THRUST MOVEMENT MONITORING PROGRAM

FOR

OCONEE 1-2-3 MAIN STEAM BYPASS TO CONDENSER

DUKE POWER COMPANY
ENGINEERING DEPARTMENT
MECHANICAL DESIGN SECTION, MECHANICAL & NUCLEAR DIVISION
CHARLOTTE, NORTH CAROLINA

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FILE NO. OS-27B

MDS REPORT NO. OS-73.3

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1. INTRODUCTION AND PURPOSE

In accordance with Section 1C.3.7 of the Oconee Final Safety Analysis Report (FSAR), Duke Power Company agreed to monitor the thrust movements of the Unit 1 Main Steam Bypass to the Condenser Piping, System 01A-1. The purpose of the monitoring program is two-fold:

1) To determine the movement of the system piping during system heat-up and during bypass operation as described in Section V of this report.
2) To review recorded data to assure that combined thermal and thrust movements within the system are acceptable with respect to stress analysis allowables.

II. INTER-COMPANY DIVISION OF RESPONSIBILITY

Responsibility for the implementation of the monitoring program is shared by the Duke Power Company Design Engineering, Construction and Steam Production Departments as outlined below.

1) Design Engineering Department

   a. Establish need for program as described in 1. of this report and Appendix A.
   b. Establish monitoring point locations based on analytical review and as described in Section III of this report.
   c. Establish installation methods of monitoring devices as described in Section IV of this report.
   d. Establish Engineering limitations and precautions as described in Section VI of this report.
   e. Establish data to be recorded during test as described in Section VII of this report.
   f. Make engineering comparison and evaluation of analytical versus actual test data as described in Section VIII of this report.
   g. Define acceptability of results as described in Section IX of this report.
   h. Describe applicability of test results with respect to Unit 2 and 3 as described in Section X of this report.
   i. Preparation of report for AEC review.
   j. Assist Steam Production Department in surveillance of test.

2) Construction Department

   Installation of monitoring point hardware at locations described in Section III and in accordance with methods described in Section IV of this report.

3) Steam Production Department

   a. Develop a procedure for monitoring the thermal and thrust movements of the Main Steam Bypass to the Condenser piping as required by Design Engineering, Appendix A.
   b. Coordinate and schedule with the Construction Department as necessary for the installation of monitoring hardware.
   c. Documentation of monitoring program results in accordance with Oconee Nuclear Station Test Procedure TP/1/B/270/8-1 (See Appendix A).
   d. Transmittal of monitoring data to the Engineering Department for review and approval and subsequent preparation of Thrust Movement Monitoring Report.

III. DETERMINATION OF MONITORING POINT LOCATIONS

Monitoring points are located at positions undergoing measurable expansion movements most likely to move under thrust conditions as shown on Figure 1 and 2 of Appendix B of this report.

Monitoring Point	Date Required	Attachment Location
1	Combined Thermal and Thrust Movement of Main Steam line "1B" in X, Y & Z directions parallel to "M" line.	On pipe clamp that connects hydraulic suppressor to pipe at Column 15.
2	Combined Thermal and Thrust Movement of Main Steam line "1A" in X, Y & Z directions parallel to "M" line.	On pipe clamp that connects hydraulic suppressor to pipe at Column 16.
3	Combined Thermal and Thrust Movement of by-pass line to condenser at El. 805'-0" parallel to "M" line.	On pipe clamp that connects hydraulic suppressor to pipe at Column 17.
4	Combined Thermal and Thrust Movement of top bypass line to condenser at El. 807'-0" parallel to "M" line.	On pipe clamp that connects hydraulic suppressor to pipe at Column 17.
5	Combined Thermal and Thrust Movement of By-pass line to condenser at El. 805'-0" parallel to "M" line.	On pipe clamp that connects hydraulic suppressor to pipe at Column 19.

IV. INSTALLATION METHODS FOR MONITORING POINT HARDWARE

A schematic sketch of the monitoring hardware is shown in Figure 3 of Appendix B of this report. Note that the monitoring hardware is comprised of 2 major components only; a pencil mechanism and a monitoring device.

Pencil mechanisms are attached to the pipe clamp connecting hydraulic suppressors to the piping at each location. The pencil mechanisms are constructed so as to maintain marking pressure on the monitoring device under all possible movements of the piping system. Associated rigidly mounted monitoring devices are attached to nearby Turbine Building structural steel columns. Installation is similar for all five (5) monitoring points.

V. SYSTEM TEST SEQUENCE AND DESCRIPTION

In an effort to meet the Duke Design Engineering Department Quality Assurance requirements for operational systems as described in FSAR 1C.3.7 and obtain data suitable for the preparation of this report, the Oconee Nuclear Station Steam Production Department prepared and executed test procedure TP/1/B/270/8-1 "Main Steam Bypass to Condenser Piping, System Thrust Movement Monitoring Test". This procedure is made a part of this report as Appendix A.

Duke's Design Engineering Department reviewed and accepted the test procedure prior to its initial use.

VI. ENGINEERING LIMITATIONS AND PRECAUTIONS

Approximate allowable movements for the Main Steam and bypass lines as listed in Appendix B (Figure 1 & 2) were established as limiting criteria for combined thermal and Thrust system movements.

These limitations were developed based on an engineering review of existing design analysis stress results and stress allowables.

Since an observer from Design Engineering observed the test, continued operation of the system after the test was dependant on the observer's review of the data immediately following the test.

VII. DATA RECORDED

The extent of information recorded is described in test procedure TP/1/B/270/8-1 (Appendix A).

Data recorded either meets or exceeds the information required for this report and is in accordance with Duke Design Engineering Department requirements.

In an effort to make this report more meaningful and brief, only the information required to confirm and satisfy the purpose of the report is tabulated in Appendix D along with the allowable analytical information for comparative purposes.

VIII. COMPARISON OF ANALYTICAL VERSUS TEST RESULTS

A comparison of allowable movements versus the actual measured movements is made for each point of interest in Appendix D. The comparison is presented in the form of Percentage of Allowable Movement such that the overall picture of actual readings versus analytical allowables can be reviewed and determined.

Review of the data clearly indicates that all combined thermal and thrust movements were well within the allowable limitations. From Appendix D, it can be noted that the maximum average movements of the piping was 66.4% or less of the engineering limitations.

IX. CONCLUSIONS

Based on the information presented in Appendix D and as summarized in Section VIII of this report, the thrust movements of the Main Steam Bypass to the Condenser Piping exhibited the following average % of allowable movements:

% of Allowable X(North-South Direction)	% of Allowable Y(Vertical Direction)	% of Allowable Z(East-West Direction)
62.7%	60.8%	66.4%

for an overall average % of allowable of 63.3%.

The following conclusions are made as the result of this study.

1) All thrust movements were well within the allowable movement, indicating actual thrust movements of the system are in accordance with original design considerations.
2) The system behaved as predicted by stress analysis techniques, thereby confirming analytical methods.
3) Actual thrust movements were controlled by the use of hydraulic suppressors, thereby confirming the effectiveness of this type of equipment and the analytical method used in determining the location of such equipment.
4) The Main Steam Bypass to Condenser Piping is adequately designed and supported for the intended service.

X. APPLICABILITY OF TEST TO UNITS 2 & 3

Main Steam Bypass to Condenser Piping for all three Oconee units is similar in arrangement, in design conditions, and in all physical parameters such as piping wall thickness, materials of construction, support and restraint location, etc., that would have a bearing on the thrust movement analysis. Thus, the results of the thrust movements monitoring test on Unit 1 are totally acceptable and indicative of results that would be expected from monitoring Units 2 and 3.

Since the purpose of this monitoring program was academic in nature, only the Unit 1 Main Steam Bypass to Condenser Piping will be monitored.

APPENDIX A

OCONEE NUCLEAR STATION

TEST PROCEDURE TP/1/B/270/8-1

FINAL

DUKE POWER COMPANY

OCONEE NUCLEAR STATION

MAIN STEAM BYPASS TO CONDENSER PIPING SYSTEM

THRUST MOVEMENT MONITORING TEST

1.0 Purpose

To measure movement of the Main Steam and bypass to condenser lines following a deliberate Turbine Trip from power.

2.0 References

2.1 Drawing 0-401A, Rev. 19

2.2 TP/1/A/800/4, Turbine-Reactor Trip Test

2.3 EP/1800/2, Turbine Trip

2.4 OP/1/1202/2, Turbine Trip

3.0 Time Required

One (1) hour

4.0 Prerequisite Test

TP/1/A/800/14, Turbine-Reactor Trip Test (corequisite with Turbine Trip portion)

5.0 Test Equipment

Five (5) motion monitoring devices

6.0 Limitations and Precautions

Take proper precautions to insure safety to all personnel during this test of Main Steam Line Movement.

7.0 Required Unit Status

____ Unit ready for heatup to cold conditions of Zero Power Physics Tests.

8.0 Prerequisite System Conditions

_____8.1 Secondary side in normal operation.

_____8.2 Notify Engineering Department two (2) days prior to Main Steam and Bypass to Condenser Lines Thrust Movement Monitoring Test so an observer can be present.

9.0 Test Method

Motion of the Main Steam Lines and Bypass Lines are to be measured by monitoring devices installed at Columns 15, 16.17, 18, and 19. Prior to the trip of the turbine Main Steam Lines and Bypass Lines expansion from cold to hot position is to be monitored and recorded. During a Turbine Trip, Main Steam Lines and Bypass Lines motion are to be monitored and recorded.

10.0 Data Required

10.1 Main Steam Lines movement

10.2 Main Steam Lines pressure

11.0 Acceptance Criteria

The movement of the Main Steam Lines is satisfactory as determined by the Design Engineering Department and preparation of subsequent report, on FSAR, Section 1C.3.7)

12.0 Procedure

_____12.1 Mark a Zero Reference Point on all monitoring devices prior to heatup above ambient temperature. (Prior to heatup for Zero Power Physics Test)

_____12.2 After reaching and recording a Reactor Coolant System temperature of 532°F, a Reactor Coolant Pressure of 2155 psia and noting the direction of Main Steam Lines movement, remove the chart and attach it to the procedure. All charts to be uniquely identified to monitoring device, applicable plane located on the device and for applicable set of readings.

_____12.3 Attach a new chart and mark a new Zero Reference Point.

_____12.4 When RCS reads 579°F and 2155 psia, mark the chart.

_____12.5 At 40% power, trip the turbine in accordance with TP/1/A/800/14.

_____12.6 Remove marking charts from all monitoring devices (noting direction of pipe movements) after all transients have settled out and attach to test procedure.

13.0 Enclosures

13.1 Drawing No. O-401A, Rev. 19

13.2 Explanation letter from Engineering Department

13.3 Sketch of Motion Monitoring Devices

Enclosures are not necessary for MDS Report #73.3. See Appendix B for equivalent informatic

/mcb

APPENDIX B

OCONEE NUCLEAR STATION

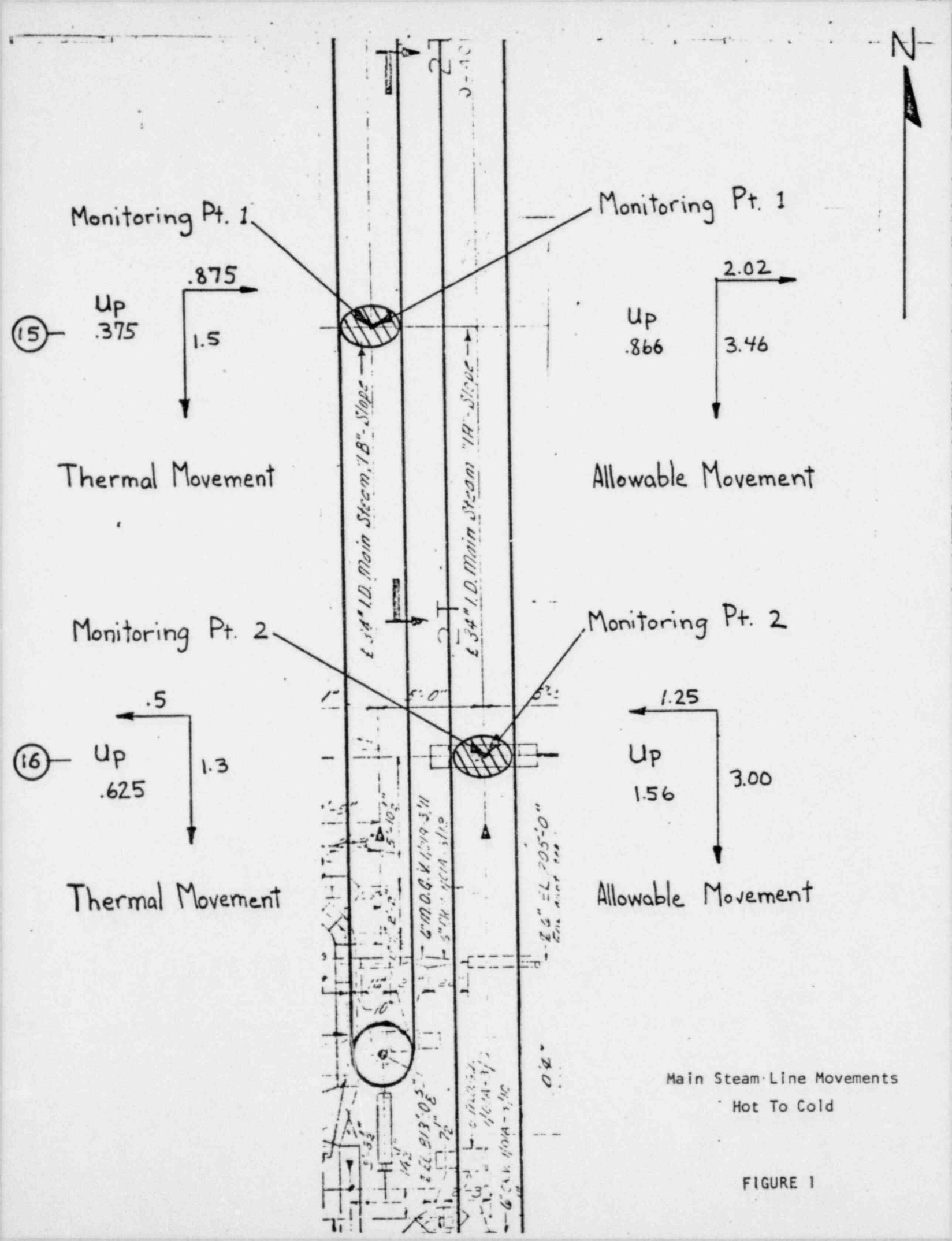
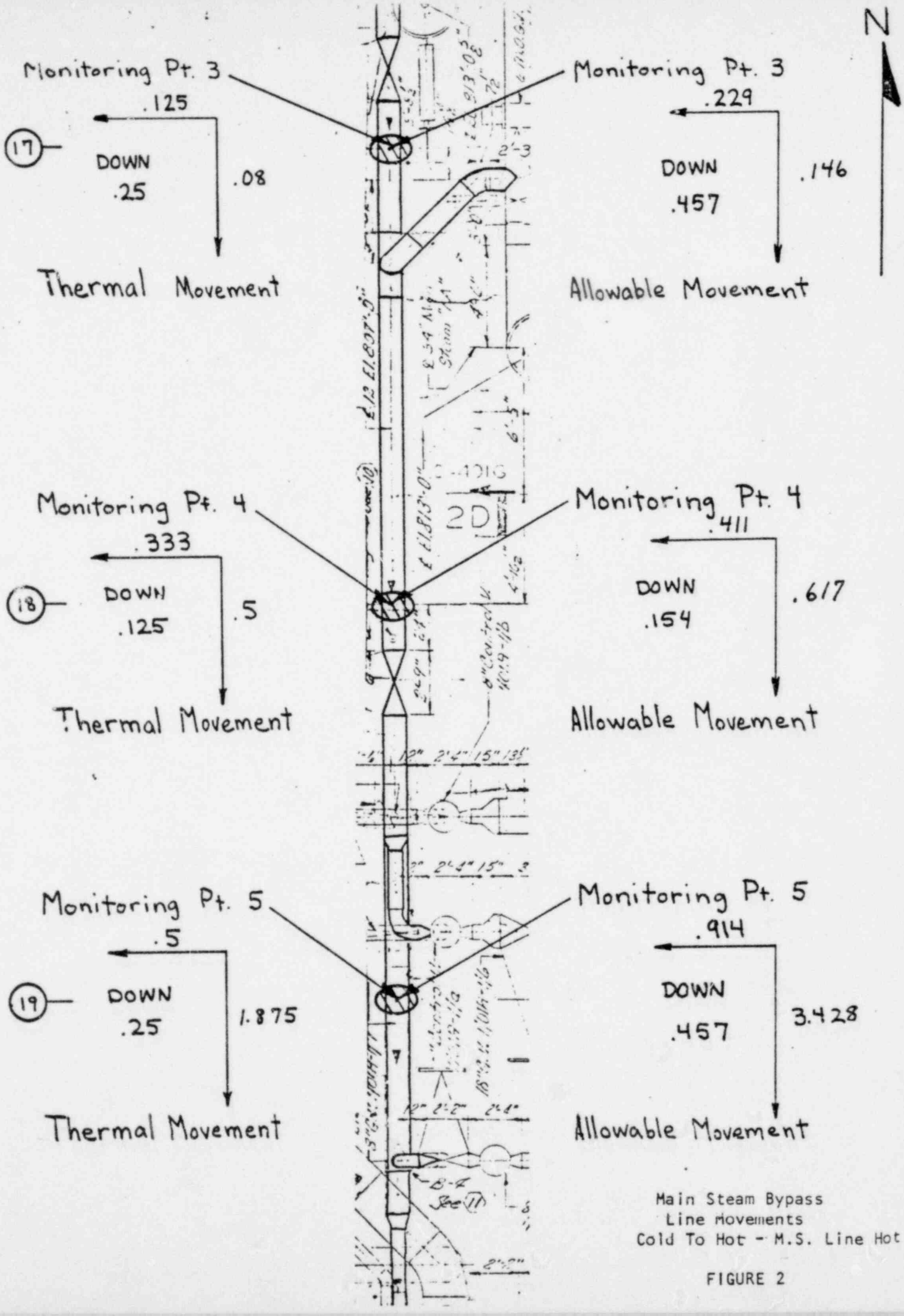
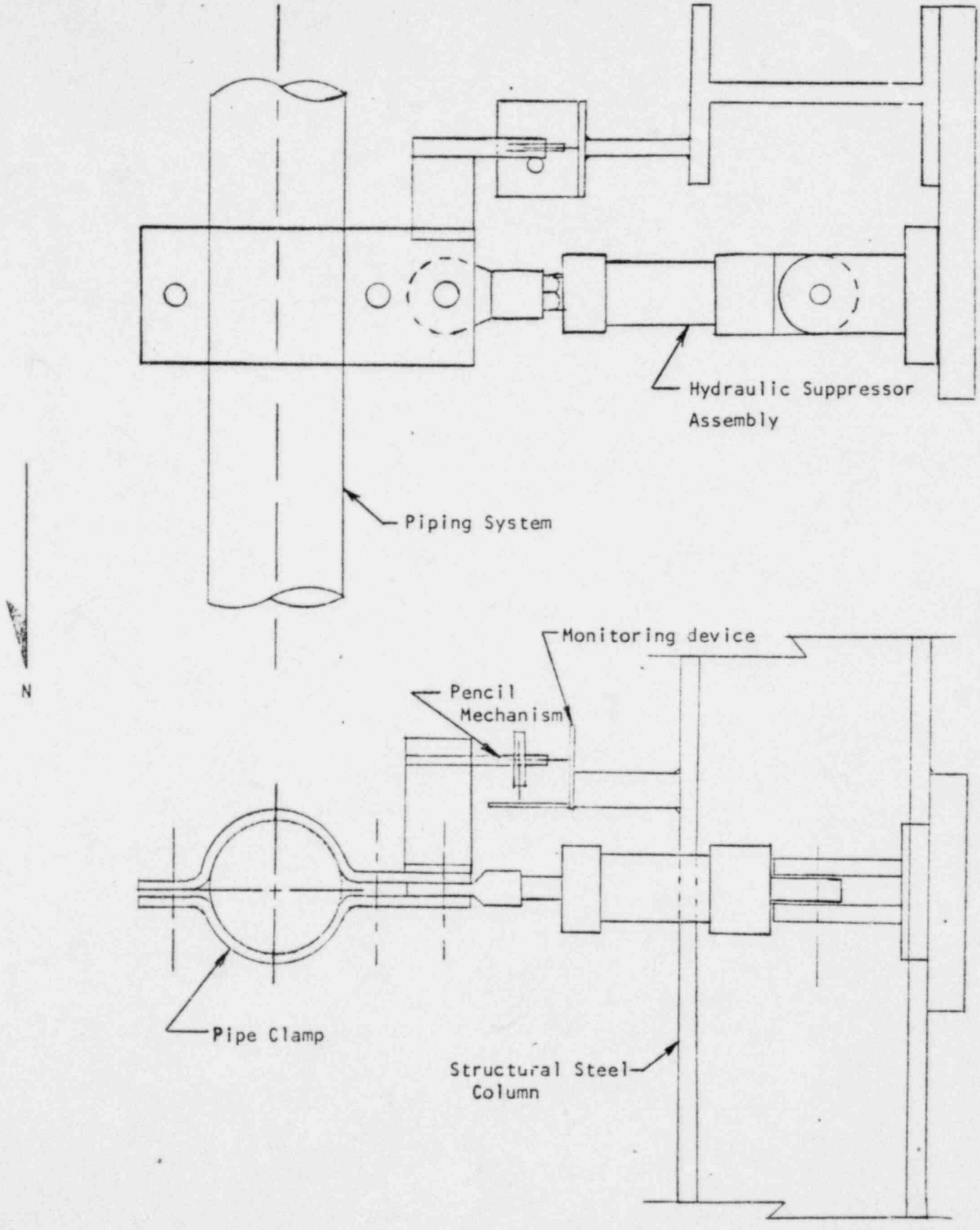

N
Monitoring Pt. 1
Monitoring Pt. 1
.875
Up
.375
1.5
15
2.02
Up
.866
3.46
Thermal Movement
Allowable Movement
Monitoring Pt. 2
Monitoring Pt. 2
.5
Up
.625
1.3
16
1.25
Up
1.56
3.00
Thermal Movement
Allowable Movement
E 34" I.D. Main Steam, 1'8"- Slope
E 34" I.D. Main Steam 1'8"- Slope
Main Steam Line Movements
Hot To Cold

FIGURE 1



Main Steam Bypass
Line Movements
Cold To Hot - M.S. Line Hot

FIGURE 2



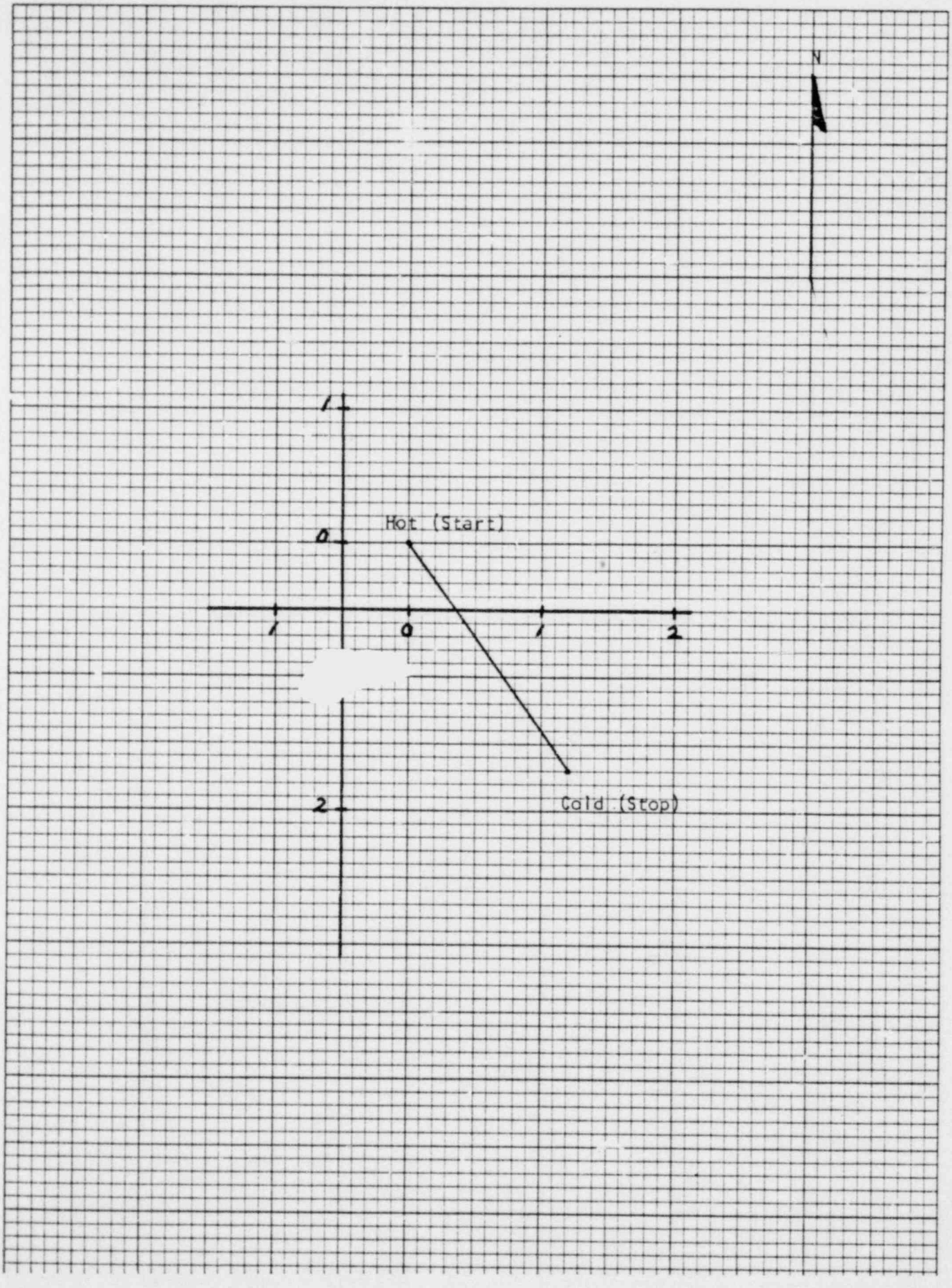
Sketch of Monitoring Hardware

FIGURE 3

APPENDIX C

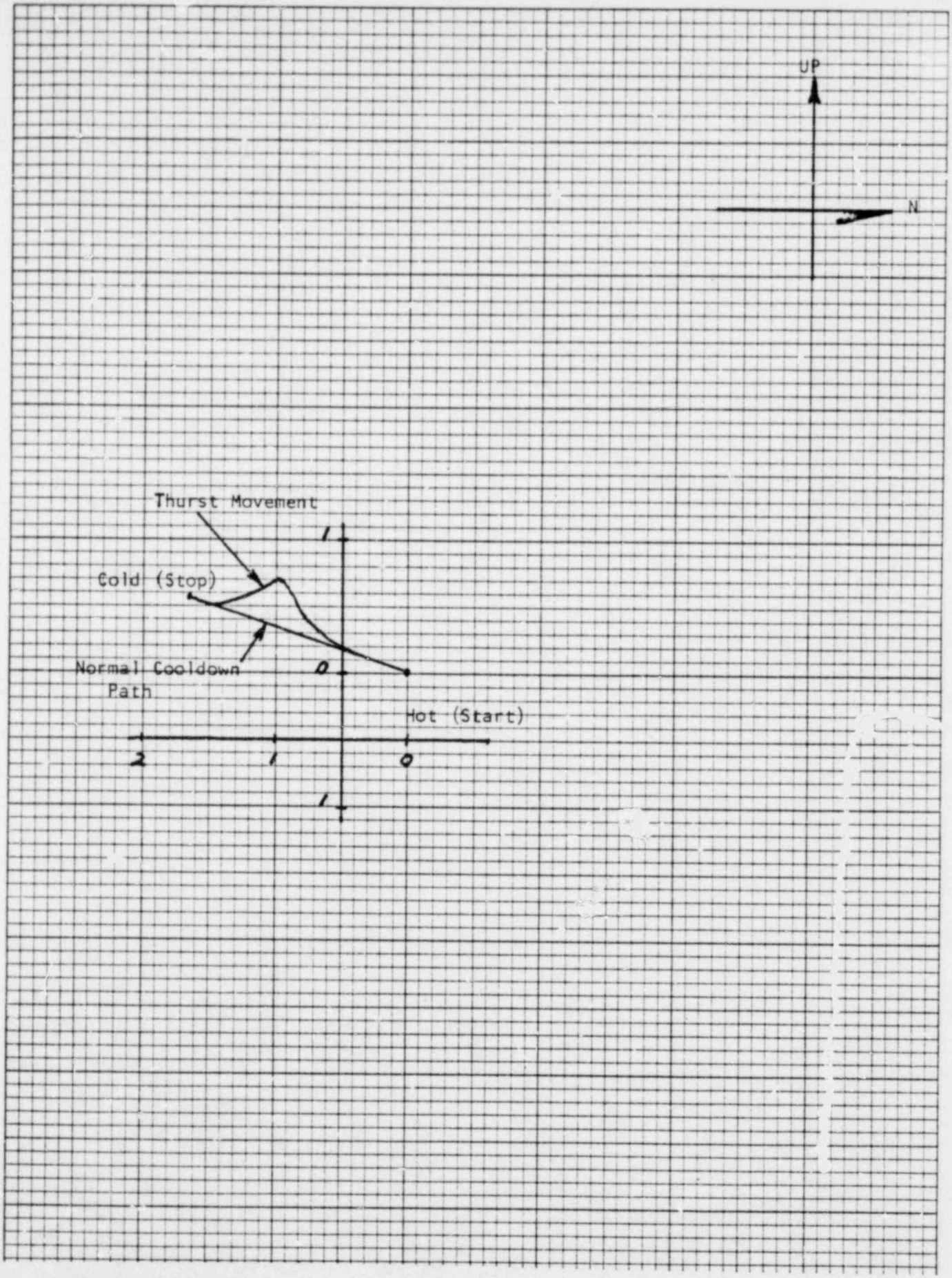
OCONEE NUCLEAR STATION

THRUST MOVEMENTS



Scale: Actual (1 major division = 1")
(1 minor division = 0.1")

Monitoring Point #1
"1B" Main Steam Line
Horizontal Movement (Hot to Cold)



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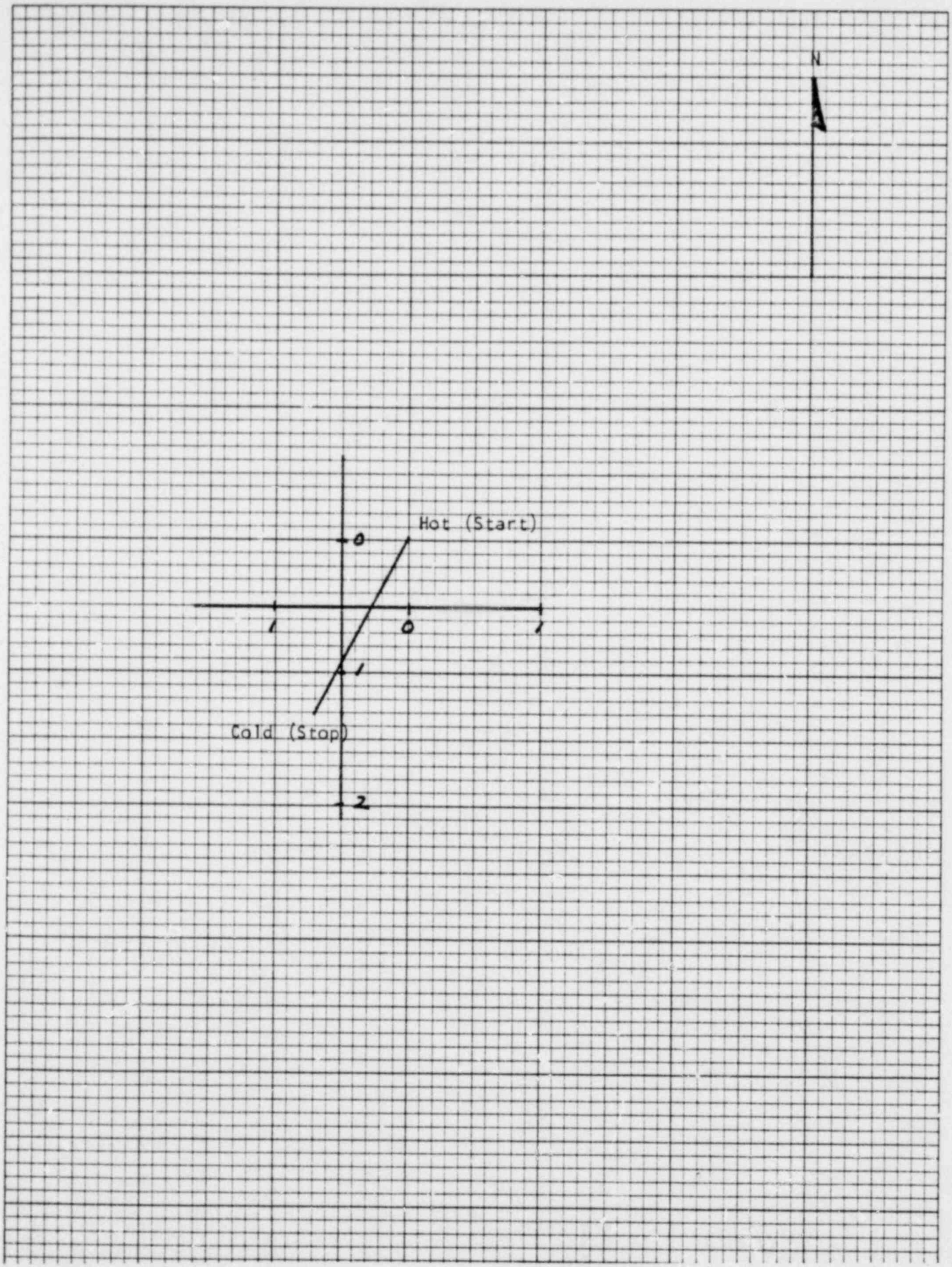
10 X 10 PER INCH

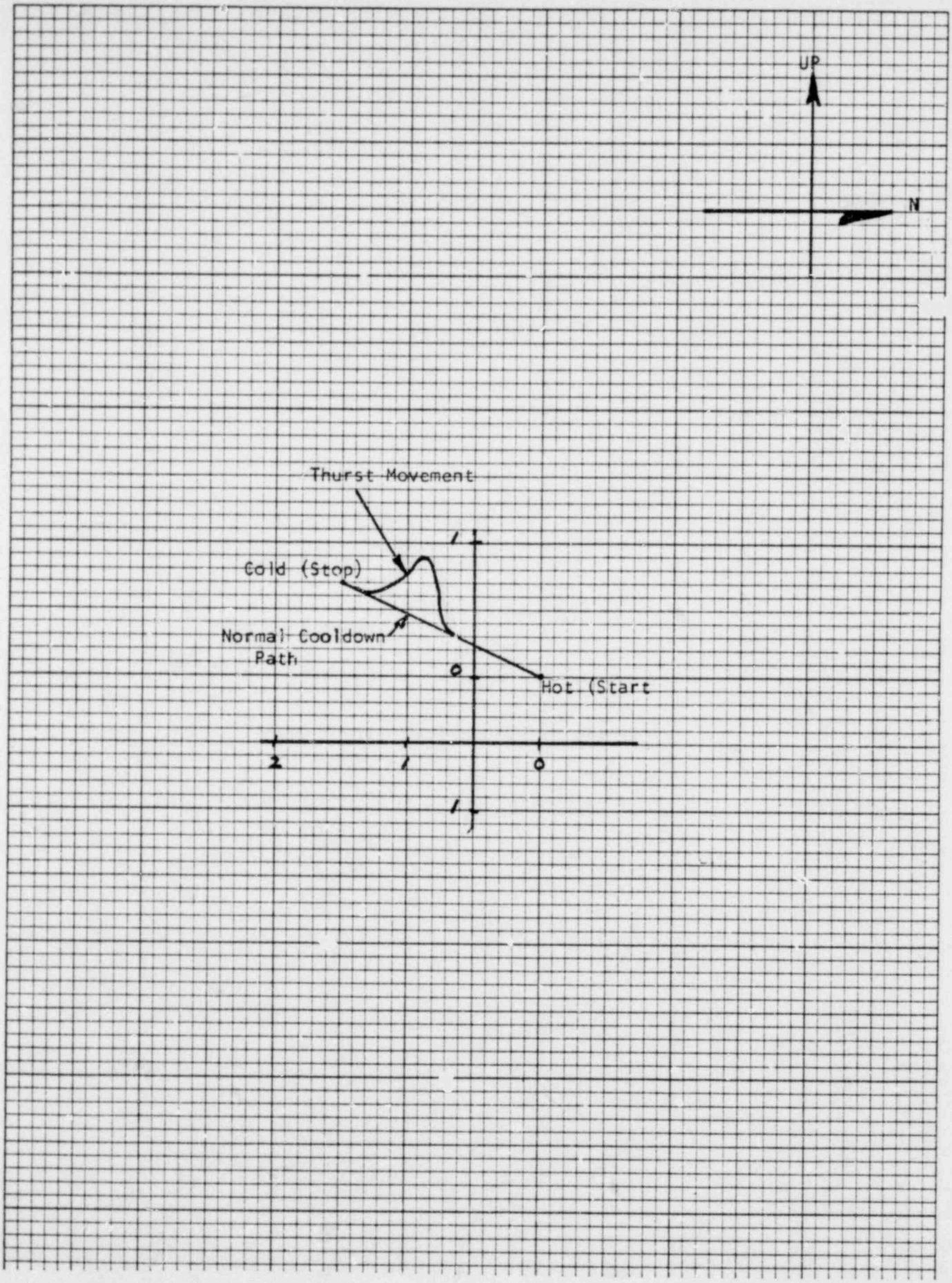
Scale: Actual (1 major division = 1")
(1 minor division = 0.1")

Monitoring Point #1
"18" Main Steam Line
Vertical Movement (Hot to Cold)



Scale: Actual (1 major division = 1")
(1 minor division = 0.1")

Monitoring Point #2
"1A" Main Steam Line
Horizontal Movement (Hot to Cold)



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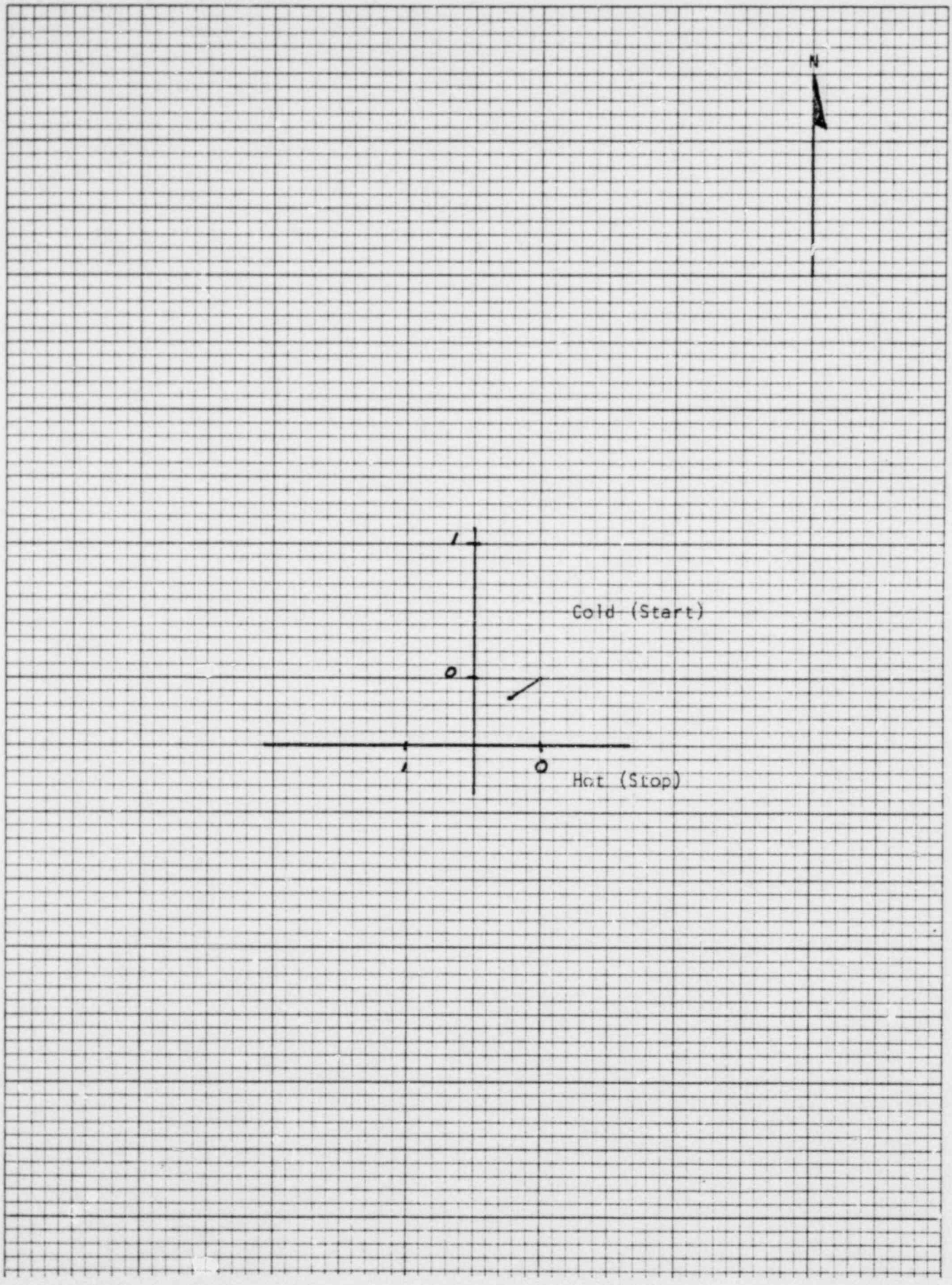
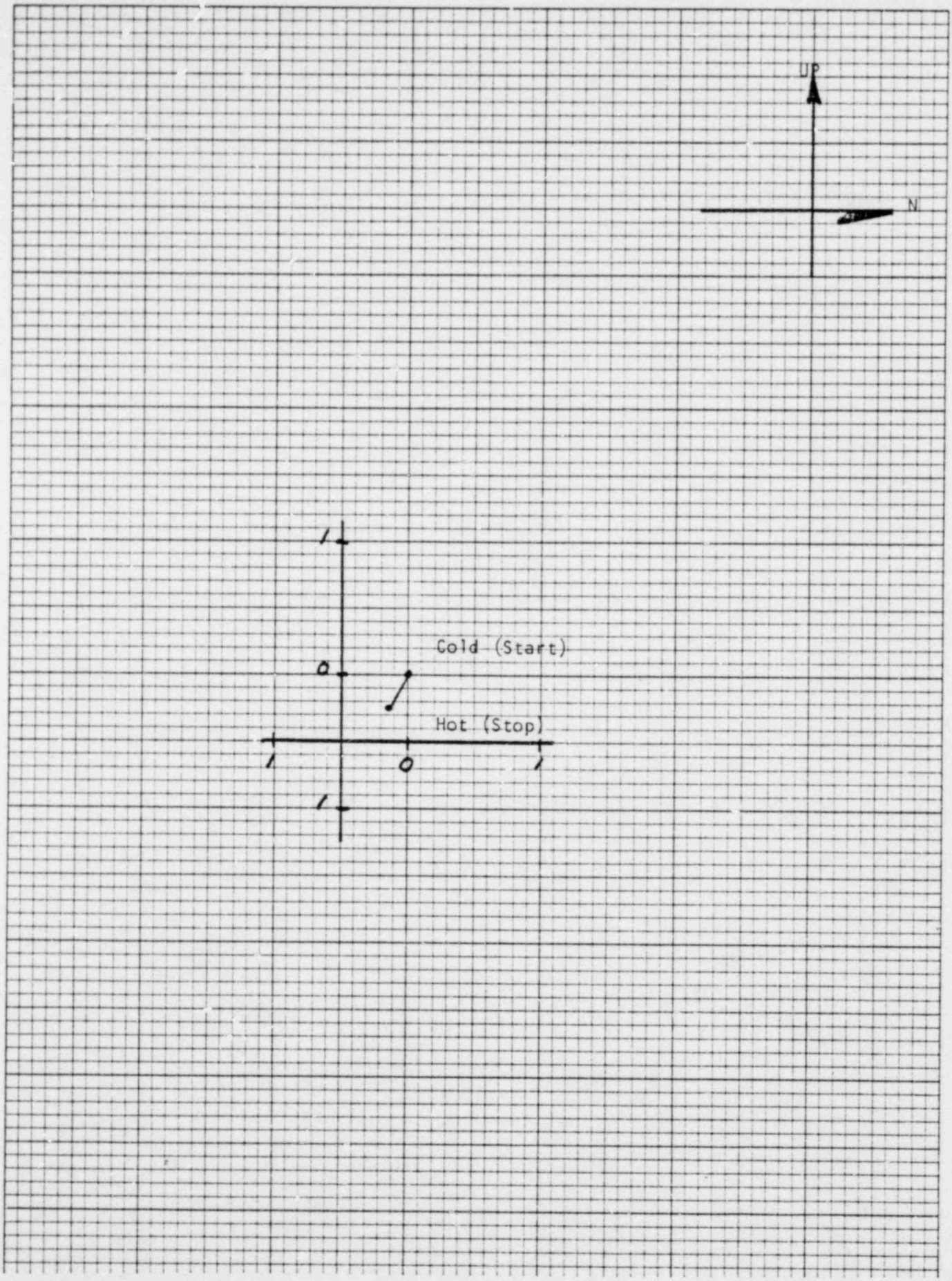
Scale: Actual (1 major division = 1")
(1 minor division = 0.1")

Monitoring Point #2
"1A" Main Steam Line
Vertical Movement (Hot to Cold)



Scale: Actual (1 major division = 1")
(1 minor division = 0.1")

Monitoring Point #3
"B" Main Steam Bypass Line
Horizontal Movement (Cold to Hot)



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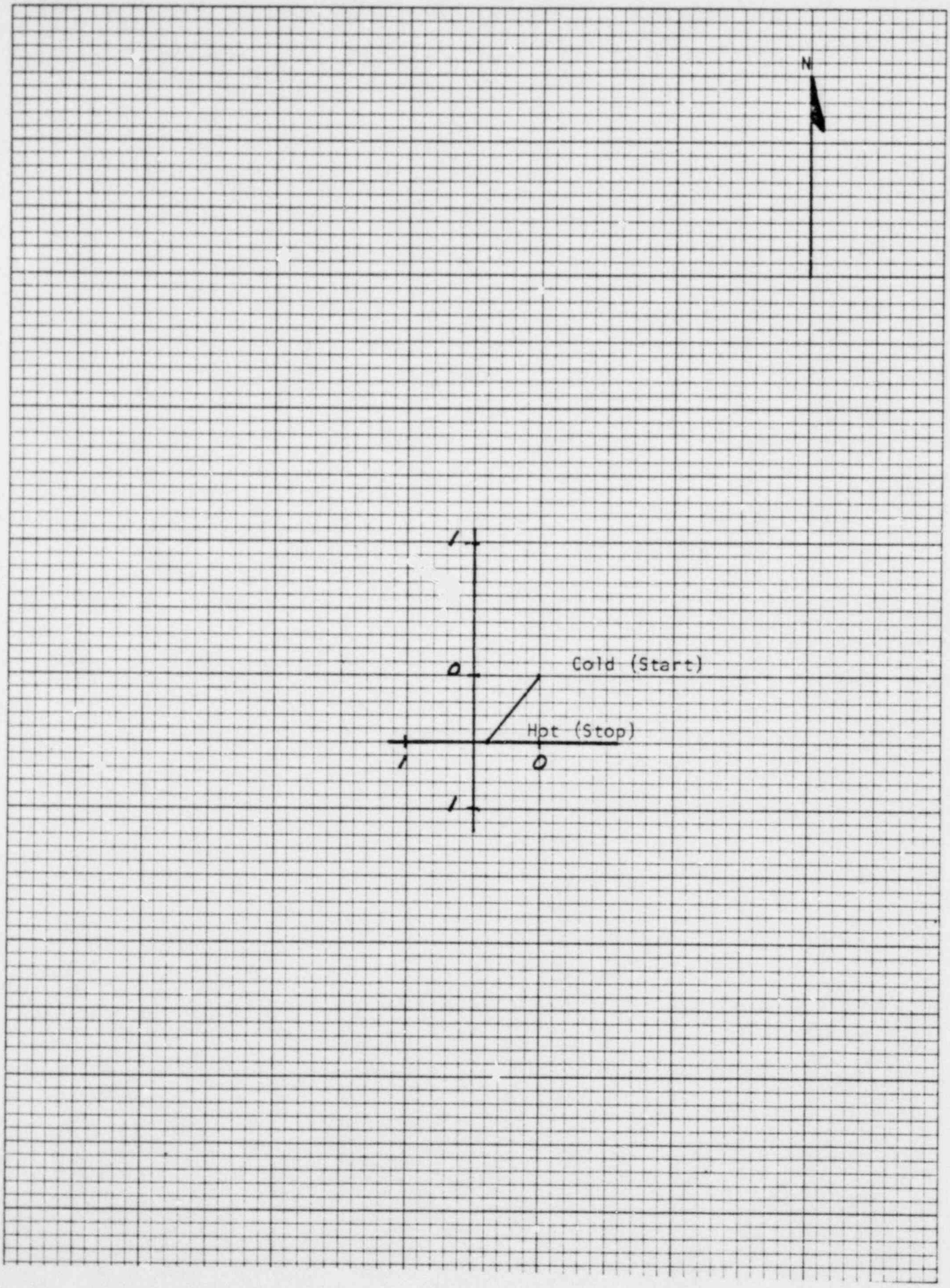
NO 340-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH

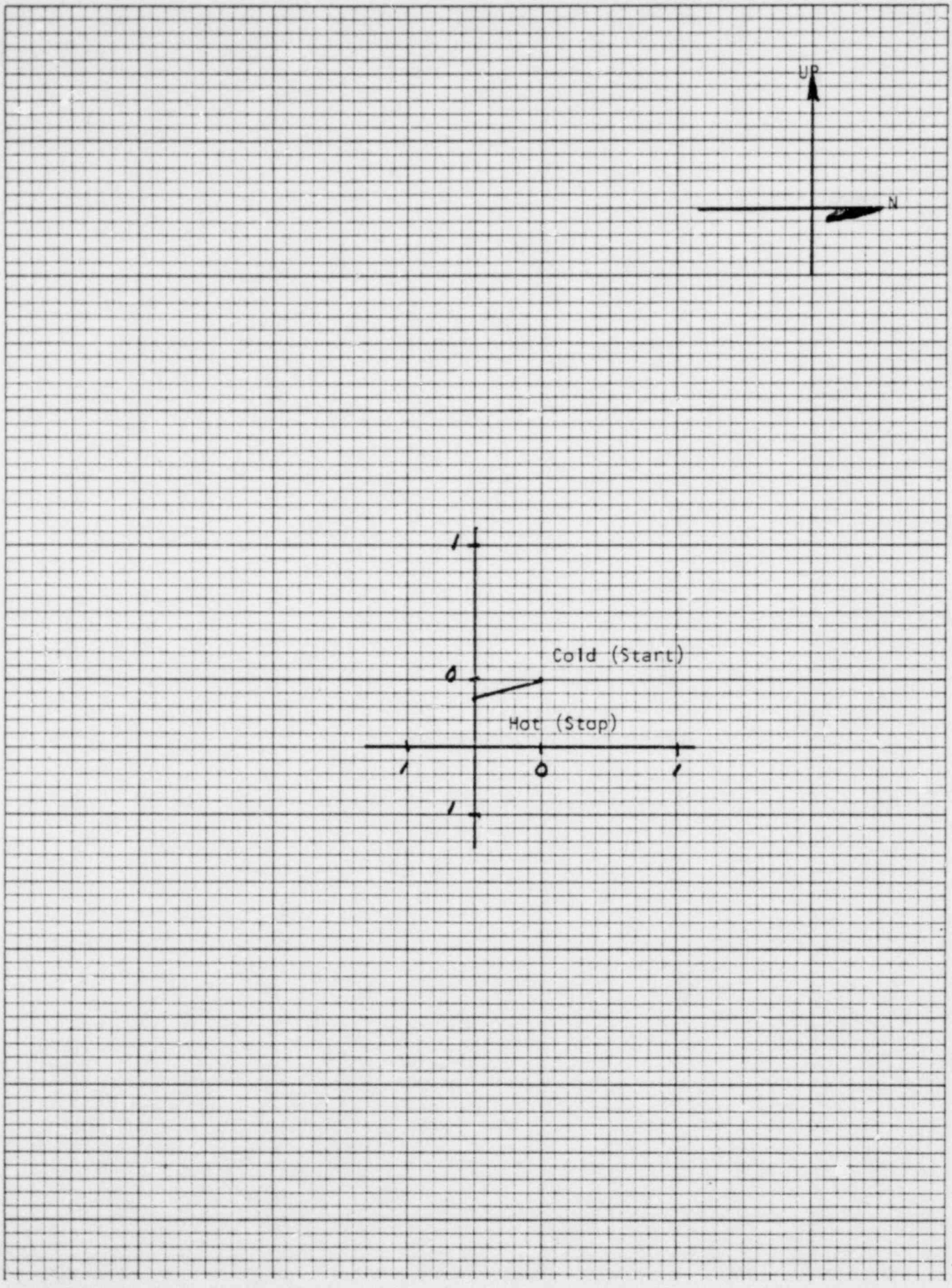
Scale: Actual (1 major division = 1")
(1 minor division = 0.1")

Monitoring Point #3
"B" Main Steam Bypass Line
Vertical Movement (Cold to Hot)



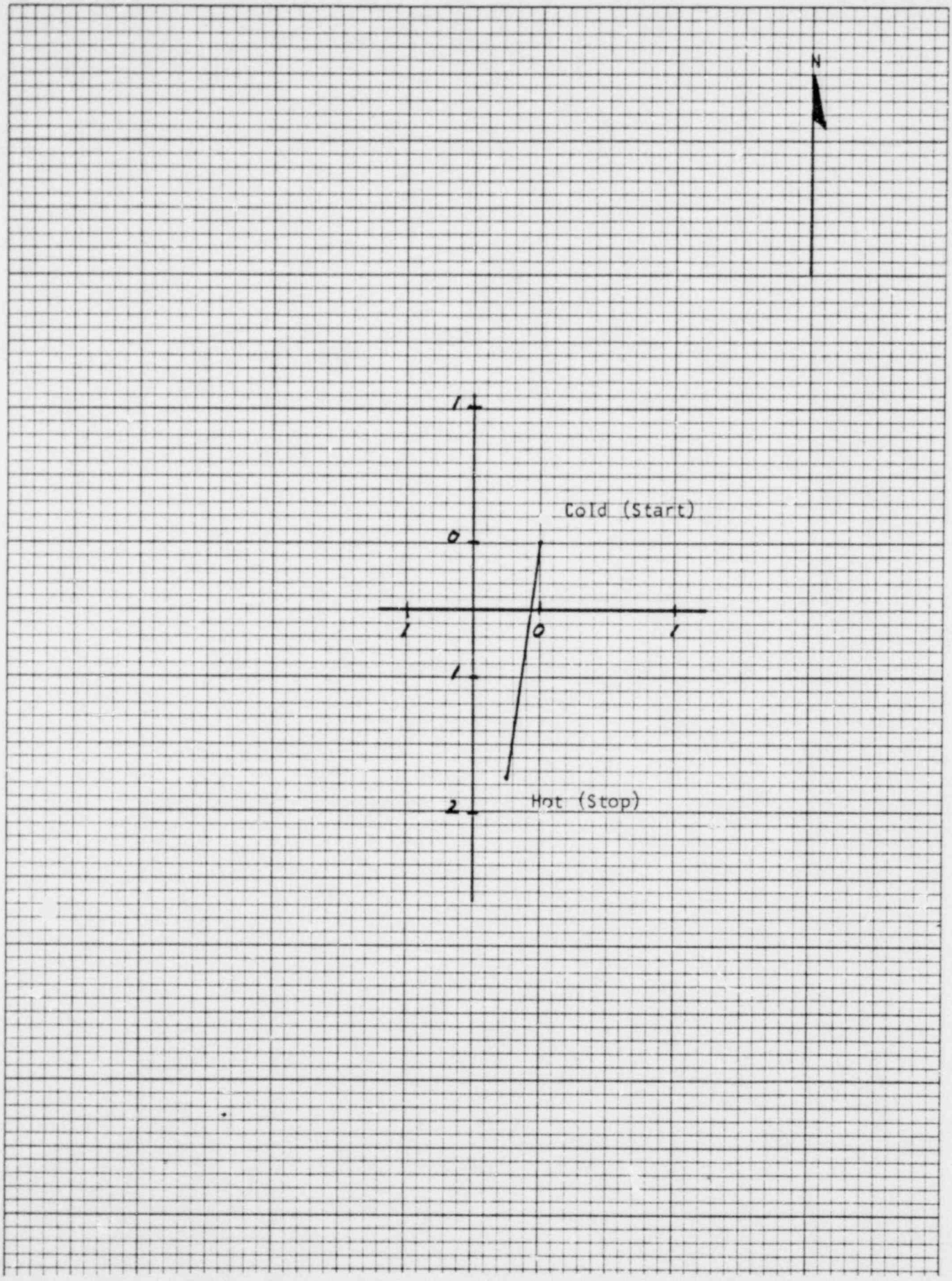
Scale: Actual (1 major division = 1")
(1 minor division = 0.1")

Monitoring Point #4
"A" Main Steam Bypass Line
Horizontal Movement (Cold to Hot)



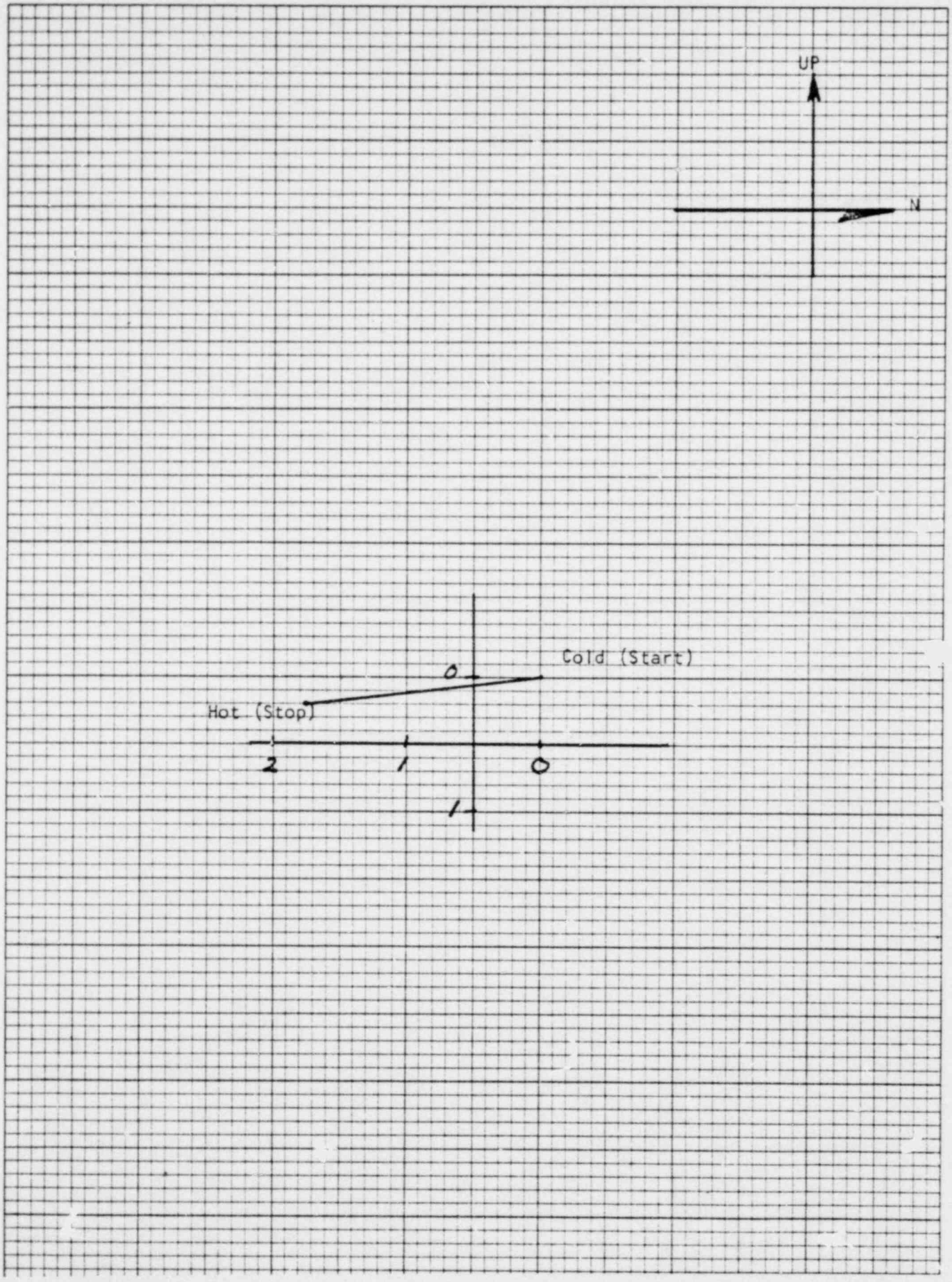
Scale: Actual (1 major division = 1")
(1 minor division = 0.1")

Monitoring Point #4
"A" Main Steam Bypass Line
Vertical Movement (Cold to Hot)



Scale: Actual (1 major division = 1")
(1 minor division = 0.1")

Monitoring Point #5
"B" Main Steam Bypass Line
Horizontal Movement (Cold to Hot)



Scale: Actual (1 major division = 1")
(1 minor division = 0.1")

Monitoring Point #5
"B" Main Steam Bypass Line
Vertical Movement (Cold to Hot)

APPENDIX D

OCONEE NUCLEAR STATION

UNIT 1 MAIN STEAM LINE BYPASS TO CONDENSER COMPARISON
OF DESIGN VERSUS ACTUAL MOVEMENTS

APPENDIX D

MAIN STEAM LINE THRUST MOVEMENT MONITORING PROGRAM
COMPARISON OF DESIGN VERSUS ACTUAL MOVEMENTS

The following tables tabulate actual differential movements recorded under test procedure TP/1/B/270/8-1. A comparison of actual movements with stress analysis allowables is made for each monitoring point and converted into % of allowable movement by the following equation:

$$\% \text{ allowable} = \frac{M_A}{M_D} \times 100\%$$

Where M_D = Design Movement (allowable analytical movement)

M_A = Actual Differential Movement

COMPARISON OF ACTUAL AND DESIGN MOVEMENTS

Monitoring Point	Actual (Inches) X(South)	Y(Up)	Z(West)	Design (Inches) X(South)	Y(Up)	Z(West)
1	1.7	.575	-1.2	3.46	.866	-2.02
2	1.3	.9	.7	3.00	1.56	1.25
3	.13	-.25	.21	.146	-.457	.229
4	.5	- .125	.40	.617	-.154	.411
5	1.75	-.2	.25	3.428	-.457	.914

% ALLOWABLE MOVEMENT

Monitoring Point	X(South)	Y(Up)	Z(West)
1	49.1%	66.4%	59.5%
2	43.3%	57.7%	56.0%
3	89.0%	54.7%	91.7%
4	81.0%	81.2%	97.3%
5	51.1%	43.8%	27.4%
AVERAGE % ALLOWABLE	62.7%	60.8%	66.4%