NORTHEAST UTILITIES

THE CONNECTICUT LIGHT AND POWER COMPANY
THE HARTFORD ELECTRIC LIGHT COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

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September 30, 1980

Docket No. 50-336
B10094

Director of Nuclear Reactor Regulation
Attn: Mr. Robert A. Clark, Chief
Operating Reactors Branch #3
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

References:
(1) W. G. Counsil letter to R. A. Clark dated May 13, 1980.
(2) W. G. Counsil letter to R. Reid dated April 15, 1980.
(3) W. G. Counsil letter to R. A. Clark dated August 14, 1980.
(4) W. G. Counsil letter to R. Reid dated March 31, 1980.
(5) W. G. Counsil letter to R. Reid dated April 24, 1980.
(6) W. G. Counsil letter to R. A. Clark dated August 25, 1980.
(7) R. Reid letter to W. G. Counsil dated May 12, 1980.

Gentlemen:

Millstone Nuclear Power Station, Unit No. 2
Additional Information - Cycle 4 Reload

In the course of the review conducted to support Cycle 4 operation, the NRC Staff identified additional information which was required to support the Cycle 4 Safety Evaluation. Specifically, the following information was requested.

1. Containment electrical penetration replacement status.

2. Results of the evaluation program to determine the amount of guide tube wear experienced after two (2) cycles of operation with sleeved fuel assemblies and one (1) cycle with the reduced flow demonstration test.

3. Results of the Cycle 4 reload outage steam generator inspections.

4. Results of the feedwater system piping examinations.

5. The effects of fuel rod bowing on DNBR margin during Cycle 4.

6. Burst strain at the burst location for the hot rod during a large break LOCA.

7. Results of the multiple-frequency and multiaxis test on the proximity probe and transmitter used in the reactor coolant pump speed sensing system.

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In response to the Staff's requests, Northeast Nuclear Energy Company (NNECO) provides the following information.

Electrical Penetration Replacement

In Reference (1), NNECO provided the Staff with the plans to replace those penetration modules which have experienced insulation resistance degradation with new modules qualified to the requirements specified in IEEE 317-1976. At the time of the Reference (1) submittal, 32 penetration modules were scheduled to be replaced.

Prior to the refueling, NNECO had determined that eighteen (18) electrical penetration assemblies had experienced insulation resistance (IR) degradation and required replacement. To date, these eighteen (18) penetration assemblies have been replaced and will be returned to service prior to plant startup.

Of the remaining fourteen (14) penetration assemblies that have not experienced IR degradation but which NNECO has committed to replace, at least eight (8) penetration assemblies will be replaced and returned to service by the end of the outage.

The remaining electrical penetrations have not indicated IR degradation (IR < 100 megohms) and NNECO has determined that they are capable of performing their intended function. These penetration assemblies are scheduled for replacement during future outages.

All electrical penetrations in-service at Millstone Unit No. 2 have an insulation resistance of greater than or equal to 100 megohms. This condition serves as the basis for NNECO's position that all penetrations are suitable for service at this time.

CEA Guide Tube Wear Inspections

NNECO provided the Staff with the evaluation program to determine the amount of guide tube wear after two cycles of operation with sleeved fuel assemblies and one cycle with the reduced flow test assemblies in Reference (2) as supplemented by Reference (3).

Six (6) fuel assemblies that were located under control element assemblies (CEA) during Cycle 3 were inspected by eddy current techniques. The results of these inspections show no indication of wear of the guide tube sleeves.

Eddy current examinations were also performed on the guide tubes of two (2) of the demonstration "small-flow-hole" assemblies which were located under CEA's during Cycle 3. The results of these examinations revealed no indication of guide tube wear.

In addition, eddy current examinations of two CEA's indicate no significant wear after three cycles of operation at Millstone Unit No. 2.

The results of the eddy current examinations of the guide tube sleeves and the reduced flow test assemblies coupled with the results of the CEA examinations demonstrate that sleeved and reduced-flow guide tubes provide an effective means of mitigating guide tube wear at Millstone Unit No. 2.

During the past core shuffle fuel inspection, it was noted that the guide tube sleeve in one of the corner guide tubes of fuel assembly D108 was raised approximately five to six inches above its seat. The fuel assembly was removed from the core, taken to the fuel pool, and inspected. The inspection revealed no other damage to the sleeve and the sleeve was reseated, recrimped, eddy current tested for adequacy of the crimp, and was returned to the Cycle 4 core.

The investigation into the raised sleeve included a historical review of the bundle in question, the implication of the raised sleeve and the adequacy of the repair.

The bundle was sleeved in the Spring of 1979 after the bundle had seen one cycle of irradiation. The sleeve was satisfactorily pull tested at the time of sleeving. Subsequently, Combustion Engineering had determined that the procedure utilized at the time resulted in undersized crimps and all guide tube sleeves in that category were considered to have the potential to be pulled upward after thermal cycling if appropriate forces were applied when the reactor coolant temperature was below 400°F. Due to this concern, administrative controls were placed on control rod motion at temperatures below 400°F.

During the present refueling, the control rod was removed from D108, as scheduled, and placed in its new fuel assembly. It is postulated that, during this period of time, with the fuel assembly in the cold condition, the sleeve was lifted by the drag forces created during the control rod exchange. It should be noted that the potential to generate additional drag forces is greater when removing the control rod with the refueling equipment as compared to the chance of misalignment during normal control rod motion.

No indication of abnormal behavior of the affected control rod during Cycle 3 operation was identified, which further reinforces the postulate that the sleeve was lifted during the control rod shuffle.

A review of the "as loaded" Cycle 4 core revealed no other cases of raised sleeves. The 400°F control rod motion restriction will remain in place during Cycle 4.

Upon review of the post-sleeving eddy current data for the center guide tube of fuel assembly D011, it was noted that the magnitude of the sleeve expansion was greater than normal and that the eddy current trace below the sleeve was abnormal as compared to the standard. Additional eddy current and visual examinations were scheduled which resulted in a better understanding of the anomaly.

Visual examinations of the guide tube exterior revealed a longitudinal opening at a position that is effectively in the vertical location of the guide tube sleeve crimp. The opening with its adjacent bulge was inspected, utilizing a periscope, by making observations of the center guide tube from various angles. From the external examinations it was determined that there was a protrusion into the adjacent cooling channel. The exact amount of subchannel blockage is judged to be insignificant due to the known longitudinal nature of the opening.

Internal examination of the guide tube utilizing a boroscope revealed an area below the newly installed sleeve that had a darker appearance than the adjacent guide tube area and an opening in the guide tube. The abnormal surface starts at the bottom of the sleeve and extends downward approximately six inches, where it fades out. The maximum observed abnormal surface covers an arc of about 45 degrees at the point where the area in question disappears behind the newly installed sleeve. The opening is about one and three quarters inches long and covers a maximum arc of about 25 degrees. Other minor markings were noted but were not significant or did not relate to the anomaly.

Eddy current examinations of the affected area verify the existence and extent of the opening, and the presence of the bulged area. The eddy current inspection also indicated wall thinning in the effected area which was a maximum of sixty percent approximately three inches below the sleeve near the opening. Although it cannot be ascertained exactly what the nature of the anomaly is, it resembles a wear type pattern.

The fuel assembly in question (D011) has been in the core for two cycles and during both cycles was under instrument locations. Other fuel assemblies that were under instrument locations, for which eddy current data existed, were reviewed and none exhibit any signs of wear. At the end of Cycle 1, fourteen assemblies from instrumented locations were eddy current tested and no wear indications were found. This sample included one assembly from the same location as fuel assembly D011. Of the assemblies recently sleeved, eleven were under instruments and no other indications of wear were found on the eddy current examinations performed beyond those associated with D011. Of this sample, two had been under instruments for two cycles and one of the two was symmetric to the position occupied by D011. The available data supports the conclusion that this is a singular incident and not a generic phenomena.

The vendor evaluated the problem and developed a repair procedure for the guide tube sleeve to assure that the sleeve would remain in place during the upcoming cycle. The guide tube sleeve was recrimped at a higher location which was supported by the top nozzle guide post and the fuel assembly was reinserted into its proper core location.

The fuel assembly D011 was evaluated with respect to its mechanical integrity, control element compatibility and thermal-hydraulic considerations. The vendor was consulted on the problem and has concurred on the applicable portions of the evaluation.

From a mechanical integrity standpoint, no structural credit is taken for the center guide tube, thus the opening does not challenge the fuel assembly integrity.

Compatibility with the control rod was evaluated with respect to additional vibration, ability to scram and additional forces that the control rod may exert on the opening. The opening is below the withdrawn position of the control rod, thus the additional flow will not impinge on the rod. The amount of additional flow is relatively small since guide tube flow is predominantly a function of the flow holes. No thermal-hydraulic problems with respect to the guide tube/control rod configuration are anticipated.

An evaluation with respect to the effect on adjacent fuel pins was performed and no adverse effects were identified. The protrusion of the bulge into the adjacent coolant channel is such that it does not seriously affect flow up the subchannels. This conclusion is supported by the longitudinal nature of the opening which would tend not to restrict the flow which is essentially parallel to the opening. The opening itself will actually introduce more coolant above the bulge thus further reducing the potential. The nature of the opening is such that it protrudes at an angle that is into the largest cooling subchannel (45 degrees). In addition, the power level of bundle D011 for Cycle 4 is approximately 92 percent of the core average bundle power level, thereby lessening any adverse effects.

Based on the evaluations done, it is concluded that the use of D011 in the Cycle 4 core assures conformance with all design basis and safety analysis requirements.

NNECO is currently evaluating the various alternatives regarding further investigation of this anomaly. This matter will be the subject of future correspondence.

<u>Results of the Steam Generator Inspections</u>

The Millstone Unit No. 2 Steam Generator inspections were conducted during the 1980 refueling outage in accordance with plant Technical Specifications and supplementary commitments described in Reference (4). A combination of multi-frequency and single frequency eddy-current methods were utilized to identify both defects and dents in the steam generator tubes.

These examinations included in excess of 10% of the "tube-support-plate" tubes in each steam generator, in excess of 3% of "egg-crate" tubes of Steam Generator No. 2, and in excess of 50% of the outer peripheral, accessible tubes in Rows 1-90 of Steam Generator No. 1.

Preliminary results are summarized below.

(1) No tube defects or degradation exceeding 20% of tube-wall thickness were detected.

(2) One tube (line 85/row 91) was blocked to the 0.540 inch diameter probe at the tenth tube support plate on the hot-leg side of Steam Generator No. 2.

(3) The fraction of "egg-crate" tubes exhibiting a dent signal by eddy current testing is increased from the previous inspection.

(4) The average dent size remained essentially unchanged for "egg-crate" tubes, approximately 1 mil, and exhibited slight increases for tube sheets and tube-support-plate regions, up to 1.5 mils. However, equipment accuracy is $\pm$ 2 mils.

As a result of the eddy current inspection results described above, the tube blocked to the 0.540 inch probe was plugged. No other corrective actions were required.

The results of the eddy current examinations for denting for Steam Generator Nos. 1 and 2 are tabulated in Tables 1 and 2, respectively. In addition, bar charts illustrating signal growth vs. the number of occurrences at various elevations for each steam generator are presented.

The eddy current inspections described above were supplemented by a profilometer inspection of approximately 300 tubes and a visual examination of the secondary side. A preliminary evaluation of the profilometer results showed variable "denting" effects associated with the egg-crate supports, as indicated by a tube ovalization. This effect was smallest at the upper egg-crate elevations. Data evaluated to date confirm the integrity of steam generator tubes and essential supports, and assure the continued applicability of current design basis analyses.

The visual inspections confirmed that the general conditions remained essentially unchanged, as compared to the condition observed during the March 1979 outage.

Based upon the above information, NNECO concludes that the steam generators at Millstone Unit 2 are suitable for continued safe operation during Cycle 4.

NNECO intends to submit a final report following the processing and evaluation of the steam generator inspection data.

Feedwater System Piping Inspections

In August, 1979, the feedwater system piping was inspected in accordance with I&E Bulletin No. 79-13. These inspections revealed cracking on each side of the steam generator feedwater nozzle safe-end to pipe welds (AC-G-1, BC-G-1) and the adjacent pipe-to-elbow welds (AC-G-2, BC-G-2). All four welds were subsequently repaired in November, 1979.

The 1980 refueling outage feedwater system piping inspection program was docketed in Reference (5). It consisted of a reevaluation of welds AC-G-1, BC-G-1, AC-G-2, and BC-G-2.

Based on the evaluation of the 1980 refueling outage radiographic inspection results, NNECO concludes that no cracking nor any other unacceptable code discontinuities exist in the feedwater pipe welds AC-G-1, AC-G-2, BC-G-1, and BC-G-2.

Effects of Fuel Rod Bowing on DNBR Margin

Fuel rod bowing effects on DNBR margin for Millstone Unit No. 2, Cycle 4 have been evaluated. Within the range of Cycle 3 termination points and predicted Cycle 4 lifetimes, no more than 73 assemblies will exceed the DNB reduction or penalty threshold burnup of 24,000 MWD/T. At EOC 4, the maximum burnup attained by any of these assemblies will be 35,800 MWD/T. The corresponding DNB penalty for 35,800 MWD/T is less than 4.4 percent.

An examination of the power distributions shows that the maximum radial peak at HFP in any of the assemblies that eventually exceed 24,000 MWD/T is at least fifteen percent less than the maximum radial peak in the entire core. Since the percent increase in DNBR has been confirmed to be never less than the percent decrease in radial peak, there exists at least fifteen percent DNB margin for assemblies exceeding 24,000 MWD/T relative to the DNB limits established by other assemblies in the core.

Burst Strain at the Burst Location

The rupture strains at the hot rod burst location are listed below for the Millstone Unit No. 2 limiting case large and small break LOCA analyses.

Case	Fuel Rod Diametral Expansion, $\frac{\Delta d}{d_o}$
Large break	0.5
Small break	0.33

The strain values at other elevations along the hot rod at the time of burst were provided in Reference (6).

Reactor Coolant Pump Speed Sensing System

NNECO hereby reports that a multiple frequency and multiaxis test in accordance with IEEE 344-1975 has been satisfactorily performed on the proximity probe and transmitter used in the reactor coolant pump speed sensing system.

The satisfactory completion of this test fulfills the commitment made by NNECO and docketed in Reference (7).

We trust you find this information responsive to your requests such that a timely Safety Evaluation in support of Cycle 4 operation of Millstone Unit No. 2 may be issued.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

W. G. Counsil
Senior Vice President

By: W. F. Fee
Executive Vice President

TABLE 1. RESULTS OF EDDY CURRENT EXAMINATION OF STEAM GENERATOR NO. 1, INLET SIDE FOR DENTING (400 kHz LOW GAIN)

TUBE SUPPORT ELEVATION	NUMBER OF TESTS	NUMBER OF DENTS	AVERAGE DENT SIZE, MILS
Tube Sheet	1229	391	3
1	1229	968	<1
2	1229	1158	1
3	1229	1191	1
4	1229	1097	<1
5	1229	1004	<1
6	1229	576	<1
7	1229	306	<1
8	1113	83	<1
9	1033	11	1
10	947	938	9
11	357	352	7
1-9	10749	6394	<1
10-11	1304	1290	8

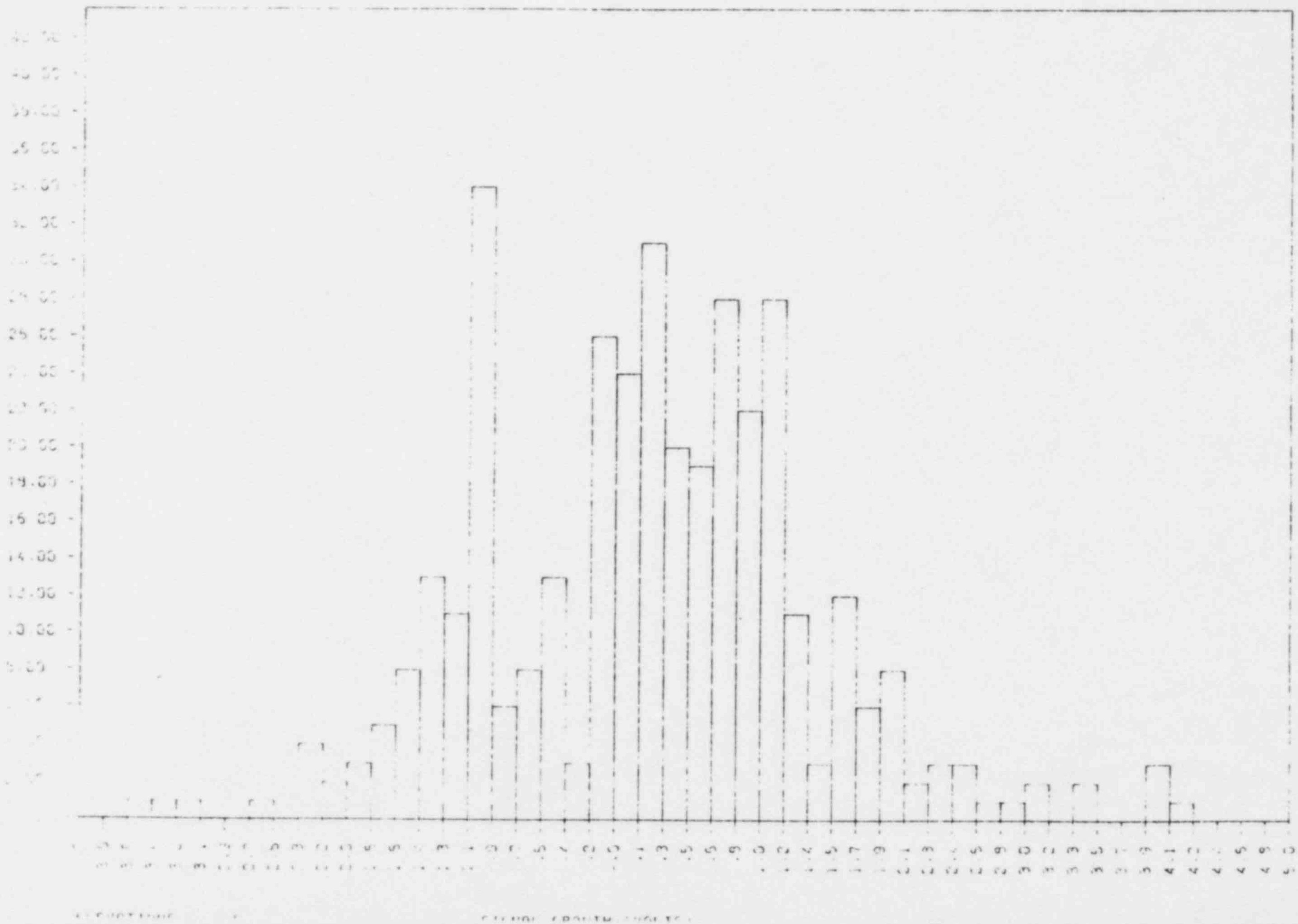
TABLE 2. RESULTS OF EDDY CURRENT EXAMINATION OF STEAM GENERATOR NO. 2 INLET SIDE FOR DENTING (400 kHz, LOW GAIN)

TUBE SUPPORT ELEVATION	NUMBER OF TESTS	NUMBER OF DENTS	AVERAGE DENT SIZE, MILS
Tube Sheet	887	257	3
1	887	681	1
2	887	740	1
3	887	722	1
4	887	496	<1
5	887	374	<1
6	887	162	<1
7	887	168	<1
8	688	18	<1
9	580	18	<1
10	504	497	11
11	260	260	9
1-9	7477	3379	<1
10-11	764	757	10

MILLSTONE II — INSPECTIONS — MARCH 17, 1979

STEAM GENERATOR 1 HOT SIDE — AUGUST 29, 1980

SIGNAL GROWTH VS NUMBER OF OCCURRENCES



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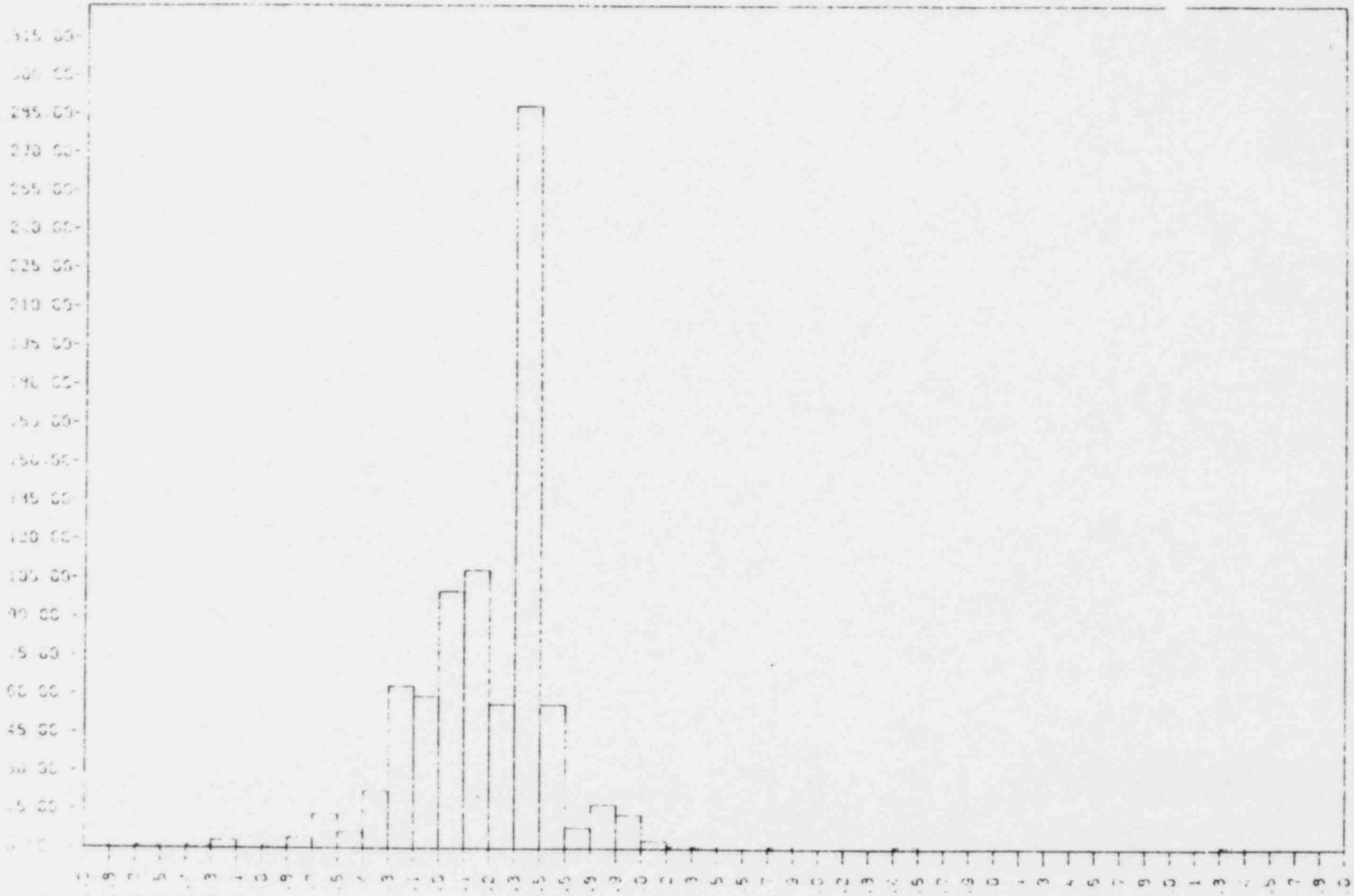
SIGNAL GROWTH VS. NUMBER OF OCCURRENCES

INSPECTIONS - MARCH [illegible] 1979
. AUGUST 29, 1980



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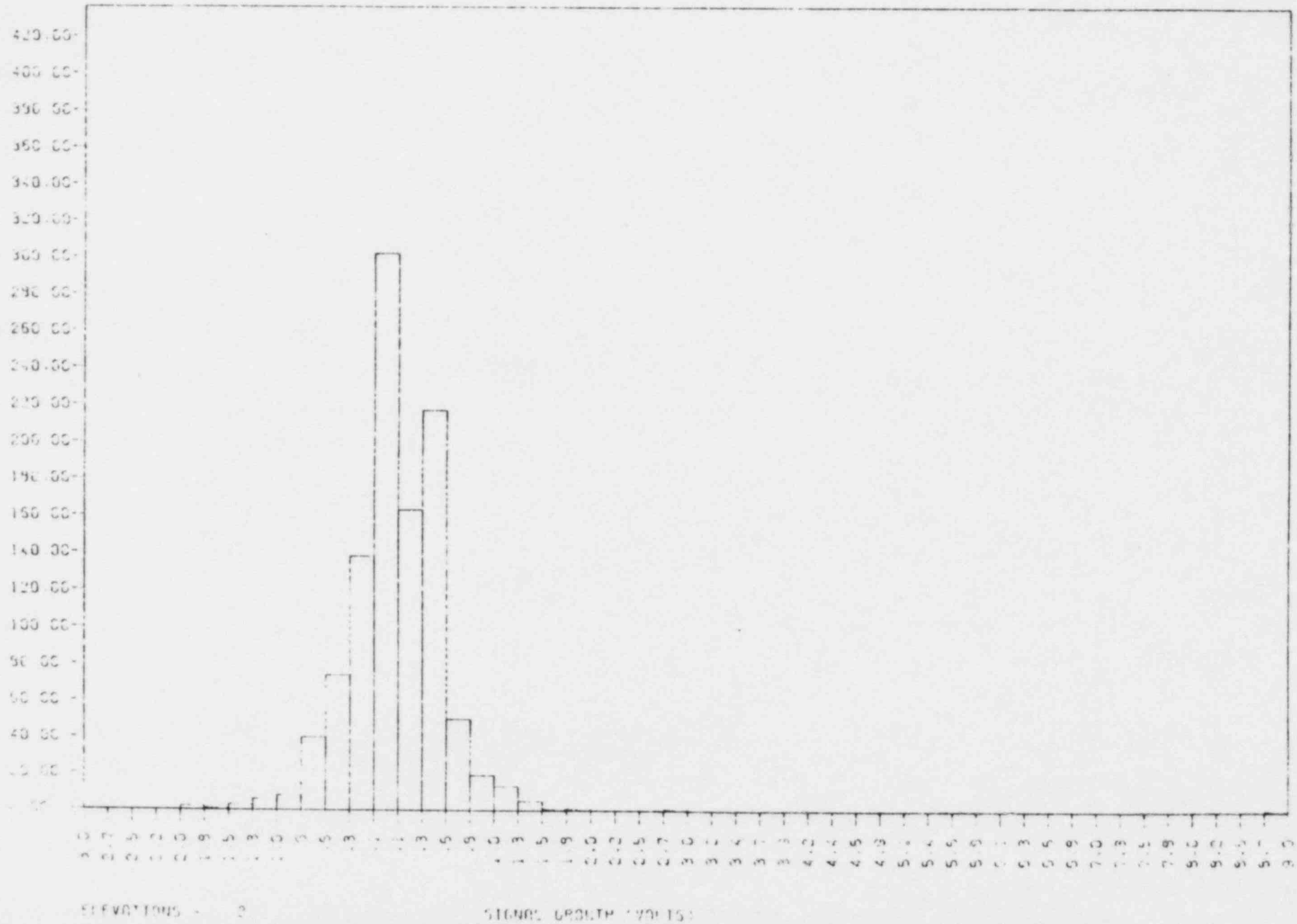
STEAM GENERATOR 1 HOT SIDE
SIGNAL GROWTH VS NUMBER OF OCCURENCES

INSPECTIONS - MARCH 17, 1979
AUGUST 28, 1980



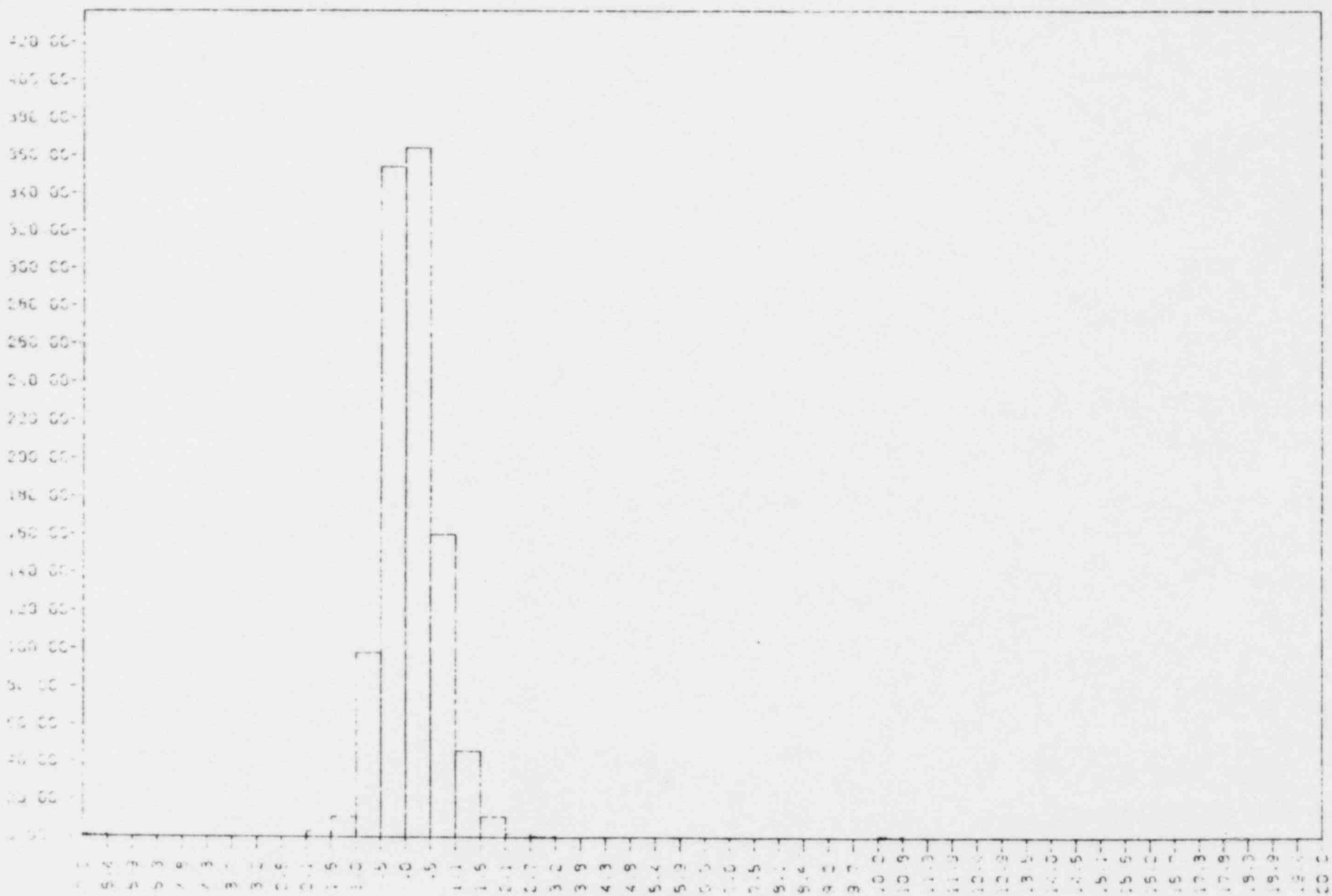
MILLSTONE II

STEAM GENERATOR 1 HOT SIDE

SIGNAL GROWTH VS NUMBER OF OCCURENCES

INSPECTIONS - MARCH 1979

AUGUST 28, 1980



ELEVATIONS -

SIGNAL GROWTH (VOLTS)

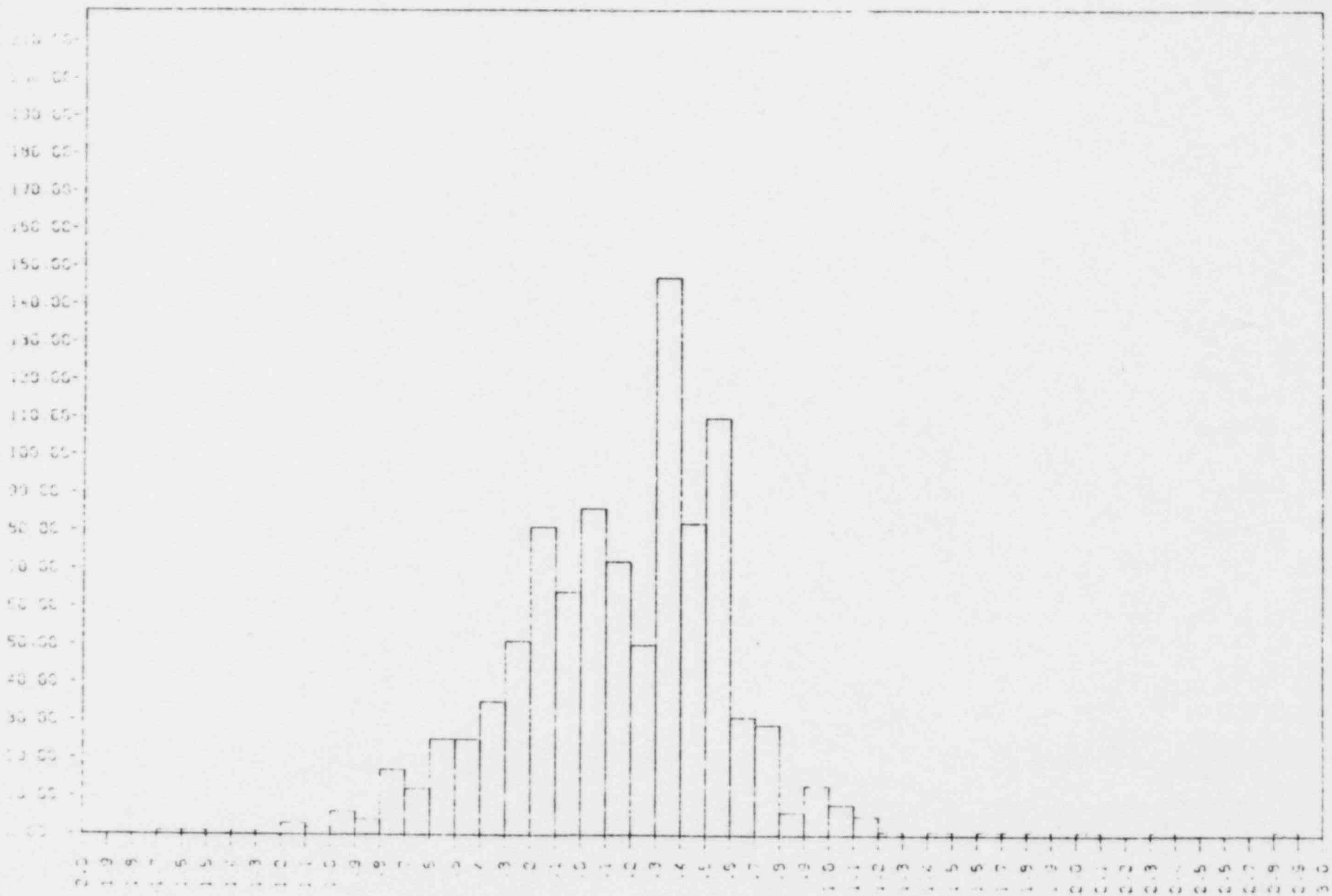
MILLSTONE II

STEAM GENERATOR 1 HOT SIDE

SIGNAL GROWTH VS. NUMBER OF OCCURRENCES

INSPECTIONS - MARCH 17, 1979

AUGUST 28, 1980



ELEVATIONS - 1

SIGNAL GROWTH (VOLTS)

MILLSTONE II

STEAM GENERATOR 1 HOT SIDE

SIGNAL GROWTH VS NUMBER OF OCCURRENCES

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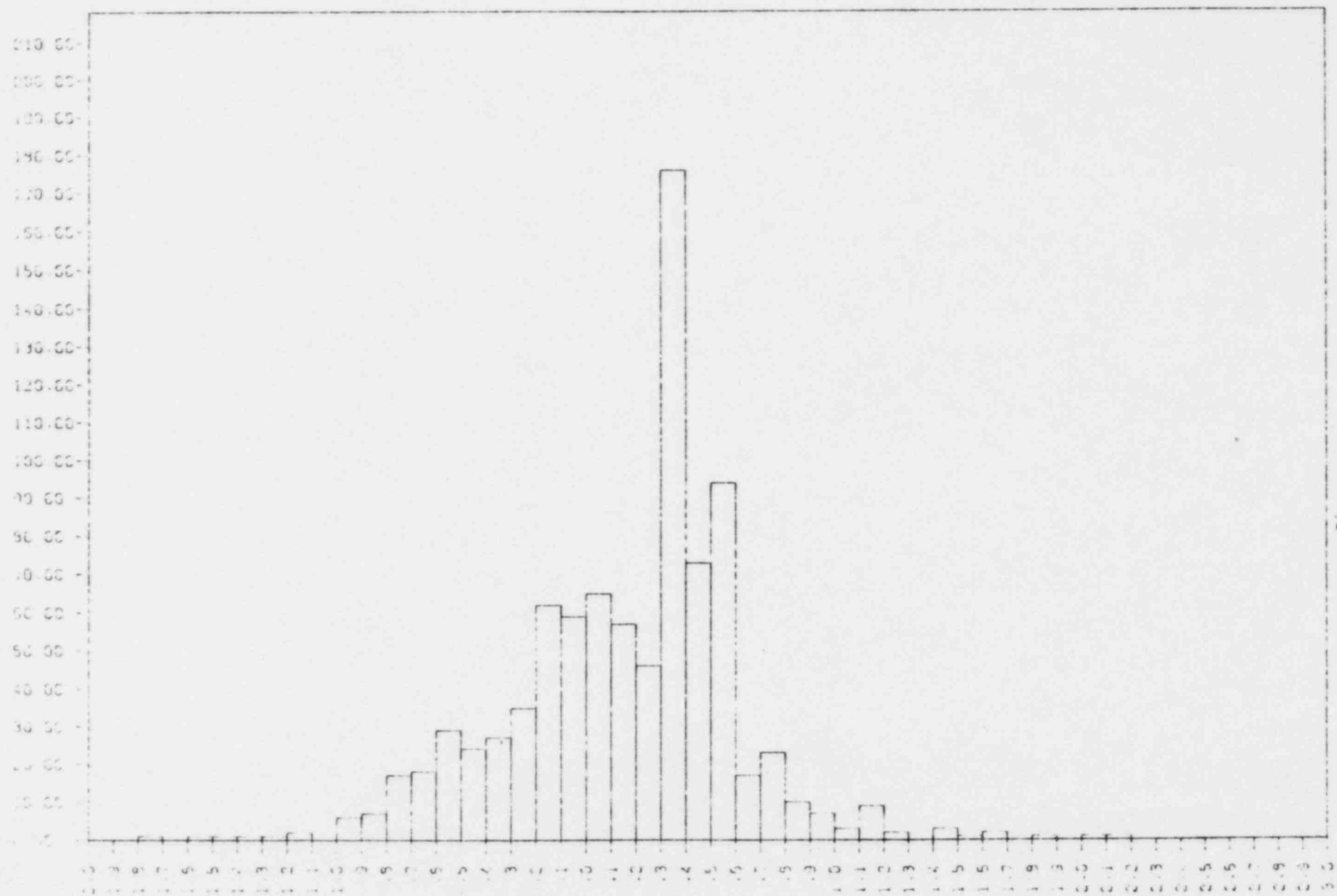
AUGUST 28, 1990



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STEAM GENERATOR 1 HOT SIDE
SIGNAL GROWTH VS NUMBER OF OCCURRENCES

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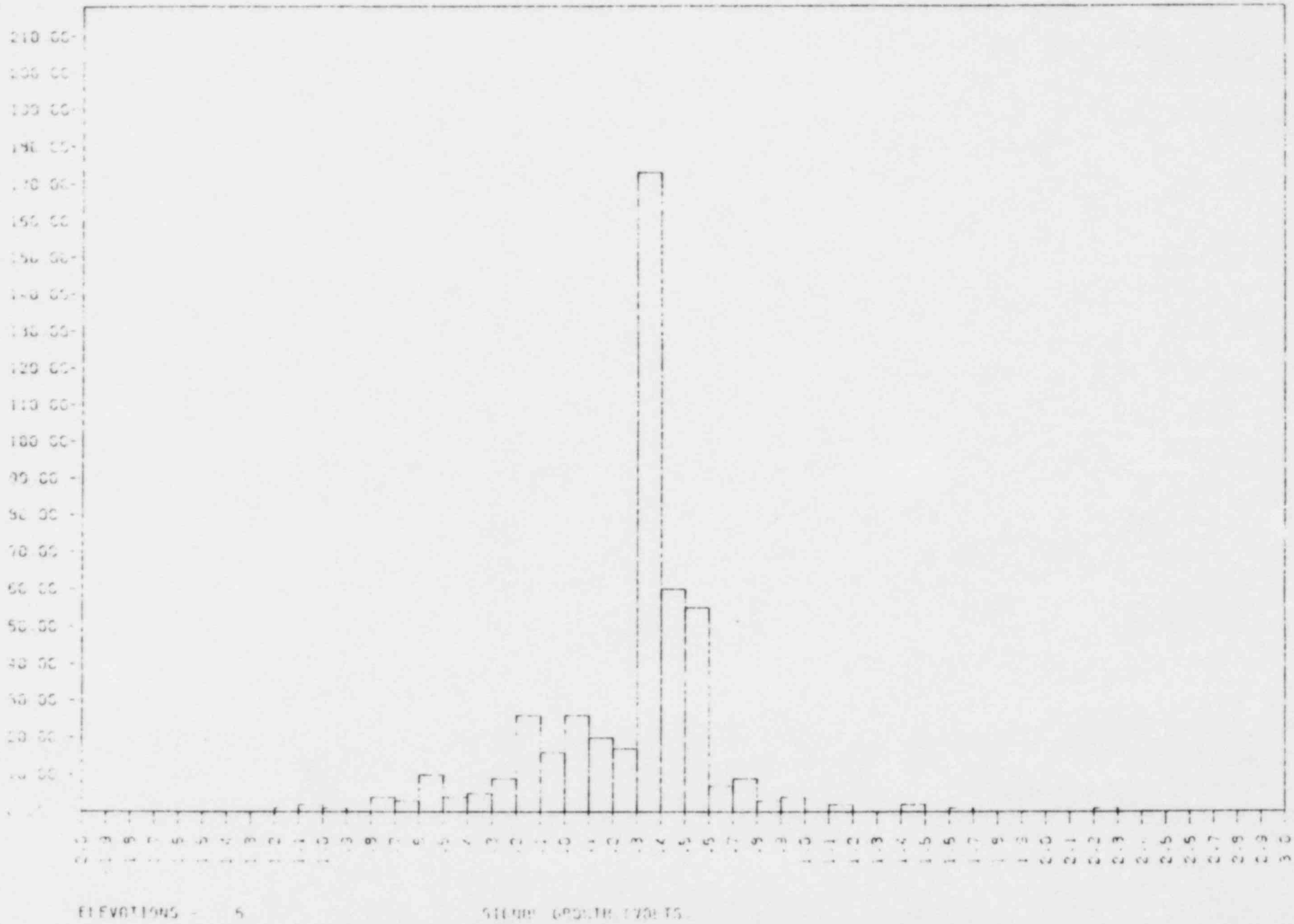

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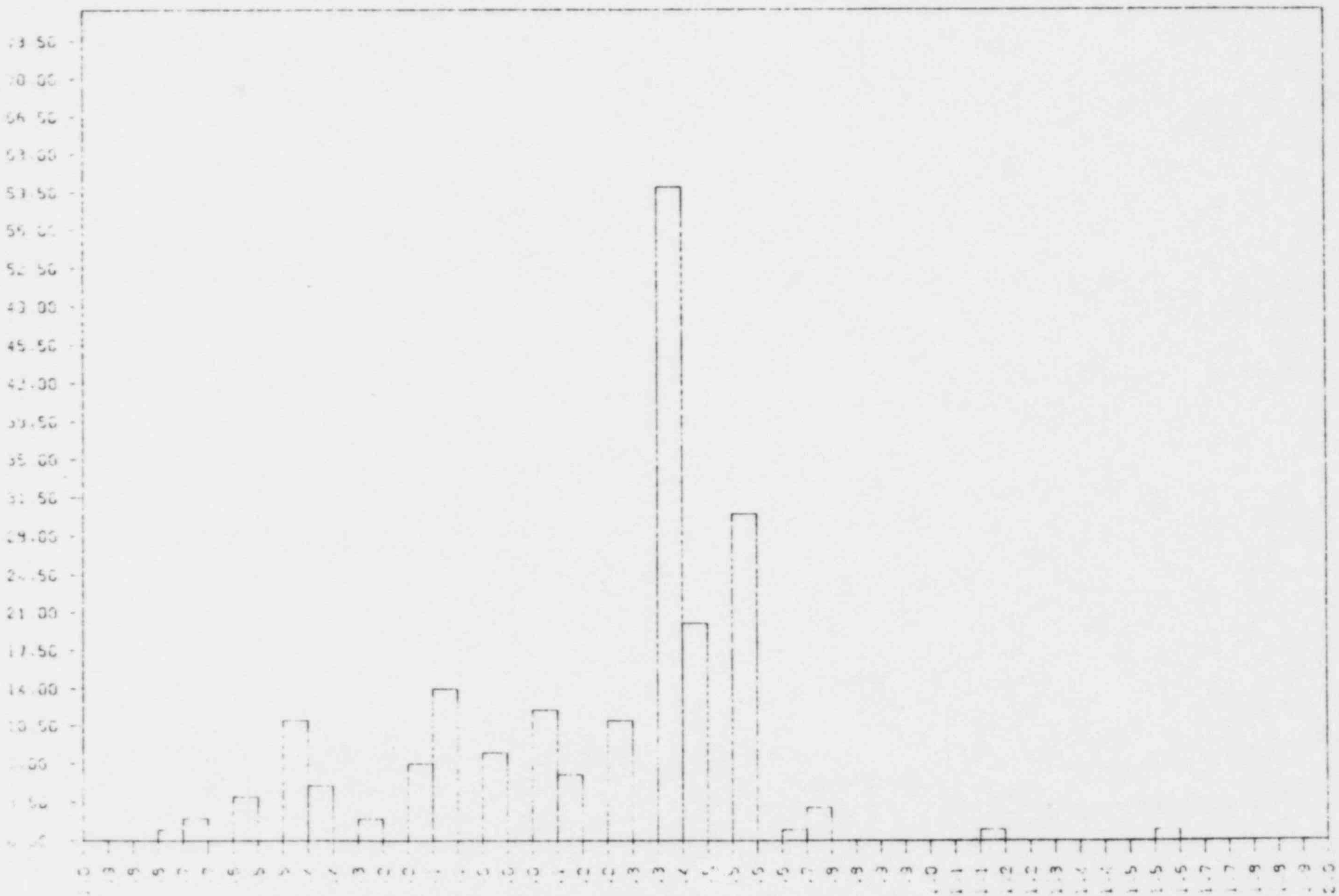
STEAM GENERATOR 1 HOT SIDE

SIGNAL GROWTH VS NUMBER OF OCCURENCES

INSPECTIONS - MARCH 17, 1979

AUGUST 28, 1980



ELEVATIONS - 7

SIGNAL GROWTH (VOLTS)

MILLSTONE II

STEAM GENERATOR 1 HOT SIDE

SIGNAL GROWTH VS. NUMBER OF OCCURRENCES

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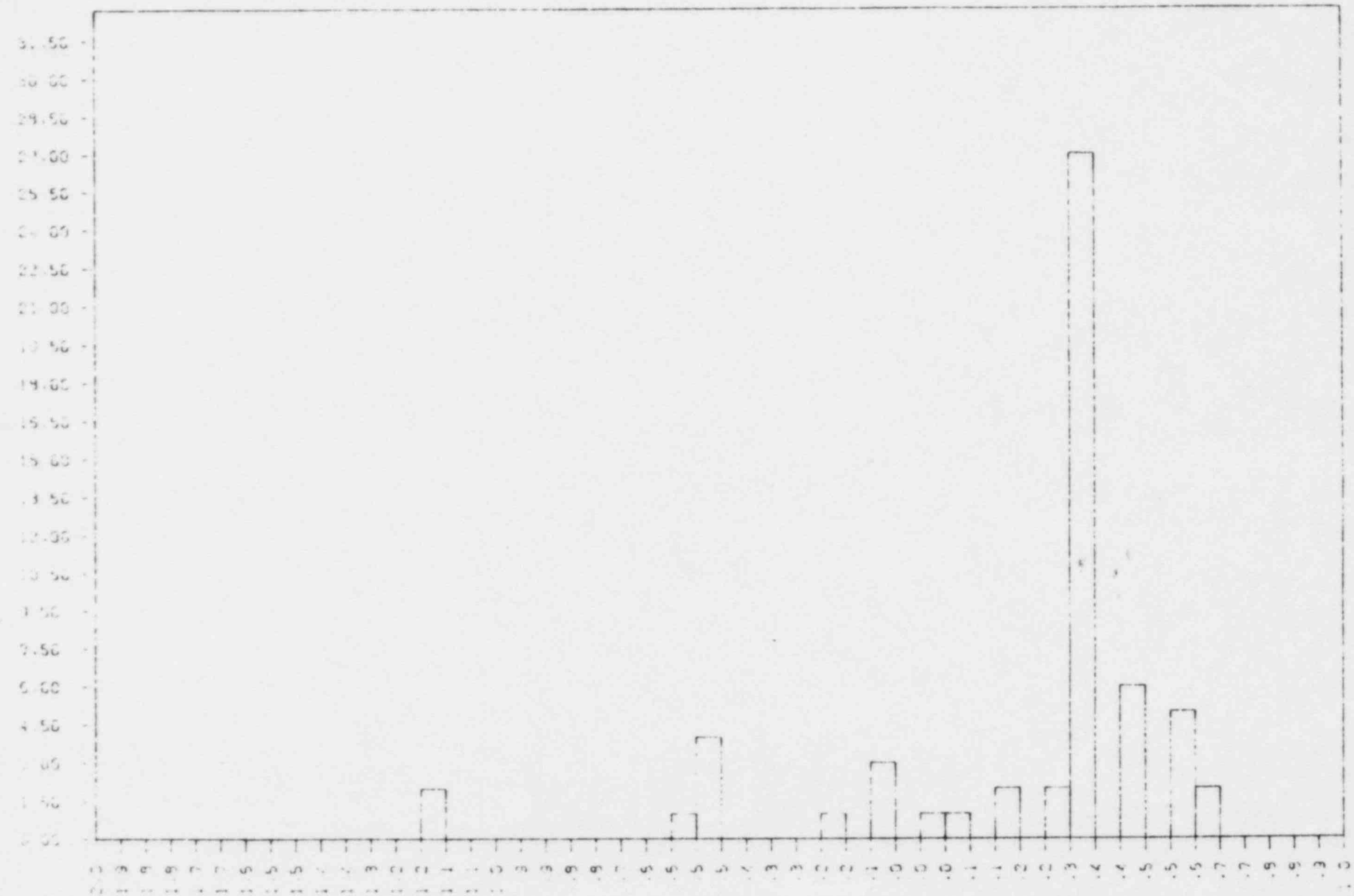
AUGUST 28, 1980



ELEVATIONS - 8 SIGNAL GROWTH (VOLTS)

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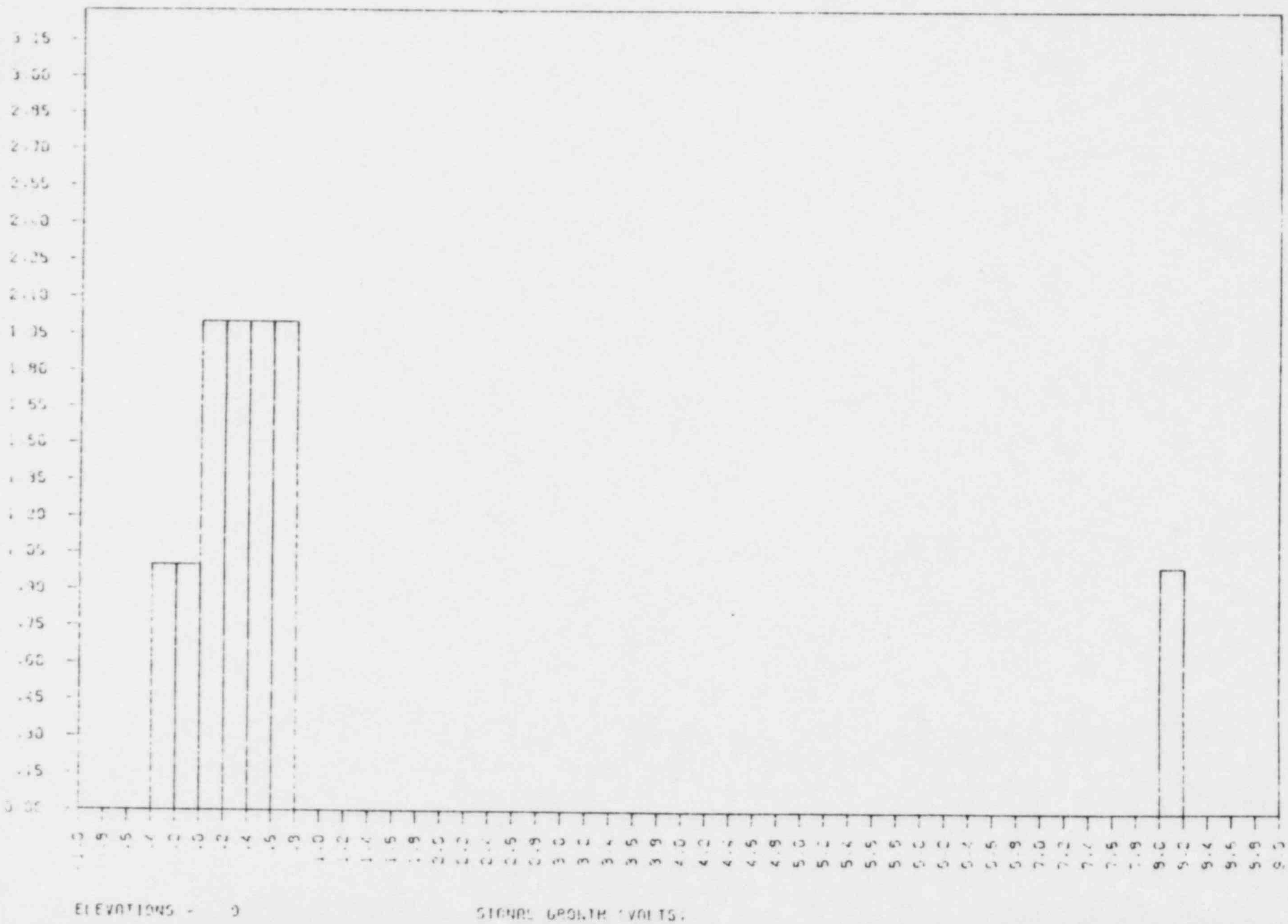
STEAM GENERATOR 1 HOT SIDE
SIGNAL GROWTH VS. NUMBER OF OCCURENCES

INSPECTIONS MARCH 17, 1979
AUGUST 29, 1980



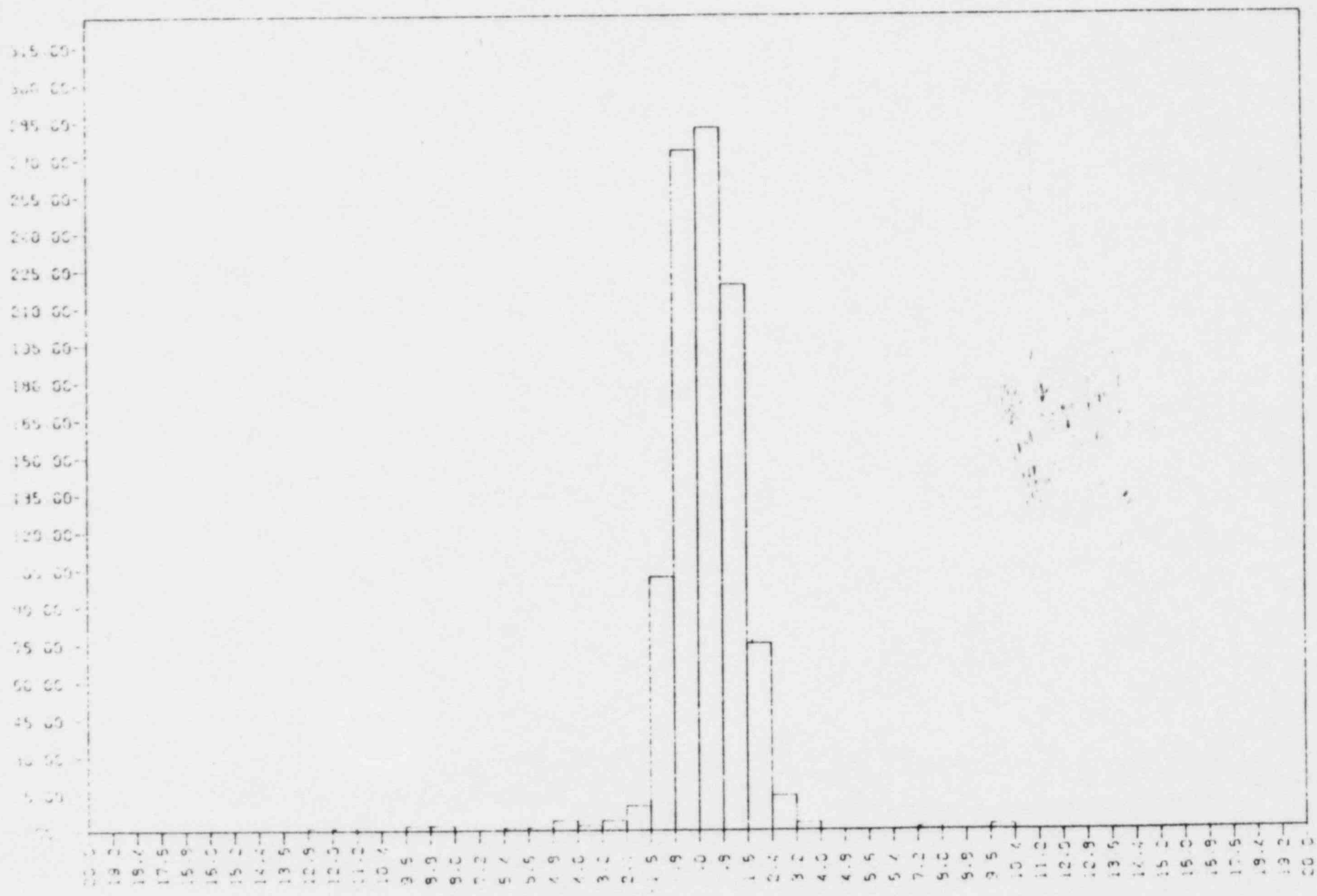
MILLSTONE II

STEAM GENERATOR 1 HOT SIDE

SIGNAL GROWTH VS. NUMBER OF OCCURENCES

INSPECTIONS - MARCH 1, 1979

AUGUST 28, 1986



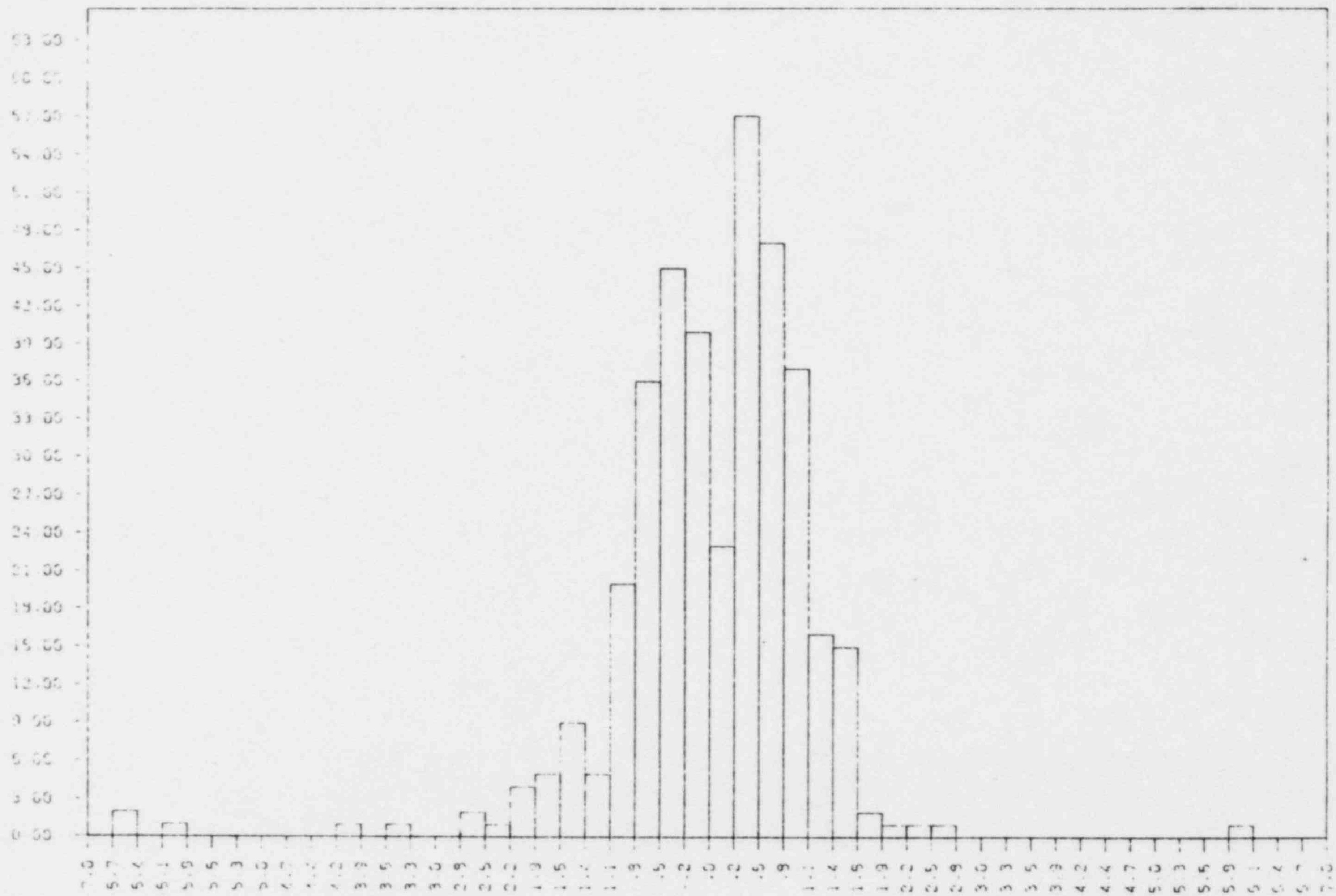
ELEVATIONS - 10

SIGNAL GROWTH (VOLTS)

MILLSTONE II INSPECTIONS - MARCH 1979

STEAM GENERATOR 1 HOT SIDE AUGUST 29, 1980

SIGNAL GROWTH VS. NUMBER OF OCCURENCES



ELEVATIONS - 11 SIGNAL GROWTH (VOLTS)

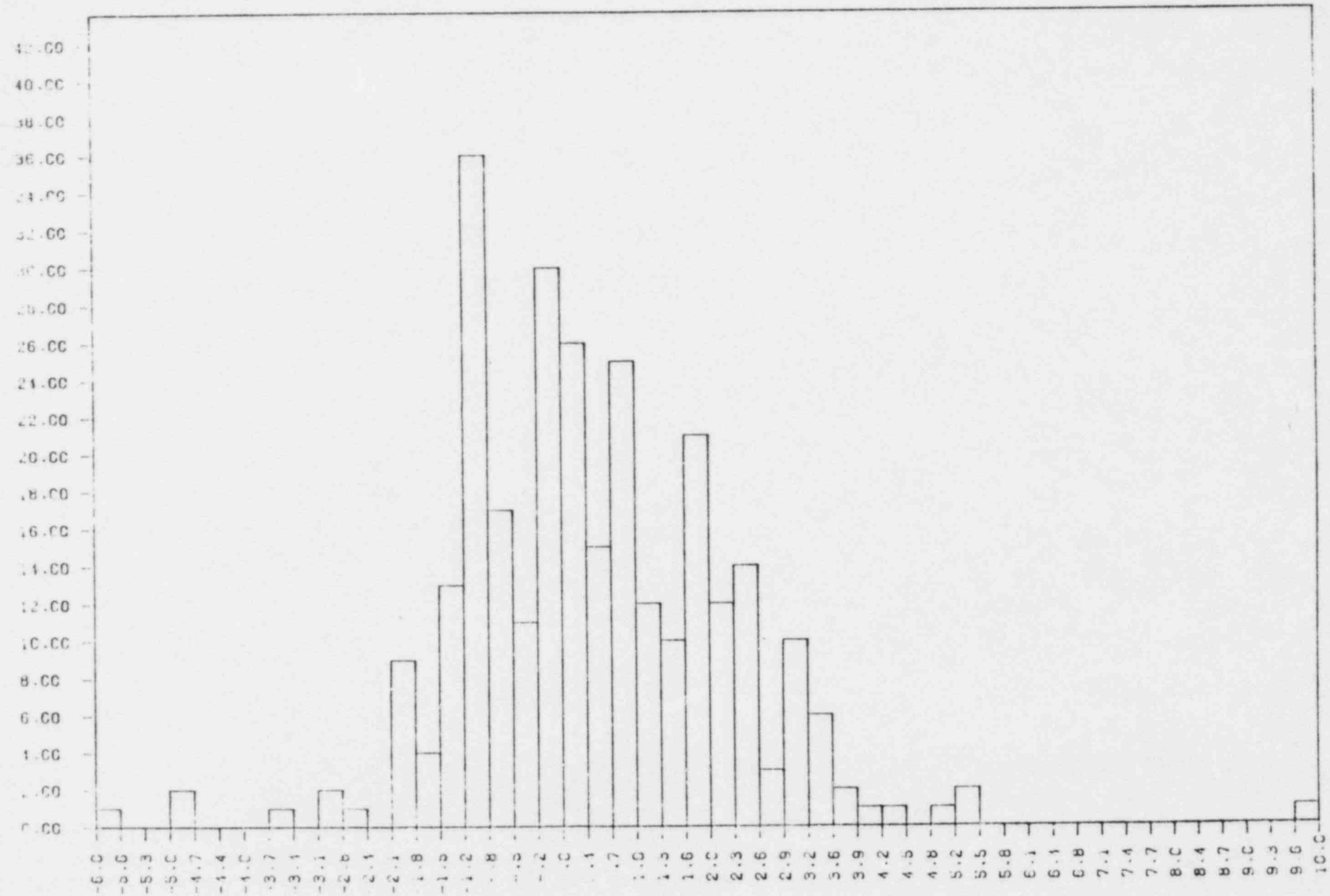
MILLSTONE II

STEAM GENERATOR 2 HOT SIDE

SIGNAL GROWTH VS. NUMBER OF OCCURENCES

INSPECTIONS - MARCH 1979

AUGUST 28, 1980



ELEVATIONS - C

SIGNAL GROWTH (VOLTS)

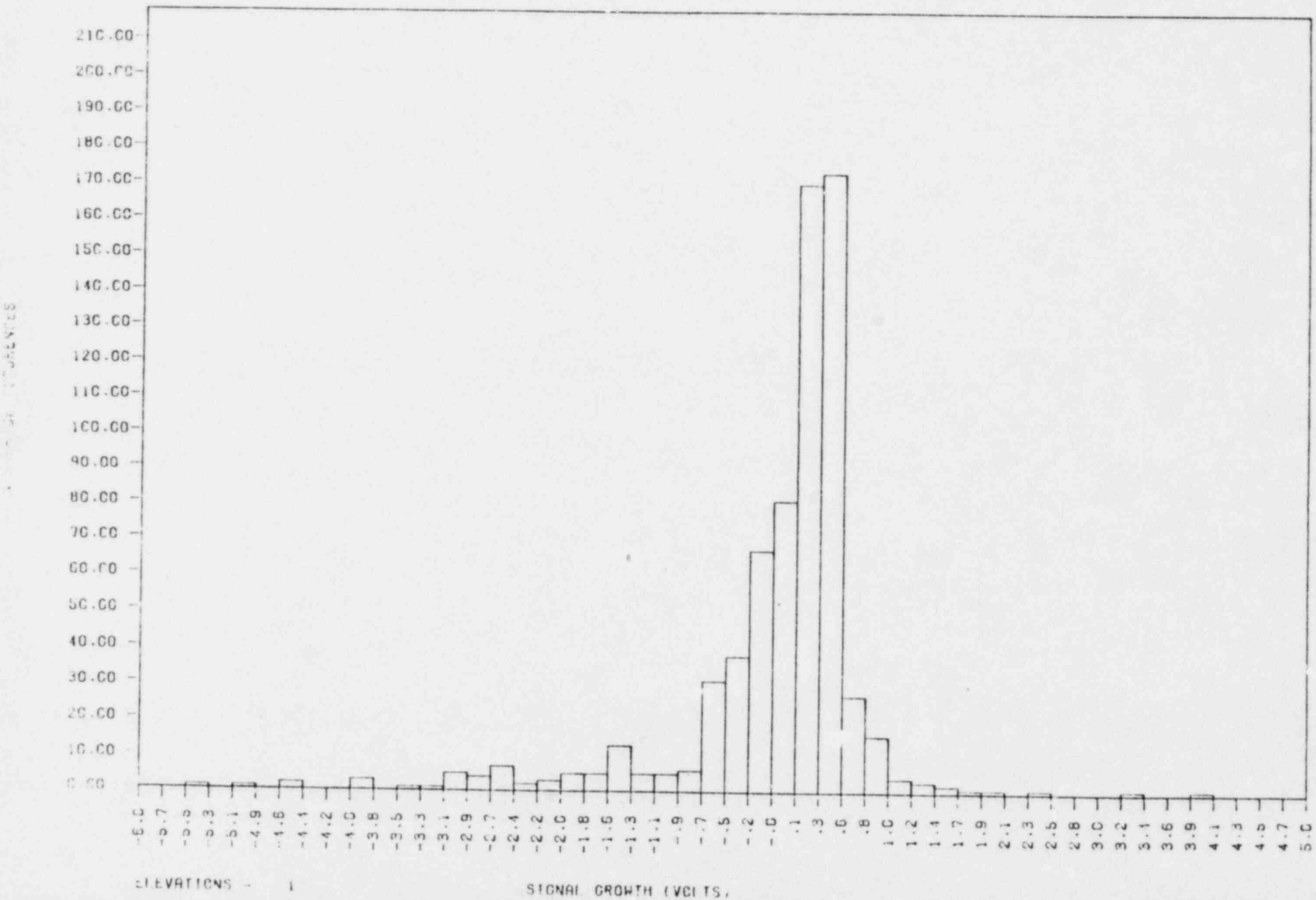
MILLSTONE II

STEAM GENERATOR 2 HOT SIDE

SIGNAL GROWTH VS. NUMBER OF OCCURENCES

INSPECTIONS - MARCH 17, 1979

AUGUST 28, 1980



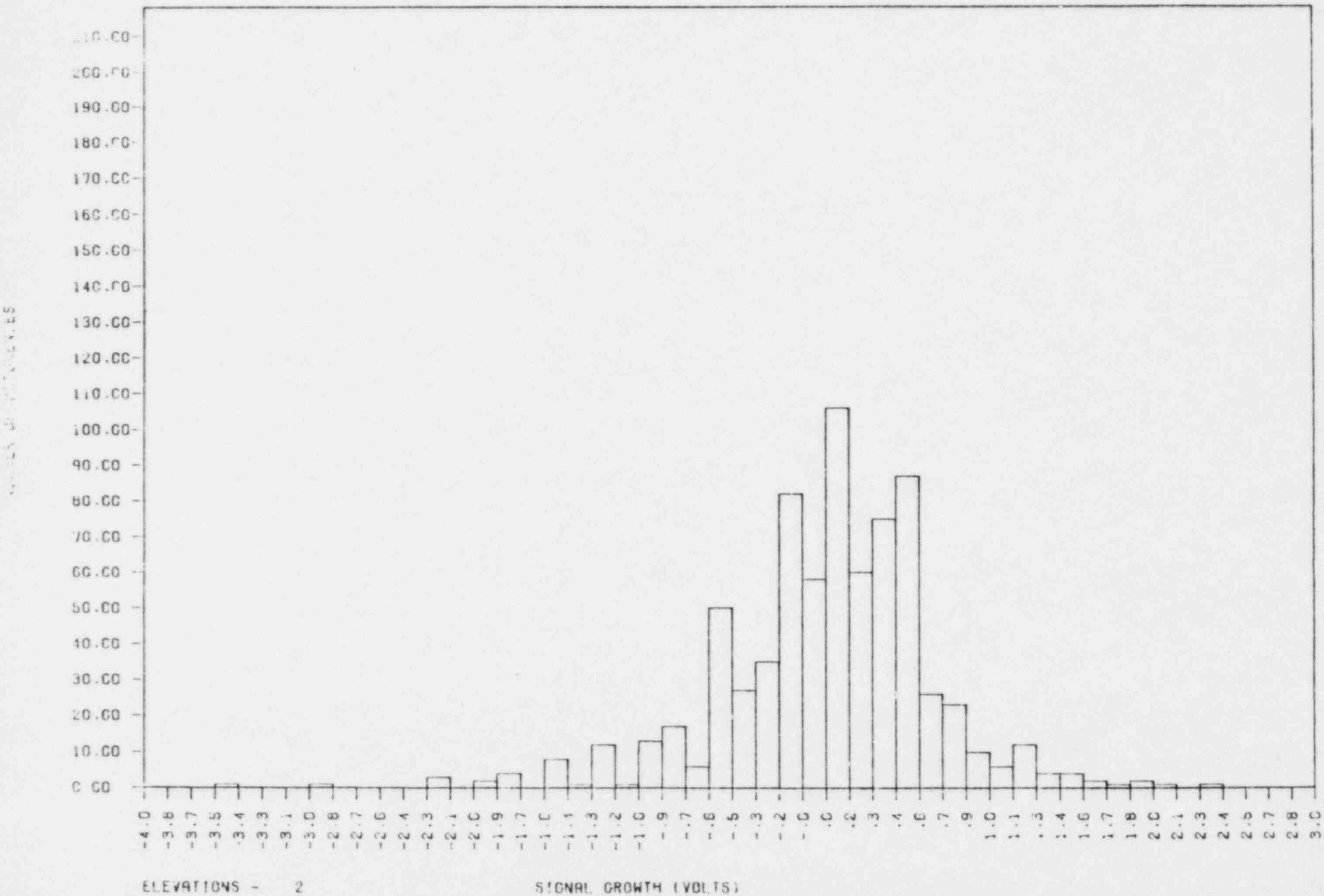
MILLSTONE II

STEAM GENERATOR 2 HOT SIDE

SIGNAL GROWTH VS. NUMBER OF OCCURENCES

INSPECTIONS - MARCH 17, 1979

AUGUST 28, 1980



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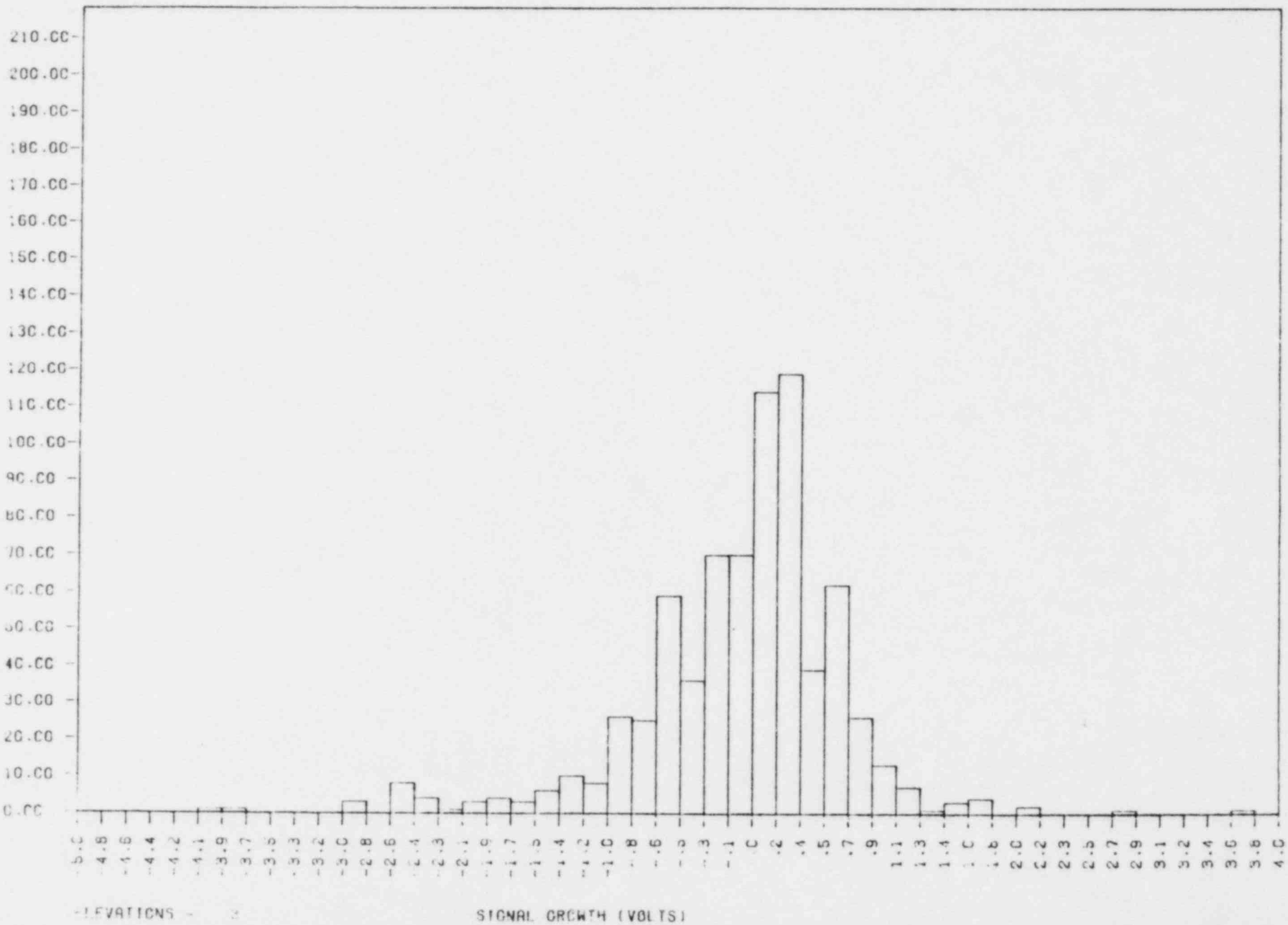
STEAM GENERATOR 2 HOT SIDE
SIGNAL GROWTH VS. NUMBER OF OCCURENCES

INSPECTIONS - MARCH 17, 1979
AUGUST 28, 1980



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STEAM GENERATOR 2 HOT SIDE

SIGNAL GROWTH VS. NUMBER OF OCCURENCES

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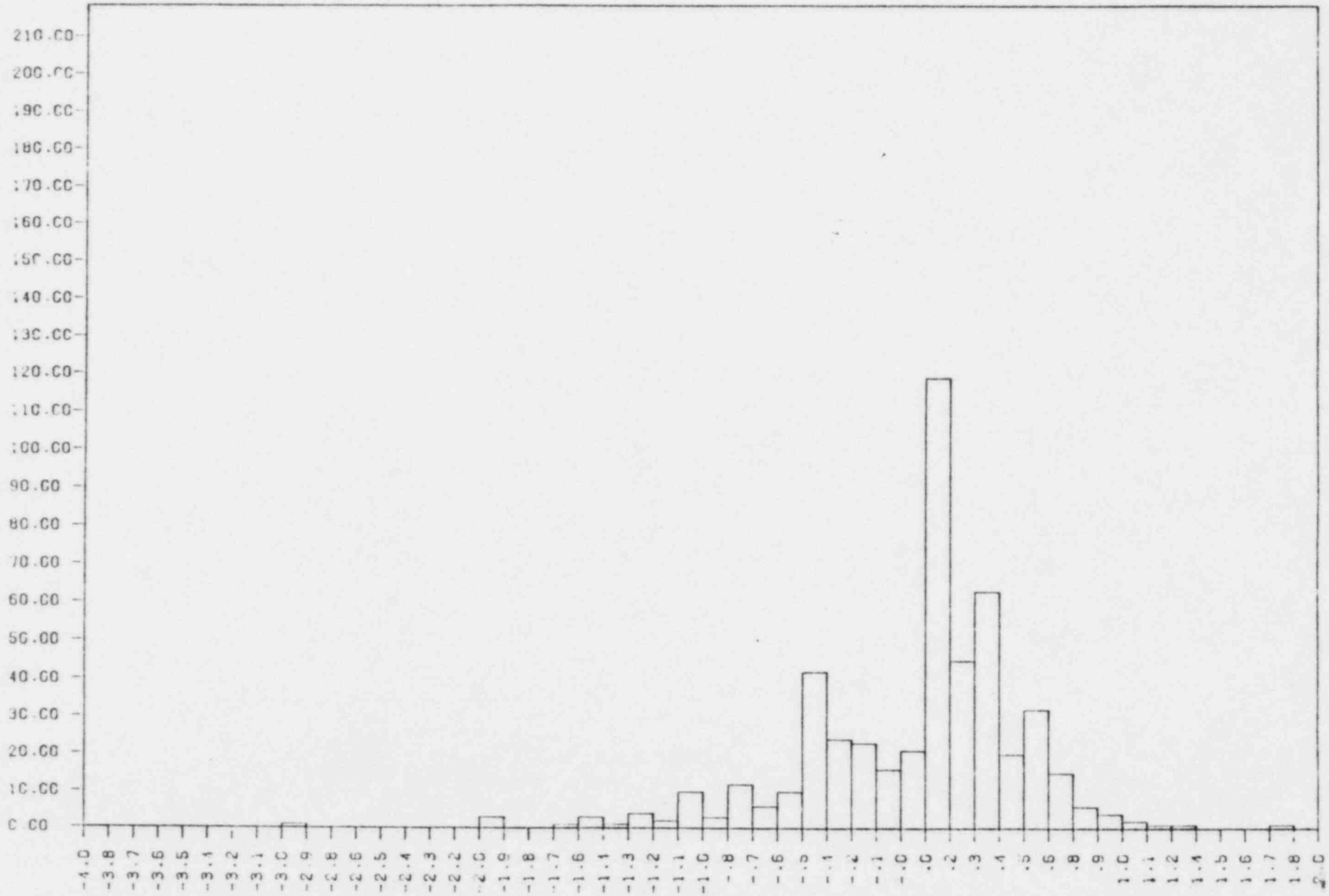
AUGUST 28, 1980



ELEVATIONS - 4

SIGNAL GROWTH (VOLTS)

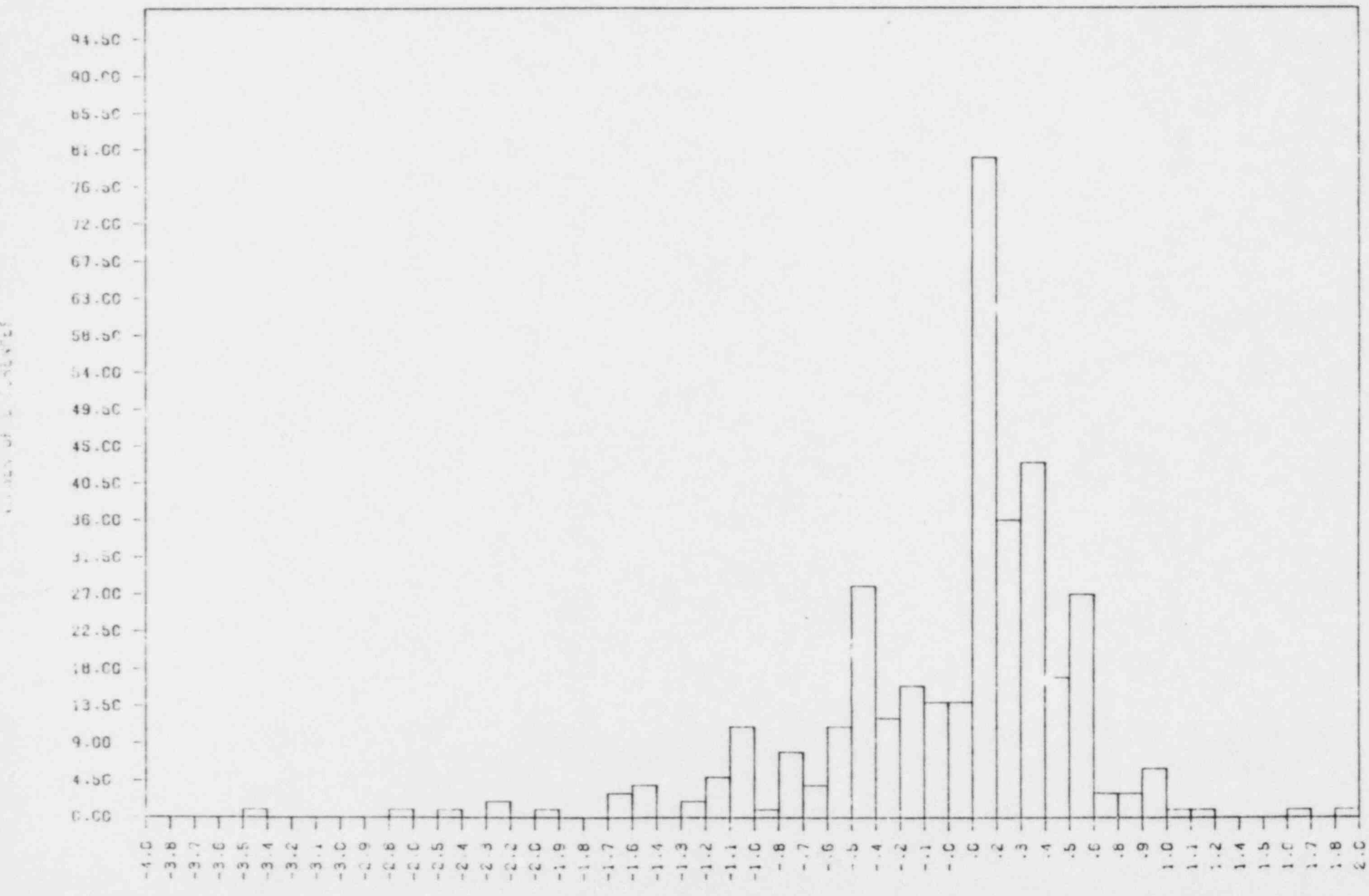
MILLSTONE II

STEAM GENERATOR 2 HOT SIDE

SIGNAL GROWTH VS. NUMBER OF OCCURENCES

INSPECTIONS - MARCH 17, 1979

AUGUST 28, 1980



ELEVATIONS - 5

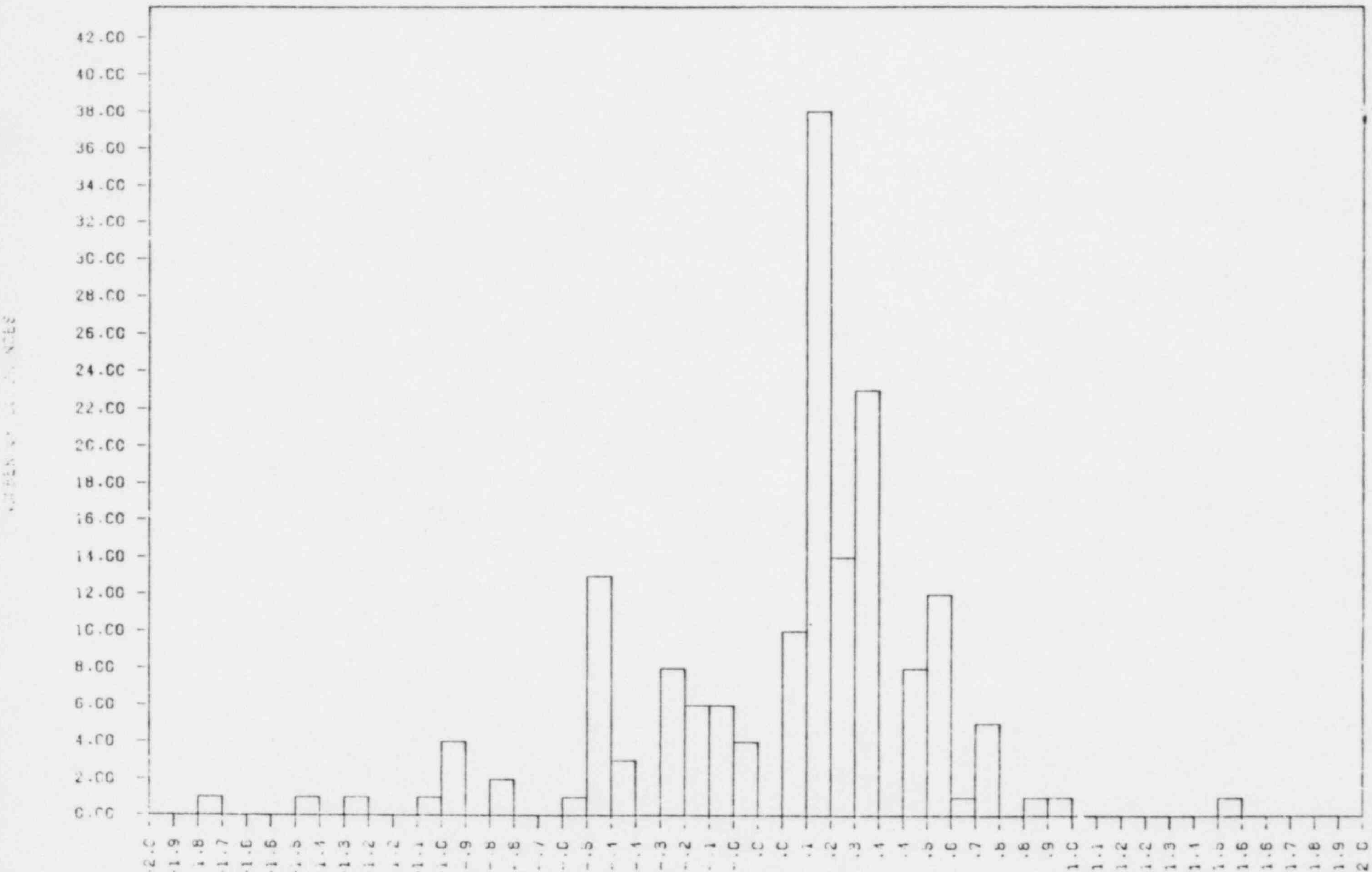
MILLSTONE II

STEAM GENERATOR 2 HOT SIDE

SIGNAL GROWTH VS NUMBER OF OCCURENCES

INSPECTIONS - MARCH 17, 1979

AUGUST 28, 1980



ELEVATIONS - 6

SIGNAL GROWTH (VOLTS)

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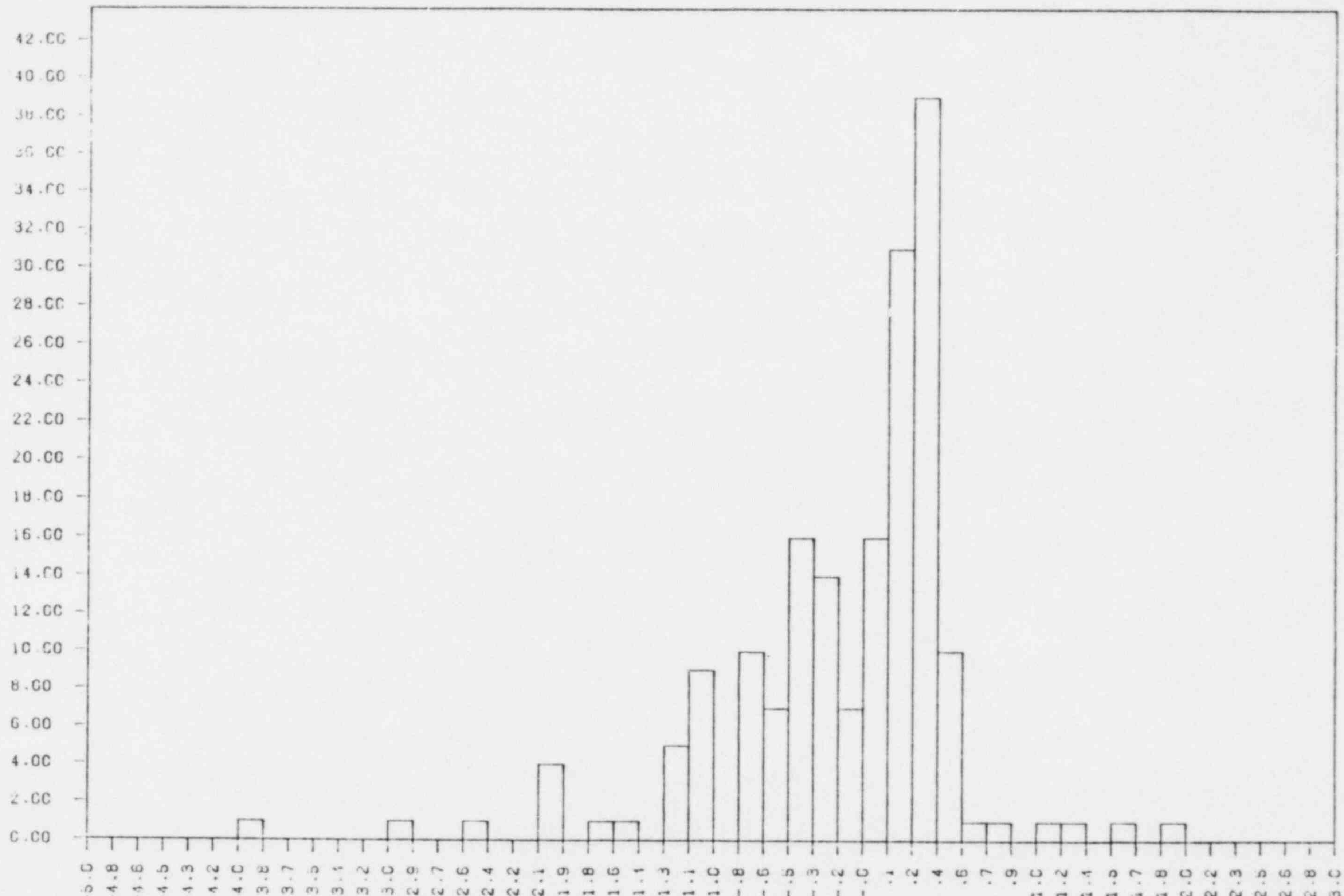
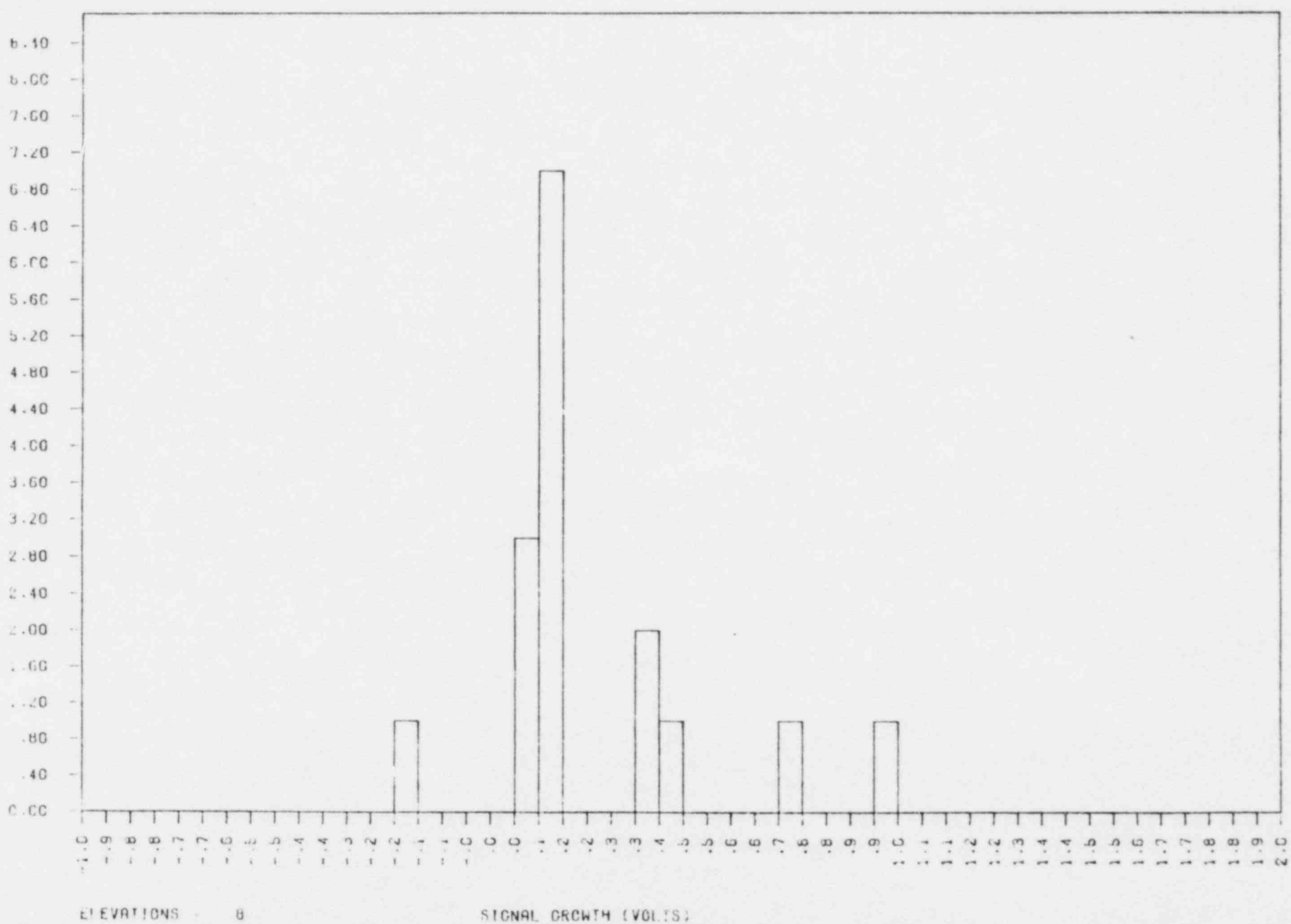
STEAM GENERATOR 2 HOT SIDE
SIGNAL GROWTH VS. NUMBER OF OCCURENCES

INSPECTIONS - MARCH ... 1979
AUGUST 28, 1980



ELEVATIONS - 7

MILLSTONE II   INSPECTIONS - MARCH 17, 1979
STEAM GENERATOR 2 HOT SIDE   AUGUST 28, 1980
SIGNAL GROWTH VS. NUMBER OF OCCURENCES



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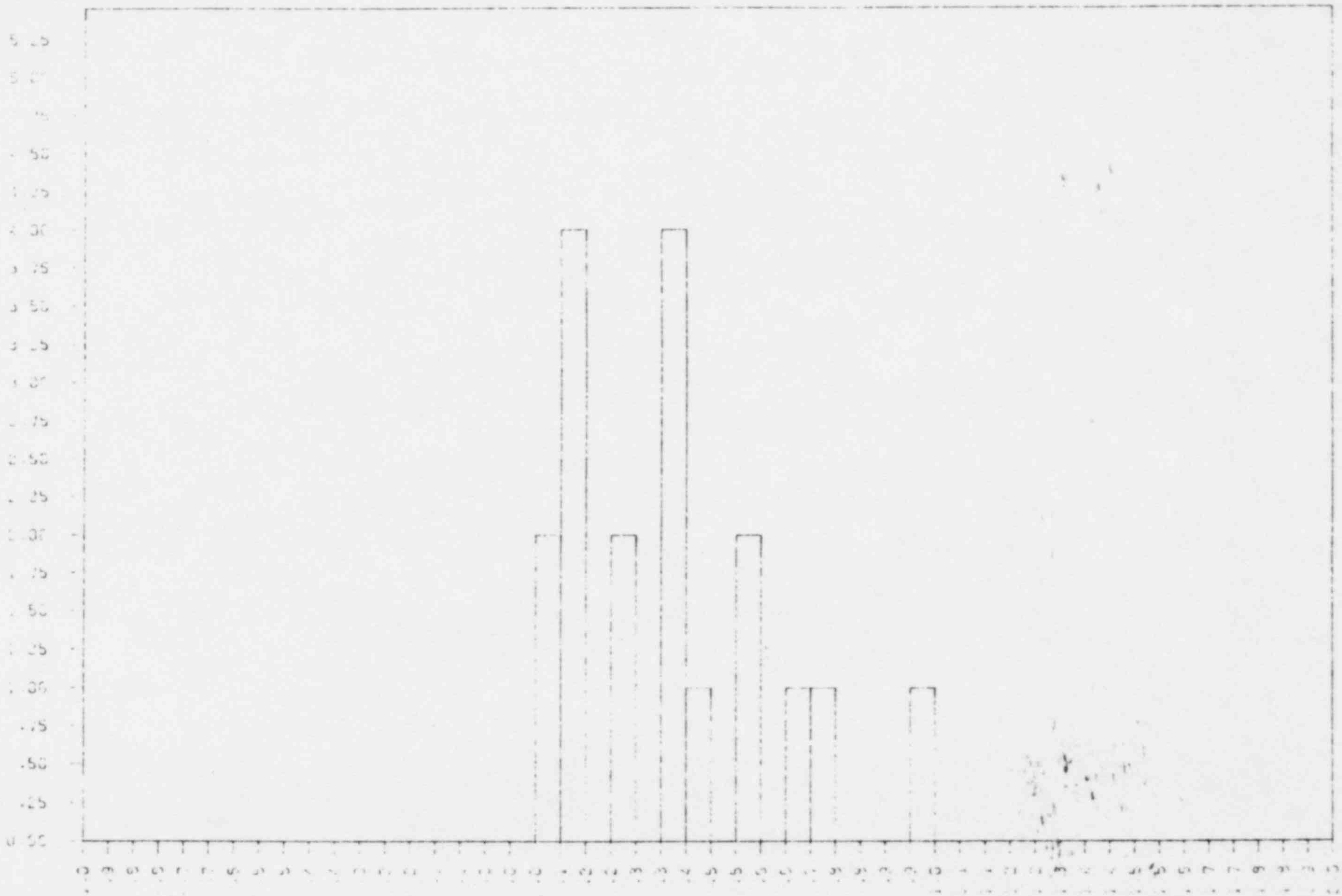

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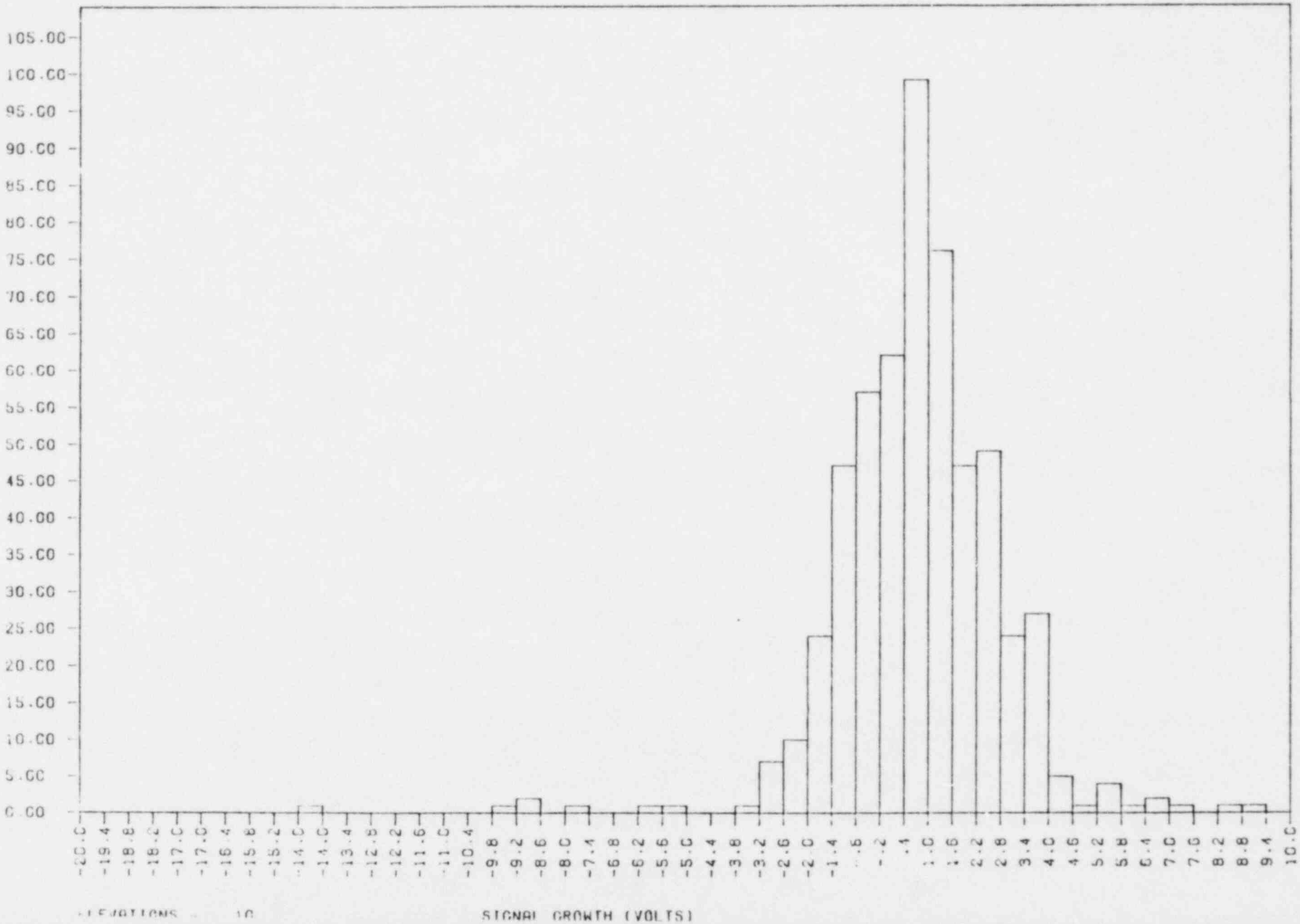
STEAM GENERATOR 2 HOT SIDE
SIGNAL GROWTH VS. NUMBER OF OCCURENCES

INSPECTIONS - MARCH 17, 1979
AUGUST 28, 1980



ELEVATIONS = 10

MILLSTONE II

STEAM GENERATOR 2 HOT SIDE

SIGNAL GROWTH VS. NUMBER OF OCCURENCES

INSPECTIONS - MARCH 17, 1979

AUGUST 26, 1980