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SUPPORT SYSTEM REDESIGN FOR PIPING RUNS ON NORTH HALF OF CONTAINMENT FOR INDIAN POINT UNIT 2

Prepared For:

CONSOLIDATED EDISION COMPANY

Prepared By:

EDS NUCLEAR, INC.

January, 1979

EDS Report No. NYO-78-005, Revision 1

EDS NUCLEAR INC.

REPORT APPROVAL COVER SHEET

Client: Consolidated Edison Company

Project: Indian Point Unit 2

Report Title: Support System Redesign for Piping Runs on North Half of Containment

Report Number: NYO-78-005 **Rev.** 0

The work described in this Report was performed in accordance with the EDS Nuclear Quality Assurance Program. The signatures below verify the accuracy of this Report and its compliance with applicable quality assurance requirements.

Prepared By: _____ (Engineer) **Date:** 6/5/78

Reviewed By: _____ (Project Engineer) **Date:** 6/5/78

Approved By: _____ (Division Manager) **Date:** 6/5/78

REVISION RECORD

Rev. No.	Prepared	Reviewed	Approved	Approval Date	Revision
1				1/17/79	Incorporation of Consolidated Edison Comments

CERTIFICATION

The undersigned, a registered Professional Engineer competent in the field of piping analysis, certifies to the best of his knowledge and belief that the analyses presented herein for the Support System Redesign for Piping Runs on North Half of Containment for Indian Point Unit 2 are correct and in accordance with the applicable provisions of the ANSI B31.1 Power Piping Code.

Gary S. Shears

Gary S. Shears

STATE OF NEW YORK

REGISTRATION NO. 053437

11/17/79

(Date)

eds nuclear

SUPPORT SYSTEM REDESIGN

FOR PIPING RUNS ON NORTH HALF OF CONTAINMENT FOR

INDIAN POINT UNIT 2

TABLE OF CONTENTS

1.0 INTRODUCTION

This report documents the analytical effort and results of a task involved in support system redesign for piping runs inside containment for INDIAN POINT UNIT 2. The objective of the support system redesign task is to improve the reliability of the subject piping runs by reducing the number of hydraulic snubbers necessary to satisfy the piping design criteria. The scope of the effort reported herein involves piping runs on the north half of containment. In addition, the support system redesign was limited for this effort to considering only snubber removal or replacement with struts.

Presentation of the documentation is as follows. The approach used to assess and justify snubber removal or replacement with a strut is set forth. The design criteria and assumptions necessary to use the criteria in establishing the structural adequacy of the piping affected by change of restraint at snubbers is presented. The source for all piping configuration data and service requirements are referenced. The analytical methods used to establish the stress in the affected piping are discussed. Finally, the results of the snubber assessment with respect to removal or replacement with a strut are presented.

2.0 APPROACH

Upon removing snubbers or replacing them with struts, in a piping run, it is necessary to requalify the piping to the piping design criteria. The requalification approach is different depending upon which action (removal or replacement) is taken.

In the case of removal, the dynamic character of the piping run has changed while the thermal expansion and static mechanical load character remains the same. This means only that section of the design criteria involved with dynamic loadings must be addressed. The requalification for this case can be accomplished in one of two ways:

i) by comparison, using the analogous INDIAN POINT UNIT 3 piping as the baseline. This is possible since the building, location, and design criteria for the two units are essentially the same.

ii) by performing response spectra analysis and the associated code compliance evaluation for the new support configuration. This requires a detailed computer model of each piping run and its support configuration be developed along with response spectra for the building.

For the snubber removal review, the first approach (comparison to a baseline) was used.

In the case of replacement with a strut, the thermal expansion and static mechanical load character of the piping run has changed while the dynamic character remains the same. This means only those portions of the design criteria involved with limitations on thermal expansion stresses and static mechanical loads, other than pressure, must be addressed. As in the previous case, requalification for this case can be accomplished in one of two ways:

i) by comparison, using the analogous INDIAN POINT UNIT 3 piping as the baseline. This is possible since the systems and design criteria for the two units are essentially the same.

ii) by performing thermal expansion and static mechanical loads analysis and the associated code compliance evaluation for the new support configuration. This requires a detailed computer model of each piping run and its support configuration be developed.

Based upon the fact that the original support configurations were developed using chart methods, it was felt that significant margins were available with respect to thermal expansion stress allowables. To take maximum advantage of this, the detailed computer analysis approach was used.

3.0 DESIGN CRITERIA

The design criteria and assumptions necessary to use the criteria in requalifying the piping runs affected by change of restraint characteristics at currently existing snubber locations is dependent upon which action (removal or replacement with a strut) is used.

In the case of removal by comparison, the criteria is composed of the following requirements:

i) The routing of the UNIT 2 piping with respect to the baseline (UNIT 3) must be the same within acceptable engineering tolerances for a distance on both sides of the snubber in question. The distance in either direction is dependent upon both routing and support configuration. The combination of routing and support configuration must be such that variations between UNIT 2 and the baseline outside this distance will not significantly affect the dynamic response to seismic loading in the area affected by the snubber.

ii) The support configuration within the region of interest for UNIT 2 must be the same as that for the baseline except for the snubber in question. This means upon removal the support configurations are the same.

iii) The piping components and valves which comprise both UNIT 2 and the baseline within the region of interest must be the same.

For each snubber removed using this criteria, a written justification for each of the items noted must be presented. The use of this criteria involves the following assumptions:

- The design seismic input for the baseline (UNIT 3) envelops the UNIT 2 design seismic input. The design seismic inputs are the same.

- The dynamic character of the containment buildings for the baseline and UNIT 2 are the same with respect to seismic loading.

- The design criteria used to establish the structural adequacy of the baseline conservatively bounds that used for UNIT 2. The criteria for both units is essentially identical.

In the case of replacement with a strut, the criteria from PART 5: EXPANSION, FLEXIBILITY AND SUPPORTING; USAS B 31.1.0 - 1967 POWER PIPING CODE was used. This criteria limits the range of stress of power piping systems subject to thermal expansion and/or to similar movements imposed by other sources such as anchor movements. The use of this criteria imposes restrictions on the method of analysis which must be followed. In line with these analysis restrictions the following assumptions were made:

- Gaps designed into supports were utilized as necessary, but only when and where specified in the support configuration design. Conservative assumptions with respect to thermal expansion stresses were made for supports where necessary.

- Valves and flanges were modelled as twice the nominal pipe thickness.

- All socket welded fitting dimensions were taken from the current ANSI standard (ANSI B16.11).

- All restraints were modelled as rigid.

- Welds were assumed only at the ends of components and fittings.

- Socket welded fittings were assumed to be as strong as the adjacent pipe. In other words, the fillet weld would fail first.

- Field fabricated branch connections were assumed as strong as the branch weld.

The only static mechanical load other than pressure which the piping in question is subject to is dead weight. Any reductions in the dead weight stresses associated with the change in the support system were conservatively ignored.

4.0 CONFIGURATION AND LOADING DATA

The piping run routing and support configuration for both INDIAN POINT UNITS 2 and 3 were obtained from the respective United Engineers and Constructors (UE & C) piping drawings. In addition, those lines which require requalification by comparison also have listed the appropriate UNIT 3 drawings and revision numbers. Support details were based upon the marked-up UE & C pipe support drawings for typical supports. For non-typical supports the Bergen-Patterson drawings were used. Pipe schedule, material, and fitting type were taken from the piping specification. The UNIT 2 flow diagrams were used to verify the qualitative routing.

System boundaries and operating temperatures were based upon the United Engineers line list for UNIT 2. TABLE I lists the operating temperatures used. Anchor movements for thermal expansion were taken from the UNIT 2 Reactor Coolant Loop Thermal Movements for lines attaching to the main coolant loop. Movements for other pieces of equipment were obtained from UNIT 3 piping isometrics.

5.0 ANALYTICAL METHOD

In order to determine the gross thermal expansion stresses, the piping runs were modelled using EDS Nuclear's PISOL program. This program represents the piping as a beam type structure and applies the stress intensification and flexibility factors contained in Appendix D of USAS B 31.1.0 - 1967 POWER PIPING CODE. Where practical, piping runs were modelled in their entirety. Otherwise, the piping model was extended to a point sufficiently past the last snubber in order that the piping omitted had an insignificant effect on the piping in the area of concern.

In cases where lines of similar stiffness attached to each other, part of the adjacent piping was included in the model to account for the interaction between the two. Figures 1 thru 20 present the PISOL math models including the support configuration for the various piping runs considered.

Thermal expansion analysis, including the application of thermal expansion anchor movements, was performed on the above noted models, replacing as many snubbers as possible with struts while meeting the requirements of the design criteria. The temperatures used are those listed in TABLE I. For the final support configuration, the resulting PISOL stress output is summarized in Table III for each of the piping runs considered. The output contains pertinent configurational information, displacements, forces, moments, and stresses.

6.0 RESULTS AND CONCLUSIONS

In the effort to redesign the support systems for piping with respect to snubber removal or replacement with a strut, the criteria for removal was applied first to all lines. Only snubber RCH-77 on line number 63 was removed by comparison with the analogous UNIT 3 configuration. The routing and all restraints except the snubber in question are the same. Based upon this snubber RCH-77 of line 63 is recommended for removal.

Next all lines were modelled and thermal expansion analysis used to establish which snubbers in each line could be replaced with struts. TABLE II presents all snubbers considered for each line along with their final recommended status. For those snubbers which are recommended for replacement with a strut, the thermal expansion load in the strut is also listed to aid in design sizing of the strut.

It should be noted that the above recommended support sytem redesign, which has as its objective the reduction of the number of snubbers in INDIAN POINT UNIT 2, has only removed snubbers based upon the restrictions setforth in this report. There are additional margins in the design criteria and analytical approach which if applied have the potential for additional snubber removal or replacement with a strut.

TABLE I LINE NUMBER VERSUS OPERATING TEMPERATURE

Line Number	Operating Temperature (degree F)
13	120
14	120
14A	120
17	300
43	130/175
44	130/175
52	120
53	120
61	140/653
62	140/653
73	130
74	130
78	350
93	120/350
94	120/350
293	270/350
318	120
350	120/550

TABLE II RECOMMENDATIONS FOR SNUBBERS ON NORTH HALF OF CONTAINMENT-INDIAN POINT UNIT 2

Line Identification	Snubber Identification	Recommended Status	Strut Load (Pounds)
13	SR1027A	Snubber	-----
	SR1028	Strut	-577.8
	SR1028A	Strut	-160.1
	SR1029A	Strut	+ 8.1
	SR1030	Snubber	-----
	SR1030A	Snubber	-----
	SR1031	Snubber	-----
	SR1032	Snubber	-----
	SR1037	Snubber	-----
	SR1037A	Snubber	-----
	SR1051	Snubber	-----
	SR1052	Snubber	-----
	SR1053	Snubber	-----
	SR1059	Strut	+294.0
	SR1060	Snubber	-----
	SR1079	Snubber	-----
	SR1080	Snubber	-----
	SR1081	Strut	- 37.8
14	14-SR-2	Strut	+ 85.5
	SR1035	Snubber	-----
	SR1036A	Snubber	-----
	SR1039A	Snubber	-----
	SR1040A	Snubber	-----
	SR1041	Strut	-157.0
	SR1042	Snubber	-----
	SR1045A	Strut	+ 47.4
	SR1048	Strut	+ 3.5
	SR1049	Snubber	-----
	SR1050	Snubber	-----
	SR1056	Strut	+136.7
	SR1057	Snubber	-----
	SR1083	Snubber	-----
	SR1084	Snubber	-----
14A	SR1001	Snubber	-----
	SR1002	Snubber	-----
	SR1002A	Strut	+166.9
	SR1003	Strut	+ 75.1
	SR1003A	Strut	- 70.4
17	SR1010	Snubber	-----

TABLE II - continued

Line Identification	Snubber Identification	Recommended Status	Strut Load (Pounds)
17 continued	SR1015	Strut	- 512.7
	SR1063	Strut	- 76.0
	SR1065	Strut	+ 440.6
	SR1069	Snubber	-----
43	SR1020	Strut	+ 9.7
	SR1020A	Snubber	-----
	SR1021	Strut	- 34.0
	SR1022	Strut	+ 270.9
	SR1024A	Snubber	-----
	SR1025A	Snubber	-----
	SR1026	Snubber	-----
44	SR1072	Snubber	-----
	SR1073	Snubber	-----
52	52-SR-1	Strut	+1400.8
53	53-SR-1	Strut	- 309.5
	53-SR-2	Strut	+ 17.1
61	SR-881	Snubber	-----
	SR-887	Snubber	-----
	SR-888	Strut	+ 458.3
	SR-890	Strut	-1810.1
62	SR-922A	Snubber	-----
	SR-922B	Snubber	-----
	SR-924	Snubber	-----
	SR-924A	Strut	+ 345.8
63	*RCH-77	Removed	
73	73-SR-1	Strut	+ 40.1
	SR1016	Strut	- 29.9
	SR1016A	Snubber	-----
	SR1017	Snubber	-----
	SR1017A	Snubber	-----
	SR1017B	Snubber	-----
	SR1018A	Snubber	-----
74	74-SR-1	Snubber	-----
	SR1085	Snubber	-----

TABLE II - continued

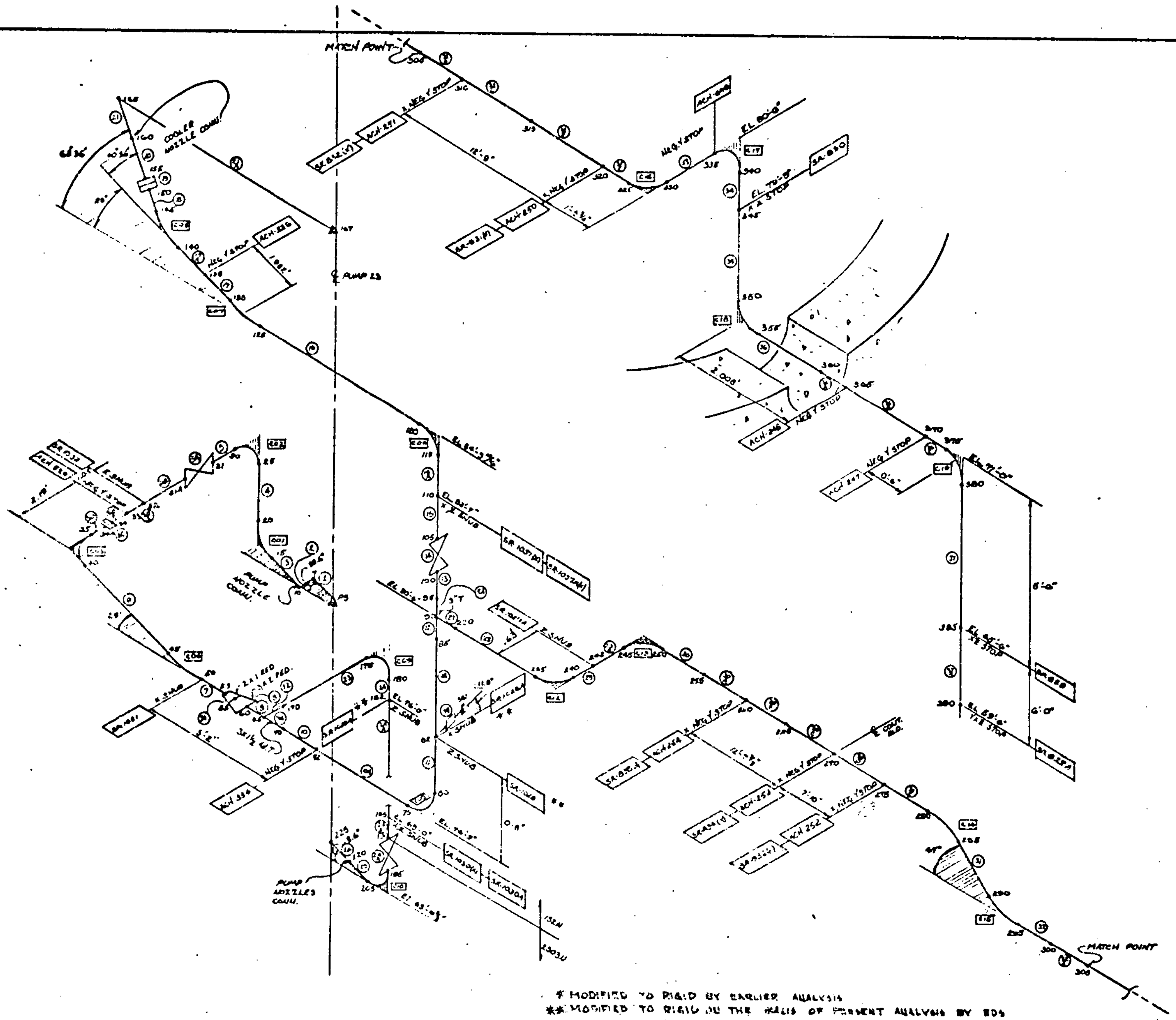
Line Identification	Snubber Identification	Recommended Status	Strut Load (Pounds)
74 continued	SR1086	Snubber	-----
	SR1087	Snubber	-----
	SR1087A	Snubber	-----
	SR1088	Strut	- 16.4
	SR1089	Snubber	-----
	SR1090	Strut	+ 10.1
	SR1092	Snubber	-----
78	78-SR-1	Snubber	-----
93	*SR-750	Strut	-7022.6
	*SR-750A	Strut	-5668.8
	*SR-751	Strut	+7017.5
	SR-752	Strut	+4062.4
	SR-752A	Strut	-5910.5
	SR-753	Strut	+ 599.8
	*SR-754	Strut	- 988.0
94	*SR-757	Strut	-6664.8
	*SR-758	Strut	+3924.6
	*SR-758A	Strut	-3703.8
	SR-759	Strut	-1279.5
293	SR-761	Strut	-9768.0
	SR-762	Strut	- 286.9
	SR-762A	Strut	-1501.5
	SR-763	Strut	-4360.8
	SR-763A	Snubber	-----
	SR-764	Strut	+ 764.8
318	318-SR-1	Strut	- 261.5
	318-SR-2	Strut	- 669.9
	318-SR-3	Strut	+ 105.8
	318-SR-5	Strut	+ 662.5
350	PWR-156	Strut	+13,379.2

* Already modified to rigid by earlier analysis by others.

TABLE III STRESS SUMMARY FOR LINES ANALYZED FOR EXPANSION LOADS

Line Number	Location		Stress (PSI)	Code Allowable Stress Limit (PSI)
	Member #	Joint #		
13 (pump 23)	C06	120	19,004.	22,500.
13 (pump 24)	23A	280	17,115.	22,500.
14	9	16	14,025.	22,500.
14 (pump 23)	31	45	16,356.	22,500.
14 (pump 24)	16	513	14,010.	22,500.
14A (pump 23)	2	1A	14,090.	22,500.
*17 (pump 23)	16	33A	23,541.	27,088.
17 (pump 24)	2	2	17,093.	27,088.
43	2	2	18,500.	27,609
44	C07	19	15,101.	27,609.
52	C07	24	14,786.	22,500.
53 & 318	C07	18	1,391.	22,500
61 & 62	24E	45	17,254.	26,338.
73	38	52	15,925.	27,919.
74	39	A53	10,235.	27,919.
78	1	1A	24,150.	27,088.
93	C02	14	13,863.	26,687.
94	C02	18	15,090.	26,687.
293	3	3	16,847.	26,687.
350	C05	17	16,886.	28,063.

* NOTE: For this line SR-1011 and SR 1012 were considered rigid restraints in this analysis, but they actually don't exist. As a result, the expansion stresses for this line are conservative.



* MODIFIED TO RIGID BY EARLIER ANALYSIS
** MODIFIED TO RIGID ON THE BASIS OF PRESENT ANALYSIS BY EDS

REF. COORD.:

EDS PROBLEM NO.: 13-23

ANALYSIS		MATH MODEL REVISION
TYPE	REVISION	
THERMAL		
GRAVITY		
SEISMIC		
SAM		
SECTION #		

REFERENCE DRAWING	REV. NO.
9321-F-2565	18
9321-F-2528	15

LINE LIST: 9321-C-2741-10 SHEET 1

SPEC. & 152, 2503

THERMAL DISPLACEMENTS FROM (UNIT 3)

	ΔX	ΔY	ΔZ
JOINT 167	1.1233	0.604	-1.5198
JOINT P5	1.1233	0.432	-1.5198
JOINT 225	1.1233	0.242	-1.5198

1	DRAWING UPDATED	BY	SM	B	

EDS NUCLEAR

INDIAN POINT PLANT 2

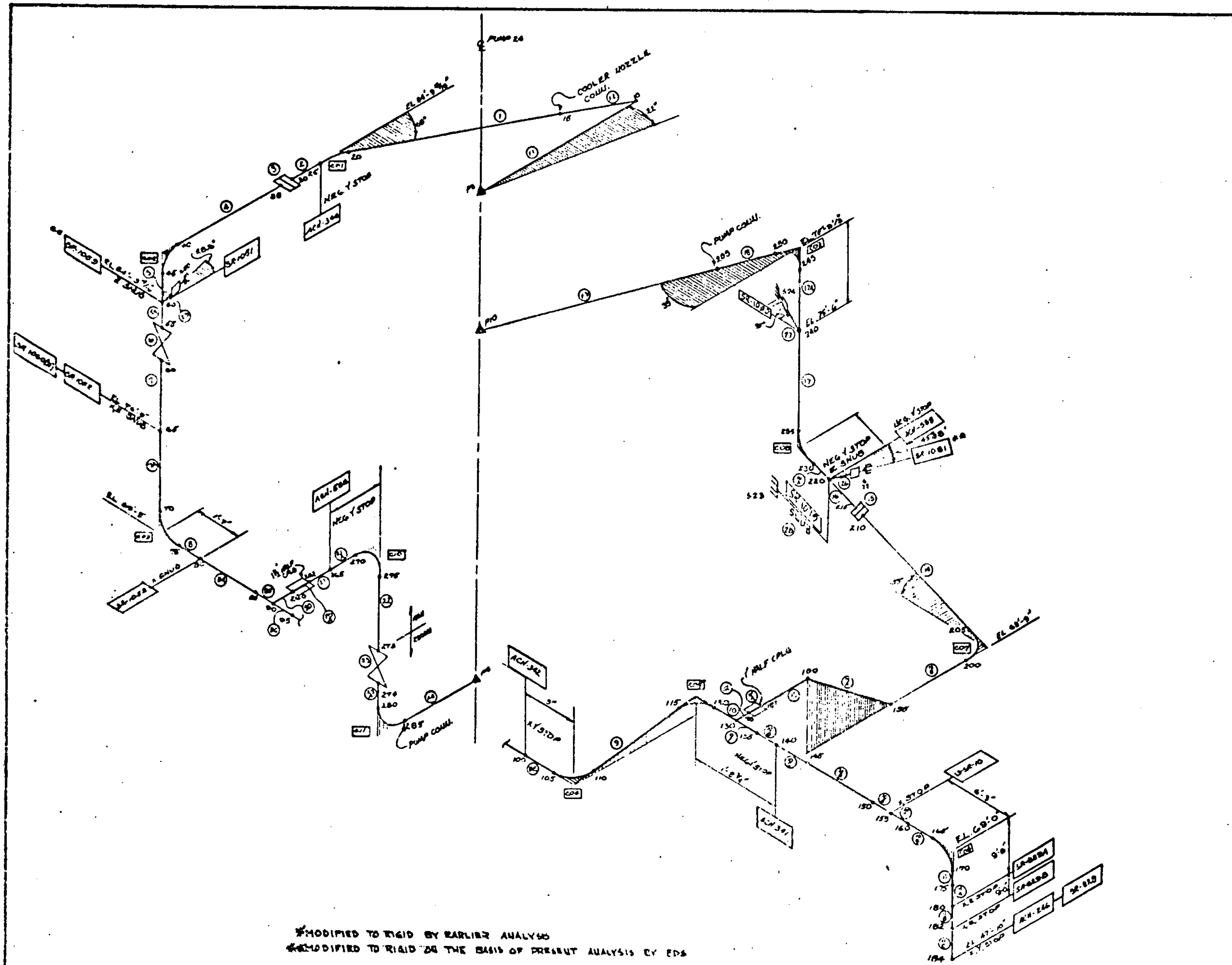
LINE 13 PUMP 23

SCALE	DRAWN	CHECKED	APPROVED	DATE
NTS				

JOB NO.	DRAWING NO.	REV.
1800004	1800004-13-23	0

LEGEND:

- X : JOINT
- (X) : STRAIGHT MEMBER
- [CXX] : CURVED MEMBER
- ▲ : ANCHOR
- FICTICIOUS MEMBER
- S.H. : SPRING HANGER
- STOP : RIGID RESTRAINT
- SNUB : SNUBBER (DYNAMIC RESTRAINT ONLY)
- SR : SHORT RADIUS ELBOW
- LR : LONG RADIUS ELBOW



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REF COORD.:

EDS PROBLEM NO.: 13-24

ANALYSIS		MATH MODEL REVISION
TYPE	REVISION	
THERMAL		
GRAVITY		
SEISMIC		
SAM		
SECTION 4		

REFERENCE DRAWING	REV. NO
9321-F-2529	15
9321-F-2565	18

LINE LIST: 9321-C-2741-10 SHEET 1

SPEC #: 157, 2508

ANCHOR MOVEMENTS FROM _ (UNITS)

	ΔX	ΔY	ΔZ
JOINT P5	1.1233	0.604	1.5198
JOINT P10	1.1233	0.432	1.5198
JOINT P15	1.1233	0.242	1.8198

NO	REVISION				
1	DRAWING UPDATED				

EDS NUCLEAR

INDIAN POINT PLANT 2

LINE 13 (PUMP 24)

SCALE	DRAWN	CHECKED	APPROVED	DATE
NTS	CAG			5/1/78

JOB NO.	DRAWING NO.	REV
180004	180004-13-24	C

LEGEND:

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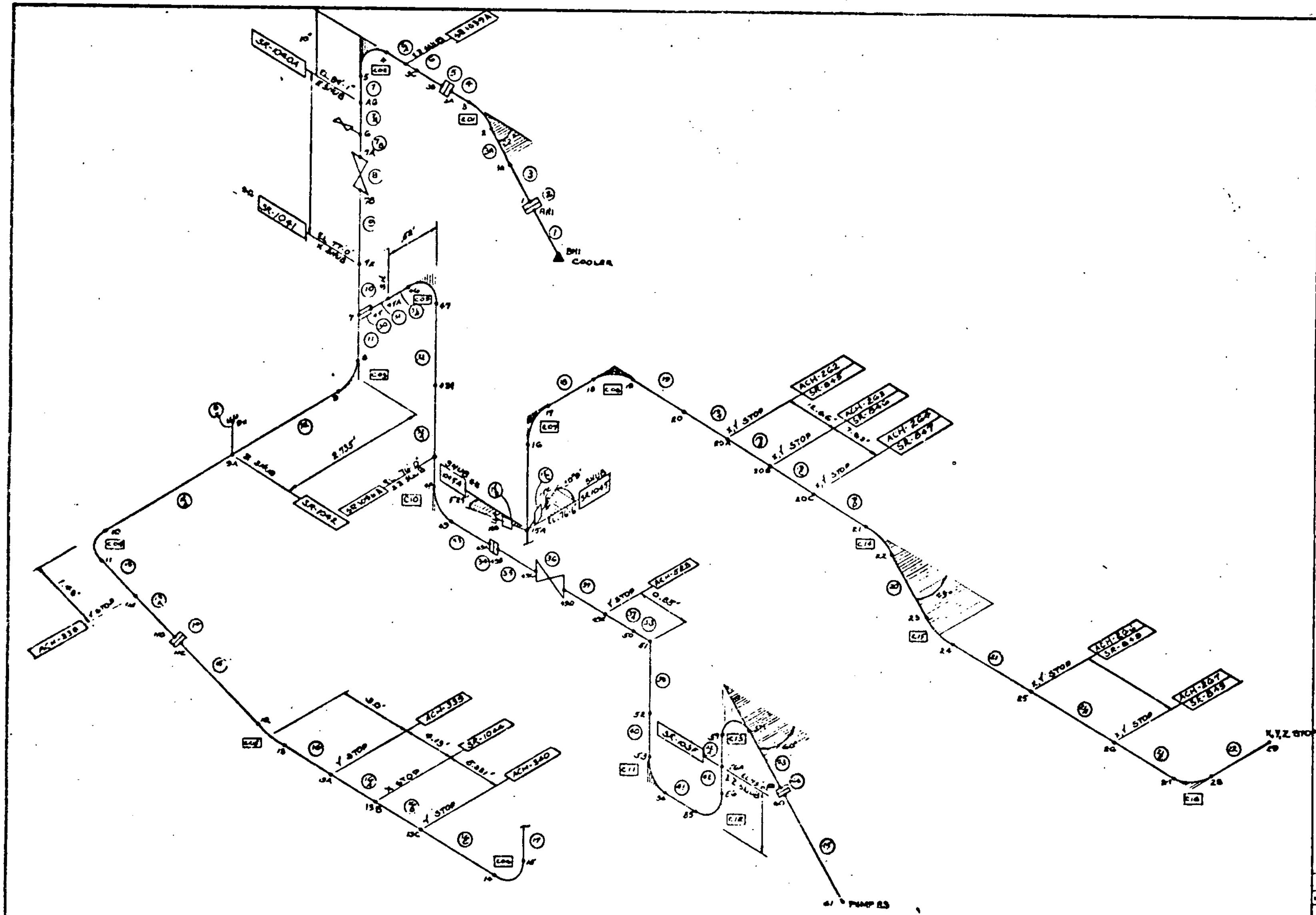
(A) : STRAIGHT MEMBER
[CXX] : CURVED MEMBER
▲ : ANCHOR
: FICTICIOUS MEMBER
S.H. : SPRING HANGER
STOP : RIGID RESTRAINT
SNUB : SNUBBER (SEISMIC RESTRAINT ONLY)
SR : SHORT RADIUS ELBOW
LR : LONG RADIUS ELBOW



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EDS PROBLEM NO.: 14-23

ANALYSIS		MATH MODEL REVISION
TYPE	REVISION	
THERMAL		
GRAVITY		
SEISMIC		
S.A.M		
SECTION III		

REFERENCE DRAWING	REV. NO.
9321-F-2528	15
9321-F-2565	G1

LINE LIST: 9321-C-2741-10 SHEET 1

SPEC # 152

THERMAL DISPLACEMENTS (UNITS)

JT	ΔX	ΔY	ΔZ
BN1	1.123"	.604"	-1.52"
G1	1.123"	.42"	-1.52"

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NO.	REVISION				
1	DRAWING UPDATED				

EDS NUCLEAR

INDIAN POINT PLANT 2

LINE 14 PUMP 23

SCALE	DRAWN	CHECKED	APPROVED	DATE
NTS	LAG	CBM	RB	5/12/80

JOB NO.	DRAWING NO.	REV
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- (X) : STRAIGHT MEMBER
- [CXX] : CURVED MEMBER
- ▲ : ANCHOR
- FICTICIOUS MEMBER
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- SR : SHORT RADIUS ELBOW
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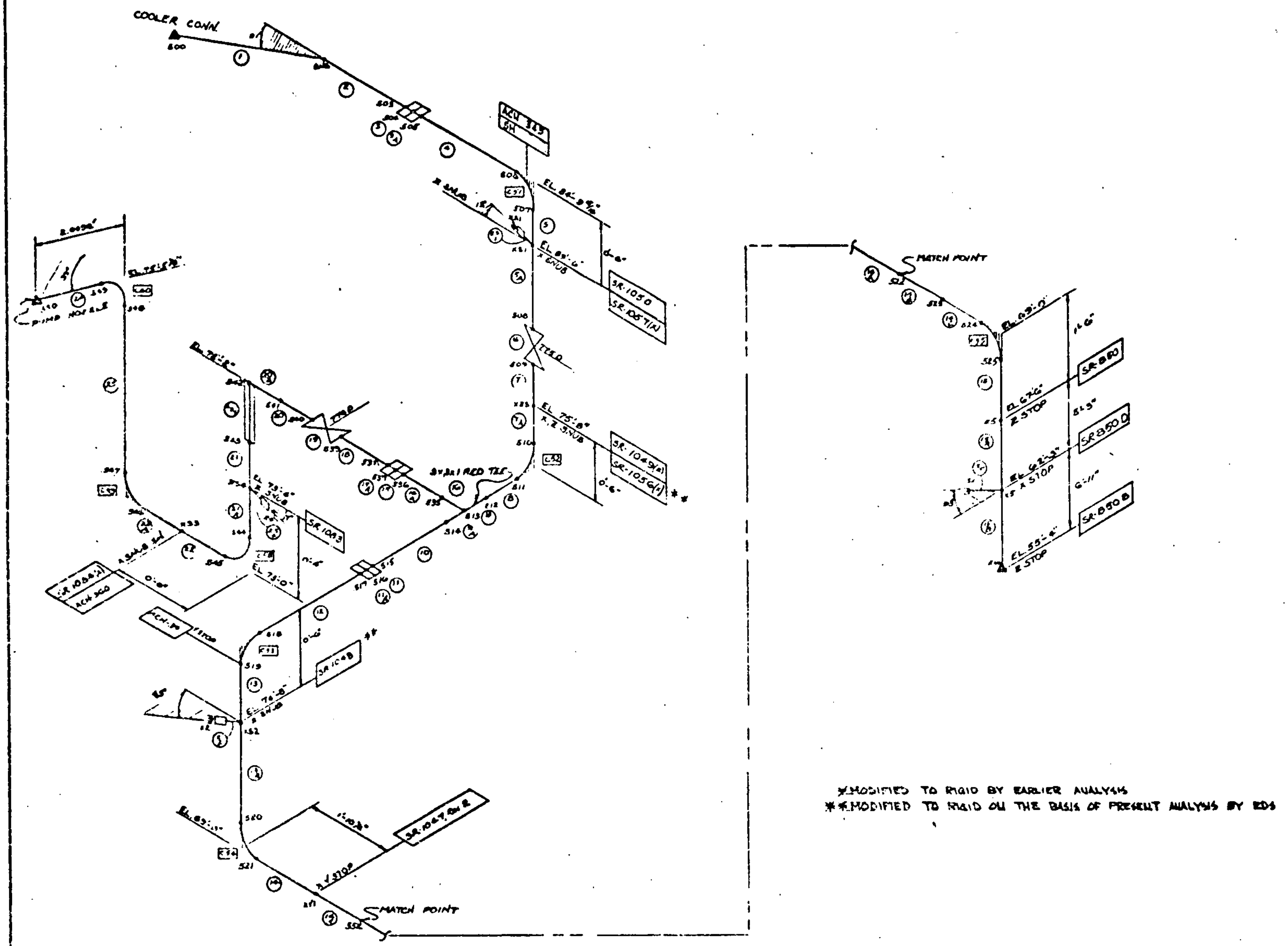

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LEGEND:

- X : JOINT
- (X) : STRAIGHT MEMBER
- [CXX] : CURVED MEMBER
- ▲ : ANCHOR
- FICTICIOUS MEMBER
- S.H. : SPRING HANGER
- STOP : RIGID RESTRAINT
- SNUB : SNUBBER OR RIGID RESTRAINT
- SR : SHORT RADIUS ELBOW
- LR : LONG RADIUS ELBOW

REF COORD.:

EDS PROBLEM NO.: M-24

ANALYSIS		MATH MODEL REVISION
TYPE	REVISION	
THERMAL		
GRAVITY		
SEISMIC		
SAM		
SECTION III		

REFERENCE DRAWING	REV. NO.
9321-F-2529	5
9321-F-2665	10
9321-F-2564	16

LINE LIST: 9321-C-2741-10 SHEET 1

SPEC #: 152

THERMAL DISPLACEMENTS (ANTS)

JT	ΔX	ΔY	ΔZ
550	1.1233	.604"	1.5196"
500	1.1235"	.45"	1.5196"

1	DRAWING UPDATED				
NO.	REVISION	BY	CHK	APPR	DATE

EDS NUCLEAR

INDIAN POINT PLANT 2

LINE 14 PUMP 24

SCALE	DRAWN	CHECKED	APPROVED	DATE
NTS	CAG	[illegible]	[illegible]	6/12/[illegible]

JOB NO.	DRAWING NO.	REV
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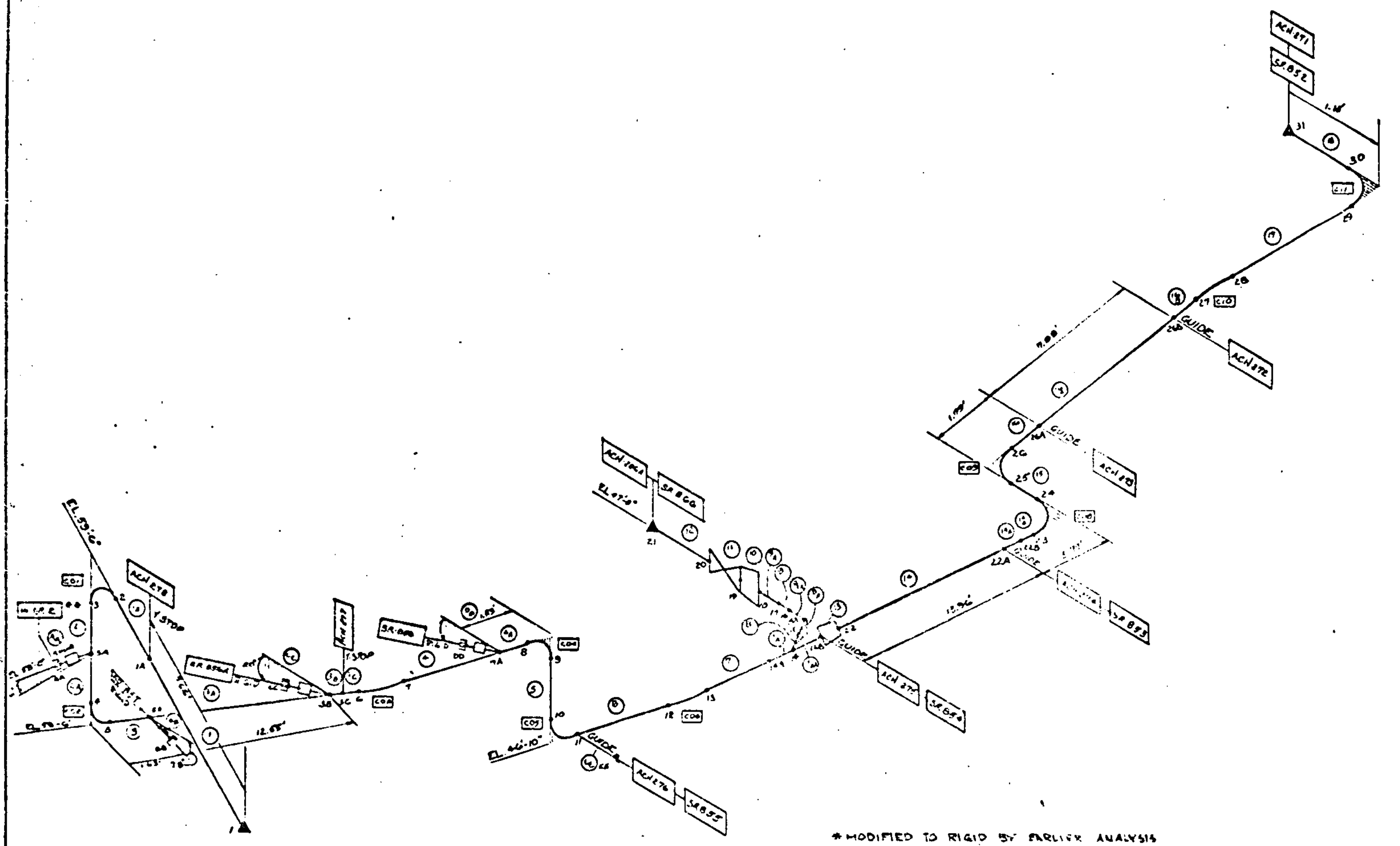

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** MODIFIED TO RIGID ON THE BASIS OF PRESENT ANALYSIS BY EDS

LEGEND:

X : JOINT	CXX : CURVED MEMBER	FICTICIOUS MEMBER	STOP : RIGID RESTRAINT	SR : SHORT RADIUS ELBOW
(X) : STRAIGHT MEMBER	▲ : ANCHOR	S.H. : SPRING HANGER	SNUB : SNUBBER (SEISMIC RESTRAINT ONLY)	LR : LONG RADIUS ELBOW

REF. COORD

EDS PROBLEM NO. 14

ANALYSIS TYPE	ANALYSIS REVISION	MATH MODEL REVISION
THERMAL		
GRAVITY		
SEISMIC		
S.A.M.		
SECTION III		

REFERENCE DRAWING	REV NO.
9321-F-2565	18

LINE LIST 9321-C-2741-10 SHEET 1
SPEC. 6E2

NO.	REVISIONS				
1	DRAWING UPDATED				

EDS NUCLEAR

INDIAN POINT PLANT 2

LINE 14

SCALE	DRAWN	CHECKED	APPROVED	DATE
NTS	CAG			

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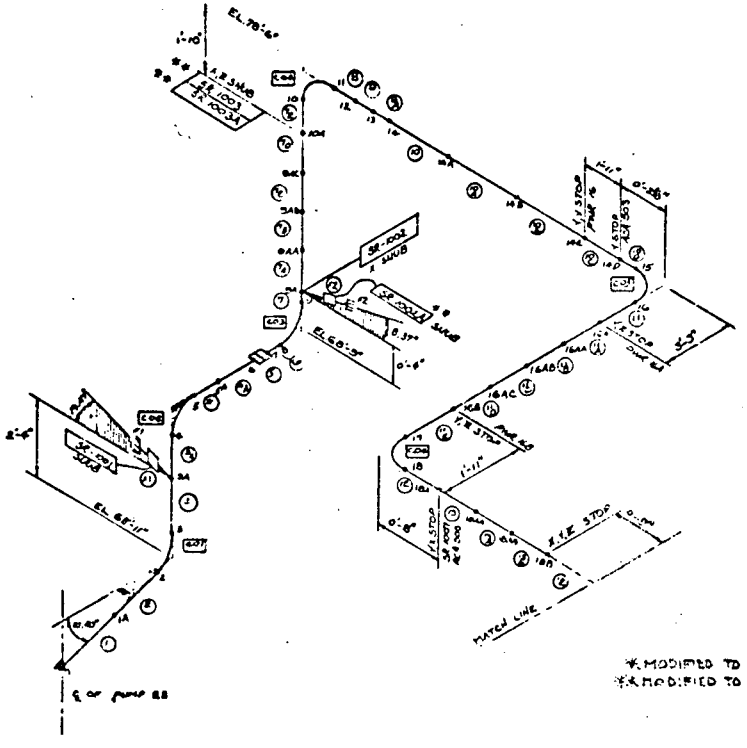

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LEGEND: X : JOINT | (X) : STRAIGHT MEMBER | CX : CURVED MEMBER | ▲ : ANCHOR | ⊣⊢ : FICTICIOUS MEMBER | S.H. : SPRING HANGER | STOP : RIGID RESTRAINT | SNUB : SNUBBER (HYDRAULIC RESTRAINT) | SR : SHORT RADIUS ELBOW | LR : LONG RADIUS ELBOW

REF. COORD.:

EDS PROBLEM NO.: 66-23

ANALYSIS		MATH MODEL REVISION
TYPE	REVISION	
THERMAL		
GRAVITY		
SEISMIC		
S.A.M.		
SECTION III		

REFERENCE DRAWING	REV. NO.
9321-F-2528	15
9321-F-2565	18
9321-F-2566	15

LINE LIST: 9321-C-274N-10 SHEET 1
SPEC. # 2503

NOTES: ANCHOR MOVEMENT AS FOLLOWS:
JOINT 1 (UNIT 3)
X = 1.1233" Y = .242" Z = -1.5139"
(IPP3)

NO.	REVISIONS	DATE	APP'D	DATE
1	DRAWING UPDATED	5/8	SAF	5/8

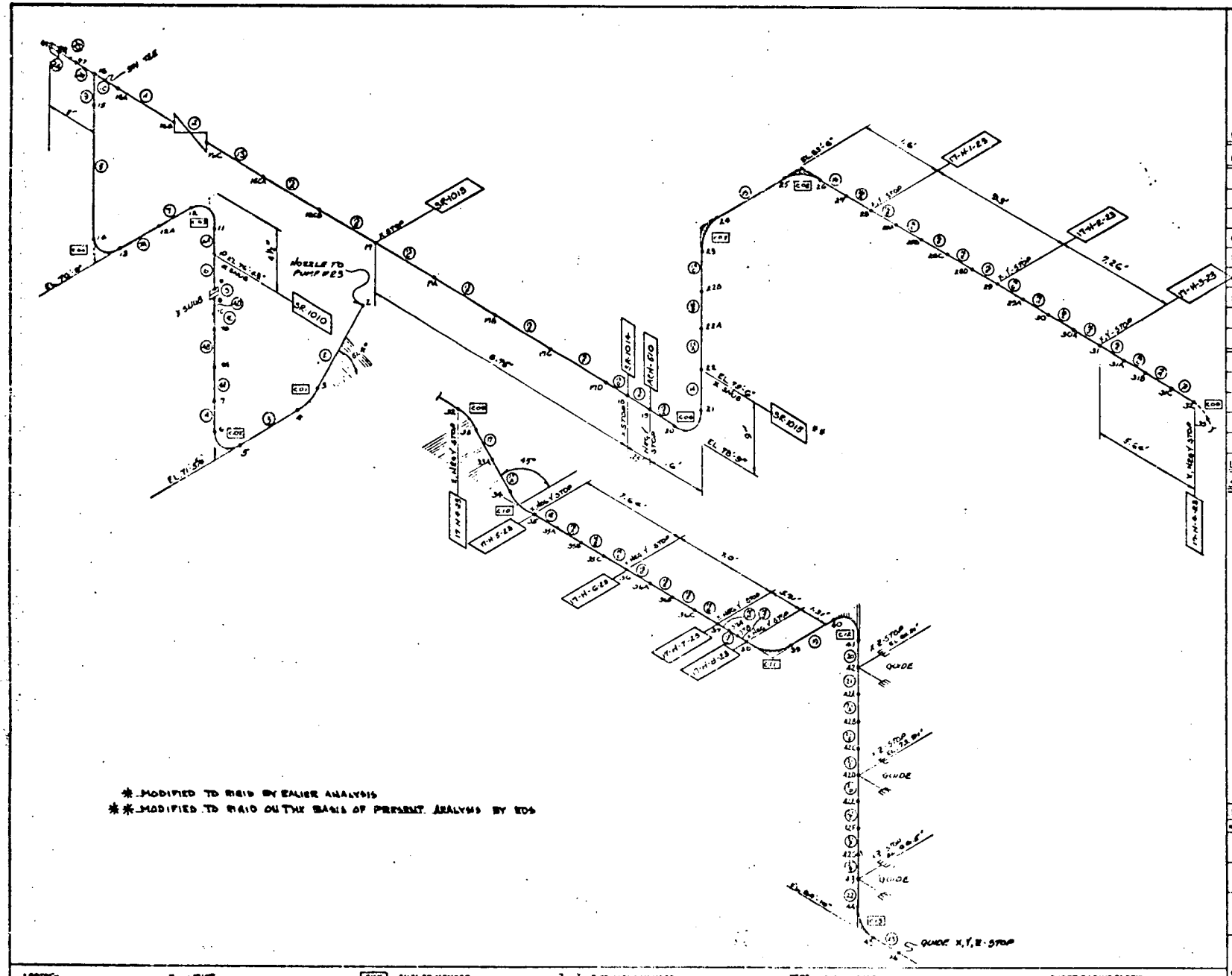
EDS NUCLEAR

INDIAN POINT PLANT 2

LINE 14A PUMP 23

SCALE	DRAWN	CHECKED	APPROVED	DATE
NTS	LAA	PJR		5/12/78

JOB NO.	DRAWING NO.	REV.
7930004	7930004 - 14A - 23	0



* MODIFIED TO RIGID BY EALIER ANALYSIS

** MODIFIED TO RIGID ON THE BASIS OF PRESENT ANALYSIS BY EDS

LEGEND: X : JOINT | (X) : STRAIGHT MEMBER | CVX : CURVED MEMBER | ▲ : ANCHOR | ⊢⊣ : FICTITIOUS MEMBER | S.H. : SPRING HANGER | STOP : RIGID RESTRAINT | SR : SHORT RADIUS ELBOW | LR : LONG RADIUS ELBOW

NORTH

REF. COORD.:

EDS PROBLEM NO.: 17-23

ANALYSIS TYPE	ANALYSIS REVISION	MATH MODEL REVISION
THERMAL		
GRAVITY		
SEISMIC		
R.A.M.		
SECTION III		

REFERENCE DRAWING	REV. NO.
9321-F-2528	
9321-F-2582	

LINE LIST: 9321-C-2764-10 SHEET 2

SPEC #: 2501 Q

THERMAL DISPLACEMENT FROM (UNITS):

	ΔX	ΔY	ΔZ
JOINT 1	1.1233	0.563	-1.5198

NO.	REVISIONS	DATE	BY	CHK'D	APP'D	DATE
1	DRAWING UPDATED	8/1	CAG	JB		

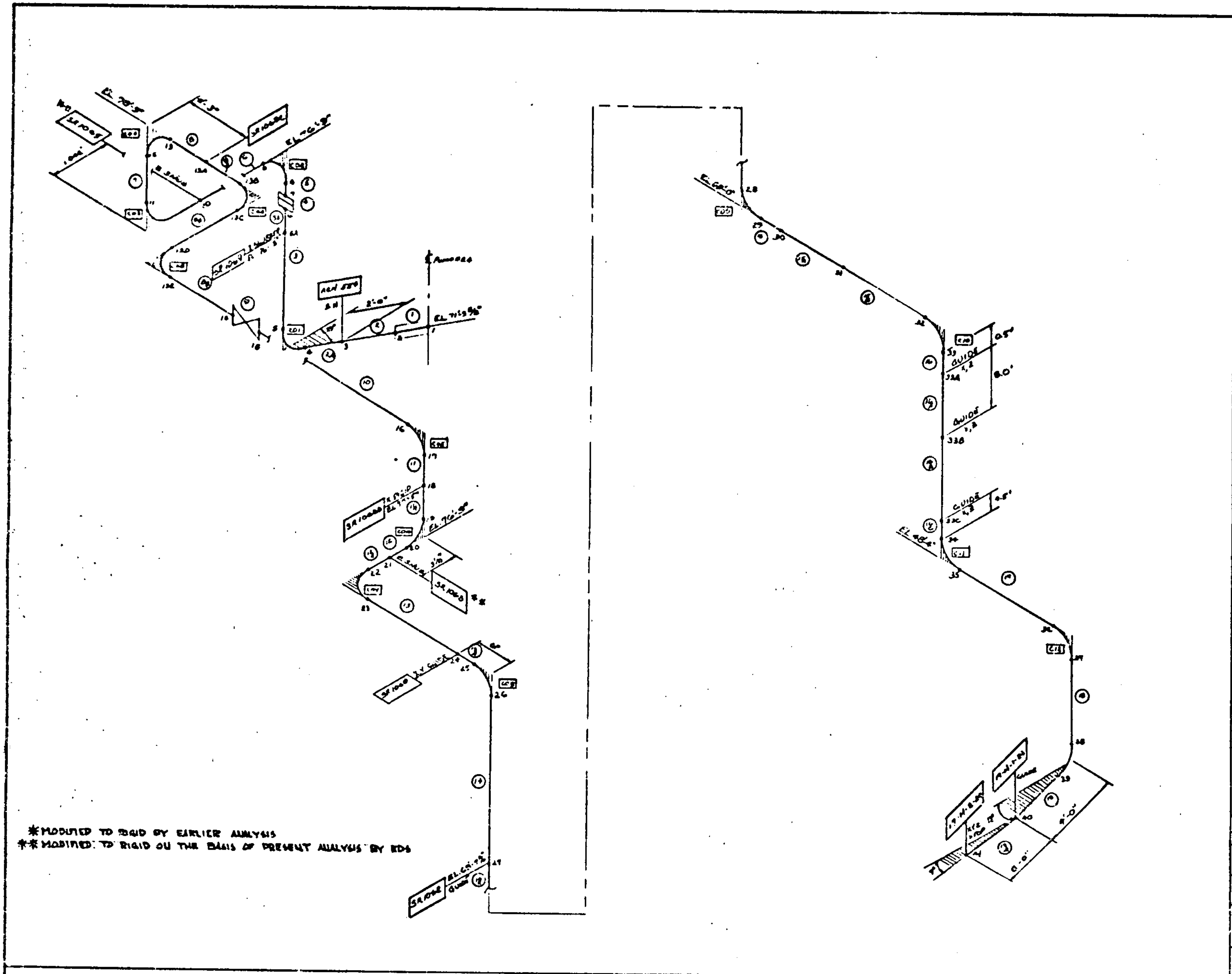
EDS NUCLEAR

INDIAN POINT PLANT 2

LINE 17 PUMP 23

SCALE	DRAWN	CHECKED	APPROVED	DATE
NTS	CAG	JB	JB	5/12/78

JOB NO.	DRAWING NO.	REV.
1800004	500004-7-23	0



✱MODIFIED TO RIGID BY EARLIER ANALYSIS
✱✱MODIFIED TO RIGID ON THE BASIS OF PRESENT ANALYSIS BY EDS

EDS PROBLEM NO.: 17-24

ANALYSIS		MATH MODEL REVISION
TYPE	REVISION	
THERMAL		
GRAVITY		
SEISMIC		
S.A.M.		
SECTION III		

REFERENCE DRAWING	REV. NO.
9321-F-2529	15

LINE LIST: 9321-C-2741-10 SHEET 1

SPEC #: 2501

THERMAL DISPLACEMENTS (UNITS)

JT	ΔX	ΔY	ΔZ
1	1.1635"	0.663"	1.5198"

1	DRAWING UPDATED			

EDS NUCLEAR

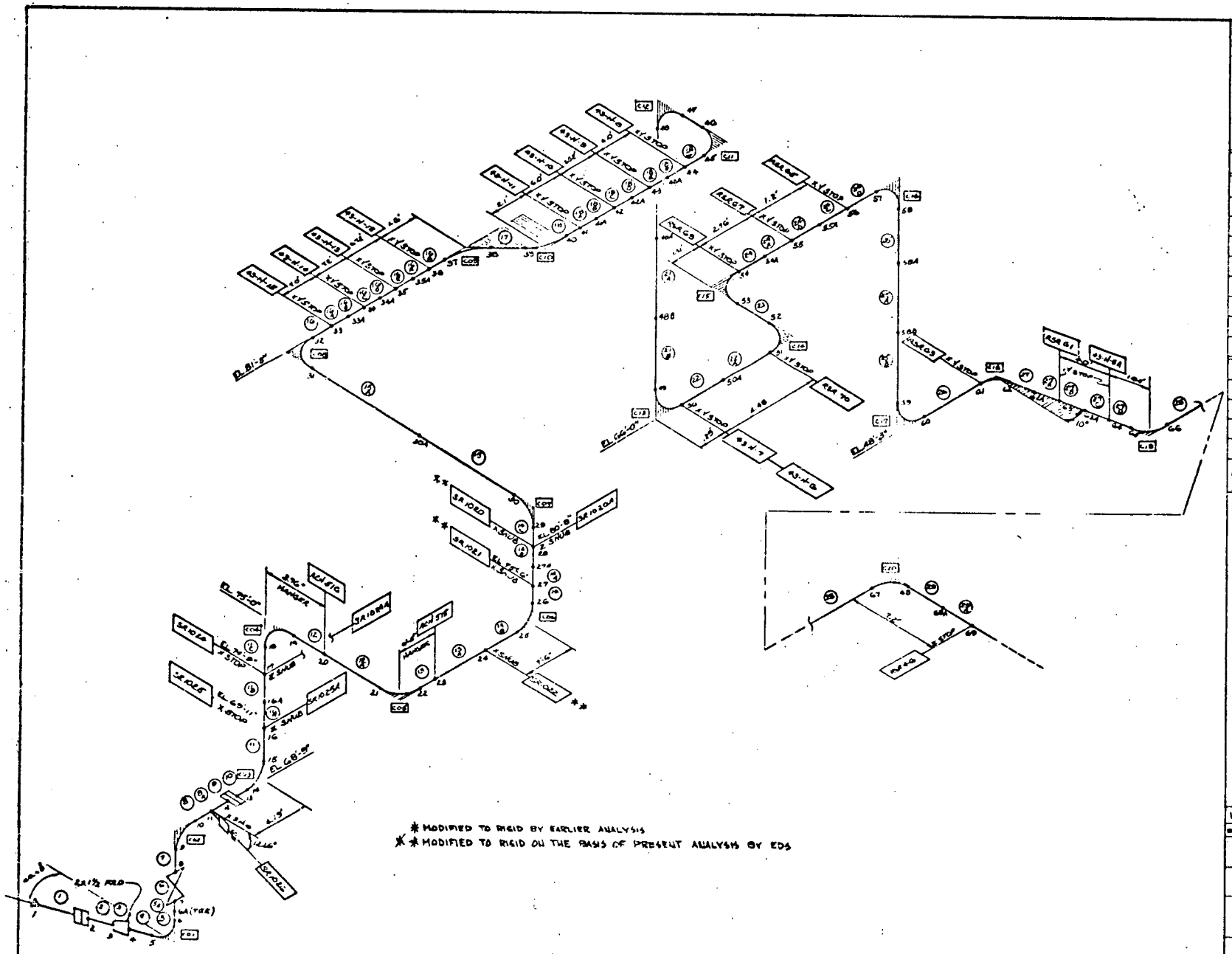
INDIAN POINT PLANT 2

LINE 17-24

SCALE	DRAWN	CHECKED	APPROVED	DATE
NTS				

JOB NO.	DRAWING NO.	REV.
1800004	800004-17-24	0

LEGEND:
X : JOINT
(X) : STRAIGHT MEMBER
[CXX] : CURVED MEMBER
▲ : ANCHOR
}—| : FICTICIOUS MEMBER
S.H. : SPRING HANGER
RIGR : RIGID RESTRAINT
SNUB : SNUBBER RESTRAINT
SR : SHORT RADIUS ELBOW
LR : LONG RADIUS ELBOW



REF. COORD.:

EDS PROBLEM NO.: 43

ANALYSIS TYPE	ANALYSIS REVISION	MATH MODEL REVISION
THERMAL		
GRAVITY		
SEISMIC		
E.A.M.		
SECTION III		

REFERENCE DRAWING	REV. NO.
9321-F-2528	4
9321-F-2582	10

LINE LIST: 9321-C-2741-12 SHEET 3

SPEC #: 2502, 2501

THERMAL DISPLACEMENTS (UNITS)

ΔT	ΔX	ΔY	ΔZ
1	1.123"	-.242"	1.52"

NO.	REVISIONS	BY	CHK	APP	DATE
1	DRAWING UPDATED	GH	CM	JB	4/8/91

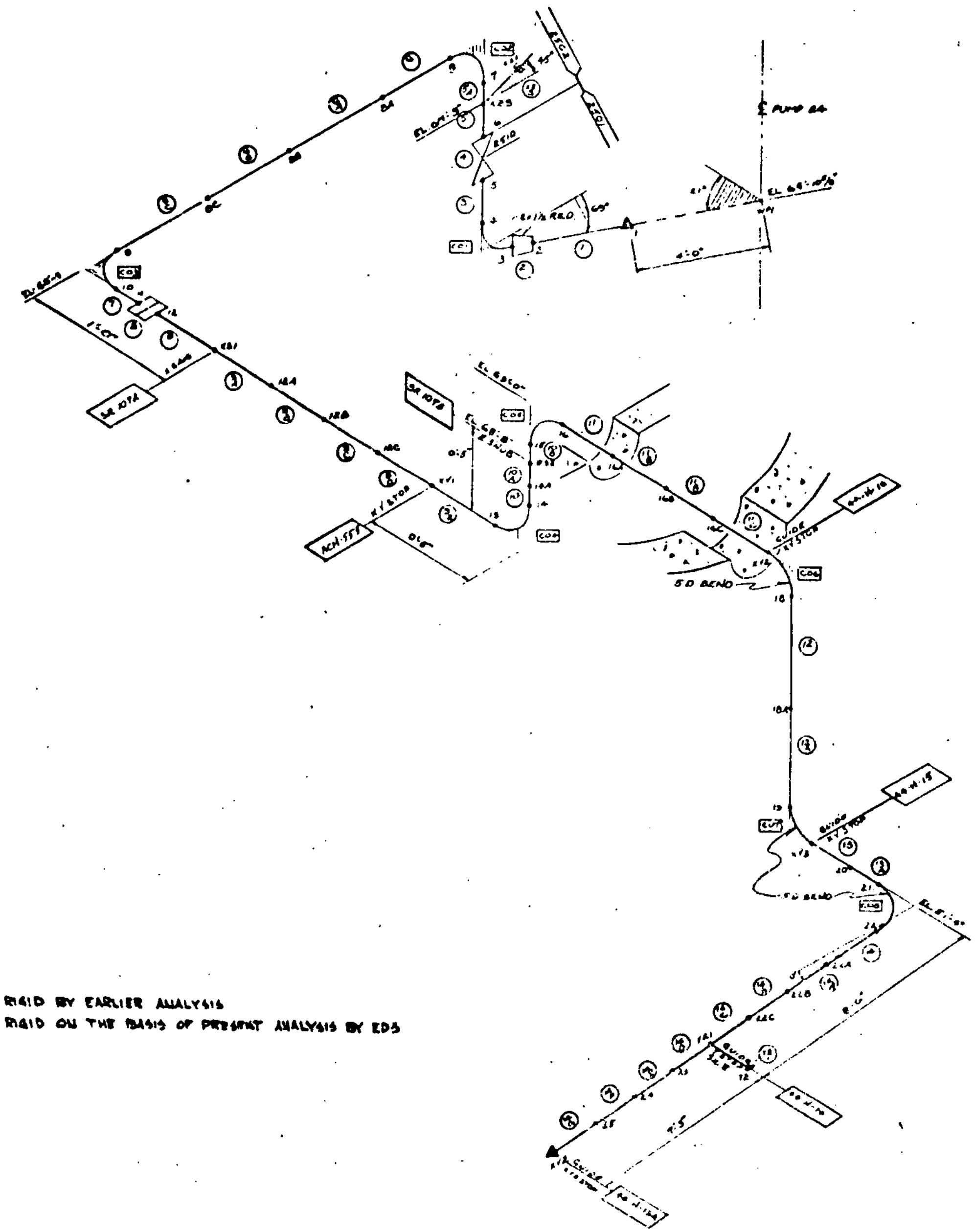
EDS NUCLEAR

INDIAN POINT PLANT 2

LINE 43

SCALE	DRAWN	CHECKED	APPROVED	DATE
NTS	JAG			5/6/88

JOB NO.	DRAWING NO.	REV.
1800004	1800004-43	0



*MODIFIED TO RIGID BY EARLIER ANALYSIS
* *MODIFIED TO RIGID ON THE BASIS OF PRESENT ANALYSIS BY EDS

REF. COORD.:

EDS PROBLEM NO.: 44

ANALYSIS		MATH MODEL REVISION
TYPE	REVISION	
THERMAL		
GRAVITY		
SEISMIC		
S.A.M		
SECTION III		

REFERENCE DRAWING	REV. NO.
9321-F-2529 (UE & C)	4
9321-F-2581	5
9321-F-2582	14

LINE LIST: 9321-C-2741-12 SHEET 3
SPEC #: 2501.2502

THERMAL DISPLACEMENTS (UNITS)

JT	ΔX	ΔY	ΔZ
1	1.1233	.242	1.5198

1	DRAWING UPDATED				
NO.	REVISION				

EDS NUCLEAR

INDIAN POINT PLANT 2

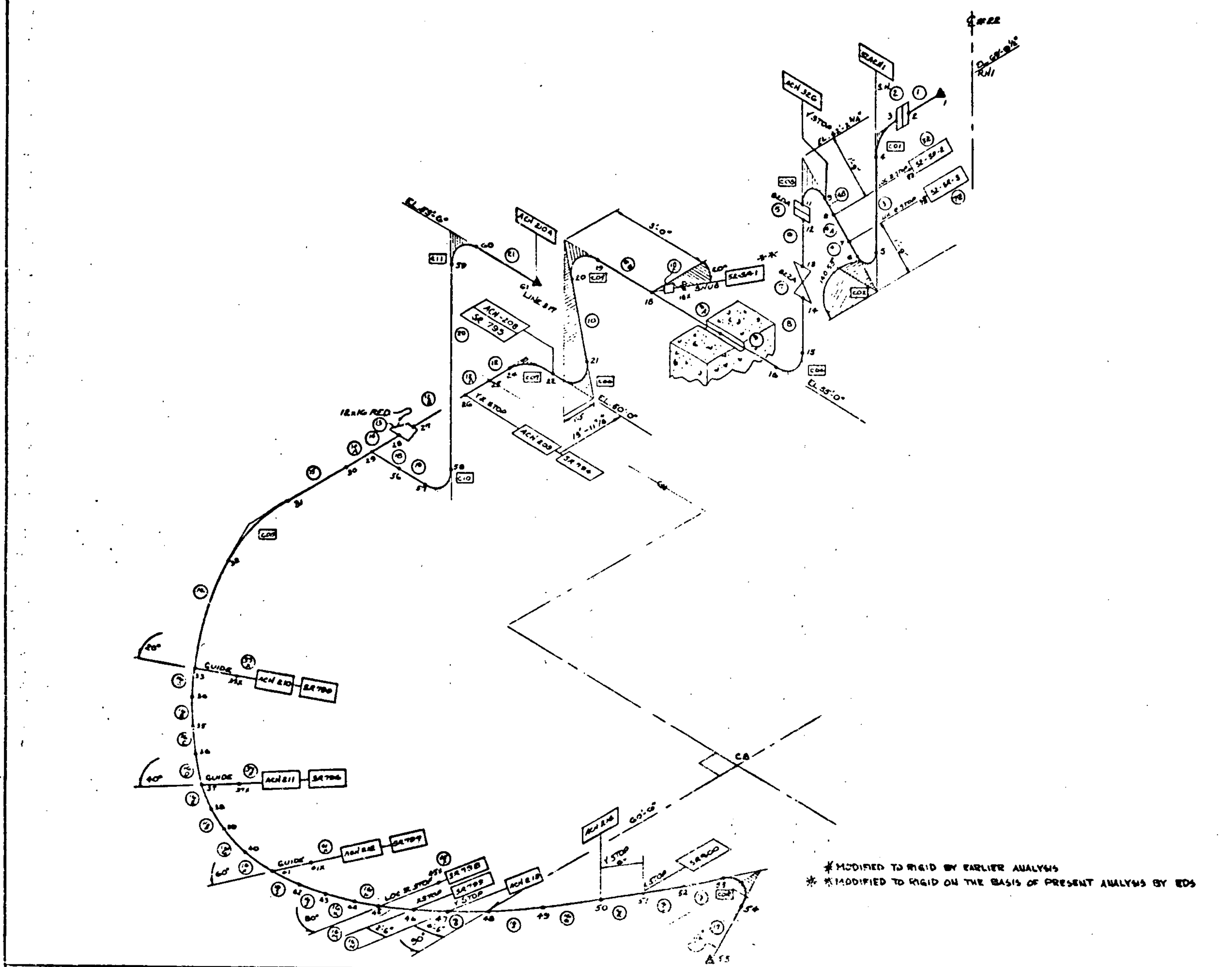
LINE 44 FROM PUMP 24

SCALE	DRAWN	CHECKED	APPROVED	DATE
NTS	CAG			3/12/78

JOB NO.	DRAWING NO.	REV.
1800004	1800004-44	0

LEGEND:

X : JOINT
(X) : STRAIGHT MEMBER
[CXX] : CURVED MEMBER
▲ : ANCHOR
FICTICIOUS MEMBER
S.H. : SPRING HANGER
STOP : RIGID RESTRAINT
SNUB : SNUBBER (SEISMIC RESTRAINT ONLY)
SR : SHORT RADIUS ELBOW
LR : LONG RADIUS ELBOW



REF. COORD.:

EDS PROBLEM NO.: 52

ANALYSIS		MATH MODEL REVISION
TYPE	REVISION	
THERMAL		
GRAVITY		
SEISMIC		
S.A.M.		
SECTION III		

REFERENCE DRAWING	REV. NO.
9321-P-2561	10
9321-F-2563	3
9321-F-2565	18
9321-F-2566	16

LINE LIST: 9321-C-2741-12 SHEET 3

SPEC: 15?

THERMAL DISPLACEMENTS (W.I.T.?)

JT	ΔX	ΔY	ΔZ
1	.009"	.101	

1	DRAWING UPDATED	CA	[illegible]	[illegible]	[illegible]
NO.	REVISIONS				

EDS NUCLEAR

INDIAN POINT PLANT 2

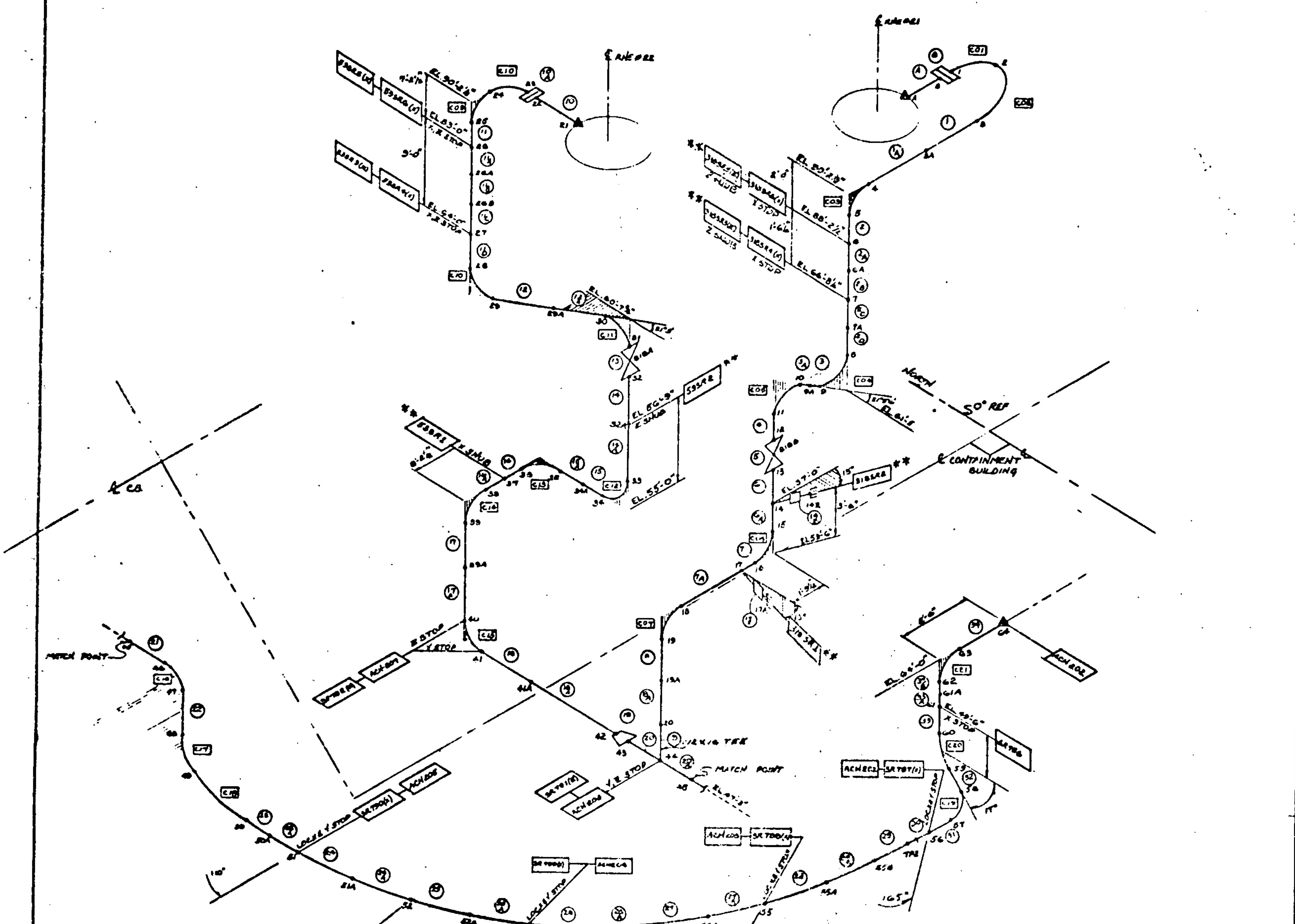
LINE 52 HEAT EX. # 22

SCALE	DRAWN	CHECKED	APPROVED	DATE
NTS	CAG	[signature]	[signature]	5/14/78

JOB NO.	DRAWING NO.	REV.
1800004	1800004-52	0

LEGEND:

X : JOINT
(X) : STRAIGHT MEMBER
[CXX] : CURVED MEMBER
▲ : ANCHOR
FICTICIOUS MEMBER
S.H. : SPRING HANGER
STOP : RIGID RESTRAINT
SNUB : SNUBBER (SEISMIC RESTRAINT ONLY)
SR : SHORT RADIUS ELBOW
LR : LONG RADIUS ELBOW



* MODIFIED TO RIGID BY EARLIER ANALYSIS
** MODIFIED TO RIGID ON THE BASIS OF PRESENT ANALYSIS BY EDS

REF. COORD.:

EDS PROBLEM NO.: 53

ANALYSIS		MATH MODEL REVISION
TYPE	REVISION	
THERMAL		
GRAVITY		
SEISMIC		
S.A.M.		
SECTION III		

REFERENCE DRAWING	REV. NO.
9321-F-2561	10
9321-F-2563	3
9321-F-2565	13
9321-F-2566	15

LINE LIST: 9321-C-2741-12 SHEET 3
SPEC#: 152

THERMAL DISPLACEMENTS (UNITS)

JT	DX	DY	DZ
A	-0.000	.153	.009
21	.009	.153	-0.000

1	DRAWING UPDATED				
NO.	REVISIONS				

EDS NUCLEAR

INDIAN POINT PLANT 2

LINE 53 & 51B

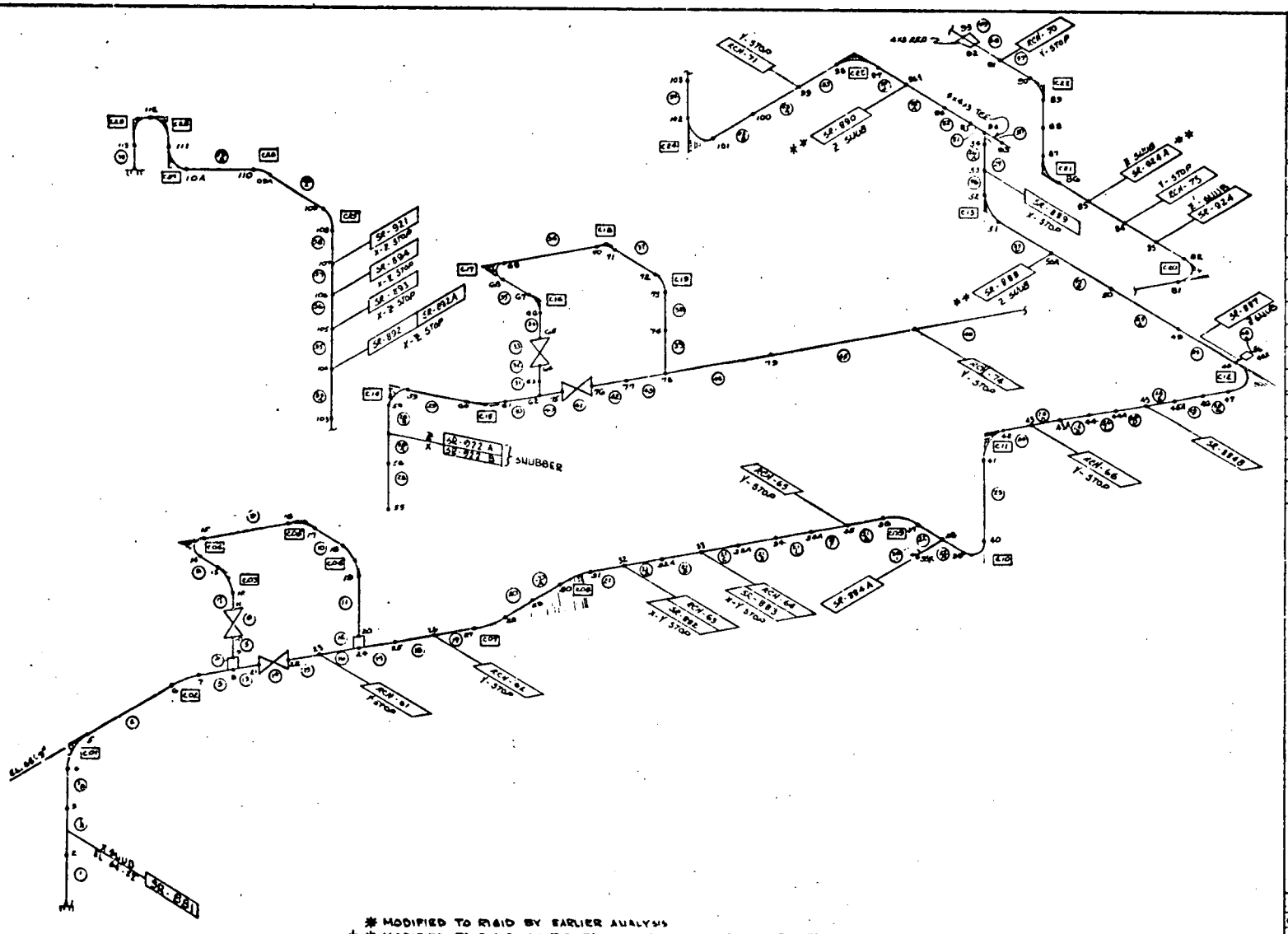
SCALE	DRAWN	CHECKED	APPROVED	DATE
NTS	CAS			

JOB NO.	DRAWING NO.	REV
1800004	1800004-53	0

LEGEND

X : JOINT	CXX : CURVED MEMBER	: FICTICIOUS MEMBER	STOP : RIGID RESTRAINT
(X) : STRAIGHT MEMBER	▲ : ANCHOR	S.H. : SPRING HANGER	SNUB : SNUBBER (SEISMIC RESTRAINT ONLY)

SR : SHORT RADIUS ELBOW
LR : LONG RADIUS ELBOW



* MODIFIED TO RIGID BY EARLIER ANALYSIS
** MODIFIED TO RIGID ON THE BASIS OF PRESENT ANALYSIS BY EDS

LEGEND:
X : JOINT
(X) : STRAIGHT MEMBER
CVX : CURVED MEMBER
▲ : ANCHOR
: FICTICIOUS MEMBER
S.H. : SPRING HANGER
STOP : RIGID RESTRAINT
SNUB : SNUBBER (SEISMIC RESTRAINT ONLY)
SR : SHORT RADIUS ELBOW
LR : LONG RADIUS ELBOW

REF. COORD.:

EDS PROBLEM NO.: 61-62

ANALYSIS TYPE	ANALYSIS REVISION	MATH MODEL REVISION
THERMAL		
GRAVITY		
SEISMIC		
E.A.M.		
SECTION III		

REFERENCE DRAWING	REV. NO.
9321-F-2537	16
LINE LIST 9321-C-2741-12	SHEETS
SPECIFICATION = 2501	

ANCHOR MOVEMENTS

JOINT	REFERENCE	ΔX	ΔY	ΔZ
1	CHART INDIAN POINT 3	.875	0.0	-1.125
55	CHART INDIAN POINT 3	.813	0.0	1.25
114	CHART INDIAN POINT 3	0.0	2.667	0.0
33	SUPPORT DRWG. 9303-1	-.125	0.0	0.0

NO.	REVISIONS	DATE	CHK'D
1	DRAWING UPDATED	5/1/78	JP

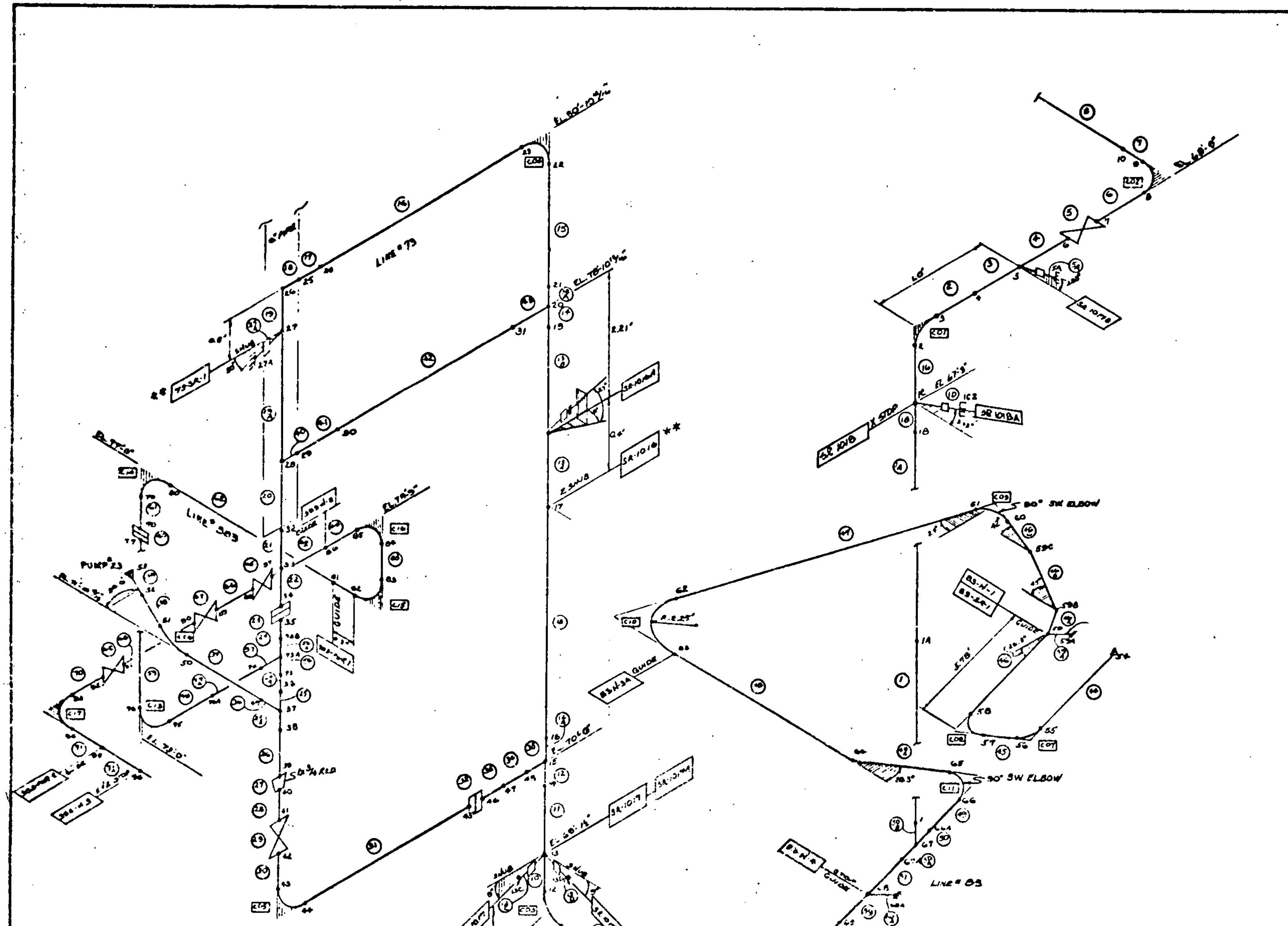
EDS NUCLEAR

INDIAN POINT PLANT 2

LINE G1 & G2

SCALE	DRAWN	CHECKED	APPROVED	DATE
NTS	CAG	ASG	JP	5/1/78

JOB NO. 1500004 | DRAWING NO. 1600004-61-62 | REV. 0



$ MODIFIED TO RIGID BY EARLIER ANALYSIS
$$ MODIFIED TO RIGID ON THE BASIS OF PRESENT ANALYSIS BY EDS

LEGEND:

X : JOINT	(X) : STRAIGHT MEMBER	[XX] : CURVED MEMBER
A : ANCHOR	FICTICIOUS MEMBER	S.H. : SPRING HANGER
STOP : RIGID RESTRAINT	SNUB : SNUBBER (SEISMIC RESTRAINT ONLY)	SR : SHORT RADIUS ELBOW
LR : LONG RADIUS ELBOW		

REF. COORD.:

EDS PROBLEM NO.: 73

ANALYSIS TYPE	REVISION	MATH MODEL REVISION
THERMAL		
GRAVITY		
SEISMIC		
S.A.M.		
SECTION III		

REFERENCE DRAWING	REV. NO.
9321-F-2520	15

LINE LIST: 9321-C-2741-9 SHEET 4

SPEC #: 151

THERMAL DISPLACEMENTS (U4T3.2)

JT.	ΔX	ΔY	ΔZ
53	1.52	.626	-1.123
54	1.28	.546	-1.265

NO.	REVISIONS				
1	DRAWING UPDATED	BM	5/81	RS	29

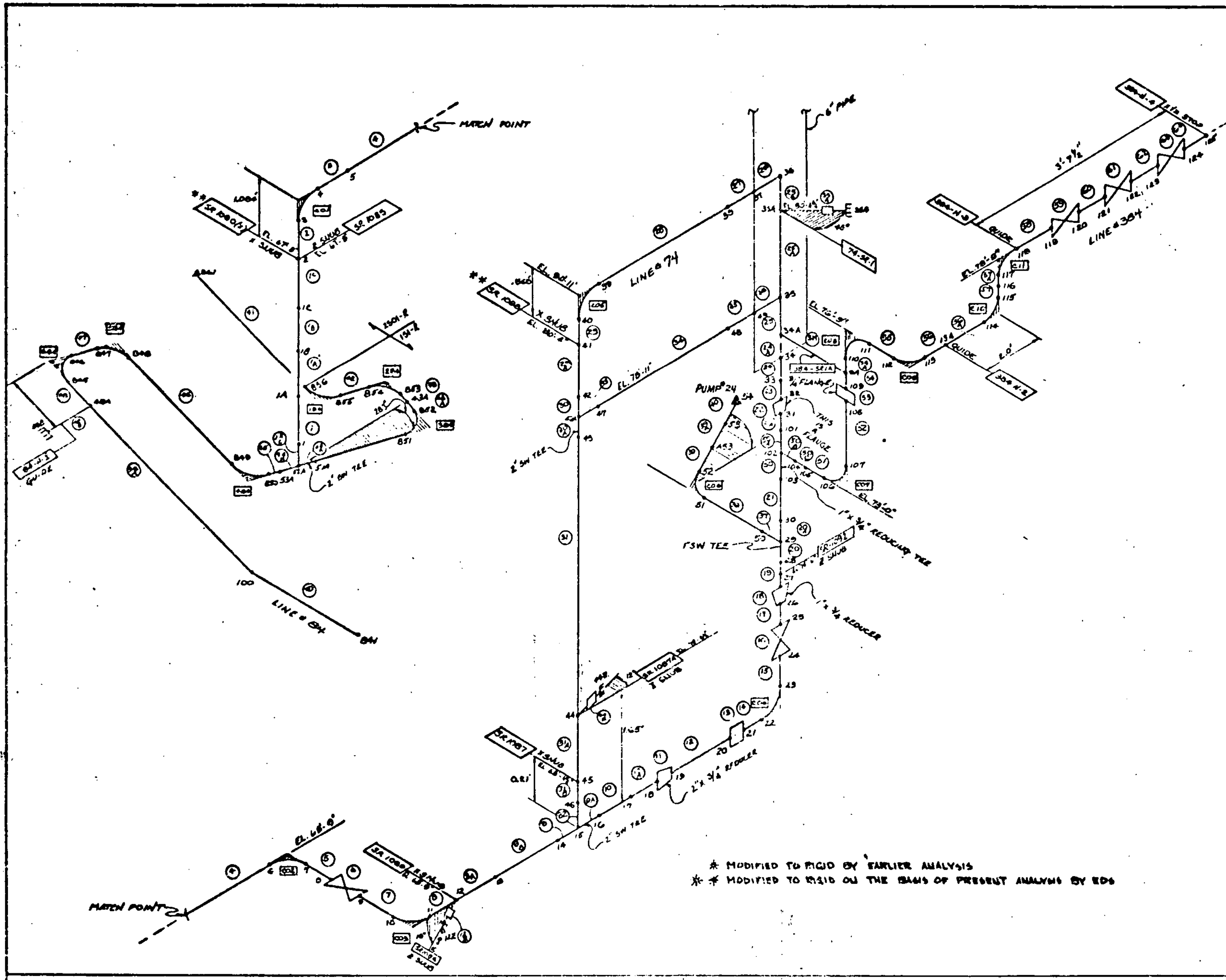
EDS NUCLEAR

INDIAN POINT PLANT 2

LINE 73 TO REACTOR COOLANT PUMP

SCALE	DRAWN	CHECKED	APPROVED	DATE
NTS	AAS	CBM	JS	5/1/78

JOB NO.	DRAWING NO.	REV.
1600004	1600004-73	0



★ MODIFIED TO RIGID BY EARLIER ANALYSIS
☆★ MODIFIED TO RIGID ON THE BASIS OF PRESENT ANALYSIS BY EDS

REF. COORD.:

EDS PROBLEM NO.: 74

ANALYSIS		MATH MODEL REVISION
TYPE	REVISION	
THERMAL		
GRAVITY		
SEISMIC		
S.A.M.		
SECTION III		

REFERENCE DRAWING	REV. NO.
9321-F-2629-14	
9321-F-2645-16	

LINE LIST: 9321-C-2741-9; SHEET 4

SPEC. #: 151

THERMAL DISPLACEMENTS

	JT	ΔX	ΔY	ΔZ
(UNIT 3)	54	1.128	.625	1.52
(UNIT 2)	861	1.28	.846	1.255

NO.	REVISION	DATE	CHK	APPD	DATE
1	DRAWING UPDATED				

EDS NUCLEAR

INDIAN POINT PLANT 2

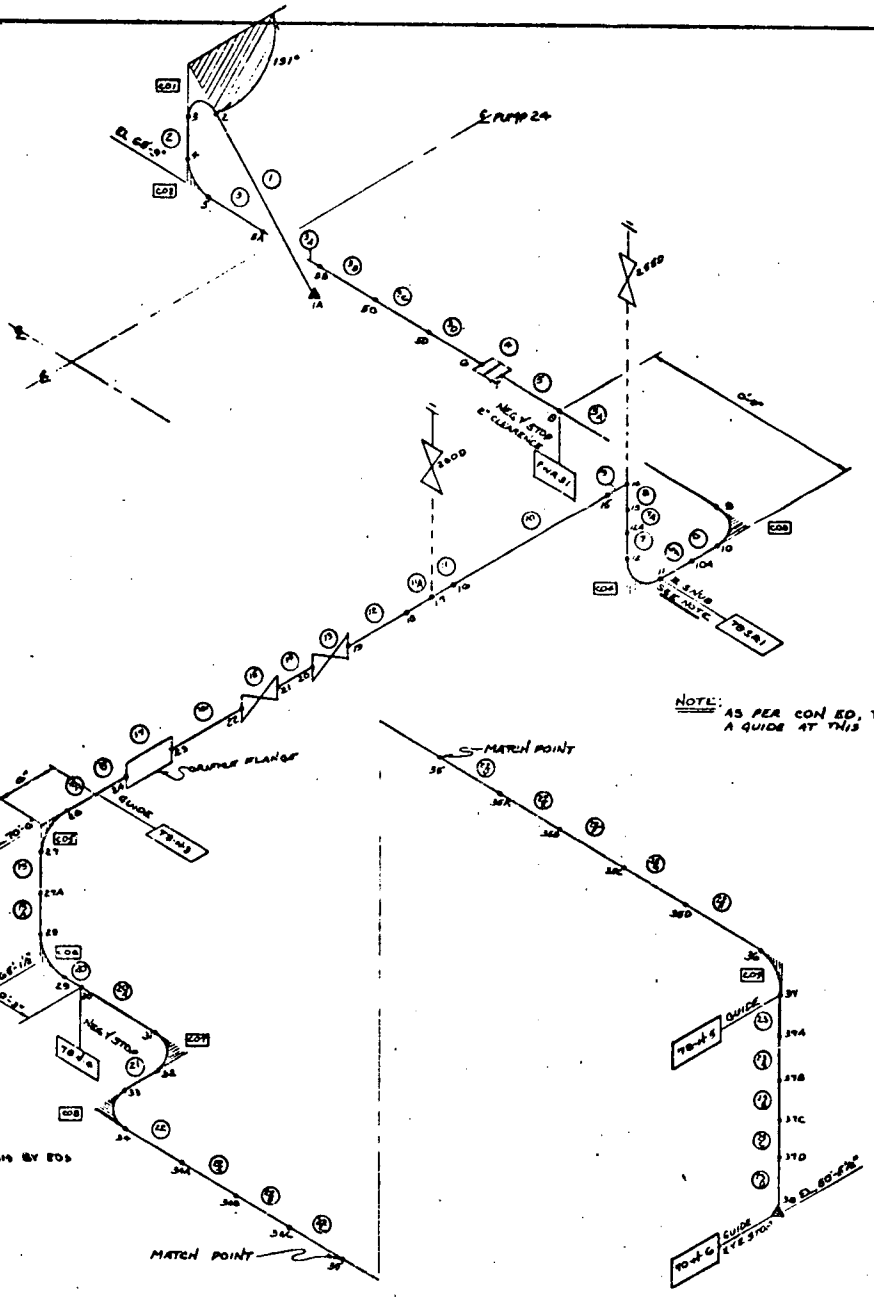
LINE # 74 PUMP 24

SCALE	DRAWN	CHECKED	APPROVED	DATE
NTS	CAG	CEM		

JOB NO.	DRAWING NO.	REV.
1800004	1800004-74	0

LEGEND:

X : JOINT
(X) : STRAIGHT MEMBER
[CXX] : CURVED MEMBER
▲ : ANCHOR
}--[: FICTICIOUS MEMBER
S.H. : SPRING HANGER
STOP : RIGID RESTRAINT
SNUB : SNUBBER (SEISMIC RESTRAINT ONLY)
SR : SHORT RADIUS ELBOW
LR : LONG RADIUS ELBOW



R MODIFIED TO RIGID BY EARLIER ANALYSIS
℞ MODIFIED TO RIGID ON THE BASIS OF PRESENT ANALYSIS BY EDS

LEGEND:
X : JOINT
(X) : STRAIGHT MEMBER
CVX : CURVED MEMBER
▲ : ANCHOR
⅓—| : FICTICIOUS MEMBER
S.H. : SPRING HANGER
RIGID : RIGID RESTRAINT
SNUB : SNUBBER (SEISMIC RESTRAINT ONLY)
SR : SHORT RADIUS ELBOW
LR : LONG RADIUS ELBOW

REF. COORD.:

EDS PROBLEM NO.: 78

ANALYSIS		MATH MODEL REVISION
TYPE	REVISION	
THERMAL		
GRAVITY		
SEISMIC		
S.A.M.		
SECTION III		

REFERENCE DRAWING	REV. NO.
9321-F-2529	4
9321-F-2582	14

LINE LIST: 9321-C-2741 SHEET 4

SPEC. #: 2501

THERMAL DISPLACEMENTS (UNITS)

JT	ΔX	ΔY	ΔZ
38	.11235"	.60"	1.5199

NO.	REVISIONS	DATE	CHK'D	APP'D	DATE
1	DRAWING UPDATED	5/12/80	EM	[illegible]	[illegible]

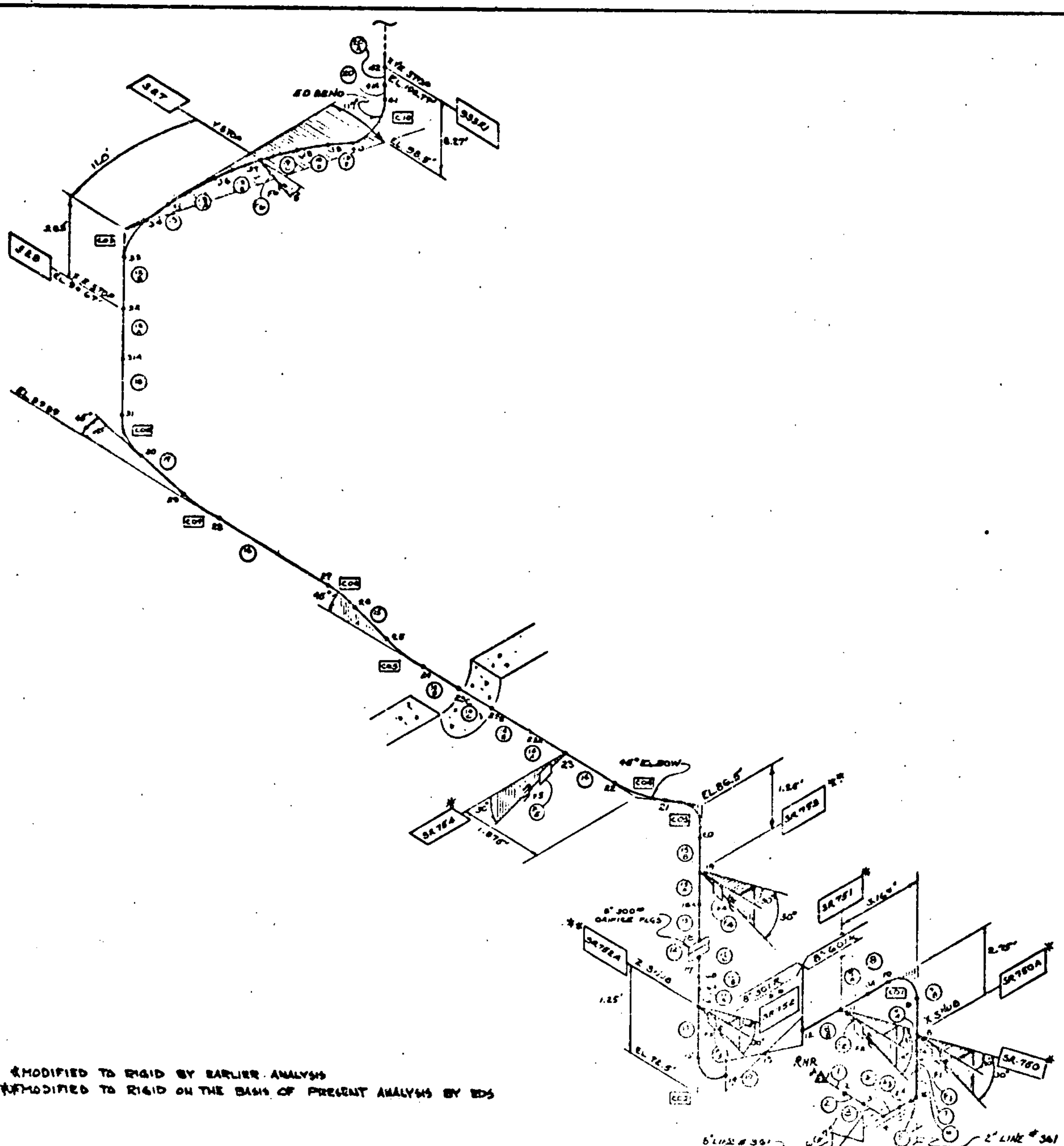
EDS NUCLEAR

INDIAN POINT PLANT 2

LINE 78

SCALE	DRAWN	CHK'D	APPROVED	DATE
NTS	CAS	[illegible]	[illegible]	5/12/80

JOB NO.	DRAWING NO.	REV.
1800004	1800004-78	0



*MODIFIED TO RIGID BY EARLIER ANALYSIS
**MODIFIED TO RIGID ON THE BASIS OF PRESENT ANALYSIS BY EDS

LEGEND:	
X : JOINT	(X) : STRAIGHT MEMBER
[CXX] : CURVED MEMBER	△ : ANCHOR
FICTITIOUS MEMBER	S.H. : SPRING HANGER
STOP : RIGID RESTRAINT	SNUB : SNUBBER (SEISMIC RESTRAINT ONLY)
SR : SHORT RADIUS ELBOW	LR : LONG RADIUS ELBOW

REF. COORD.: Y, X (NORTH), Z

EDS PROBLEM NO.: 93

ANALYSIS		MATH MODEL REVISION
TYPE	REVISION	
THERMAL		
GRAVITY		
SEISMIC		
S.A.M.		
SECTION III		

REFERENCE DRAWING	REV. NO.
9321-F-2552	19
9321-F-2624	6
ISOMETRIC 9321-C-2741 SHEET 3	0
WAPO E-SPEC. G 569866-301/601	2

ANCHOR MOVEMENTS (UNITS)

JOINT 1A Y=.028" Z=.075"

NO.	REVISION				
1	DRAWING UPDATED				

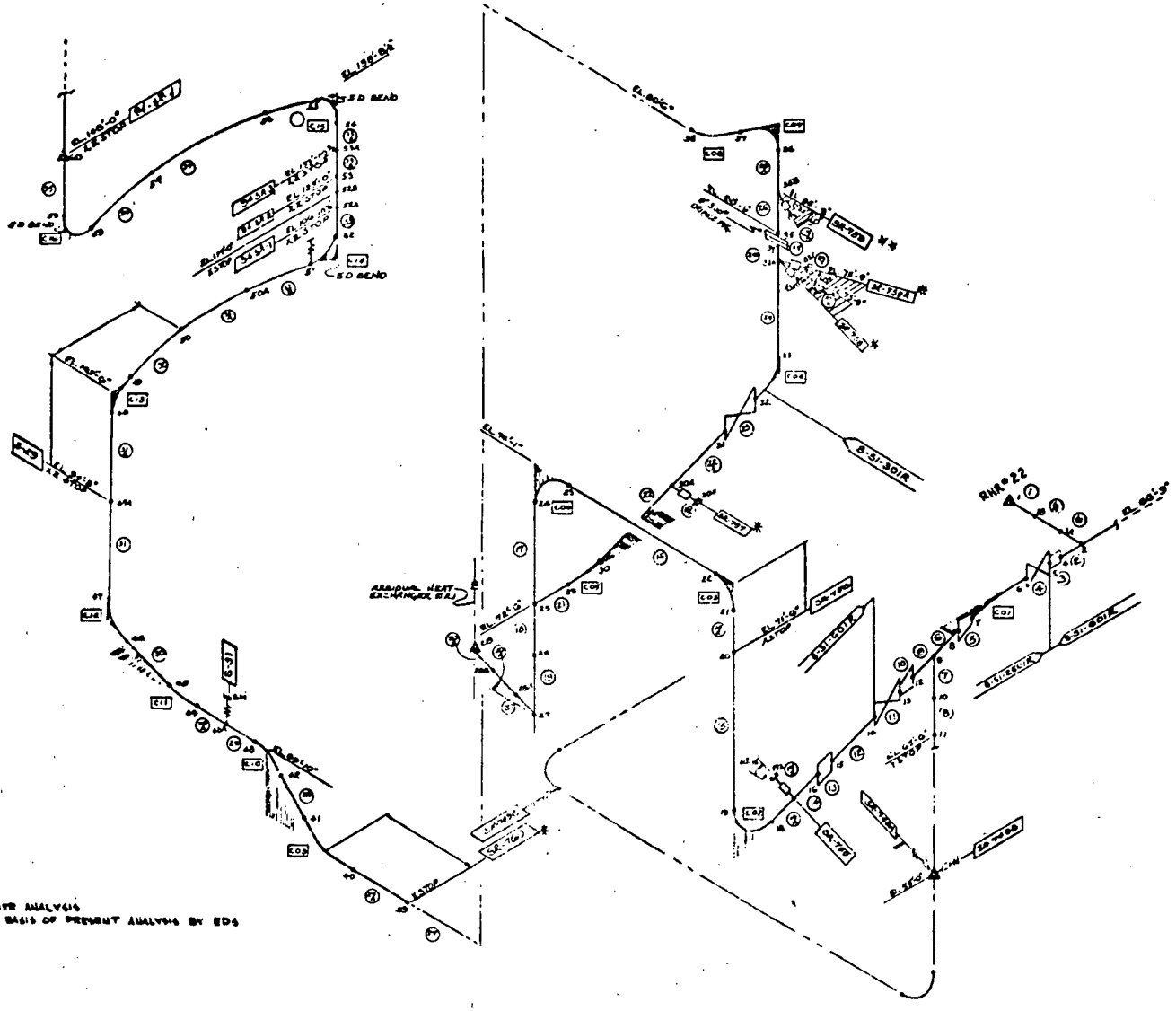
EDS NUCLEAR

INDIAN POINT PLANT 2

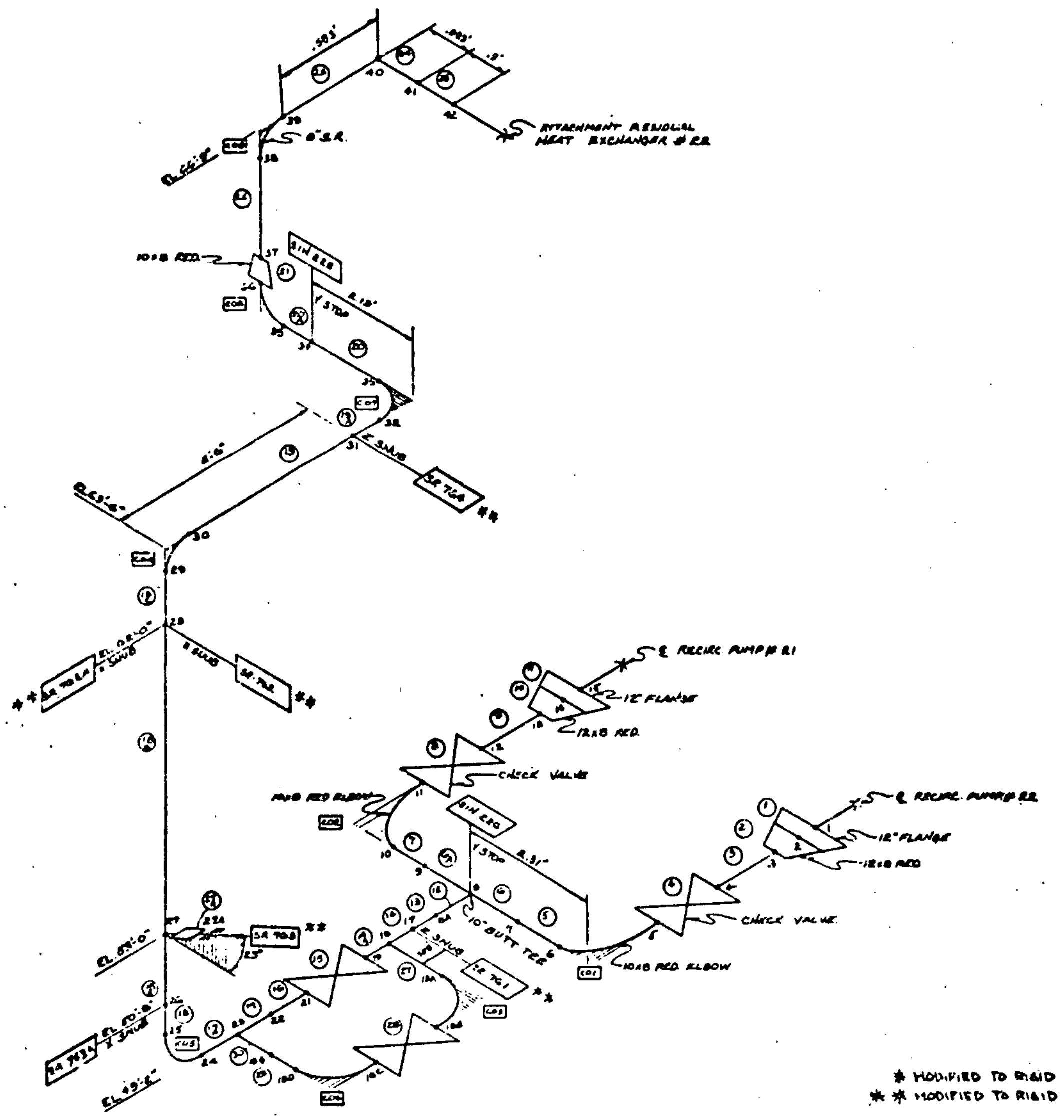
LINE 93

SCALE	DRAWN	CHECKED	APPROVED	DATE
NTS	CAG			5/12/78

JOB NO.	DRAWING NO.	REV
1800004	1800004-93	0



* MODIFIED TO RIGID BY EARLIER ANALYSIS
** MODIFIED TO RIGID ON THE BASIS OF PRESENT ANALYSIS BY EDS



* MODIFIED TO RIGID BY EARLIER ANALYSIS

** MODIFIED TO RIGID ON THE BASIS OF PRESENT ANALYSIS BY EDS

REF. COORD.:

EDS PROBLEM NO.: 293

ANALYSIS		MATH MODEL REVISION
TYPE	REVISION	
THERMAL		
GRAVITY		
SEISMIC		
S.A.M.		
SECTION III		

REFERENCE DRAWING	REV. NO.
9321-F-2562	10

LINE LIST: 9321-C-2741-11 SHEET 13

SPEC #: G01

THERMAL DISPLACEMENTS (UNIT 3)

JT	ΔX	ΔY	ΔZ
42	0.0	0.028	-.0756
1	.141	.037	.054
15	0.081	.037	-.032

1	DRAWING UPDATED				
NO.	REVISION				

EDS NUCLEAR

INDIAN POINT PLANT 2

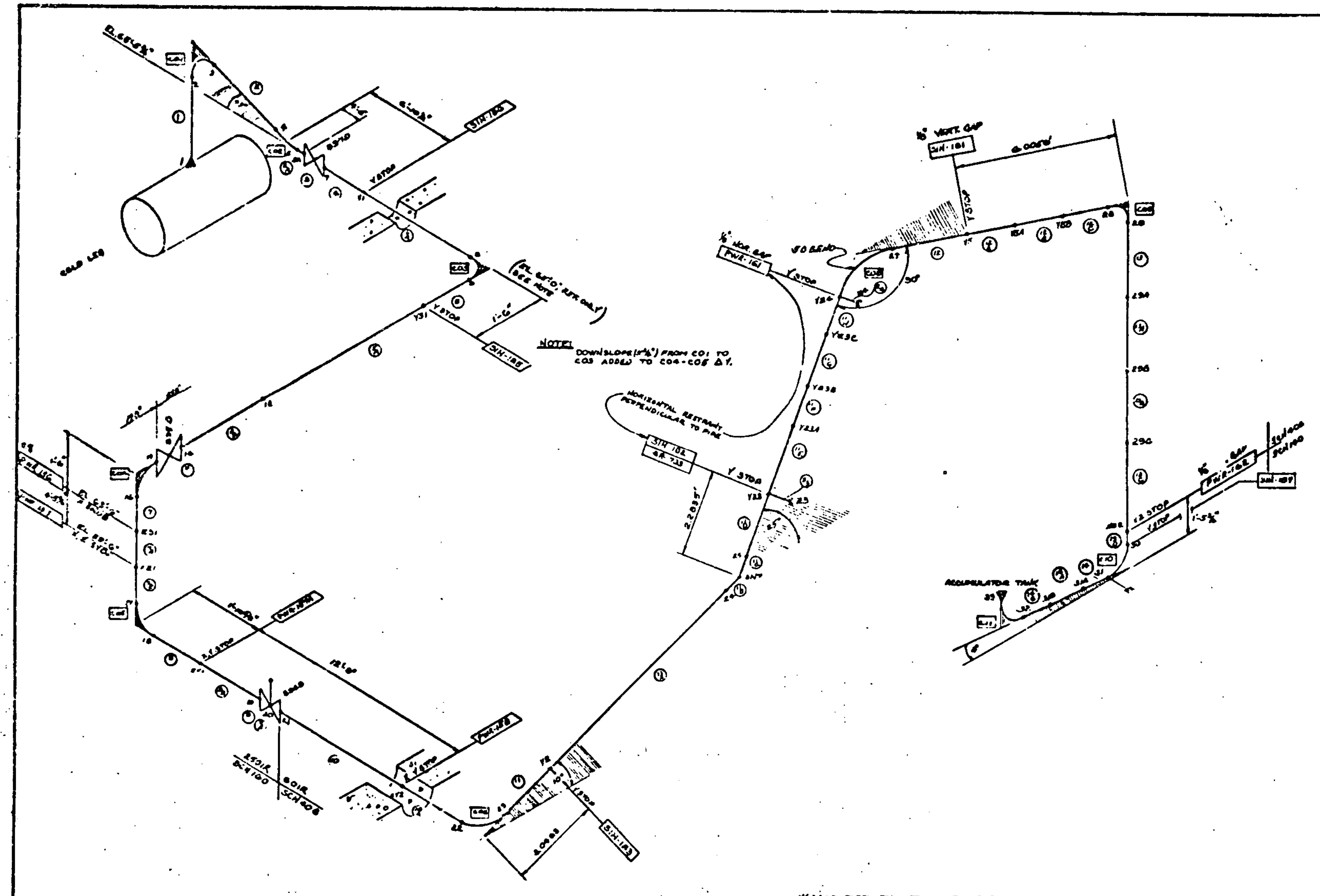
LINE 293

SCALE	DRAWN	CHECKED	APPROVED	DATE
NTS	CAG	CBR		7/78

JOB NO.	DRAWING NO.	REV.
1800004	1800004-293	0

LEGEND:

X : JOINT	CXX : CURVED MEMBER	FICTICIOUS MEMBER	STOP : RIGID RESTRAINT	SR : SHORT RADIUS ELBOW
(X) : STRAIGHT MEMBER	△ : ANCHOR	S.H. : SPRING HANGER	SNUB : SNUBBER (SEISMIC RESTRAINT ONLY)	LR : LONG RADIUS ELBOW



REF. COORD.:

EDS PROBLEM NO.: 350

ANALYSIS		MATH MODEL REVISION
TYPE	REVISION	
THERMAL		
GRAVITY		
SEISMIC		
S.A.M.		
SECTION III		

REFERENCE DRAWING	REV. NO.
9321-F-26.7	
9321-F-2626	
9321-F-2535	
9321-F-2536	

LINE LIST: 9321-C-2941-11 SHEET 15

SPEC # 1501, CO1

THERMAL DISPLACEMENTS (UAT8)

JT	ΔX	ΔY	ΔZ
1	.387	0.000	1.175
Y5	0.00	.06250	0.000
A22	.12460	0.000	.00874
Z4	-.05280	0.000	-.11330

* MODIFIED TO RIGID BY EARLIER ANALYSIS

** MODIFIED TO RIGID ON THE BASIS OF PRESENT ANALYSIS BY EDS.

1	DRAWING UPDATED				
NO	REVISION	DATE	DATE	DATE	DATE

EDS NUCLEAR

INDIAN POINT PLANT 2

SAFETY INJECTION SYSTEM LINE 350

SCALE	DRAWN	CHECKED	APPROVED	DATE
NTS	CAG	jl.	JS	6/1/76

JOB NO	DRAWING NO.	REV
1800004	1800004-350	0

LEGEND:

X : JOINT
(X) : STRAIGHT MEMBER
[CYX] : CURVED MEMBER
▲ : ANCHOR
}—{ : FICTITIOUS MEMBER
S.H. : SPRING HANGER
STOP : RIGID RESTRAINT
SNUB : SNUBBER (SEISMIC RESTRAINT ONLY)
SR : SHORT RADIUS ELBOW
LR : LONG RADIUS ELBOW