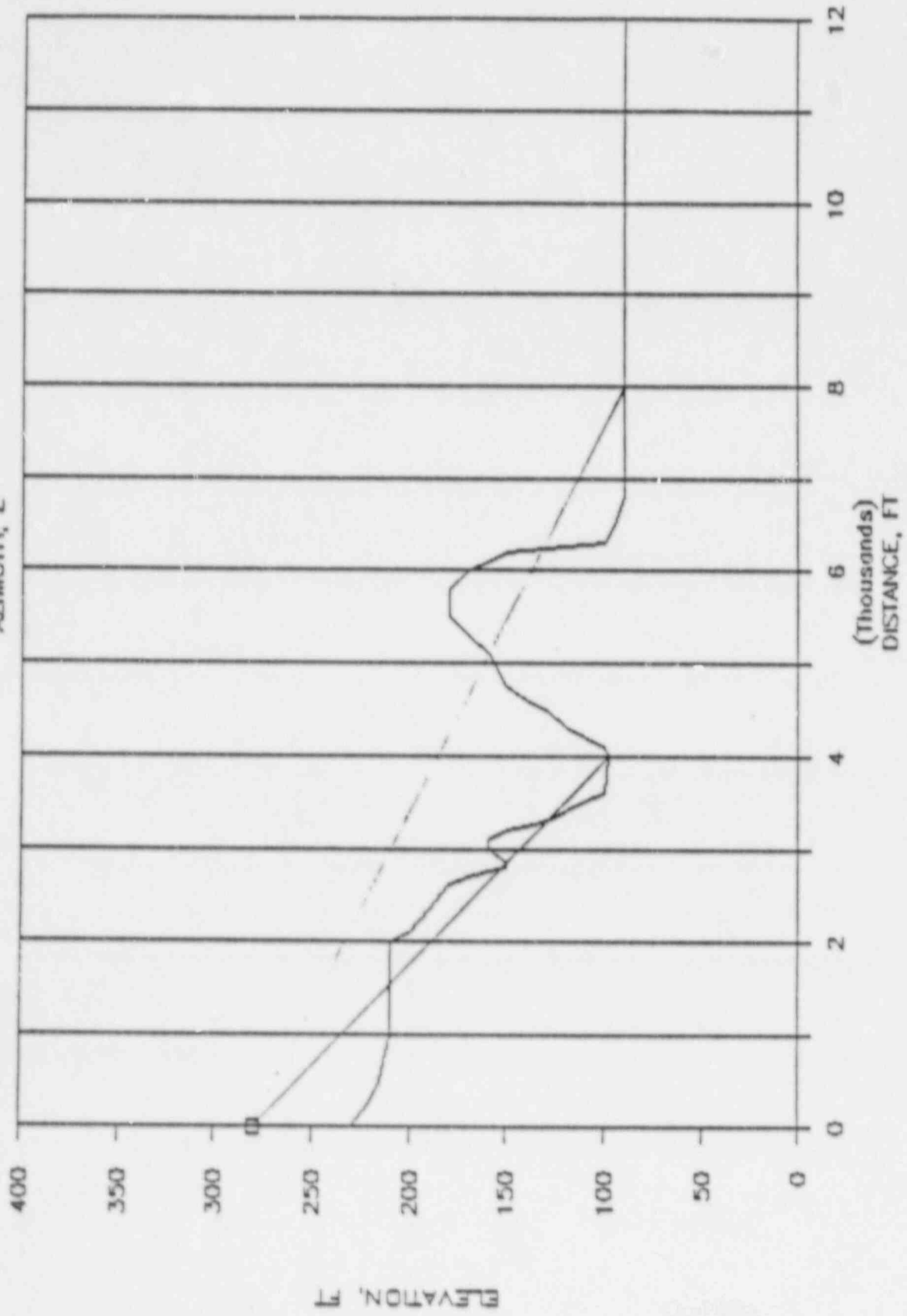
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AZIMUTH, ESE



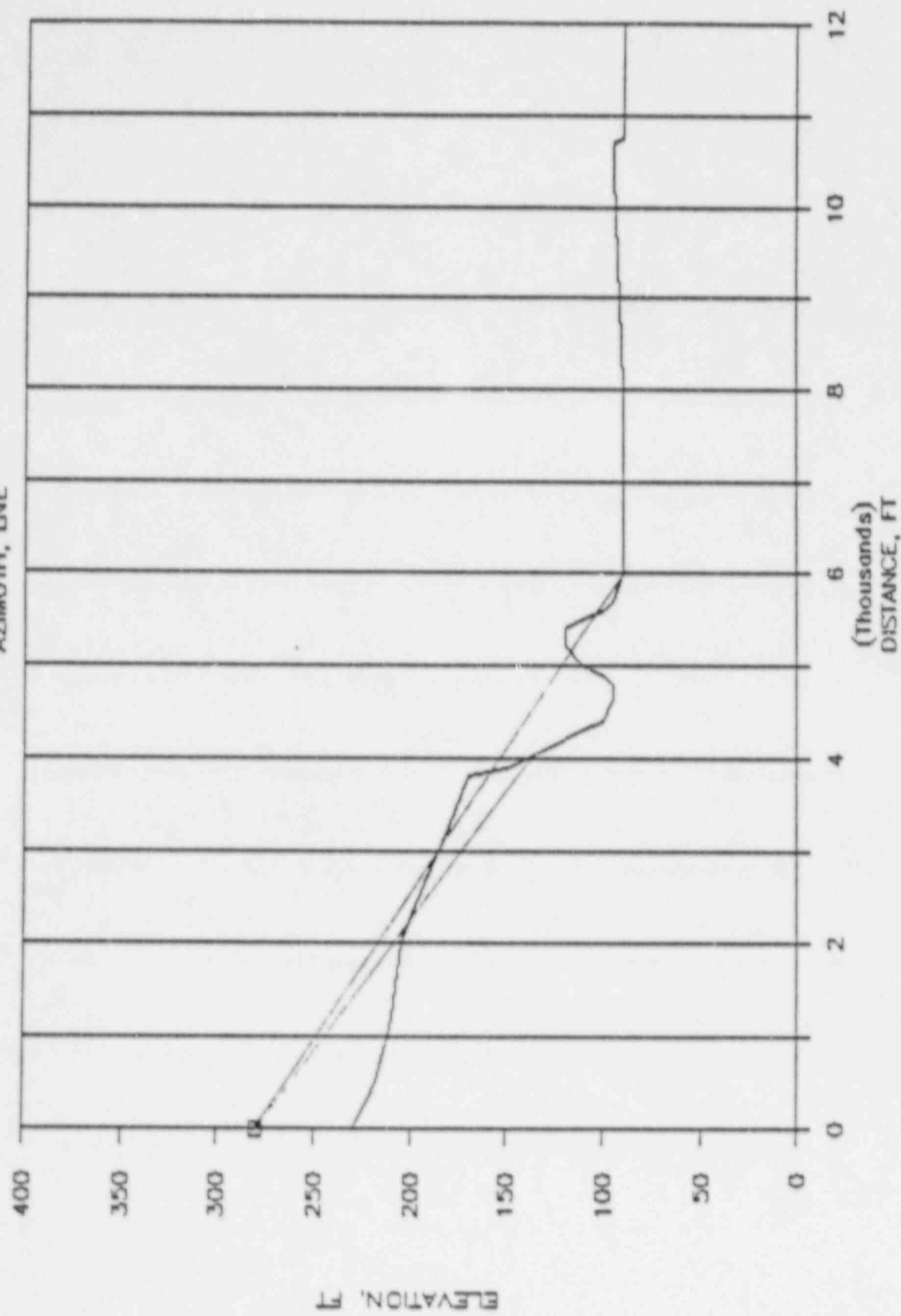
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AZIMUTH, E



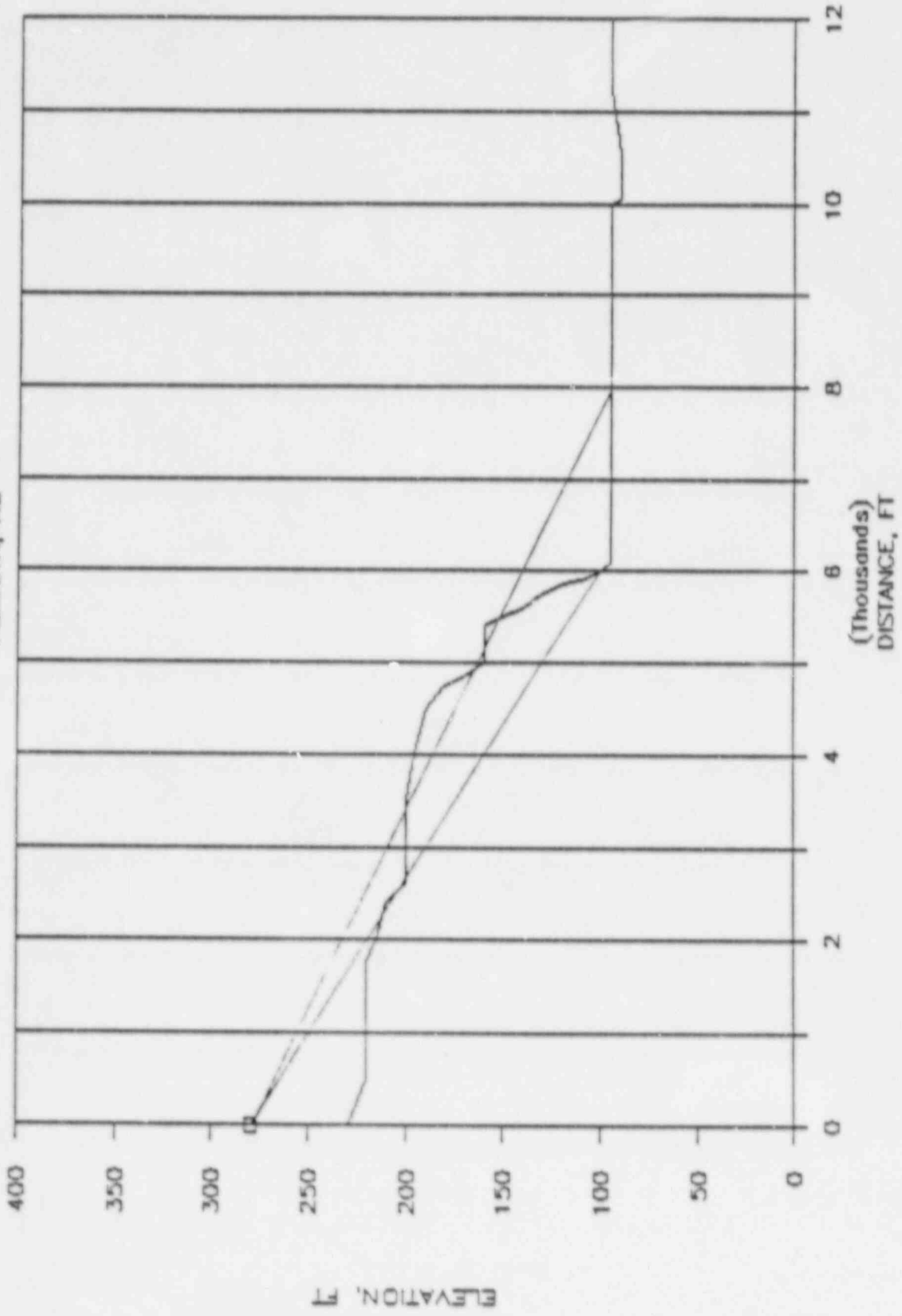
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AZIMUTH, BNE



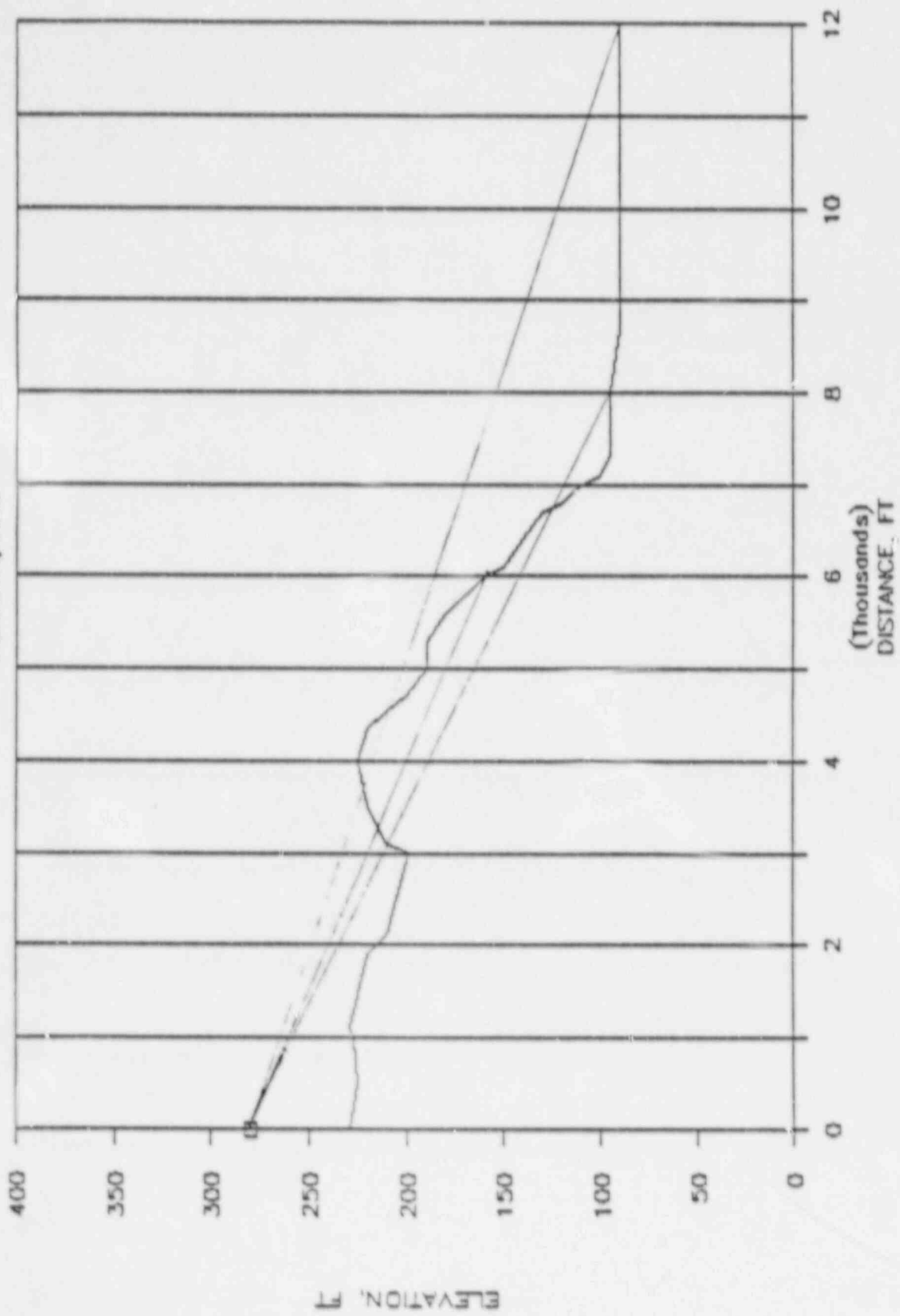
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AZIMUTH, NE



# VOGTLE B10

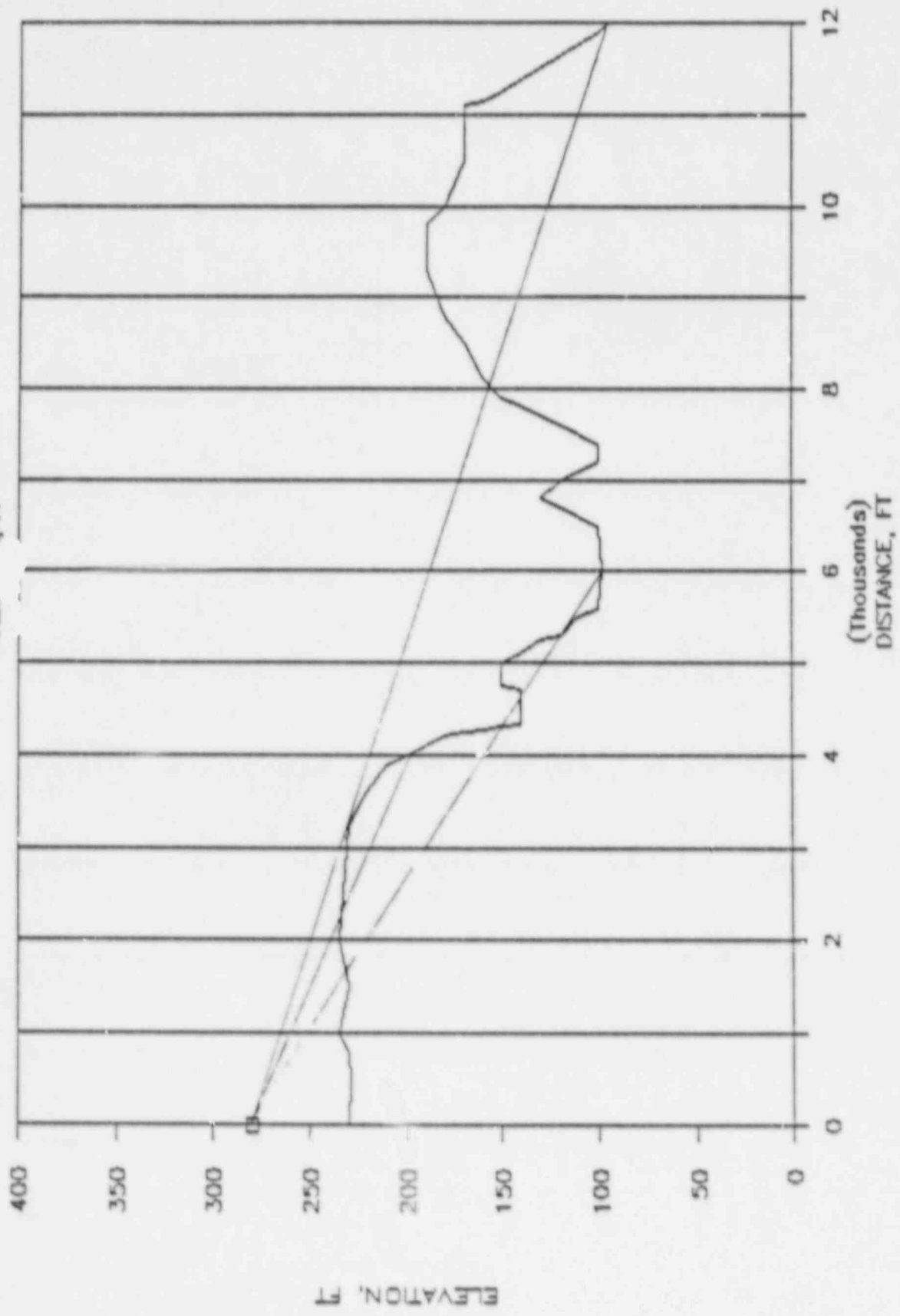
AZIMUTH, NNE





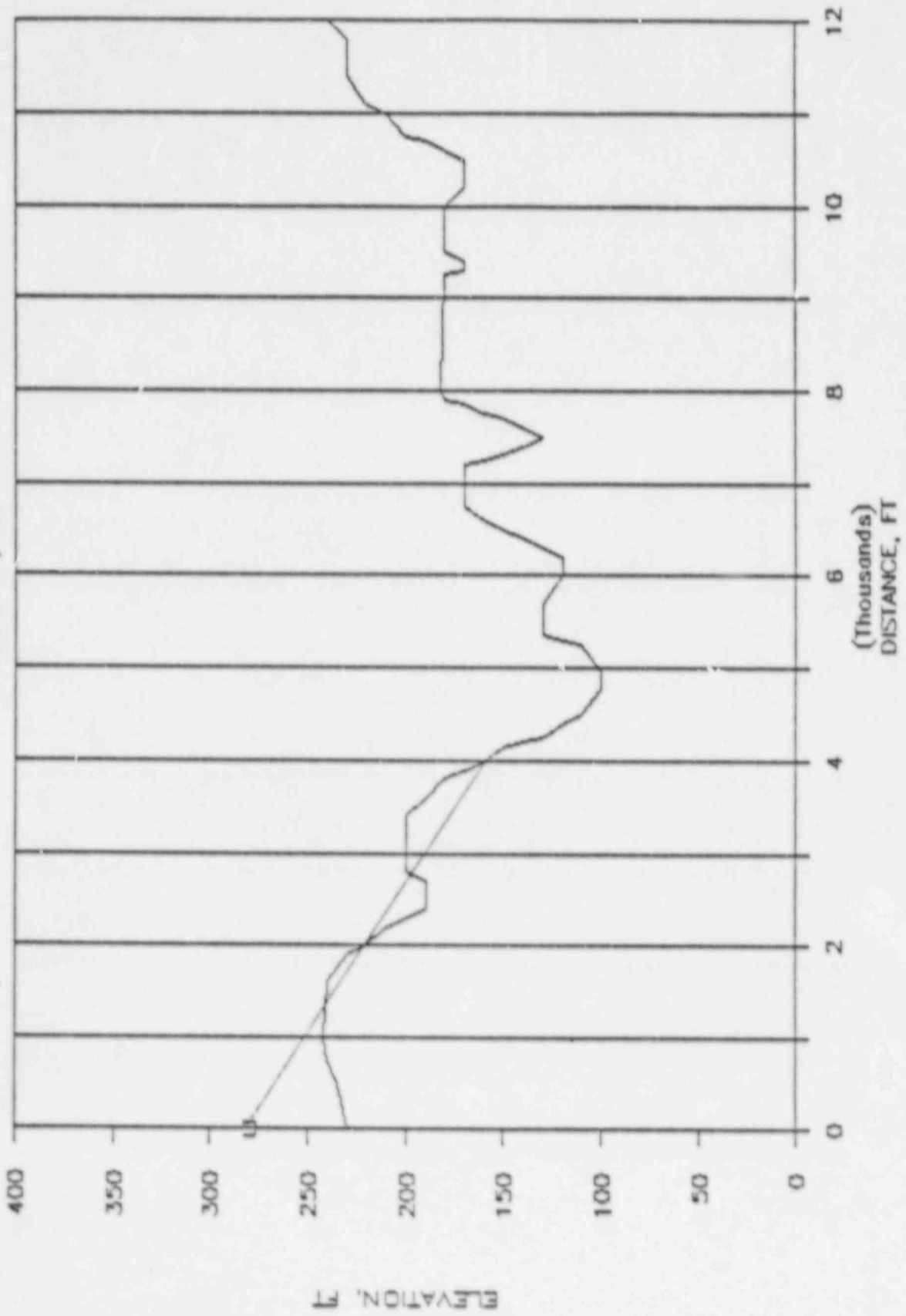
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AZ114 0TH, N



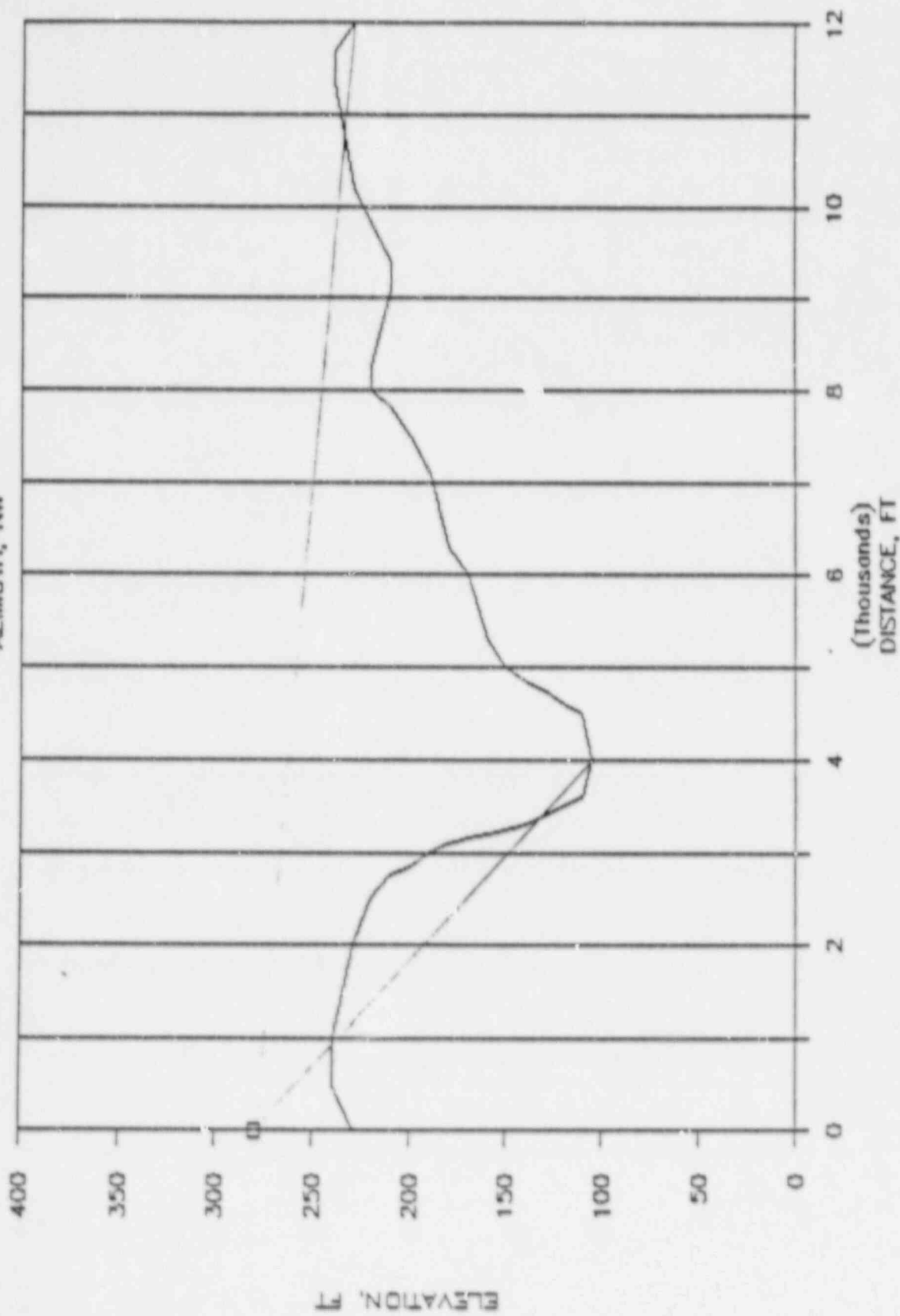
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AZIMUTH, NNW



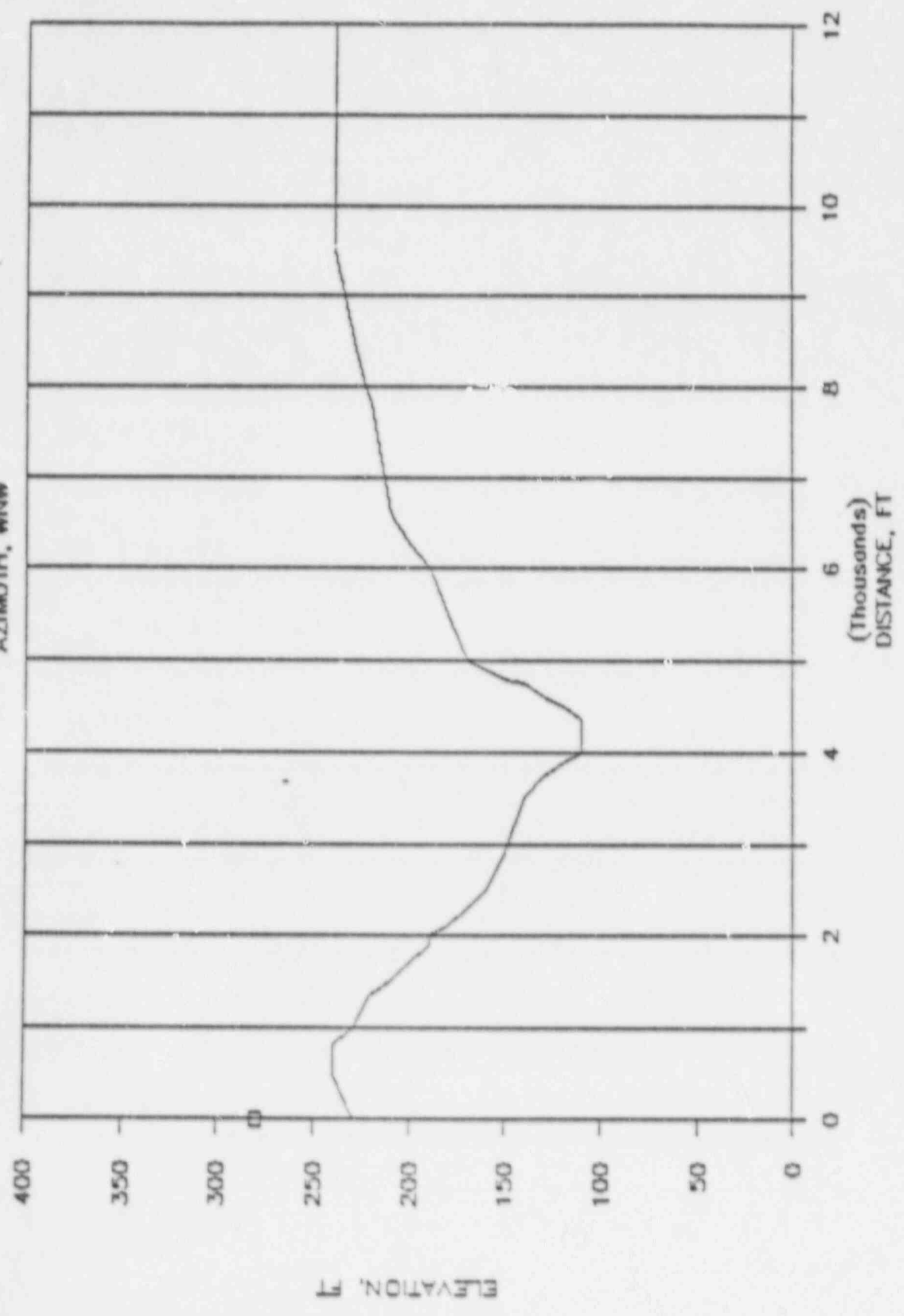
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AZIMUTH, NW



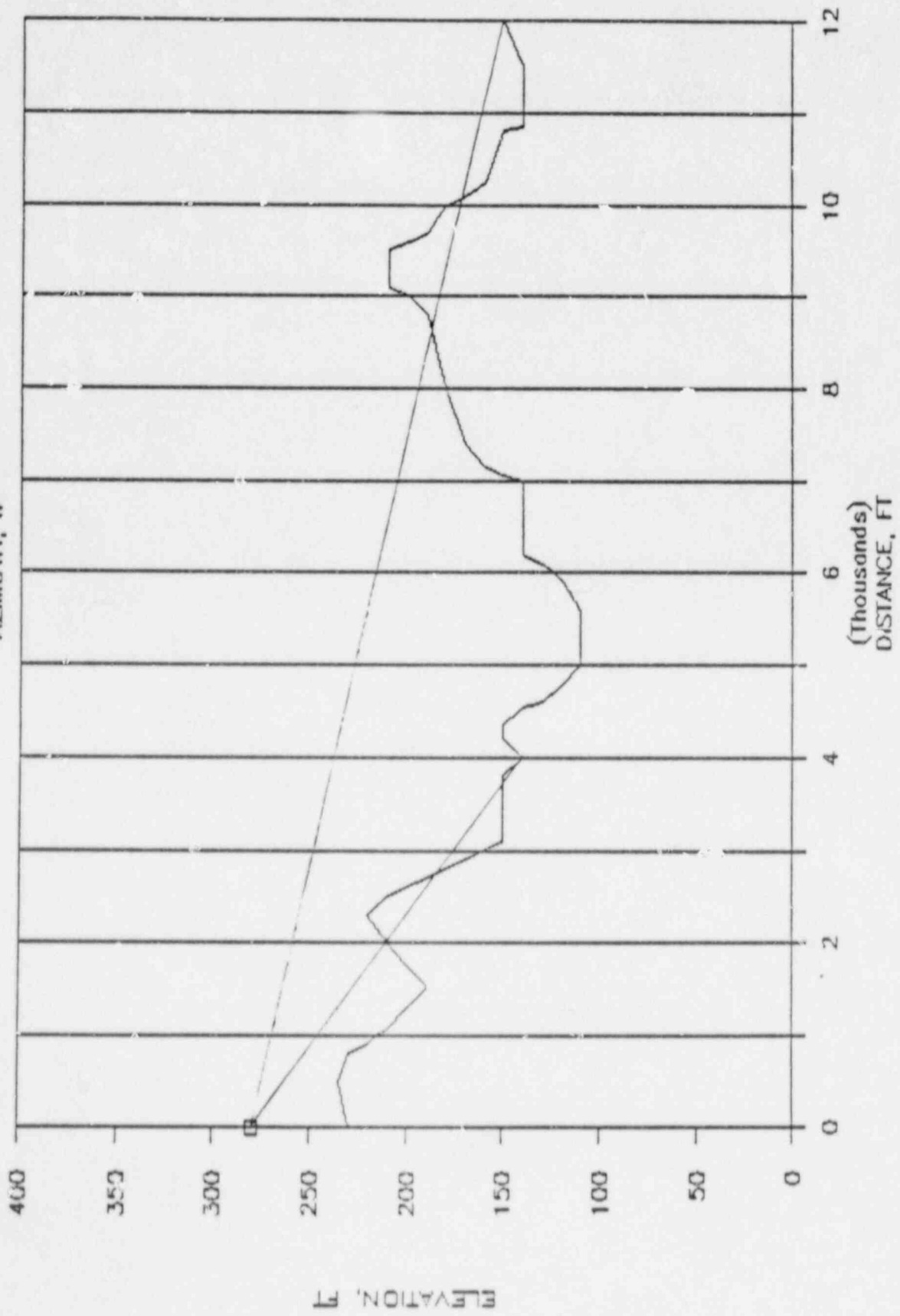
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AZIMUTH, WNW



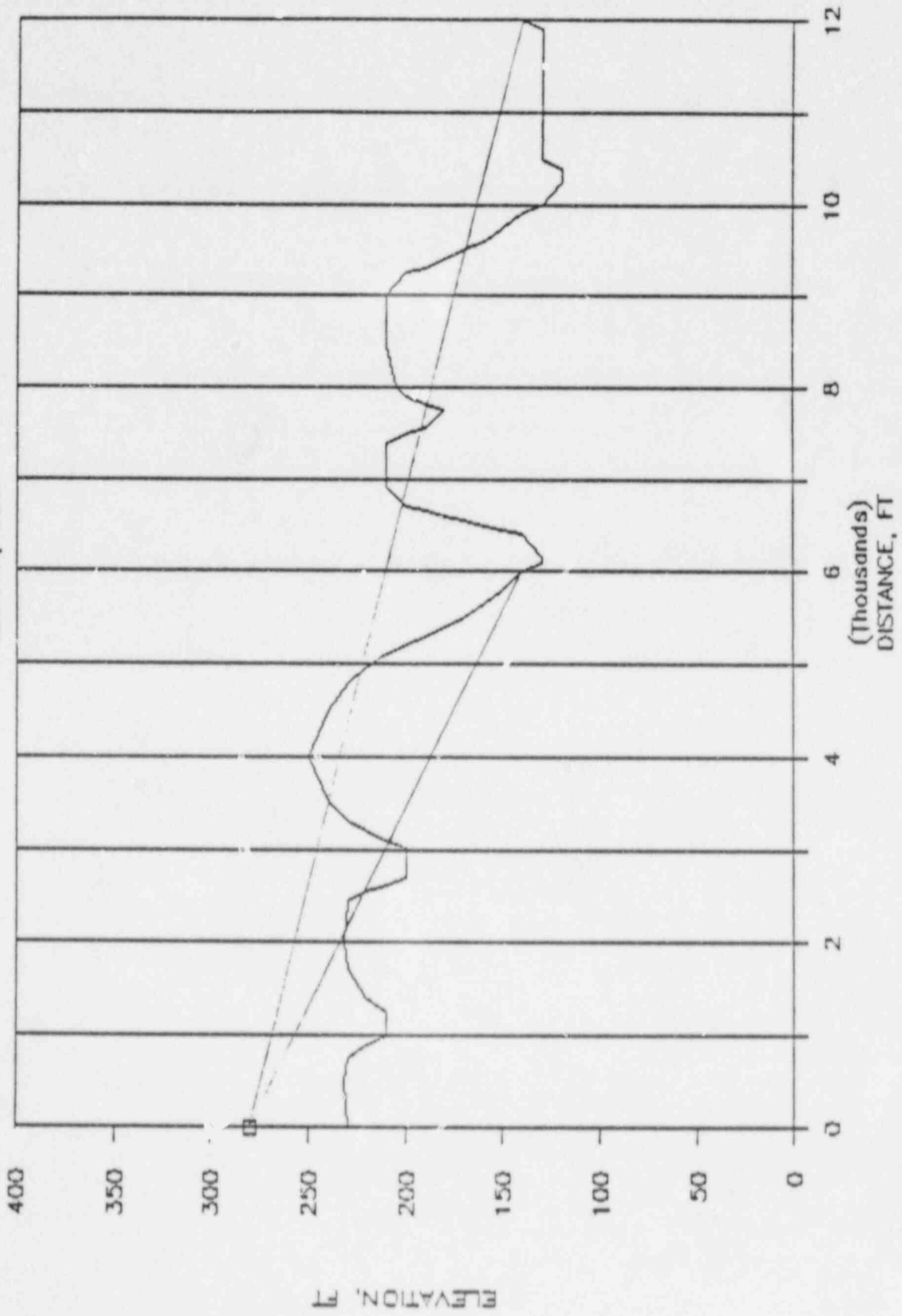
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AZIMUTH, W



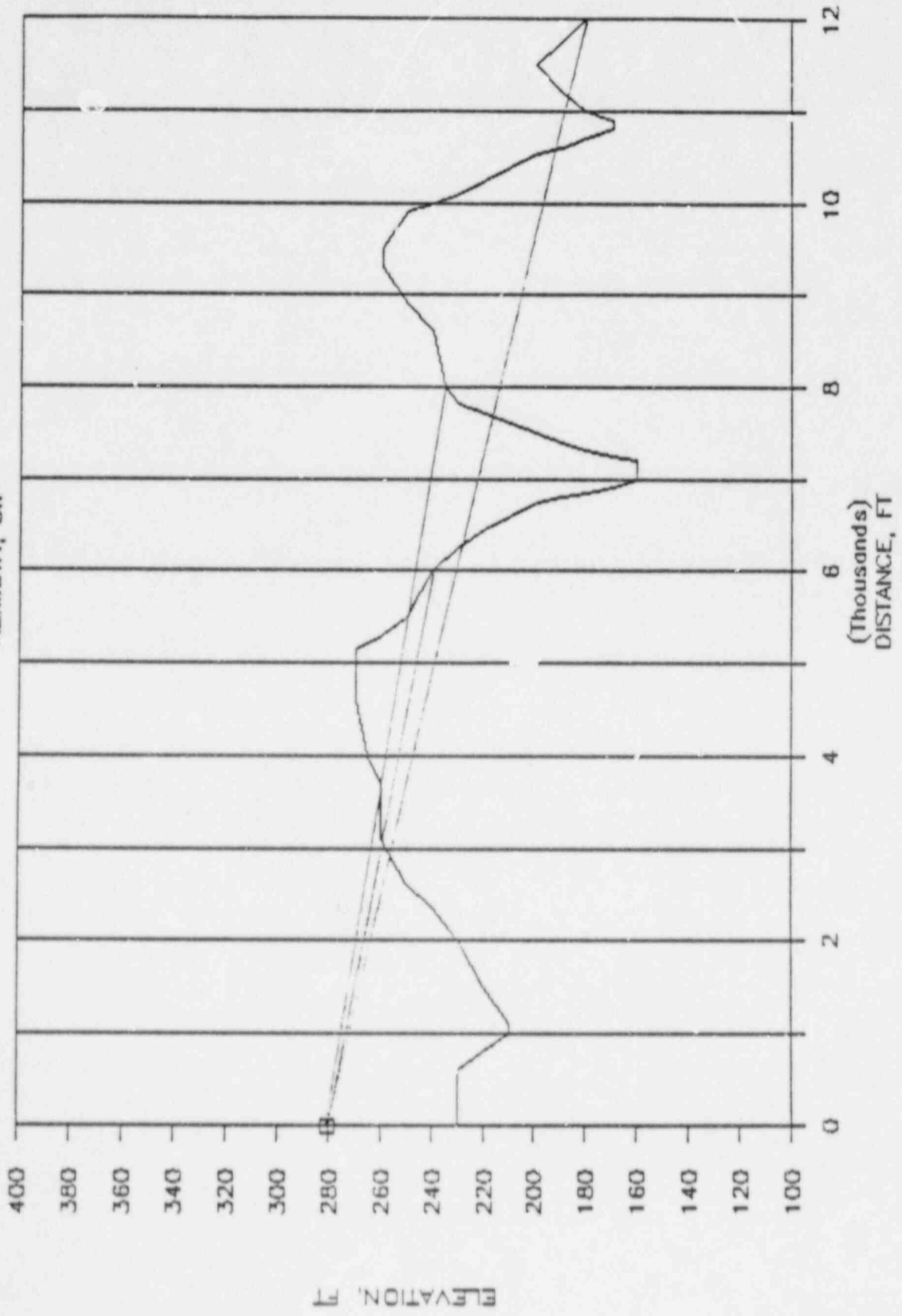
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AZIMUTH, WSW



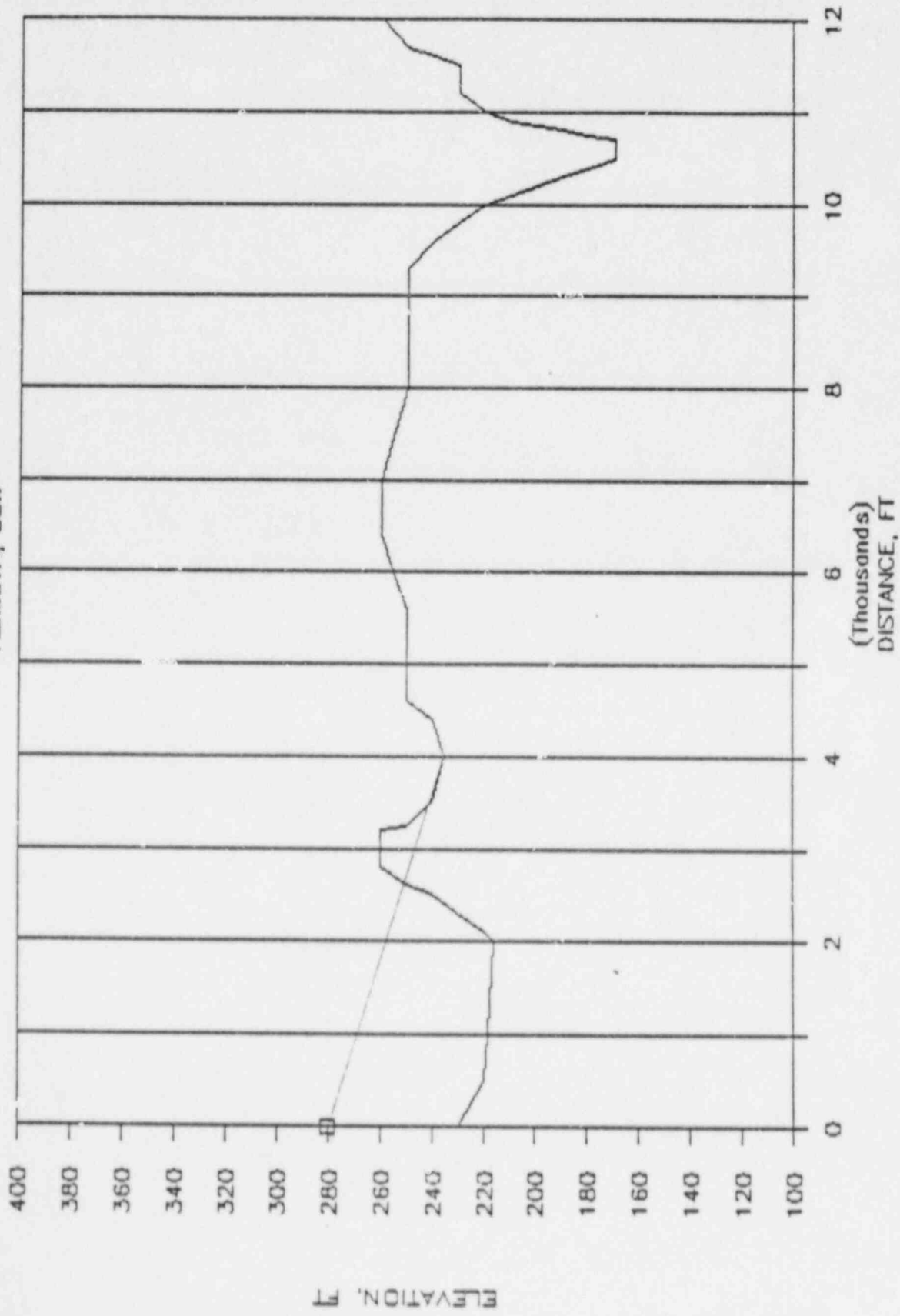
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AZIMUTH, SW



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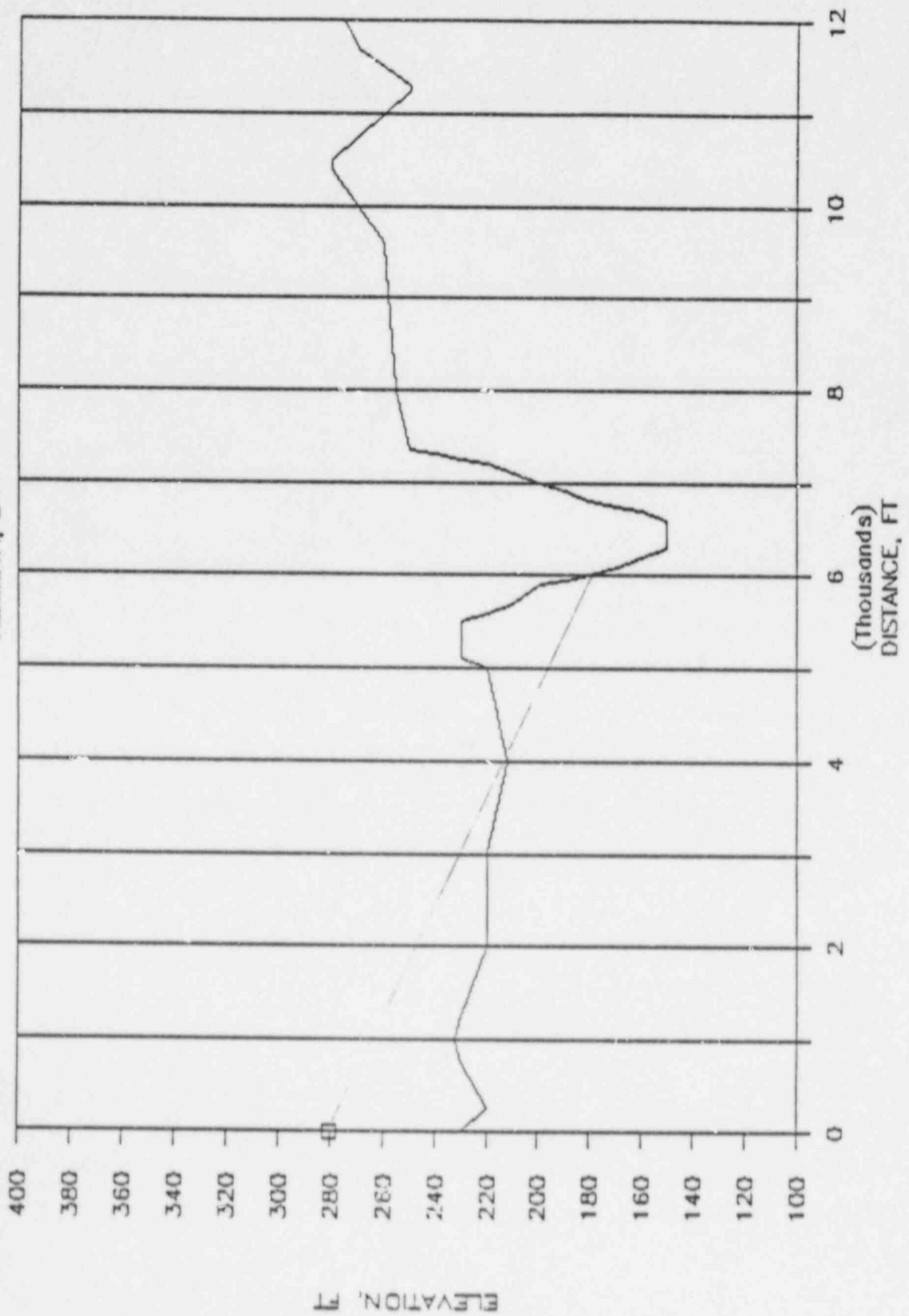
AZIMUTH, SSW





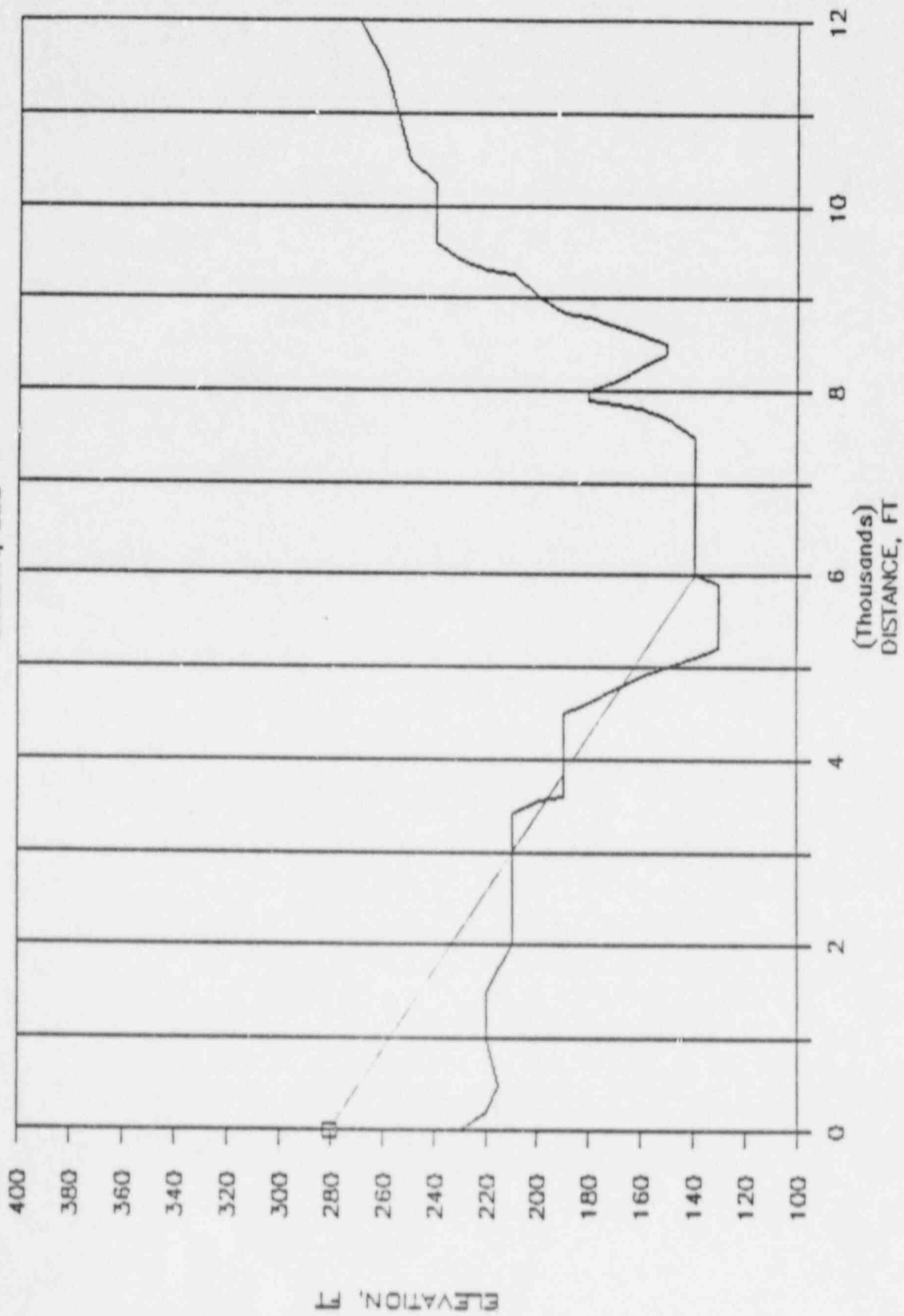
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AZIMUTH, S



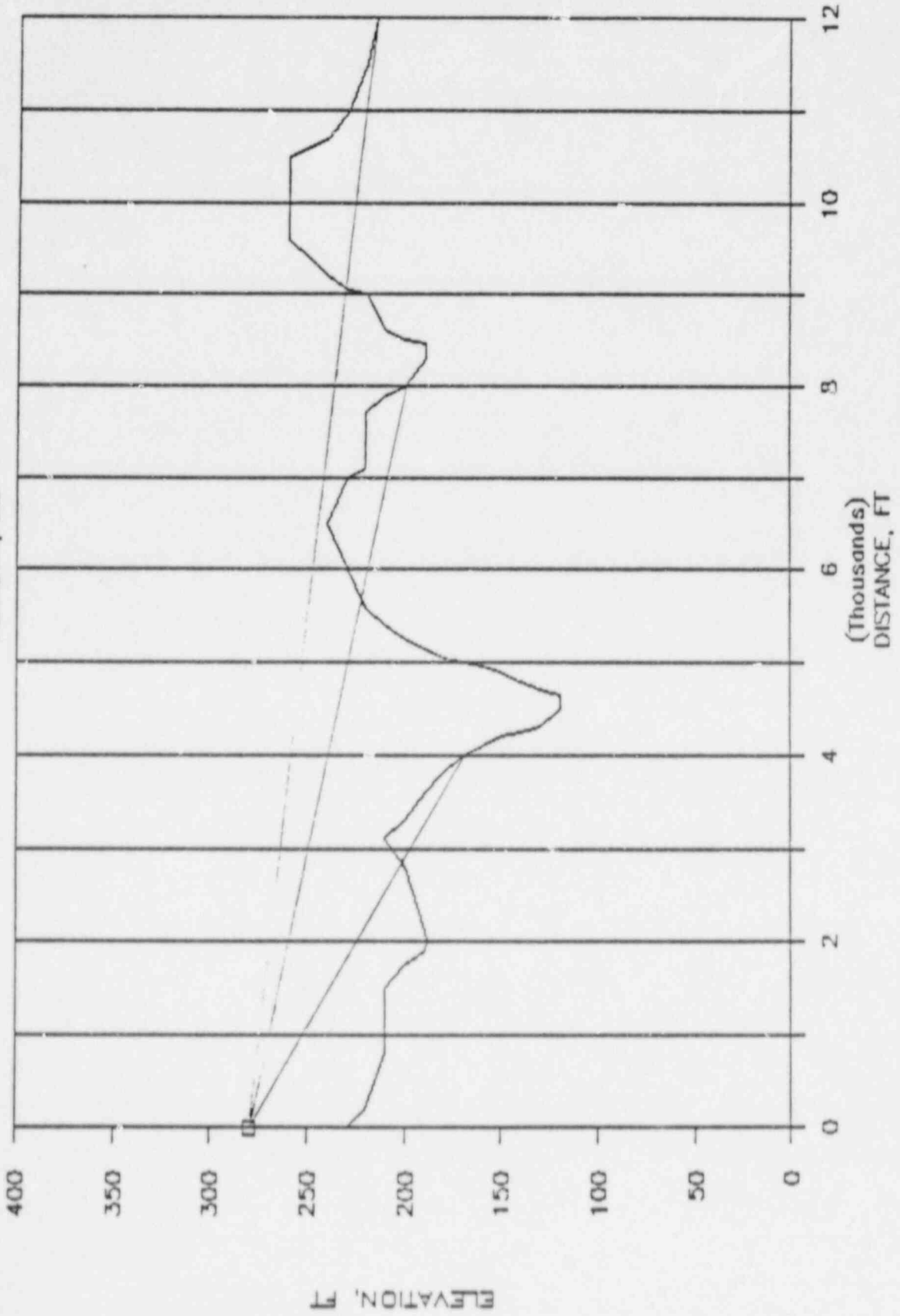
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AZIMUTH, SSE



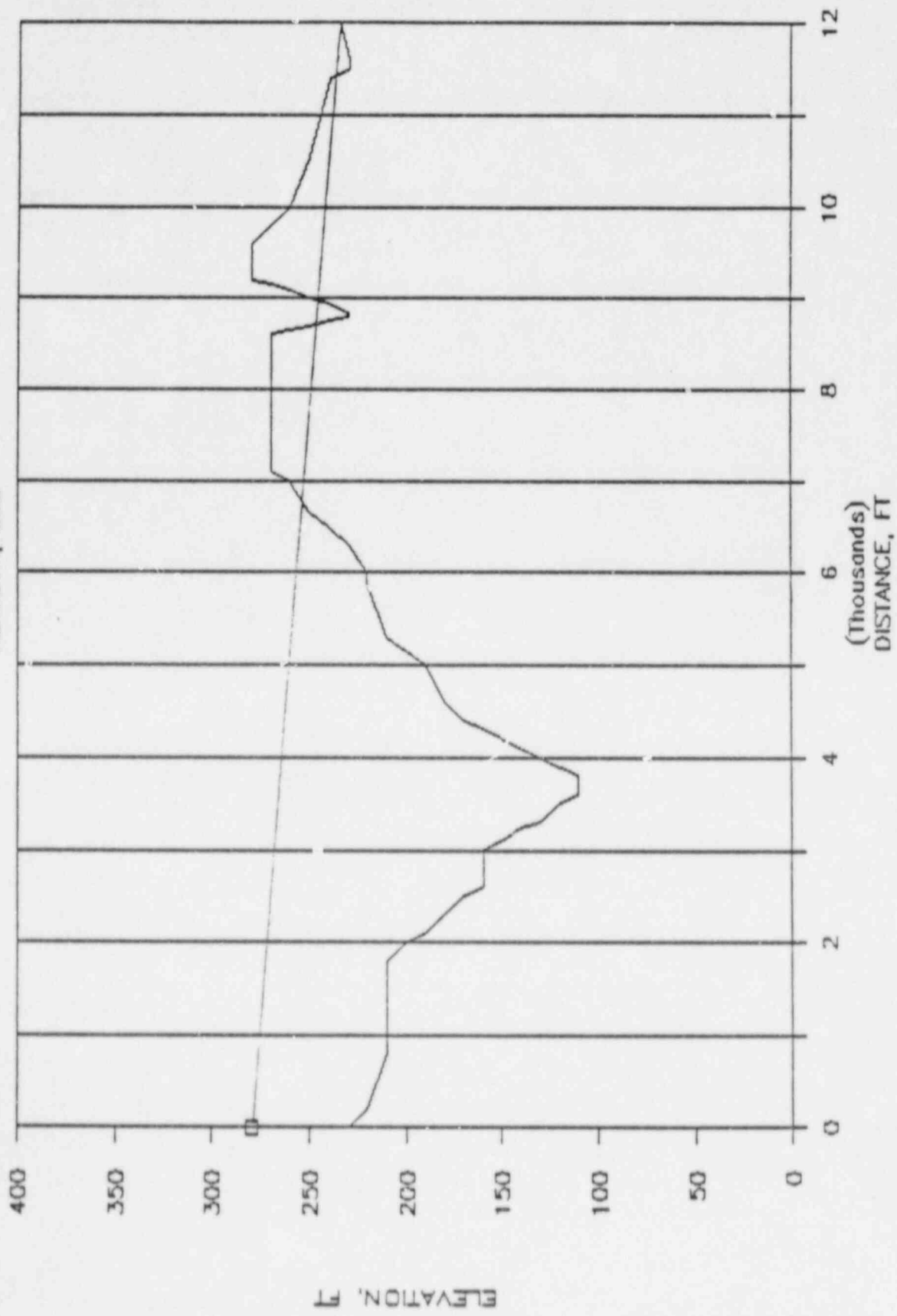
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AZIMUTH, SE



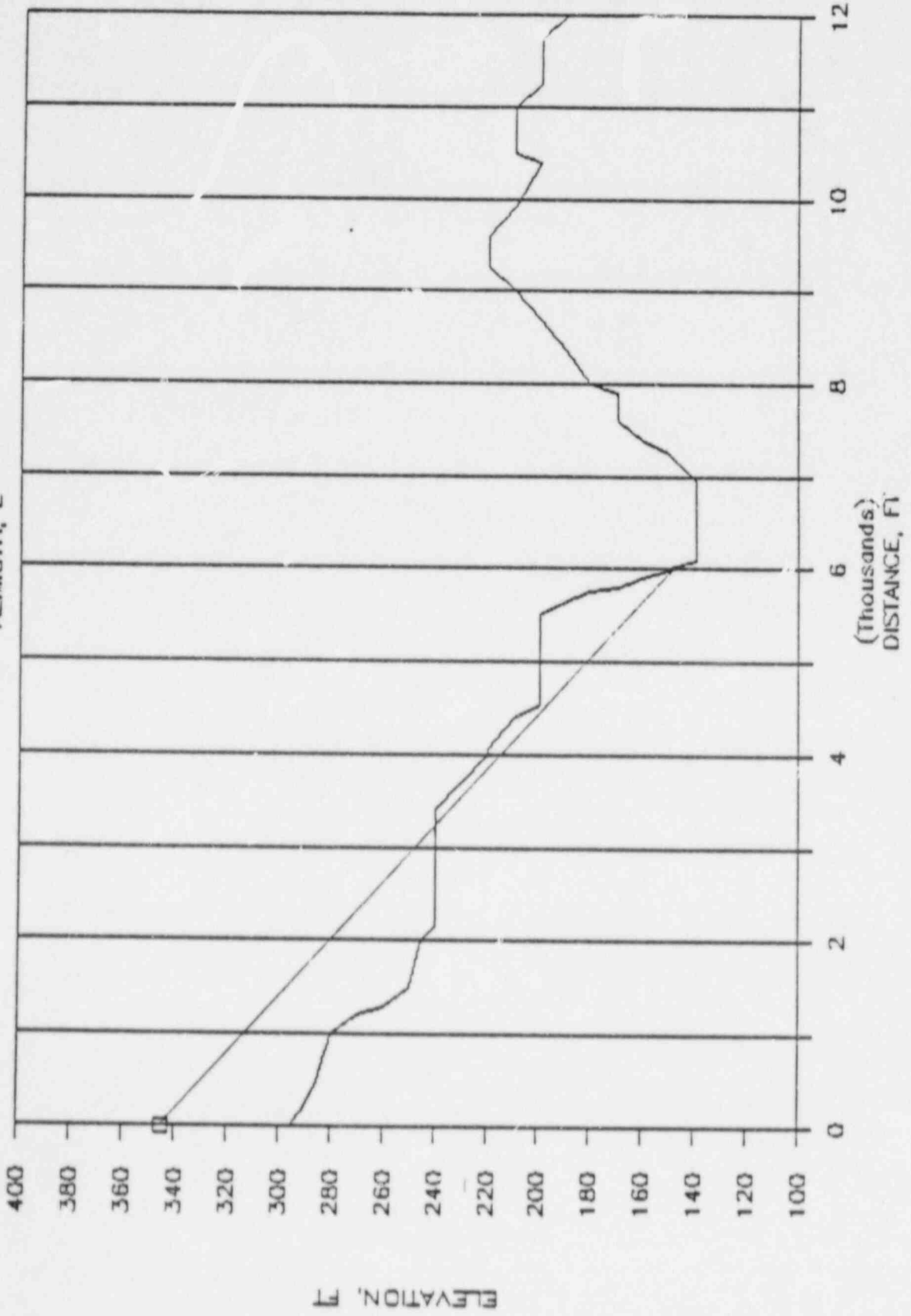
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AZIMUTH, ESE



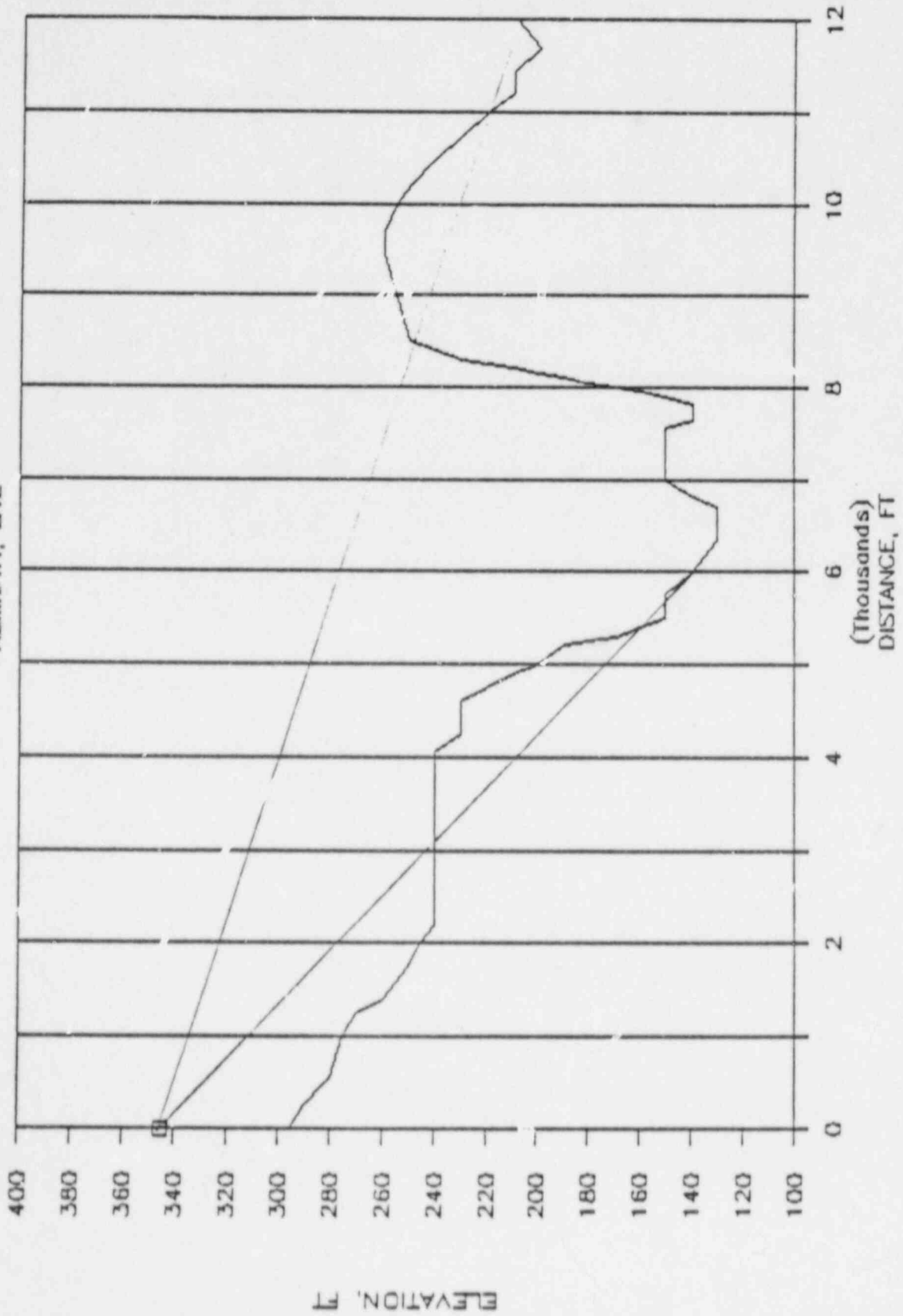
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AZIMUTH, E



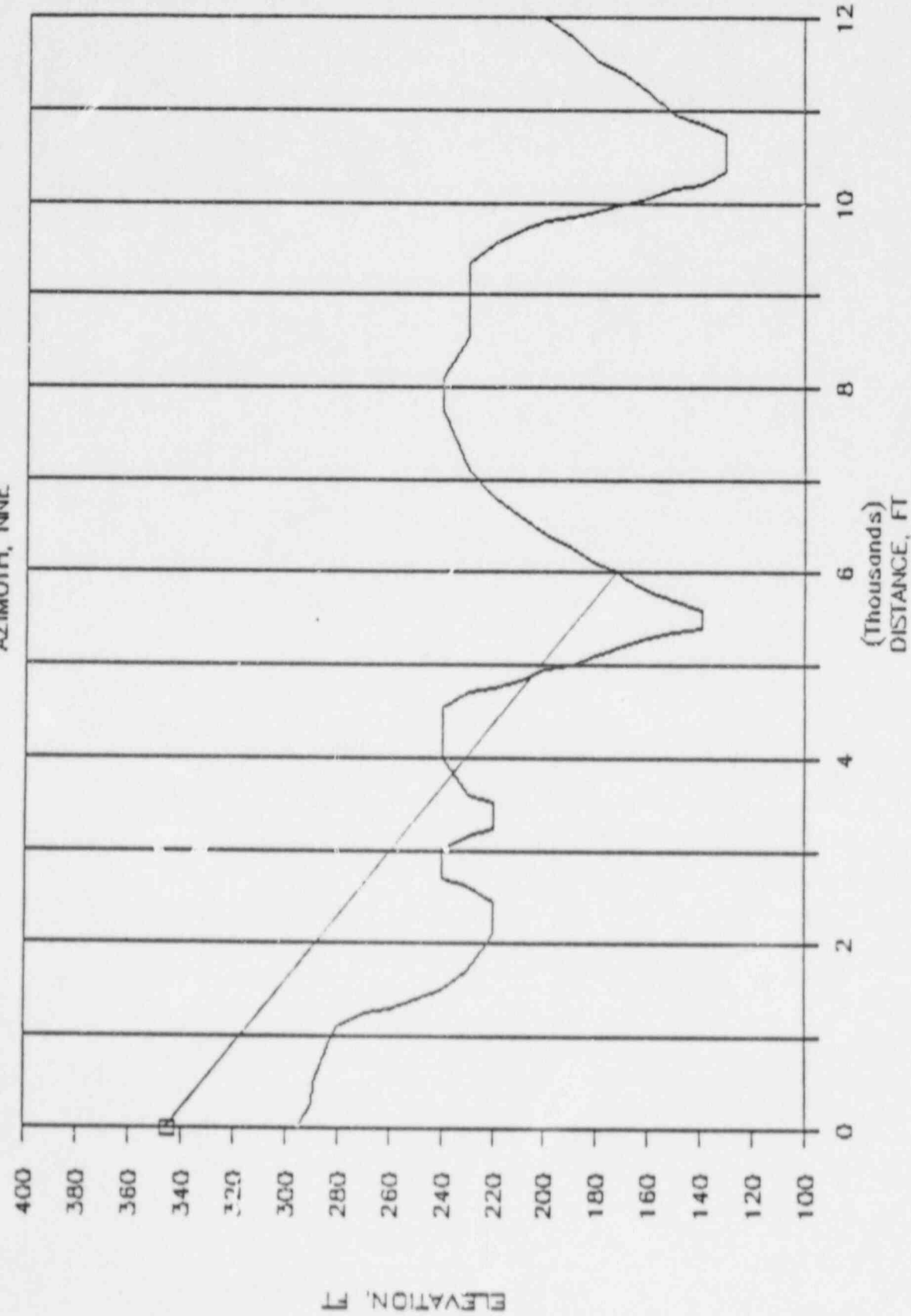
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AZIMUTH, ENE



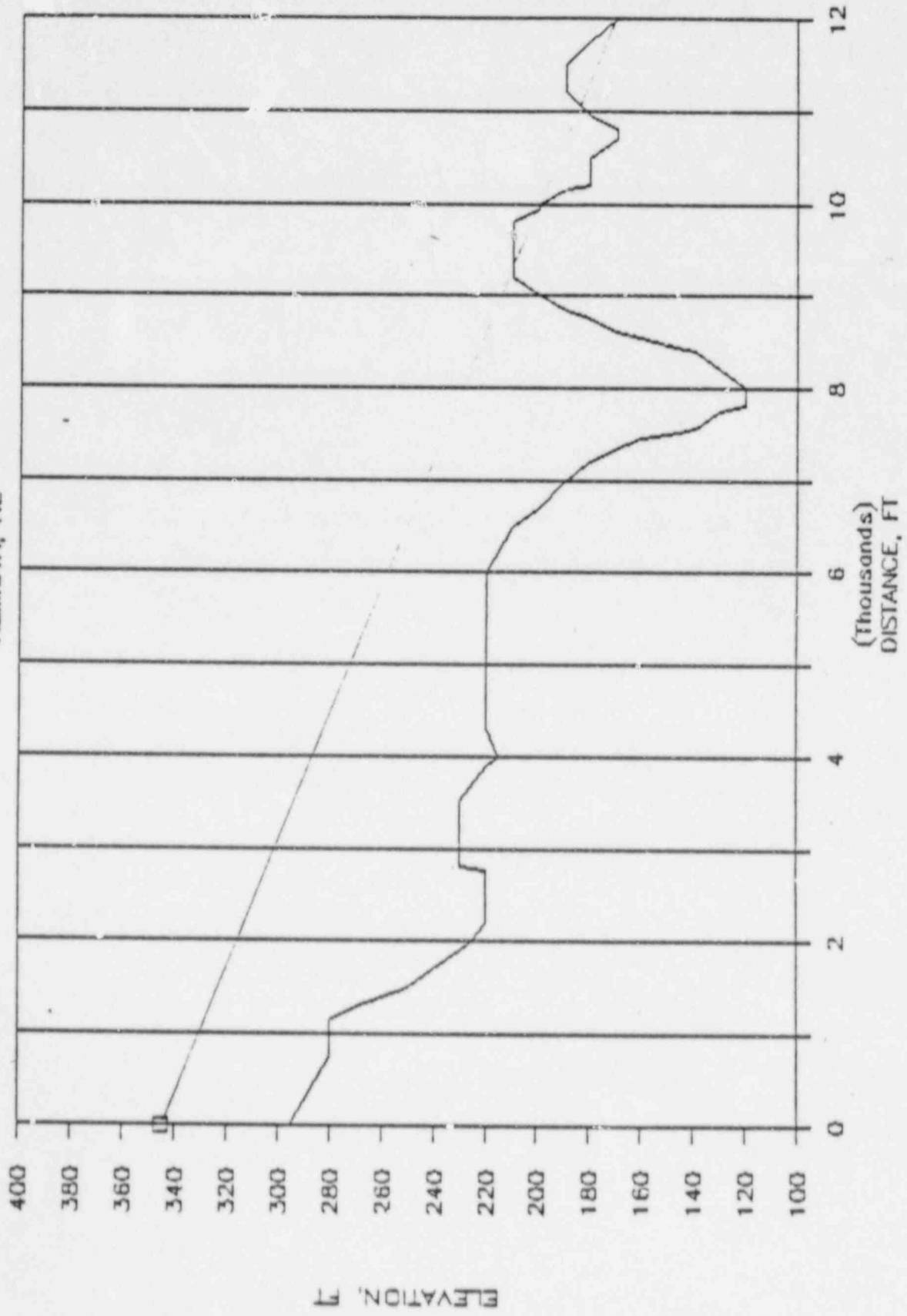
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AZIMUTH, NNE



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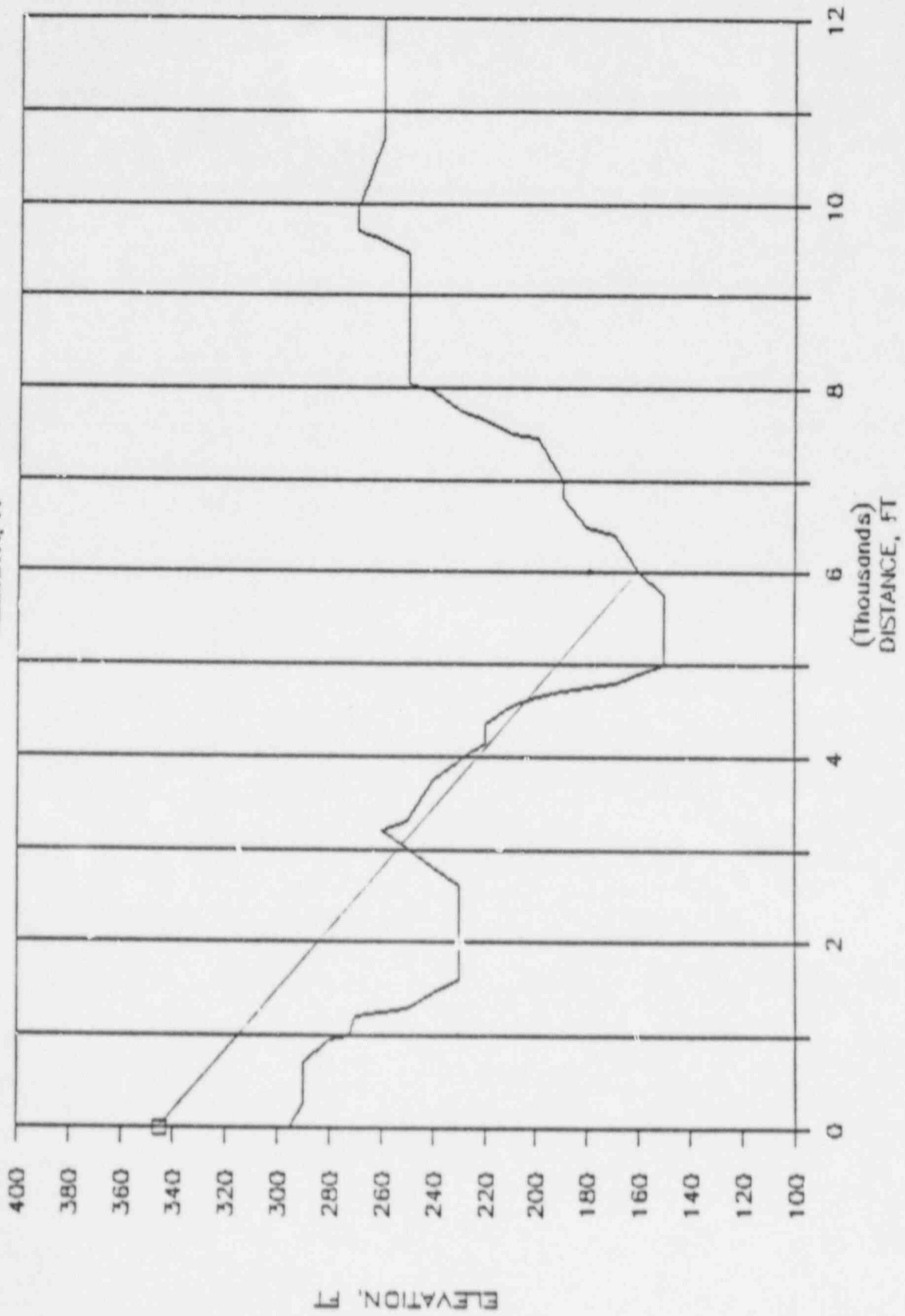
AZIMUTH, NE





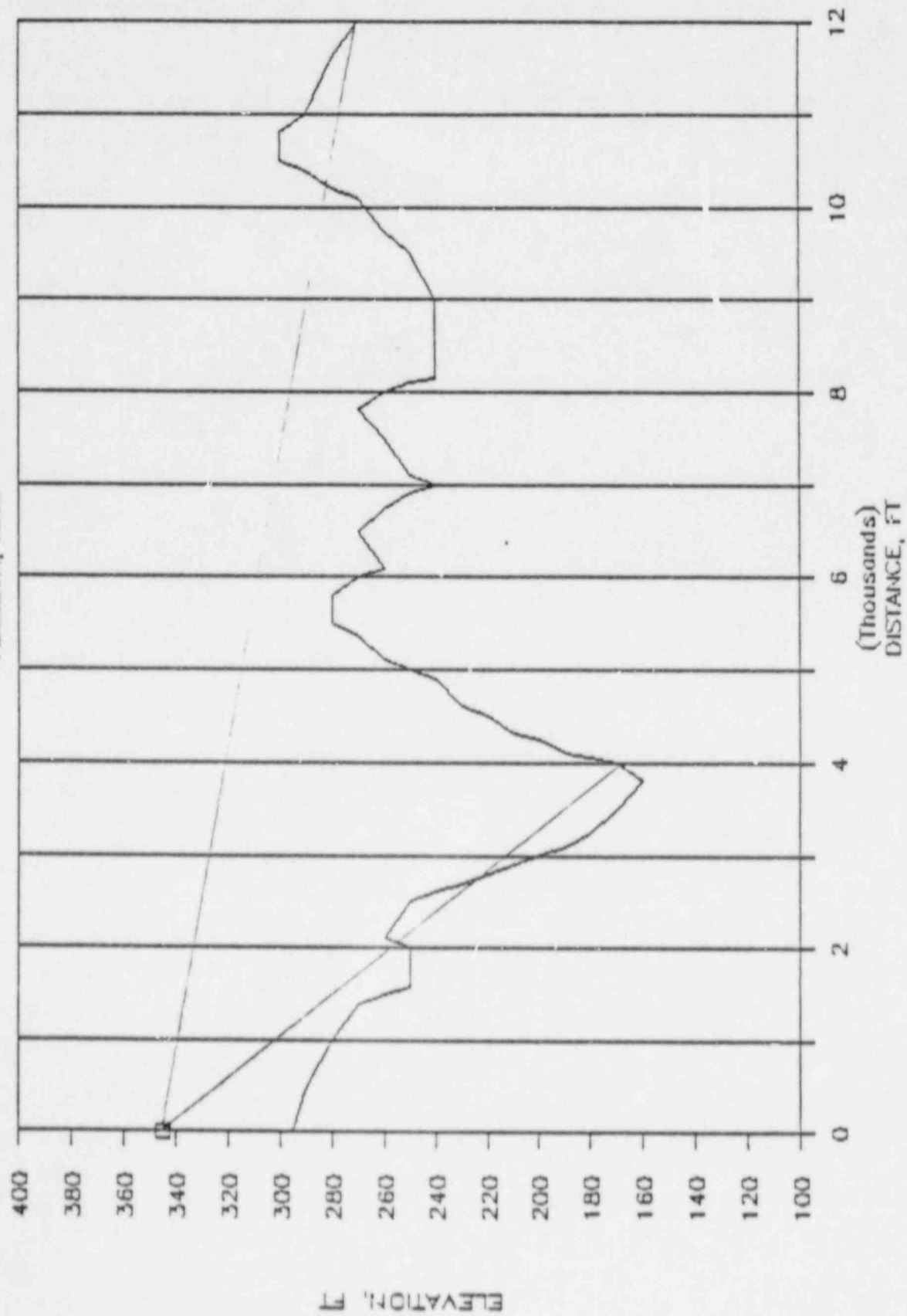
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AZIMUTH, N



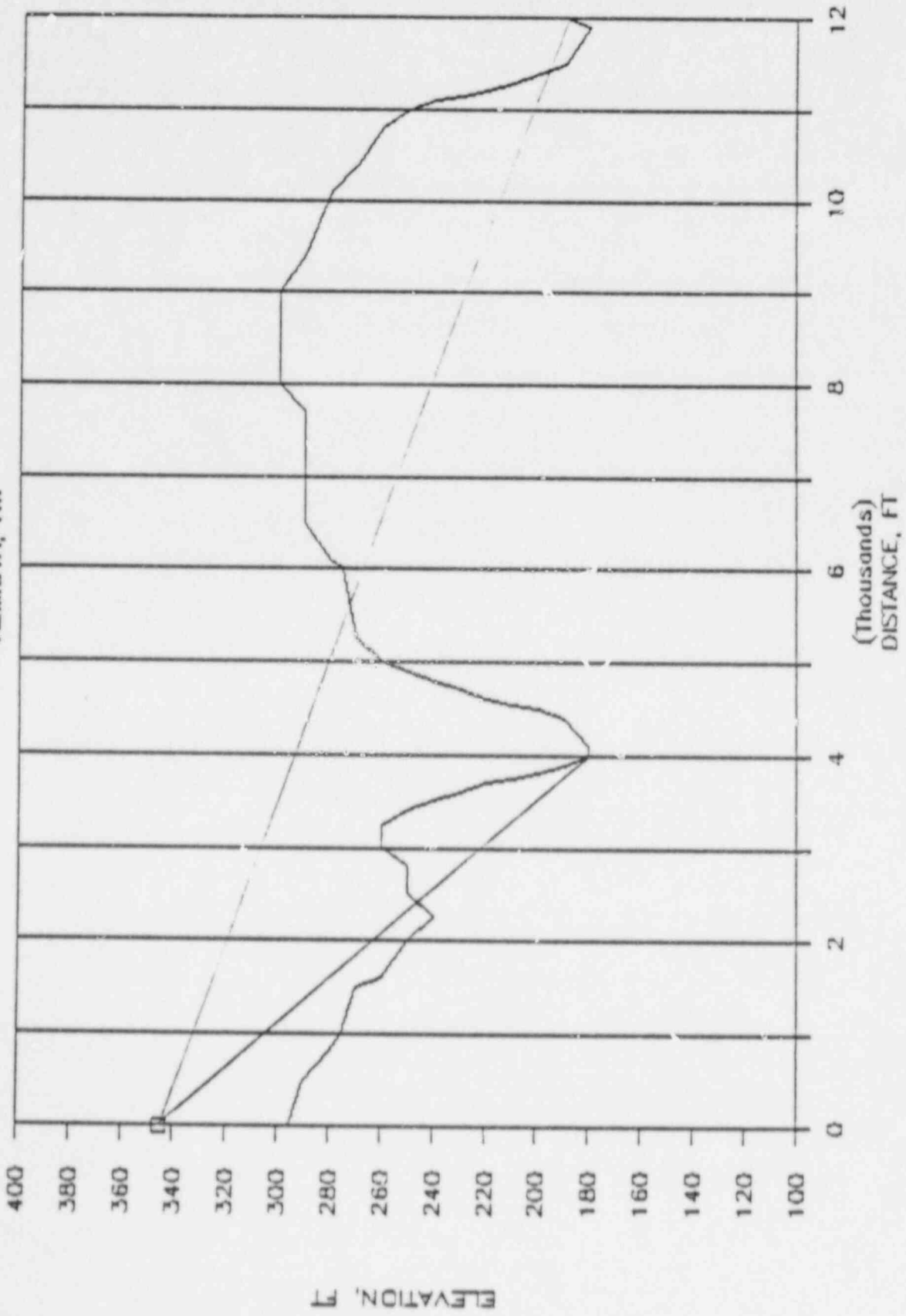
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AZIMUTH, NNW



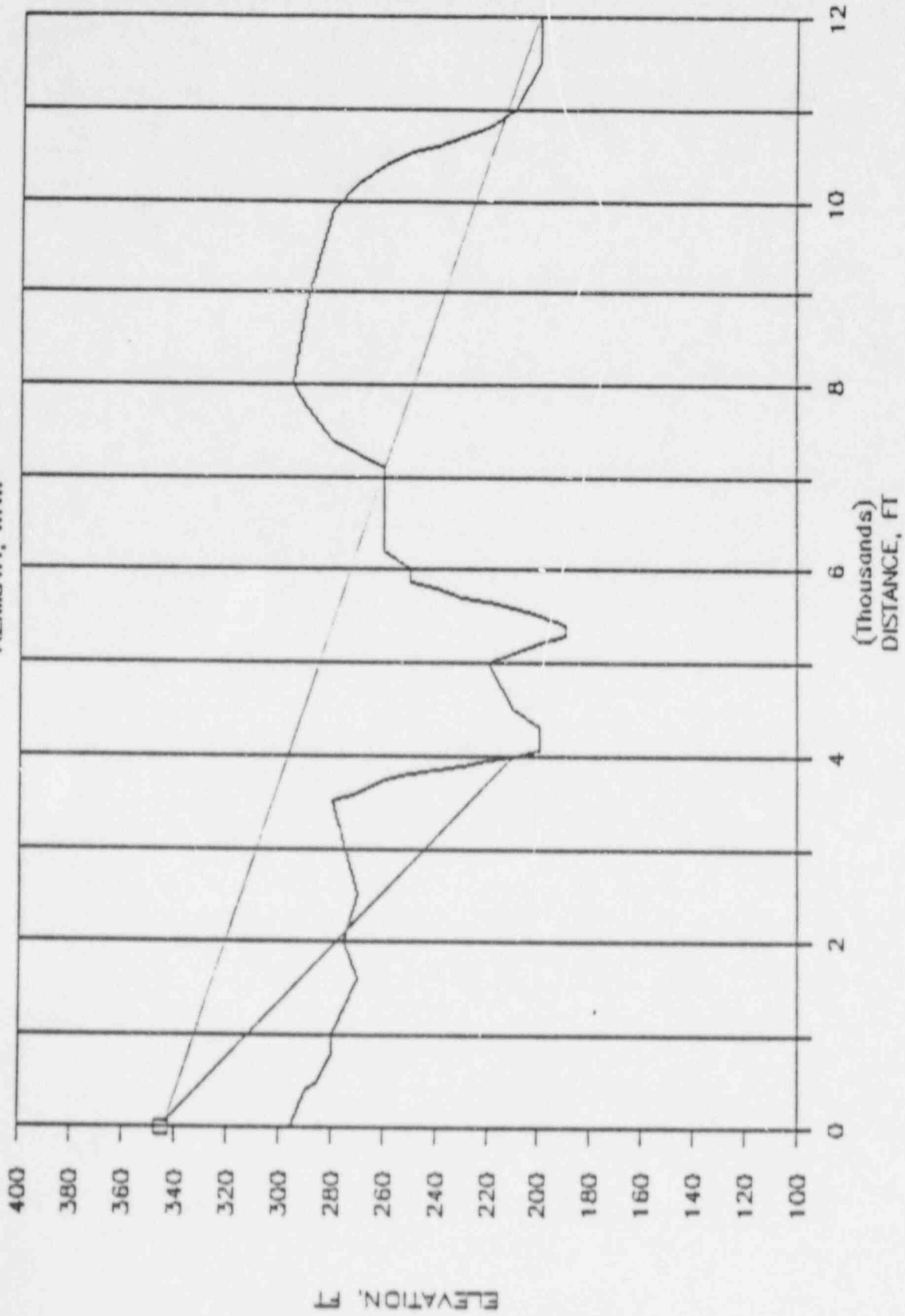
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AZIMUTH, NW



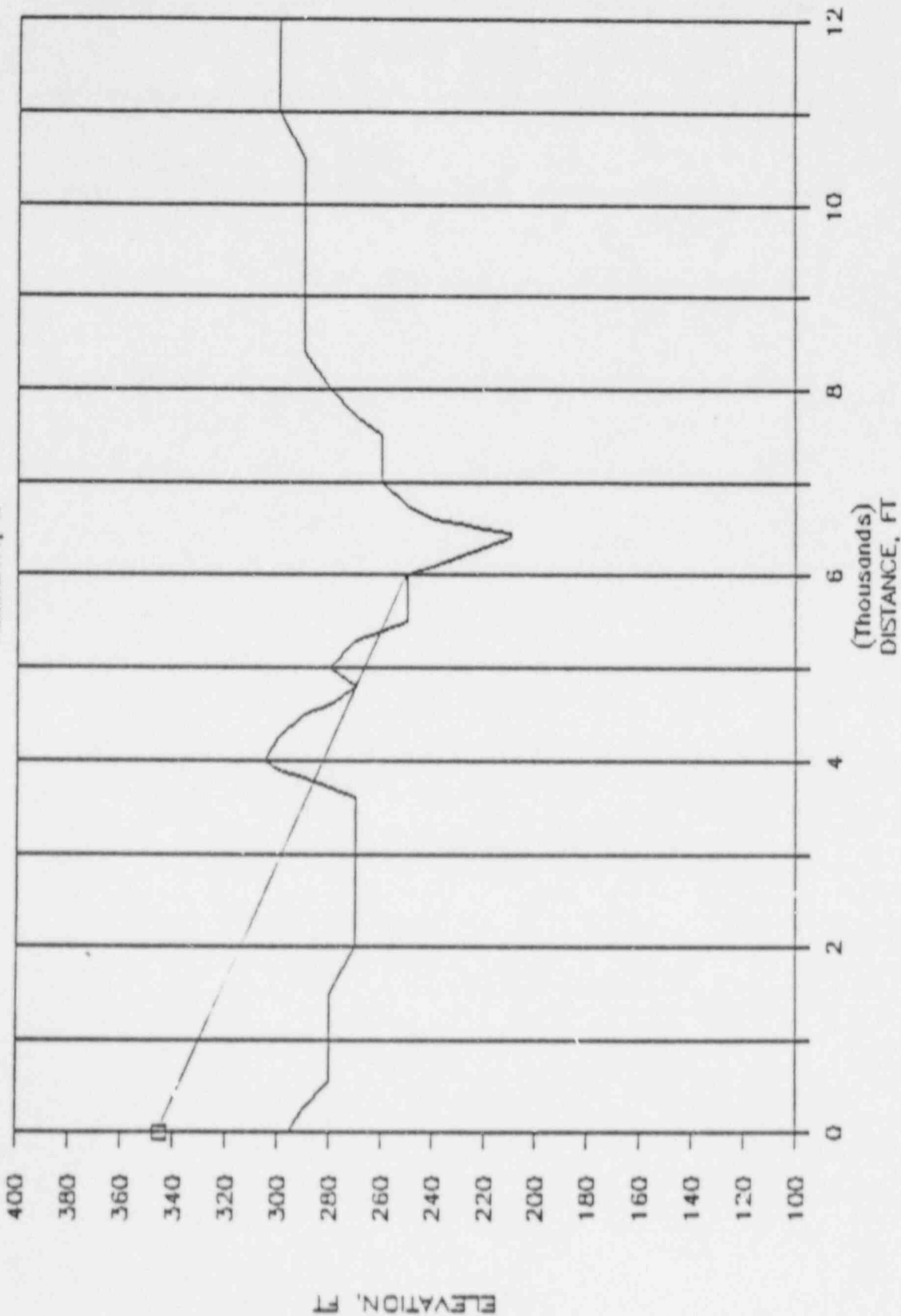
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AZIMUTH, WINW



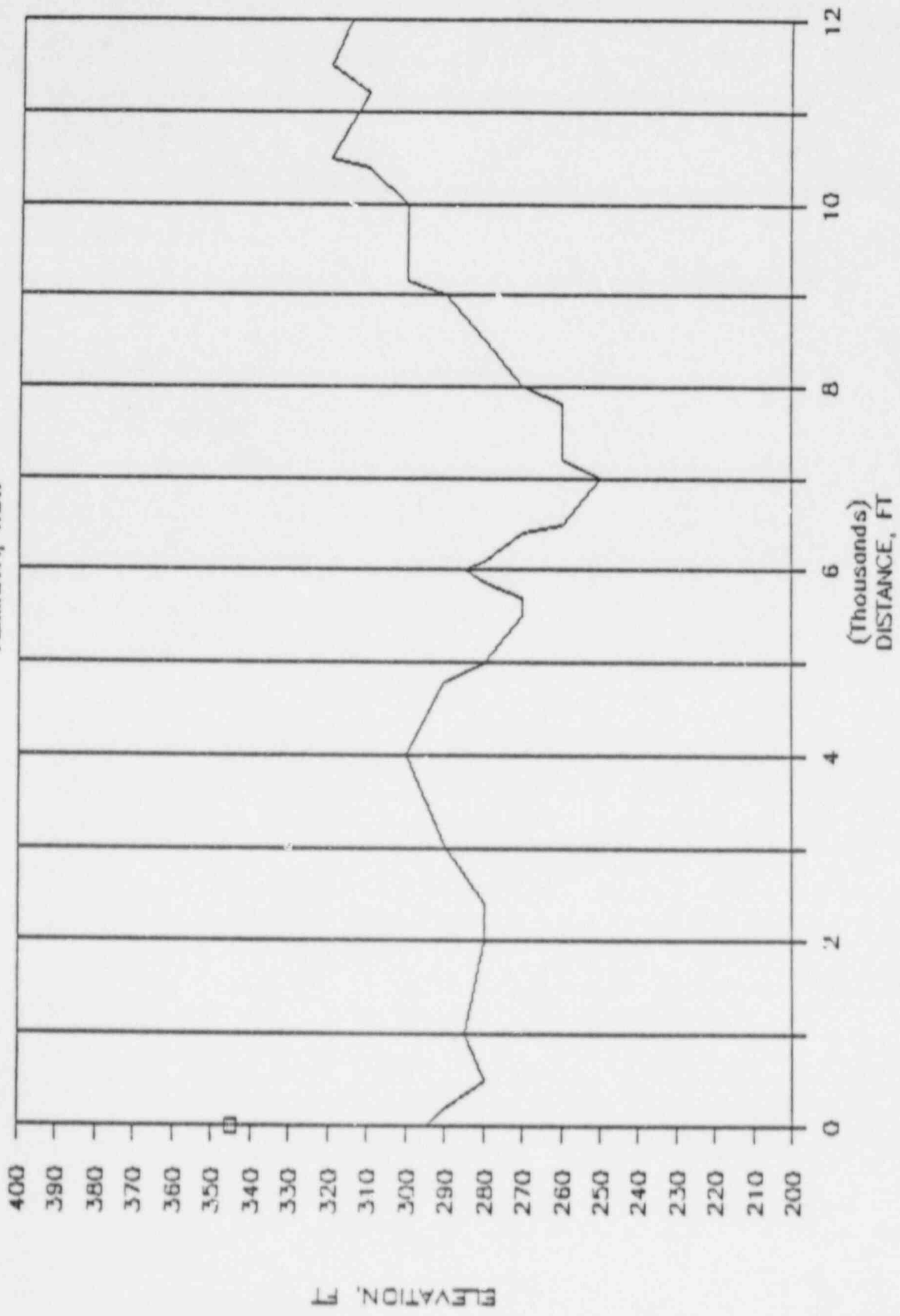
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AZIMUTH, W



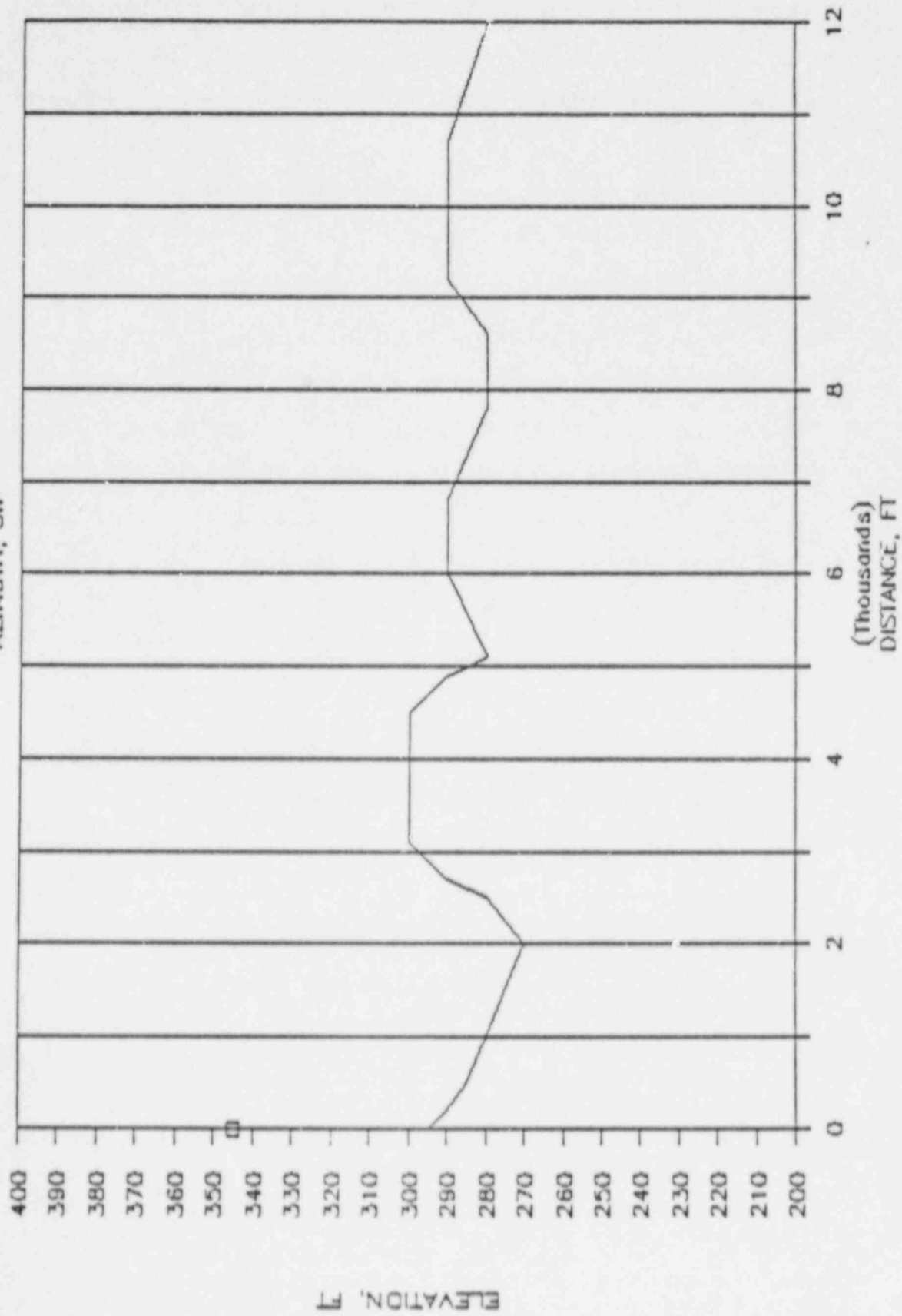
# VOGTLE B9

AZIMUTH, WSW



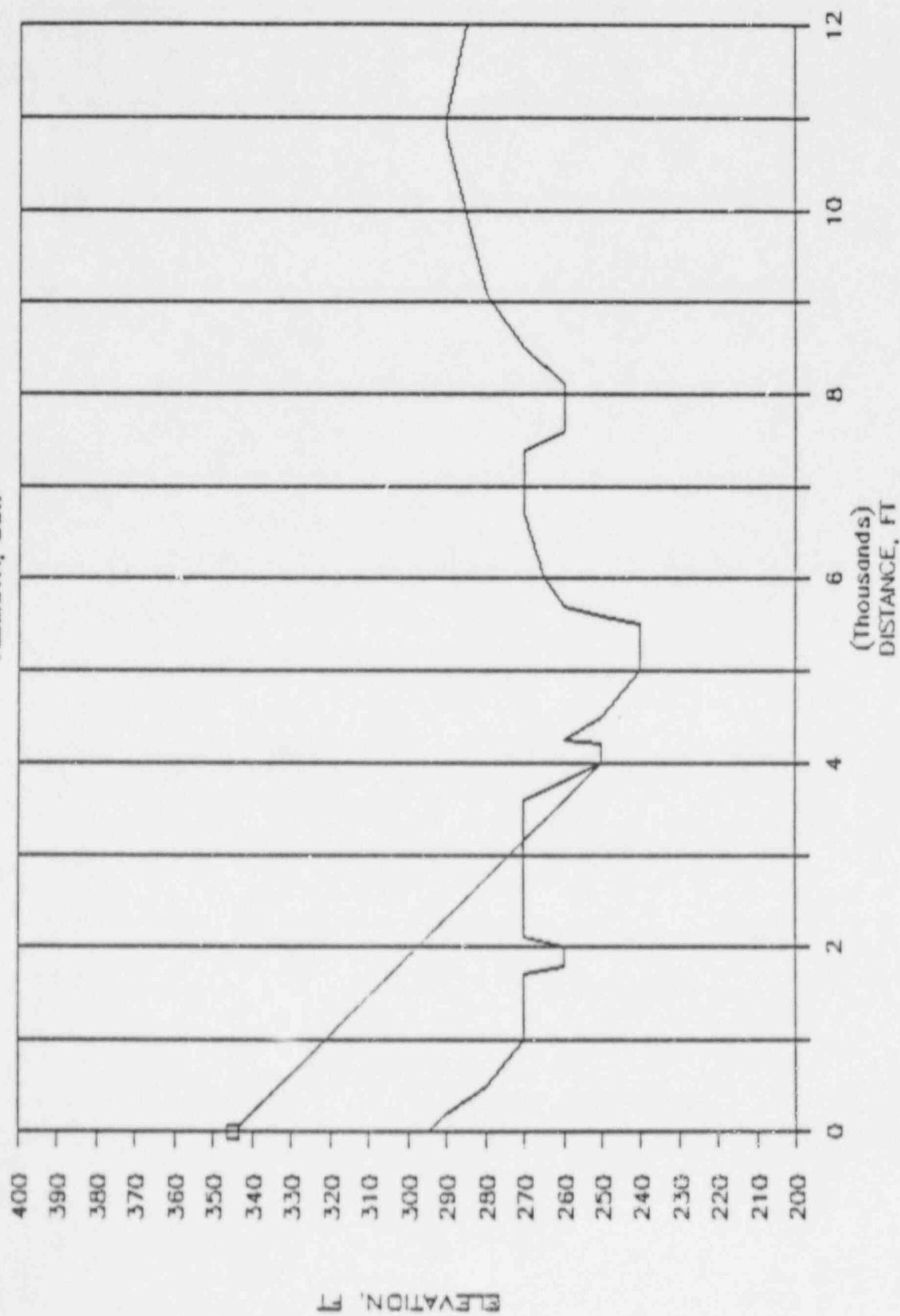
# VOGTLE B9

AZIMUTH, SW



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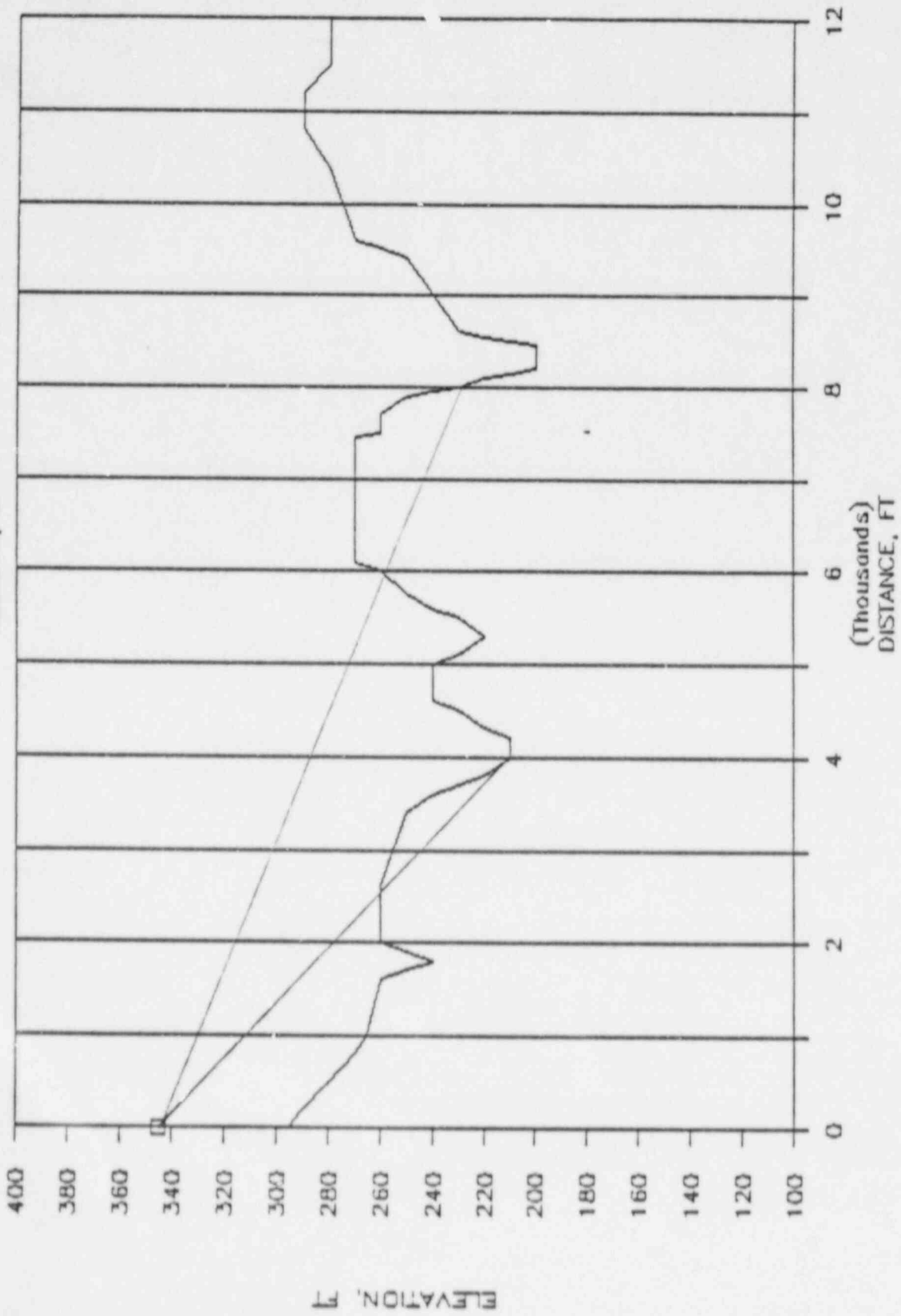
AZIMUTH, SSW





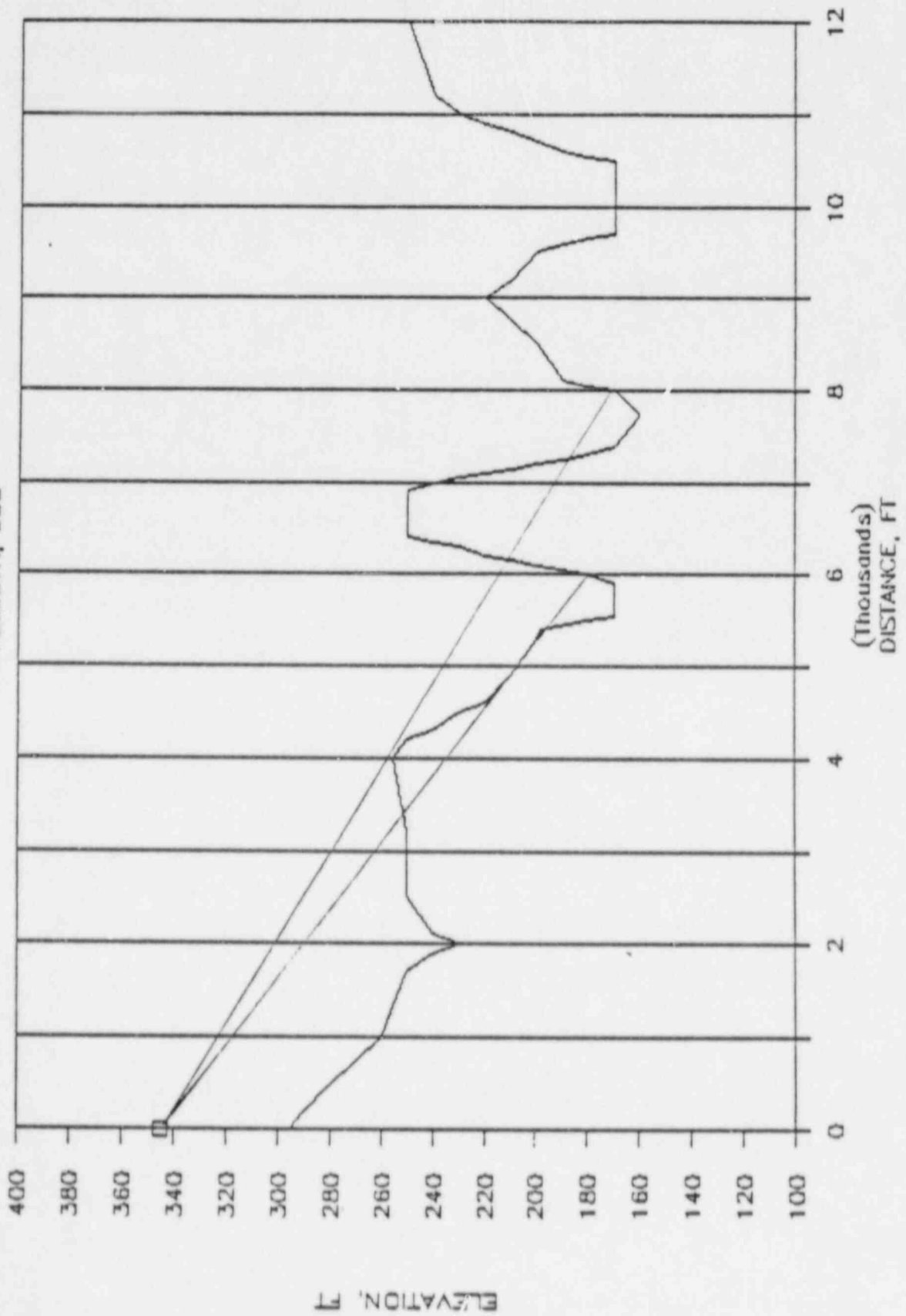
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AZIMUTH, S



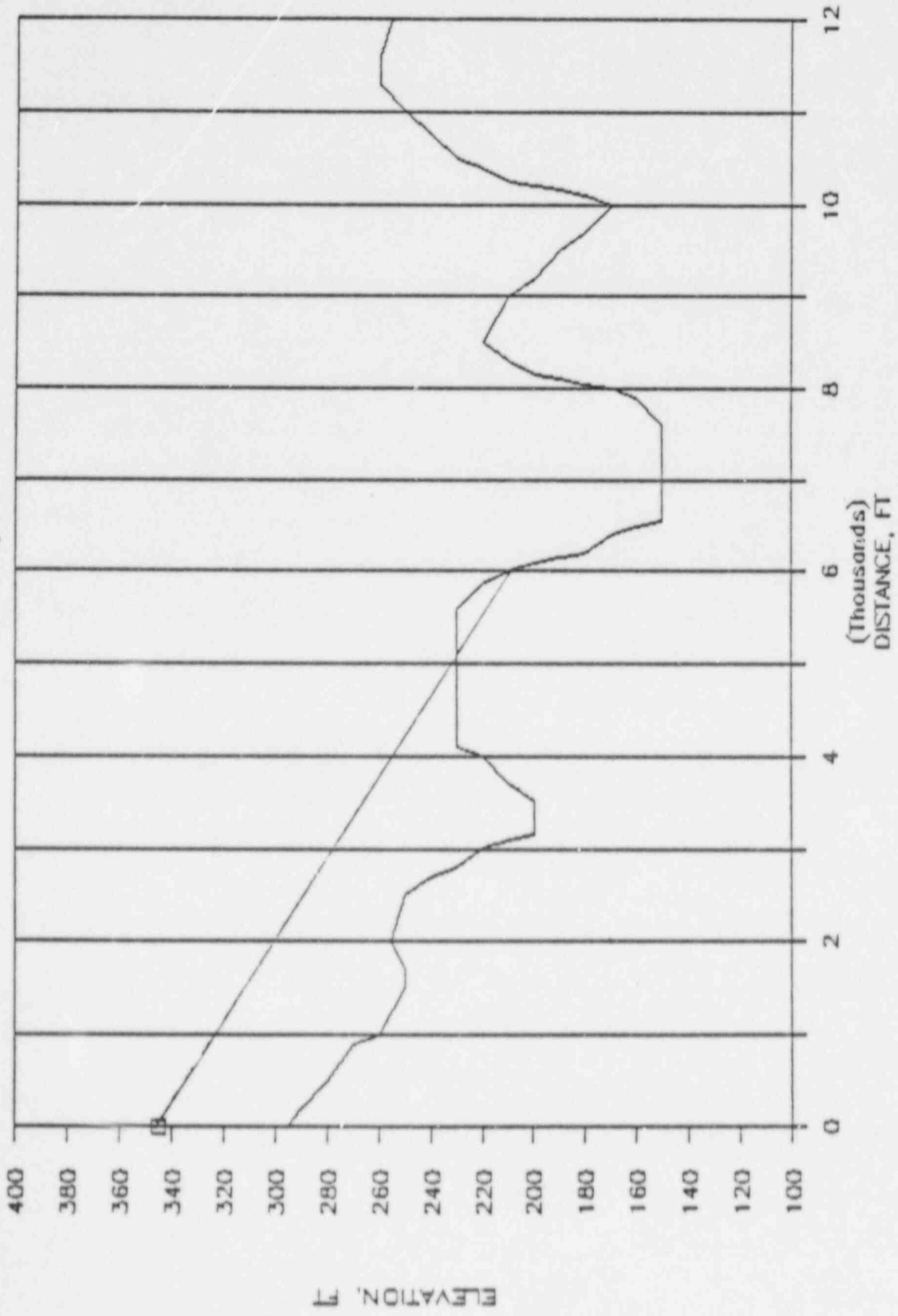
# VOGTLE B9

AZIMUTH, SSE



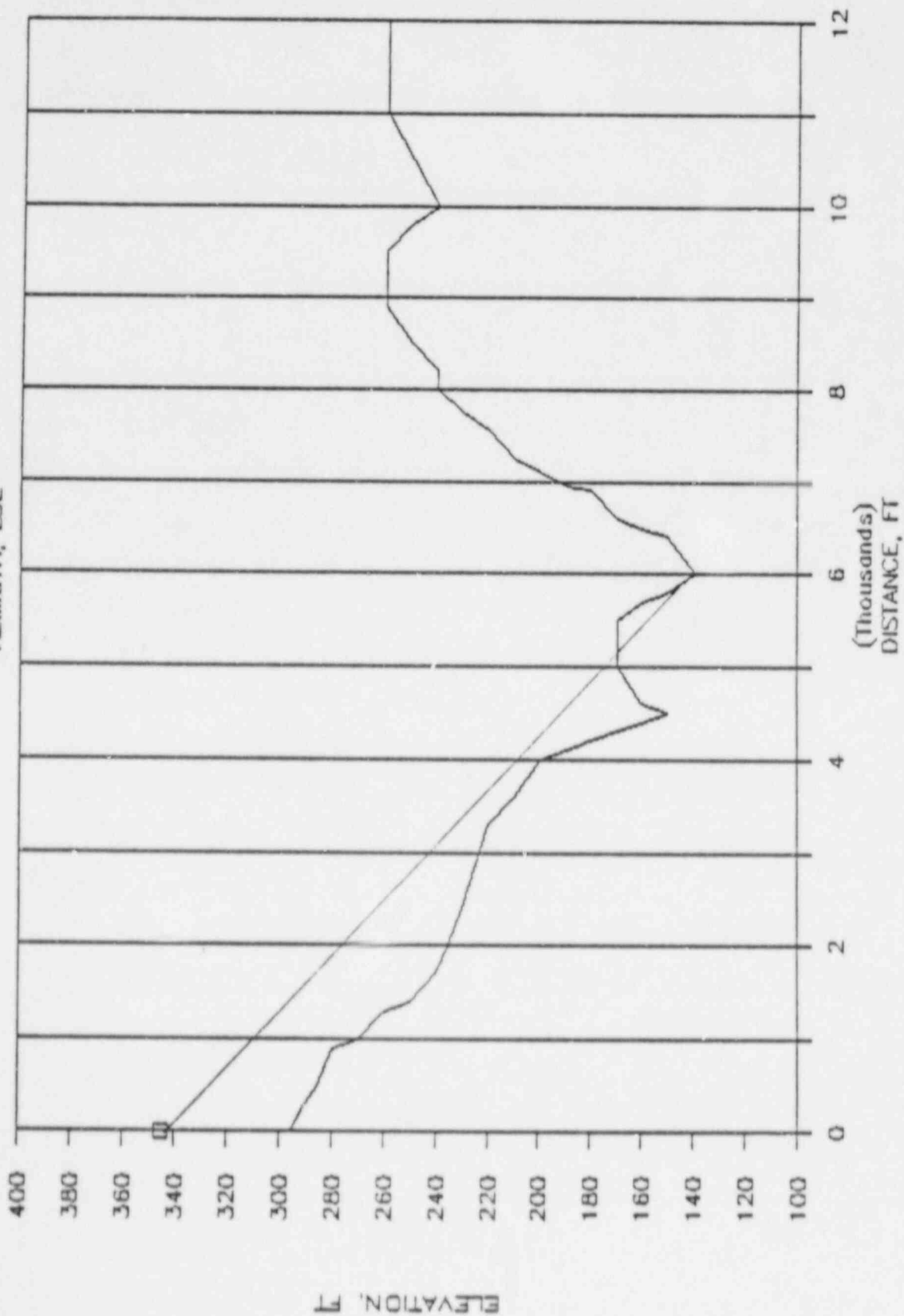
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AZIMUTH, SE



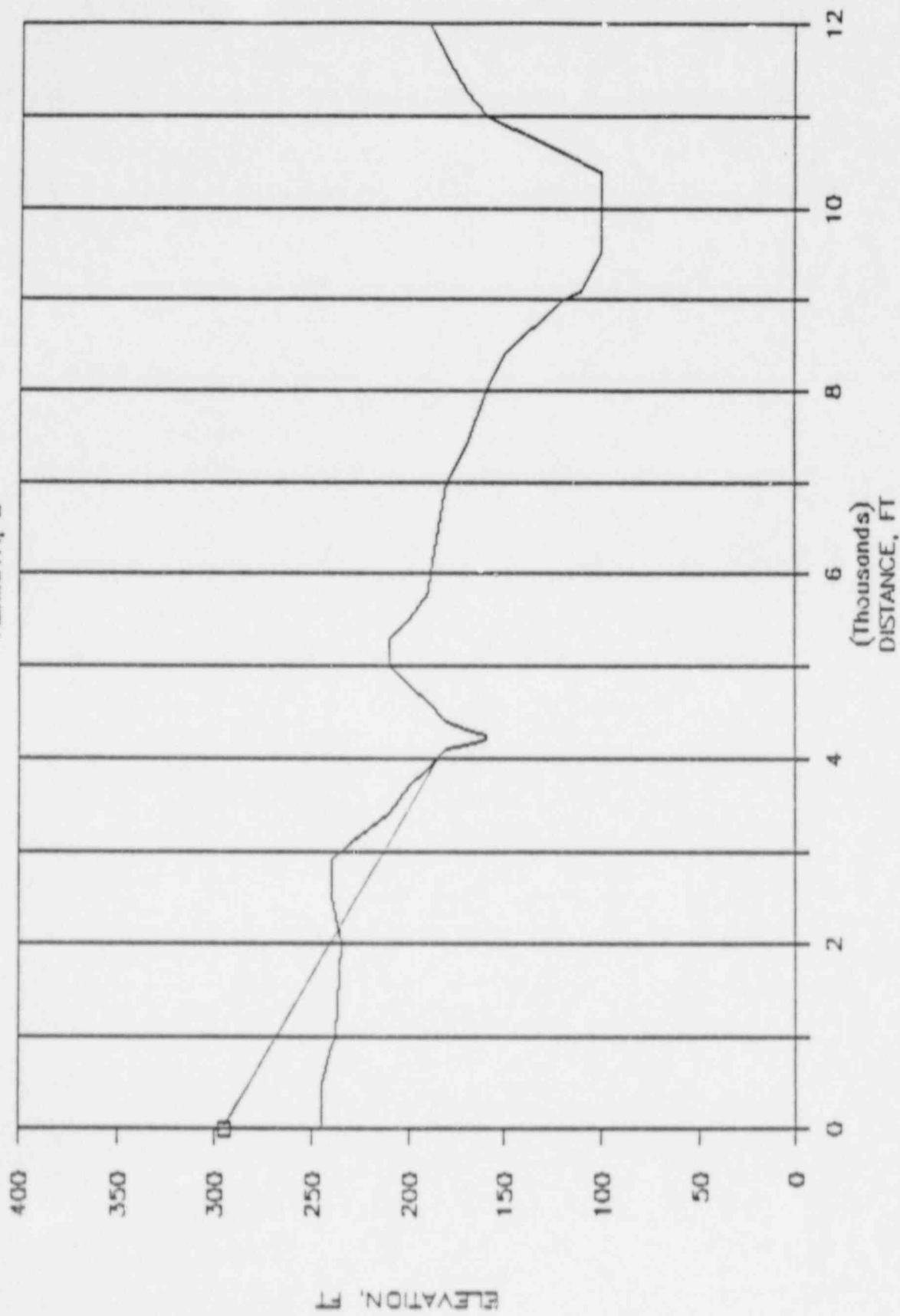
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AZIMUTH, ESE



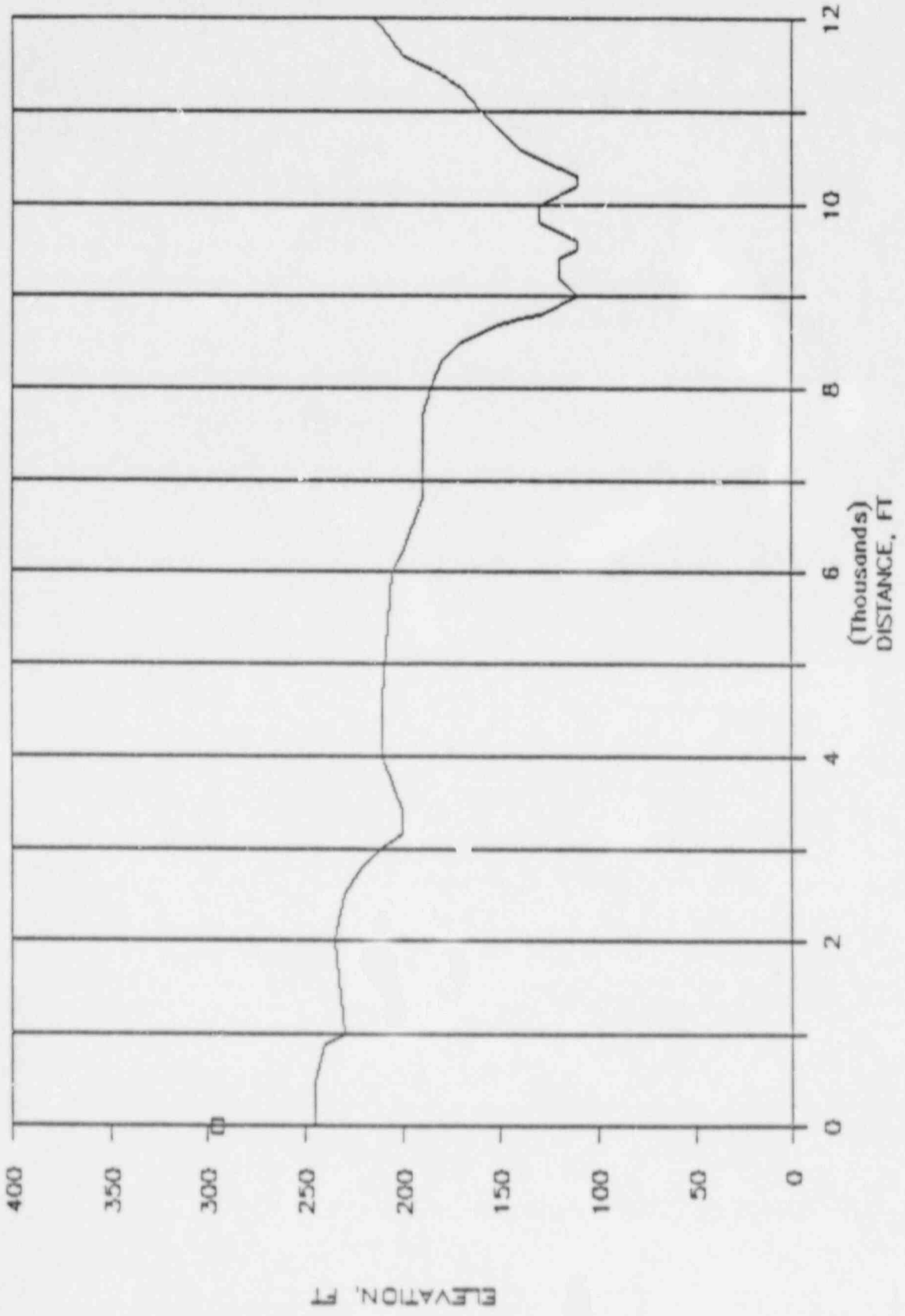
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AZIMUTH, E



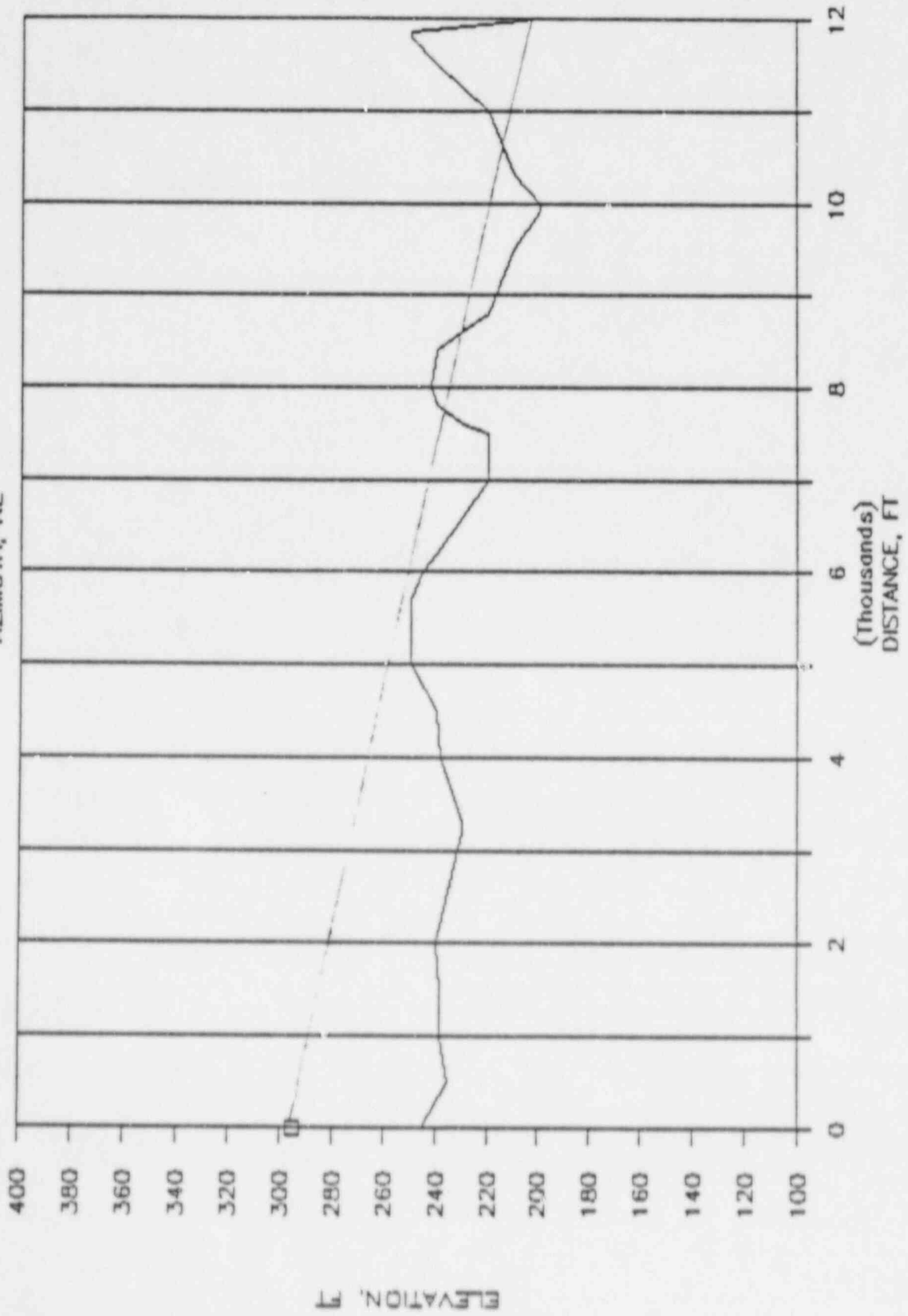
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AZIMUTH, BNE



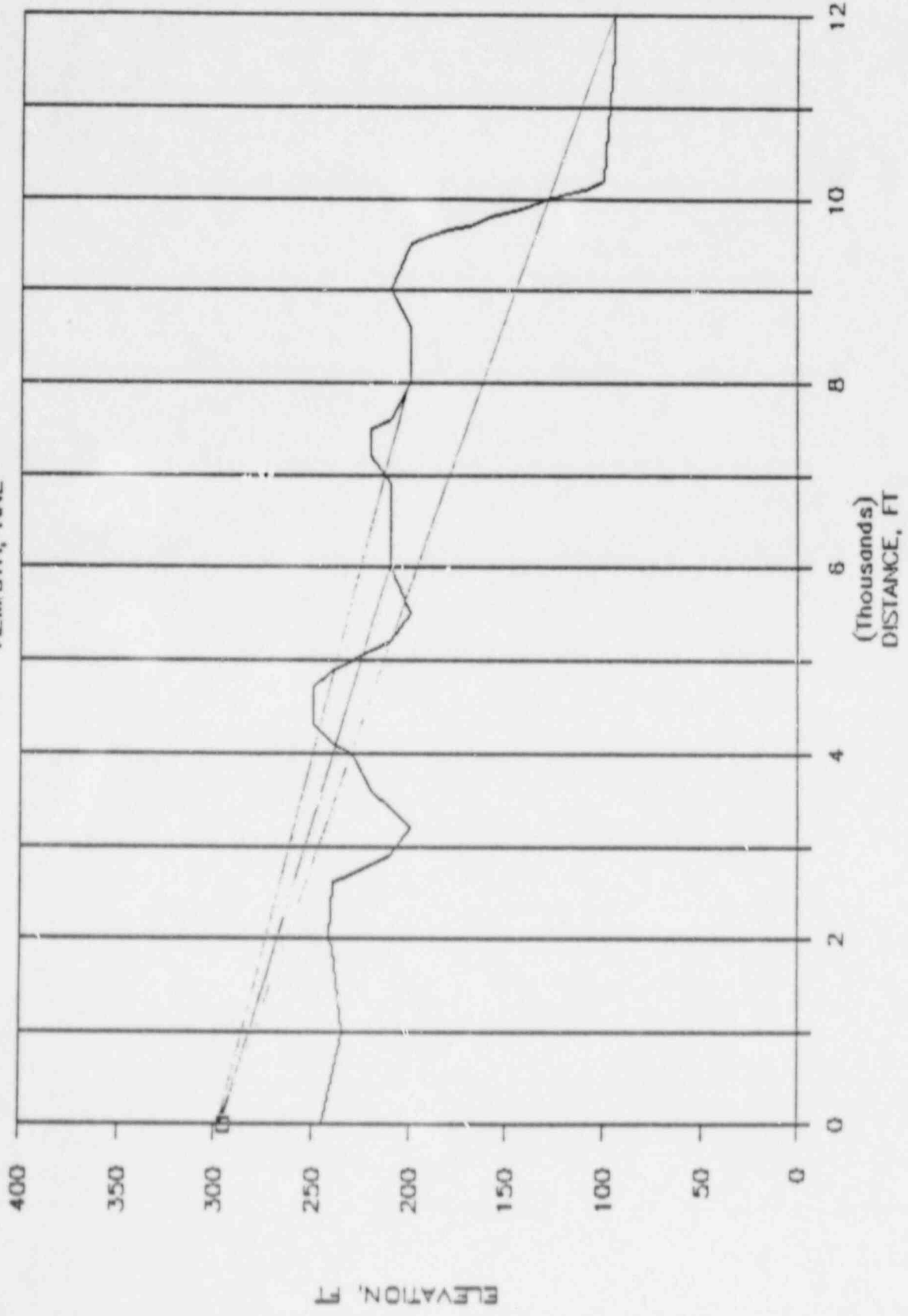
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AZIMUTH, NE



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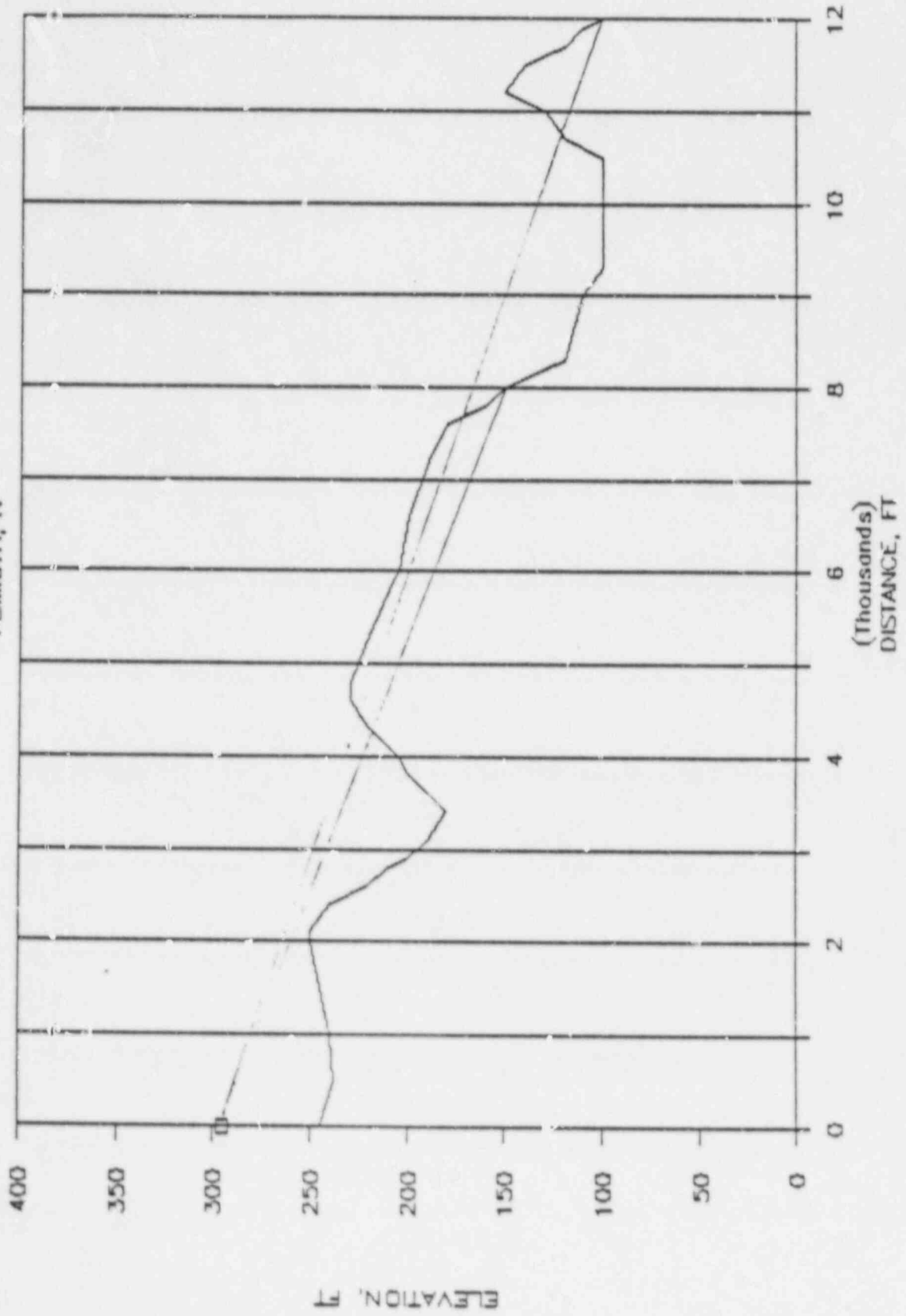
AZIMUTH, NNE





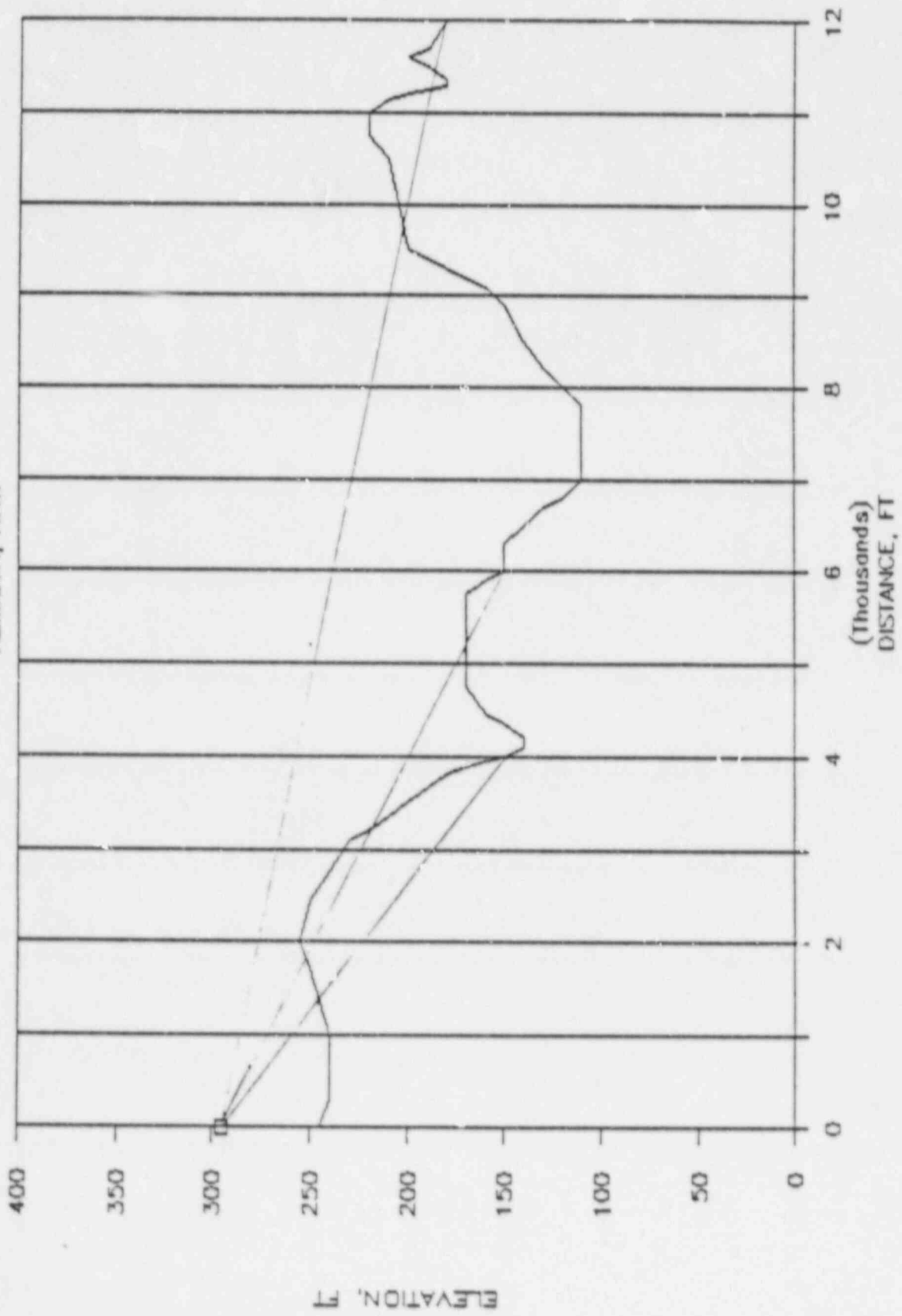
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AZIMUTH, N



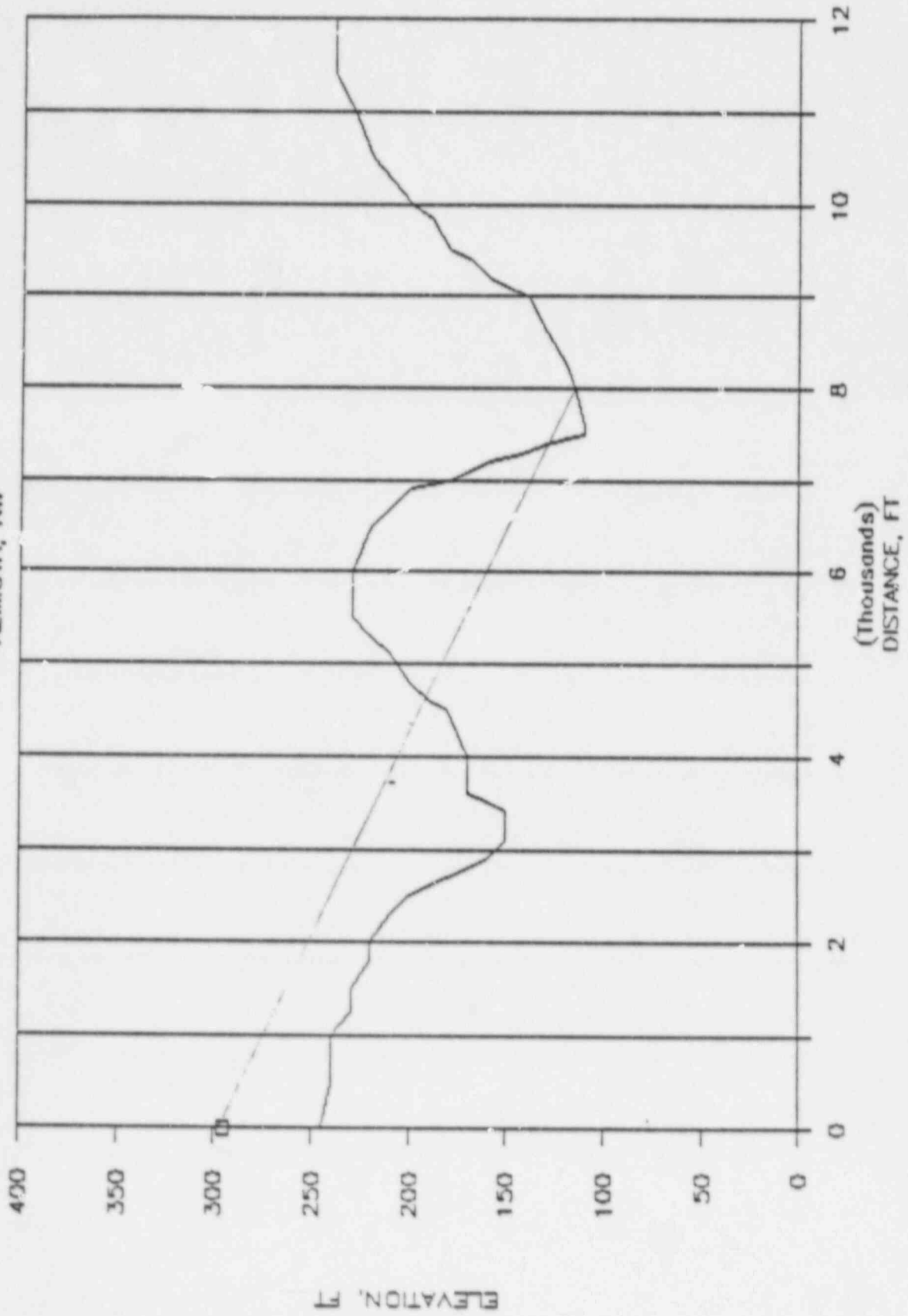
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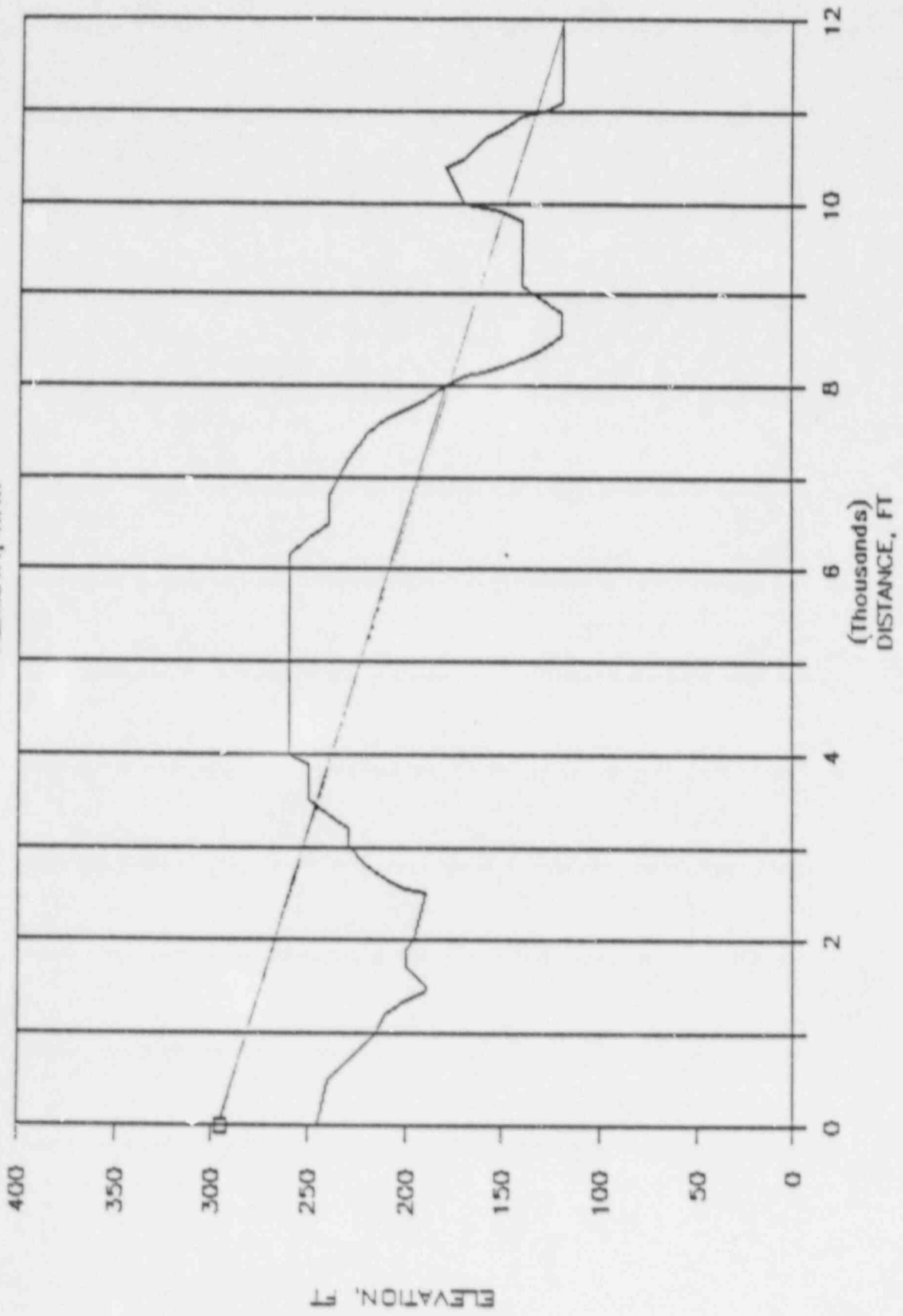
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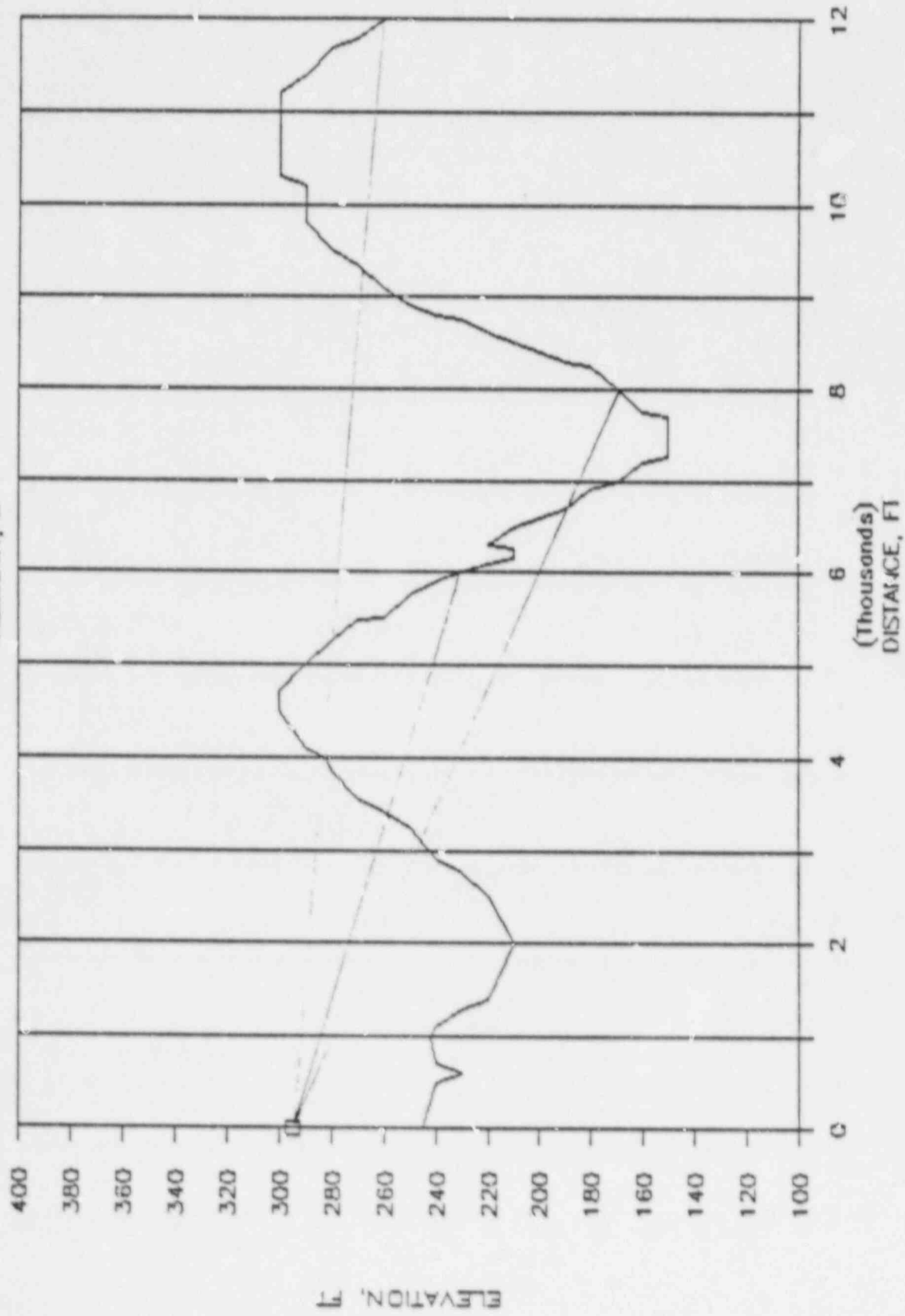
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AZIMUTH, WNW



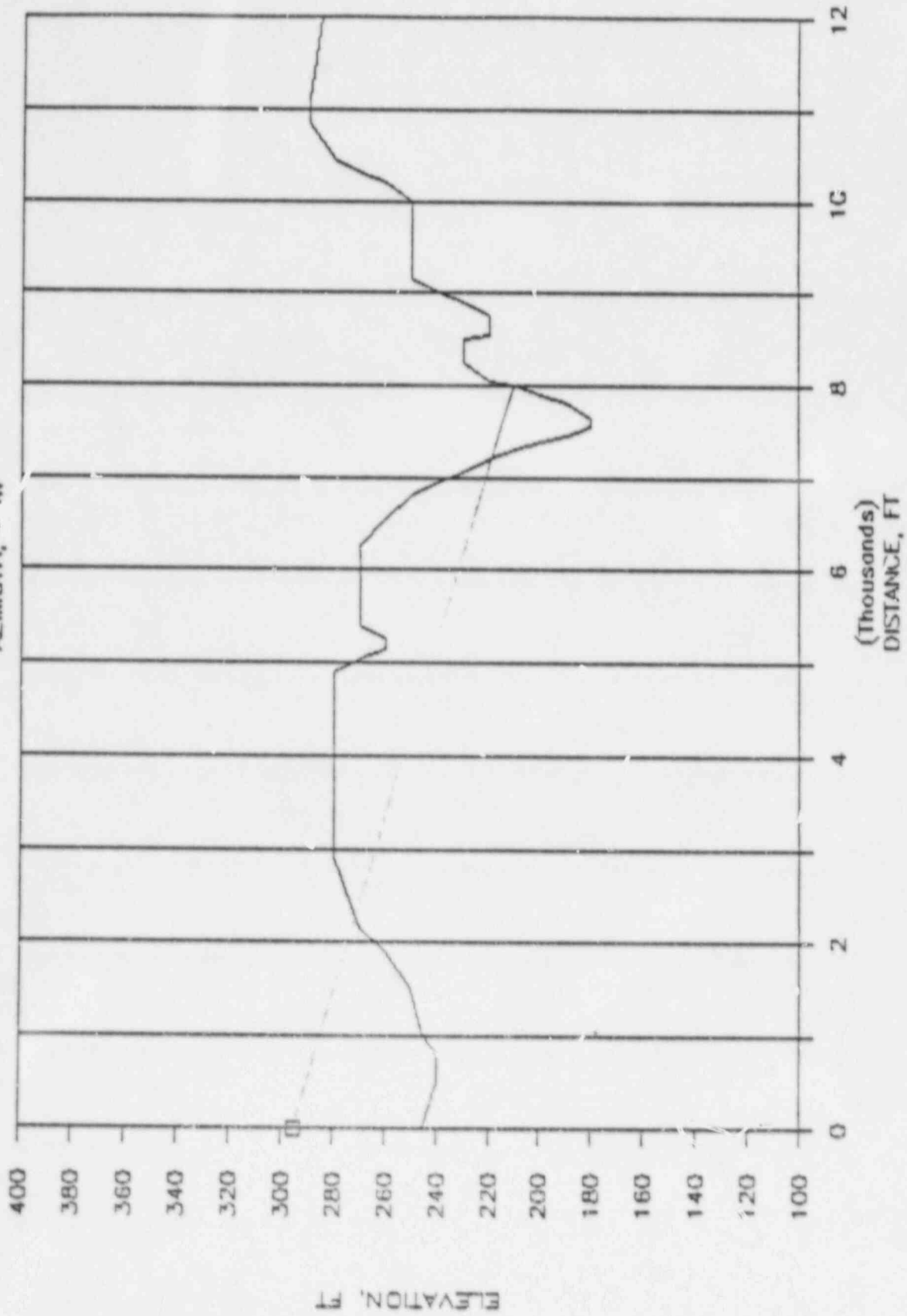
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AZIMUTH, W



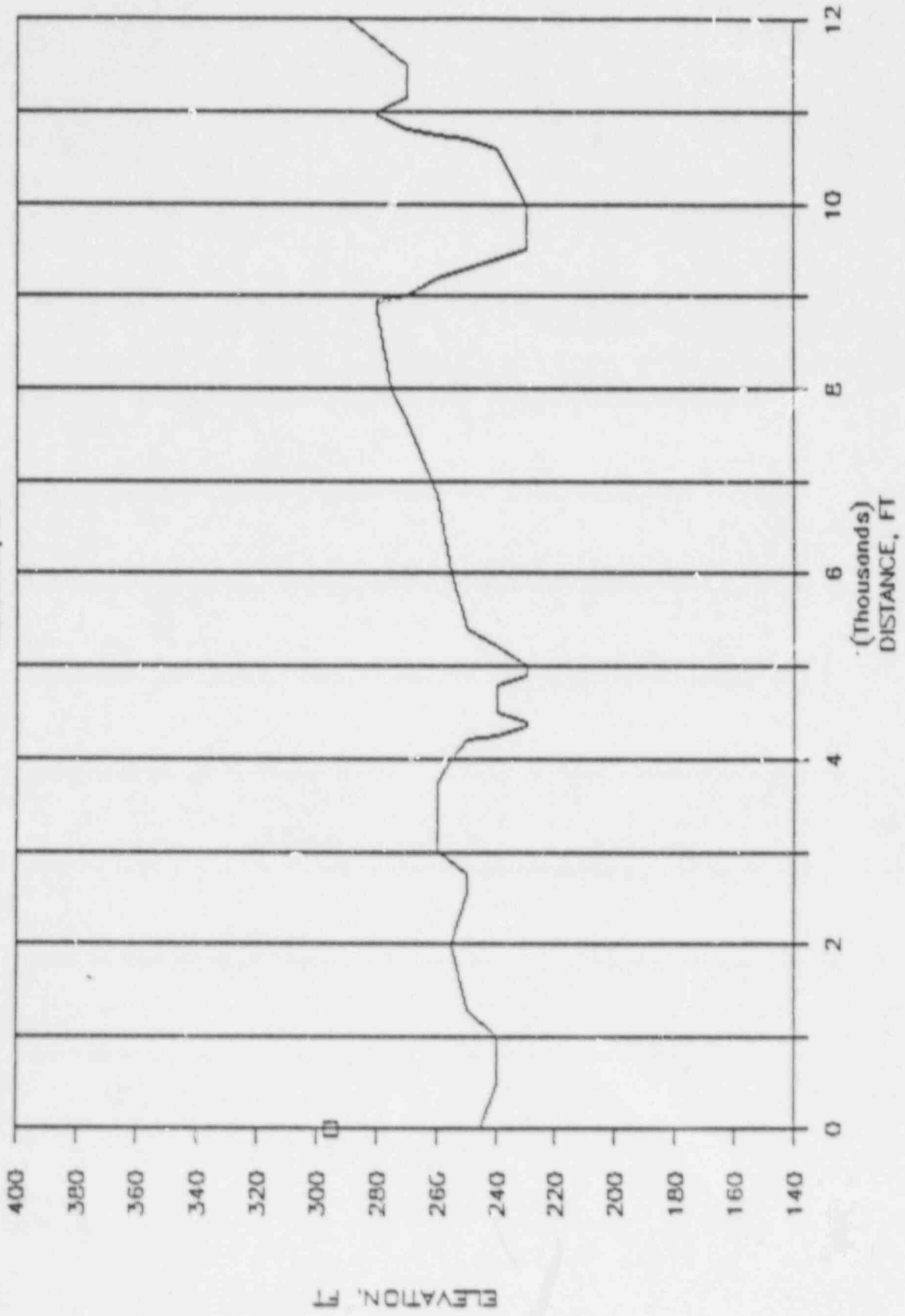
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AZIMUTH, °SW



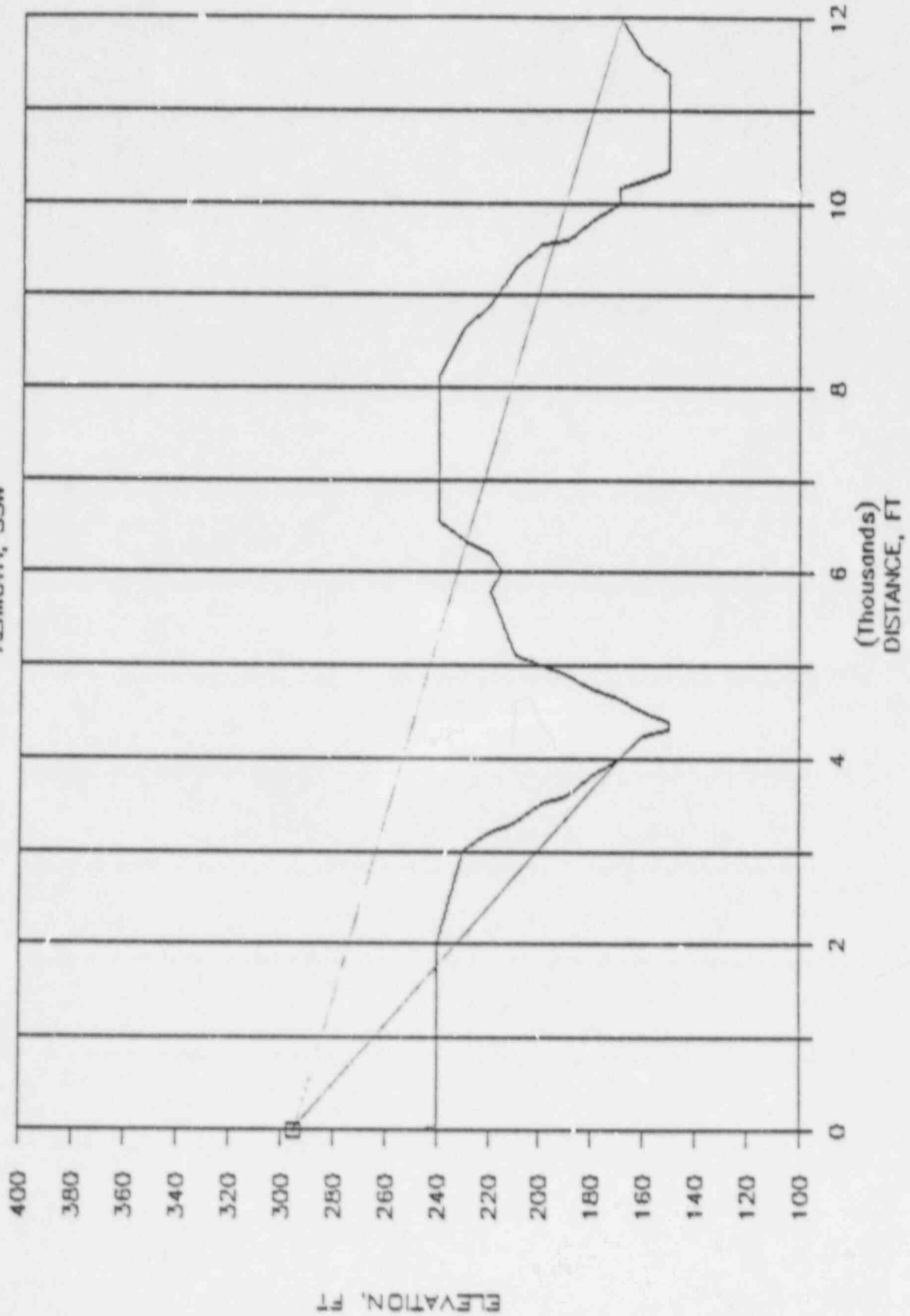
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AZIMUTH, SW



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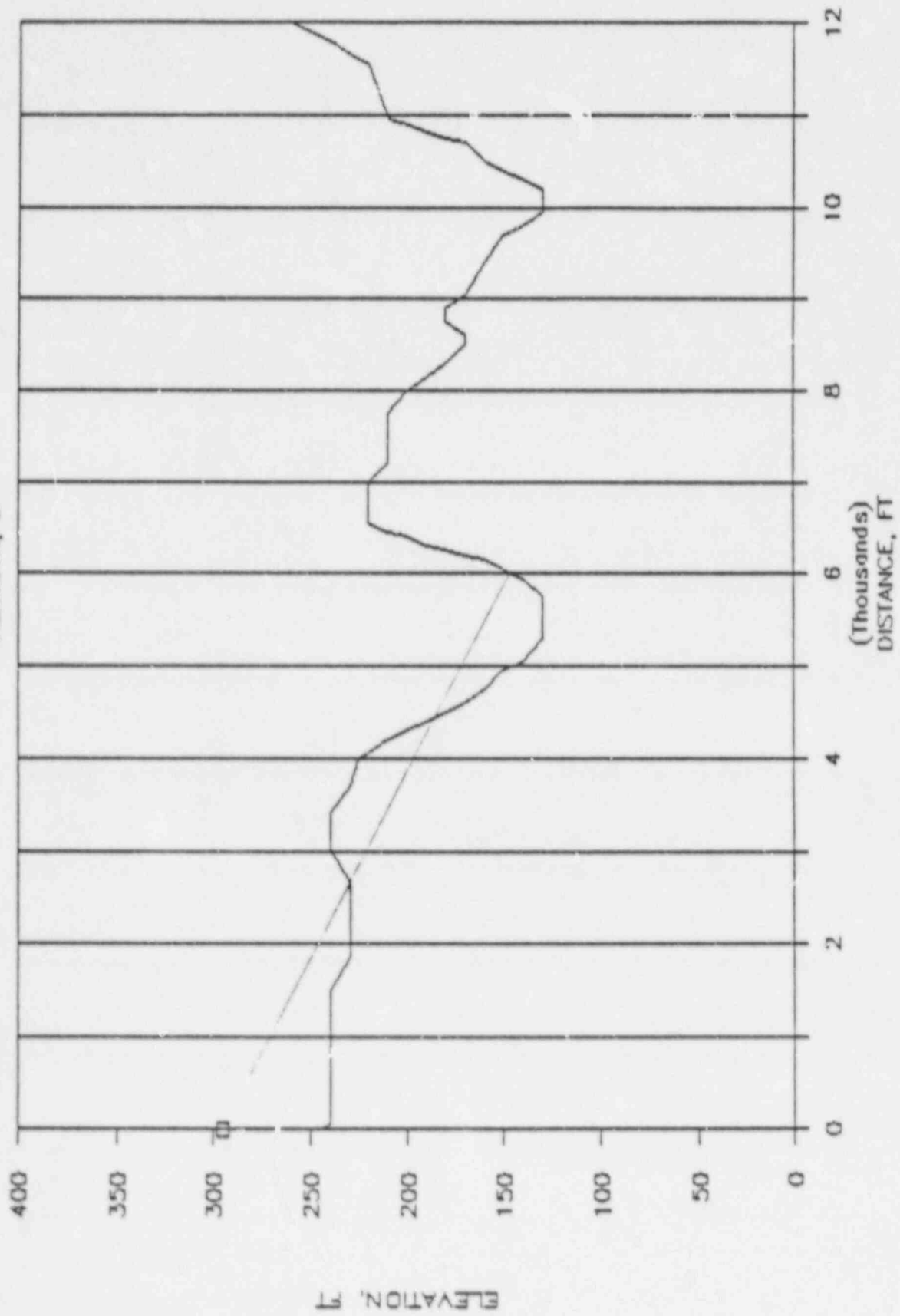
AZIMUTH, SSW





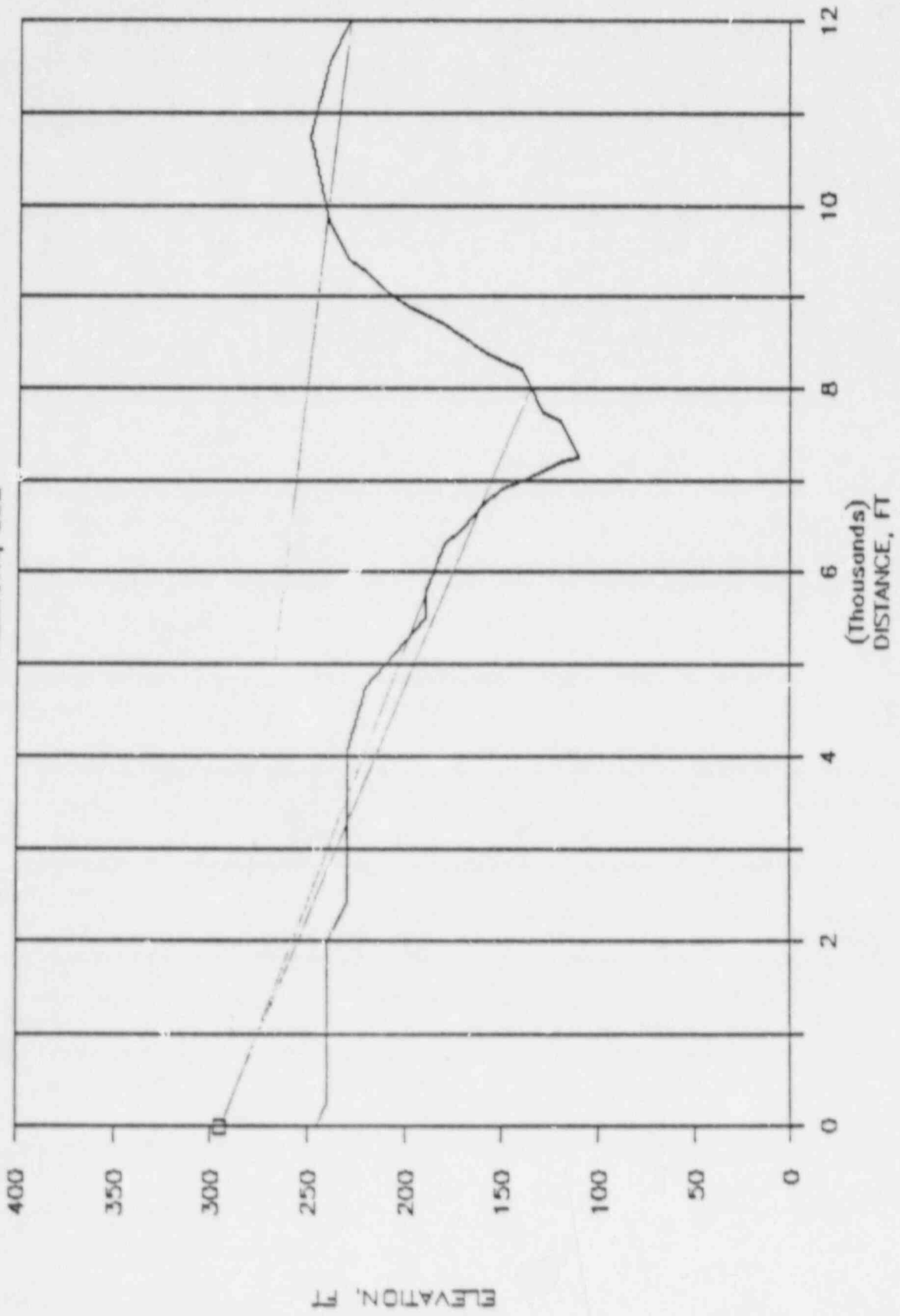
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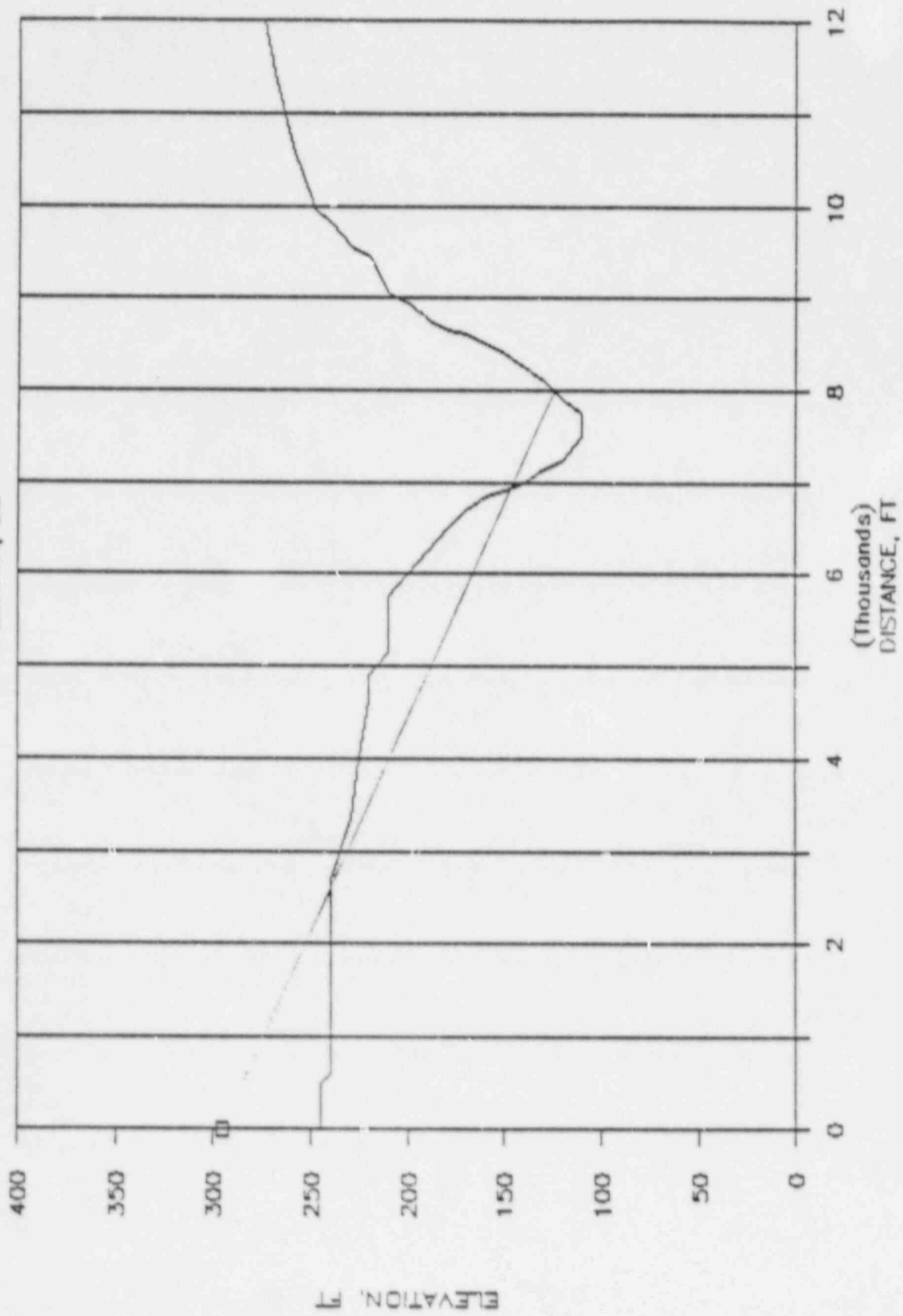
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AZIMUTH, SSE



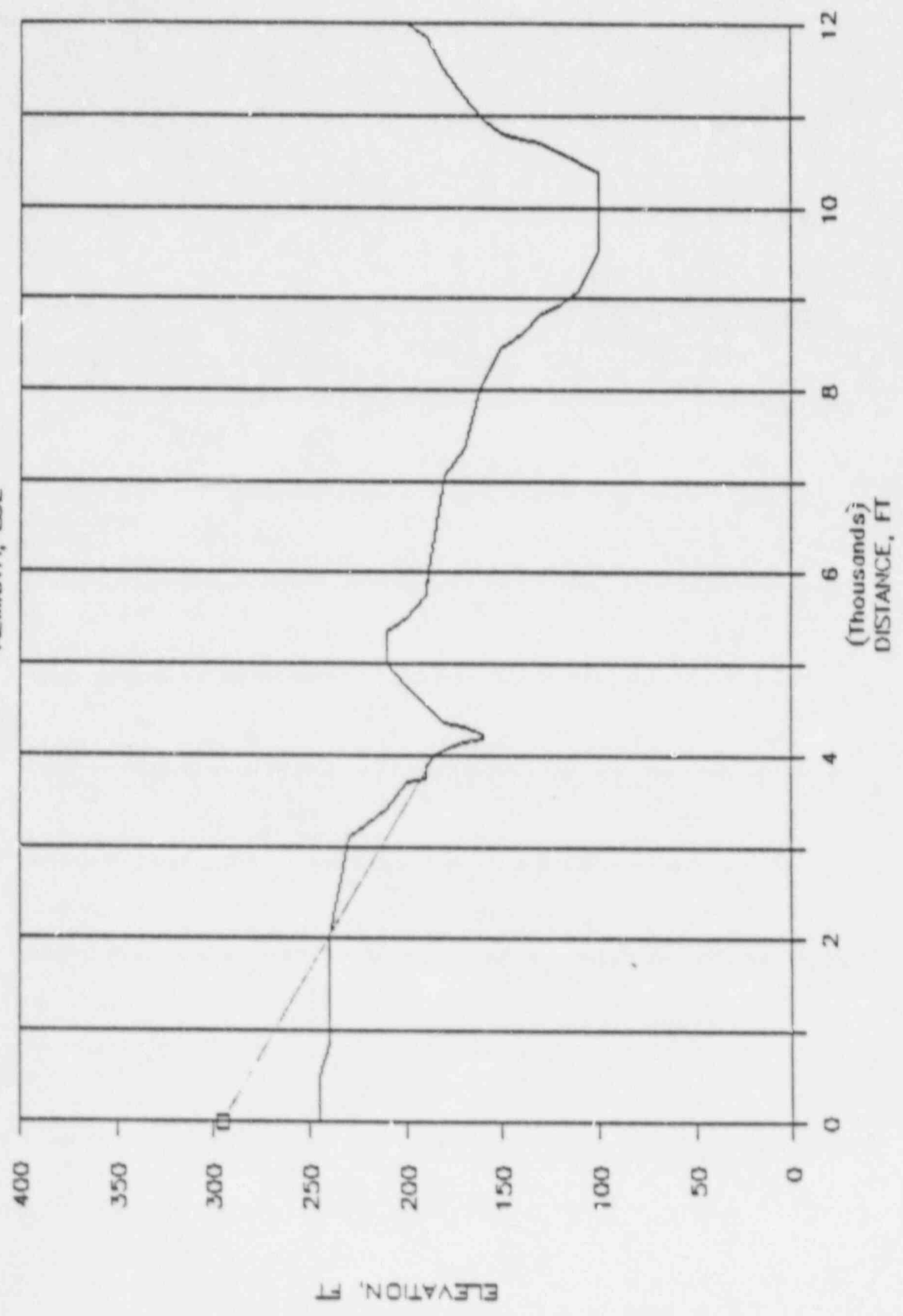
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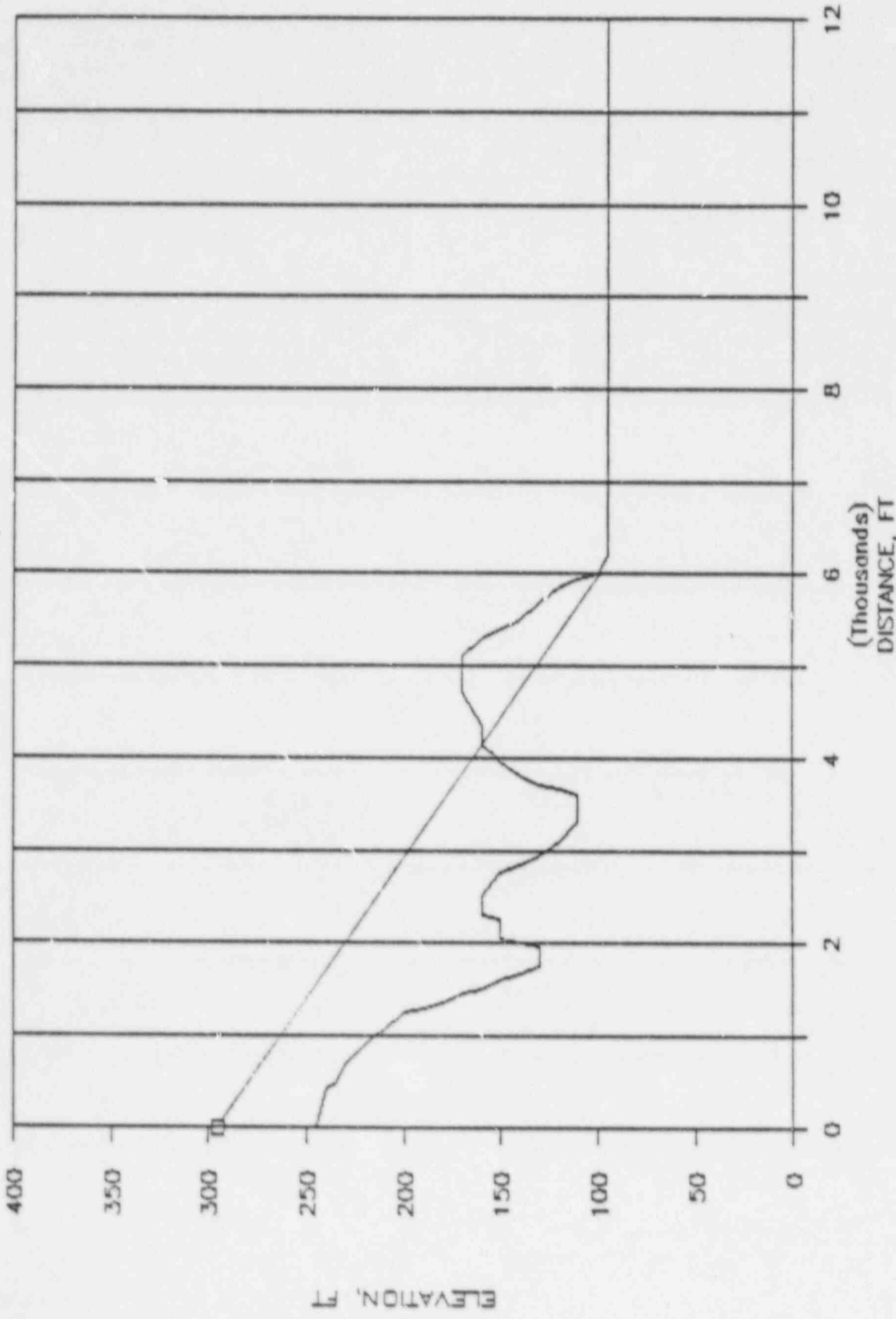
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AZIMUTH, ESE



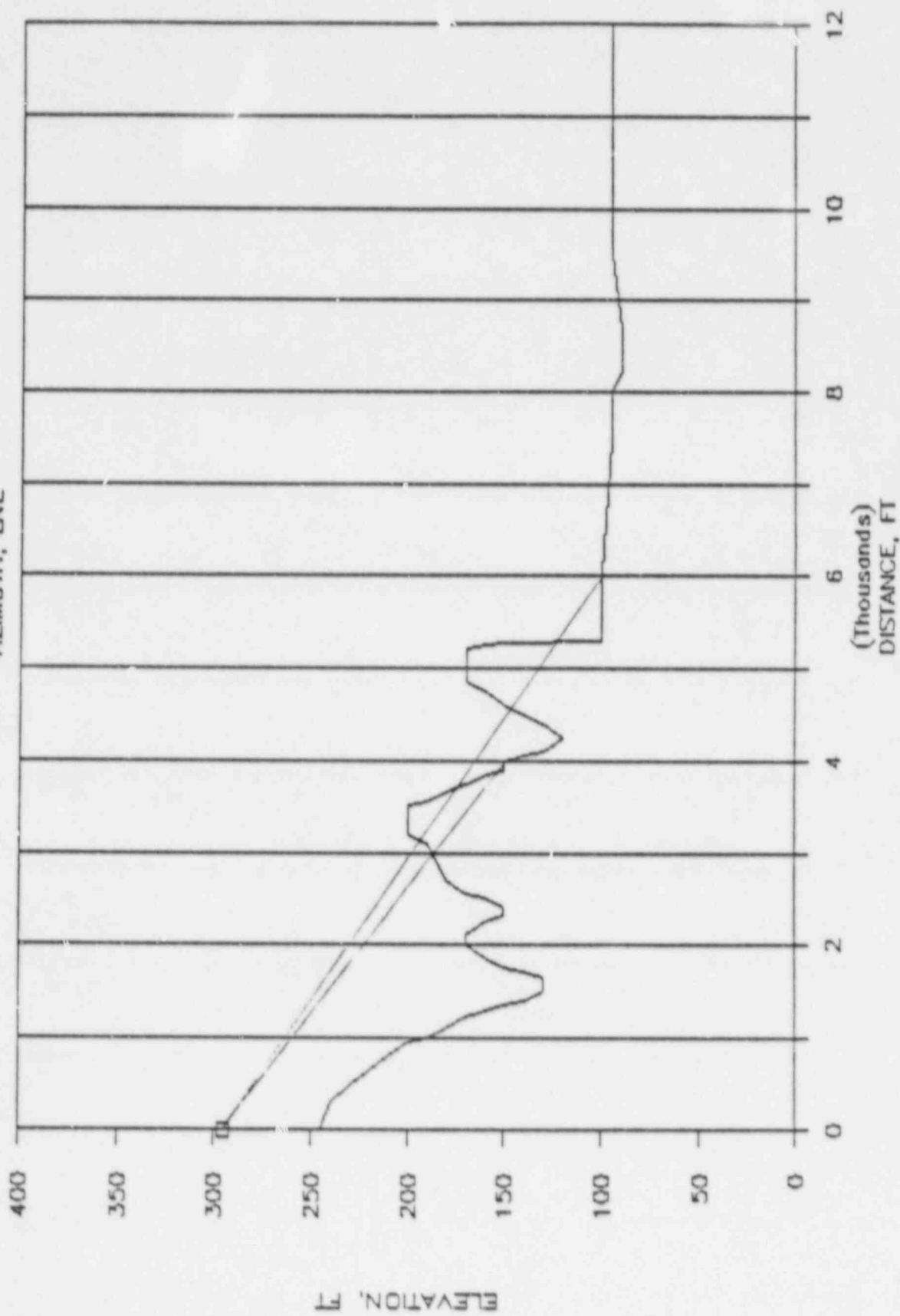
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AZIMUTH, E



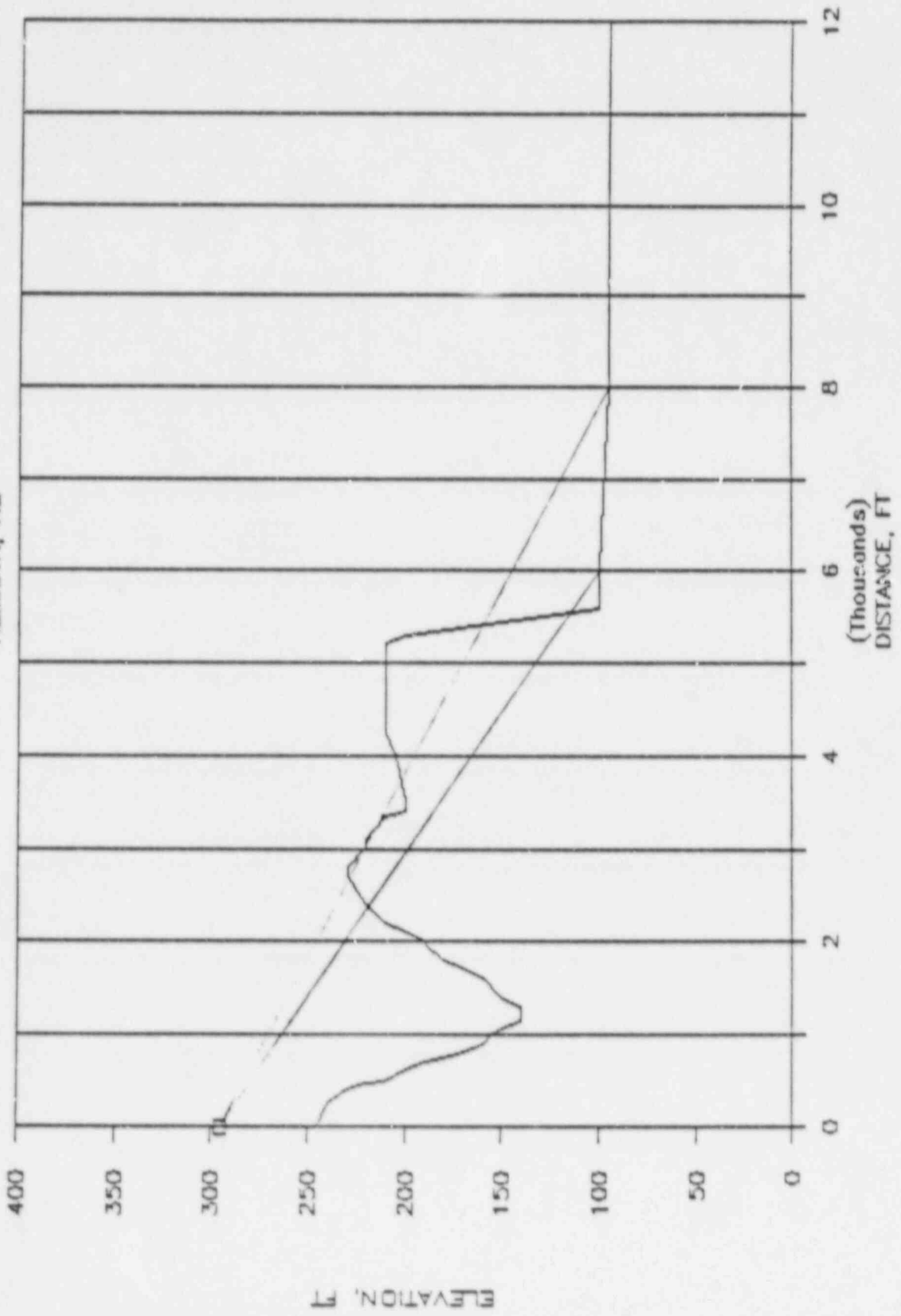
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AZMUTH, ENE



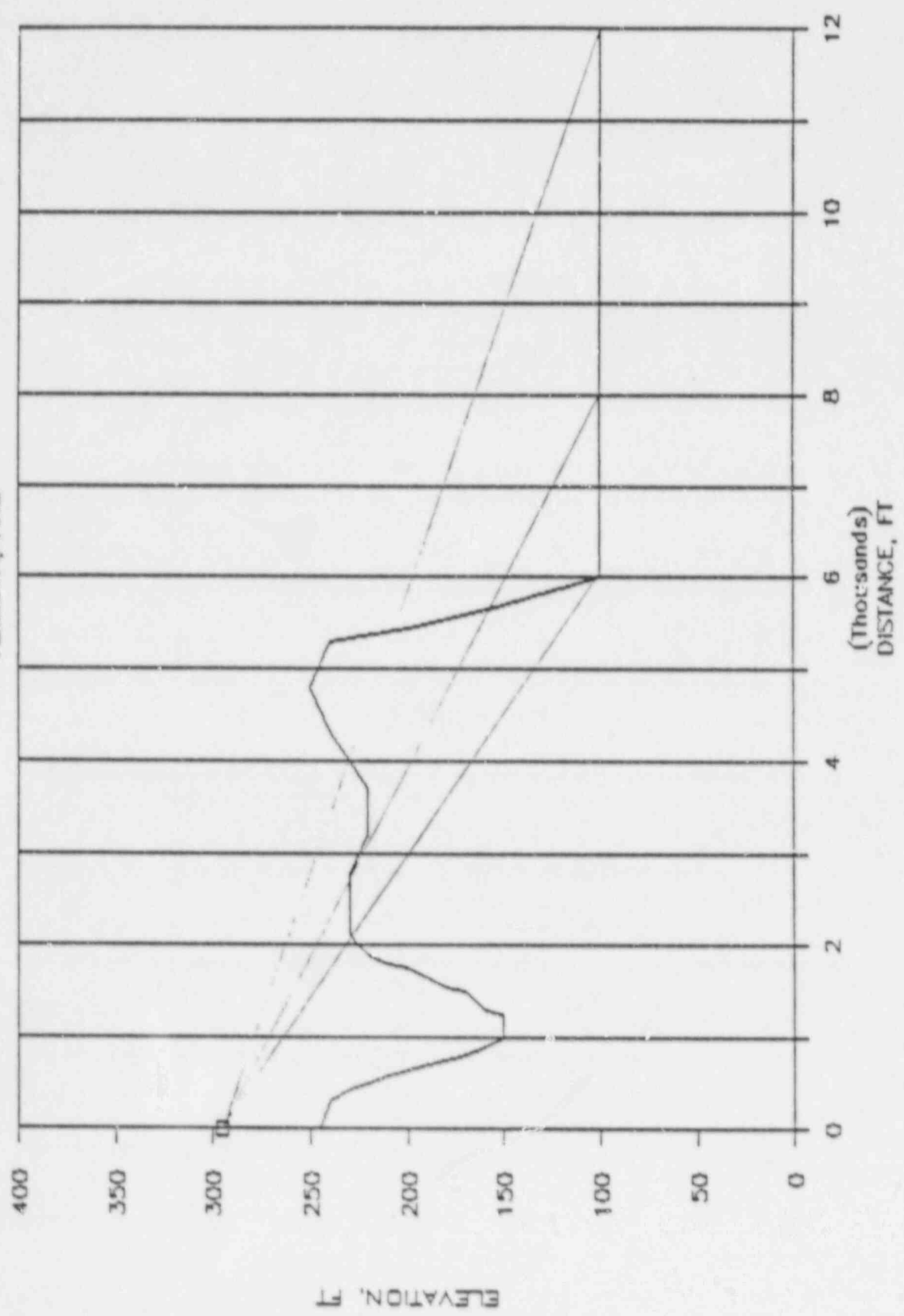
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AZIMUTH, NE



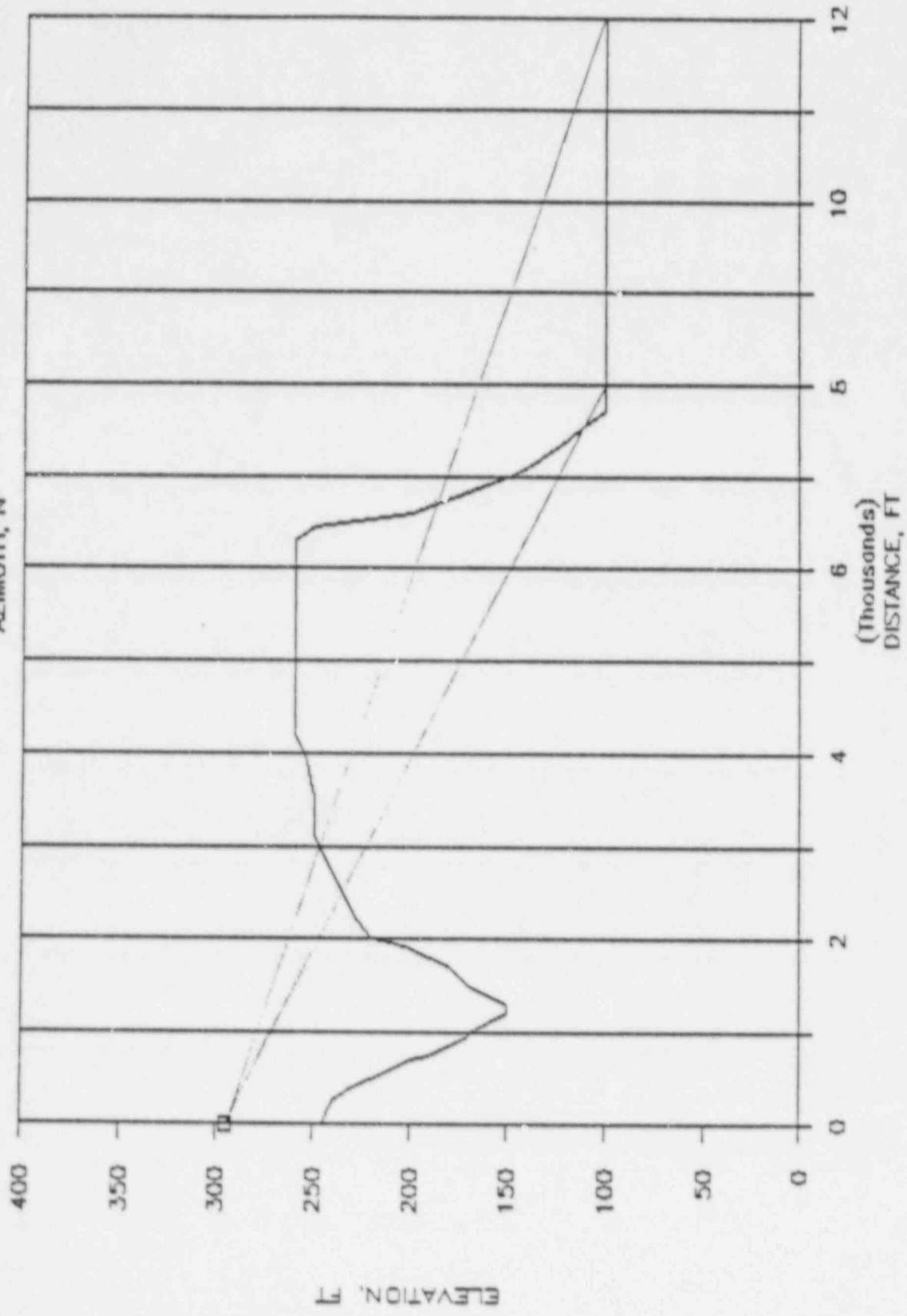
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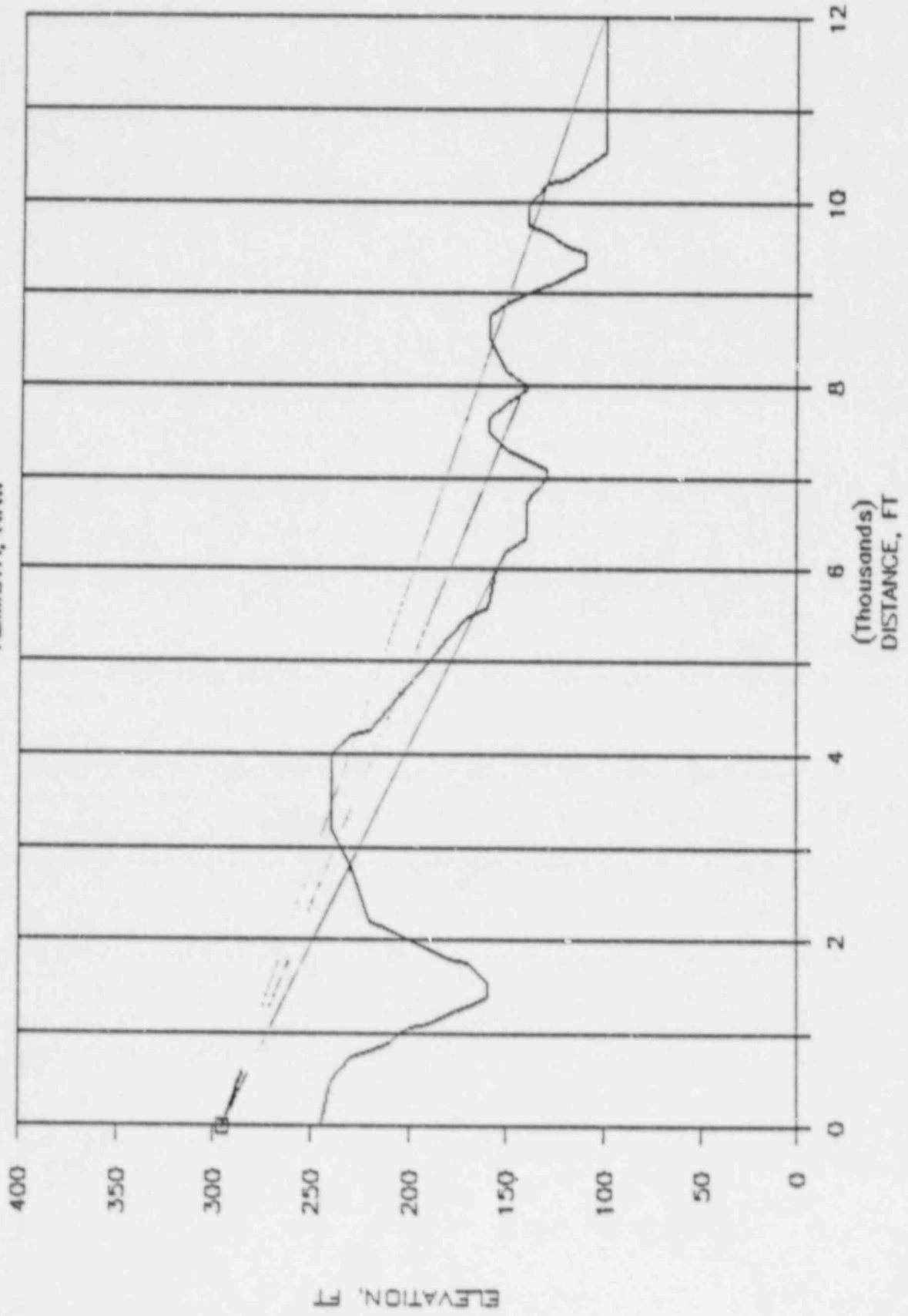


VOGTLE B1  
AZIMUTH, N



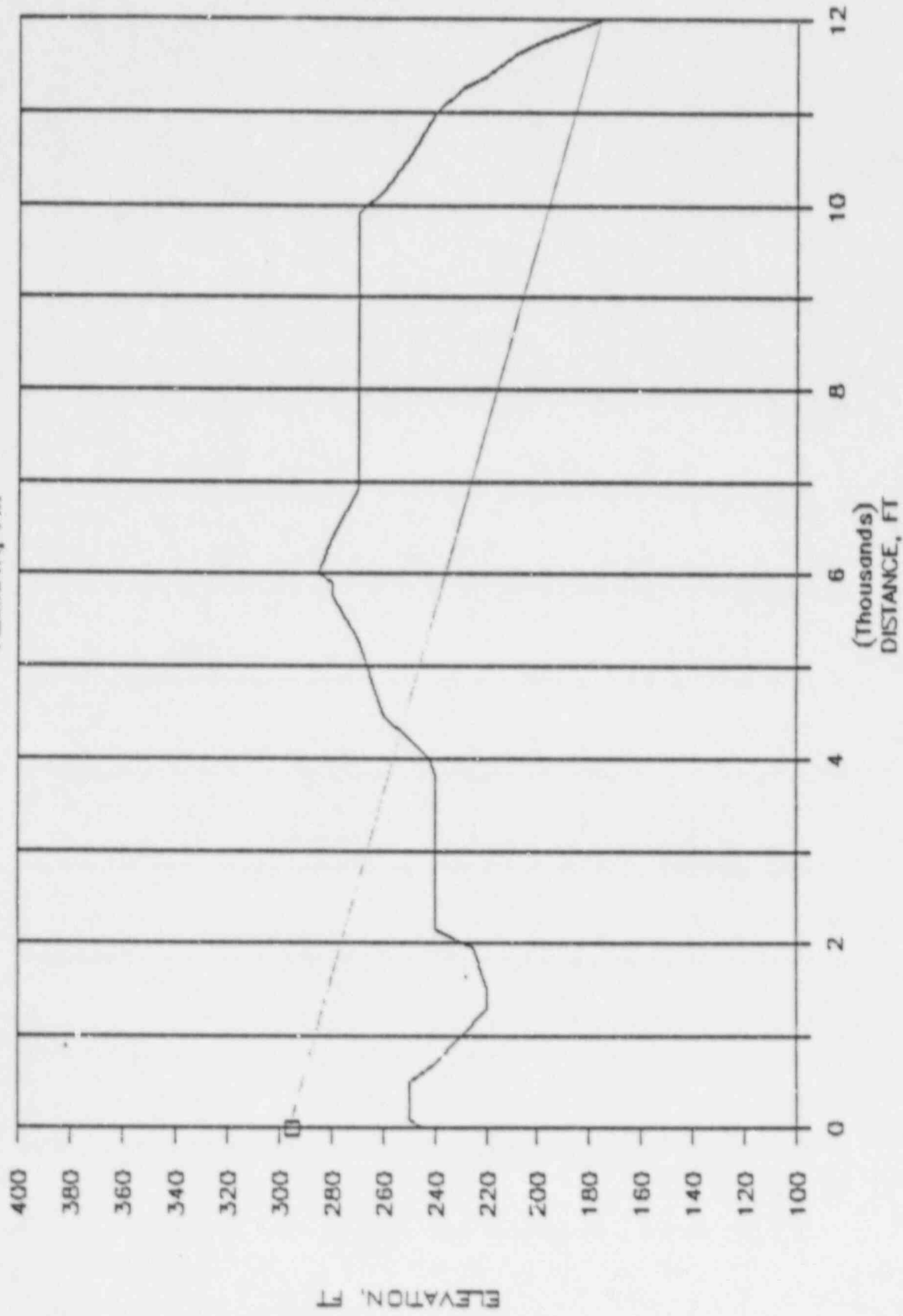
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AZIMUTH, NNW



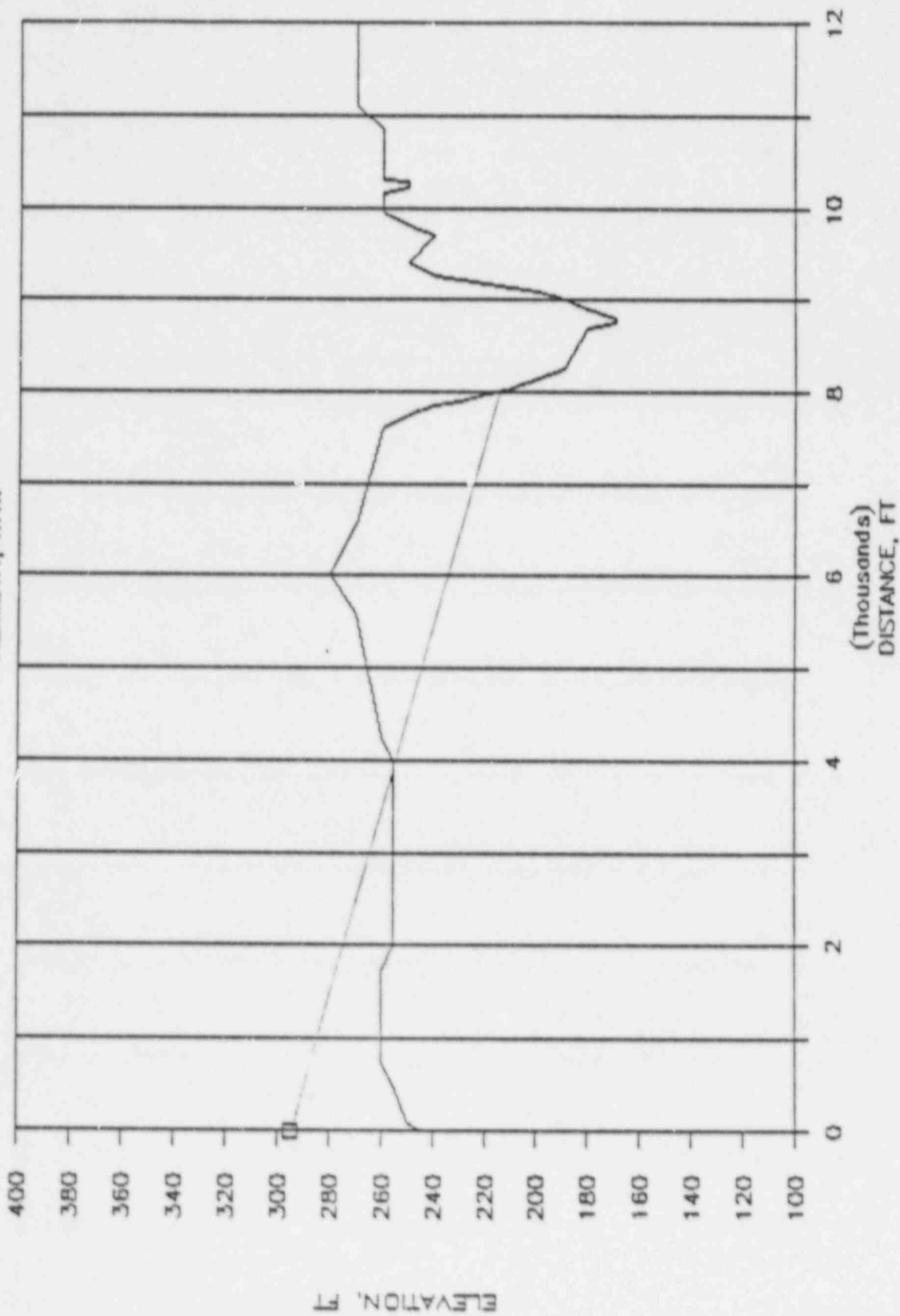
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AZIMUTH, M<sup>o</sup>



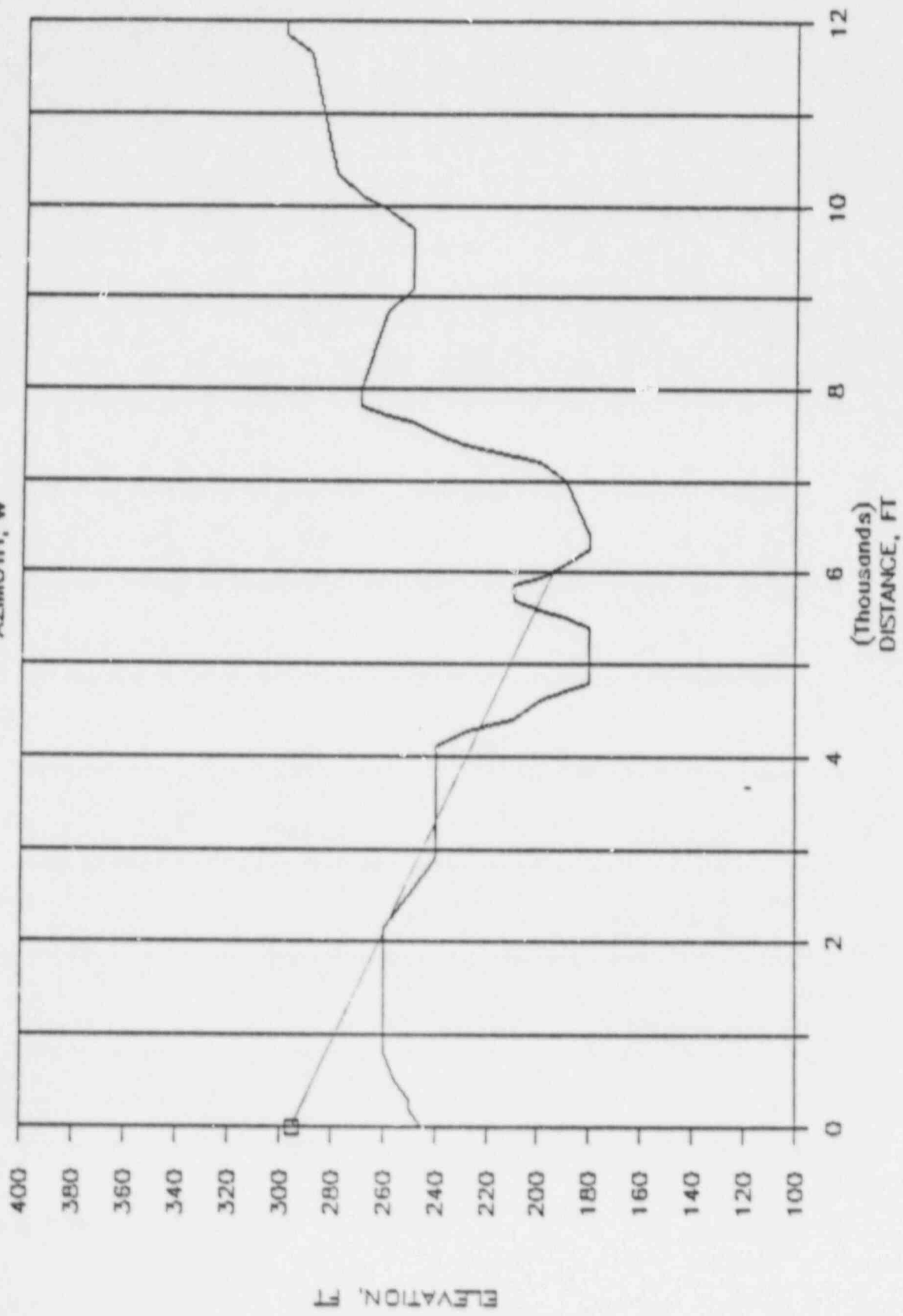
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AZIMUTH, WNW



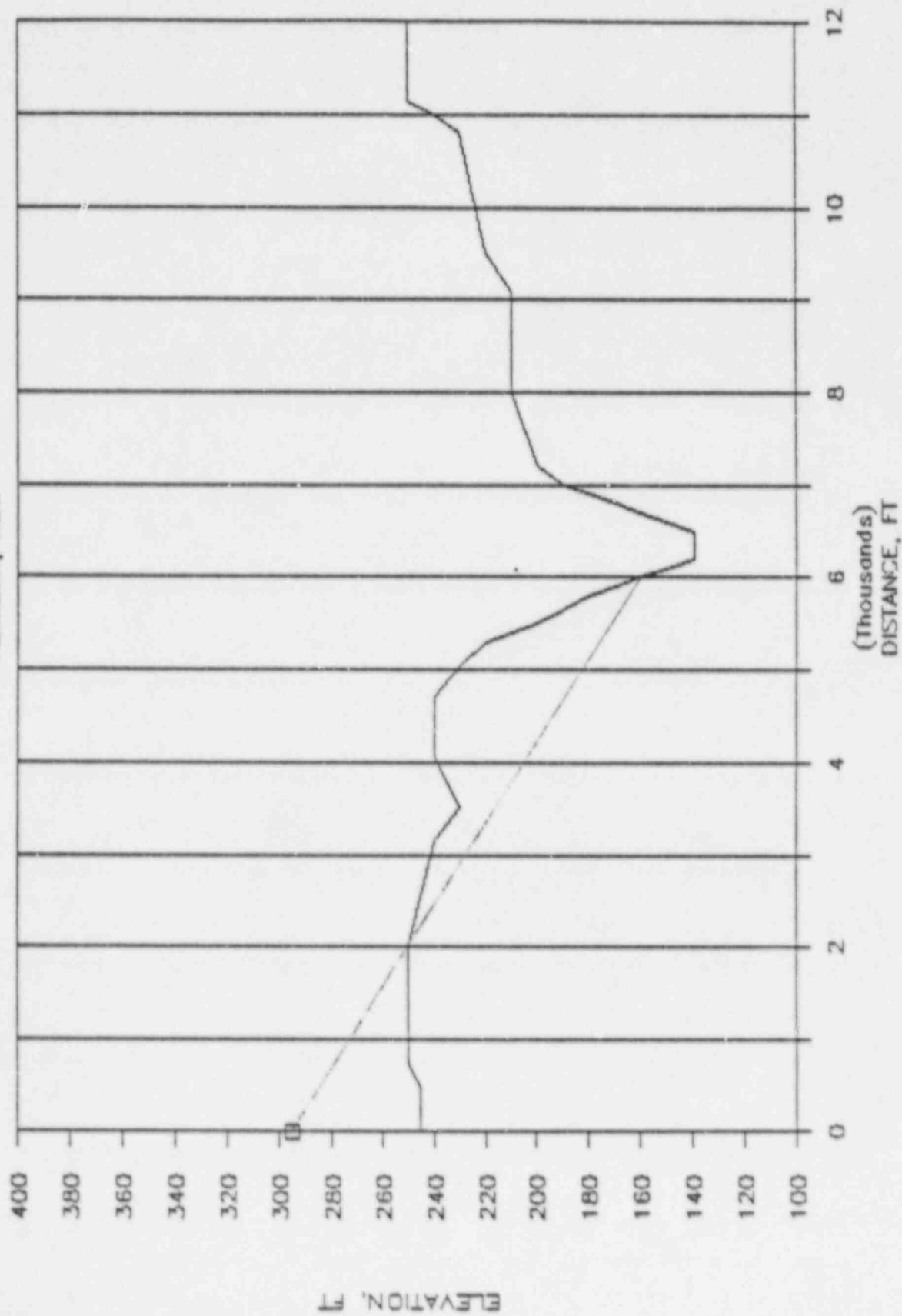
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AZIMUTH, W



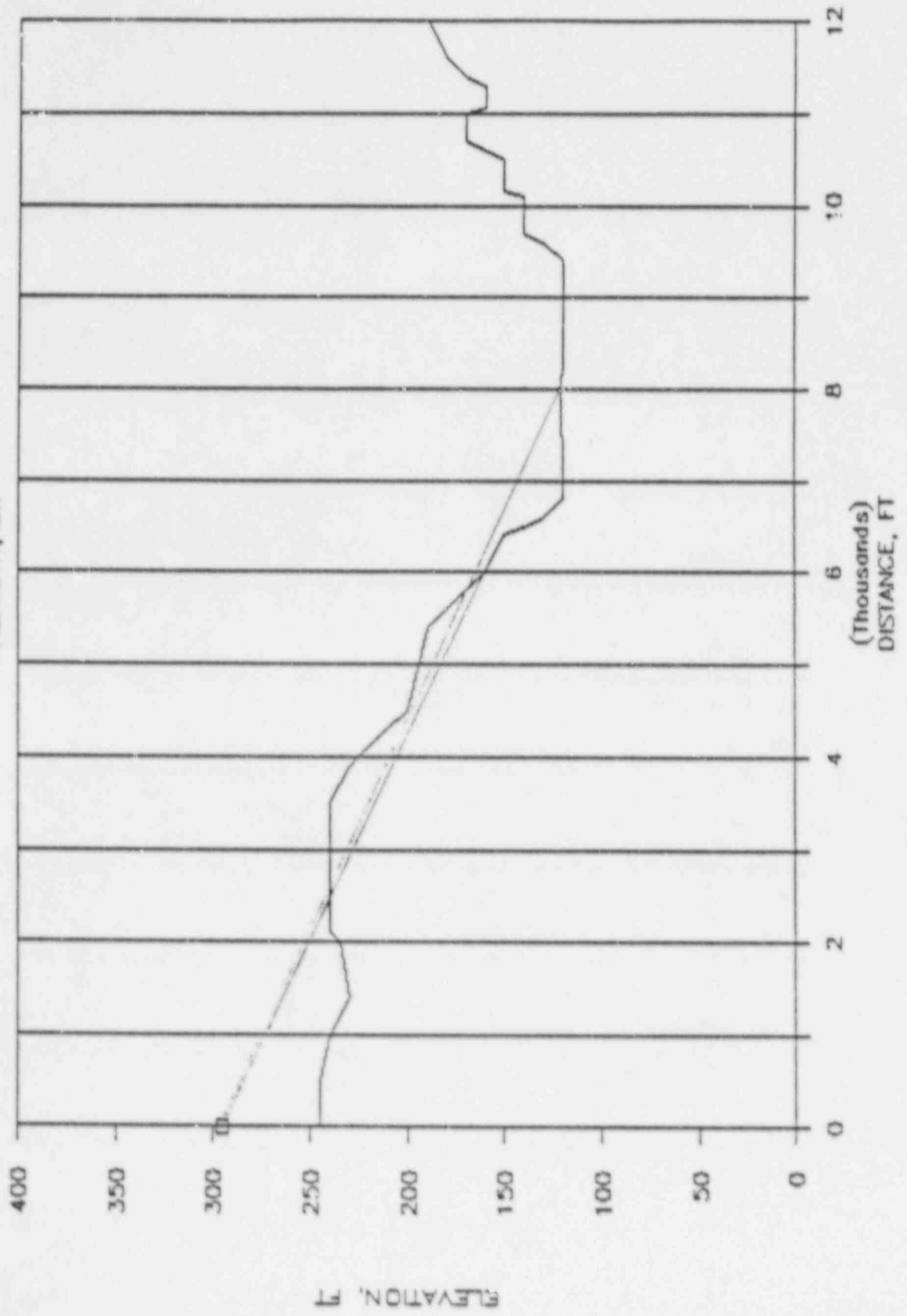
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AZIMUTH, WSW



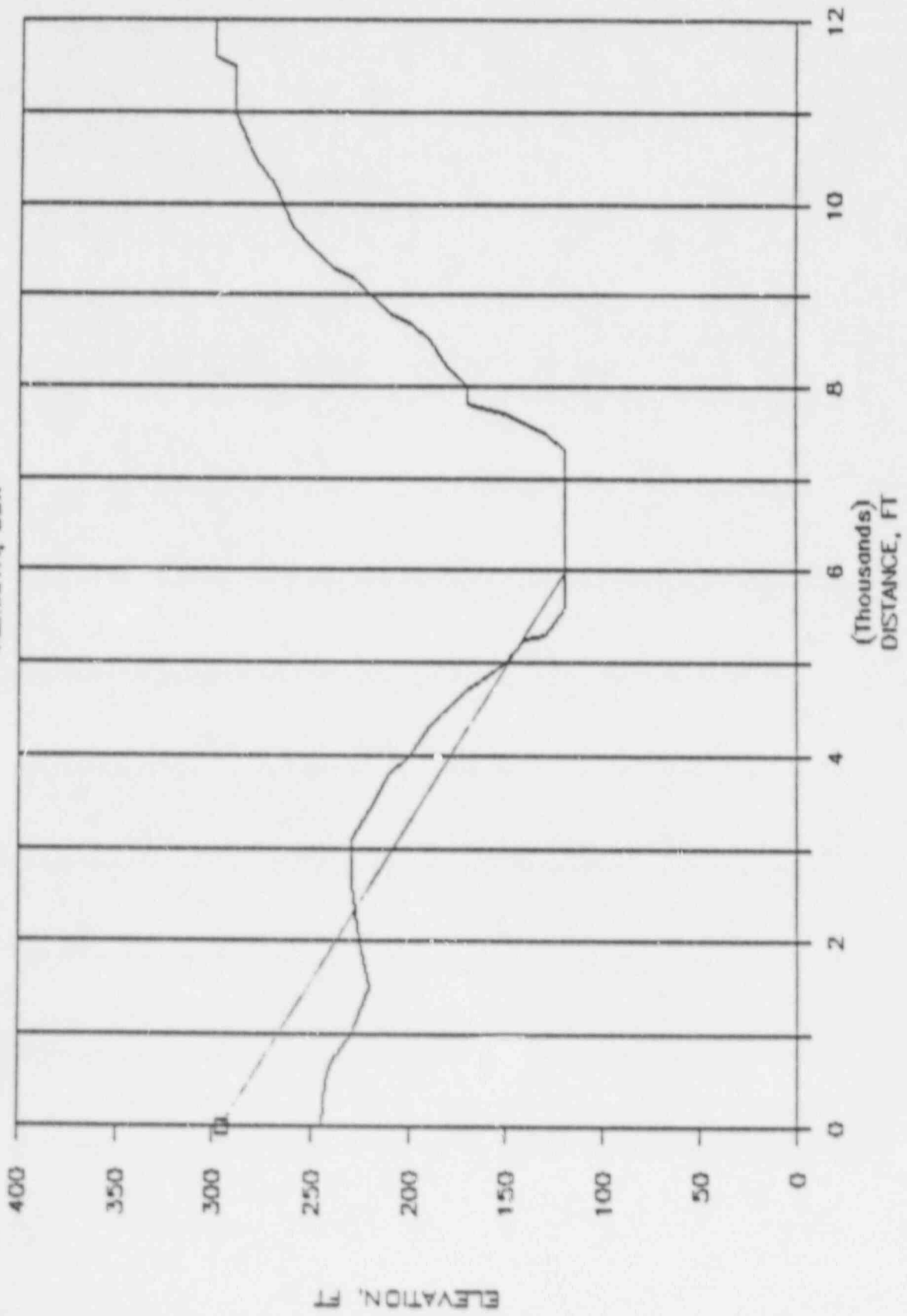
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AZIMUTH, SW



# VOGTLE B1

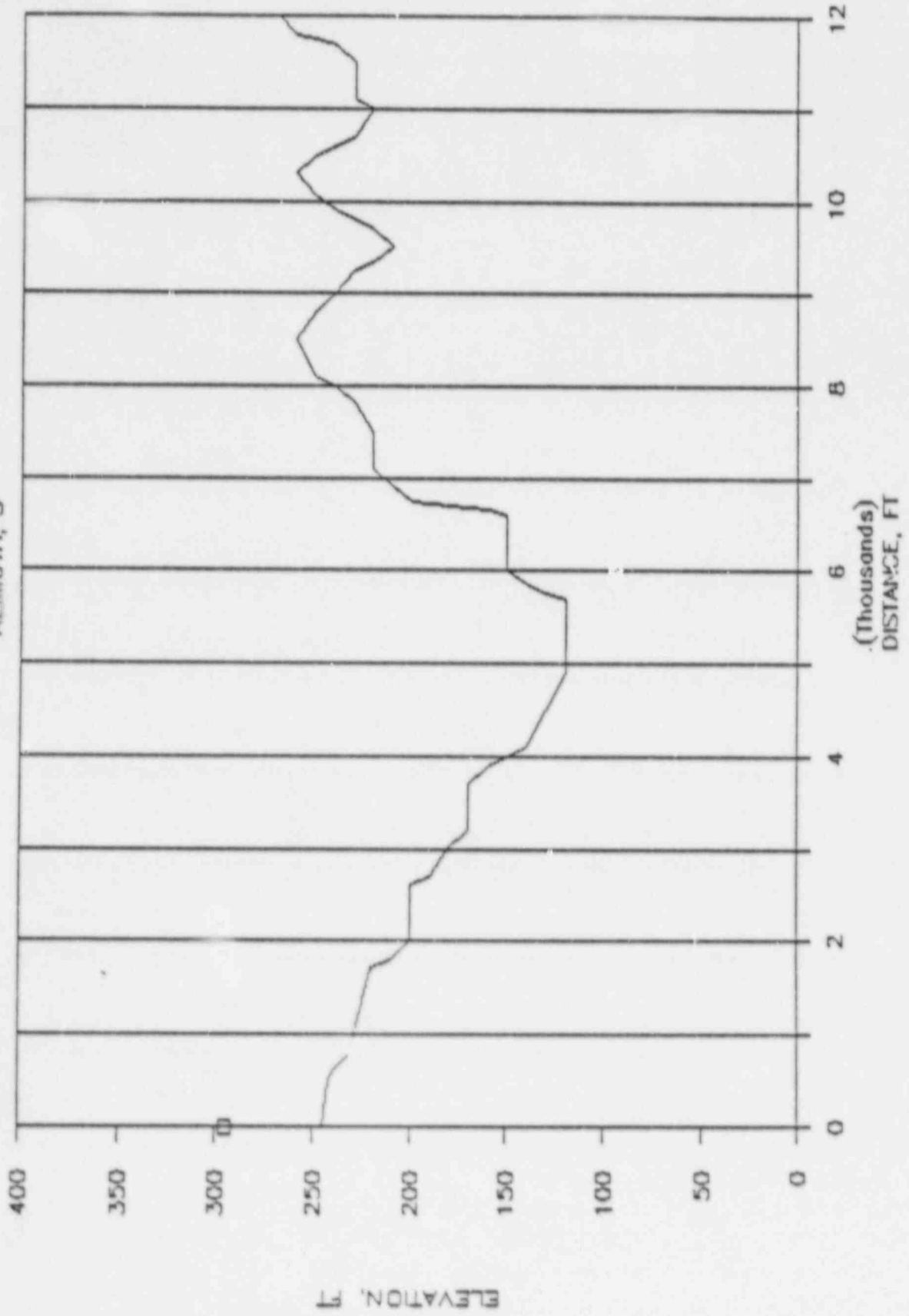
AZIMUTH, SSW





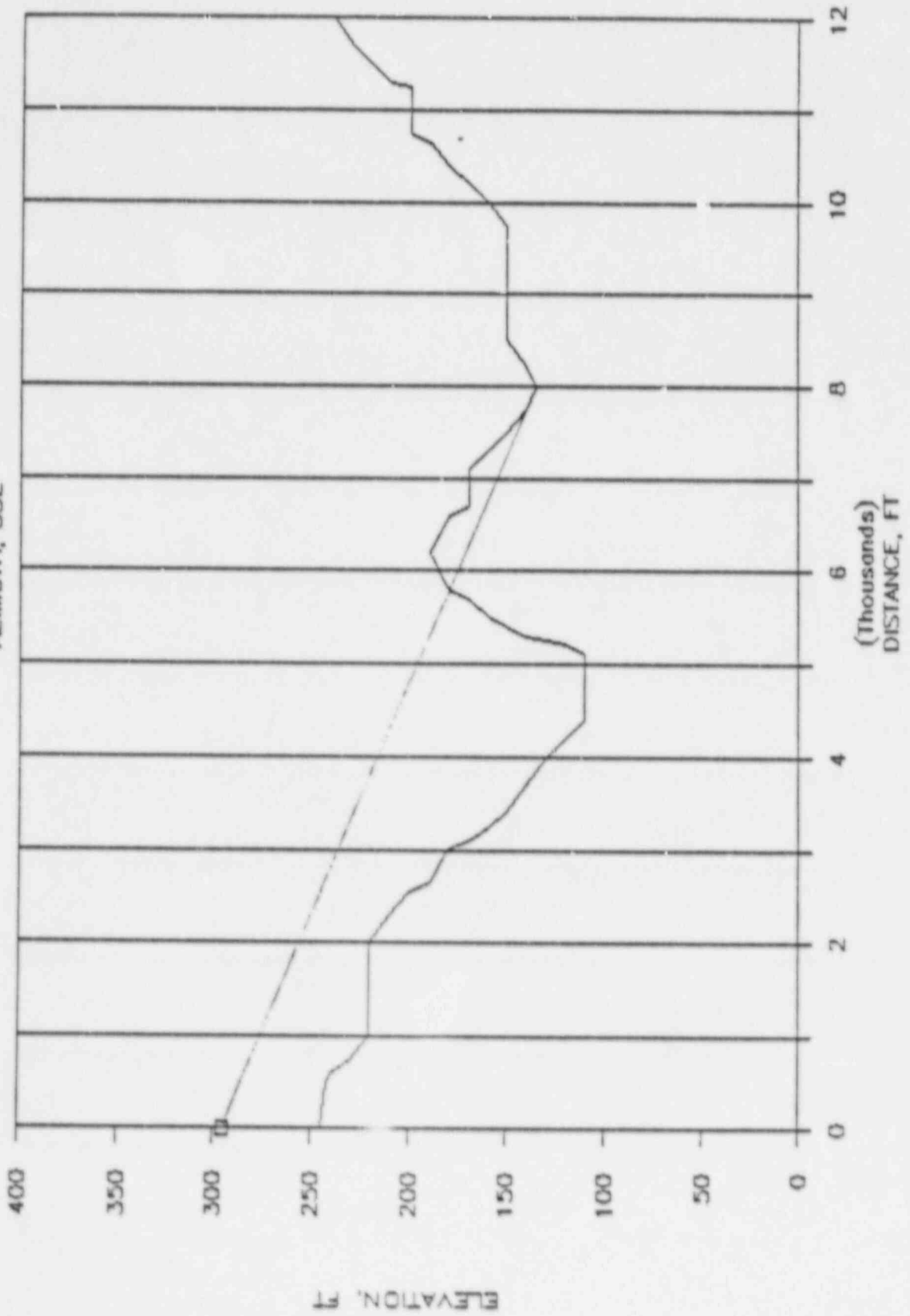
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AZIMUTH, S

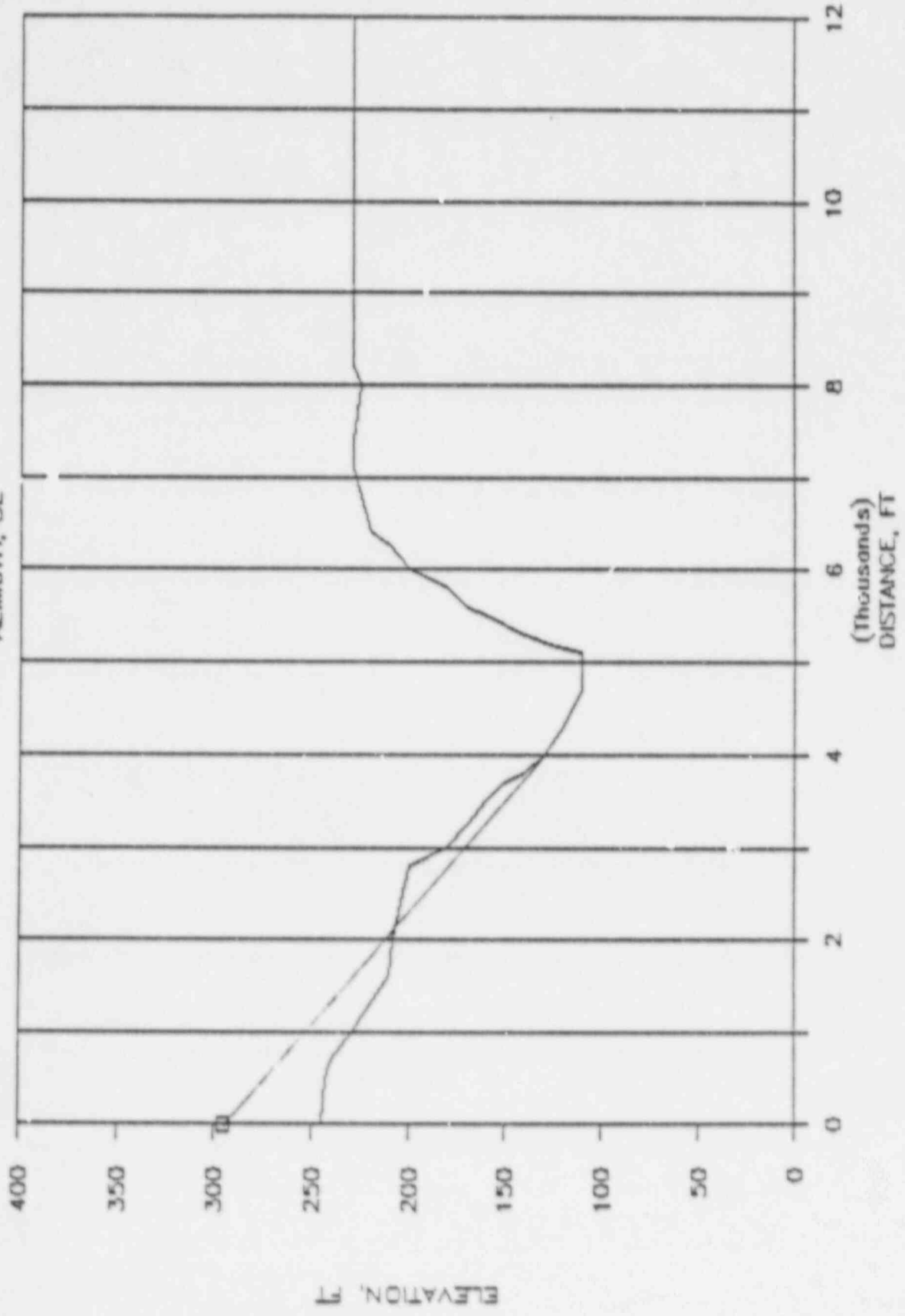


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AZIMUTH, SSE

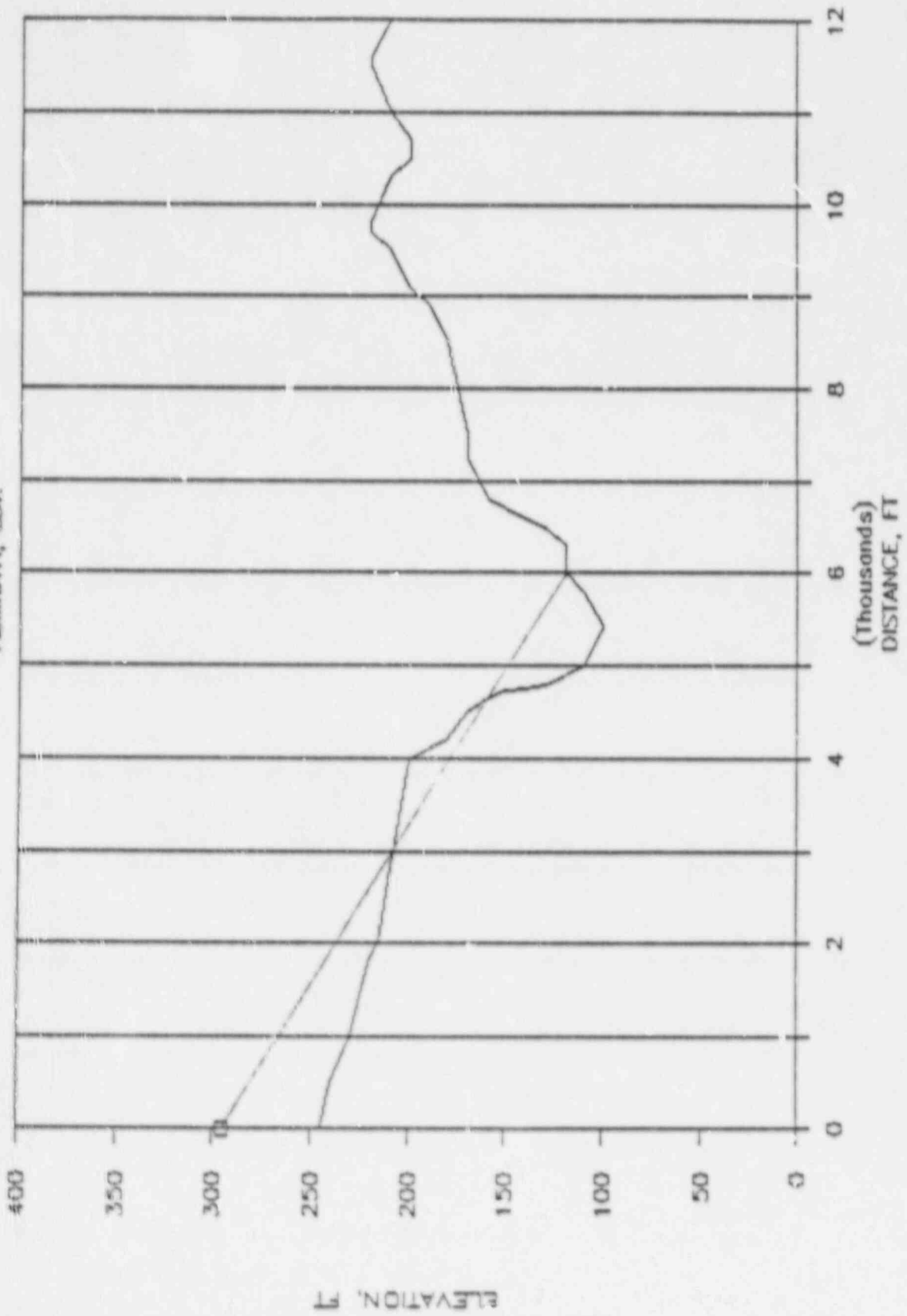


**VOGTLE B1**  
AZIMUTH, SE



# VOGTLE B1

AZIMUTH, ESE



APPENDIX B

SAMPLE SIZE DETERMINATION

## APPENDIX B

### 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 proportion 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:

$$p \pm \frac{Z_c^2}{2n} \left( \frac{N-n}{N-1} \right) \pm Z_c \sqrt{\frac{p(1-p)}{n} \left( \frac{N-n}{N-1} \right)} = \frac{Z_c^2}{2n} \left( \frac{N-n}{N-1} \right) \pm Z_c \sqrt{\frac{p(1-p)}{n} \left( \frac{N-n}{N-1} \right)}$$

and

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

$$p \pm \frac{z_c^2}{2n} \left( \frac{N-n}{N-1} \right) + z_c \sqrt{\frac{p(1-p)}{n} \left( \frac{N-n}{N-1} \right) + \frac{z_c^2}{4n^2} \left( \frac{N-n}{N-1} \right)^2}$$

$$1 + \frac{z_c^2}{n} \left( \frac{N-n}{N-1} \right)$$

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:

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

Although this expression for n can be used directly, it is cumbersome to make several approximations. First, since the term 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 324 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.

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SOURCE: International Energy Associates Limited. "Analysis of Tone Alert Pilot Test." IEAL-111. September 27, 1981.