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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

Before Administrative Judges:

James L. Kelley, Chairman
Dr. James H. Carpenter
Glenn O. Bright

SERVED AUG 20 1985

In the Matter of CAROLINA POWER & LIGHT COMPANY and NORTH CAROLINA EASTERN MUNICIPAL POWER AGENCY (Shearon Harris Nuclear Plant)	Docket No. 50-400-OL (ASLBP No. 82-472-03 OL)

PARTIAL INITIAL DECISION
ON SAFETY CONTENTIONS

August 20, 1985

DS02

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Appearances

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John Runkle, Chapel Hill, North Carolina, for the Joint Intervenors.

Charles A. Barth and Janice E. Moore for the Nuclear Regulatory Commission Staff.

August 20, 1985

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I. INTRODUCTION

The factual and procedural background concerning this contested operating license case are set forth in our first partial initial decision on environmental issues. 17 NRC 410, 412-414 (1985). This partial initial decision addresses most of the safety contentions that were heard in the Fall of 1984. It resolves those contentions in favor of the Applicants and adversely to the Intervenors. The decision also has the effect of making other dispositive Board rulings on safety contentions -- i.e., rulings granting summary disposition motions or rejecting proposed contentions -- ripe for appellate review.

Hearings were held on certain emergency planning contentions in June 1985 and the remaining emergency planning contention is scheduled to be heard in September. The Board anticipates that a final partial initial decision will issue late this year and resolve emergency planning and all other remaining contentions.

II. MANAGEMENT CAPABILITY

A. Background

The ability of Carolina Power & Light Co. to manage the Shearon Harris facility -- often referred to as "management capability" -- had been a principal area of controversy at the construction permit stage. Although the construction permit Licensing Board found that CP&L management could construct Shearon Harris safely, it was not then in a position to determine management capability to operate the facility. However, that Board, the Appeal Board, and, ultimately, the Commission adopted somewhat different approaches to the same end -- that management capability would receive more than routine Staff review at the operating license stage.[1] In response to the Commission's direction, the NRC Staff performed a special "preliminary assessment" of CP&L's management capability to operate the Harris facility. This assessment was published in the Federal Register prior to the Notice of Opportunity for Hearing on the operating license application. See JI Ex. 38.

Possibly in response to the Staff's published assessment, several of the petitioners for intervention proposed sixteen relatively detailed

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1 The Licensing Board conditioned the construction permit on a demonstration by the Applicants of their management capability in a hearing at the operating license stage. See 10 N.R.C. 37, 98 (1979). The Appeal Board invalidated that condition, but directed the Staff to prepare a preliminary assessment of management capability at that stage. 11 NRC 18, 36 (1980). The Commission reversed that Appeal Board order as beyond that Board's delegated authority, but adopted that Board's relief as its own. 11 NRC 514 (1980).

"management" contentions at the initial stage of this proceeding. 16 NRC at 2075. In order to simplify and consolidate these contentions, the Board encouraged the petitioners, the Applicants and the NRC Staff to negotiate stipulated management contentions. The result was a stipulation by all parties to Joint Contention I, which reads as follows:

> The Applicants have not demonstrated the adequacy of their managing, engineering, operating and maintenance personnel to safely operate, maintain and manage the Shearon Harris Nuclear Power Plant as evidenced by their record of safety and performance at their other nuclear power facilities. A pattern of management inadequacies and unqualified and/or inadequate staff is likely to be reproduced at Shearon Harris Nuclear Power Plant and result in health and safety problems.

Joint Contention I is very broad. Indeed it is so lacking in specifics that we probably would not have admitted it over an Applicant or Staff objection on that ground. In this case, however, it was apparent that a relative lack of specificity was the quid pro quo for a single stipulated contention, a price the Applicants and Staff were willing to pay. A principal reason for requiring specificity in contentions is to protect the opposing parties from unduly broad discovery. Because the Applicants and Staff evidenced a willingness (through their stipulations to Joint Contention I) to waive that protection here, there was no reason for the Board to insist on it. In any event, the Applicants and Staff apparently foresaw that they could adequately particularize this broad contention in the discovery process. To a large extent, that is what happened.

B. Standards

Management capability or "competence"[2] (as it is sometimes called) is a murky area of nuclear power regulation. The Commission, in one of its few pronouncements on the subject, has recognized "that it has not established definitive standards for management organization and operation for nuclear power plants." Metropolitan Edison Co. (Three Mile Island Nuclear Station, Unit 1), 11 NRC 408, 409-410 (1980). Acknowledging the present lack of standards, the Appeal Board has called management competence a "nebulous . . . slippery concept." Id., 19 NRC 1193, 1206, 1208 (1984). Not surprisingly, the few decided cases in this area do not illustrate clear "management" principles, but tend to turn on their particular facts. See id., 11 NRC 381 (1982); Carolina Power & Light Co. (Shearon Harris Nuclear Plant), 10 NRC 37 (1979); Houston Lighting & Power Co. (South Texas Project), 19 NRC 659, 669-698 (1984).

The lack of clear standards for "management capability" becomes less significant, however, when it is recognized that in a particular case that phrase may be little more than a loosely-descriptive label for certain kinds of fairly specific problems that can arise at a nuclear

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2 The phrases "management capability" and "management competence" are used interchangeably in this decision and in the decided cases. Both grow out of the requirement that an applicant for an operating license be "technically qualified" to operate the facility. 10 CFR 50.40(b). That rule, in turn, derives from section 182(a) of the Atomic Energy Act, 42 USC 2232.

power plant. So viewed, a "management competence" label can be similar to the "safety", "environmental" and "emergency planning" labels Boards have become accustomed to using as convenient demarcation lines for segregable parts of big cases. For example, in the "management" phase of the TMI Restart proceeding, the Commission raised a series of relatively detailed questions for exploration by the Licensing Board -- e.g., whether the Unit 1 health physics program and radiation waste system were appropriately staffed with qualified individuals to ensure the safe operation of the facility. 11 NRC at 409. Presumably, these questions could have been raised as separate "safety" issues in the case without any explicit reference to "management capability."[3] Similarly, in the present case and for the most part, the Intervenors' concerns about CP&L management eventually focused upon reasonably specific areas, such that the parties were fairly called upon to respond to them, and the Board is now in a position to make reasonably specific findings, based on the hearing record.

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3 So too, in this case the Intervenors' particular concerns --although related in one way or another to "management" -- could have been heard individually as "safety" contentions. Conversely, a contention like Eddleman Contention 41, which was labeled a "safety" contention, might have been heard as a "management" contention in light of widespread problems in the pipe hanger inspection process. See Testimony of Paul Bemis, p. 22, ff. Tr. 3660.

C. Management -- General Considerations[4]

The Applicants presented a panel of high-level management officials to testify about CP&L's management structure for nuclear activities and related matters, including E. E. Utley, Executive Vice President, Power Supply, Engineering and Construction, and M. A. McDuffie, Senior Vice President, Nuclear Generation Group. See Applicants Joint Testimony of Utley, McDuffie, Elleman and Banks on Contention I, ff. Tr. 2452, pp. 1-5. These panel witnesses have extensive experience in nuclear matters generally and in CP&L's nuclear activities in particular. For example, Mr. Utley has been a senior management officer of CP&L since 1972, and is currently Chairman of the Evaluation and Assistance Division of the Institute of Nuclear Power Operations (INPO). Mr. McDuffie has seventeen years of nuclear plant construction experience; he has been a senior management officer of CP&L since 1974.

It is not necessary for us to describe CP&L's organizational structure and functional relationships in detail. We include such description only as necessary to provide a context for the Joint Intervenors' criticisms in the management area.

Like all corporations, CP&L is headed by a Board of Directors. The Board has ten "outside" Directors; four corporate officers also serve as

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4 This section incorporates the Board's findings of fact and conclusions of law on Joint Contention 1. Cf. Rule 52(a), Fed. R. Civ. P.

"inside" Directors.[5] Sherwood H. Smith, Jr. is the Chairman of the Board, President and Chief Executive Officer of CP&L and, as such, oversees all of the company's operations. Utley Testimony at 7. Mr. Smith has been a member of CP&L senior management since 1971, when he was named Senior Vice President and General Counsel. Smith, Tr. 3906. He devotes a substantial portion of his time to CP&L nuclear activities and to national nuclear industry activities. Tr. 3919-21, 3924-26.

The Intervenors ask us to find , without any record citation, that "reliance on one person [Mr. Smith] for the three top positions has the potential to preclude effective change in response to problems in nuclear operation." Joint Intervenors Proposed Finding (JI PF) 10. The Board declines. In the first place, it is unclear whether Mr. Smith

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5 In 1982, at the request of the North Carolina Public Utilities Commission, a firm of management consultants reviewed CP&L's activities and made a number of recommendations for change, about half involving "management process improvements opportunities." The first such recommendation was that CP&L include on its Board "outside" directors having nuclear experience. In 1984, CP&L reported to the Utilities Commission that the status of the "outside nuclear director" recommendation was "completed." JI Ex. 14, p. 3. However, Mr. Utley testified that there is no outside director with nuclear experience on the CP&L Board. We were told that the intent of the status report was to reflect the hiring of a particular individual with extensive experience in nuclear activities as a consultant to the Board. Utley Testimony at 7, Tr. 2797; Smith, Tr. 3910-13. The Board finds CP&L's report to the Utilities Commission on this recommendation misleading even taking into account Applicants' Exhibit 3, which provided a fuller explanation. Nevertheless, we attach no substantial significance to this matter, in and of itself, nor does any other evidence tend to prove a proclivity to make misleading statements to regulatory authorities.

actually holds three separate corporate positions. His testimony suggests that he is "Chief Executive Officer" by virtue of his being President of the company. Smith, Tr. 3906. In any event, there is no evidence in the record to support the Intervenors' proposition. On the contrary, it is not uncommon for senior corporate officers to wear two or more hats, some of which may be largely titular. Smith, Tr. 3914. Overall, the Board was favorably impressed with Mr. Smith's appearance as a witness. See Tr. 3907-3936. We have no reason to think that CP&L's nuclear activities will suffer as a result of Mr. Smith's having more than one title in the company.

Mr. Utley, as Executive Vice President for Power Supply, Engineering and Construction, reports to Mr. Smith. Five organizations, each headed by a Vice President, are involved in CP&L's nuclear power activities and report to Mr. Utley. These organizations are the Nuclear Generation Group (headed by Mr. McDuffie), the Brunswick Nuclear Project, the Operations Support Group, the Corporate Nuclear Safety and Research Department, and the Corporate Quality Assurance Department. Two of the five groups -- Nuclear Generation and the Brunswick Department -- are concerned solely with nuclear activities. Utley, pp. 8-11. The other three groups support all of CP&L's generating activities, including coal, hydro and petroleum fired plants. CP&L has approximately fifteen non-nuclear generating plants employing about one thousand people.

A provision of the Staff's Standard Review Plan states that: "A corporate officer should clearly be responsible for nuclear activities,

without having ancillary responsibilities that might detract from his attention to nuclear safety matters."[6] The Intervenors correctly point out that "the only CP&L corporate officer responsible for all nuclear activities is Mr. Utley, who is also responsible for all fossil generation, transmission and distribution for the company." JI PF 28. The Intervenors further point out, again correctly, that "this does not meet the Standard Review Plan acceptance criteria." Id. However, the Staff's Standard Review Plan does not rise to the level of a binding regulation. Like Regulatory Guides, the Standard Review Plan merely reflects the Staff's position on how one aspect of an Applicants' technical qualifications should be judged. Furthermore, the Staff is free to waive criteria in its Standard Review Plan if, under the circumstances, it is nevertheless satisfied with the Applicants' organizational structure. That is what happened in this case.

Staff witness Bemis testified that "the Staff finds . . . the present organization within CP&L is acceptable . . . although further nuclear consolidation is desirable." Bemis Testimony ff. Tr. 3660, p. 36. More specifically, Mr. Bemis testified that:

> The Corporate Quality Assurance and the Corporate Nuclear Safety and Research Departments report to the Executive Vice President, PSE&C rather than to the corporate officer who has primary responsibility for nuclear support activities, which appears to be common industry practice. The reportability of the departments was determined by the applicant to give these departments additional independence. However, not only does this place excessive direct responsibility on the Executive

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6 SRP 13.1.1, quoted in Bemis Testimony ff. Tr. 3660, at 36.

> Vice President who is already responsible for the largest majority of the company employees and operation, it also removes the day-to-day decision-making capabilities involving interface with the departments from the corporate officer who is considered as the primary corporate officer for nuclear support activities. The staff finds this reportability to be acceptable for the three sites at this time. However, the staff will continue to review this organization in practice. Id. at 37.

The Staff considered it significant that in August 1983, only a year before its testimony in this case, CP&L had undergone "a major restructuring of the corporate organization" which had been explained to NRC as "a major step in CP&L's movement toward nuclear consolidation in the CP&L organization." Bemis at 30. Mr. Bemis went on to outline the major features of these changes and their rationale. Id. at 31-35.

Mr. Utley provided further details about the recent changes, most notably the assignment of a corporate officer (or manager with the status of a department head) to each of the three nuclear plant sites to manage activities at that site. The principal purpose of this change had been to "provide firmer management control over and greater accountability for activities at the plant." Mr. Utley regarded this change as the "single most important improvement . . . CP&L has made in the way in which it manages its nuclear program." Utley at 34.

In view of the recentness and significance of these changes, the Staff decided to give its qualified approval to them at this time. The Staff also promised to "closely monitor . . . to determine whether actual performance is clearly demonstrated during major evaluations." Bemis at 38.

Based in part on the Staff's assurance that it will monitor the practical working of the recent changes in the CP&L organization, this Board accepts that structure, as it has been presented to us. That structure appears to be reasonable and calculated to focus prompt, high-level management attention on safety concerns as they arise. The Intervenors propose no finding that the CP&L organizational structure does not meet any binding licensing standard. Nor, except as already discussed, do they direct us toward any record evidence calling that structure into question.[7]

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[7] The Joint Intervenors propose a finding that senior management personnel do not receive written evaluations of their performance. JIPF 22. While the record supports that fact, we see little relevance to the issue of technical competence. Joint Intervenors' proposed finding 23 seeks to fault Mr. Smith for taking into account the performance of the nuclear units in his evaluation of Mr. Utley, as distinguished from an evaluation based solely of safety considerations, apparently without regard to cost. Mr. Smith made it clear that top-level management officials are evaluated under various criteria; he testified, however, that "you have to start with their safe performance . . . safety to the public has to come first." Smith at 3917. The implication that management officials should be evaluated solely on the basis of safety, without regard to such things as output, schedules or cost, is not merely unrealistic, but fatuous.

Intervenors ask us to find that "only limited personnel actions" have been taken in response to violations of NRC regulations. IPF 25. There is insufficient evidence in the record to make any generalizations about this subject. Joint Intervenors Exhibit 17 indicates that more regulation violations occur at operating plants (Robinson and Brunswick) than at a construction site (Harris). That would not be surprising, but it proves nothing about the Applicants' managerial competence.

D. Brunswick -- General

Apart from general management considerations, the testimony and exhibits largely focused on particular aspects of the Applicants' management of its Brunswick facility and on the Applicants' ratings in the Staff's annual "Systematic Assessment of License Performance" (commonly called "SALP Reports") for 1981-84. The pertinent history at Brunswick and these SALP Reports are closely interrelated. For the sake of clarity, we turn to the Brunswick history first.

Applicants' testimony concerning Brunswick came principally from Mr. Utley (Testimony at 29-33) and from the current senior CP&L managers at Brunswick -- Patrick Howe, Vice President - Brunswick Nuclear Project, and C. R. Dietz, General Manager - Brunswick Plant. See Howe/Dietz Testimony, ff. Tr. 3124. The senior managers and the organizational structure presently in place at Brunswick are pertinent, not in and of themselves, but for what they say about the Applicants' willingness and ability to identify management problems and to implement corrective action in a timely manner.

Both Mr. Howe and Mr. Dietz have extensive training and experience in the nuclear field. Mr. Howe has some thirty years of nuclear experience, including senior positions at the Lawrence Radiation Laboratory, the Atomic Energy Commission and CP&L. Mr. Dietz has held a variety of responsible positions in the nuclear industry. Howe/Dietz Testimony, at 1-3. Messrs. Howe and Dietz spoke on the basis of first-hand experience about the Brunswick plant and, generally, the Board found their testimony persuasive. Messrs. Howe and Dietz

testified in some detail about the present organization and staffing of the Brunswick Nuclear Project. Howe/Dietz at 1-10. The record reflects that the present organization and staffing at Brunswick are adequate. However, an earlier period at Brunswick, from about 1977 until late 1982, raises questions about CP&L's management competence, not only at that facility, but in all its nuclear operations.

E. The NRC Staff's View of Brunswick

The NRC Staff's principal witness on the management contention was Paul R. Bemis, a Section Chief in the NRC's Atlanta Office. Mr. Bemis was very well qualified to address the management contention. His general background and experience were set forth in his extensive testimony. Furthermore, for approximately two years preceding the hearing, Mr. Bemis was directly responsible "for managing the performance of the NRC inspection and enforcement program at all of the CP&L facilities." Bemis at 6. Mr. Bemis explained this unusual assignment, as follows:

> In the fall of 1982, the Regional Administrator and his top management staff decided that due to numerous continuing problems at CP&L facilities, in particular the Brunswick site, a break from a conventional NRC management style was required and a radical management style would be put into place . . . . Rather than managing solely from the Regional Office I was detailed to observe first hand the operations at the individual nuclear sites and corporate office. During the first six months of this new assignment, I spent approximately 85% of my normal work time assignment at CP&L nuclear sites and the corporate office evaluating: the management at the nuclear sites, and at the corporate office; plant operation, including support groups; and progress of the Brunswick and Robinson Improvement Programs to ensure that lessons learned from these programs were implemented at Harris. During the

> past year, I have been evaluating the programs put in place to ensure that progress is being achieved, evaluating implementation of the new corporate and site organizations including individual managers, and following closely the Robinson Steam Generator Repair Project, the implementation of the Brunswick and Robinson Improvement Programs, and the construction progress at the Harris facility.

Among other matters, Mr. Bemis testified in some detail concerning the following areas of concern at Brunswick.

1. Enforcement History. According to Mr. Bemis, "Brunswick's enforcement history has been poor." Id. at 15. (This assessment is also indicated by prior SALP ratings, as discussed further below.) Mr. Bemis singled out a civil penalty of $600,000 -- the largest penalty levied by NRC to that date -- associated with certain surveillance and quality assurance activities. Id. at 15. See JI Ex. No. 18. He testified that:

> Originally, it was thought that only a few surveillance requirements were missed but after a thorough check of the Technical Specifications it was determined that a large number of Limiting Conditions for Operation could not be verified. When the magnitude of these problems was recognized, CP&L management shut down both units, performed the required verifications, and began development of the Brunswick Improvement Program (BIP).

Mr. Bemis characterized this incident as a "breakdown in management controls" (Id. at 20), a characterization with which Mr. Smith and Mr. Utley of CP&L seemed to agree. Tr. 2907, 3928.

With respect to more recent trends in enforcement matters, however, Mr. Bemis testified that "my review of enforcement history of CP&L sites indicates violations are becoming fewer in number. More importantly,

the level of severity of the violation is decreasing" Id. at 18. He further concluded that violations at the Harris plant over the past three years, for the most part, "did not represent programmatic or management control system failures." Id. at 20.[8]

2. Other Brunswick Problems Relevant to Management Competence. Mr. Bemis also cited certain other Brunswick problem areas he considered pertinent to future operation of Harris. For several years, Brunswick had a relatively small operating Staff which had led to high turnover rates, long working hours and generally poor staff morale. These factors undoubtedly made it difficult to attract and retain qualified personnel. Mr. Bemis noted, however, that "due to management directed changes at Brunswick of the past 18 months, employee morale has improved and site attrition has dropped from greater than 11% to less than 4% per year." Id. at 25. As Mr. Howe testified, the number of employees at Brunswick has increased dramatically, from 400 in 1980 to about triple that number at the present time. Howe at 15-16. Completion of required

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8 The Joint Intervenors also point to an incident that occurred in January 1983 involving refueling operations as evidence of programmatic deficiencies at Brunswick. JI PF 106; Tr. 3754-3757. The circumstances concerning this incident were not fully developed on the record and it is unclear whether it represents an isolated incident or a programmatic deficiency. In any event, the incident occurred when the Brunswick Improvement Plan was first being implemented. In view of improvements under that Plan and thereafter, we see no significance in the incident for present purposes.

rework flowing from TMI requirements and equipment failures, and NRC regulations limiting working hours have reduced extended working hours. All of these related changes have improved the quality of work and employee morale. Bemis at 25-26.

Brunswick had experienced "numerous problems" in its radiation protection program. Mr. Bemis attributed these problems to "poor management control of the problem." Id. at 26. He testified that:

> In the summer of 1980, the radiation protection problems culminated with a large civil penalty being issued for Brunswick allowing contaminated material to be dumped in a clean area. CP&L management then took decisive action by installing a new manager over the program and gave him the required backing to completely restructure the radiation protection program. Upgrading procedures, additional upgrading of equipment, and more qualified personnel were installed at the facility. This program has seen continued improvement to the present and is reflected in each SALP rating since that time. . . . The Harris program has benefited from the problems experienced at Brunswick, in that personnel are better trained from the beginning, a superior program will be in place at fuel load, and Harris has state-of-the-art equipment to begin operation. These items lead the NRC to conclude that the Harris radiation program will meet requirements[9] and not have the problems experienced at Brunswick. Id.

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9 The Applicants presented testimony and proposed findings on several other aspects of Brunswick operations, including shift rotations, radwaste control and training programs. APFs 101-108. In general, the Board was favorably impressed with the Applicants' evidence in these areas. We do not make specific findings on these areas since the Intervenors propose no such findings.

The Intervenors cite the high number of LER's at Brunswick in the 1979-1982 period. JIPF 39. They fail to note, however, that LER's decreased sharply after that, a trend that conforms with our overall assessment of Brunswick management. See APF (Reply) 19.

(Footnote Continued)

3. The Brunswick Improvement Plan. As the foregoing discussion indicates, Mr. Bemis saw in Brunswick a disconcerting pattern of regulatory problems between the late 70's and late 1982, followed by marked, even dramatic, improvement from then until the present time. It appears that from a management perspective these healthy changes come about partly as a result of changes in CP&L attitudes and partly as a result of strong pressure from NRC officials in Region 2. Mr. Bemis testified that:

> By mid-1982, the Regional Office had concluded that no substantial program improvements had been observed since the Cantrell concerns were aired in the 1979 ASLB hearings on Harris. Therefore, the NRC insisted on a formal improvement program. The NRC gave general input to the BIP requirements. The general requirements of this program were:
>
> o Establish a centralized tracking system to insure all regulatory requirements and commitments are met.
>
> o Rewrite all procedures required for safe plant operation insuring technical adequacy.
>
> o Upgrade the corporate and site QA organization.
>
> o Continue post-maintenance testing program.
>
> o Upgrade training and discipline of operations.
>
> o Upgrade the corporate and site Nuclear Safety organizations.
>
> o Implement the findings of several previous outside audits.

(Footnote Continued)
The Intervenors also propose findings on Brunwick capacity factors. JIPF 44-45. The Intervenors do not explain the relevance of such factors to this case, which we think is marginal.

This program was confirmed and imposed by an NRC Order on December 22, 1982. Id. at 15-16.

F. Conclusions About Brunswick. Partly as a result of implementation of the Brunswick Improvement Plan, Mr. Bemis expressed a positive view about Brunswick operations, present and future. As he saw it:

> The Brunswick facility has shown steady improvement over the past 18 months in management programs, control and ability to adhere to regulatory requirements. Each project improved over its predecessor indicating a management committed to improvement. CP&L acknowledged . . . NRC concerns and was able to implement corrective actions in such a way that many major improvements resulted, bringing about a more enlightened and aggressive staff attitude that was more sensitive to detail and NRC regulations than before implementation of the Brunswick Improvement Plan. CP&L recognized where weak areas existed and filled positions with capable individuals from outside the company when necessary. The result has been an improved, more closely coordinated operation, capable of performing difficult, integrated site projects. Region II feels that the Brunswick of today is significantly improved over the Brunswick of five years ago. Our aggressive inspection and enforcement program gives us confidence that CP&L will continue to improve its management and operation of its entire nuclear program. Id. at 23.

The Licensing Board agrees with the Staff's evolving assessment of management performance at Brunswick from the late 70's until the hearing in the fall of 1984. That assessment, in its essentials, reflects poor management performance for several years, until implementation of the Brunswick Improvement Plan in late 1982. Since then, however, there has been fairly steady improvement in Brunswick management. At the present time, the record indicates that Brunswick management is basically sound.

We reach these general conclusions about Brunswick for several reasons. First, we rely substantially on the detailed and informed

testimony of Mr. Bemis. He was in a unique position -- based on his unusual assignment to oversee all CP&L facilities in the relevant time period -- to assess Brunswick management in depth and to provide an objective viewpoint. That assessment is also supported by the weight of the other evidence. Thus, the Applicants' witnesses (although generally more favorable to the CP&L performance than Mr. Bemis) testified to much the same effect. For example, they candidly conceded that some of their past difficulties at Brunswick stemmed from management deficiencies. Tr. 2907, 3928. The Intervenors did not present witnesses on Brunswick; responses to their cross-examination were generally consistent with the conclusions we reach here. Furthermore, the "SALP" Reports, which we discuss next, also support our conclusions about Brunswick.

G. The "SALP" Reports on CP&L Facilities.

1. Introduction.

For the past several years, the NRC Regional Offices have conducted annual "Systematic Assessments of Licensee Performance" of each Licensee of a nuclear power plant, including an evaluation of each facility. Uniform procedures for such assessments were first formalized in 1982.[10]

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10 See 47 Fed. Reg. 12240, Systematic Assessment of Licensee Performance; Request for Public Comment.

The nature and purposes of the SALP program were summarized at that time, as follows:

> SALP is an integrated NRC staff effort to collect available observations on an annual basis and evaluate licensee performance based on those observations. Positive and negative attributes of licensee performance are considered. Emphasis is placed upon understanding the reasons for licensee's performance in important functional areas, and sharing this understanding with the licensee. The SALP process is oriented toward furthering NRC's understanding of the manner in which: (1) The licensee management directs, guides, and provides resources for assuring plant safety; and (2) such resources are used and applied. The integrated SALP assessment is intended to be sufficiently diagnostic to provide a rational basis for allocating NRC resources and to provide meaningful guidance to licensee management.

Each year, a licensees' performance at each site is assessed in several functional areas -- for example, plant operations, fire protection, security, refueling. On the basis of that assessment, including consideration of inspection reports, the SALP Board for that particular licensee assigns a rating for each functional area. Such ratings, in turn, call for varying levels of NRC inspection and enforcement effort, as follows:

> a. Category 1. Reduced NRC attention may be appropriate. Licensee management attention and involvement are aggressive and oriented toward nuclear safety; Licensee resources are ample and effectively used such that a high level of performance with respect to operational safety or construction is being achieved.
>
> b. Category 2. NRC attention should be maintained at normal levels. Licensee management attention and involvement are evident and are concerned with nuclear safety; licensee resources are adequate and are reasonably effective such that satisfactory performance with respect to operational safety or construction is being achieved.
>
> c. Category 3. Both NRC and licensee attention should be

> increased. Licensee management attention or involvement is acceptable and considers nuclear safety, but weaknesses are evident; licensee resources appear to be strained or not effectively used such that minimally satisfactory performance with respect to operational safety or construction is being achieved. Id. at 12,241.

SALP boards are composed of Regional Office personnel particularly knowledgeable about the licensee; they receive input from knowledgeable sources, including resident inspectors at particular sites. Written input is obtained from the Office of Nuclear Reactor Regulation and other Washington offices, as appropriate. Ratings are arrived at through discussion and consensus judgments, with differences resolved by Board vote. Id. See Bemis, Tr. 3653-3655.

One or more of the following criteria are used to evaluate performance in each functional area:

1. Management involvement in assuring quality.
2. Approach to resolution of technical issues from a safety standpoint.
3. Responsiveness to NRC initiatives.
4. Enforcement history.
5. Reporting and analysis of reportable events.
6. Staffing (including management).
7. Training effectiveness and qualification.[11]

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11 JI. Ex. 21, SALP III, at 1.

As can be inferred from the criteria, a conscious effort is made to assess managerial effectiveness in the various areas. In addition to assessments of individual facilities, the SALP Report contains an overall evaluation of the licensee. Following completion of the SALP Board's assessment, the licensee is given an opportunity to file written comments. Thereafter, both the Board assessment and the licensee comments, if any, are issued as an NRC Report by the Regional Administration.

The NRC Staff introduced the most recent SALP report into evidence, the 1984 Report. Bemis testimony, ff. Tr. 3660, at 42. The three preceding reports were introduced by the Joint Intervenors. JI Exs. 19, 20 and 21. These four SALP Reports were referred to in the hearing as SALP I - IV; they covered the following time periods:

SALP I	April 1, 1979 - March 31, 1980
SALP II	July 1, 1980 - December 31, 1981
SALP III	January 1, 1982 - January 31, 1983
SALP IV	February 1, 1983 - April 30, 1984

In the aggregate, these time periods cover the time periods of principal interest in this case. Events occurring prior to April 1979 would probably be too remote in time to have much bearing on future management ability to operate Shearon Harris.

The Joint Intervenors seek to make selective use of these SALP Reports in order to denigrate CP&L's management capability. See JI PF

32-43. As we explain hereafter, although some individual findings do not reflect very favorably on CP&L, read as a whole the SALP Reports support CP&L's claim of improved management competence. The other parties make references to the Reports, but do not rely strongly on them in their findings. This is understandable in the case of CP&L, which emphasized the testimony of their own witnesses, who occasionally disagreed with the SALP findings. See e.g., Utley, Tr. 2969. The Staff's approach was to rely on its witness, Mr. Bemis, who made only a passing reference in his prepared testimony to the most recent SALP Report.[12]

The Board considers the four SALP Reports to be highly significant evidence on the management contention. As noted above, the reports blanket the relevant time period and therefore should reflect any significant trends. They represent the judgments of disinterested observers, as contrasted with necessarily self-serving declarations from the Applicants' witnesses. The SALP Reports are based upon expertise from a wide range of technical disciplines. For example, the Board that produced the most recent SALP Report on CP&L included four members,

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12 Had the Staff chosen to rely heavily on the SALP Reports, it may have been required to produce several additional witnesses to stand cross-examination on them. That, in turn, might have strained the Staff's resources. We note in this connection that the Staff nevertheless produced more than a dozen witnesses at the 1979 remand hearing, a hearing held at the Commission's behest. See 10 NRC at 43-44. We imply no criticism of Mr. Bemis, who was an effective witness, in observing that the Staff chose to present a modest direct case in this proceeding, compared to its command performance in 1979.

three of whom are Division Directors at Region II, and thirteen "attendees", among these Mr. Bemis, four Resident Inspectors, and three NRC specialists from Washington. SALP IV, at 8. The reports attempt to factor in management considerations, including an overall judgment about the licensee's competence.

Before turning to the most pertinent aspects of the four SALP Reports on CP&L, we emphasize again that a rating of "3" is not a "failing grade." As we have explained, a "3" means that "minimally satisfactory performance . . . is being achieved." A "3" rating probably would result in greater inspection attention by NRC Regional personnel, but licensees can continue to operate notwithstanding a "3" rating on a safety-related function.

2. <u>SALP I (1979-1980)</u>. The first SALP Report on CP&L was relatively brief and conclusory, perhaps because it was the first such assessment to be performed.[13] SALP I did not include numerical category ratings. Because of the problems then being encountered at Brunswick, we will focus particularly on SALP I's assessments of that facility.

The Review Board stated that there had been "no adverse trends with respect to noncompliance" at Brunswick, but that "problems related to

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13 SALP I (JI Ex. 19) was 17 typewritten pages long. The subsequent SALPS were: II -- 40 pages; III -- 61 pages; and IV -- 69 pages. Generally, each successive SALP has provided more data and analyses than its predecessor.

radiation protection and contamination had been observed . . . ." The Board concluded generally that "Brunswick had been responsive to NRC regulations and findings of noncompliance." The view was expressed that "the recent reorganization at the corporate and site levels appears to be providing increased responsiveness to our concerns." SALP I at 2-2. The assessment of Brunswick concluded with a discussion of an unmonitored, uncontrolled release of airborne radioactive material. However, the "Action Plan" portion of the assessment did not call for any escalated enforcement action. SALP I, App. B. The "Overall Evaluation" of Brunswick was as follows:

> The performance of licensed activities was adequate during the appraisal period as compared to other Region II facilities. Subsequent performance would indicate a well below average performance as indicated by recent inspection findings in the areas of radiation control, contamination control, and environmental protection program. These areas are being closely monitored by Region II and corrective action is being taken by the licensee. SALP I at 2-4.

The SALP I assessments of the Robinson and Shearon Harris facilities were generally favorable. Overall, Robinson was deemed to be "slightly above average as compared to other Region II facilities." Shearon Harris was rated "slightly below average," with certain deficiencies noted in the quality assurance area. SALP I at 3-3, 4-3.

In its overview of CP&L as a licensee, SALP I noted certain areas of "good performance", other areas where "improved performance is warranted", including contamination and procedural controls. The "overall evaluation" for the licensee was that:

> CP&L is, in general, responsive to NRC requirements, findings of noncompliance, and information requests from the NRC. Their performance is evaluated to be below average for Region II. However, their reorganization appears to be improving their performance. A continuation of this uptrend is expected.

3. SALP II (1980-81). The SALP II report represented the low point for Brunswick. The performance analysis for Brunswick was relatively lengthy and frequently critical. SALP II at pp. 5-21. For example, the discussion of numerous violations in plant operations concluded that they were "examples of recurrent problems and the lack of management control in the area of plant operations." Id. at 5. Following a lengthy discussion of radiation control problems, the Report concluded that "significant management control problems" were present. Id. at 13. Similarly, the analysis of certain quality assurance problems found that "insufficient management attention" had been given to that area. Id. at 16.

SALP II was the first SALP to assign numerical category ratings to functional areas. Brunswick received the following ratings (SALP II at 2-3):

	Functional Area	Rating
1.	Plant Operations	3
2.	Refueling Operations	-
3.	Maintenance	3
4.	Surveillance and Inservice Testing	2
5.	Personnel, Training, and Plant Procedures	3
6.	Fire Protection and Housekeeping	3
7.	Design Changes and Modifications	2
8.	Radiation Protection, Radioactive Waste Management, and Transportation	3

9.	Environmental Protection	3
10.	Emergency Preparedness	2
11.	Security and Safeguards	2
12.	Audits, Review and Committee Activities	3
13.	Administrative, QA, and Records	3
14.	Corrective Action and Reporting	2

These ratings represent an average rating of 2.6. In terms of the category definitions stated above, this rating may be equated with a below average, slightly above minimally acceptable, -- in a word, mediocre -- performance.

The overall facility evaluation for Brunswick was as follows:

> During the review period the licensee underwent a reorganization which included major personnel changes. Evaluation of these changes is still in progress although improved performance is expected to result. Major weaknesses were noted in the areas of plant operations, maintenance, fire protection, plant procedures, radiation protection, environmental protection, and quality assurance. SALP II at 2.

The SALP II analyses for the Robinson and Harris facilities were less extensive. These facilities received ratings of "2" for almost all functional areas. Id. at 3-4.

SALP II's "overall utility evaluation" was that the licensee is cooperative with the Commission and displays good technical competence. Weaknesses common to both operating sites were found in the areas of plant operations, procedures, and radiation protection. Id. at 2.

CP&L filed extensive comments on the Review Group's Report, contending that that report was not fairly balanced, and taking issue with numerous specific finding and ratings. Addendum 3 to JI Ex. 20.

The Regional Administrator reviewed these comments but, in the main, upheld the Review Board's positions. Addendum 4 to JI Ex. 20.

4. SALP III (1982-83). SALP III found improvement at Brunswick in a few areas, but other problems persisted. Licensee performance was termed "acceptable". SALP III at 3. On the positive side, the Report noted that "major strengths were identified in the areas of emergency preparedness and security and safeguards." Positive actions taken during the period were the assignment of a senior manager to the site and development of a long range improvement plan. Improvements were evident over the previous SALP period in the area of radiological controls." Id.

However, on the negative side "major weaknesses were identified in the areas of plant operations, maintenance, surveillance, fire protection, refueling, licensing activities, and quality assurance. Improvements from the previous SALP were not apparent in the areas of plant operations, maintenance, and fire protection." Id.

The Report expressed the hope that "the long range improvement initiative, which is currently being implemented, is expected to result in improved licensee performance in the weak areas. The licensee has committed a substantial amount of facility and corporate resources to this improvement program." Id.

Brunswick's SALP III ratings were as follows:

Functional Area	Rating
1. Plant Operations	3

2.	Radiological Controls	2
3.	Maintenance	3
4.	Surveillance	3
5.	Fire Protection	3
6.	Emergency Preparedness	1
7.	Security and Safeguards	1
8.	Refueling	3
9.	Licensing Activities	3
10.	Quality Assurance Program	3

These ratings yield an average rating of 2.5, not a significant improvement over SALP II's 2.6 average.

The SALP III ratings of Robinson and Harris were substantially similiar to SALP II -- i.e., an average of 2.

The "overall utility evaluation" for SALP III was, in part, as follows:

> During this appraisal period, the licensee has shown significant improvement in some areas; but several areas, identified during the previous review period as requiring increased management attention, have not shown improvement. The licensee has identified those areas and has initiated extensive long-range improvement programs.
>
> The licensee has exhibited a positive attitude to NRC initiatives; but, in general, licensee responses have demonstrated inadequate management involvement in licensing activities, particularly in the interface with NRR. Levels of performance were consistent with that noted in the previous review period.

Once again, CP&L filed extensive comments on the Review Board's report and, again, the Regional Administration generally upheld the Review Board. See JI Ex. 21, Letter from O'Reilly to Utley dated June 14, 1983.

5. SALP IV (1983-84). SALP IV found very marked improvement at Brunswick, as reflected in the ratings for functional areas.

Functional Area	Rating
1. Plant Operations	2
2. Radiological Controls	1
3. Maintenance	2
4. Surveillance	2
5. Fire Protection	2
6. Emergency Preparedness	1
7. Security and Safeguards	1
8. Refueling	1
9. Licensing Activities	2
10. Quality Assurance Program	2

The rating for each functional area improved from SALP III, except for Emergency Preparedness and Safeguards, which retained their maximum ratings of "1". The average rating for SALP IV was 1.6, almost a full unit higher-than SALP III's 2.5. The SALP IV average of ratings for Robinson and Harris were also improved and were very similar. SALP IV at 4, 8.

The overall evaluation of Brunswick was quite favorable. Id. at 5. It spoke of "several major achievements," including implementation of the Brunswick Improvement Plan. No "major weaknesses" were identified. The following comments are particularly relevant here:

> The reorganization at Brunswick has resulted in a significant increase in management awareness and control, particularly in the areas of operations and outage management. The effects of assigning a corporate Vice President (VP) to the site became evident during this SALP period, as many problems were handled quickly and effectively with the VP dealing directly with administrative obstacles. Id. at 6.

Similarly, the SALP IV overall evaluation of CP&L was favorable, including the following endorsement:

> During the evaluation period, the increased licensee management attention applied to the entire nuclear organization has changed CP&L from being considered as a poor performer during the previous SALP period to a significantly improved utility. The Improvement Program implemented by CP&L has been used as a model by some other Region II utilities to follow in development of their own improvement programs. Id. at 3.

H. The Joint Intervenors' Approach to the SALP Reports. The preceding description of the SALP Reports casts CP&L in an improving and generally favorable light. The Joint Intervenors ask us to look at various pieces of these same Reports from some different angles and to draw less favorable conclusions about CP&L. We consider these Intervenor perspectives next.

In their Proposed Finding 32, Joint Intervenors note that several areas of weakness in SALP II showed up again as weaknesses in SALP III, notwithstanding Executive Vice President Utley's statements to the effect that CP&L would attempt to make improvements in areas of weakness. Tr. 2968-2974. In this same connection, SALP III criticized CP&L for not moving with sufficient vigor in areas cited as weak in the past. Report at 3. We do not believe that, taken in context, the areas of continuing weakness from SALP II to SALP III are fairly viewed as an indictment of CP&L. Most importantly, all the areas of cited weakness were cited as improved (to category 1 or 2) in SALP IV. This trend of gradual improvement supports Mr. Utley's testimony that remedial actions were underway early, but that some would take time. Furthermore, CP&L's

extensive comments on SALP's II and III reflect that the SALP criticisms were being taken seriously at the time, even if we assume that CP&L might have taken remedial action more quickly and effectively than it did.

The Joint Intervenors introduced into evidence their Exhibit 39, which "compares selected functional areas for SALP II through SALP IV in those areas where comparisons can be made . . . ." They assert that JI-39 "is helpful in assisting in comparison between the different SALP reports and their evaluations." JI PF 33. However, they do not go on to explain why this exhibit is "helpful". This exhibit might be somewhat helpful if the SALP methodology simply equated numbers of violations with category ratings. As Mr. Bemis made clear, however, violations are only one factor. Tr. 3855. Even under Exhibit 39's violation-counting approach, it generally indicates that higher numbers of violations lead to lower ratings, and vice versa. See, e.g., Robinson: Radiation Controls, Emergency Preparedness, Quality Assurance. Other ratings do not exhibit the same relationship between numbers of violations and ratings. See, e.g., Robinson: Maintenance; Brunswick: Surveillance, Fire Protection. Apparently, other factors were controlling in the latter group of ratings.[14] In any event, we do not think we can draw any useful conclusions from JI Ex. 39.

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14 Under this management contention, we are not considering the merits of any of the individual ratings. For example, if Brunswick were (Footnote Continued)

Joint Intervenors' Exhibit 40 consists of excerpts from a publication entitled Public Citizen 1983 Nuclear Power Safety Report. The publication was based upon and included data derived from NRC Reports, including SALP II on CP&L's facilities. One apparent purpose of this Public Citizen compilation was to compare the sixty-two commercial reactors operating in 1982 in order to show which were "safest" or "least safe", "best" or "worst" in the country. It comes as no surprise that Brunswick fared poorly in that comparison. Thus, among the ten reactors having more than 100 LER's (License Events Reports), Brunswick 1 and 2 ranked 4th and 5th, with 150 and 141 LER's, respectively. In the category of "5 or more incidents with an NRC rating of 2," Brunswick 2 tied for first place. (Brunswick 1 also scored high in this dubious distinction category with seven incidents. Forty-three of the sixty-two operating reactors had fewer than five incidents.) Brunswick 1 and 2 exposed 4957 workers to measurable doses of radiation, the highest number by far of any facility in the country. Finally, Public Citizen averaged the SALP ratings for Brunswick (as we have done above) and compared them with the averaged ratings of the other sixty operating reactors. Brunswick's average rating for 1982, as we have already seen, was 2.57. Comparatively, Brunswick had the

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(Footnote Continued)
rated "3" for fire protection, we consider that along with other evidence only to determine CP&L's overall management competence as reflected in the SALP Reports, e.g., whether they take prompt remedial action in response to Staff criticism.

highest (and poorest) average in the country. The next highest average rating went to Arkansas 1 and 2 -- 2.45; the lowest and best average ratings went to Yankee Rowe and Haddam Neck, with perfect "1" ratings.[15]

Joint Intervenor Exhibit 40 indicates that Brunswick was a poorly managed facility in 1981. The clear preponderance of the other evidence in this case supports the same conclusion. It may be worth noting that Exhibit 40 casts a somewhat more favorable light on CP&L's contemporaneous performance at Robinson (average rating 2.13) and Shearon Harris (average rating 2). Beyond that, however, Exhibit 40 sheds little or no light on the ultimate issue before us -- will CP&L operate Shearon Harris competently in 1986 and thereafter? Most significantly, Exhibit 40, based largely on SALP II, does not reflect the very different results of SALP IV at all.

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15 To be sure, the comparative "rankings" of Brunswick and other facilities reflected in Exhibit 40 may not be taken uncritically to demonstrate that Brunswick was then one of the worst managed facilities in the country. For example, as the Applicants point out (App. PFs 19-20) the number of LER's a facility generates can depend on factors unrelated to safety. In addition, the Applicants and the Staff urge that "SALP ratings cannot be algebraically manipulated to result in an arithmetic mean. Tr. 3655-56 (Bemis)." App. PF 18. While that may be true in the strict sense, we think that a simple averaging of SALP ratings for a facility in a given year does yield a good rough estimate of how a licensee performed at that facility at that time. Similarly, we think it is legitimate to compare the averages of different facilities.

I. Other Matters

1. Robinson. CP&L's operation of its Robinson 2 facility was not a major focus of separate attention at the hearing and there is little evidence in the record on that subject. As noted above, the SALP Reports on Robinson are generally favorable. The Intervenors proposed findings on Robinson (JI PF 71-77), viewed in context, do not lead to any relevant conclusions.

2. Shearon Harris. Similarly, while certain of the Intervenors' proposed findings on Shearon Harris (JI PF 78-90) find some support in the record, they say little about the ultimate management issue before us. See, e.g., JI PF's 87-90. The portions of Mr. Maxwell's testimony cited in proposed findings 84-86 appear to be the kind of grist one would expect to find in any resident inspector's mill, and not to reflect management failures.[16] The subject of cable tray supports -- as discussed in SALP IV and referred to in JI PF 81 -- is fairly characterized by the Applicants in their PF 28. On the whole, the SALP IV evaluation of this activity area was favorable. SALP IV at 61-62.

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16 The Intervenors cite Mr. Maxwell's testimony that he has been a resident inspector at Shearon Harris since 1980, and that he was employed by CP&L as a quality assurance technician at Brunswick in 1973-74. Tr. 3816-3817. The Board implies no personal criticism of Mr. Maxwell in questioning the wisdom of assigning a former employee to police activities at the former employer's site.

3. Training. The Applicants presented two witnesses, Messrs. Davis and Powell, who testified at some length about the CP&L training program for its nuclear plant personnel. Testimony ff. Tr. 3399. In their proposed findings, the Joint Intervenors take exception with only two narrow aspects of the training program. First, they allege that the record evidence is inadequate to determine whether "GET" Levels I and II satisfy regulatory training requirements. JI PF 91. As the Applicants correctly point out, their witnesses, who were well qualified to address the question, testified that Levels I & II did satisfy regulatory requirements. Testimony at 9. Tr. 3423-3435; 3453-3455. There was no evidence to the contrary, except as noted hereafter.

Joint Intervenor Exhibit 29 is an NRC Information Notice entitled "Deliberate Circumventing of Station Health Physics Procedures." The Intervenors point to it as proof that the CP&L GET Level I or II Training received by contractor personnel is not adequate. JI PF 92. We agree with the main thrust of the Applicants' reply finding 32, as follows:

> An investigation of the incident at Brunswick, which involved two contract personnel allegedly swapping dosimeters, revealed no evidence that there was a widespread practice of any duration. There is no evidence that this incident at Brunswick was the result of inadequate training.

J. Conclusion.

Generalizing largely from the Brunswick experience to CP&L's overall nuclear program, including Harris, Mr. Bemis expressed

confidence in CP&L's managerial ability and commitment to safety. He testified that:

> At the time of my assignment my impression about the management at all levels of the CP&L structure was that they were not being kept informed as to what was occurring at the nuclear facilities, that they were only interested in meeting the minimum requirements, and that they did not understand the difference in operating a nuclear facility with its many different rules and regulations for protection of the public health and safety and operating a fossil facility. We in nuclear regulation call this "fossil mentality". . . . The development of the Brunswick Improvement Program in 1982 and the issuance of the civil penalty for the breakdown in management controls was where I feel that CP&L's genesis of a "nuclear mentality" took place. From the summer of 1982 to present I found strong dedication from all CP&L management not only to meet the NRC regulations, but to exceed our requirements when possible. . . . I found management open minded about preventative enforcement. By this I mean they would envelop areas that the resident inspectors and I would see as having potential enforcement concerns and implement immediate corrective measures in these areas prior to NRC being required to institute enforcement actions.

Mr. Bemis summarized his conclusions and the NRC Staff's position, as follows:

> The staff concludes CP&L is technically qualified to operate the Harris facility within the purview of the regulations and with due regard for public health and safety. The Region II inspection and enforcement program will be applied to assure the CP&L continues to operate within the regulations and continues to make improvements in the nuclear program.

The Board basically agrees with this Staff assessment. As we stated previously, we have high confidence in Mr. Bemis, based on his technical expertise and extensive experience with CP&L. Moreover, the Staff's assessment at the hearing, as expressed by Mr. Bemis, is consistent with the SALP Reports. The Joint Intervenors' rather

miscellaneous collection of evidence unfavorable to CP&L largely derives from events occurring in 1982 and earlier. This evidence has been superseded (substantially, if not entirely) by a sustained period of improved CP&L management performance since that time. The Applicants, supported by the NRC Staff, have effectively refuted Joint Contention I.

III. THERMOLUMINESCENT DOSIMETERS

A. Introduction

1. A thermoluminescent dosimeter is a device used for measuring exposure to radiation. When a TLD is irradiated by ionizing radiation, some energy is absorbed and stored. If the TLD subsequently is heated, some of the stored energy is released as light which can be detected and measured. The quantity of light released is proportional to the dose received by the individual wearing the TLD. (Browne, ff. Tr. 6407 at 3.)

2. Joint Contention IV concerning Applicants' use of thermoluminescent dosimeters (TLDs) originally consisted of four claims: 1) TLDs are inaccurate; 2) TLDs lack real-time monitoring capability; 3) TLDs are inadequate to assure worker health and safety; and 4) pressurized ionization monitors are necessary to protect worker health and safety. Applicants moved for summary disposition and the NRC Staff supported the motion. Summary disposition was granted on three of the issues. The Board found that other instruments provide real-time monitoring capability; that TLDs used in conjunction with the totality of the radiation protection program are not inadequate and that pressurized ionization monitors are not necessary. The sole issue litigated was "whether the TLDs and measuring equipment and processes to be used at the Harris facility can measure occupational doses with sufficient accuracy to comply with the NRC regulations." (Memorandum and

Order Ruling on Motions for Summary Disposition, April 13, 1984, and Tr. 2218 for Telephone Conference of August 10, 1984.)

3. Mr. Stephen A. Browne, who currently is responsible for the technical direction of personnel dosimetry programs at all CP&L nuclear plants, testified for the Applicants. (Browne, ff. Tr. 6407 at 1.) Mr. John P. Cusimano, Mr. Seymour Block and Mr. Ross Albright testified on behalf of the NRC Staff. Mr. Cusimano is employed by the U.S. Department of Energy, Radiological and Environmental Sciences Laboratory, as a Senior Physicist in the Dosimetry branch. Mr. Block is employed by the NRC as a Senior Health Physicist and is responsible for reviewing Applicants' radiation protection programs. (Cusimano/Block, ff. Tr. 6560 at 1-2.) Mr. Albright is a Radiation Specialist with NRC Region II. His responsibilities include the inspection of the radiation protection and radioactive materials transportation programs at various licensed facilities in Region II. (Albright, ff. Tr. 6567 at 1.)

4. At the request of the Board, the Staff also presented Dr. Phillip Plato as a witness in this proceeding. Dr. Plato is a Professor of Radiological Health at the University of Michigan. Dr. Plato was a member of the Health Physics Society Working Group which wrote draft standard ANSI N13.11. He is also the contractor who conducted the pilot studies involving both versions of this draft standard. (Plato, Tr. 6562.) Dr. Plato adopted and agreed with the

Staff's testimony of Messrs. Cusimano and Block to the extent that it described the third pilot study. (Id.)

5. Joint Intervenors did not contribute any testimony on this contention.

B. Background

6. NRC regulations do not contain an explicit standard for accuracy in measurements of radiation doses to workers. In 1975, the Health Physics Society Standards Committee formed Working Group 1.4 to prepare a standard that could be used to test the performance of organizations that provide personnel dosimetry processing for radiation workers. The Standard was issued for trial use by the American National Standards Institute as ANSI N13.11 in 1976. At this same time, the NRC announced its intention to amend 10 C.F.R. 20 to require that NRC licensees obtain personnel dosimetry from a processor that had passed the ANSI standard. The NRC held a public meeting to discuss this potential amendment to 10 C.F.R. 20 [and other Government agencies expressed similar intentions]. The attendees at the NRC's public meeting requested that, before a mandatory testing program were initiated, a pilot study should be conducted which would use the ANSI standard. In 1977, the University of Michigan was awarded an NRC contract to provide two tests to dosimetry processors that chose to participate voluntarily.

The results from Tests #1 and #2 were reviewed by the Health Physics Society Standards Committee and formed the basis for revision of the Standard in 1981. Subsequently, the revised Standard was used in Test #3 conducted by the University of Michigan during 1981-82. (NUREG/CR 2891, Performance Testing of Personnel Dosimetry Services.)

The revised Standard was adopted by ANSI and published as ANSI Standard N13.11 1983. Further, the NRC has issued a proposed rule under 10 C.F.R. Part 20 titled "Improved Personnel Dosimetry Processing" (49 F.R. 1205-11, January 10, 1984) that includes the ANSI N13.11 1983 Standard as part of the evaluation of dosimetry processors. The Summary in the Proposed Rule states: "Tests have indicated that a significant percentage of personnel dosimetry processors may not be performing with a reasonable degree of accuracy. Current regulations do not address the competency of these processors. The NRC is proposing amendments that would require its licensees to utilize the specified services of processors that have been accredited by the National Voluntary Laboratory Accreditation Program (NAVLP) of the National Bureau of Standards."

This nationwide and decade long concern with dosimetry inaccuracy formed much of the basis for the Joint Intervenors allegations in this proceeding.

C. The ANSI Standard [17]

7. The ANSI standard is formulated in terms of tolerance limits, L, as a pass/fail criterion. The performance index for a single dosimeter, P, is calculated as:

$$P = \frac{H' - H}{H}$$

where:

H = delivered quantity

H' = reported quantity

For each radiation category, the average performance index, $\bar{P}$, and the standard deviation, S, are calculated. These two statistics are combined in the ANSI formulation of the pass/fail criterion. A processor passes a category if

$$\bar{P} + S \leq L$$

where:

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[17] As the Board saw it, we were not directly litigating the adequacy of the ANSI Standard, which, as we have noted, is the subject of a pending rulemaking. See Duke Power Co. (Catawba Nuclear Station), ALAB-813, slip op. p. 48. Rather the litigation focused on whether the Applicants' dosimetry was sufficiently accurate to meet existing NRC accuracy standards. As the record developed, however, the two subjects were to some extent necessarily intertwined.

L = 0.5 (doses below 10 rem)
L = 0.3 (doses above 10 rem)

This formulation of the tolerance limit is less stringent than the original formulation in the draft ANSI standard, which was $\overline{P} + 2S \leq L$. The Health Physics Society Standards Committee recognized that the revised formulation was weaker than the recommendations of international authorities in the field of radiation protection. [18]

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18 The rationale for the tolerance level is described in ANSI N13.11 - 1983 in Appendix D3 to the standard in the following words:

Choice of Tolerance Level, L

The values chosen for the tolerance level represent a compromise between the recommendations of international authorities in the field of radiation protection and radiation measurements, and the limitations dictated by available measurement techniques. In ICRU Report 20 [E20] and NCRP Report 57 [E42], a 30-percent limit is recommended for the uncertainty in the interpretation of the dose equivalent (or absorbed dose) in the vicinity of the maximum permissible levels, although an uncertainty of as much as a factor of three is considered acceptable at levels smaller by an order of magnitude. In ICRP Report 12 [E43], on the other hand, a limit of 50 percent is recommended in the vicinity of maximum permissible levels under field conditions, when errors caused by unknown irradiation geometry or ambient conditions are taken into account. For dose interpretations at accident levels, a tolerance level of 20 percent is recommended in NCRP Report 57 [E44].

In this standard, a fixed irradiation geometry and fixed laboratory ambient conditions are specified for the test irradiations. Because of limitations in measurement technique, the tolerance level is set at 0.5 (50 percent) for all but the accident categories, where it is set at 0.3 (30 percent). Larger tolerance levels for dose equivalents well below the maximum permissible dose equivalent were considered and, in fact, had been incorporated in the first version of this standard. Subsequent to the experience

(Footnote Continued)

8. As Applicants' witness Browne testified, a recent publication [19] of the International Commission on Radiation Protection (ICRP) states the following concerning the measurement of dose equivalent:

> If these quantities are of the order of the relevant annual limits, the uncertainties should not exceed a factor of 1.5 at the 95% confidence level. Where they amount to less than 10 mSv [1 rem] an uncertainty of a factor of 2 at the 95% confidence level is acceptable.

(Browne, ff. Tr. 6407 at 6.)

The Board finds, in agreement with Mr. Browne, that the ICRP 35 recommendation can be expressed in mathematical terms as: $\overline{P} + 2S \leq 0.5$, for doses of approximately 5 rem (the annual limit). (Browne, ff. Tr. 6407 at 10, 11.) The weaker ANSI standard appears to be questionable when viewed against the ICRP recommendation.

9. In our April 13, 1984 Memorandum and Order, the Board took the position that the NRC regulations require that personnel dosimetry be

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(Footnote Continued)
gained in the pilot testing program referred to in the Foreword, this feature was deleted since for the tests specified in this standard (calling for irradiation in relatively straightforward radiation fields under ideal laboratory conditions and analysis of performance based on the average performance quotient obtained over a large range of dose equivalents), relaxation of the tolerance levels was found to be unnecessary.

19 ICRP Publication 35 (1982) "General Principles of Monitoring for Radiation Protection of Workers" at 25.

carried out in a manner such that the results can be relied upon to be accurate to integer values or one significant figure for doses of a few rem. Regulatory compliance is not compatible with the acceptance of performance with a standard deviation of 50%. A conventional interpretation of the 50% standard deviation would be that, at the 95% confidence level, an individual dose estimate would be uncertain by two standard deviations amounting to 100%. An observed dose, for example, of 2 rem in one calender quarter could not be viewed, with reasonable confidence, as meeting the regulatory 3 rem quarterly limit because the uncertainty would range from zero to 4 rem by the ANSI standard. We find the ICRP recommendation to be compatible with our reading of the NRC regulatory requirement and, thus, from both points of view, we review the Applicants' TLD program to see if these performance qualities will be achieved.

D. CP&L Performance in Dosimetry Tests

10. The Applicants propose to use Panasonic Model UD-802 AQ TLDs at the Harris Plant. These TLDs were used by CP&L in the performance testing carried out by Dr. Plato at the University of Michigan. (Browne, ff. Tr. 6407 at 10.) The results of the testing were summarized as follows:

Category	Radiation Type	1982 CP&L Performance (P+S)	1984 CP&L Performance (P+S)	ANSI Limit
I	X-ray Accident	.24	.18	.3
II	Gamma Accident	.10	.15	.3
III	X-ray Shallow	.11	.18	.5
	X-ray Deep	.12	.16	.5
IV	Gamma	.06	.10	.5
V	Beta	.30	.28	.5
VI	Gamma & X-ray Shallow	.06	.19	.5
	Gamma & X-ray Deep	.16	.18	.5
VII	Gamma & Beta Shallow	.16	.29	.5
	Gamma & Beta Deep	.11	.10	.5
VIII	Gama & Neutron	*	.09	.5

*CP&L did not participate in this test category in 1982.

The Board finds that the CP&L performance in all eight radiation categories met the ANSI tolerance limits with fairly comfortable margins. Further, the Applicants testified that the test results would be acceptable even if the more stringent tolerance formulation of ICRP 35 or the original 1976 ANSI standard were used, as shown in the following tabulation.

Category	Radiation Type	1982 CP&L Performance (P+2S)	1984 CP&L Performance (P+2S)	1976 ANSI Limit
I	X-ray, Accident	.37	.29	.3
II	Gamma, Accident	.14	.21	.3
III	X-ray Shallow	.16	.26	.5
	X-ray Deep	.22	.25	.5
IV	Gamma	.09	.17	.5
V	Beta	.36	.37	.5
VI	Gamma & X-Ray Shallow	.12	.26	.5
	Gamma & X-Ray Deep	.23	.28	.5
VII	Gamma & Beta Shallow	.22	.41	.5
	Gamma & Beta Deep	.17	.18	.5
VIII	Gamma & Neutron Deep	*	.15	.5

*CP&L did not participate in this category in 1982.

(Browne, ff. Tr. 6407 at 10.)

11. Applicants witness noted the exceedance in the results for the accident x-ray category in 1982 and took the view that it is not realistic to expect that an individual could receive accident level exposures to x-rays in a nuclear power plant. We agree and, further, the improved 1984 results in this category lead us to give little weight to this one exceedance.

12. The Board finds these test results provide an unusually clear and unequivocal line of evidence that refute the allegation of dosimetry inaccuracies in this contention, and demonstrate compliance with NRC regulations.

E. Applicants' Quality Control for TLDs

13. Test results may be questioned in terms of whether unusual care was exercised during the tests, so that the results might not be representative of the accuracy achieved during routine personnel dosimetry. Consistent accuracy will be dependent on the existence of an appropriate quality control program.

14. NUREG/CR-2891, the report of the results of the 1982 Pilot study, noted the existence of four common reasons for poor performance of dosimetry processors. These were: 1) use of incorrect calibration factors; 2) dosimeter variability; 3) clerical errors; and 4) poor calibration for accident doses. CP&L has taken steps to minimize errors in each of these four areas through an extensive quality assurance program. (Browne, ff. Tr. 6407 at 20-21.)

15. Calibration factors have been determined for the Applicants' TLD system based on irradiation of TLDs to NBS traceable radiation standards. These correction factors have been verified by the tests conducted in 1982 and 1984, and will also be verified by the quarterly

intercomparison program engaged in by Applicants with the University of Michigan. (Browne, ff. Tr. 6407 at 21.) This program follows the format of the ANSI performance test, except that CP&L has added two additional radiation categories which are applicable to the radiation types and energies found in its nuclear plants, and has dropped the accident categories which differ from other categories only in the dose level. These two added categories are low energy beta and mixtures of low energy beta with high energy photons. (Id. at 12-13.) A monthly cross-check program is conducted where a number of TLDs are read on each TLD reader with a 0.3 accuracy standard. Each reader is calibrated semi-annually and after any maintenance affecting calibration. (Id.) The TLD readers also undergo a daily quality assurance check which requires a 15% standard of accuracy for critical parameters. (Id.)

16. In the semi-annual calibration of the readers, 10 TLDs are read at five exposure levels from 0.25 to 4.0 rem. They must be within 10% of the known dose, and the standard deviation must not exceed 10%. For daily TLD reader calibration checks, TLDs are read after being irradiated to known doses of 0.5 and 4.0 rem. Each TLD must read within ±15% of the actual irradiated dose. If a reading within ±15% is not obtained, the check is repeated two more times; if the check fails two out of three times, the TLD is removed from service. (Browne, ff. Tr. 6407 at 22.)

17. Dosimeter variability is minimized by carrying out an initial acceptance test of TLDs received from the manufacturer. Each TLD in a batch of five hundred must be accurate to within ±15%. The same test procedure is performed semi-annually to determine whether any TLDs should be removed from service. Id. at 23.

18. In order to eliminate the potential for clerical error CP&L has installed an automatic data processing system with detailed verification techniques. Individual records are on a computer which interfaces with the TLD reader. Where a manual entry is required it is verified by other people, and hard copies of records are maintained to back up the computer. (Browne, ff. Tr. 6407 at 23.)

19. With regard to poor calibration for accident doses, CP&L has performed in-house tests which establish the dose response of the TLDs up to doses of 100 rem. The response is essentially linear within approximately ±15%. In addition, CP&L has participated in and passed the accident dose categories during ANSI performance tests in 1982 and 1984. This verifies that poor calibration for accident doses is not a problem at CP&L. (Browne, ff. Tr. 6407 at 24.)

20. During cross-examination of Applicants' witness, Intervenors raised the issue of whether the effects of fading are considered in the reading of TLDs. (Browne, Tr. 6440.) Applicants' witness indicated that their procedures consider fading and that most fading of the stored

signal on the TLD occurs within a relatively short time period after exposure. (Id.) It is Applicants' opinion that fading is contingent on temperature, and that at the temperatures experienced in a nuclear power plant, fading is not a significant problem. (Id. at 6441.)

21. The effects of fading also depend on the way the TLD reader is calibrated. (Browne, Tr. 6442.) Applicants allow the badges used to calibrate their readers to fade for 24 hours before they calibrate their system, so that most fading has occurred. (Id.) The fading of the TLD which occurs between the first and 30th day after exposure is relatively small, less than 10 percent. (Id. at 6442-43.) Applicants' witness testified that the elements in the TLD, which are sensitive to light, are always protected to prevent fading from light. (Id.)

22. It is the Staff's position that the Panasonic System has been found to provide reliable and accurate information. (Cusimano, Tr. 6568.) In addition, inspections of the Applicants' dosimetry program indicate that the Licensee has quality control programs for dosimetry equipment. Such inspections also indicate that the TLD program is adequate to protect the health and safety of the Applicants' workers. (Albright, Tr. 6569-70.) Finally, it is the Staff's position that the results of the third pilot study conducted by the University of Michigan indicate that Applicants have the capability to perform good quality dosimetry processing. (Cusimano/Block, ff. Tr. 6560 at 8.) Therefore, Applicants' personnel monitoring program is adequate, in the Staff view,

to protect the health and safety of the workers and complies with 10 C.F.R. § 20.202(a) of the Commission's Regulations. (Id.)

23. The Board finds that the CP&L quality assurance program for TLD personnel dosimetry appropriately controls the sources of errors that have plagued other dosimeter processors. Although CP&L's self-imposed accuracy requirements are more stringent than the ANSI standard, CP&L has no intention of relaxing its own in-house standards if the ANSI standard is adopted by the NRC as part of a final rule for accrediting dosimetry processors (Browne, Tr. 6536.) We concur with Staff that the program is adequate and go further to the view that indeed we think the program is commendable.

24. Joint Intervenors proposed findings basically comport with the record as we have described it. However, their proposed Finding 12 urges the Board to require Applicants to have written procedures for the performance of all routine dosimetry operations, formal training and qualification of all operating personnel and supervisory review of all quality control records. This suggestion has no merit since Applicants have testified that their program already contains these features (Browne, ff. Tr. 6407 at 24, 25), and the NRC Staff has confirmed their existence and functioning during recent inspections. (Albright, ff. Tr. 6567.)

25. Joint Intervenors advocate, in their proposed Findings 13 and 14, that Applicants should be required to compensate for possible inaccuracy in TLD measurements by limiting worker exposure to two-thirds of the regulatory limit. Such an exotic modification to the regulations is beyond our authority. As the NRC Staff points out in reply, if the Intervenors wish to challenge the regulatory limits, then their remedy would have been to show "special circumstances" pursuant to 10 C.F.R. Section 2.758.

26. The results of the testing by the University of Michigan and the Applicants' quality assurance program for personnel dosimetry using TLDs provide clear and uncontroverted evidence that resolves this contention in favor of the Applicant.

IV. ENVIRONMENTAL QUALIFICATION OF ELECTRICAL EQUIPMENT

A. Introduction

1. Contention 9 as litigated in this proceeding states:

> The Program for environmental qualification of electrical equipment at Shearon Harris is inadequate for the following reasons: A) the proposed resolution and vendors modification for ITT-Barton transmitters has not been shown to be adequate. (Ref. IE Information Notices 81-29, 82-52, and 83-72.) B) There is not sufficient assurance that the concerns with Limitorque valve operators identified in IE Information Notice 83-72 (except for items C2, C5 and C7) have been adequately resolved. C) It has not been demonstrated that the RTDs have been qualified in that the Arrhenius thermal aging methodology employed is not adequate to reflect the actual effects of exposures to temperatures of normal operation and accidents over the times the RTDs could be exposed to those temperatures. (Ref. NUREG/CR-1466, SAND-79-1561, Predicting Life Expectancy of Complex Equipment Using Accelerated Aging Techniques.) D) The qualification of instrument cables did not include adequate consideration and analysis of leakage currents resulting from the radiation environment. These leakage currents could cause degradation of signal quality and/or spurious signals in Harris instrument cables. E) There is not sufficient assurance that the physical orientation of equipment in testing is the same as the physical orientation of equipment installed. F) The effects of radiation on lubricants and seals has not been adequately addressed in the environmental qualification program. G) There is inadequate assurance that failure to report all results of environmental qualification tests, including failures, has been brought to light in connection with electrical equipment installed at Harris. This includes past test failures of equipment which subsequently

> passes an EQ test and test failures of equipment which is said to be qualified by similarity. (REF. Item 2, Page 5, L. D. Bustard et al., Annual Report: Equipment Qualification Inspection Program, Sandia National Laboratories, FY83).

2. Eddleman Contention 9 was originally admitted by the Board in September of 1982. LBP-82-119A, supra, 16 NRC 2069, 2091. The contention was modified to read, as stated above, by negotiations between Applicants and Intervenor Eddleman. This modification was accepted by the Board in July of 1984. "Memorandum and Order (Revision of and Schedule for Filing Written Testimony on Eddleman Contention 9; Rulings on Eddleman Contentions 45 and 67) (July 24, 1984)."

3. Intervenor presented no direct evidence on this contention.

4. The Staff presented the testimony of Armando Masciantonio with respect to each of the seven subparts of this contention. Mr. Masciantonio is employed as an Equipment Qualification Engineer, Division of Engineering, Office of Nuclear Reactor Regulation. He is responsible for the technical reviews, analyses and evaluations of the adequacy of the environmental qualification of electrical equipment important to safety, and safety-related mechanical equipment whose failure under postulated environmental conditions could adversely affect the performance of safety systems in nuclear power plants. Masciantonio, ff. Tr. 5567 at Attachment 1. Mr. Masciantonio is

directly responsible for the review of the Shearon Harris Environmental Qualification Program. Masciantonio, Tr. 5608.

5. The Applicants presented the testimony of various panels concerning different subparts of the contention and those panels are identified <u>infra</u> in the findings for the specific subcontentions. In addition, Applicants' panel, consisting of Mr. Robert W. Prunty and Peter M. Yandow, provided for informational purposes introductory testimony which described briefly Applicants' program for environmental qualification of electrical equipment ("EQ Program"). (Mr. Masciantonio's testimony also included general discussion of Applicants' EQ Program.) Mr. Prunty is employed by CP&L as a Principal Engineer in the Electrical Group and Instrumentation and Control Group at Harris. He is responsible for the EQ Program in a supervisory capacity. Mr. Yandow is employed by CP&L as a Senior Engineer in the Instrumentation and Control Group and is responsible for the detailed aspects of the EQ Program, ff. Tr. 4971 at 2.

6. The purpose of the EQ Program at the SHNPP is to ensure all safety-related electrical equipment and other electrical equipment important to safety is capable of performing its safety functions in the environment postulated for design basis events. Environmental conditions include temperature, pressure, humidity, radiation, chemical spray and submergence. Applicants' Introductory Testimony at 9; Masciantonio at 3-5.

7. The Commission's regulations at 10 C.F.R. § 50.49 establish requirements for environmental qualification of electrical equipment important to safety. Equipment "important to safety" includes safety-related electrical equipment, nonsafety-related electrical equipment whose failure under postulated environmental conditions could prevent satisfactory accomplishment of safety functions by safety-related equipment, and certain post-accident monitoring equipment. In general, environmental qualification is required to meet General Design Criteria 1, 2, 4 and 23 of Appendix A, and Sections III and XI of Appendix B, to 10 C.F.R. Part 50. Staff guidance for meeting the regulatory requirements in 10 C.F.R. § 50.49 is provided in NUREG-0588 (Revision 1), "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment." Applicants' Introductory Testimony at 9-10; Masciantonio at 3-5.

8. Applicants' Environmental Qualification Program is contained in Section 3.11 of the FSAR. FSAR Appendix 3.11A compares Applicants' procedures for environmental qualification of electrical equipment with NUREG-0588. Prunty/Yandow, ff. Tr. 4971 at 10. The Staff's review of Applicants' submittals is in the early stages. Masciantonio, Tr. 5601.

9. However, Applicants submitted letters on July 25 and August 24, 1984 indicating how the specific concerns raised by Contention 9 were being resolved in their Environmental Qualification Program. Masciantonio, ff. Tr. 5567 at 7. The Staff has reviewed the

information provided by the Applicants to determine the adequacy of the Environmental Qualification Program in addressing each of the issues raised in this contention. Id. The Staff also made a site visit to verify the accuracy of the information submitted by Applicants. Id. at

10. Intervenor Eddleman points out in his proposed Finding 30 that the NRC Staff requested additional information after the hearing on the Harris EQ Program (transmittal December 5, 1984), and Mr. Eddleman takes the position that this request for information "undermines all assertions that the Harris EQ Program is adequate." Mr. Eddleman has ignored Applicant and Staff testimony that only the specific concerns in this contention had been reviewed at the time of the hearing. We do not find any merit in this proposed finding.

B. Contention 9A: ITT-Barton Transmitters

11. Testimony for the Applicants on this contention was presented by Peter M. Yandow, Robert W. Prunty and Richard B. Miller. Mr. Yandow is employed by CP&L as an Electrical Engineer and is currently responsible for the Environmental Qualification Program at Harris. Mr. Prunty is employed by CP&L as a Principal Engineer in the Electrical and Instrumentation and Control ("I&C") areas, and he established the EQ Program for the Harris plant. Mr. Miller is employed as a Principal Engineer with the Nuclear Safety Department of Westinghouse Electric

Corporation. Mr. Miller is a co-author of WCAP-8587, which describes Westinghouse's methodology for qualifying electrical equipment. Mr. Miller was active in the performance of safety evaluations concerning the problems noted with ITT-Barton Transmitters. Prunty et al., ff. Tr. 5093 at 2-3.

12. ITT-Barton Transmitters are pressure type transmitters. They use either a bourdon tube or bellows assembly to measure pressure and differential pressure respectively. Pressure changes cause the mechanical movement of strain gauges. The variation in tension causes changes in electrical resistance of the strain gauges, which is converted into an electrical output by the electronic circuitry of the transmitters. Prunty et al., ff. Tr. 5093 at 4.

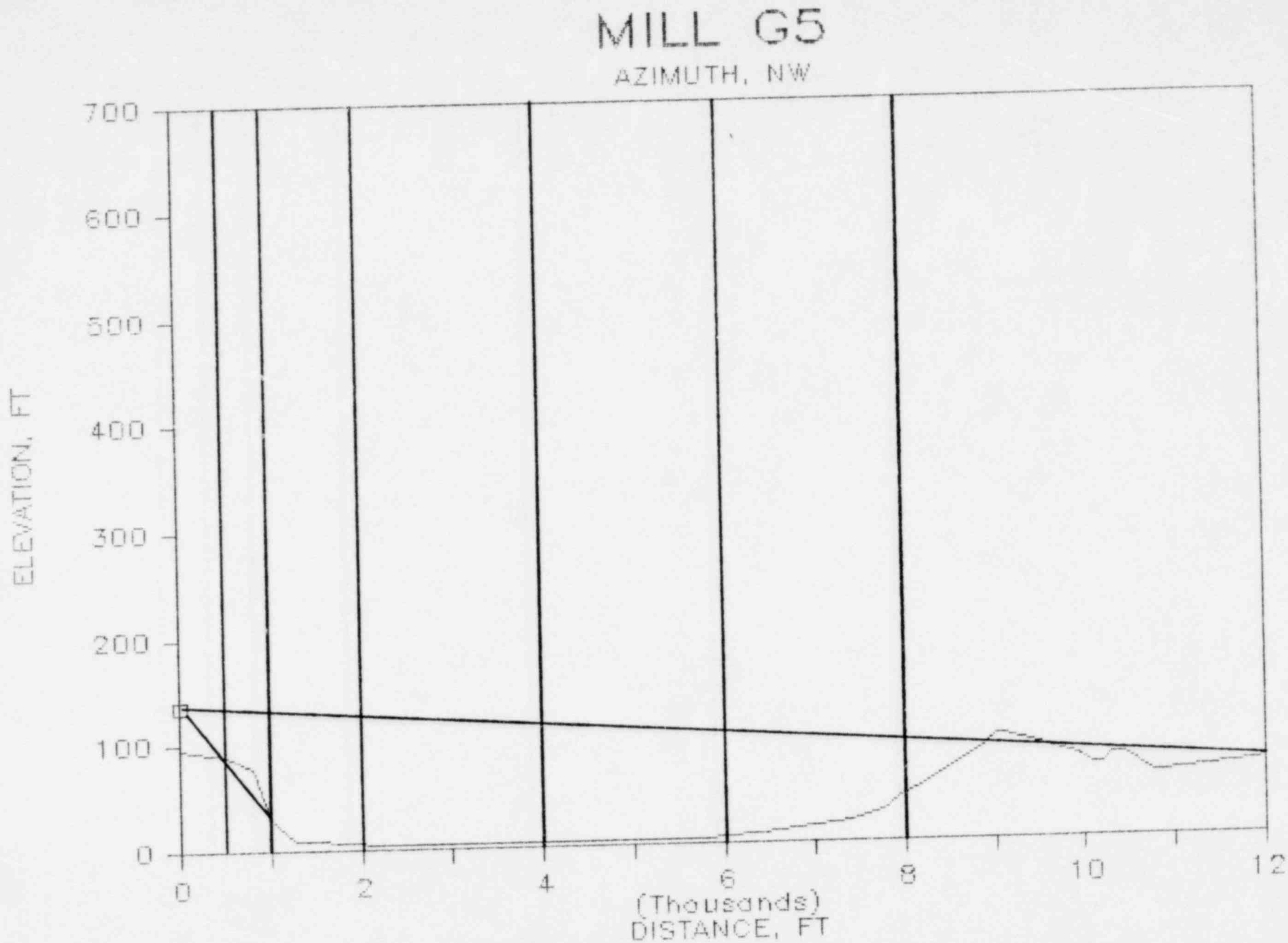
13. At Harris both models 763 and 764 ITT-Barton Transmitters are used for various safety functions such as to check reactor coolant pressure, pressurizer pressure, steam pressure, pressurizer level, steam generator level, and steam flow. Such transmitters are located throughout the containment building. Prunty et al., ff. Tr. 5093 at 6.

14. Both Applicants and Staff testified that three deficiencies with ITT-Barton Transmitters were noted by Information Notices 81-29, 82-52 and 83-72. Prunty et al., ff. Tr. 5093 at 5; Masciantonio, ff. Tr. 5567 at 8-10.

15. The first defect consisted of failure of initial qualification tests due to erratic behavior. The significance of the failure was an error in output which could have resulted in the safety analysis limits being exceeded. Prunty et al., ff. Tr. 5093 at 5. The failure was determined to result from degradation of contacts in internal circuit connector assemblies of the transmitters. Id. This problem was corrected by the soldering of connector assemblies. Id The modification and test results were reported to the Staff and approved by the Staff on November 10, 1983. Id. at 6; Masciantonio ff. Tr. 5567 at 8.

16. Applicants returned the affected models of ITT-Barton Transmitters to ITT-Barton for performance of the above described modifications. Applicants have received test reports to confirm that the modification is adequate to qualify the equipment. Prunty et al., ff. Tr. 5093 at 7.

17. The two additional problems with ITT-Barton Transmitters concern the negative shift which is a decrease in output during initial exposure to constant operating pressure, and thermal non-repeatability of both models 763 and 764 ITT-Barton Transmitters. Prunty et al., ff. Tr. 5093 at 7-8; Masciantonio, ff. Tr. 5567 at 8-9. Thermal non-repeatability is the inability of the instrument to repeat a specified output within allowable limits when exposed to the same



MILL G5
AZIMUTH, NW
700
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ELEVATION, FT
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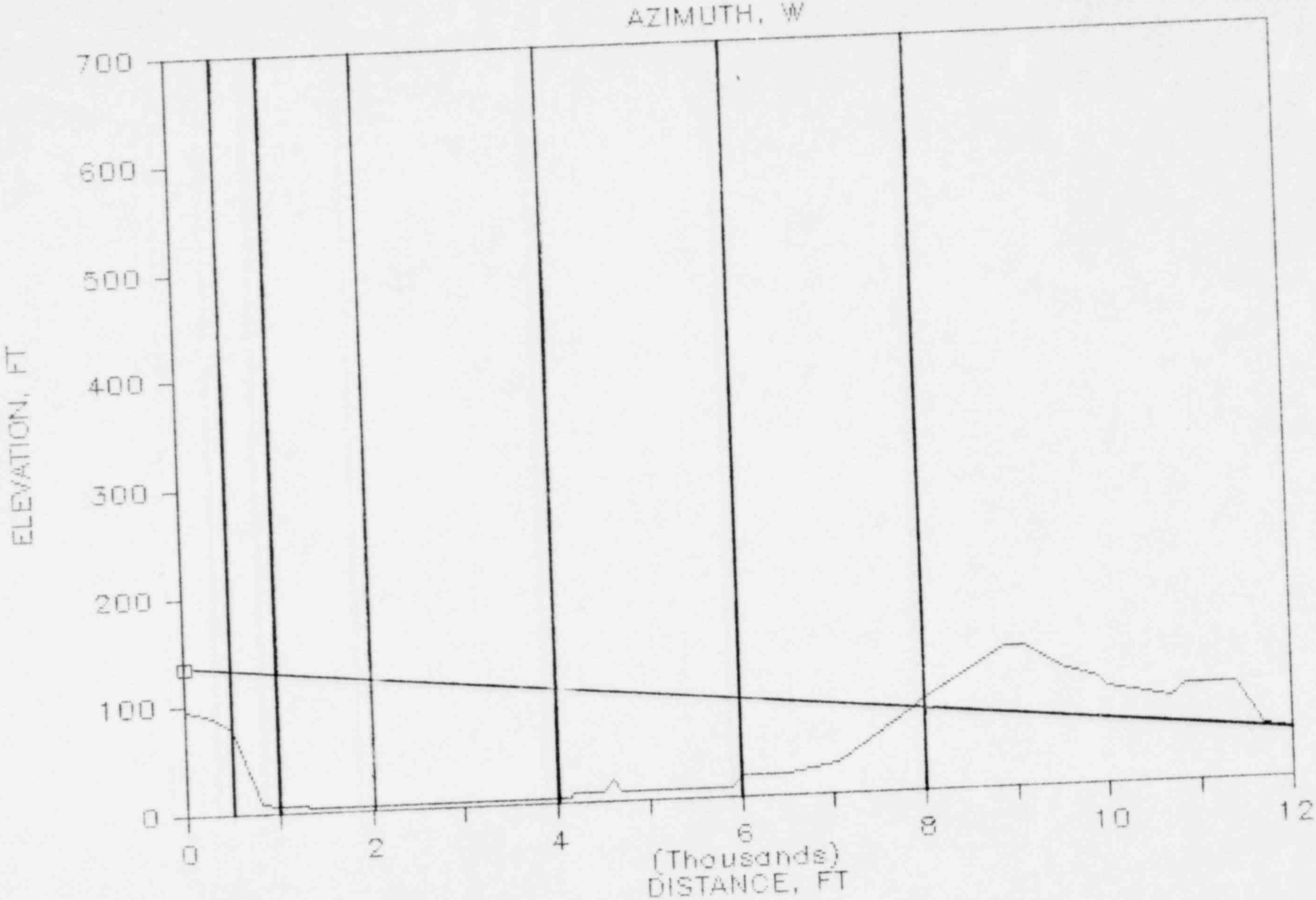
(Thousands)
DISTANCE, FT

MILL G5

AZIMUTH, W




MILL G5
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ELEVATION, FT
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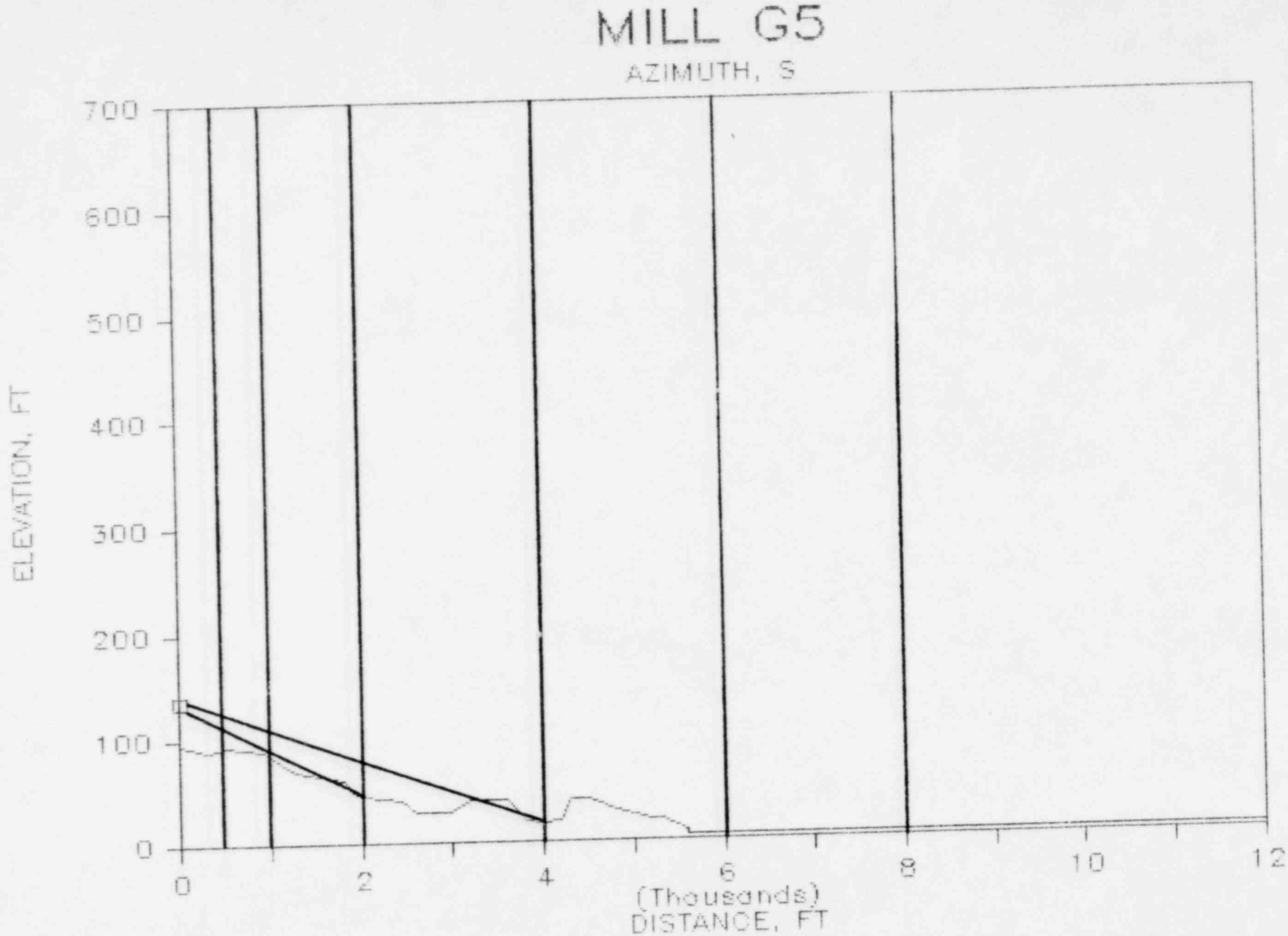
MILL G5
AZIMUTH, S
ELEVATION, FT
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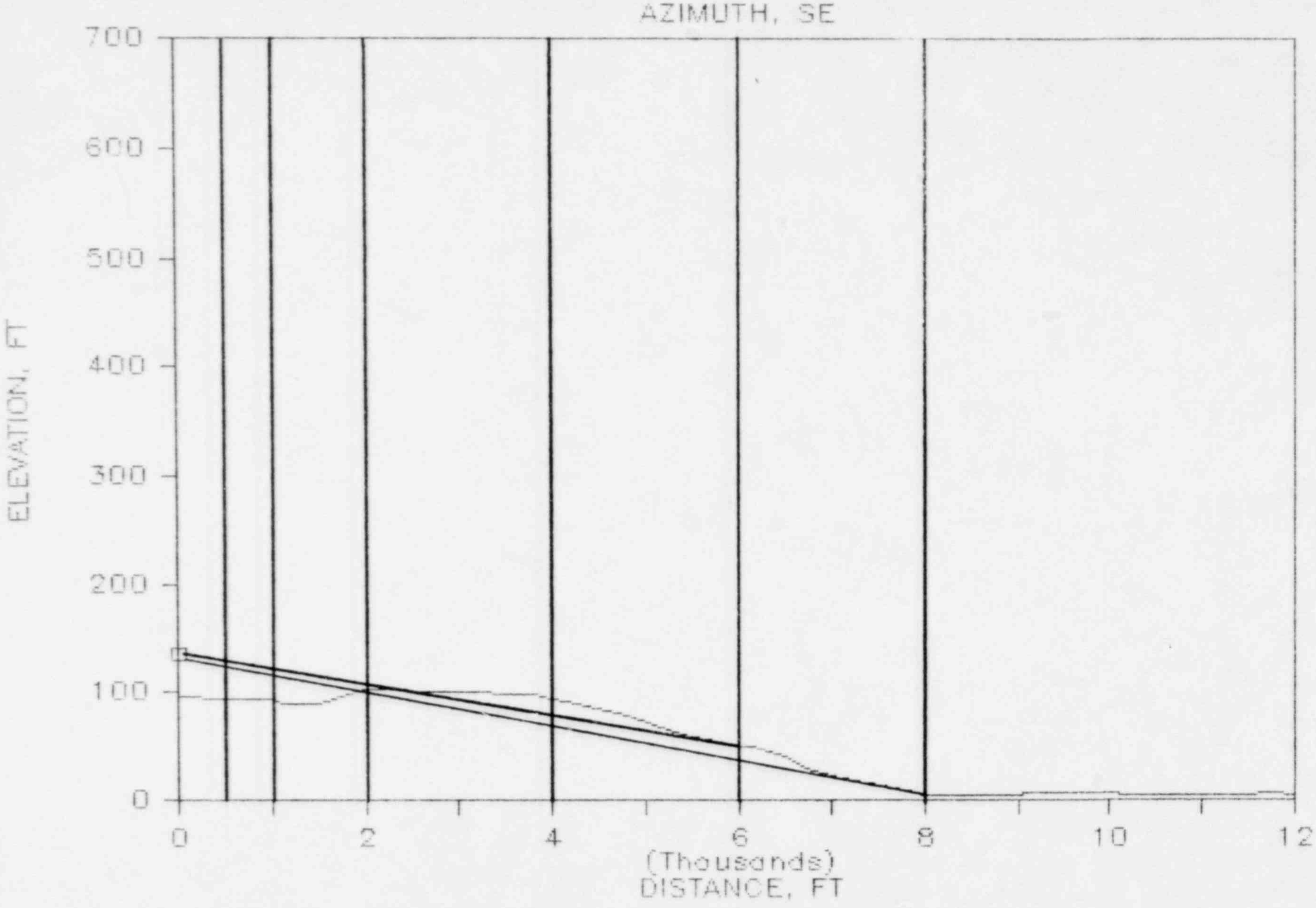
(Thousands)
DISTANCE, FT

MILL G5



AZIMUTH, SE
ELEVATION, FT
700
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500
400
300
200
100
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2
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10
12
(Thousands)
DISTANCE, FT

NORTHEAST UTILITIES
MILLSTONE ANS SIREN #65
SOURCE-RECEIVER TOPOGRAPHICAL INPUTS

ALL BEARINGS ARE WITH RESPECT TO THE NORTH MEASURING CLOCKWISE

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
1	500.	90.00	100.00	HARD	0.	NO	0.	0.
2	1000.	90.00	110.00	HARD	0.	NO	0.	0.
3	2000.	90.00	130.00	HARD	0.	NO	0.	0.
4	4000.	90.00	7.00	SOFT	0.	YES	2400.	130.
5	6000.	90.00	30.00	SOFT	0.	YES	2400.	130.
6	8000.	90.00	22.00	SOFT	0.	YES	2400.	130.
7	12000.	90.00	18.00	HARD	0.	YES	2400.	130.
8	500.	45.00	100.00	HARD	0.	NO	0.	0.
9	1000.	45.00	111.00	HARD	0.	NO	0.	0.
10	2000.	45.00	95.00	HARD	0.	NO	0.	0.
11	4000.	45.00	47.00	SOFT	0.	YES	3400.	148.
12	6000.	45.00	135.00	SOFT	0.	YES	3400.	148.
13	8000.	45.00	85.00	SOFT	0.	YES	3400.	148.
14	12000.	45.00	50.00	SOFT	0.	YES	10400.	164.
15	500.	0.0	95.00	SOFT	0.	NO	0.	0.
16	1000.	0.0	92.00	SOFT	0.	NO	0.	0.
17	2000.	0.0	82.00	SOFT	0.	NO	0.	0.
18	4000.	0.0	130.00	HARD	0.	NO	0.	0.
19	6000.	0.0	110.00	HARD	0.	YES	4000.	130.
20	8000.	0.0	122.00	SOFT	0.	NO	0.	0.
21	12000.	0.0	160.00	SOFT	0.	NO	0.	0.
22	500.	315.00	90.00	SOFT	0.	NO	0.	0.
23	1000.	315.00	30.00	SOFT	0.	YES	800.	68.
24	2000.	315.00	7.00	SOFT	0.	NO	0.	0.
25	4000.	315.00	5.00	HARD	0.	NO	0.	0.
26	6000.	315.00	7.00	HARD	0.	NO	0.	0.
27	8000.	315.00	45.00	SOFT	0.	NO	0.	0.
28	12000.	315.00	73.00	HARD	0.	YES	9150.	100.
29	500.	270.00	80.00	SOFT	0.	NO	0.	0.
30	1000.	270.00	7.00	SOFT	0.	NO	0.	0.
31	2000.	270.00	5.00	HARD	0.	NO	0.	0.
32	4000.	270.00	5.00	HARD	0.	NO	0.	0.
33	6000.	270.00	20.00	HARD	0.	NO	0.	0.
34	8000.	270.00	85.00	HARD	0.	NO	0.	0.
35	12000.	270.00	45.00	SOFT	0.	YES	9100.	128.
36	500.	225.00	75.00	SOFT	0.	NO	0.	0.

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
37	1000.	225.00	40.00	SOFT	0.	NO	0.	0.
38	2000.	225.00	5.00	SOFT	0.	NO	0.	0.
39	4000.	225.00	5.00	HARD	0.	NO	0.	0.
40	6000.	225.00	5.00	HARD	0.	NO	0.	0.
41	8000.	225.00	69.00	HARD	0.	NO	0.	0.
42	12000.	225.00	20.00	SOFT	0.	YES	9500.	88.
43	500.	180.00	95.00	HARD	0.	NO	0.	0.
44	1000.	180.00	85.00	HARD	0.	NO	0.	0.
45	2000.	180.00	45.00	HARD	0.	YES	1850.	56.
46	4000.	180.00	18.00	SOFT	0.	YES	3650.	40.
47	6000.	180.00	5.00	SOFT	0.	NO	0.	0.
48	8000.	180.00	5.00	HARD	0.	NO	0.	0.
49	12000.	180.00	5.00	HARD	0.	NO	0.	0.
50	500.	135.00	95.00	HARD	0.	NO	0.	0.
51	1000.	135.00	95.00	HARD	0.	NO	0.	0.
52	2000.	135.00	104.00	HARD	0.	NO	0.	0.
53	4000.	135.00	95.00	SOFT	0.	NO	0.	0.
54	6000.	135.00	50.00	SOFT	0.	YES	3900.	100.
55	8000.	135.00	6.00	SOFT	0.	YES	3900.	100.
56	12000.	135.00	5.00	HARD	0.	NO	0.	0.
57	14366.	319.66	195.00	SOFT	0.	YES	9150.	100.
58	11278.	13.85	95.00	SOFT	0.	YES	9100.	128.
59	18330.	53.32	145.00	SOFT	0.	YES	10400.	164.
60	9359.	263.56	[illegible]	SOFT	0.	YES	9100.	128.
61	2897.	111.25	115.00	SOFT	0.	NO	0.	0.
62	14737.	94.09	10.00	SOFT	0.	YES	2400.	130.
63	16025.	215.48	25.00	SOFT	0.	YES	9500.	88.
64	13326.	168.31	5.00	HARD	0.	NO	0.	0.
65	19657.	131.60	5.00	HARD	0.	NO	0.	0.

NORTHEAST UTILITIES
MILLSTONE ANS SIREN #G5
NOISE SOURCE POWER LEVEL INPUT

INDEX	SOURCE	DBA	DBC	31.5	63	125	250	500	1000	2000	4000	8000 (HZ)
1	SIREN G 5 -WS2000	152.9	152.6	0.0	0.0	0.0	0.0	0.0	152.0	143.0	138.0	126.0

XO= 0.0 YO= 0.0 ZO= 129.00 HEIGHT ABOVE GROUND= 39.00

NORTHEAST UTILITIES
MILLSTONE ANS SIREN #G5
METEOROLOGICAL INPUT CONDITIONS

H1= 10.06 METERS H2= 43.28 METERS

YEAR	SEASON	MONTH	DATE	HOUR	WIND DIRECTION	WIND SPEED(MPS) H1	WIND SPEED(MPS) H2	TEMPERATURE(C) H1	TEMPERATURE(C) H2	RELATIVE HUMIDITY	BAROMETRIC PRESSURE(MM OF HG)
1983	S	7	1	12	245.0	3.8	5.1	21.9	21.3	42.0	764.0

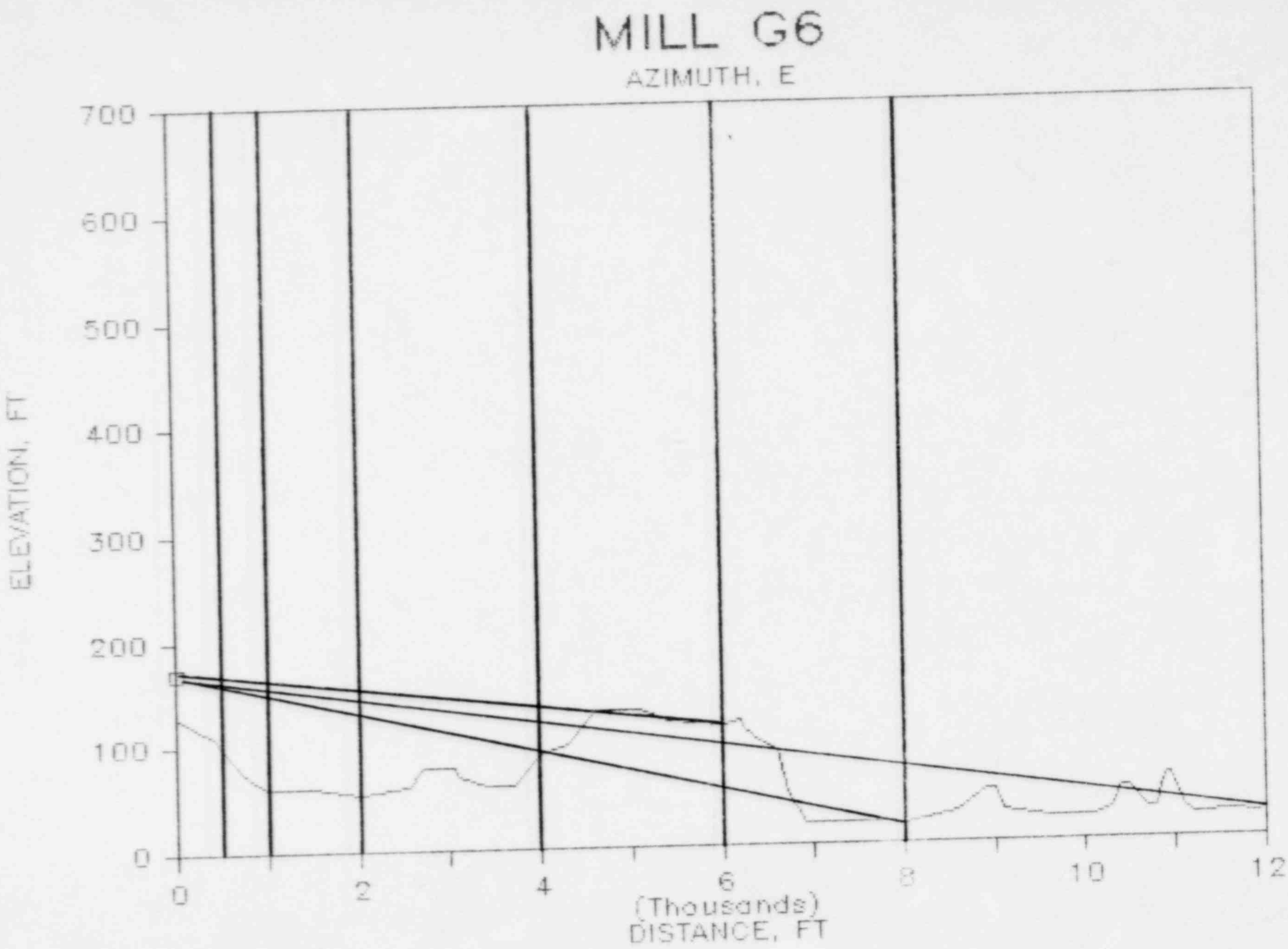
NORTHEAST UTILITIES
MILLSTONE ANS SIREN #65

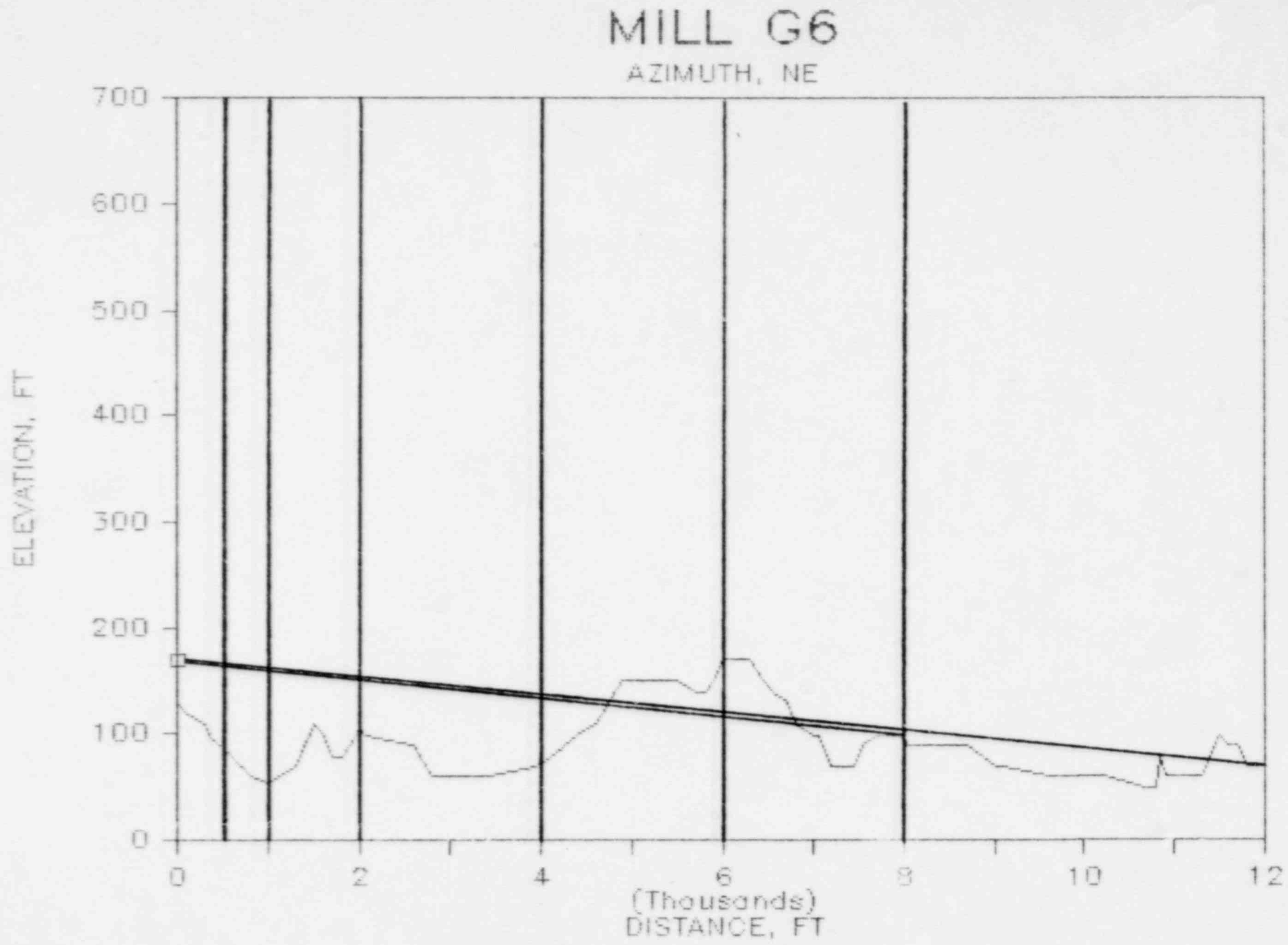
SIREN SOUND LEVELS IN DBC

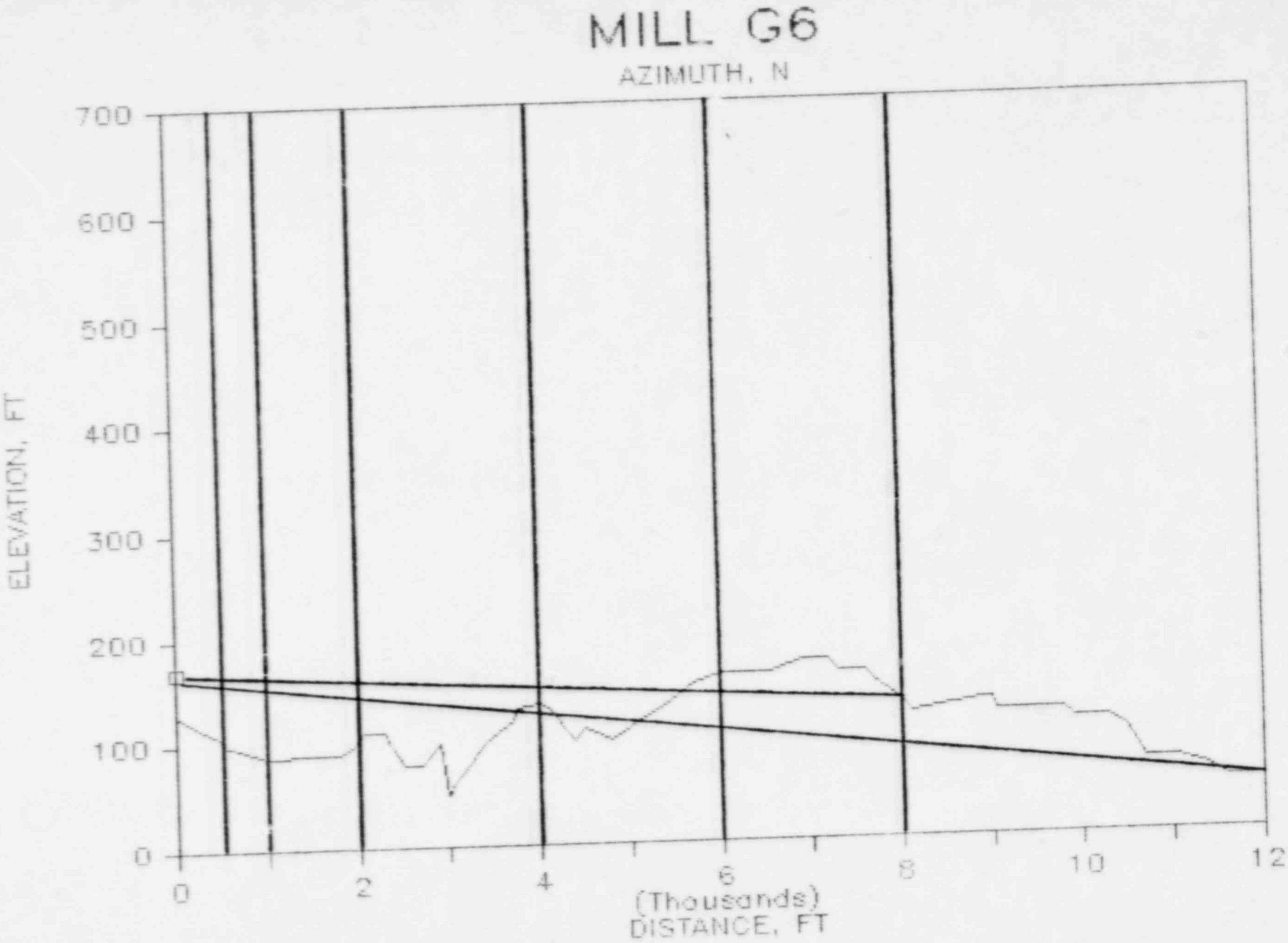
UNDER MET CONDITION 1

DISTANCE IN FEET

AZIMUTH	500.	1000.	2000.	4000.	6000.	8000.	12000.
E	100.	93.	85.	48.	45.	42.	43.
NE	100.	93.	85.	43.	50.	42.	26.
N	100.	92.	79.	75.	62.	52.	44.
NW	100.	80.	81.	67.	54.	34.	25.
W	100.	93.	85.	69.	56.	45.	11.
SW	100.	93.	81.	69.	56.	45.	13.
S	100.	93.	79.	49.	43.	44.	31.
SE	100.	93.	85.	65.	49.	43.	51.


MILL G6
AZIMUTH, E
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

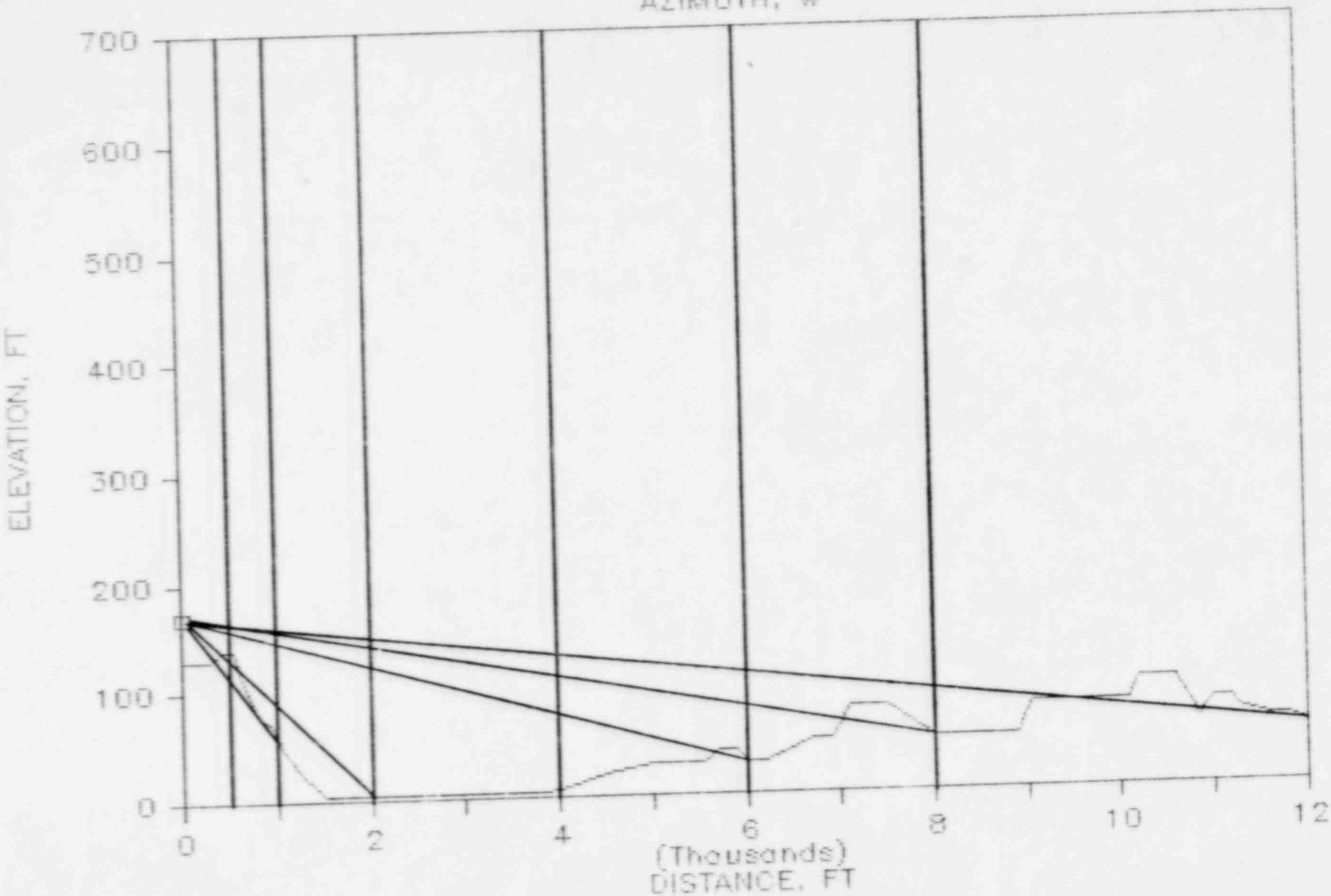

MILL G6
AZIMUTH, NE
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT


MILL G6
AZIMUTH, N
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

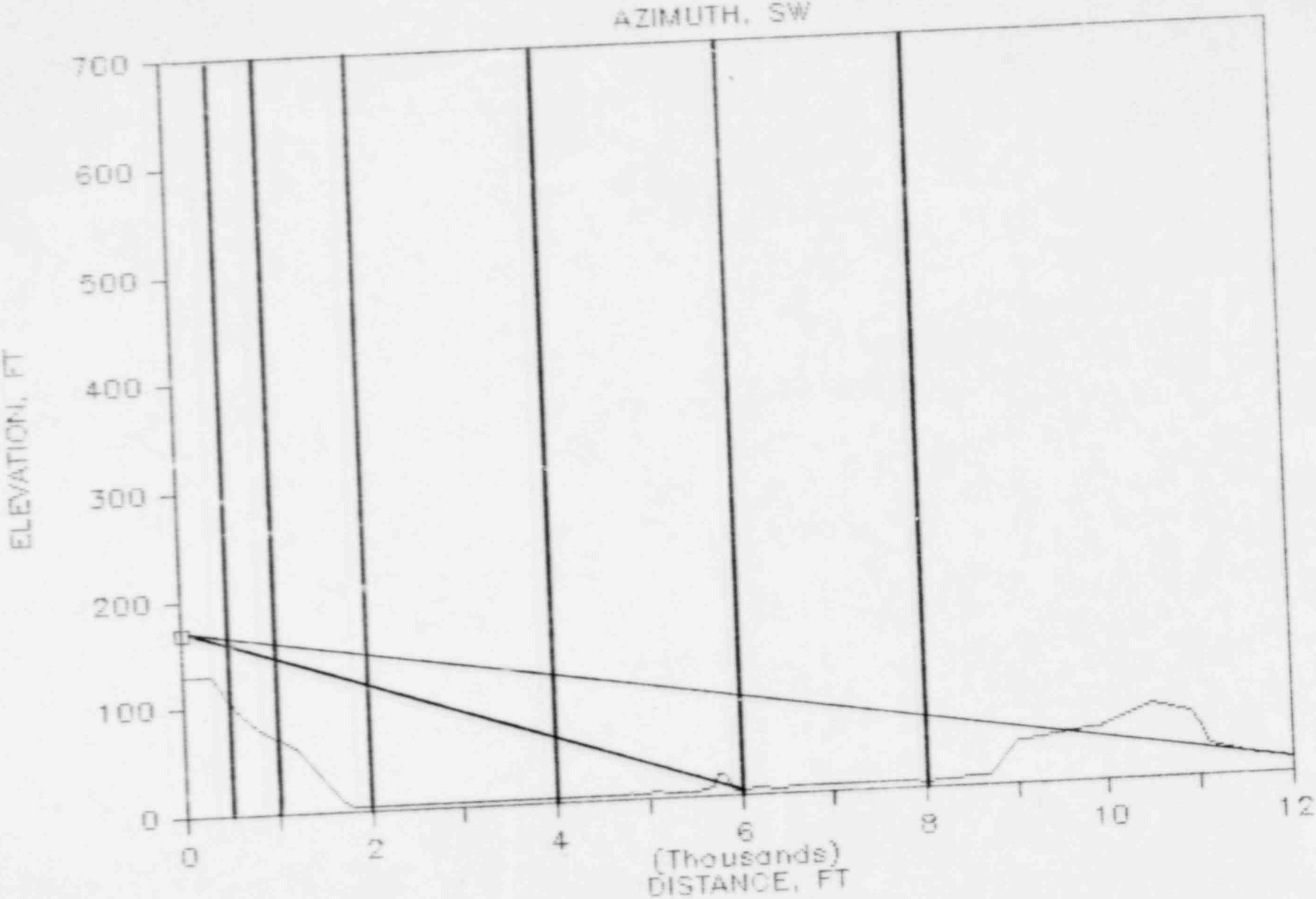
MILL G6
AZIMUTH, NW
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

MILL G6

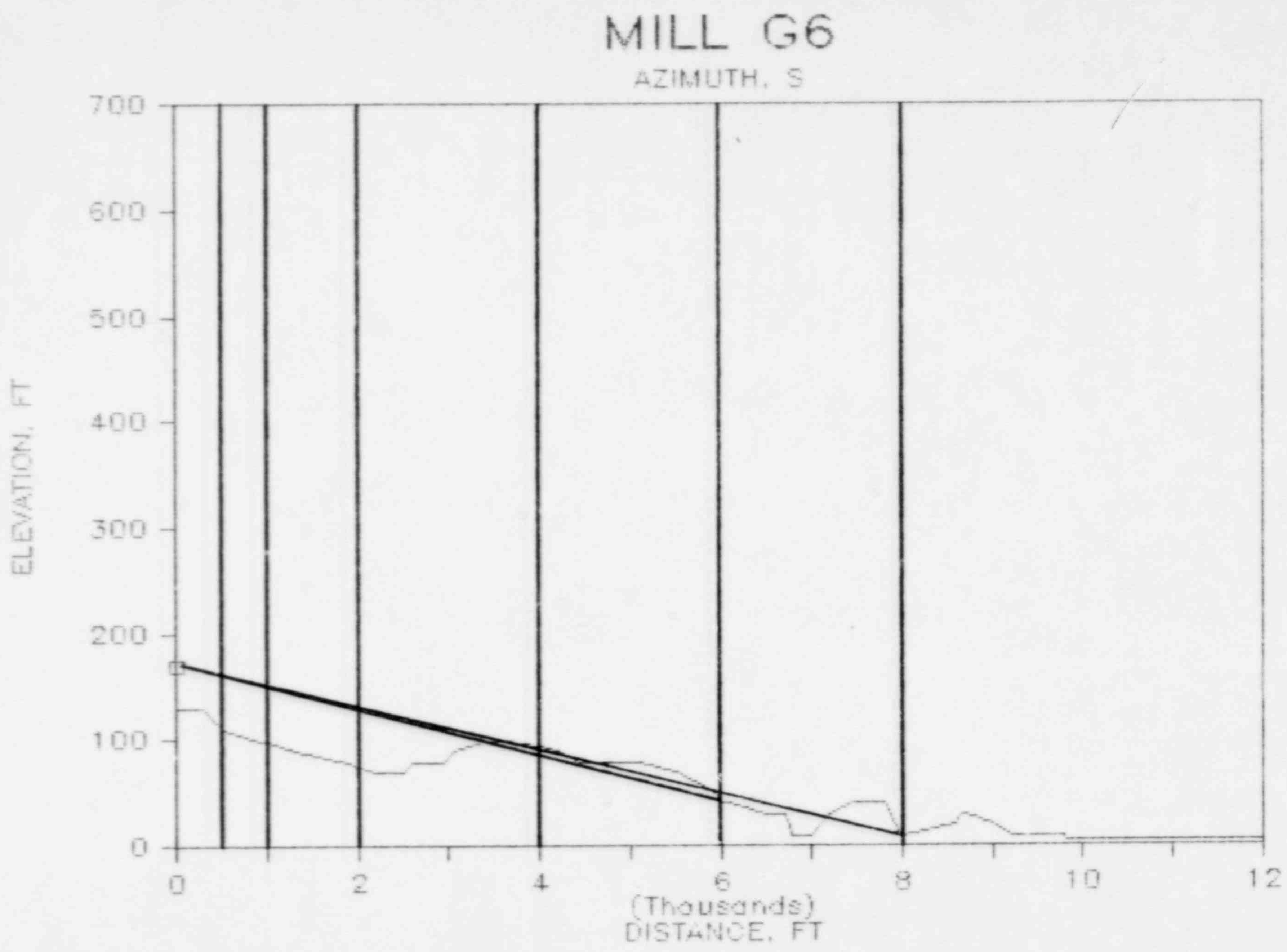
AZIMUTH, W

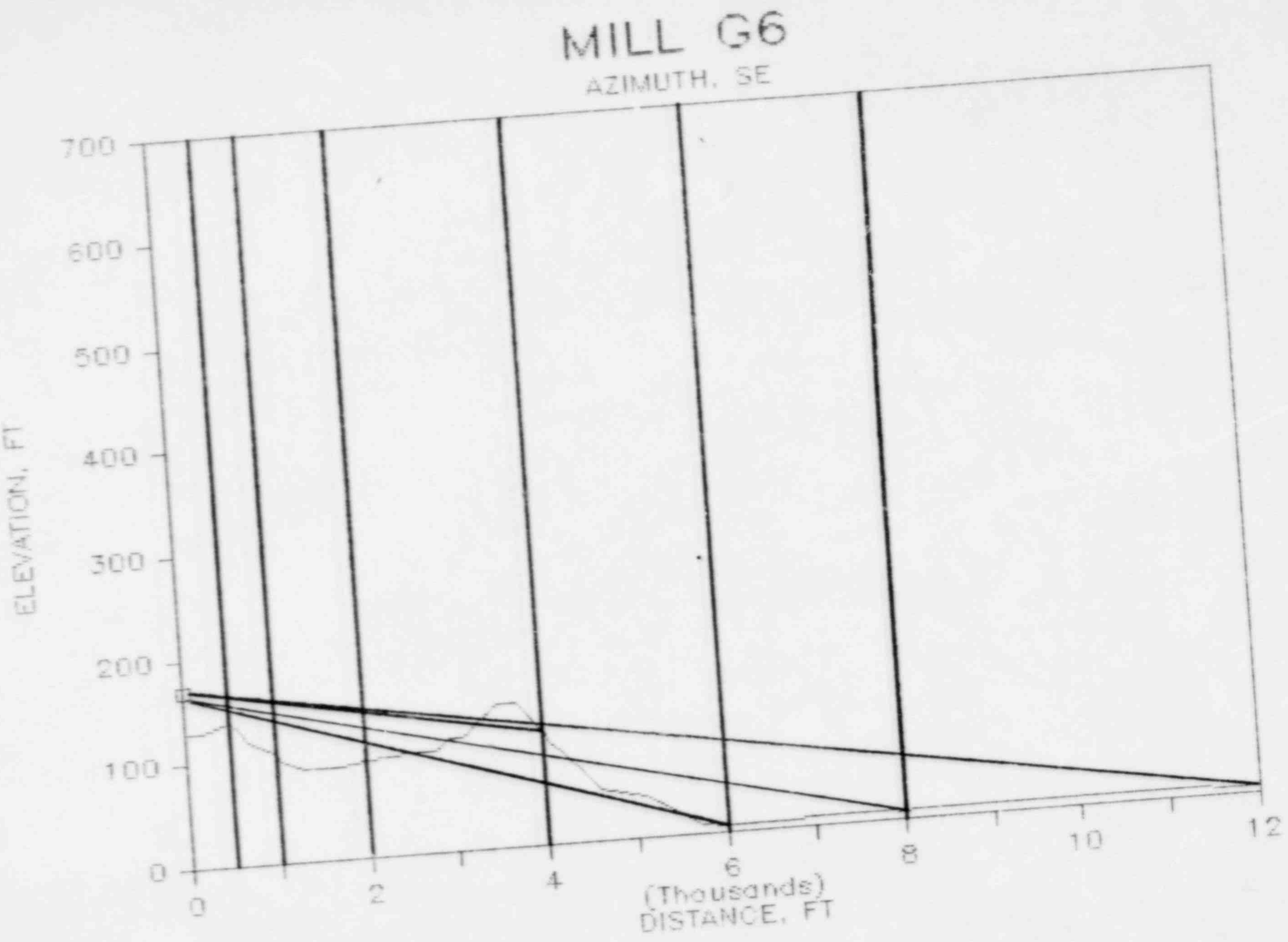


MILL G6



AZIMUTH, SW
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT


MILL G6
AZIMUTH, S
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT


MILL G6
AZIMUTH, SE
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

NORTHEAST UTILITIES
MILLSTONE ANS SIREN #66
SOURCE-RECEIVER TOPOGRAPHICAL INPUTS

ALL BEARINGS ARE WITH RESPECT TO THE NORTH MEASURING CLOCKWISE

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
1	500.	90.00	100.00	HARD	0.	NO	0.	0.
2	1000.	90.00	60.00	SOFT	0.	NO	0.	0.
3	2000.	90.00	55.00	SOFT	0.	NO	0.	0.
4	4000.	90.00	90.00	SOFT	0.	NO	0.	0.
5	6000.	90.00	115.00	SOFT	0.	YES	5150.	128.
6	8000.	90.00	18.00	SOFT	0.	YES	5150.	128.
7	12000.	90.00	25.00	SOFT	0.	YES	5150.	128.
8	500.	45.00	88.00	HARD	0.	NO	0.	0.
9	1000.	45.00	55.00	SOFT	0.	NO	0.	0.
10	2000.	45.00	105.00	SOFT	0.	NO	0.	0.
11	4000.	45.00	73.00	SOFT	0.	NO	0.	0.
12	6000.	45.00	170.00	SOFT	0.	NO	0.	0.
13	8000.	45.00	100.00	SOFT	0.	YES	6300.	170.
14	12000.	45.00	70.00	SOFT	0.	YES	6300.	170.
15	500.	0.0	105.00	HARD	0.	NO	0.	0.
16	1000.	0.0	88.00	HARD	0.	NO	0.	0.
17	2000.	0.0	103.00	HARD	0.	NO	0.	0.
18	4000.	0.0	135.00	SOFT	0.	NO	0.	0.
19	6000.	0.0	160.00	SOFT	0.	NO	0.	0.
20	8000.	0.0	130.00	SOFT	0.	YES	7200.	172.
21	12000.	0.0	50.00	SOFT	0.	YES	7200.	172.
22	500.	315.00	128.00	SOFT	0.	NO	0.	0.
23	1000.	315.00	90.00	SOFT	0.	NO	0.	0.
24	2000.	315.00	40.00	HARD	0.	YES	1950.	48.
25	4000.	315.00	5.00	HARD	0.	NO	0.	0.
26	6000.	315.00	7.00	HARD	0.	NO	0.	0.
27	8000.	315.00	80.00	SOFT	0.	NO	0.	0.
28	12000.	315.00	190.00	SOFT	0.	YES	11900.	216.
29	500.	270.00	140.00	SOFT	0.	NO	0.	0.
30	1000.	270.00	60.00	SOFT	0.	YES	600.	140.
31	2000.	270.00	5.00	HARD	0.	YES	600.	140.
32	4000.	270.00	7.00	HARD	0.	NO	0.	0.
33	6000.	270.00	30.00	HARD	0.	YES	5950.	40.
34	8000.	270.00	50.00	HARD	0.	YES	7550.	76.
35	12000.	270.00	55.00	SOFT	0.	YES	10650.	100.
36	500.	225.00	105.00	SOFT	0.	NO	0.	0.

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
37	1000.	225.00	70.00	SOFT	0.	NO	0.	0.
38	2000.	225.00	5.00	HARD	0.	NO	0.	0.
39	4000.	225.00	5.00	HARD	0.	NO	0.	0.
40	6000.	225.00	5.00	HARD	0.	YES	5850.	20.
41	8000.	225.00	5.00	SOFT	0.	NO	0.	0.
42	12000.	225.00	15.00	HARD	0.	YES	10550.	68.
43	500.	180.00	112.00	HARD	0.	NO	0.	0.
44	1000.	180.00	98.00	HARD	0.	NO	0.	0.
45	2000.	180.00	75.00	HARD	0.	NO	0.	0.
46	4000.	180.00	95.00	SOFT	0.	NO	0.	0.
47	6000.	180.00	40.00	SOFT	0.	YES	5500.	68.
48	8000.	180.00	10.00	SOFT	0.	YES	7850.	40.
49	12000.	180.00	5.00	HARD	0.	NO	0.	0.
50	500.	135.00	140.00	HARD	0.	NO	0.	0.
51	1000.	135.00	105.00	HARD	0.	NO	0.	0.
52	2000.	135.00	95.00	SOFT	0.	NO	0.	0.
53	4000.	135.00	110.00	SOFT	0.	YES	3750.	140.
54	6000.	135.00	7.00	SOFT	0.	YES	3750.	140.
55	8000.	135.00	7.00	HARD	0.	YES	3750.	140.
56	12000.	135.00	7.00	HARD	0.	YES	3750.	140.
57	11238.	307.30	195.00	SOFT	0.	YES	11900.	216.
58	7466.	24.20	95.00	SOFT	0.	YES	6300.	170.
59	16528.	65.67	145.00	SOFT	0.	YES	5150.	128.
60	10337.	239.86	95.00	SOFT	0.	YES	10550.	68.
61	6025.	149.48	115.00	SOFT	0.	NO	0.	0.
62	15929.	109.02	10.00	SOFT	0.	NO	0.	0.
63	19376.	207.48	25.00	SOFT	0.	NO	0.	0.
64	17460.	169.91	5.00	HARD	0.	NO	0.	0.
65	22854.	138.78	5.00	HARD	0.	NO	0.	0.

NORTHEAST UTILITIES
MILLSTONE ANS SIREN #66
NOISE SOURCE POWER LEVEL INPUT

INDEX	SOURCE	DBA	DBC	31.5	63	125	250	500	1000	2000	4000	8000 (HZ)
1	SIREN 6 6 -WS2000	152.9	152.6	0.0	0.0	0.0	0.0	0.0	152.0	143.0	138.0	126.0

XO= 0.0 YO= 0.0 ZO= 169.00 HEIGHT ABOVE GROUND= 39.00

NORTHEAST UTILITIES
MILLSTONE ANS SIREN #66
METEOROLOGICAL INPUT CONDITIONS

H1= 10.06 METERS H2= 43.28 METERS

YEAR	SEASON	MONTH	DATE	HOUR	WIND DIRECTION	WIND SPEED(MPS) H1	WIND SPEED(MPS) H2	TEMPERATURE(C) H1	TEMPERATURE(C) H2	RELATIVE HUMIDITY	BAROMETRIC PRESSURE(MM OF HG)
1983	5	7	1	12	245.0	3.8	5.1	21.9	21.3	42.0	764.0

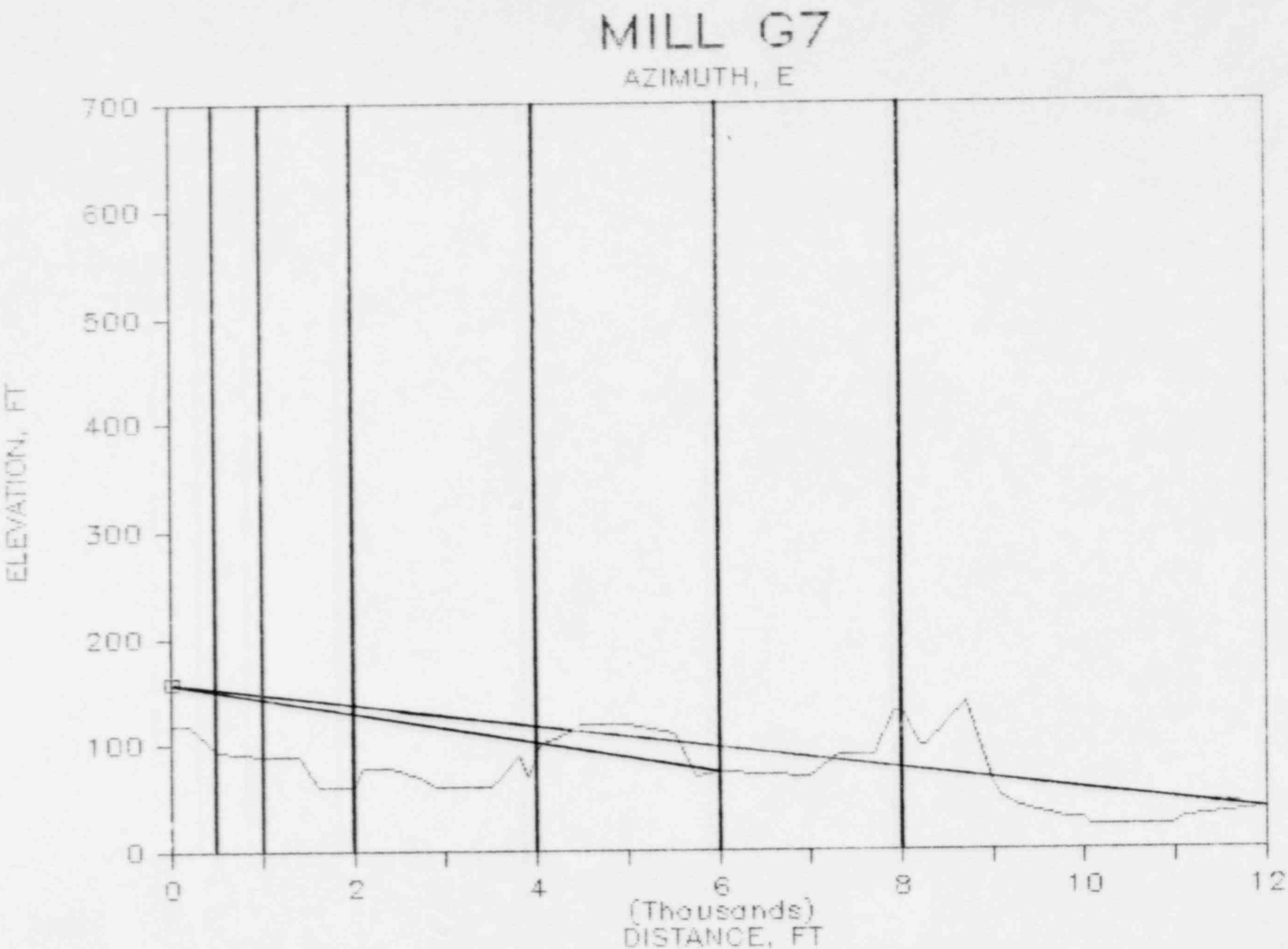
NORTHEAST UTILITIES
MILLSTONE ANS SIREN #66

SIREN SOUND LEVELS IN DBC

UNDER MET CONDITION 1

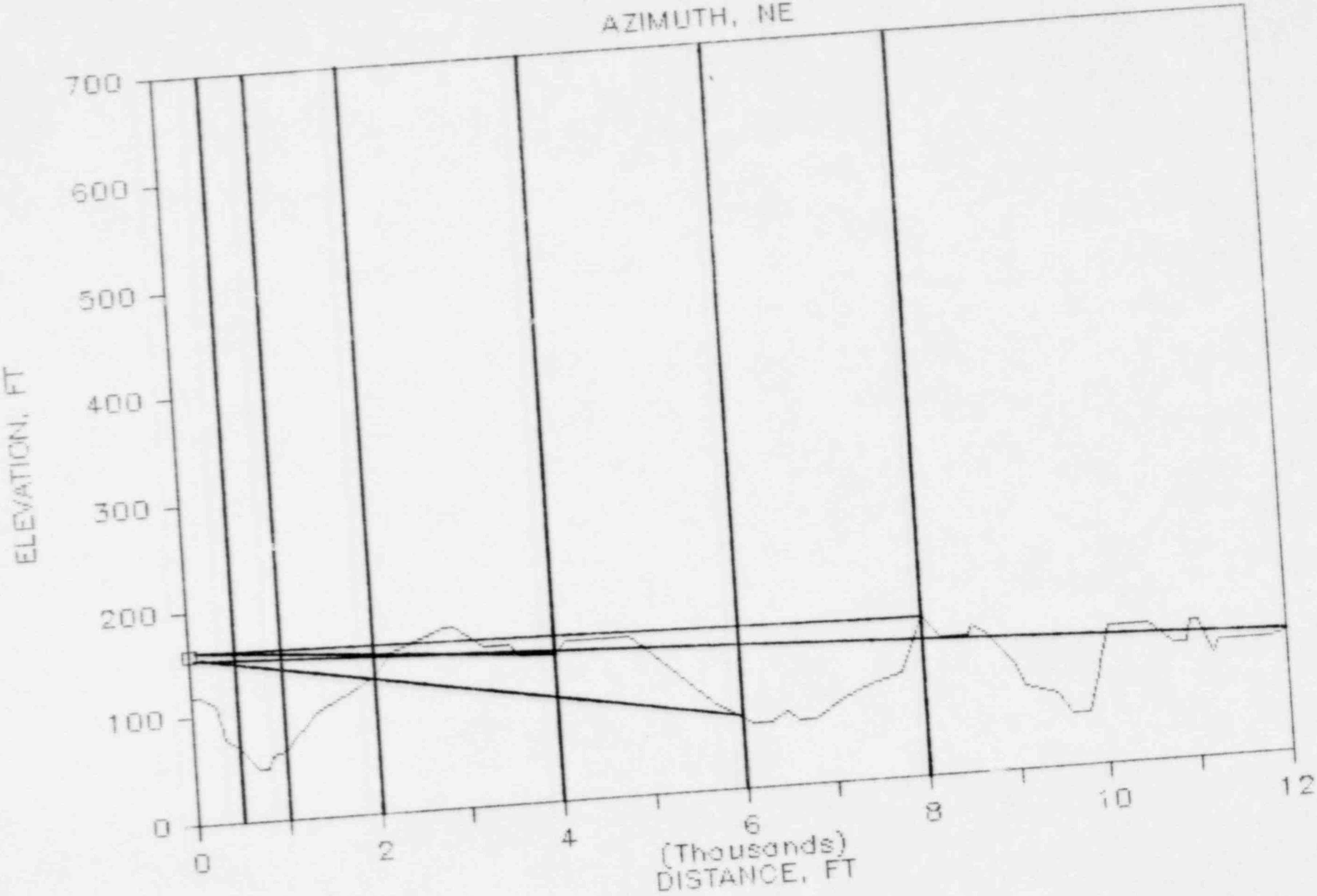
DISTANCE IN FEET

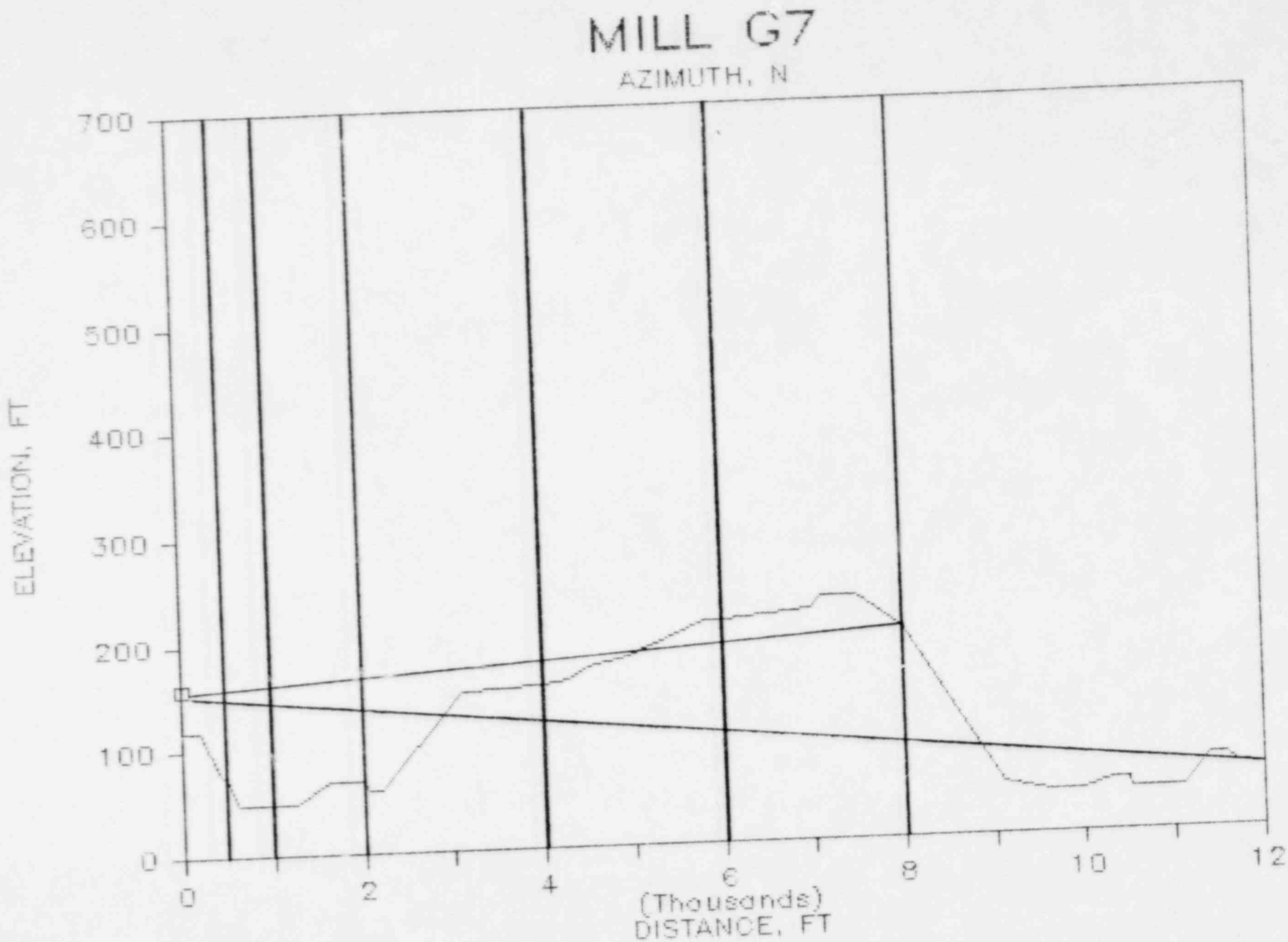
AZIMUTH	500.	1000.	2000.	4000.	6000.	8000.	12000.
E	100.	93.	81.	65.	51.	39.	38.
NE	100.	93.	79.	65.	57.	38.	34.
N	100.	93.	85.	65.	57.	38.	31.
NW	100.	93.	76.	67.	54.	34.	11.
W	100.	76.	74.	69.	43.	35.	14.
SW	100.	93.	85.	69.	46.	35.	20.
S	100.	93.	85.	57.	34.	17.	31.
SE	100.	93.	79.	50.	41.	51.	44.


MILL G7
AZIMUTH, E
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

MILL G7

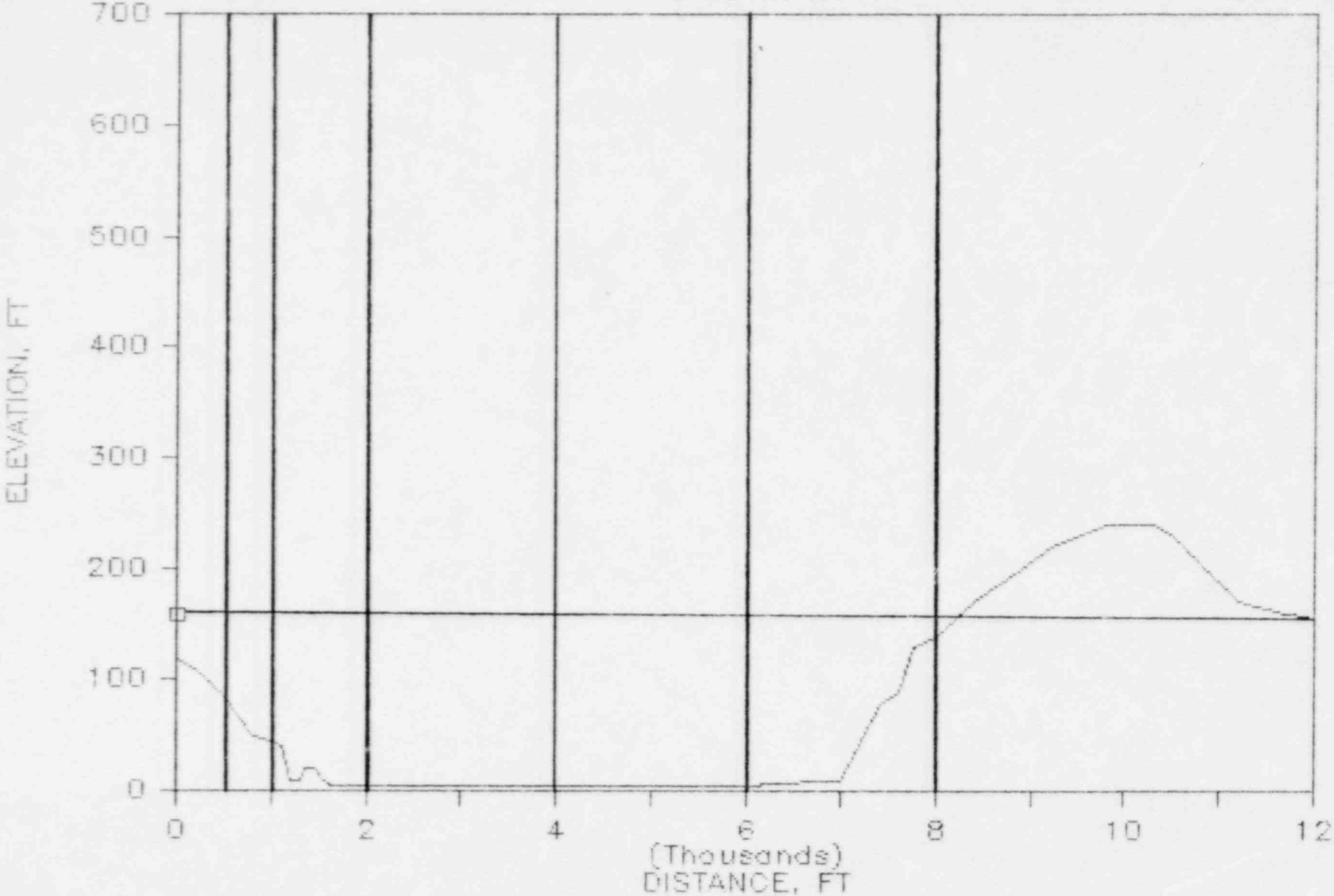
AZIMUTH, NE

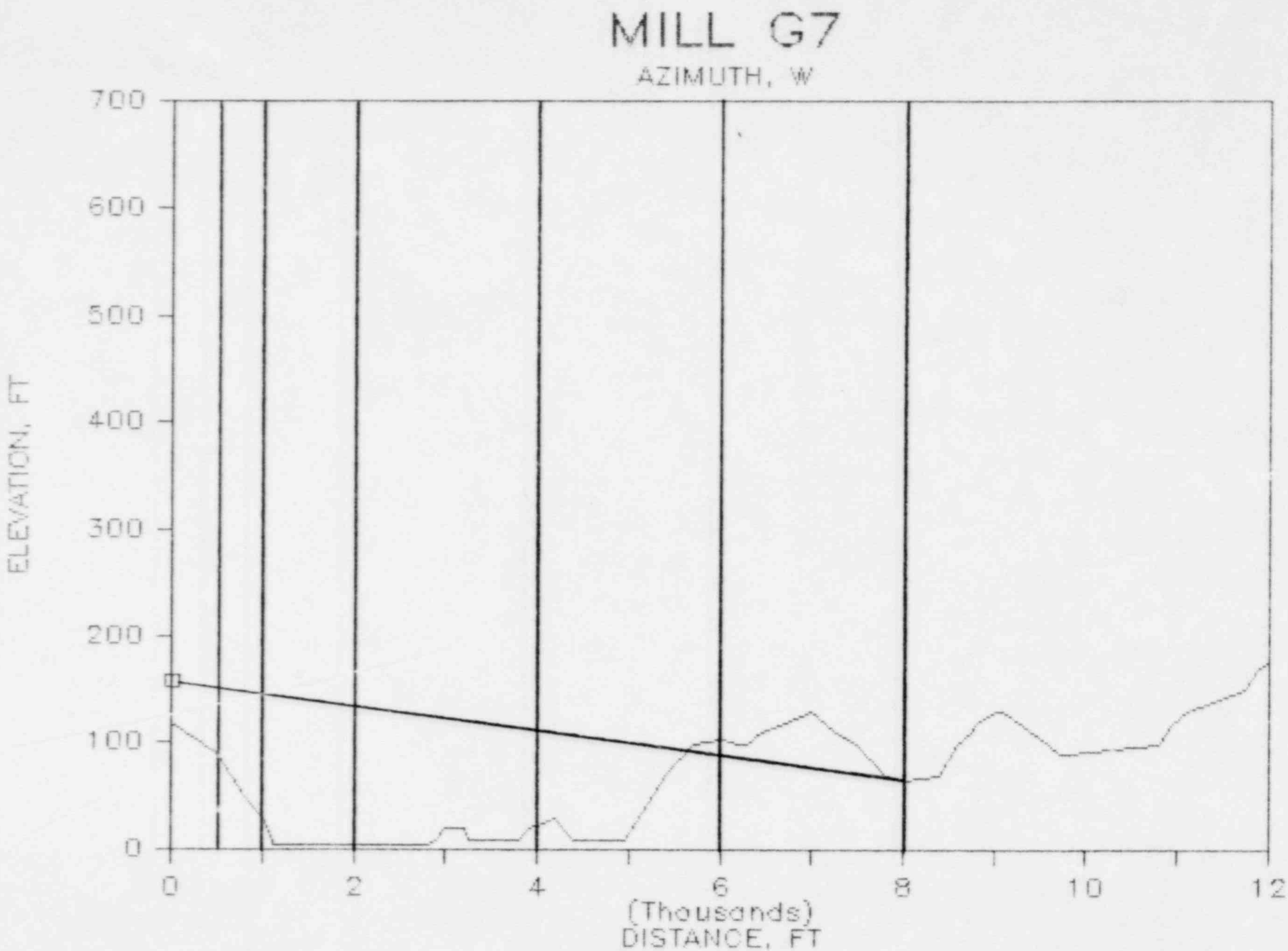


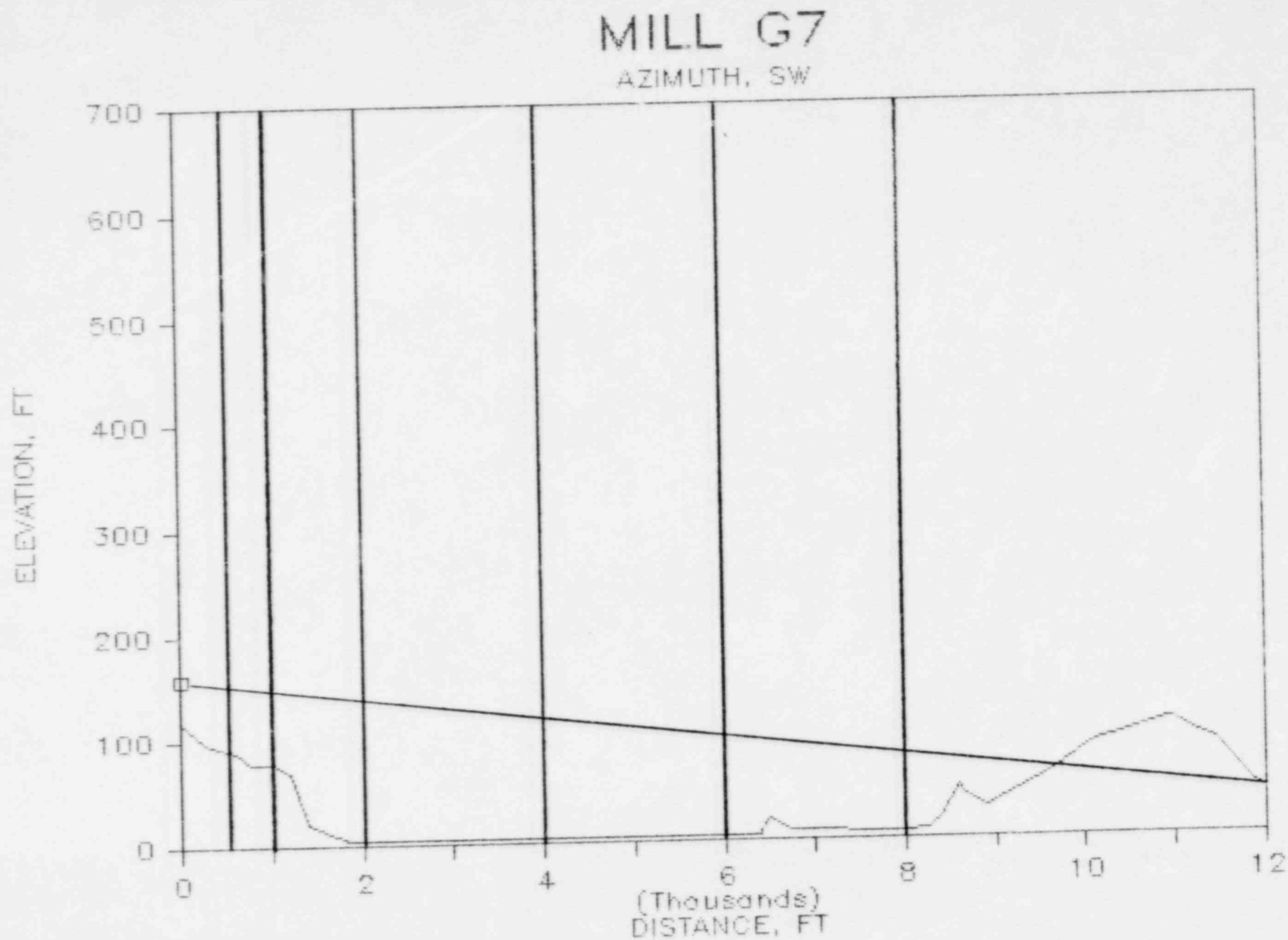

MILL G7
AZIMUTH, N
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

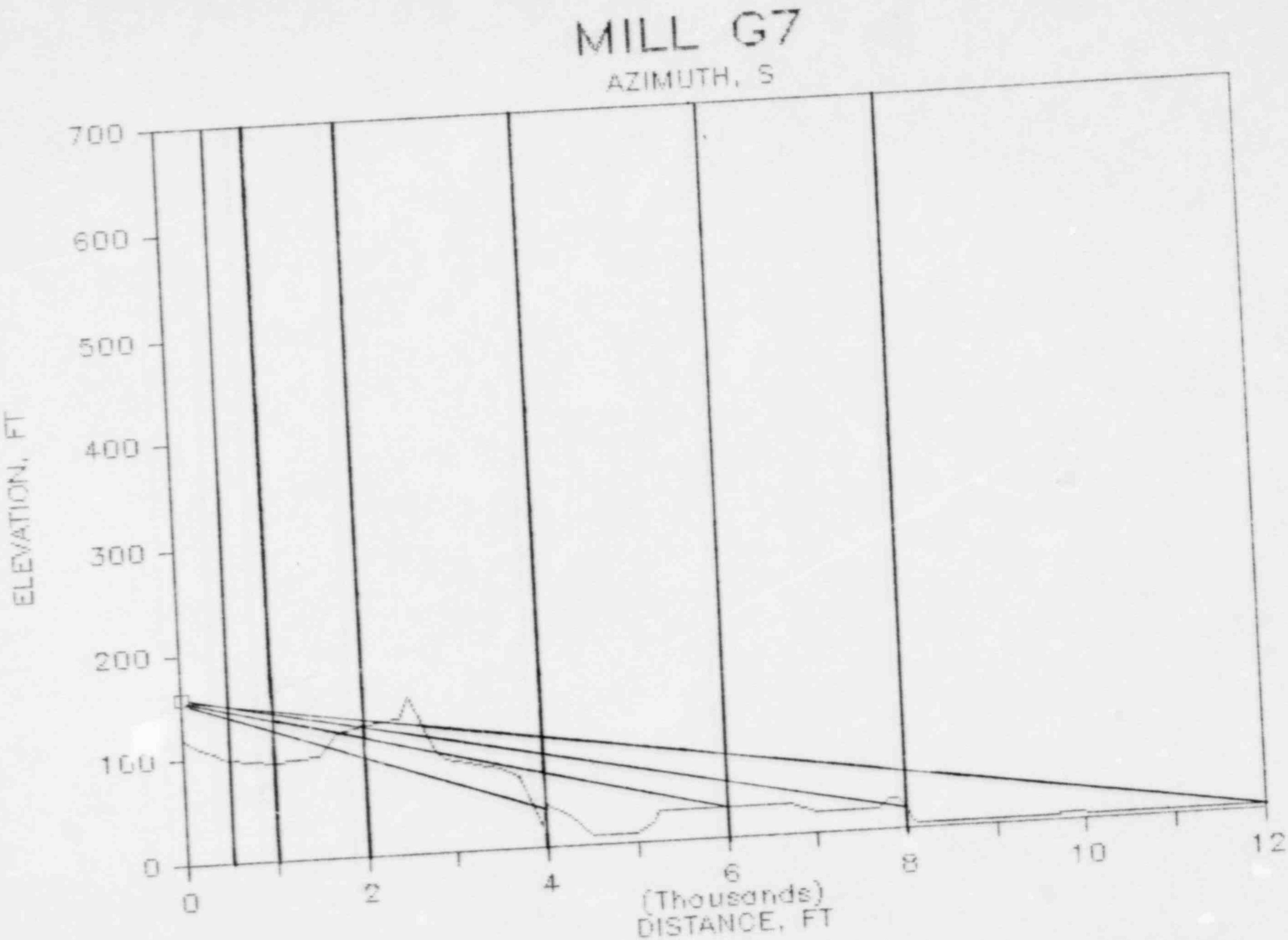
MILL G7

AZIMUTH, NW



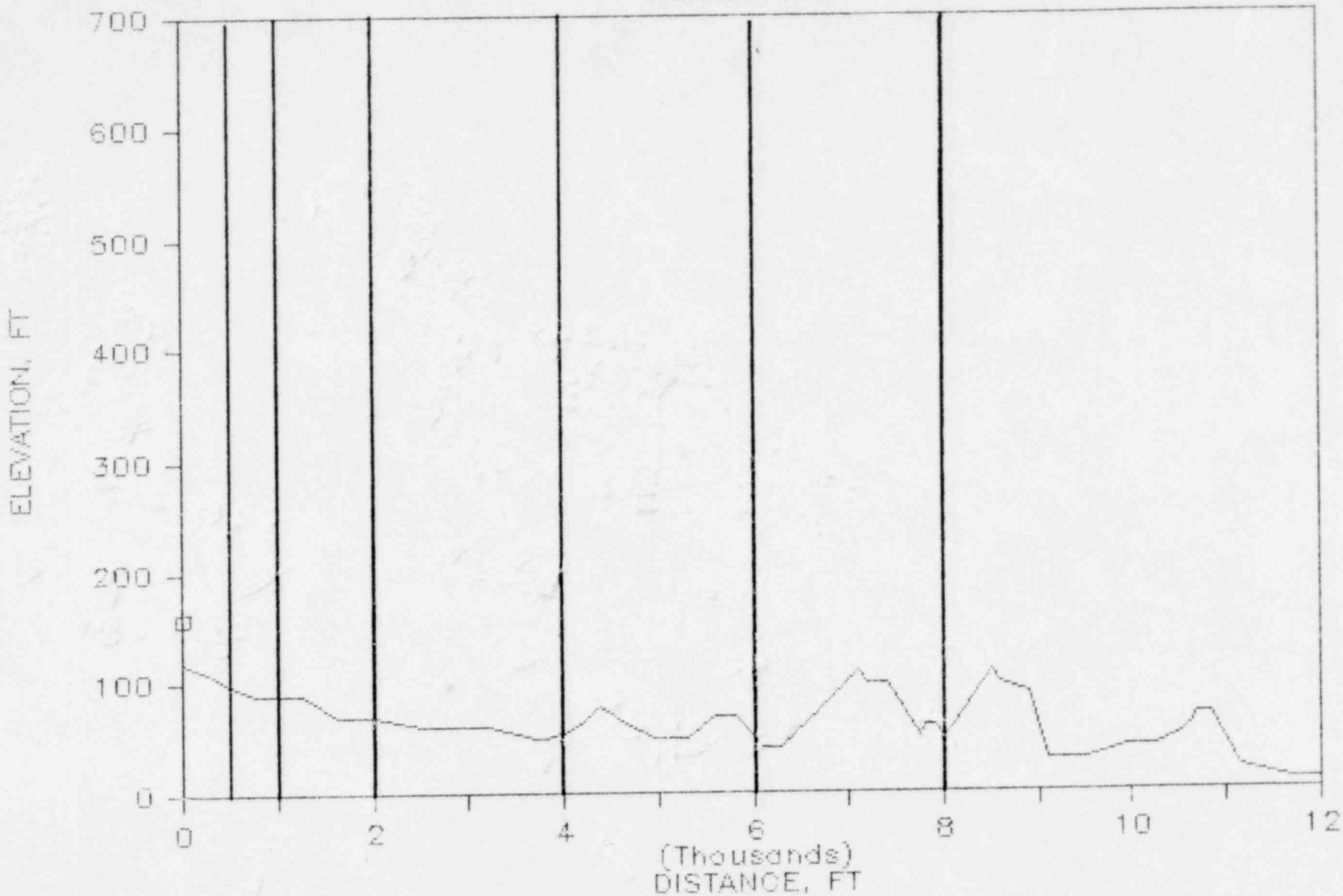

MILL G7
AZIMUTH, W
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT


MILL G7
AZIMUTH, SW
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT


MILL G7
AZIMUTH, S
700
600
500
400
300
200
100
0
ELEVATION, FT
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

MILL G7

AZIMUTH, SE



NORTHEAST UTILITIES
MILLSTONE ANS SIREN #67
SOURCE-RECEIVER TOPOGRAPHICAL INPUTS

ALL BEARINGS ARE WITH RESPECT TO THE NORTH MEASURING CLOCKWISE

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
1	500.	90.00	95.00	HARD	0.	NO	0.	0.
2	1000.	90.00	90.00	HARD	0.	NO	0.	0.
3	2000.	90.00	60.00	SOFT	0.	NO	0.	0.
4	4000.	90.00	90.00	SOFT	0.	NO	0.	0.
5	6000.	90.00	75.00	SOFT	0.	YES	5000.	125.
6	8000.	90.00	130.00	SOFT	0.	NO	0.	0.
7	12000.	90.00	39.00	SOFT	0.	YES	8700.	160.
8	500.	45.00	70.00	HARD	0.	NO	0.	0.
9	1000.	45.00	65.00	SOFT	0.	NO	0.	0.
10	2000.	45.00	130.00	SOFT	0.	NO	0.	0.
11	4000.	45.00	140.00	SOFT	0.	YES	2900.	175.
12	6000.	45.00	65.00	SOFT	0.	YES	2900.	175.
13	8000.	45.00	150.00	HARD	0.	YES	2900.	175.
14	12000.	45.00	115.00	SOFT	0.	YES	2900.	175.
15	500.	0.0	72.00	HARD	0.	NO	0.	0.
16	1000.	[illegible]	50.00	SOFT	0.	NO	0.	0.
17	2000.	0.0	70.00	SOFT	0.	NO	0.	0.
18	4000.	0.0	155.00	SOFT	0.	NO	0.	0.
19	6000.	0.0	210.00	SOFT	0.	NO	0.	0.
20	9000.	0.0	200.00	SOFT	0.	YES	7550.	228.
21	12000.	0.0	59.00	SOFT	0.	YES	7550.	228.
22	500.	315.00	85.00	HARD	0.	NO	0.	0.
23	1000.	315.00	45.00	HARD	0.	NO	0.	0.
24	2000.	315.00	5.00	SOFT	0.	NO	0.	0.
25	4000.	315.00	5.00	HARD	0.	NO	0.	0.
26	6000.	315.00	5.00	HARD	0.	NO	0.	0.
27	8000.	315.00	139.00	SOFT	0.	NO	0.	0.
28	12000.	315.00	155.00	SOFT	0.	YES	10350.	224.
29	500.	270.00	90.00	HARD	0.	NO	0.	0.
30	1000.	270.00	30.00	HARD	0.	NO	0.	0.
31	2000.	270.00	5.00	HARD	0.	NO	0.	0.
32	4000.	270.00	22.00	SOFT	0.	NO	0.	0.
33	6000.	270.00	103.00	SOFT	0.	NO	0.	0.
34	8000.	270.00	65.00	HARD	0.	YES	7000.	124.
35	12000.	270.00	175.00	SOFT	0.	NO	0.	0.
36	500.	225.00	92.00	HARD	0.	NO	0.	0.

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
37	1000.	225.00	80.00	HARD	0.	NO	0.	0.
38	2000.	225.00	5.00	HARD	0.	NO	0.	0.
39	4000.	225.00	5.00	HARD	0.	NO	0.	0.
40	6000.	225.00	5.00	HARD	0.	NO	0.	0.
41	8000.	225.00	8.00	HARD	0.	NO	0.	0.
42	12000.	225.00	40.00	HARD	0.	YES	11000.	108.
43	500.	180.00	100.00	HARD	0.	NO	0.	0.
44	1000.	180.00	95.00	HARD	0.	NO	0.	0.
45	2000.	180.00	125.00	HARD	0.	NO	0.	0.
46	4000.	180.00	40.00	HARD	0.	YES	2550.	148.
47	6000.	180.00	30.00	SOFT	0.	YES	2550.	148.
48	8000.	180.00	20.00	SOFT	0.	YES	2550.	148.
49	12000.	180.00	5.00	HARD	0.	YES	2550.	148.
50	500.	135.00	100.00	HARD	0.	NO	0.	0.
51	1000.	135.00	90.00	HARD	0.	NO	0.	0.
52	2000.	135.00	70.00	SOFT	0.	NO	0.	0.
53	4000.	135.00	55.00	SOFT	0.	NO	0.	0.
54	6000.	135.00	50.00	SOFT	0.	YES	5800.	66.
55	8000.	135.00	50.00	SOFT	0.	YES	7100.	108.
56	12000.	135.00	9.00	SOFT	0.	YES	7100.	108.
57	9472.	296.73	195.00	SOFT	0.	YES	10350.	224.
58	5539.	39.73	95.00	SOFT	0.	YES	2900.	175.
59	16113.	74.67	145.00	SOFT	0.	YES	8700.	160.
60	11466.	227.54	95.00	SOFT	0.	YES	11000.	108.
61	8511.	155.42	115.00	SOFT	0.	YES	2550.	148.
62	17361.	116.48	10.00	SOFT	0.	YES	7100.	108.
63	21476.	203.20	25.00	SOFT	0.	NO	0.	0.
64	20055.	169.83	5.00	HARD	0.	NO	0.	0.
65	25123.	141.79	5.00	HARD	0.	NO	0.	0.

NORTHEAST UTILITIES
MILLSTONE ANS SIREN #67
NOISE SOURCE POWER LEVEL INPUT

INDEX	SOURCE	DBA	DBC	31.5	63	125	250	500	1000	2000	4000	8000 (HZ)
1	SIREN 6 7 -WS2000	152.9	152.6	0.0	0.0	0.0	0.0	0.0	152.0	143.0	138.0	126.0

XO= 0.0 YO= 0.0 ZO= 149.00 HEIGHT ABOVE GROUND= 39.00

NORTHEAST UTILITIES
MILLSTONE SIREN #67

METEOROLOGICAL INPUT CONDITIONS

H1= 10.06 METERS H2= 43.28 METERS

YEAR	SEASON	MONTH	DATE	HOUR	WIND DIRECTION	WIND SPEED(MPS) H1	WIND SPEED(MPS) H2	TEMPERATURE(C) H1	TEMPERATURE(C) H2	RELATIVE HUMIDITY	BAROMETRIC PRESSURE(MM OF HG)
1983	S	7	1	12	245.0	3.8	5.1	21.9	21.3	42.0	764.0

NORTHEAST UTILITIES
MILLSTONE ANS SIREN #67

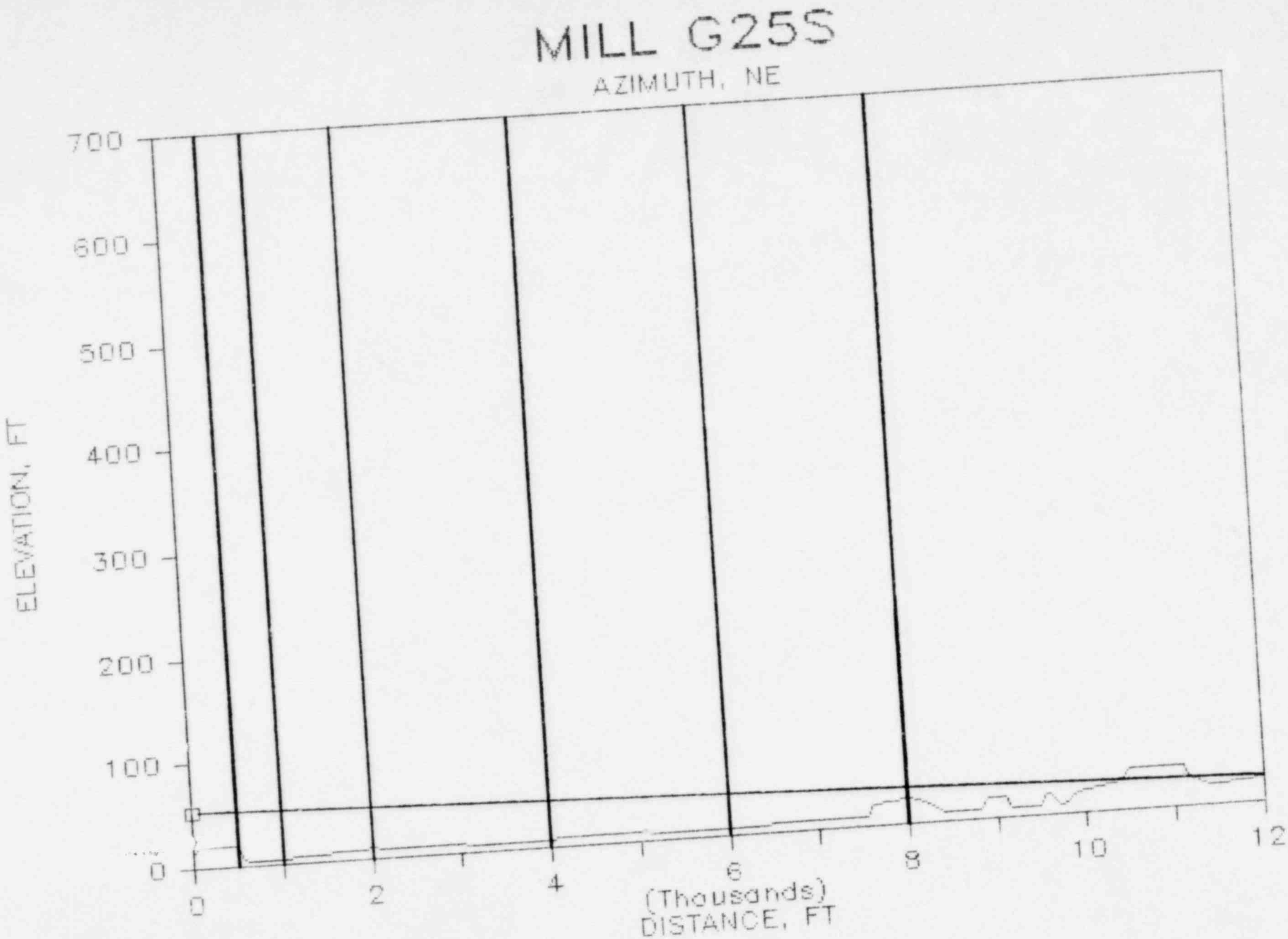
SIREN SOUND LEVELS IN DBC

UNDER MET CONDITION 1

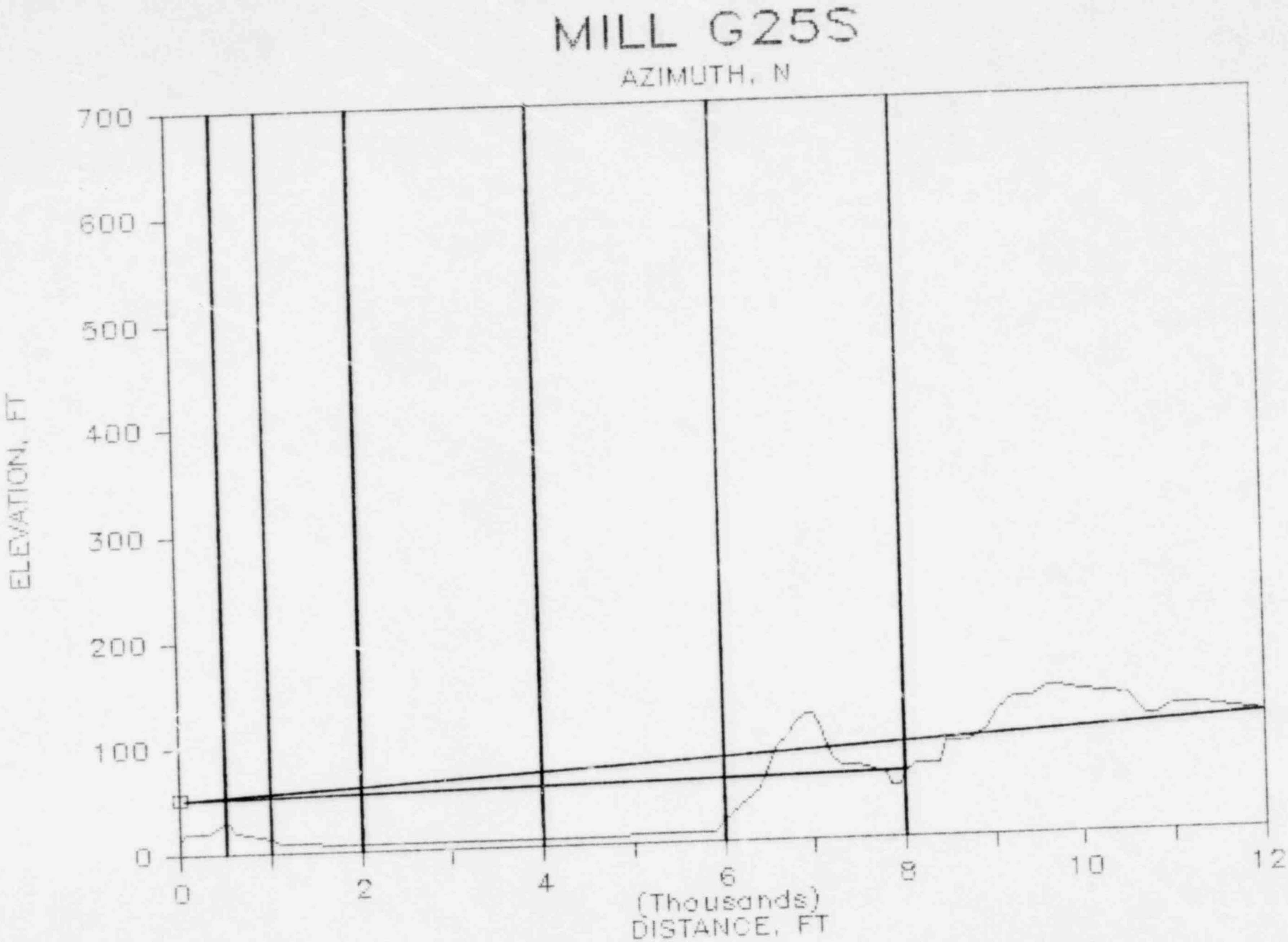
DISTANCE IN FEET

AZIMUTH	500.	1000.	2000.	4000.	6000.	8000.	12000.
E	100.	93.	80.	65.	44.	52.	29.
NE	100.	93.	79.	53.	42.	54.	35.
N	100.	93.	79.	65.	57.	38.	26.
NW	100.	93.	81.	67.	54.	36.	10.
W	100.	93.	85.	59.	44.	31.	30.
SW	100.	93.	85.	69.	56.	45.	15.
S	100.	93.	85.	51.	30.	23.	22.
SE	100.	93.	79.	65.	46.	37.	35.


MILL G25S
AZIMUTH, E
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT



MILL G25S
AZIMUTH, NE
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

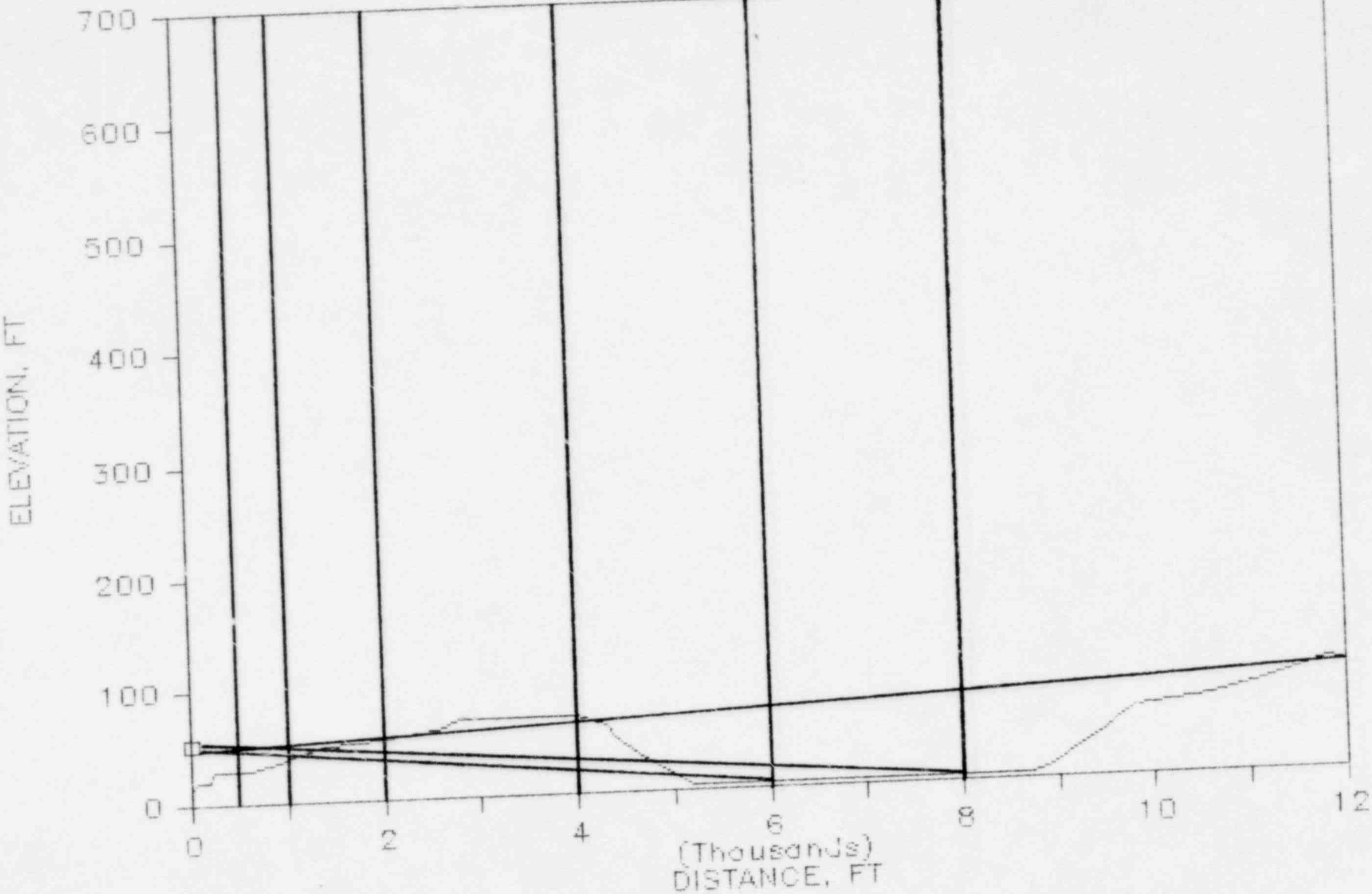


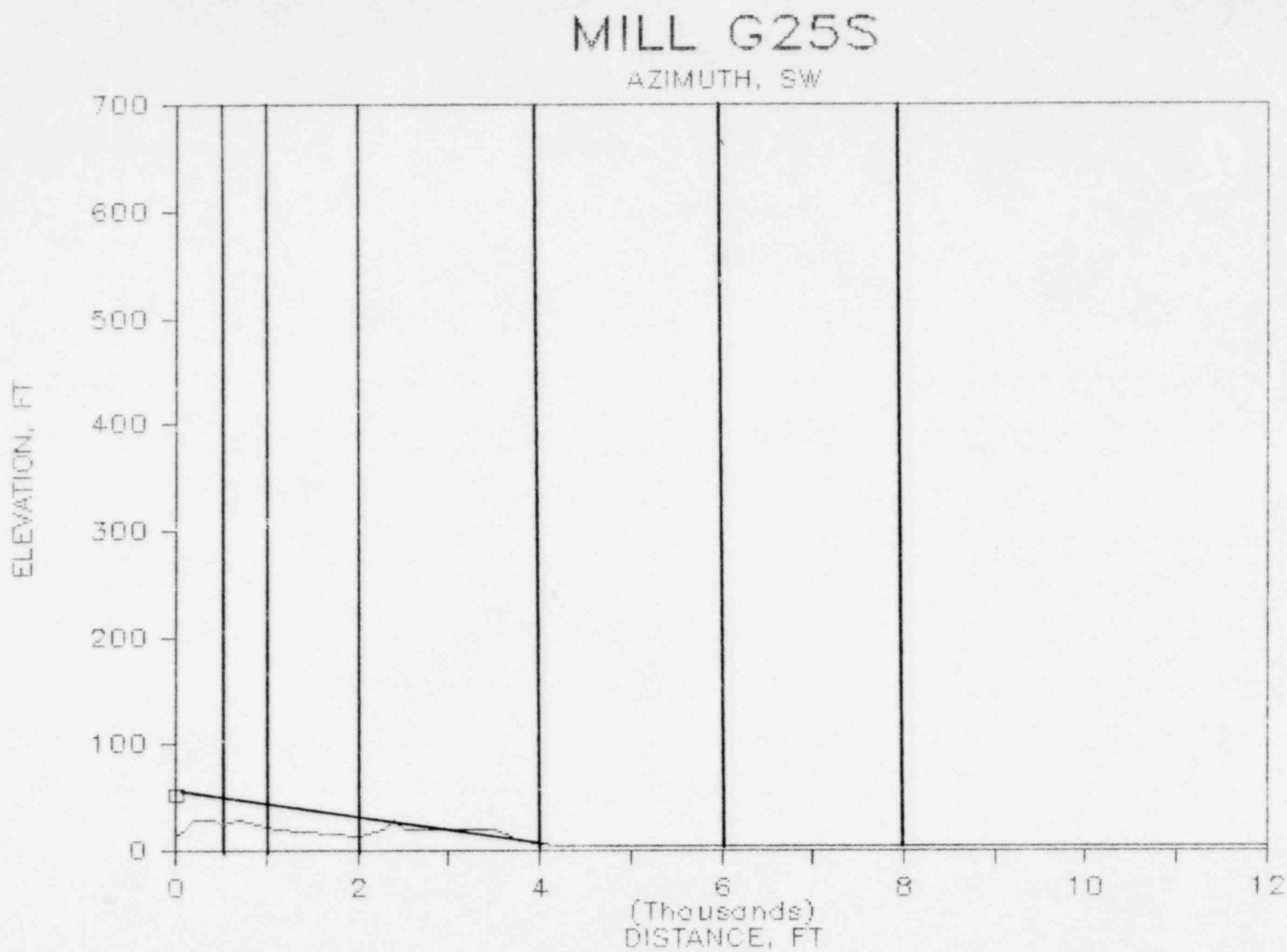
MILL G25S
AZIMUTH, N
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

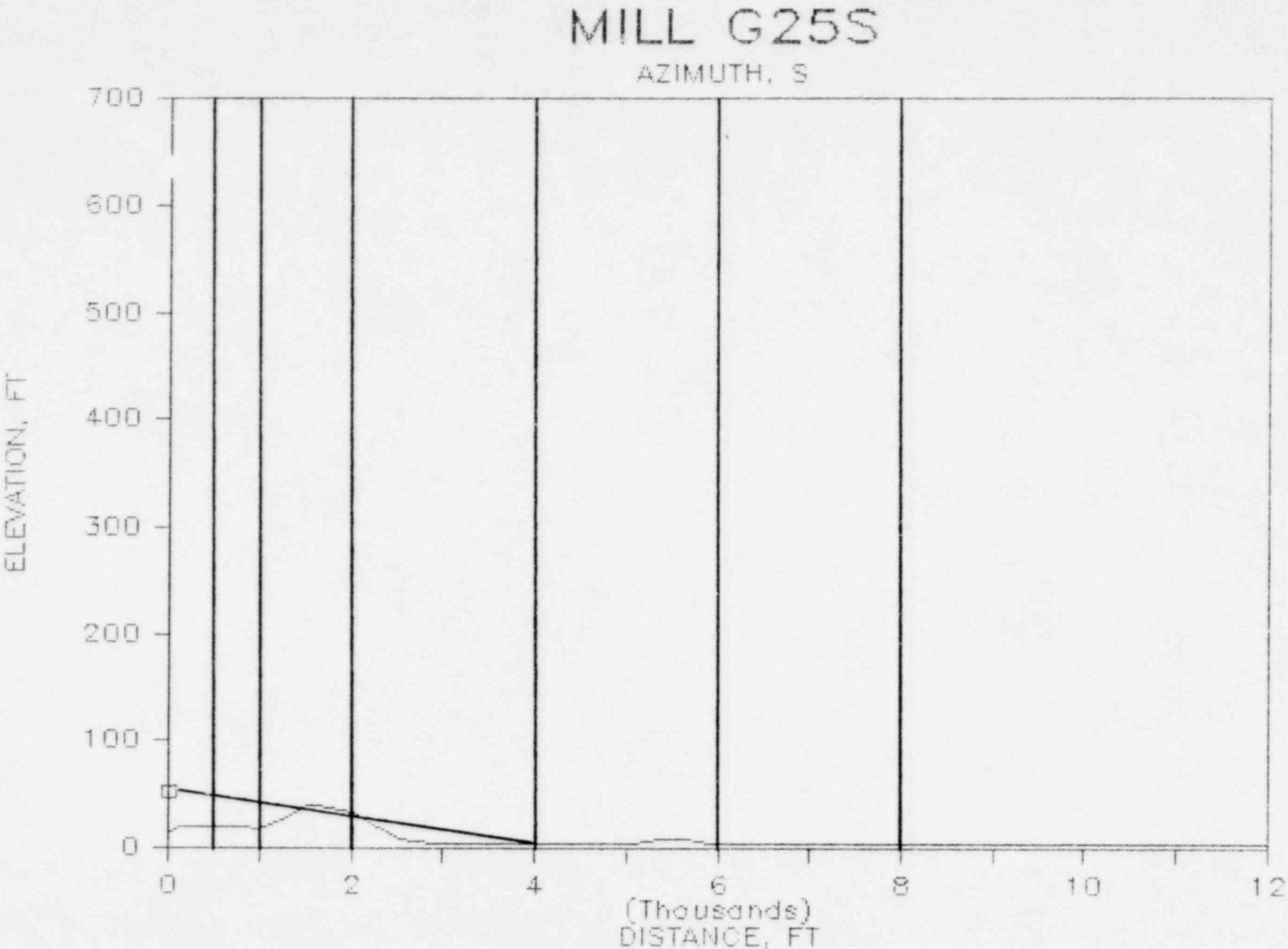

MILL G25S
AZIMUTH, NW
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

MILL G25S

AZIMUTH, W

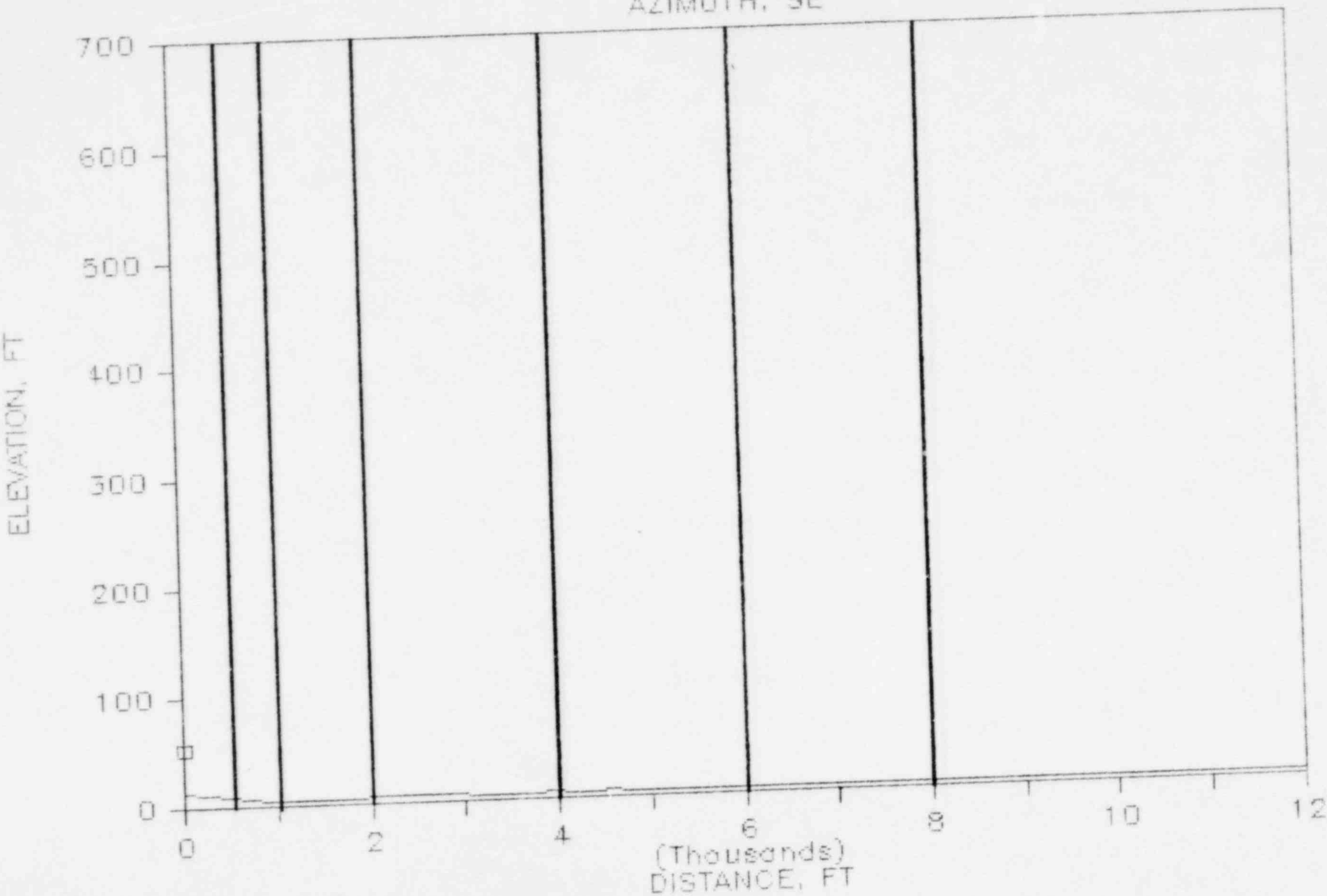



MILL G25S
AZIMUTH, SW
700
600
500
400
300
200
100
0
ELEVATION, FT
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT


MILL G25S
AZIMUTH, S
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

MILL G25S

AZIMUTH, SE



NORTHEAST UTILITIES
MILLSTONE ANS SIREN #625S
SOURCE-RECEIVER TOPOGRAPHICAL INPUTS

ALL BEARINGS ARE WITH RESPECT TO THE NORTH MEASURING CLOCKWISE

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
1	500.	90.00	10.00	SOFT	0.	NO	0.	0.
2	1000.	90.00	5.00	SOFT	0.	NO	0.	0.
3	2000.	90.00	7.00	HARD	0.	NO	0.	0.
4	4000.	90.00	7.00	HARD	0.	NO	0.	0.
5	6000.	90.00	5.00	HARD	0.	NO	0.	0.
6	8000.	90.00	90.00	SOFT	0.	NO	0.	0.
7	12000.	90.00	25.00	HARD	0.	YES	8400.	108.
8	500.	45.00	20.00	SOFT	0.	NO	0.	0.
9	1000.	45.00	5.00	SOFT	0.	NO	0.	0.
10	2000.	45.00	12.00	SOFT	0.	NO	0.	0.
11	4000.	45.00	7.00	SOFT	0.	NO	0.	0.
12	6000.	45.00	7.00	HARD	0.	NO	0.	0.
13	8000.	45.00	25.00	SOFT	0.	NO	0.	0.
14	12000.	45.00	25.00	SOFT	0.	YES	11100.	40.
15	500.	0.0	30.00	SOFT	0.	NO	0.	0.
16	1000.	0.0	15.00	SOFT	0.	NO	0.	0.
17	2000.	0.0	7.00	HARD	0.	NO	0.	0.
18	4000.	0.0	7.00	HARD	0.	NO	0.	0.
19	6000.	0.0	20.00	HARD	0.	NO	0.	0.
20	8000.	0.0	60.00	SOFT	0.	YES	7000.	120.
21	12000.	0.0	110.00	SOFT	0.	YES	7000.	120.
22	500.	315.00	25.00	SOFT	0.	NO	0.	0.
23	1000.	315.00	45.00	SOFT	0.	NO	0.	0.
24	2000.	315.00	70.00	SOFT	0.	NO	0.	0.
25	4000.	315.00	90.00	SOFT	0.	NO	0.	0.
26	6000.	315.00	95.00	SOFT	0.	YES	4000.	90.
27	8000.	315.00	15.00	HARD	0.	YES	4000.	90.
28	12000.	315.00	5.00	HARD	0.	YES	4000.	90.
29	500.	270.00	30.00	SOFT	0.	NO	0.	0.
30	1000.	270.00	39.00	SOFT	0.	NO	0.	0.
31	2000.	270.00	55.00	SOFT	0.	NO	0.	0.
32	4000.	270.00	70.00	SOFT	0.	NO	0.	0.
33	6000.	270.00	5.00	SOFT	0.	YES	4000.	70.
34	8000.	270.00	5.00	HARD	0.	YES	4000.	70.
35	12000.	270.00	95.00	SOFT	0.	YES	11900.	100.
36	500.	225.00	25.00	SOFT	0.	NO	0.	0.

37	1000.	225.00	23.00	SOFT	0.	NO	0.	0.
38	2000.	225.00	15.00	SOFT	0.	NO	0.	0.
39	4000.	225.00	7.00	SOFT	0.	YES	3550.	20.
40	6000.	225.00	5.00	HARD	0.	NO	0.	0.
41	8000.	225.00	5.00	HARD	0.	NO	0.	0.
42	12000.	225.00	5.00	HARD	0.	NO	0.	0.
43	500.	180.00	20.00	SOFT	0.	NO	0.	0.
44	1000.	180.00	18.00	SOFT	0.	NO	0.	0.
45	2000.	180.00	35.00	SOFT	0.	NO	0.	0.
46	4000.	180.00	5.00	SOFT	0.	YES	2000.	35.
47	6000.	180.00	5.00	HARD	0.	NO	0.	0.
48	8000.	180.00	5.00	HARD	0.	NO	0.	0.
49	12000.	180.00	5.00	HARD	0.	NO	0.	0.
50	500.	135.00	10.00	SOFT	0.	NO	0.	0.
51	1000.	135.00	5.00	SOFT	0.	NO	0.	0.
52	2000.	135.00	7.00	HARD	0.	NO	0.	0.
53	4000.	135.00	7.00	HARD	0.	NO	0.	0.
54	6000.	135.00	5.00	HARD	0.	NO	0.	0.
55	8000.	135.00	5.00	HARD	0.	NO	0.	0.
56	12000.	135.00	5.00	HARD	0.	NO	0.	0.
57	21229.	318.38	195.00	SOFT	0.	NO	0.	0.
58	16008.	352.46	95.00	SOFT	0.	NO	0.	0.
59	18705.	31.96	145.00	SOFT	0.	NO	0.	0.
60	14621.	285.35	95.00	SOFT	0.	YES	4000.	90.
61	4403.	331.51	115.00	SOFT	0.	NO	0.	0.
62	10630.	68.65	10.00	SOFT	0.	YES	11100.	40.
63	16276.	240.03	25.00	SOFT	0.	NO	0.	0.
64	8397.	194.48	5.00	HARD	0.	NO	0.	0.
65	12810.	129.39	5.00	HARD	0.	NO	0.	0.

NORTHEAST UTILITIES
MILLSTONE ANS SIREN #625S
NOISE SOURCE POWER LEVEL INPUT

INDEX	SOURCE	DBA	DBC	31.5	63	125	250	500	1000	2000	4000	8000 (HZ)
1	SIREN 625S-WS2000	152.9	152.6	0.0	0.0	0.0	0.0	0.0	152.0	143.0	138.0	126.0

XO= 0.0 YO= 0.0 ZO= 59.00 HEIGHT ABOVE GROUND= 39.00

NORTHEAST UTILITIES
MILLSTONE ANS SIREN #625S
METEOROLOGICAL INPUT CONDITIONS

H1= 10.06 METERS H2= 43.28 METERS

YEAR	SEASON	MONTH	DATE	HOUR	WIND DIRECTION	WIND SPEED(MPS) H1	WIND SPEED(MPS) H2	TEMPERATURE(C) H1	TEMPERATURE(C) H2	RELATIVE HUMIDITY	BAROMETRIC PRESSURE(MM OF HG)
1983	S	7	1	12	245.0	3.8	5.1	21.9	21.3	42.0	764.0

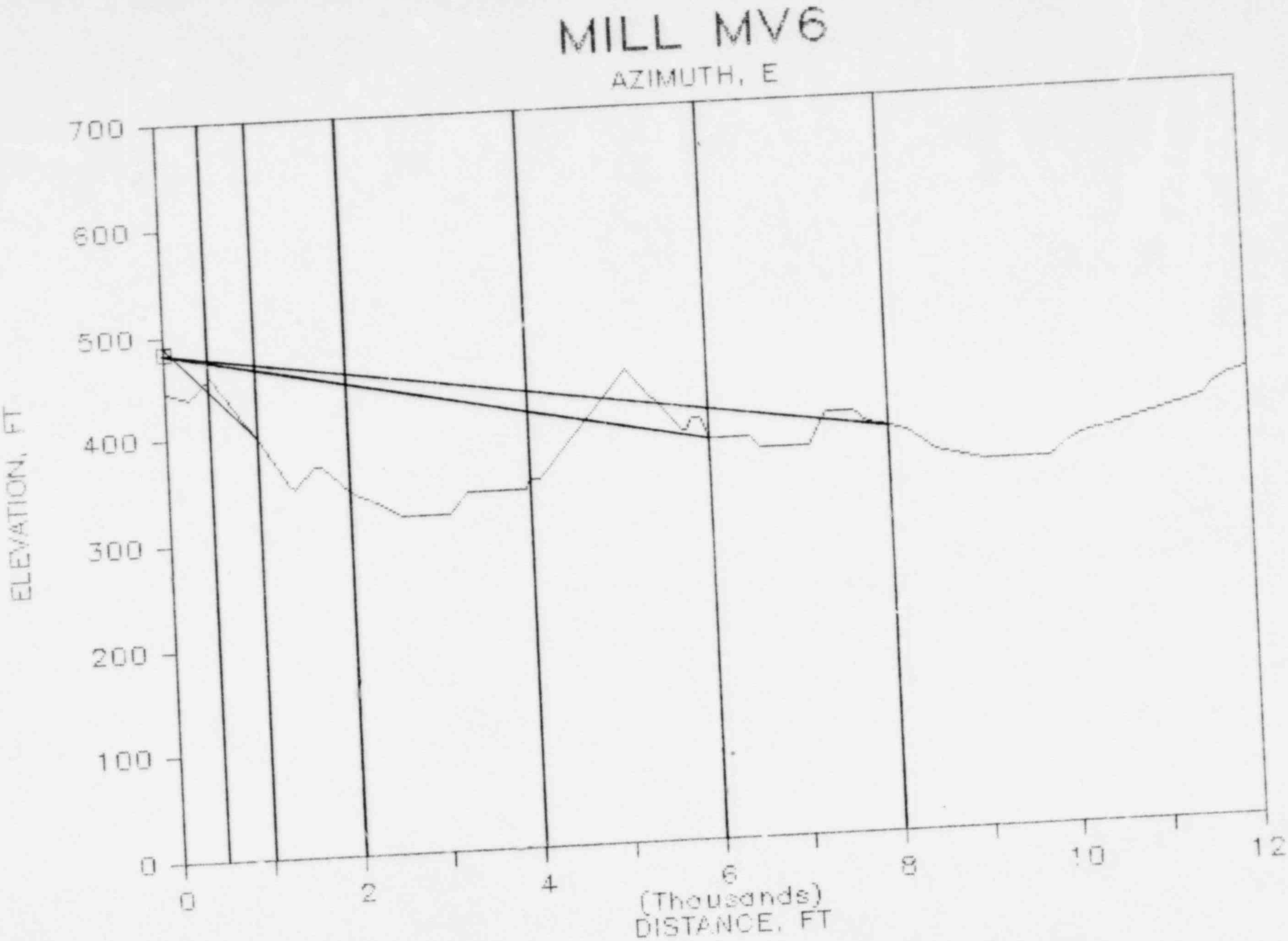
NORTHEAST UTILITIES
MILLSTONE ANS SIREN #625S

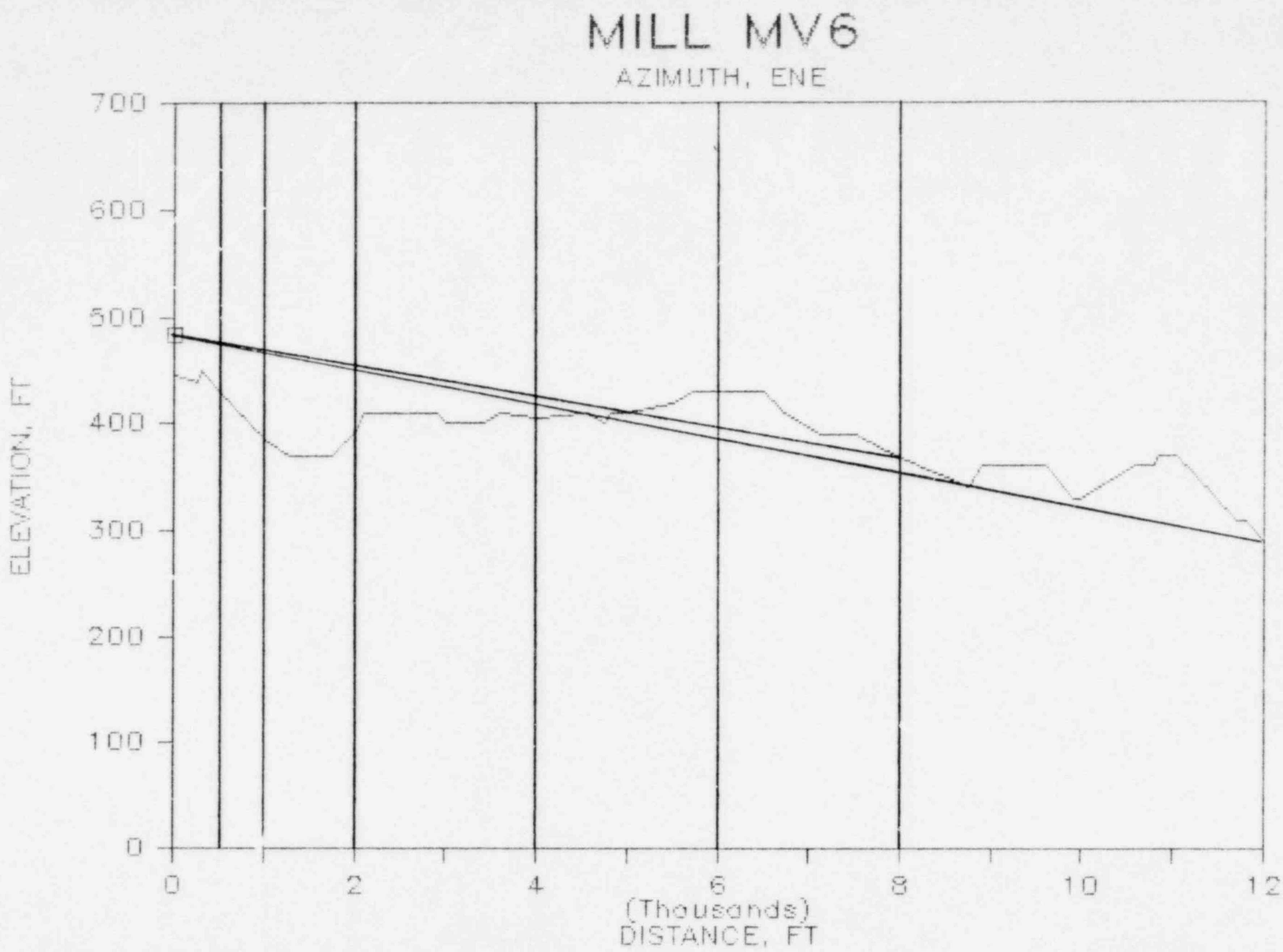
SIREN SOUND LEVELS IN DBC

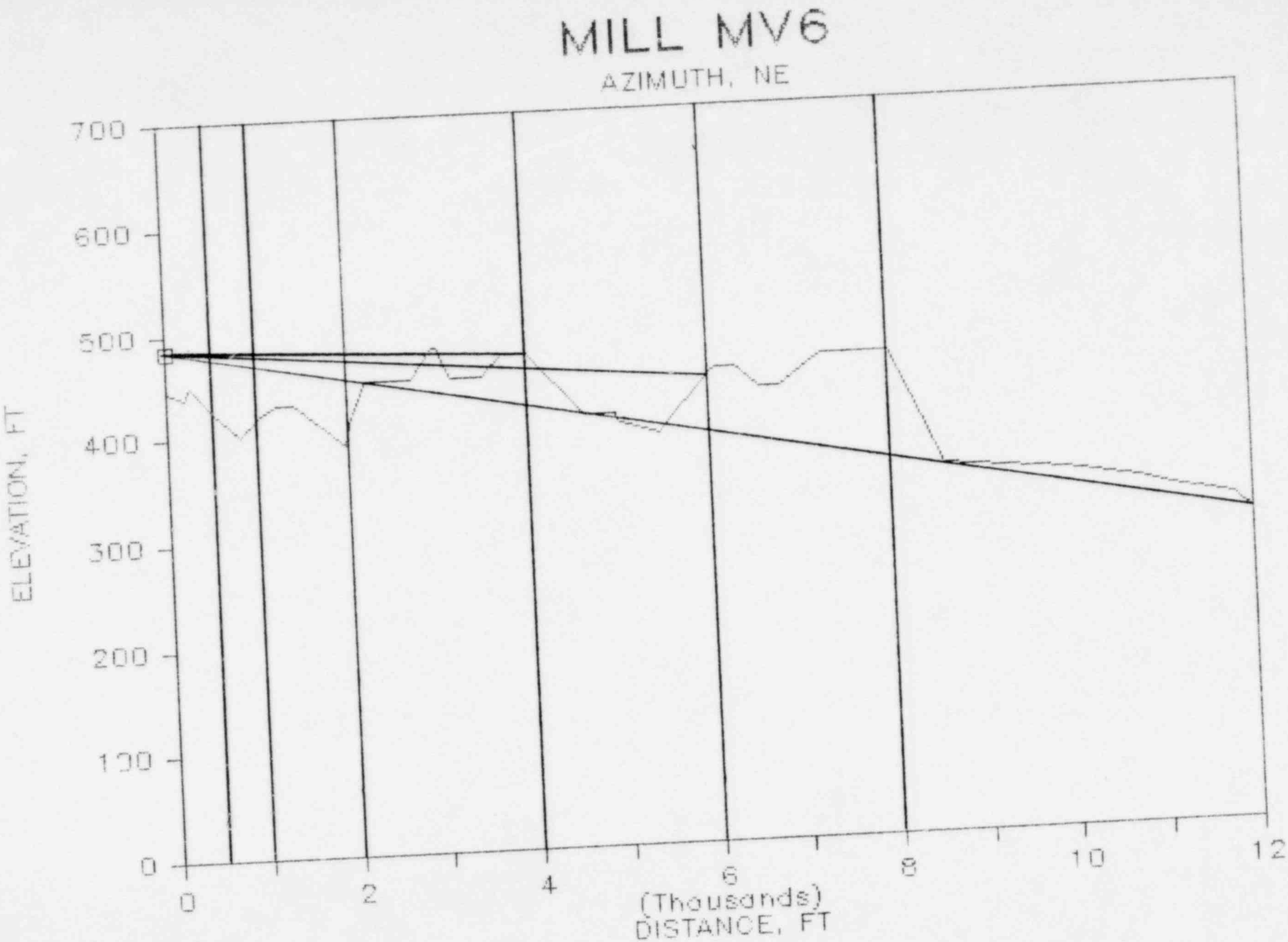
UNDER MET CONDITION 1

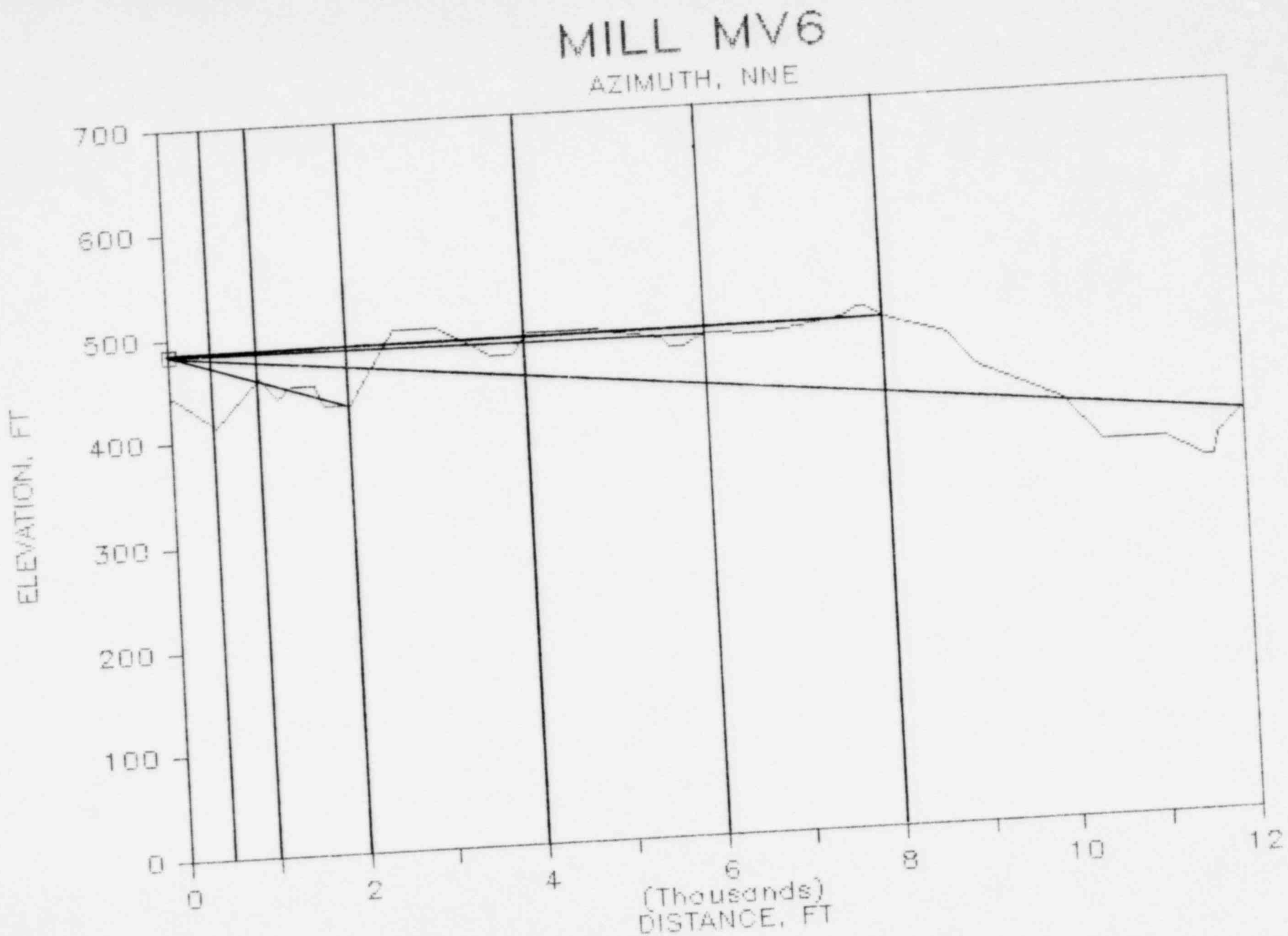
DISTANCE IN FEET

AZIMUTH	500.	1000.	2000.	4000.	6000.	8000.	12000.
E	100.	93.	85.	75.	68.	52.	38.
NE	100.	93.	79.	65.	68.	52.	37.
N	100.	92.	85.	75.	68.	36.	36.
NW	100.	92.	79.	65.	49.	32.	20.
W	100.	92.	79.	65.	32.	36.	26.
SW	100.	92.	79.	52.	56.	45.	31.
S	100.	92.	79.	52.	54.	44.	31.
SE	100.	93.	85.	75.	68.	62.	51.


MILL MV6
AZIMUTH, E
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

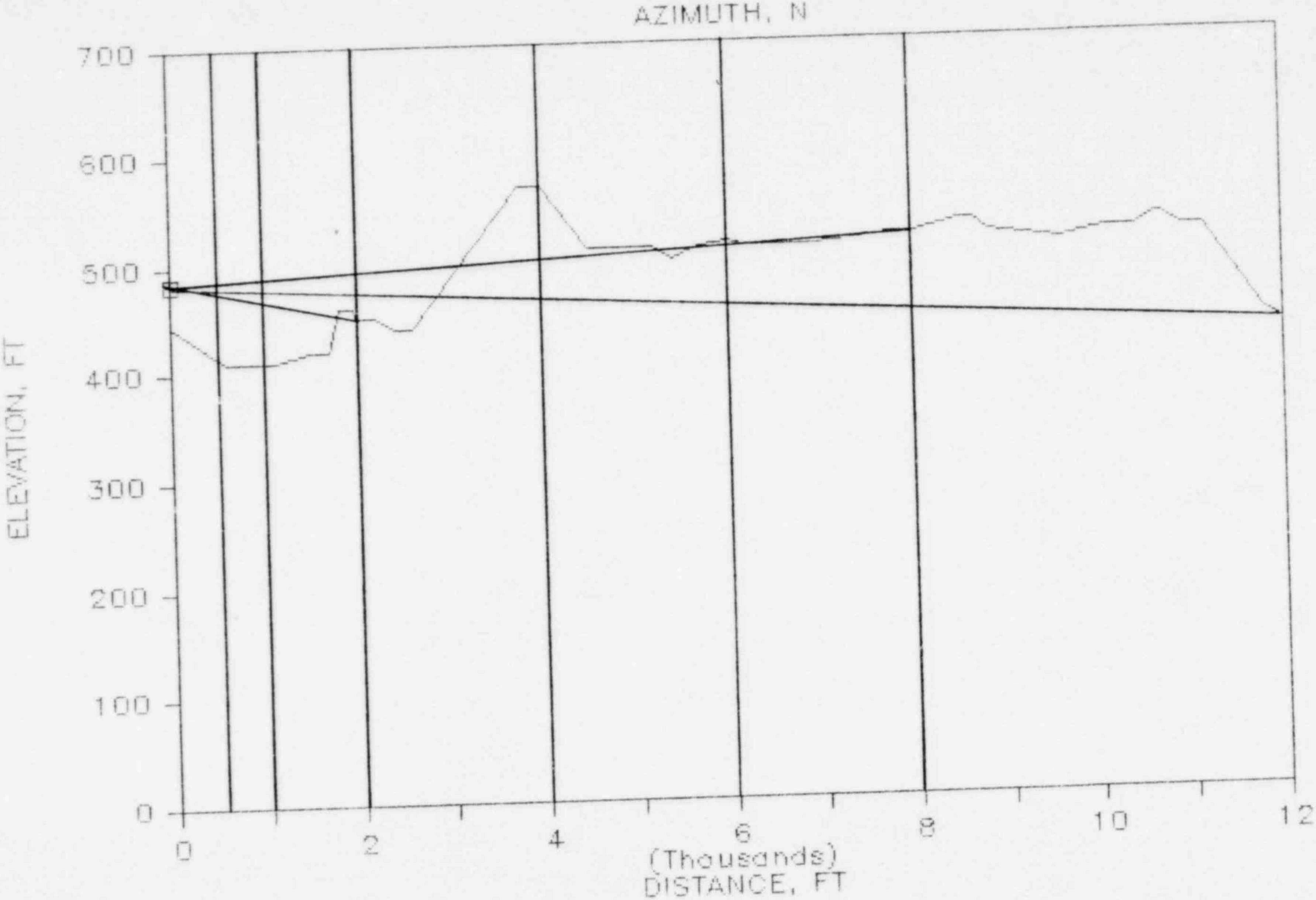

MILL MV6
AZIMUTH, ENE
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

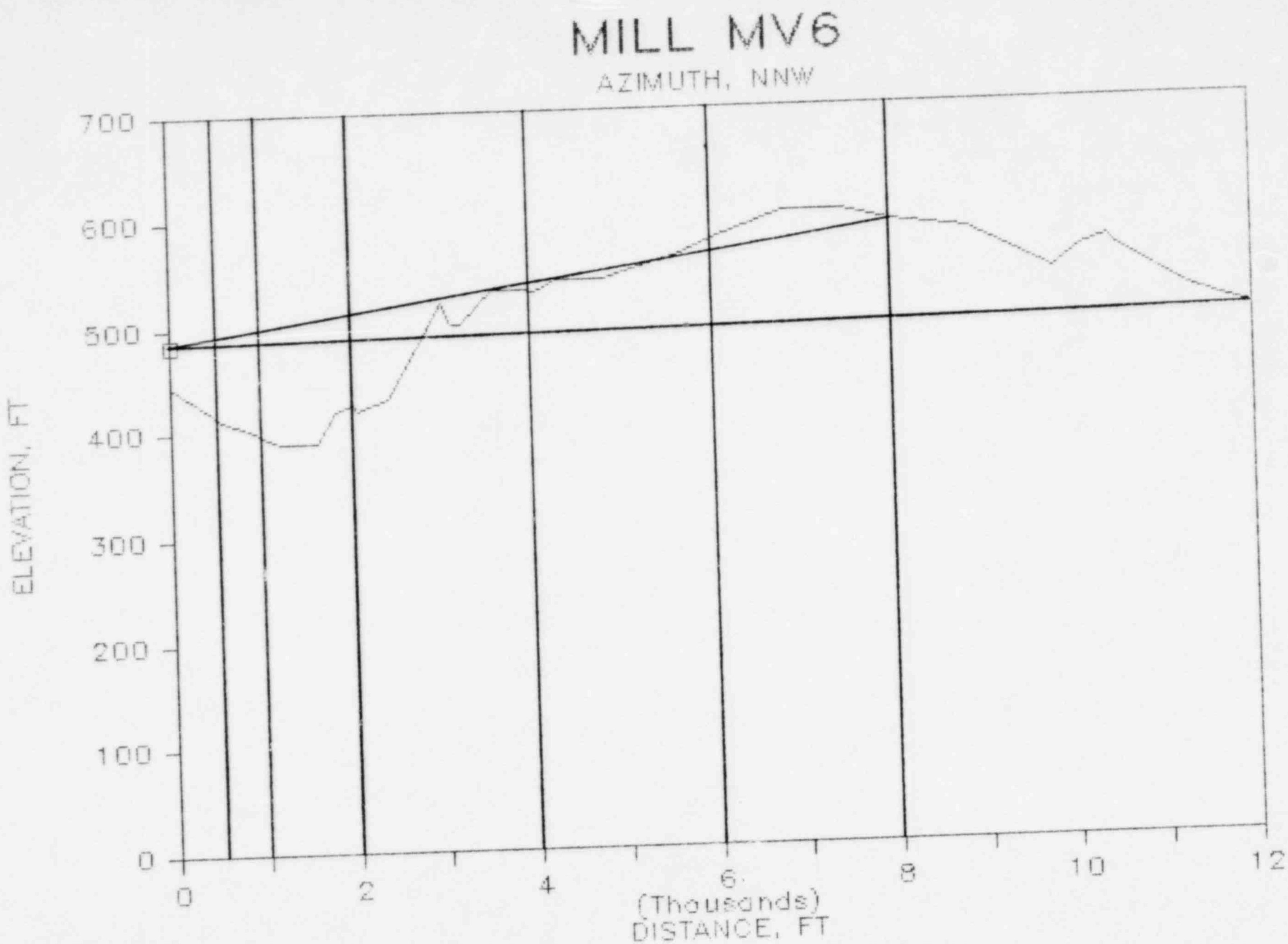

MILL MV6
AZIMUTH, NE
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT


MILL MV6
AZIMUTH, NNE
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

MILL MV6

AZIMUTH, N

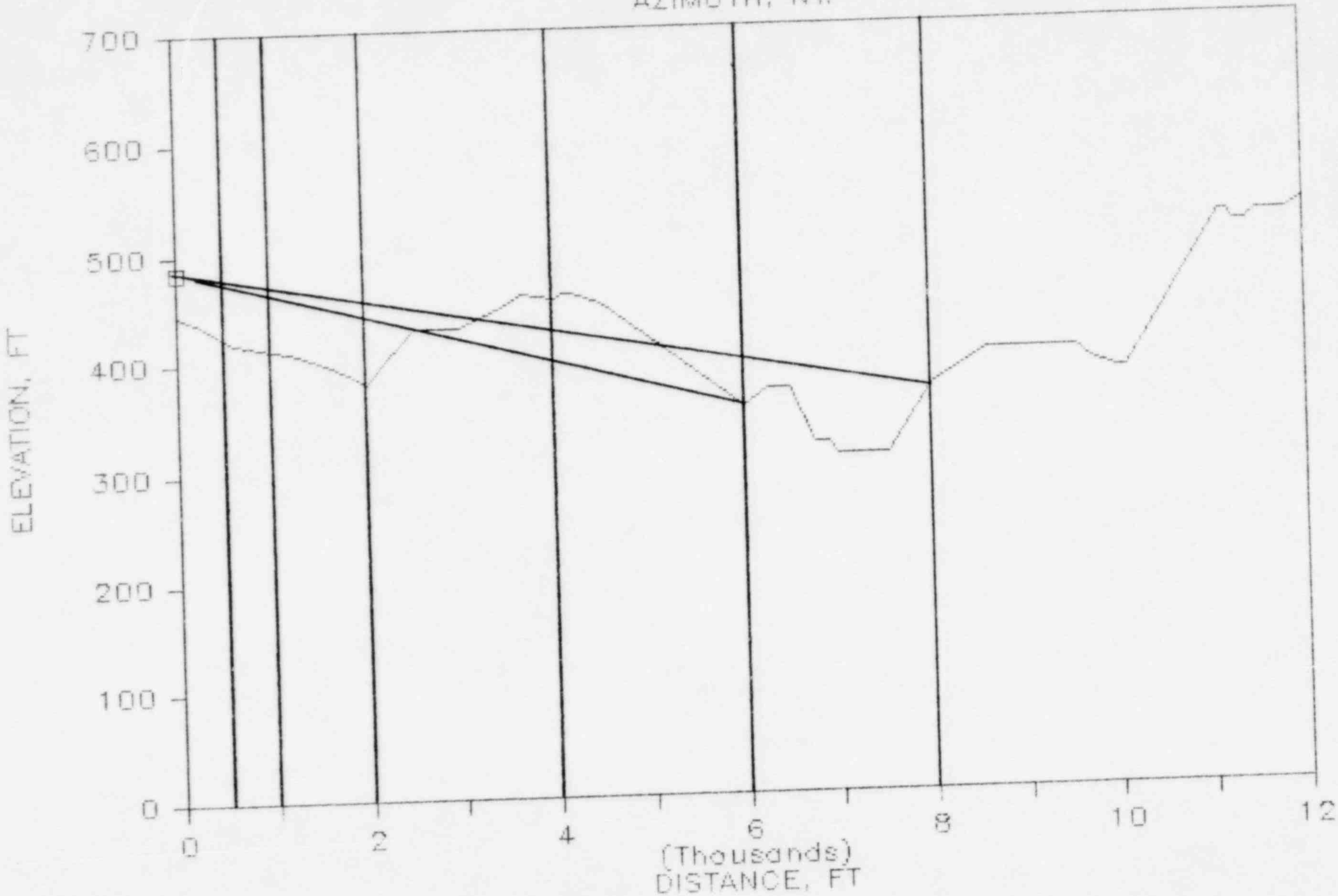




MILL MV6
AZIMUTH, NNW
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

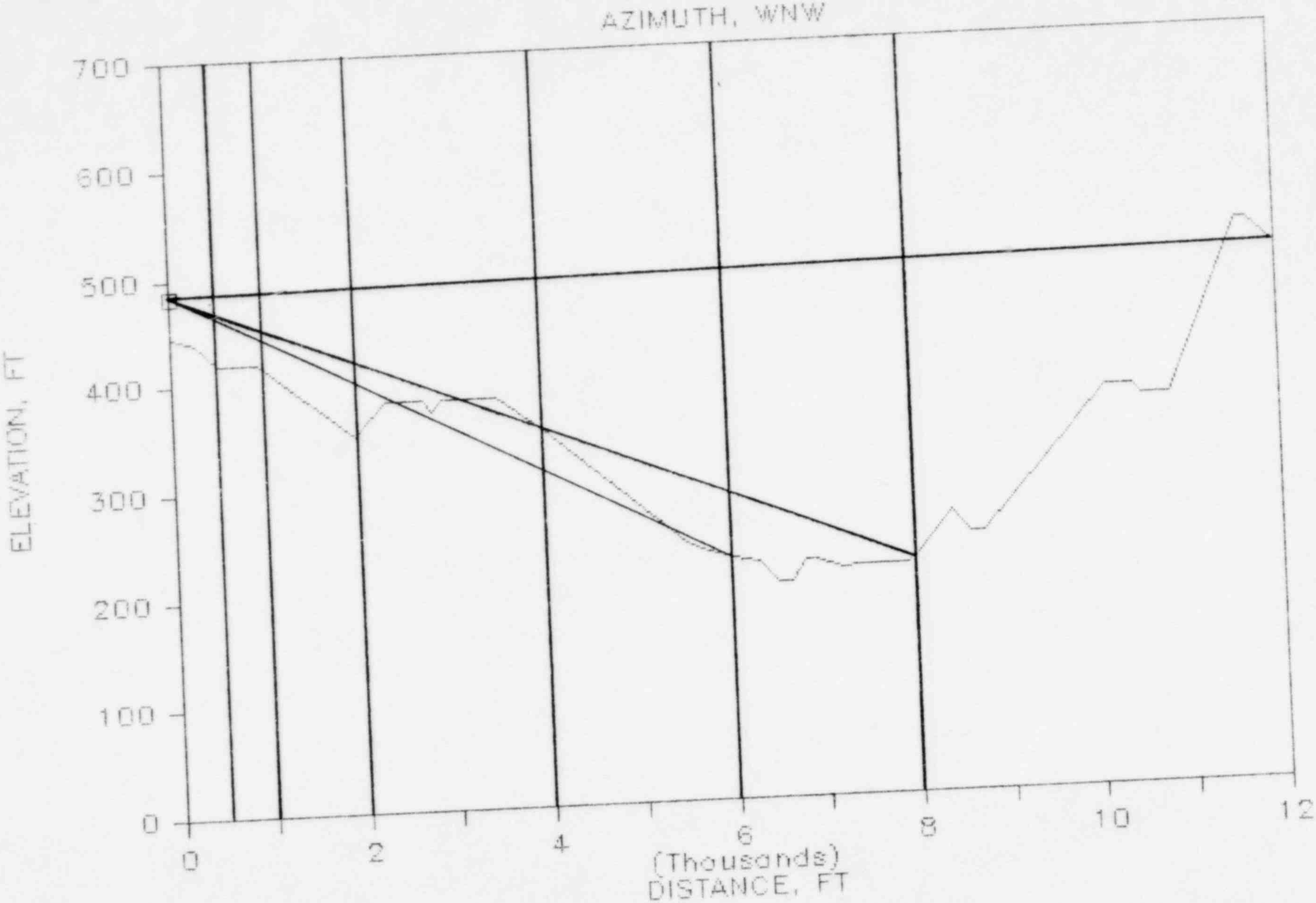
MILL MV6

AZIMUTH, NW



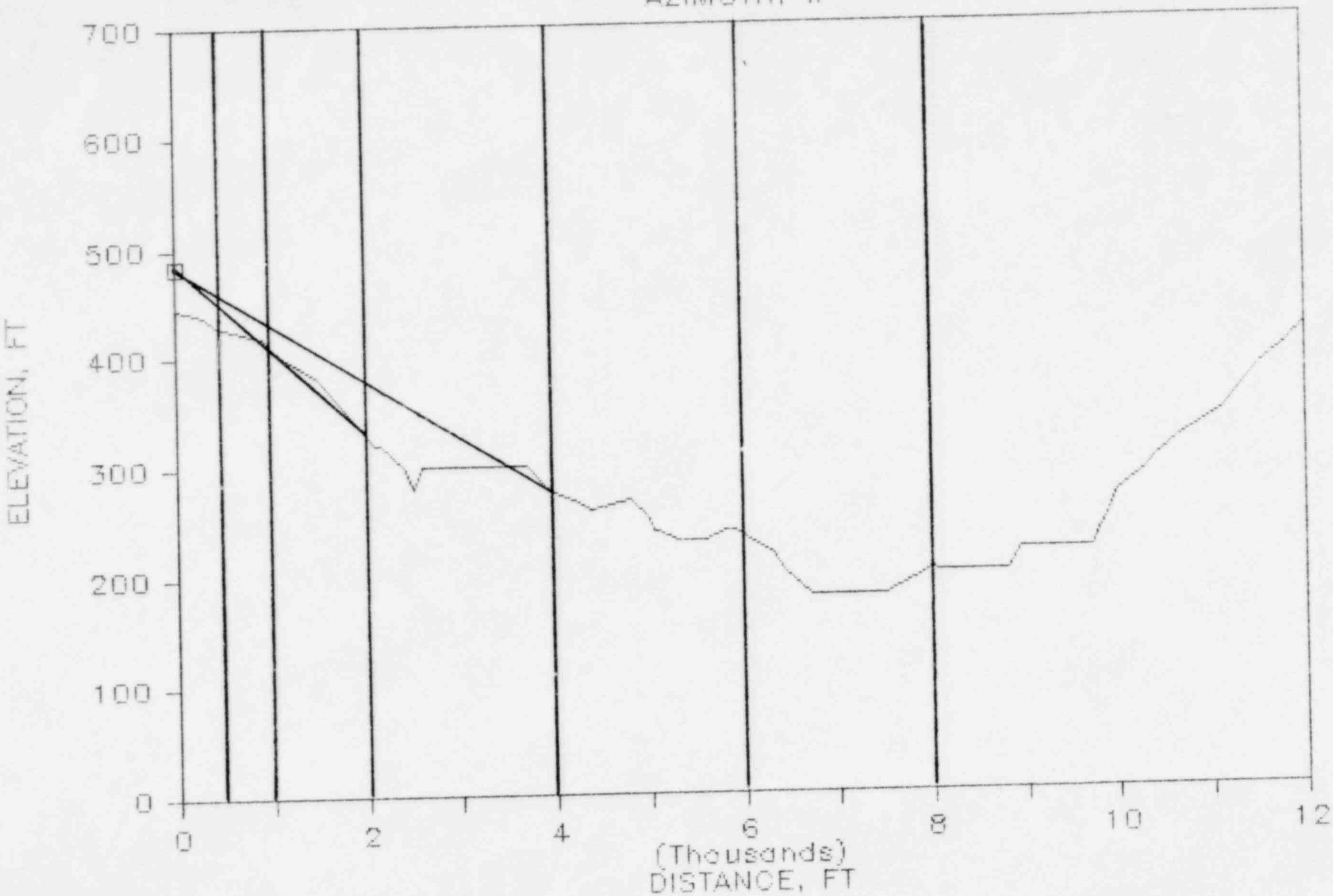
MILL MV6

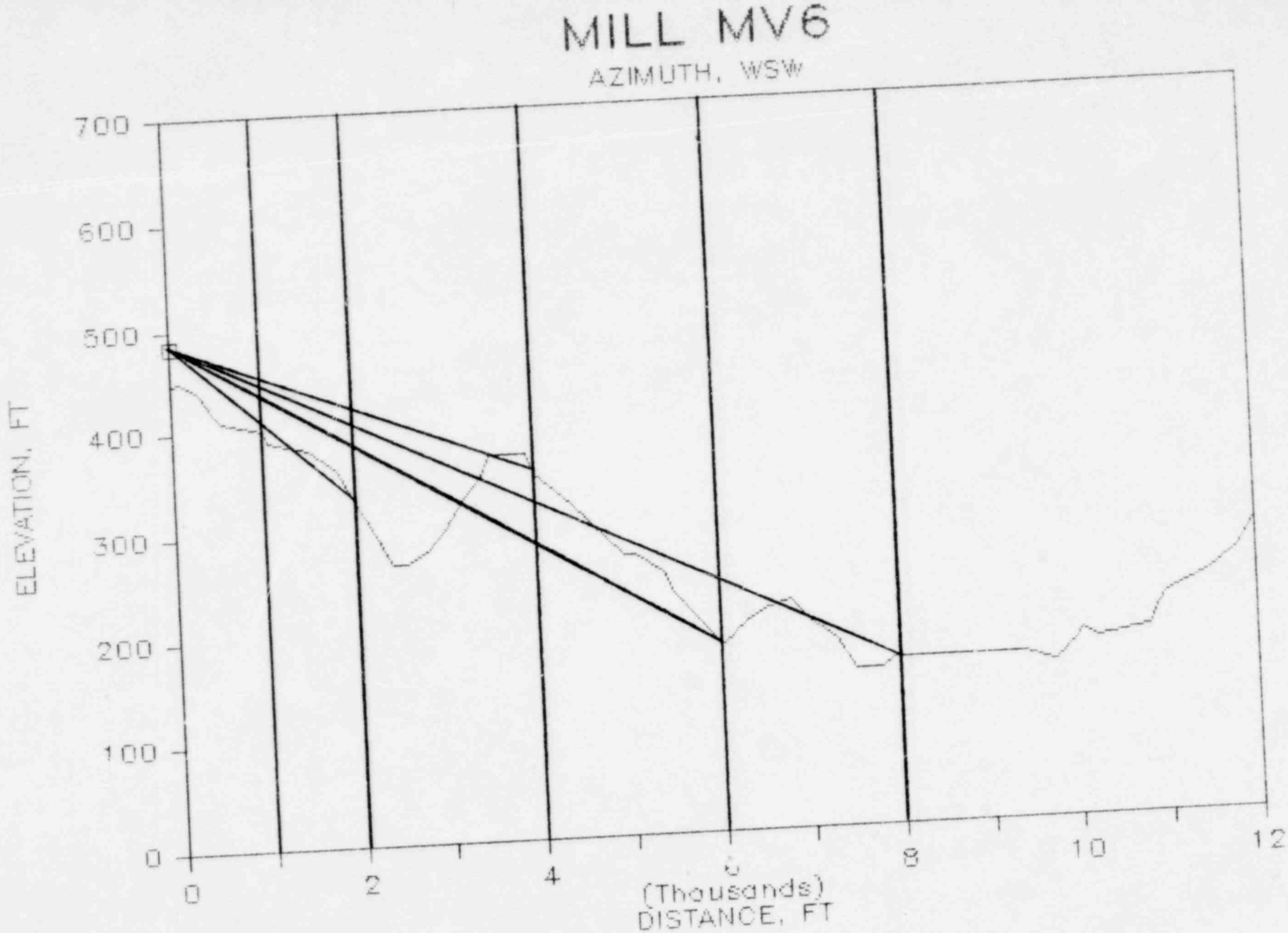
AZIMUTH, WNW



MILL MV6

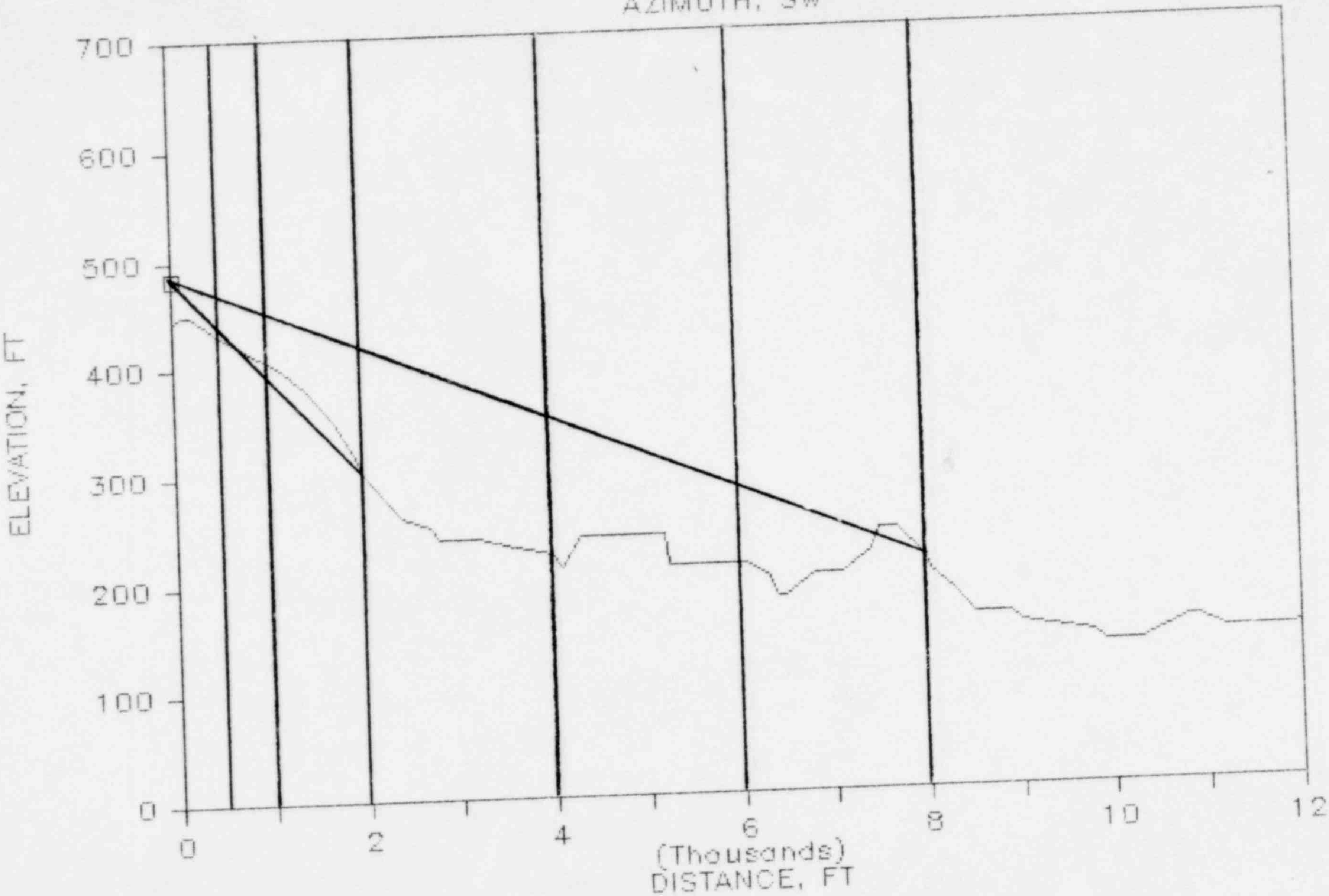
AZIMUTH, W

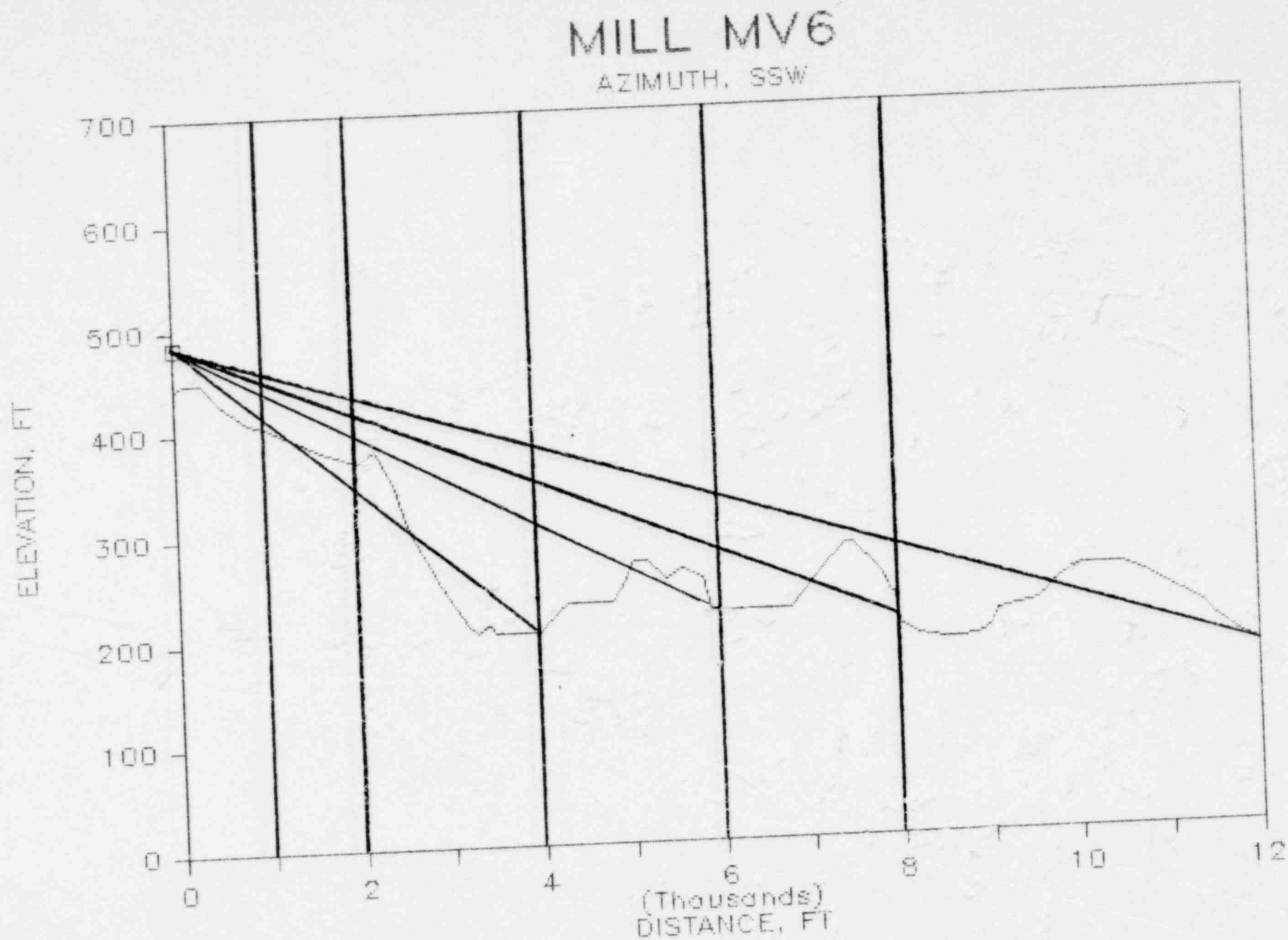


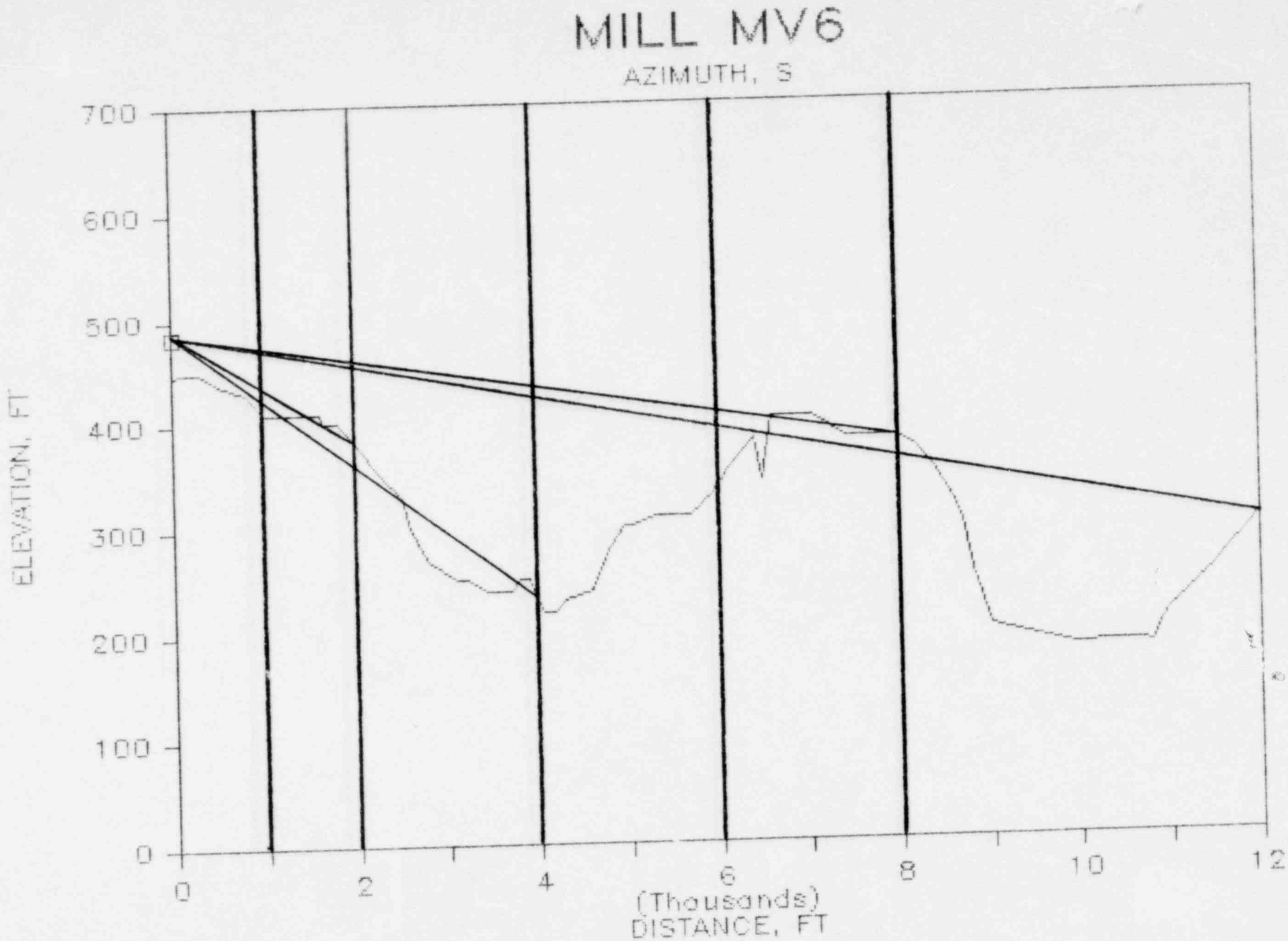

MILL MV6
AZIMUTH, WSW
700
600
500
400
300
200
100
0
ELEVATION, FT
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

MILL MV6

AZIMUTH, SW



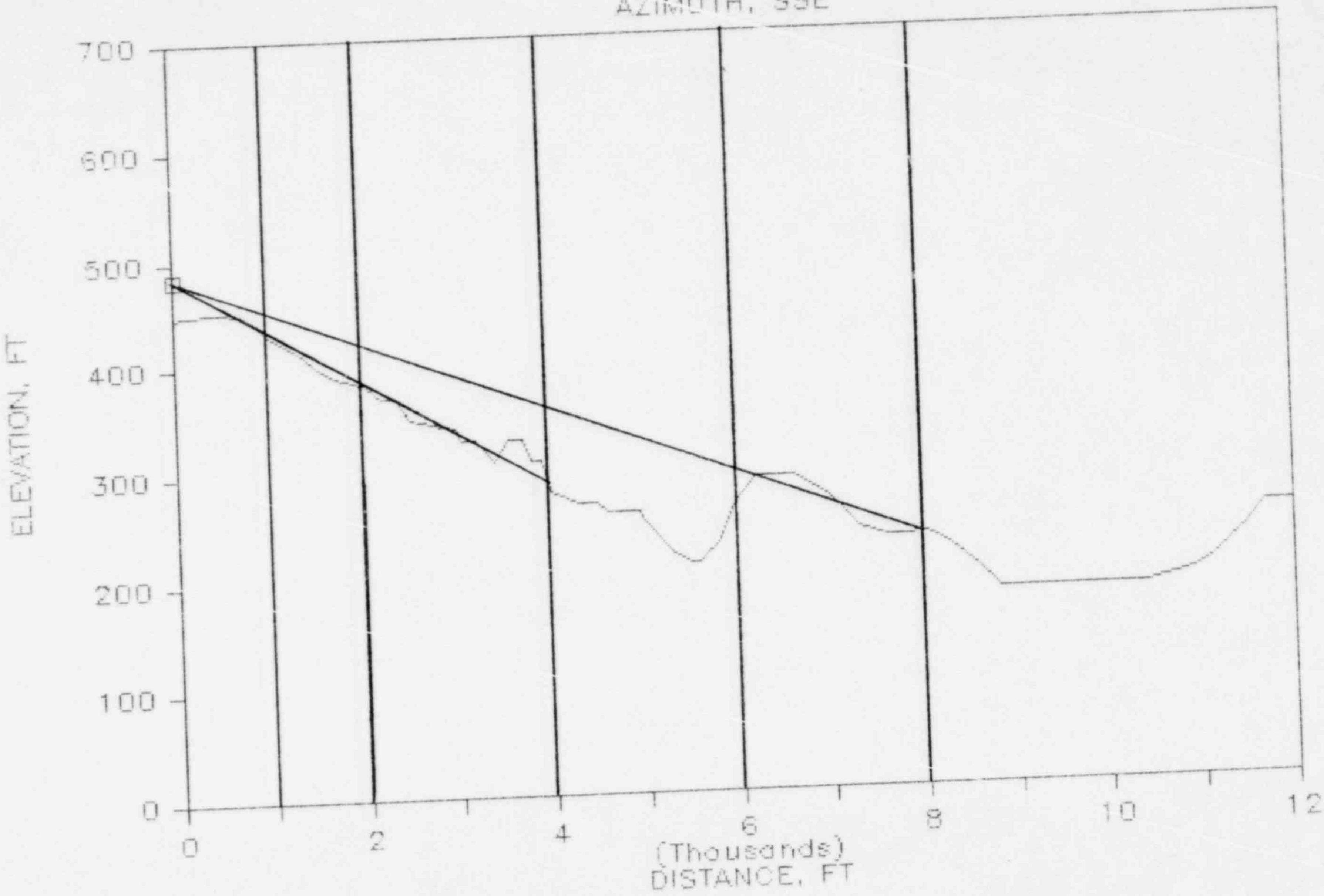

MILL MV6
AZIMUTH, SSW
700
600
500
400
300
200
100
0
ELEVATION, FT
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

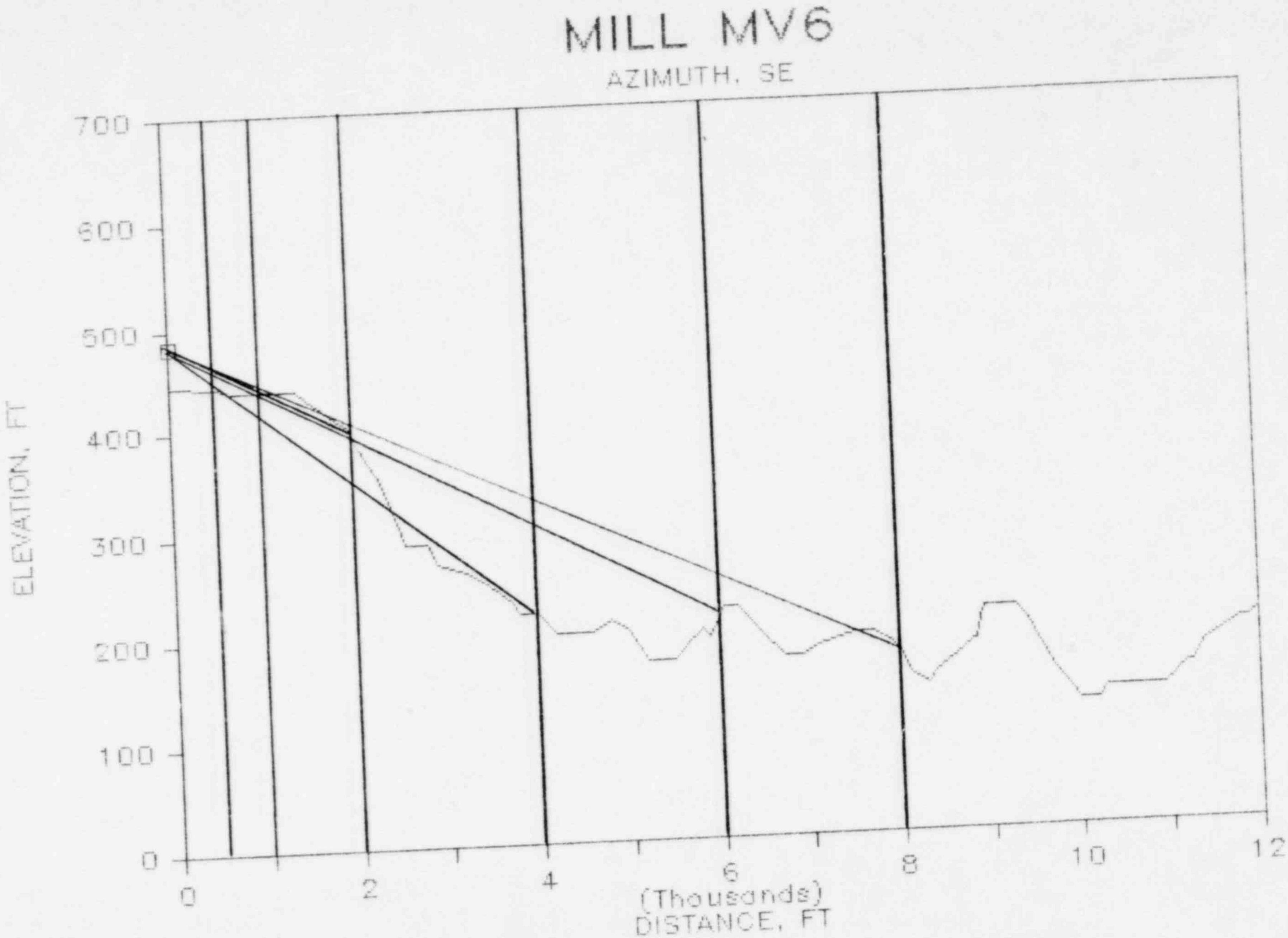


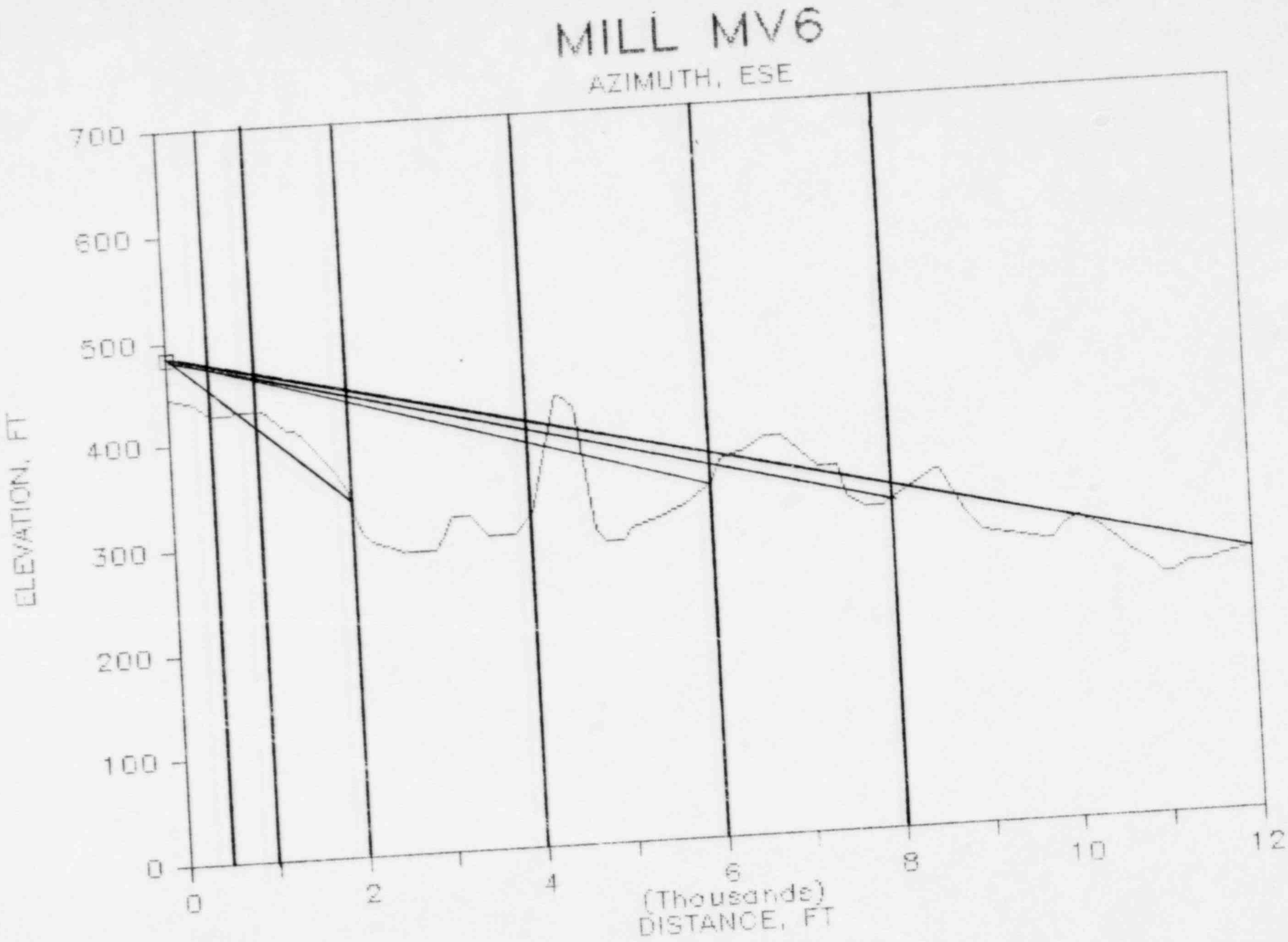
MILL MV6
AZIMUTH, S
700
600
500
400
300
200
100
0
ELEVATION, FT
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

MILL MV6

AZIMUTH, SSE




MILL MV6
AZIMUTH, SE
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT


MILL MV6
AZIMUTH, ESE
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

NORTHEAST UTILITIES
MILLSTONE ANS SIREN #MV6
SOURCE-RECEIVER TOPOGRAPHICAL INPUTS

ALL BEARINGS ARE WITH RESPECT TO THE NORTH MEASURING CLOCKWISE

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
1	500.	90.00	430.00	SOFT	0.	NO	0.	0.
2	1000.	90.00	398.00	SOFT	0.	YES	500.	430.
3	2000.	90.00	345.00	SOFT	0.	NO	0.	0.
4	4000.	90.00	350.00	SOFT	0.	NO	0.	0.
5	6000.	90.00	380.00	SOFT	0.	YES	5100.	452.
6	8000.	90.00	385.00	SOFT	0.	YES	5100.	452.
7	12000.	90.00	425.00	SOFT	0.	NO	0.	0.
8	500.	67.50	430.00	SOFT	0.	NO	0.	0.
9	1000.	67.50	385.00	SOFT	0.	NO	0.	0.
10	2000.	67.50	395.00	SOFT	0.	NO	0.	0.
11	4000.	67.50	405.00	SOFT	0.	NO	0.	0.
12	6000.	67.50	430.00	SOFT	0.	NO	0.	0.
13	8000.	67.50	368.00	SOFT	0.	YES	6500.	430.
14	12000.	67.50	290.00	SOFT	0.	YES	6500.	430.
15	500.	45.00	425.00	SOFT	0.	NO	0.	0.
16	1000.	45.00	420.00	SOFT	0.	NO	0.	0.
17	2000.	45.00	410.00	SOFT	0.	NO	0.	0.
18	4000.	45.00	470.00	SOFT	0.	YES	3050.	476.
19	6000.	45.00	445.00	SOFT	0.	YES	3050.	476.
20	8000.	45.00	460.00	SOFT	0.	NO	0.	0.
21	12000.	45.00	295.00	SOFT	0.	YES	8000.	460.
22	500.	22.50	415.00	SOFT	0.	NO	0.	0.
23	1000.	22.50	460.00	SOFT	0.	NO	0.	0.
24	2000.	22.50	430.00	SOFT	0.	YES	1600.	448.
25	4000.	22.50	489.00	SOFT	0.	YES	3000.	500.
26	6000.	22.50	481.00	SOFT	0.	YES	3000.	500.
27	8000.	22.50	489.00	SOFT	0.	YES	3000.	500.
28	12000.	22.50	385.00	SOFT	0.	YES	3000.	500.
29	500.	0.0	415.00	SOFT	0.	NO	0.	0.
30	1000.	0.0	410.00	SOFT	0.	NO	0.	0.
31	2000.	0.0	450.00	SOFT	0.	YES	1950.	456.
32	4000.	0.0	570.00	SOFT	0.	NO	0.	0.
33	6000.	0.0	515.00	SOFT	0.	YES	4000.	470.
34	8000.	0.0	520.00	SOFT	0.	YES	4000.	470.
35	12000.	0.0	430.00	SOFT	0.	YES	4000.	470.
36	500.	337.50	415.00	SOFT	0.	NO	0.	0.

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
37	1000.	337.50	397.00	SOFT	0.	NO	0.	0.
38	2000.	337.50	425.00	SOFT	0.	NO	0.	0.
39	4000.	337.50	528.00	SOFT	0.	NO	0.	0.
40	6000.	337.50	575.00	SOFT	0.	NO	0.	0.
41	8000.	337.50	590.00	SOFT	0.	YES	7550.	600.
42	12000.	337.50	500.00	SOFT	0.	YES	7550.	600.
43	500.	315.00	423.00	SOFT	0.	NO	0.	0.
44	1000.	315.00	413.00	SOFT	0.	NO	0.	0.
45	2000.	315.00	382.00	SOFT	0.	NO	0.	0.
46	4000.	315.00	455.00	SOFT	0.	NO	0.	0.
47	6000.	315.00	355.00	SOFT	0.	YES	4250.	456.
48	8000.	315.00	370.00	SOFT	0.	YES	4250.	456.
49	12000.	315.00	528.00	SOFT	0.	NO	0.	0.
50	500.	292.50	420.00	SOFT	0.	NO	0.	0.
51	1000.	292.50	415.00	SOFT	0.	NO	0.	0.
52	2000.	292.50	355.00	SOFT	0.	NO	0.	0.
53	4000.	292.50	350.00	SOFT	0.	YES	3550.	380.
54	6000.	292.50	225.00	SOFT	0.	YES	3550.	380.
55	8000.	292.50	220.00	SOFT	0.	YES	3550.	380.
56	12000.	292.50	495.00	SOFT	0.	YES	11700.	524.
57	500.	270.00	428.00	SOFT	0.	NO	0.	0.
58	1000.	270.00	410.00	SOFT	0.	NO	0.	0.
59	2000.	270.00	330.00	SOFT	0.	YES	1500.	380.
60	4000.	270.00	275.00	SOFT	0.	YES	3800.	300.
61	6000.	270.00	235.00	SOFT	0.	NO	0.	0.
62	8000.	270.00	205.00	SOFT	0.	NO	0.	0.
63	12000.	270.00	420.00	SOFT	0.	NO	0.	0.
64	500.	247.50	415.00	SOFT	0.	NO	0.	0.
65	1000.	247.50	400.00	SOFT	0.	NO	0.	0.
66	2000.	247.50	330.00	SOFT	0.	YES	1750.	370.
67	4000.	247.50	350.00	SOFT	0.	YES	3900.	372.
68	6000.	247.50	180.00	SOFT	0.	YES	3900.	372.
69	8000.	247.50	160.00	SOFT	0.	YES	3900.	372.
70	12000.	247.50	278.00	SOFT	0.	NO	0.	0.
71	500.	225.00	430.00	SOFT	0.	NO	0.	0.
72	1000.	225.00	405.00	SOFT	0.	NO	0.	0.

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
73	2000.	225.00	300.00	SOFT	0.	YES	1400.	380.
74	4000.	225.00	225.00	SOFT	0.	NO	0.	0.
75	6000.	225.00	212.00	SOFT	0.	NO	0.	0.
76	8000.	225.00	210.00	SOFT	0.	YES	7750.	240.
77	12000.	225.00	143.00	SOFT	0.	NO	0.	0.
78	500.	202.50	430.00	SOFT	0.	NO	0.	0.
79	1000.	202.50	405.00	SOFT	0.	NO	0.	0.
80	2000.	202.50	370.00	SOFT	0.	NO	0.	0.
81	4000.	202.50	204.00	SOFT	0.	YES	2200.	380.
82	6000.	202.50	220.00	SOFT	0.	YES	5850.	252.
83	8000.	202.50	200.00	SOFT	0.	YES	7550.	276.
84	12000.	202.50	173.00	SOFT	0.	YES	10500.	252.
85	500.	180.00	440.00	SOFT	0.	NO	0.	0.
86	1000.	180.00	410.00	SOFT	0.	NO	0.	0.
87	2000.	180.00	380.00	SOFT	0.	YES	1600.	410.
88	4000.	180.00	230.00	SOFT	0.	YES	1600.	410.
89	6000.	180.00	338.00	SOFT	0.	NO	0.	0.
90	8000.	180.00	380.00	SOFT	0.	YES	6450.	404.
91	12000.	180.00	300.00	SOFT	0.	YES	6450.	404.
92	500.	157.50	453.00	SOFT	0.	NO	0.	0.
93	1000.	157.50	430.00	SOFT	0.	NO	0.	0.
94	2000.	157.50	383.00	SOFT	0.	NO	0.	0.
95	4000.	157.50	280.00	SOFT	0.	YES	3750.	324.
96	6000.	157.50	270.00	SOFT	0.	NO	0.	0.
97	8000.	157.50	233.00	SOFT	0.	YES	6400.	292.
98	12000.	157.50	250.00	SOFT	0.	NO	0.	0.
99	500.	135.00	443.00	SOFT	0.	NO	0.	0.
100	1000.	135.00	440.00	SOFT	0.	NO	0.	0.
101	2000.	135.00	370.00	SOFT	0.	YES	1450.	440.
102	4000.	135.00	220.00	SOFT	0.	YES	1450.	440.
103	6000.	135.00	210.00	SOFT	0.	YES	1450.	440.
104	8000.	135.00	170.00	SOFT	0.	YES	7750.	188.
105	12000.	135.00	200.00	SOFT	0.	NO	0.	0.
106	500.	112.50	428.00	SOFT	0.	NO	0.	0.
107	1000.	112.50	430.00	SOFT	0.	NO	0.	0.
108	2000.	112.50	330.00	SOFT	0.	YES	1400.	408.
109	4000.	112.50	320.00	SOFT	0.	NO	0.	0.
110	6000.	112.50	340.00	SOFT	0.	YES	4400.	424.
111	8000.	112.50	315.00	SOFT	0.	YES	4400.	424.
112	12000.	112.50	250.00	SOFT	0.	YES	4400.	424.

NORTHEAST UTILITIES
MILLSTONE ANS SIREN #MV6
NOISE SOURCE POWER LEVEL INPUT

INDEX	SOURCE	DBA	DBC	31.5	63	125	250	500	1000	2000	4000	8000 (HZ)
1	SIREN MV6-WS2000	152.9	152.6	0.0	0.0	0.0	0.0	0.0	152.0	143.0	138.0	126.0

XO= 0.0 YO= 0.0 ZO= 529.00 HEIGHT ABOVE GROUND= 9.00

NORTHEAST UTILITIES
MILLSTONE ANS SIREN #MV6
METEOROLOGICAL INPUT CONDITIONS

H1= 10.06 METERS H2= 43.28 METERS

YEAR	SEASON	MONTH	DATE	HOUR	WIND DIRECTION	WIND SPEED(MPS) H1	WIND SPEED(MPS) H2	TEMPERATURE(C) H1	TEMPERATURE(C) H2	RELATIVE HUMIDITY	BAROMETRIC PRESSURE(MM OF HG)
1983	S	7	1	12	245.0	3.8	5.1	21.9	21.3	42.0	764.0

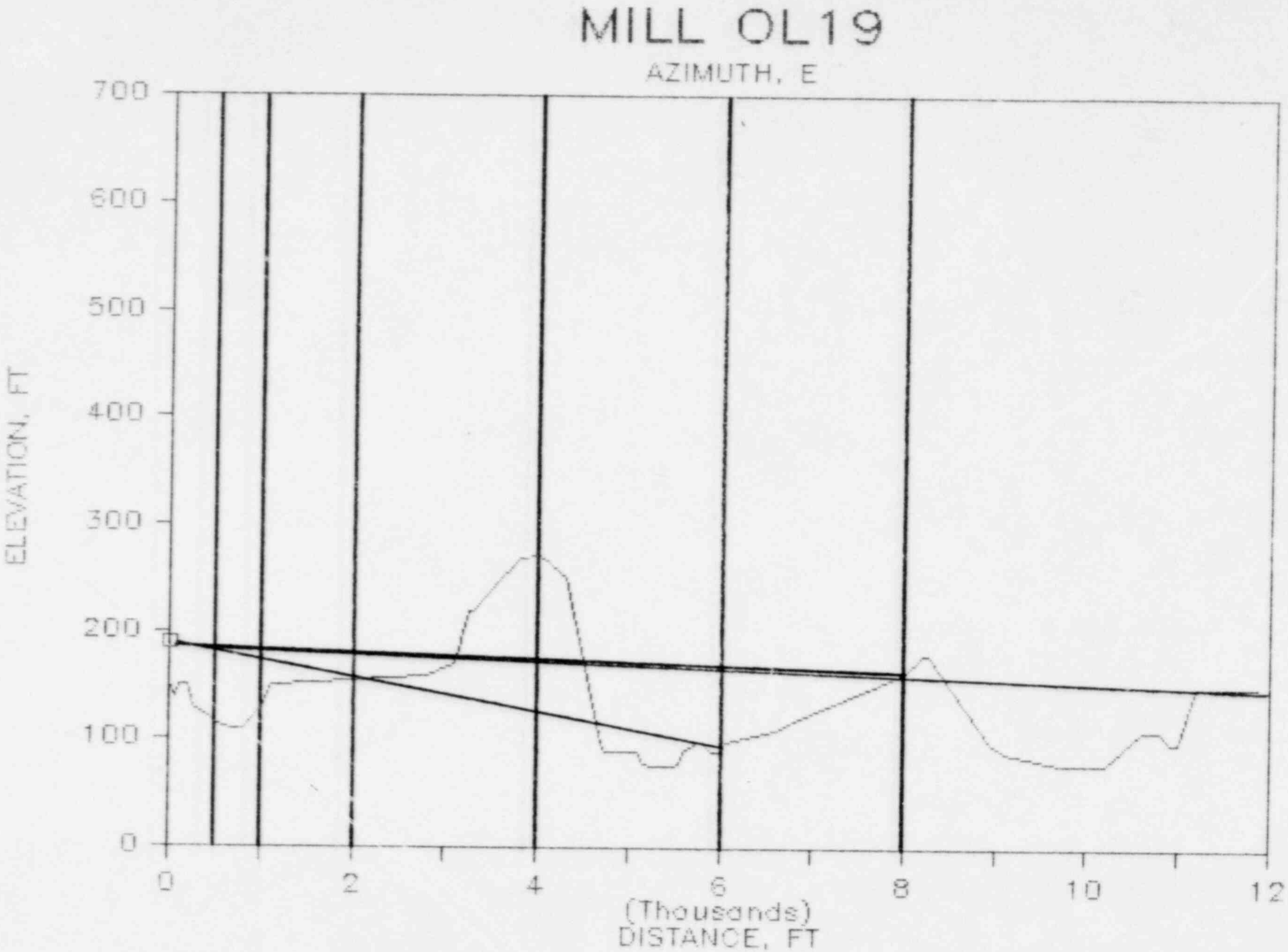
NORTHEAST UTILITIES
MILLSTONE ANS SIREN #MV6

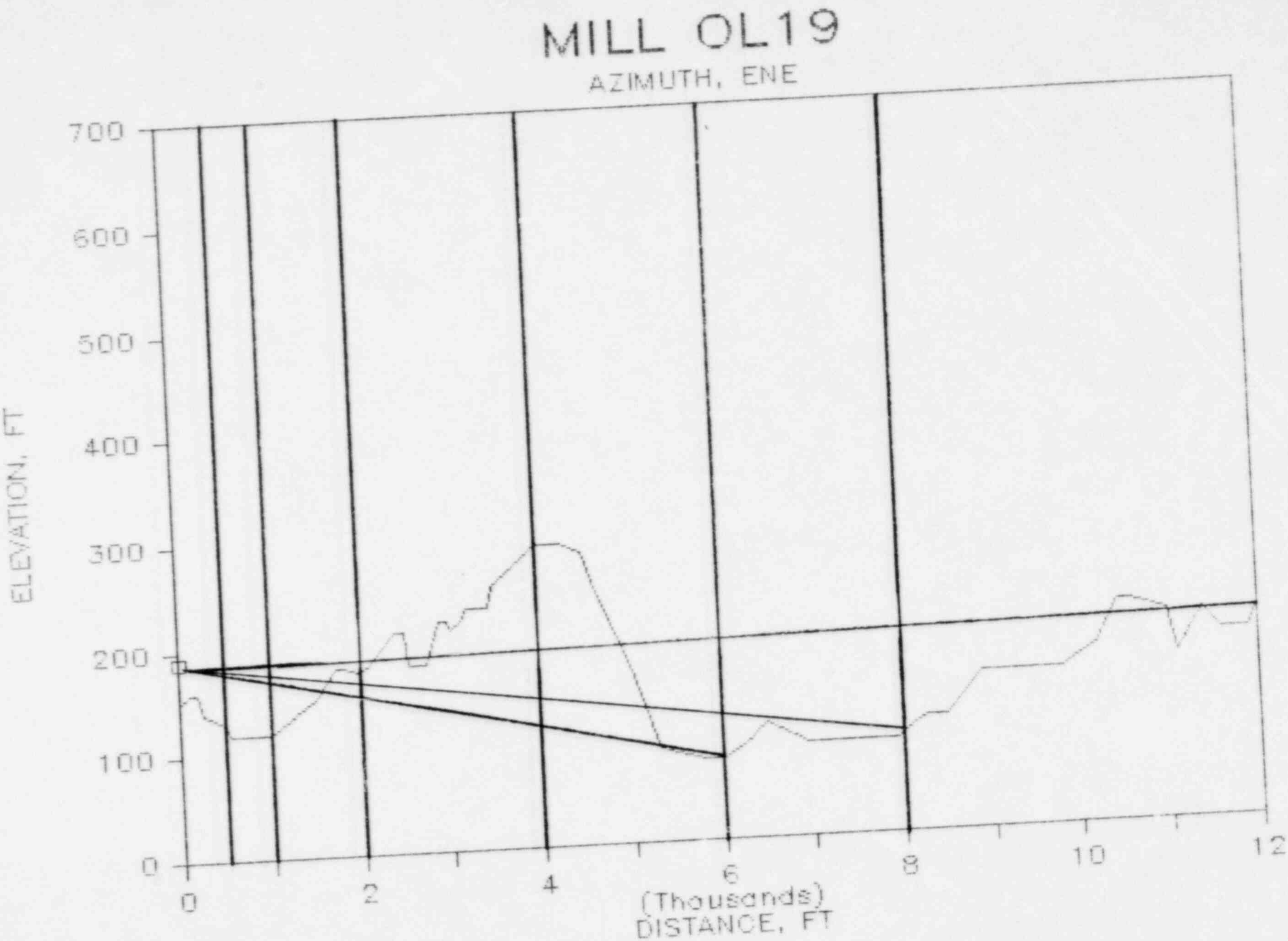
SIREN SOUND LEVELS IN DBC

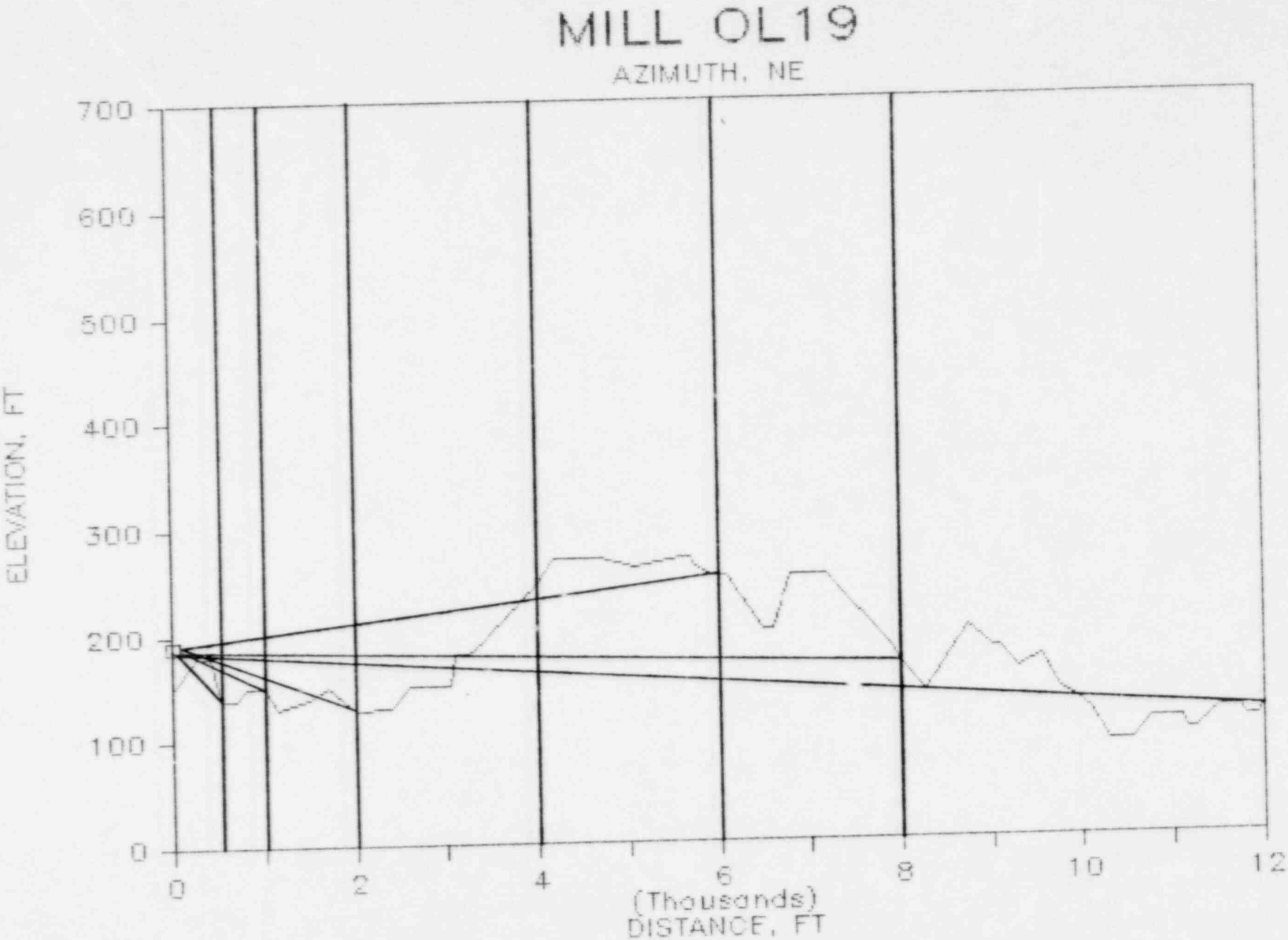
UNDER MET CONDITION 1

DISTANCE IN FEET

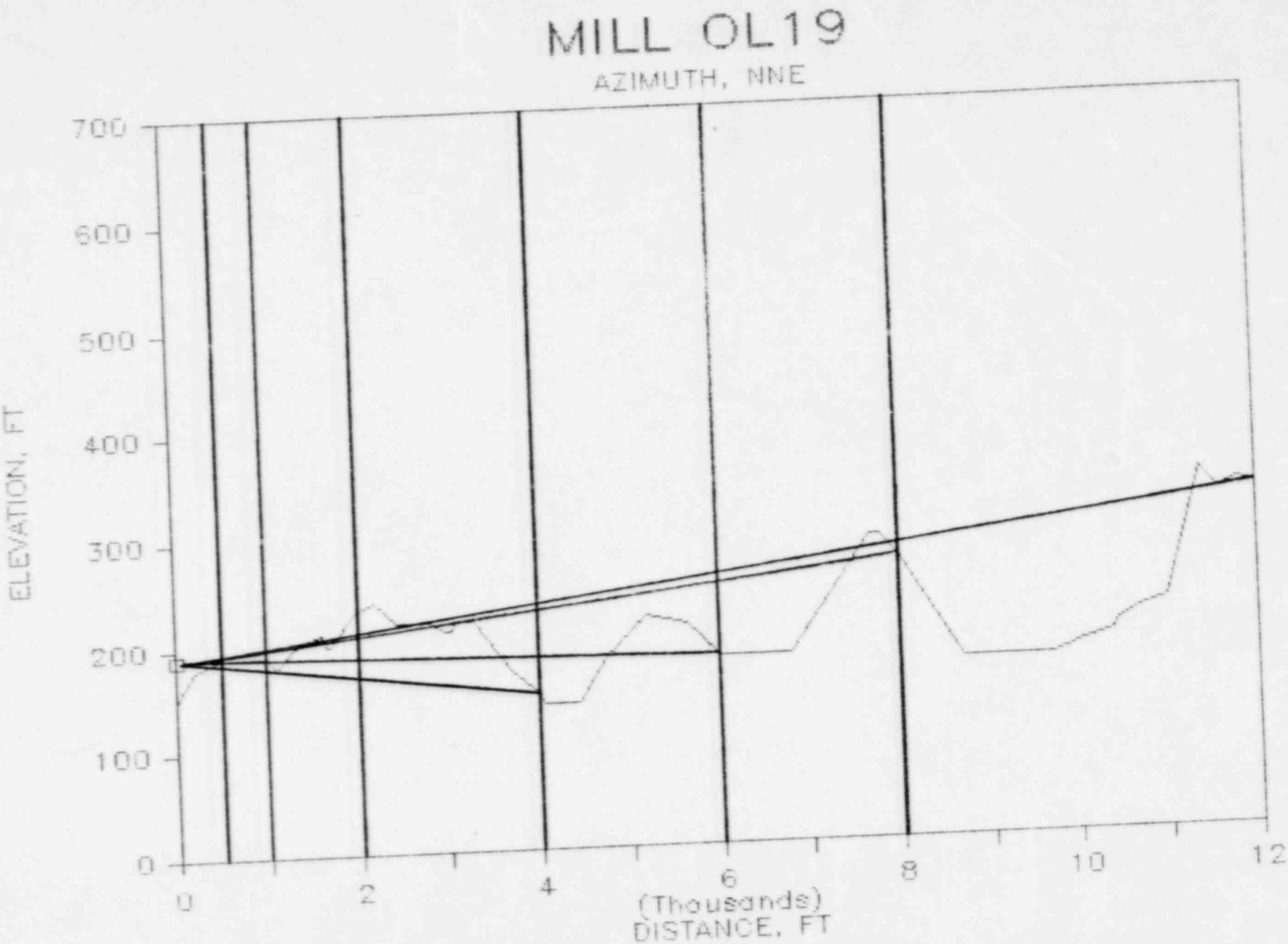
AZIMUTH	500.	1000.	2000.	4000.	6000.	8000.	12000.
E	100.	77.	82.	65.	40.	41.	33.
ENE	100.	93.	81.	65.	55.	37.	26.
NE	100.	93.	80.	59.	50.	47.	19.
NNE	100.	93.	75.	60.	50.	41.	28.
N	100.	93.	71.	65.	42.	35.	26.
NNW	100.	93.	80.	65.	55.	39.	19.
NW	100.	87.	66.	45.	22.	22.	13.
WNW	100.	93.	78.	44.	27.	22.	0.
W	100.	93.	74.	38.	36.	27.	13.
WSW	100.	91.	59.	30.	21.	21.	13.
SW	100.	93.	65.	47.	36.	15.	13.
SSW	100.	93.	81.	54.	32.	16.	4.
S	100.	89.	67.	42.	35.	22.	13.
SSE	100.	93.	81.	51.	55.	47.	33.
SE	100.	93.	73.	58.	50.	41.	33.
ESE	100.	93.	72.	66.	45.	42.	28.


MILL OL19
AZIMUTH, E
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

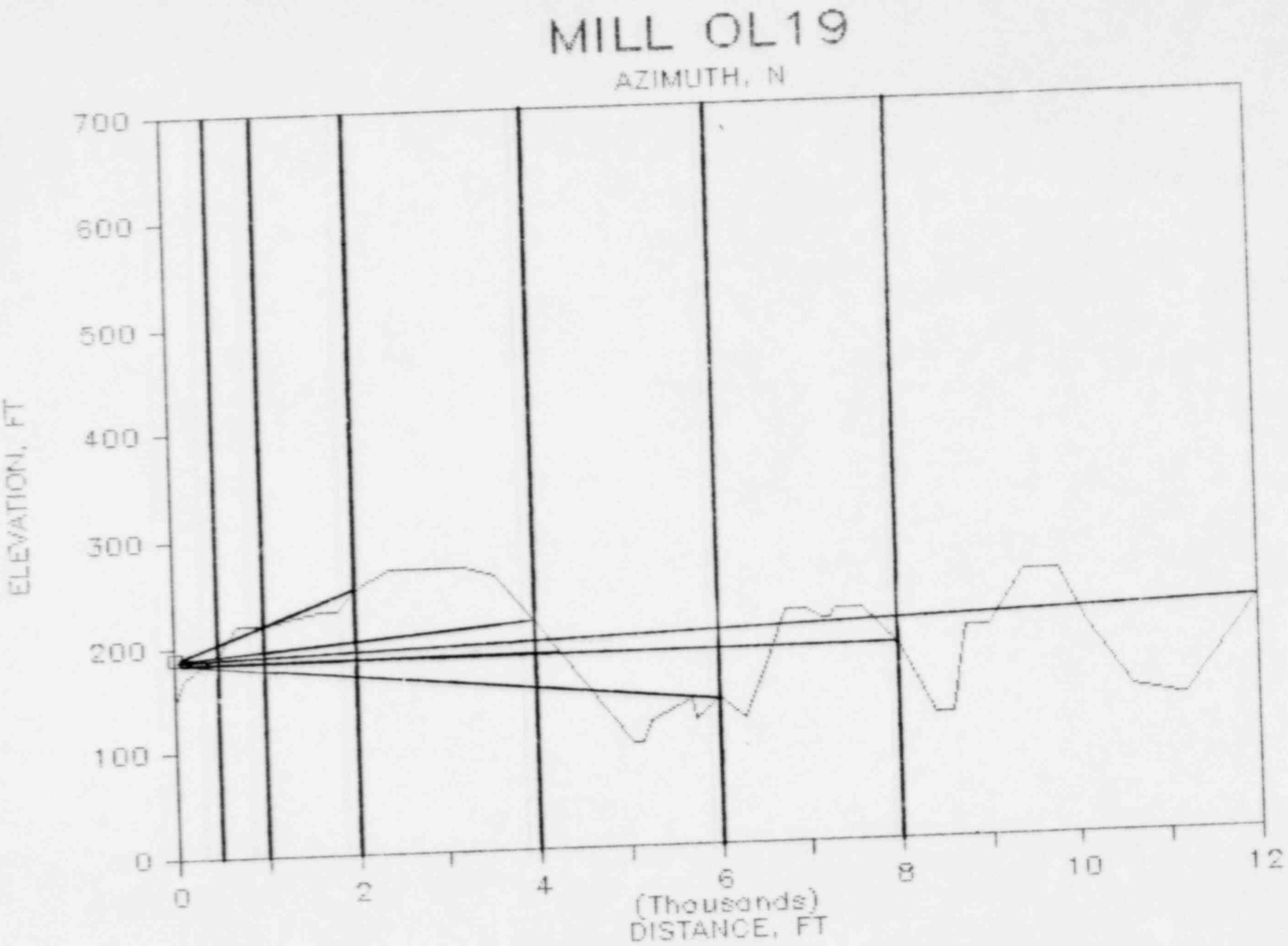

MILL OL19
AZIMUTH, ENE
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT



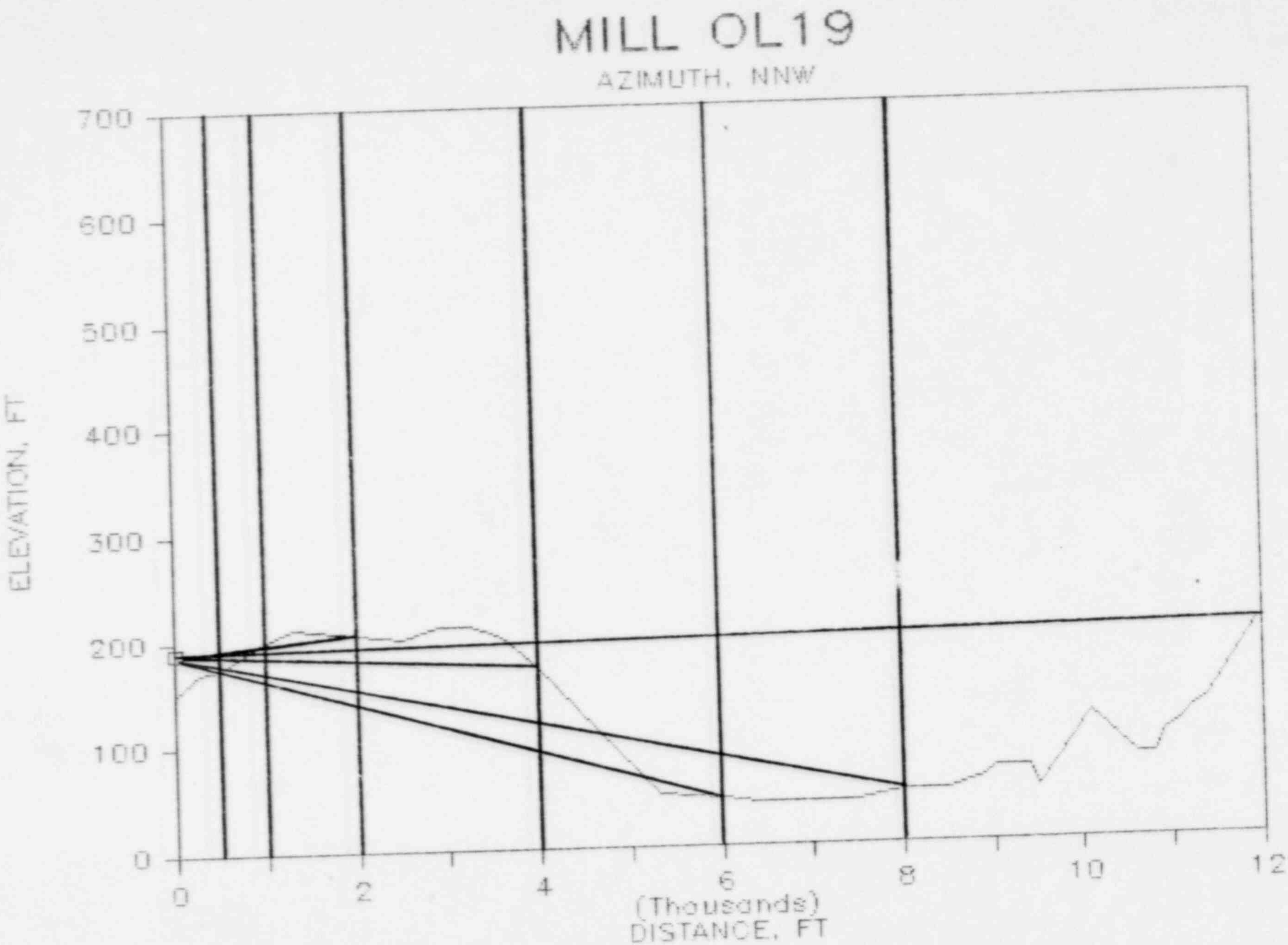
MILL OL19
AZIMUTH, NE
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT



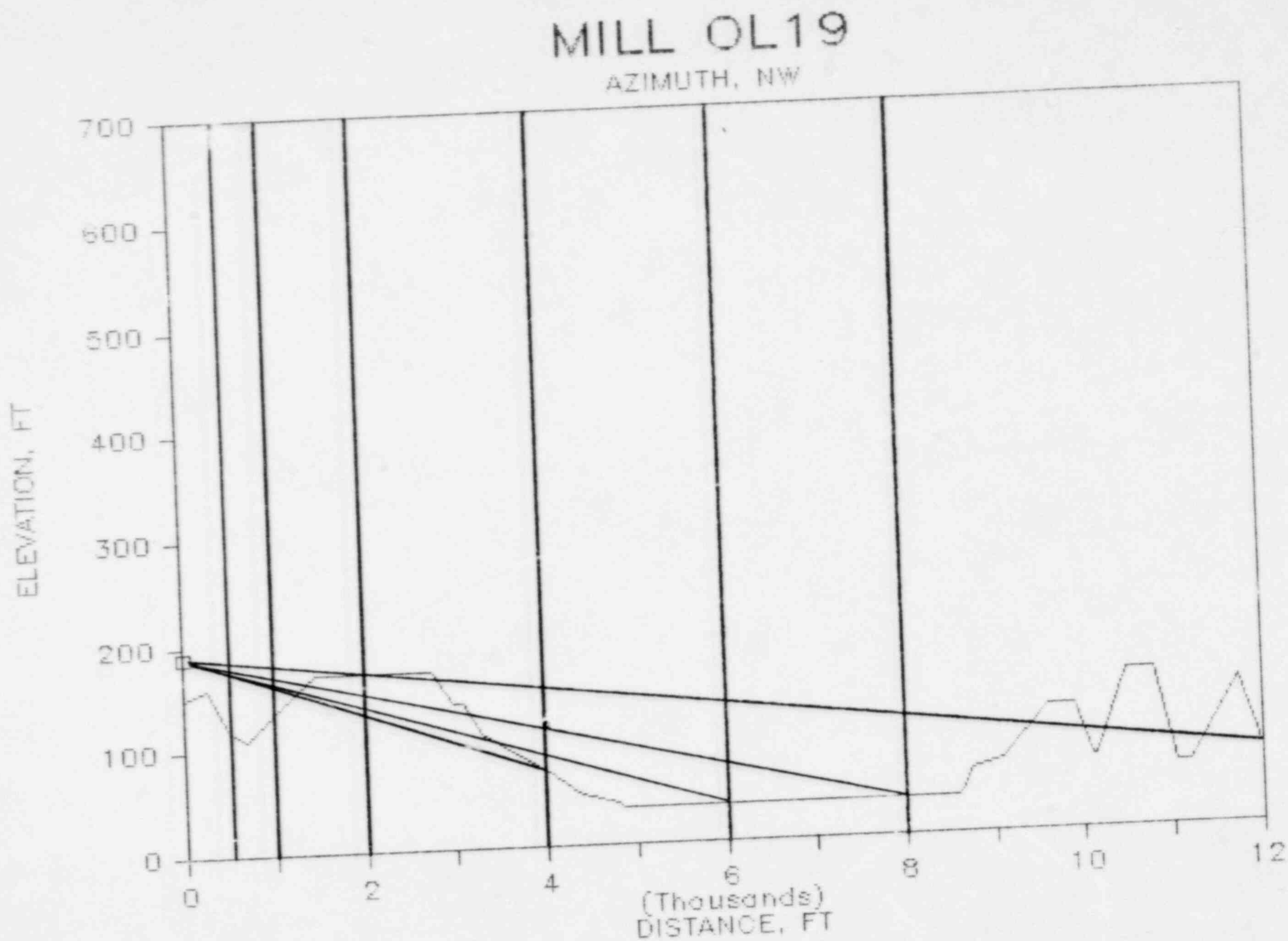
MILL OL19
AZIMUTH, NNE
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT



MILL OL19
AZIMUTH, N
700
600
500
400
300
200
100
0
ELEVATION, FT
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

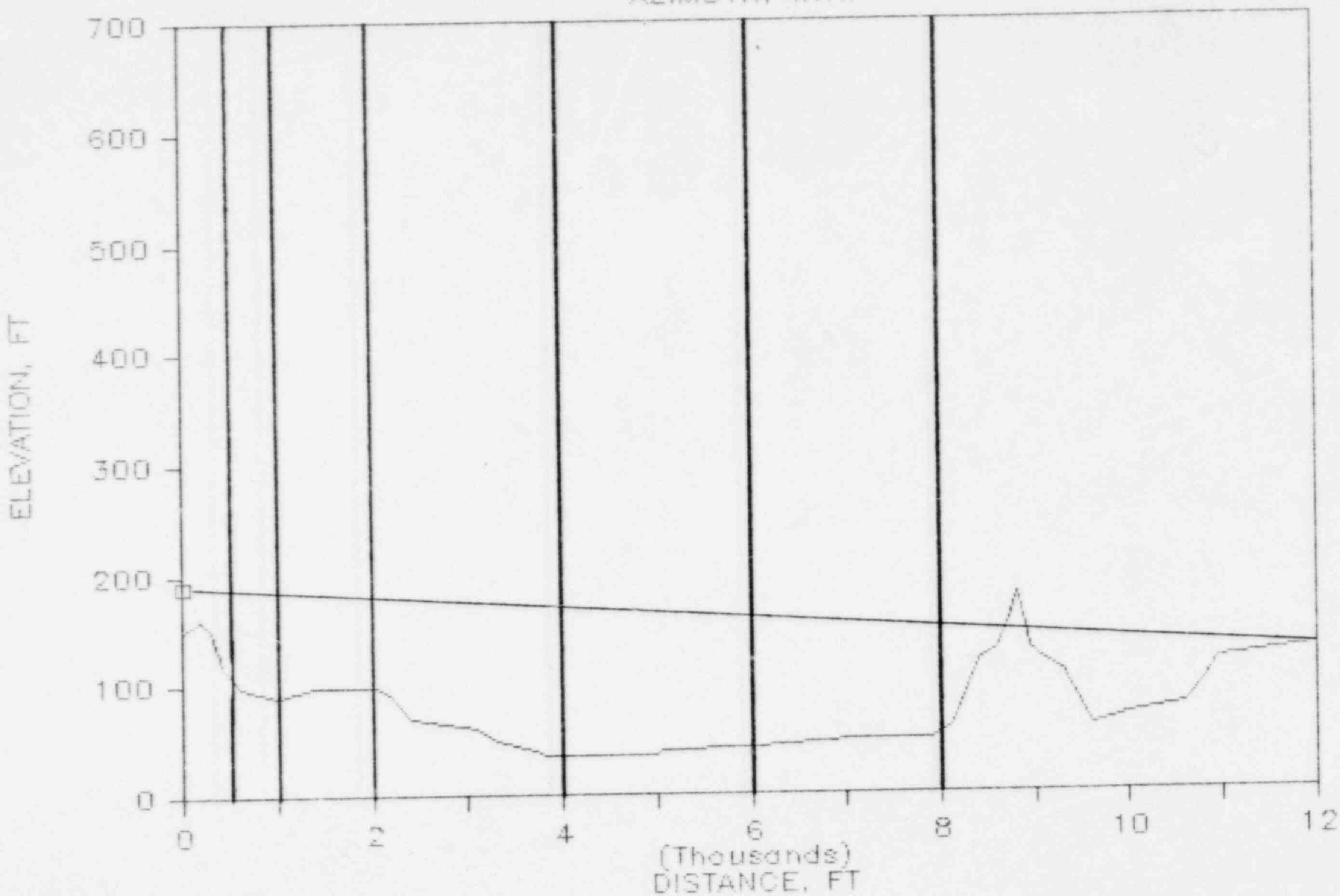


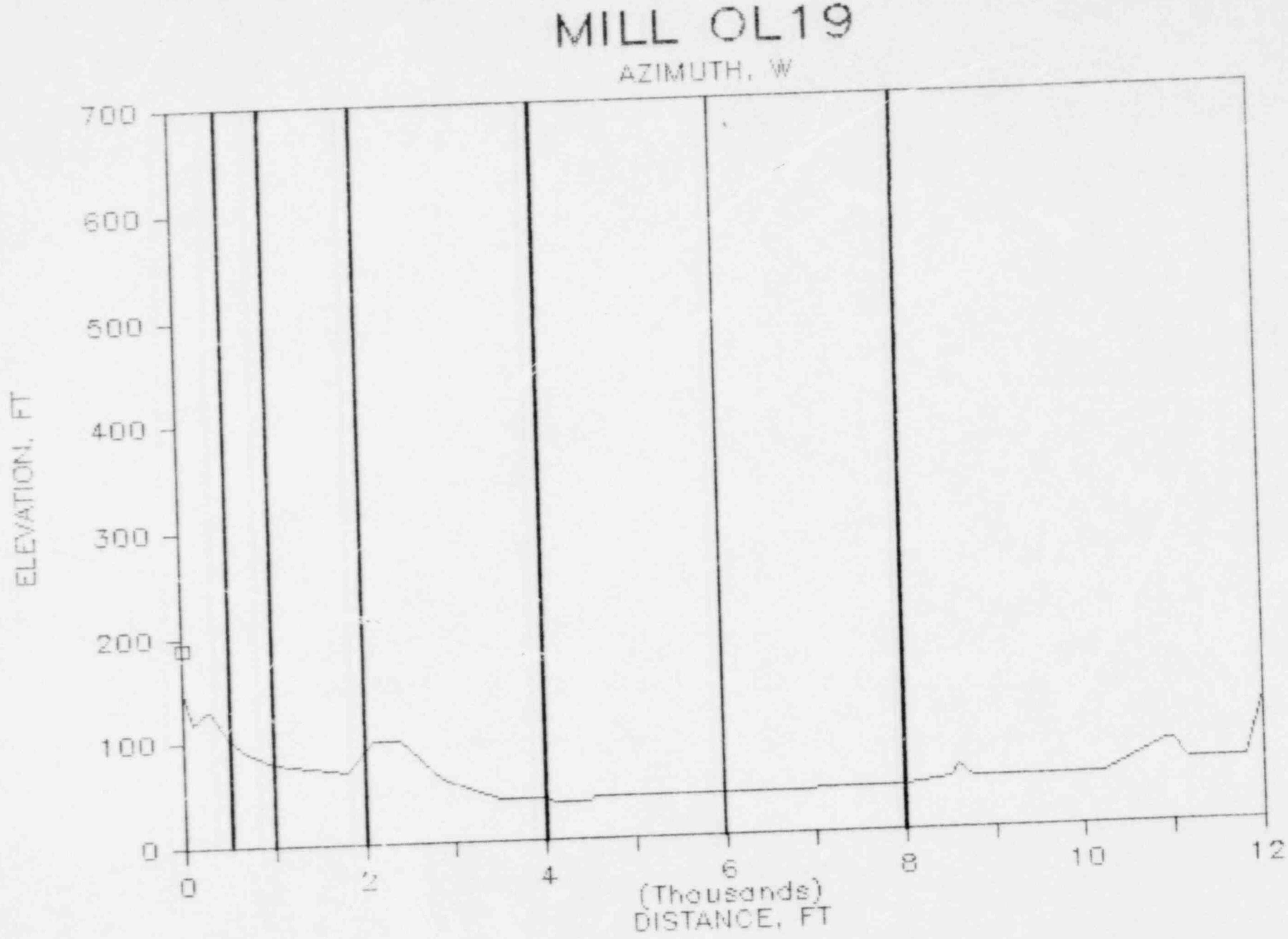
MILL OL19
AZIMUTH, NNW
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT


MILL OL19
AZIMUTH, NW
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

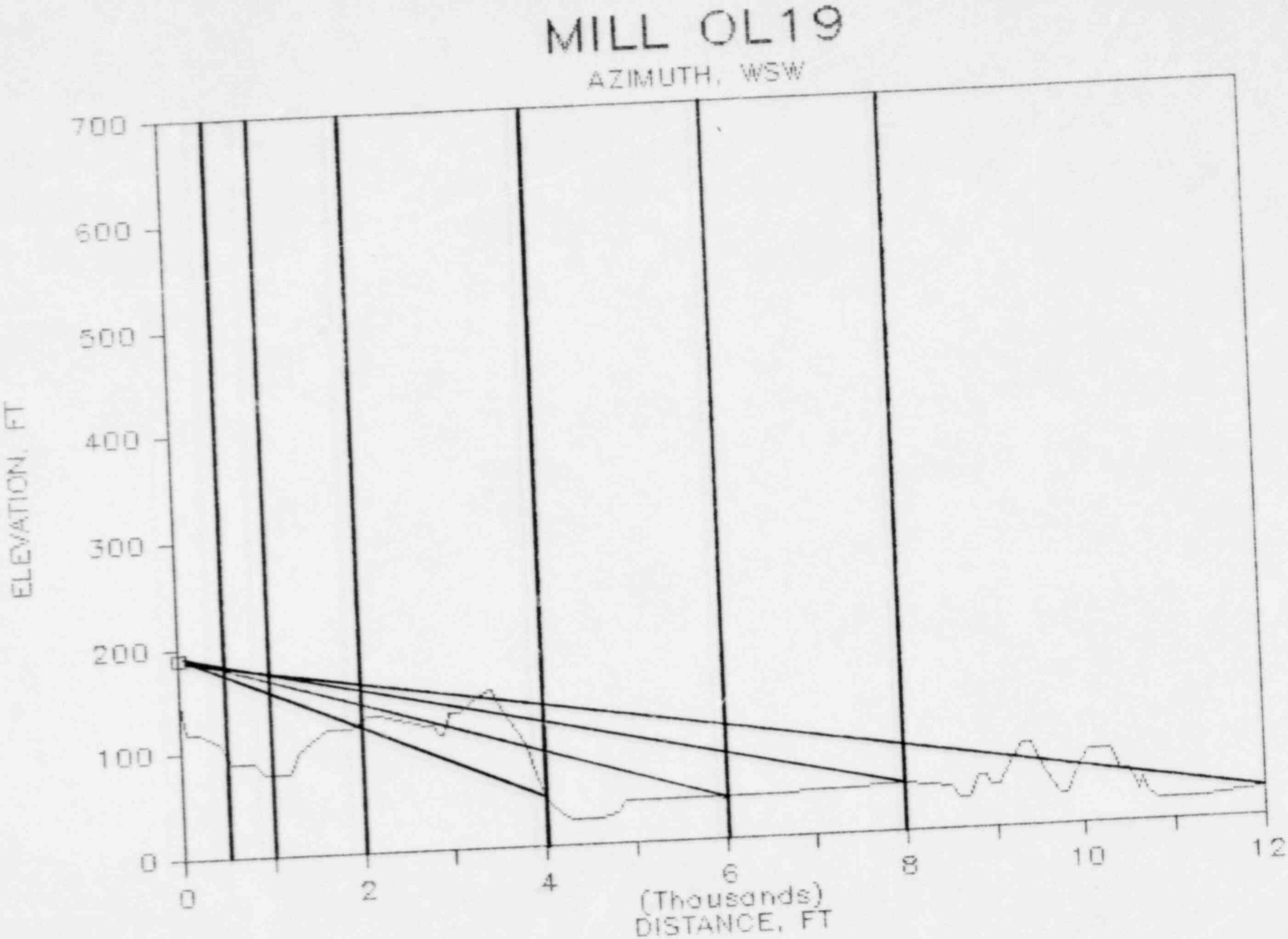
MILL OL19

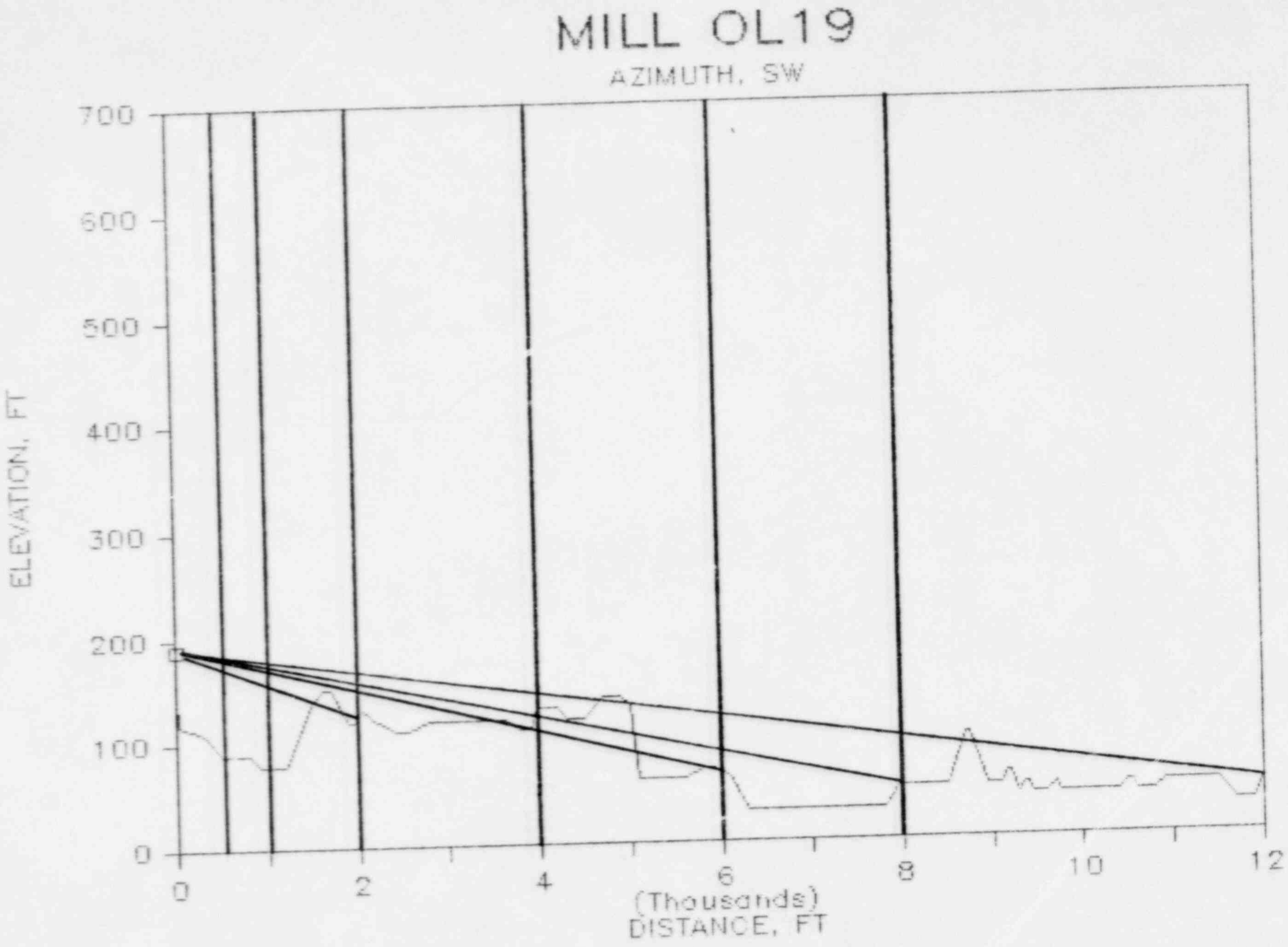
AZIMUTH, WNW

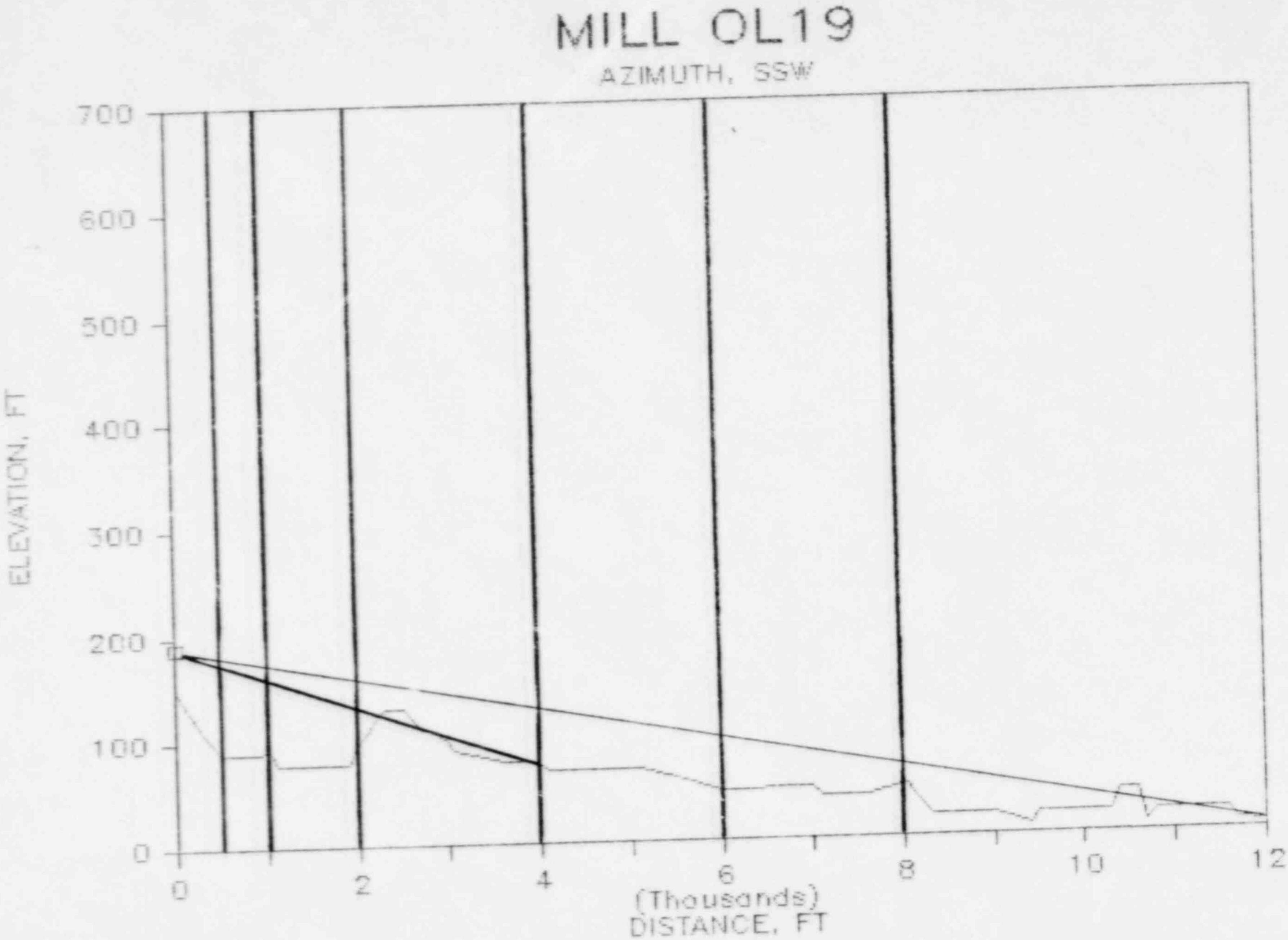




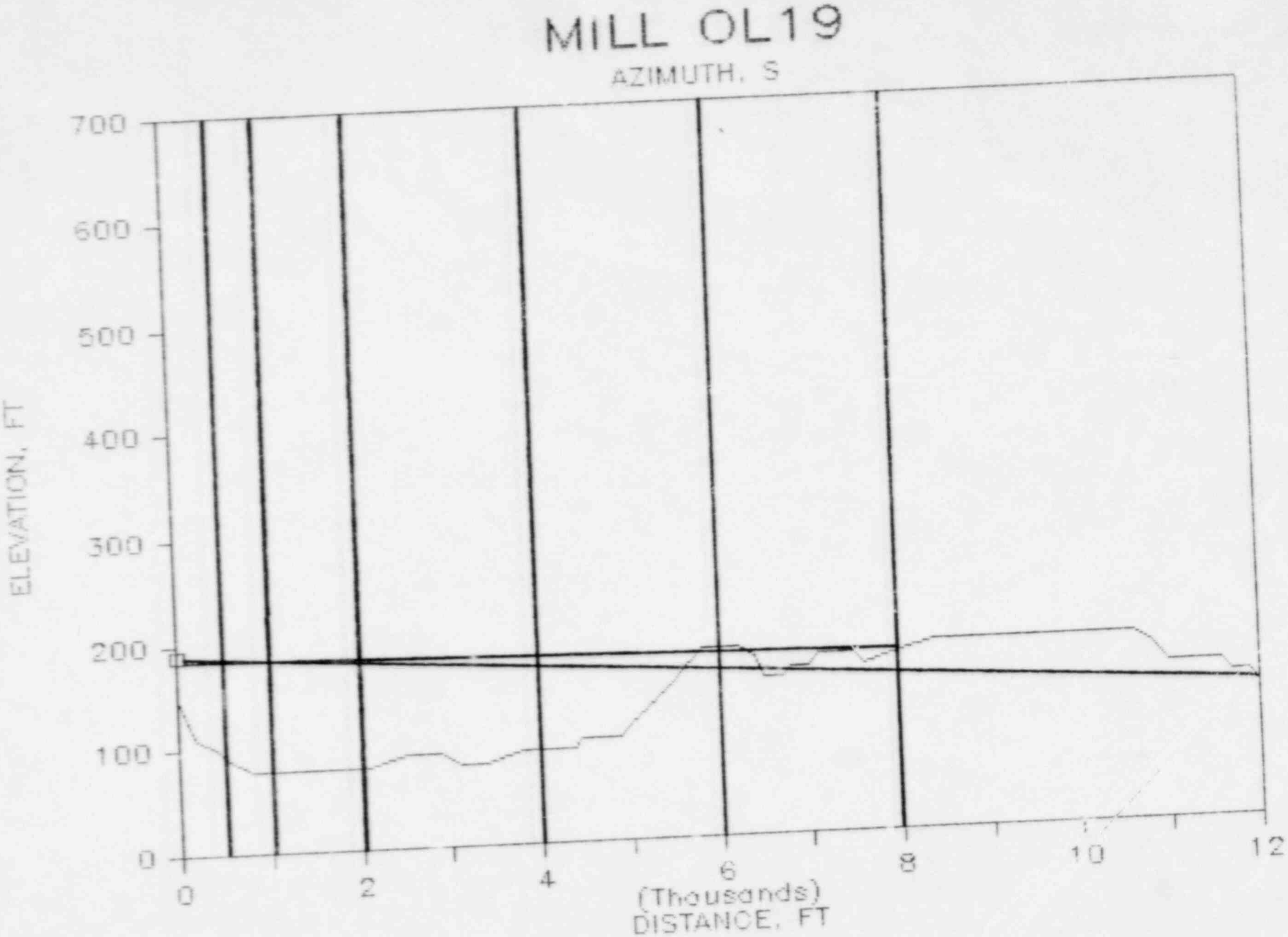
MILL OL19
AZIMUTH, W
700
600
500
400
300
200
100
0
ELEVATION, FT
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT


MILL OL19
AZIMUTH, WSW
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

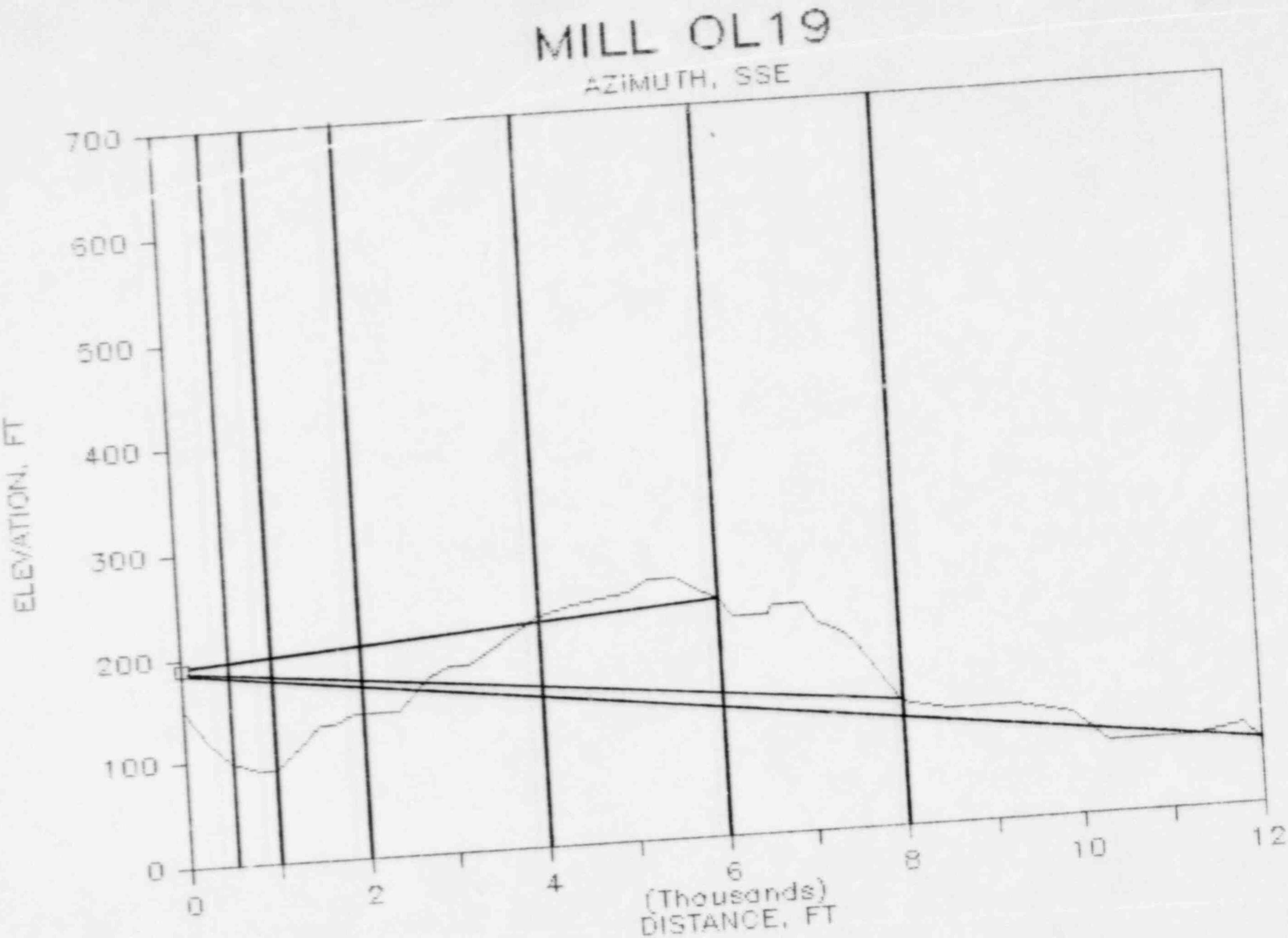

MILL OL19
AZIMUTH, SW
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

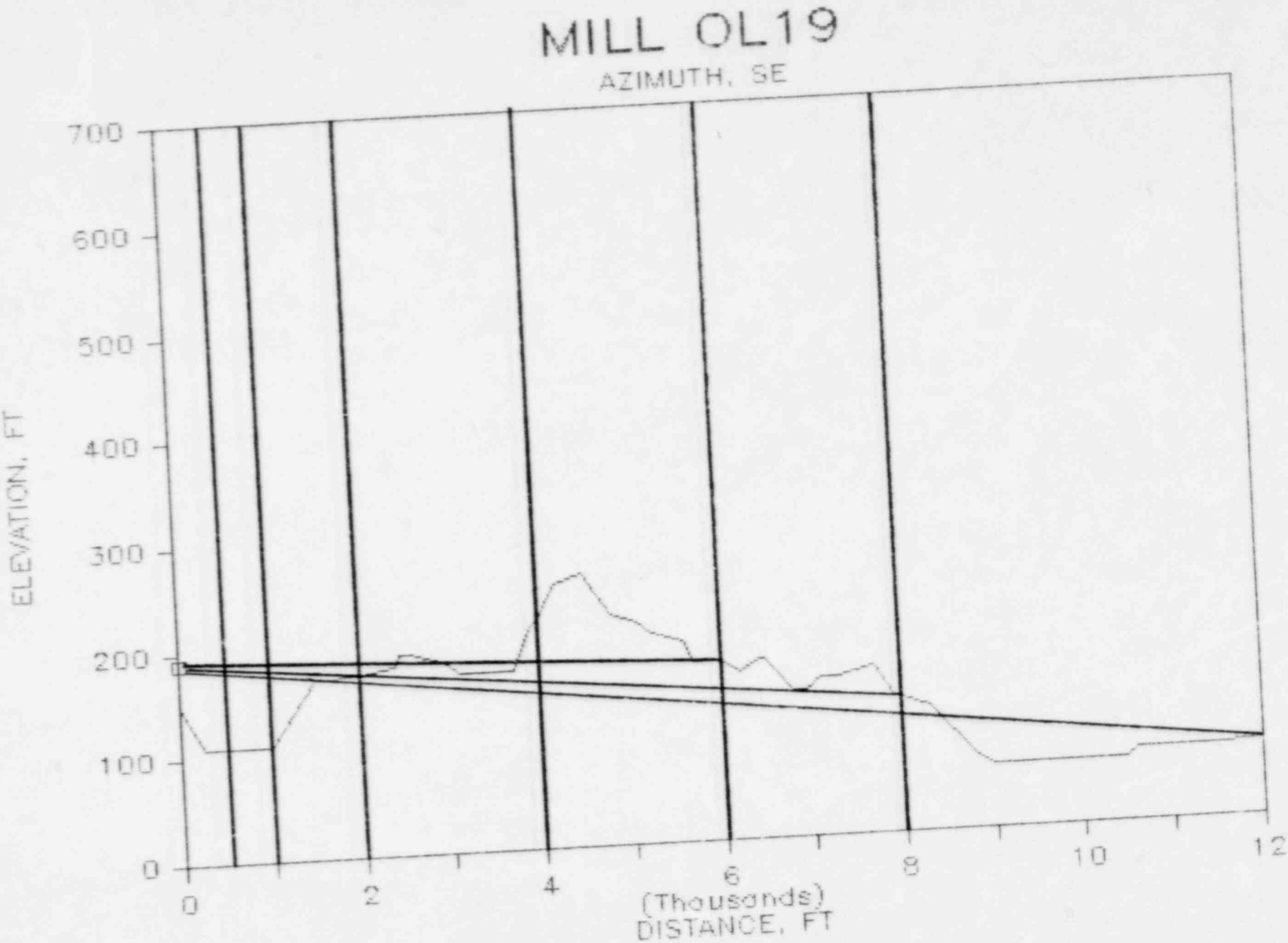


MILL OL19
AZIMUTH, SSW
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

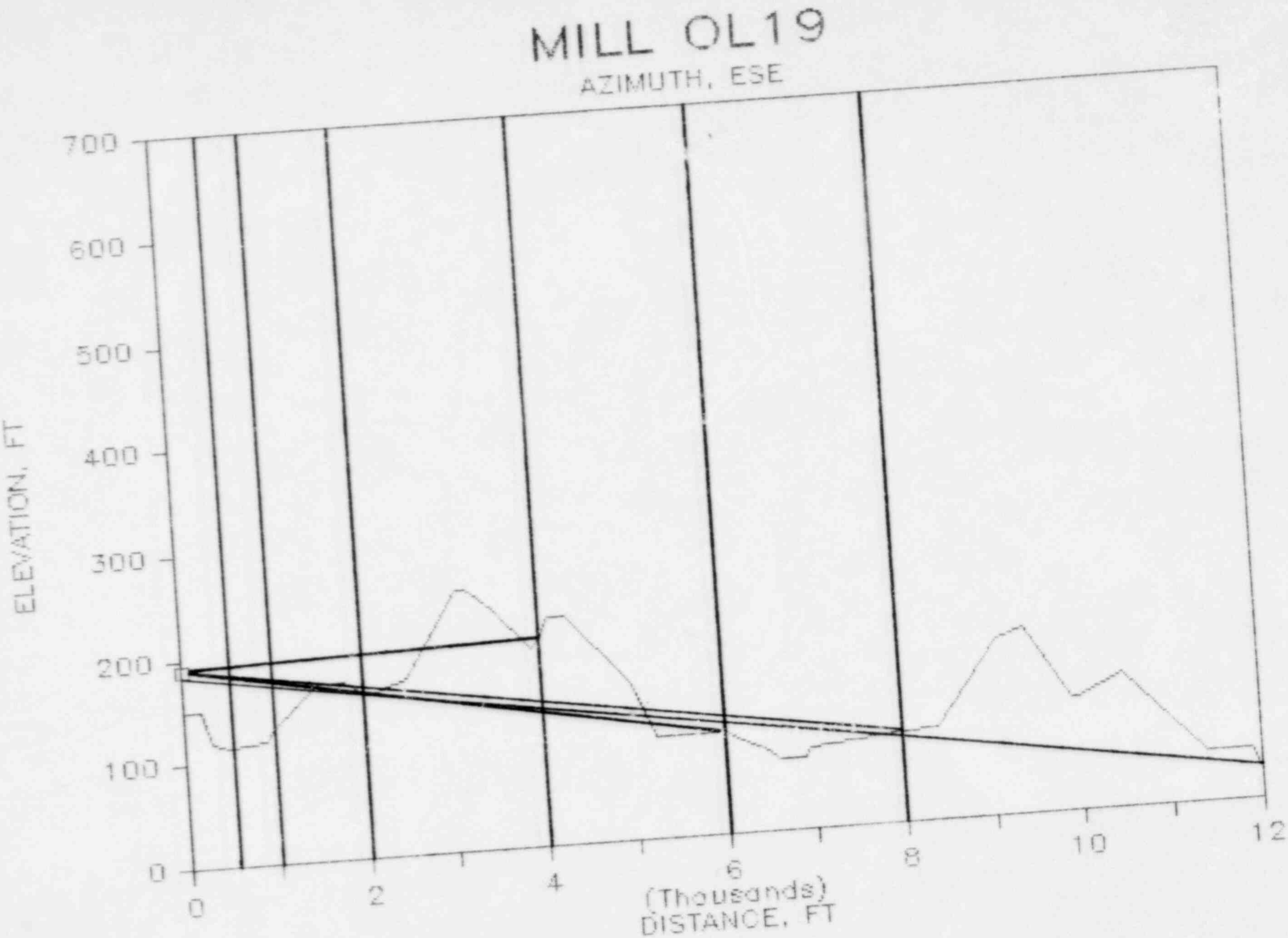


MILL OL19
AZIMUTH, S
700
600
500
400
300
200
100
0
ELEVATION, FT
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT


MILL OL19
AZIMUTH, SSE
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT



MILL OL19
AZIMUTH, SE
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT



MILL OL19
AZIMUTH, ESE
ELEVATION, FT
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
(Thousands)
DISTANCE, FT

NORTHEAST UTILITIES
MILLSTONE ANS SIREN #OL19
SOURCE-RECEIVER TOPOGRAPHICAL INPUTS

ALL BEARINGS ARE WITH RESPECT TO THE NORTH MEASURING CLOCKWISE

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
1	500.	90.00	115.00	SOFT	0.	NO	0.	0.
2	1000.	90.00	130.00	SOFT	0.	NO	0.	0.
3	2000.	90.00	155.00	SOFT	0.	NO	0.	0.
4	4000.	90.00	271.00	SOFT	0.	NO	0.	0.
5	6000.	90.00	90.00	SOFT	0.	YES	4000.	271.
6	8000.	90.00	161.00	SOFT	0.	YES	4000.	271.
7	12000.	90.00	148.00	SOFT	0.	YES	4000.	271.
8	500.	67.50	130.00	SOFT	0.	NO	0.	0.
9	1000.	67.50	120.00	SOFT	0.	NO	0.	0.
10	2000.	67.50	175.00	SOFT	0.	YES	1800.	180.
11	4000.	67.50	290.00	SOFT	0.	NO	0.	0.
12	6000.	67.50	80.00	SOFT	0.	YES	4300.	290.
13	8000.	67.50	95.00	SOFT	0.	YES	4300.	290.
14	12000.	67.50	200.00	SOFT	0.	YES	4300.	290.
15	500.	45.00	150.00	SOFT	0.	YES	450.	176.
16	1000.	45.00	150.00	SOFT	0.	YES	450.	176.
17	2000.	45.00	129.00	SOFT	0.	YES	1700.	148.
18	4000.	45.00	245.00	SOFT	0.	NO	0.	0.
19	6000.	45.00	250.00	SOFT	0.	YES	4200.	364.
20	8000.	45.00	165.00	SOFT	0.	YES	4200.	364.
21	12000.	45.00	120.00	SOFT	0.	YES	4200.	364.
22	500.	22.50	190.00	SOFT	0.	NO	0.	0.
23	1000.	22.50	190.00	SOFT	0.	NO	0.	0.
24	2000.	22.50	233.00	SOFT	0.	NO	0.	0.
25	4000.	22.50	150.00	SOFT	0.	YES	2200.	240.
26	6000.	22.50	180.00	SOFT	0.	YES	2200.	240.
27	8000.	22.50	270.00	SOFT	0.	YES	2200.	240.
28	12000.	22.50	325.00	SOFT	0.	YES	2200.	240.
29	500.	0.0	195.00	SOFT	0.	NO	0.	0.
30	1000.	0.0	220.00	SOFT	0.	NO	0.	0.
31	2000.	0.0	250.00	SOFT	0.	YES	1000.	220.
32	4000.	0.0	215.00	SOFT	0.	YES	1000.	220.
33	6000.	0.0	140.00	SOFT	0.	YES	1000.	220.
34	8000.	0.0	185.00	SOFT	0.	YES	1000.	220.
35	12000.	0.0	220.00	SOFT	0.	YES	1000.	220.
36	500.	337.50	175.00	SOFT	0.	NO	0.	0.

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
37	1000.	337.50	200.00	SOFT	0.	NO	0.	0.
38	2000.	337.50	205.00	SOFT	0.	YES	1400.	210.
39	4000.	337.50	170.00	SOFT	0.	YES	1400.	210.
40	6000.	337.50	45.00	SOFT	0.	YES	1400.	210.
41	8000.	337.50	50.00	HARD	0.	YES	1400.	210.
42	12000.	337.50	205.00	SOFT	0.	YES	1400.	210.
43	500.	315.00	120.00	SOFT	0.	NO	0.	0.
44	1000.	315.00	135.00	SOFT	0.	NO	0.	0.
45	2000.	315.00	170.00	SOFT	0.	NO	0.	0.
46	4000.	315.00	75.00	SOFT	0.	YES	2750.	168.
47	6000.	315.00	36.00	HARD	0.	YES	2750.	168.
48	8000.	315.00	36.00	HARD	0.	YES	2750.	168.
49	12000.	315.00	70.00	SOFT	0.	YES	10800.	148
50	500.	292.50	110.00	SOFT	0.	NO	0.	0.
51	1000.	292.50	90.00	SOFT	0.	NO	0.	0.
52	2000.	292.50	100.00	SOFT	0.	NO	0.	0.
53	4000.	292.50	36.00	SOFT	0.	NO	0.	0.
54	6000.	292.50	44.00	SOFT	0.	NO	0.	0.
55	8000.	292.50	54.00	SOFT	0.	NO	0.	0.
56	12000.	292.50	130.00	SOFT	0.	YES	8800.	176.
57	500.	270.00	103.00	SOFT	0.	NO	0.	0.
58	1000.	270.00	80.00	SOFT	0.	NO	0.	0.
59	2000.	270.00	90.00	SOFT	0.	NO	0.	0.
60	4000.	270.00	40.00	SOFT	0.	NO	0.	0.
61	6000.	270.00	41.00	SOFT	0.	NO	0.	0.
62	8000.	270.00	43.00	SOFT	0.	NO	0.	0.
63	12000.	270.00	120.00	SOFT	0.	NO	0.	0.
64	500.	247.50	100.00	SOFT	0.	NO	0.	0.
65	1000.	247.50	78.00	SOFT	0.	NO	0.	0.
66	2000.	247.50	125.00	SOFT	0.	NO	0.	0.
67	4000.	247.50	50.00	SOFT	0.	YES	3500.	146.
68	6000.	247.50	38.00	SOFT	0.	YES	3500.	146.
69	8000.	247.50	45.00	SOFT	0.	YES	3500.	146.
70	12000.	247.50	28.00	SOFT	0.	YES	10300.	166.
71	500.	225.00	90.00	SOFT	0.	NO	0.	0.
72	1000.	225.00	78.00	SOFT	0.	NO	0.	0.

GRID POINT	DISTANCE	BEARING	HEIGHT	GROUND TYPE	FOLIAGE PENETRATION	INTERVENING OBSTRUCTIONS	DISTANCE TO HIGHEST OBSTRUCTION FROM SOURCE	HEIGHT OF OBSTRUCTION
73	2000.	225.00	125.00	SOFT	0.	YES	1700.	150.
74	4000.	225.00	131.00	SOFT	0.	NO	0.	0.
75	6000.	225.00	65.00	SOFT	0.	YES	4900.	145.
76	8000.	225.00	50.00	HARD	0.	YES	4900.	145.
77	12000.	225.00	50.00	HARD	0.	YES	8750.	100.
78	500.	202.50	90.00	SOFT	0.	NO	0.	0.
79	1000.	202.50	92.00	SOFT	0.	NO	0.	0.
80	2000.	202.50	100.00	SOFT	0.	NO	0.	0.
81	4000.	202.50	75.00	SOFT	0.	YES	2500.	130.
82	6000.	202.50	47.00	HARD	0.	NO	0.	0.
83	8000.	202.50	50.00	SOFT	0.	NO	0.	0.
84	12000.	202.50	7.00	HARD	0.	NO	0.	0.
85	500.	180.00	92.00	SOFT	0.	NO	0.	0.
86	1000.	180.00	79.00	SOFT	0.	NO	0.	0.
87	2000.	180.00	79.00	HARD	0.	NO	0.	0.
88	4000.	180.00	90.00	HARD	0.	NO	0.	0.
89	6000.	180.00	180.00	SOFT	0.	NO	0.	0.
90	8000.	180.00	170.00	SOFT	0.	YES	6200.	180.
91	12000.	180.00	128.00	SOFT	0.	YES	10700.	180.
92	500.	157.50	100.00	SOFT	0.	NO	0.	0.
93	1000.	157.50	90.00	SOFT	0.	NO	0.	0.
94	2000.	157.50	140.00	SOFT	0.	NO	0.	0.
95	4000.	157.50	222.00	SOFT	0.	NO	0.	0.
96	6000.	157.50	229.00	SOFT	0.	YES	5600.	248.
97	8000.	157.50	120.00	SOFT	0.	YES	5600.	248.
98	12000.	157.50	60.00	SOFT	0.	YES	5600.	248.
99	500.	135.00	110.00	SOFT	0.	NO	0.	0.
100	1000.	135.00	110.00	SOFT	0.	NO	0.	0.
101	2000.	135.00	172.00	SOFT	0.	NO	0.	0.
102	4000.	135.00	220.00	SOFT	0.	NO	0.	0.
103	6000.	135.00	170.00	SOFT	0.	YES	4750.	260.
104	8000.	135.00	128.00	SOFT	0.	YES	4750.	260.
105	12000.	135.00	72.00	SOFT	0.	YES	4750.	260.
106	500.	112.50	115.00	SOFT	0.	NO	0.	0.
107	1000.	112.50	130.00	SOFT	0.	NO	0.	0.
108	2000.	112.50	160.00	SOFT	0.	NO	0.	0.
109	4000.	112.50	200.00	SOFT	0.	NO	0.	0.
110	6000.	112.50	98.00	SOFT	0.	YES	3250.	256.
111	8000.	112.50	88.00	SOFT	0.	YES	3250.	256.
112	12000.	112.50	30.00	SOFT	0.	YES	3250.	256.
						YES	3250.	256.

NORTHEAST UTILITIES
MILLSTONE ANS SIREN #0L19

SIREN SOUND LEVELS IN DBC

UNDER MET CONDITION 1

DISTANCE IN FEET

AZIMUTH	500.	1000.	2000.	4000.	6000.	8000.	12000.
E	100.	92.	79.	65.	34.	34.	27.
ENE	100.	92.	72.	65.	32.	30.	27.
NE	79.	77.	69.	65.	35.	29.	22.
NNE	100.	92.	80.	46.	40.	38.	31.
N	100.	93.	70.	49.	39.	35.	28.
NNW	100.	93.	68.	50.	39.	45.	30.
NW	100.	92.	79.	40.	39.	31.	8.
WNW	100.	93.	79.	58.	44.	34.	14.
W	100.	93.	79.	59.	44.	35.	24.
WSW	100.	93.	79.	37.	30.	25.	4.
SW	100.	93.	67.	59.	28.	33.	24.
SSW	100.	93.	79.	48.	55.	35.	31.
S	100.	93.	85.	67.	54.	36.	11.
SSE	100.	93.	79.	65.	44.	33.	26.
SE	100.	92.	79.	65.	37.	33.	26.
ESE	100.	92.	79.	47.	36.	32.	25.

NORTHEAST UTILITIES
MILLSTONE ANS SIREN #OL19
NOISE SOURCE POWER LEVEL INPUT

INDEX	SOURCE	DBA	DBC	31.5	63	125	250	500	1000	2000	4000	8000 (HZ)
1	SIREN OL19-WS2000	152.9	152.6	0.0	0.0	0.0	0.0	0.0	152.0	143.0	138.0	126.0

XO= 0.0 YO= 0.0 ZO= 149.00 HEIGHT ABOVE GROUND= 39.00

NORTHEAST UTILITIES
MILLSTONE ANS SIREN #OL19
METEOROLOGICAL INPUT CONDITIONS

H1= 10.06 METERS H2= 43.28 METERS

YEAR	SEASON	MONTH	DATE	HOUR	WIND DIRECTION	WIND SPEED(MPS) H1	WIND SPEED(MPS) H2	TEMPERATURE(C) H1	TEMPERATURE(C) H2	RELATIVE HUMIDITY	BAROMETRIC PRESSURE(MM OF HG)
1983	S	7	1	12	245.0	3.8	5.1	21.9	21.3	42.0	764.0

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 porportion alerted. The exact number of households to be surveyed can be derived from the following statistical considerations. For relatively large sample sizes ($n \geq 30$), taken without replacement from a population (N), the sampling distribution for proportions (e.g., the proportion of the population alerted) is nearly a normal distribution, the mean of which is the proportion (p) of the population alerted and the variance of which is

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

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

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

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

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

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

Thus, the precision (W) is simply given by

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

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

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

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

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

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

or using 1.96 for Z_c and 0.05 for W,

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

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

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