EROSION-CORROSION MONITORING PROGRAM FOR FEEDWATER/CONDENSATE SYSTEM PIPING

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TCN

EROSION-CORROSION MONITORING PROGRAM FOR FEEDWATER/CONDENSATE SYSTEM PIPING

1.0 OBJECTIVE

This procedure defines the periodic surveillance requirements for monitoring for erosion-corrosion of feedwater/condensate system piping at the San Onofre Nuclear Generating Station, Units 1, 2 and 3. The program details those lines and the locations on selected lines which are to be inspected, the frequency of the surveillance required, and the criteria for determining if repairs or replacements are required.

2.0 REFERENCES

2.1 Other

2.1.1 Institute of Nuclear Power Operations Significant Operating Experience Report 87-3, dated March 20, 1987.

2.1.2 Institute of Nuclear Power Operations Significant Event Report 1-87, dated January 7, 1987

2.1.3 Institute of Nuclear Power Operations Significant Event Notice 4, dated December 10, 1986

2.1.4 Nuclear Regulatory Commission I.E. Information Notice No. 86-106, Supplement 1, dated February 13, 1987

2.1.5 Nuclear Regulatory Commission I.E. Information Notice No. 86-106, Supplement 1, dated February 13, 1987

2.1.6 Nuclear Regulatory Commission I.E. Information Notice No. 86-106, Supplement 2, dated March 18, 1987

2.1.7 Memorandum from D. O. Henry to J. A. Mundis, dated May 25, 1987, Subject: Selection of Steam Extraction Lines for Erosion-Corrosion Monitoring, San Onofre Nuclear Generating Station, Unit 1

2.1.8 Electric Power Research Institute Report NP-3944, Erosion/Corrosion in Nuclear Steam Plant Piping: Causes and Inspection Program Guidelines, dated April 1985

3.0 PREREQUISITES

3.1 Prior to use of a user-controlled (pink) copy of this procedure, it is the user's responsibility to verify that the revision and any TCNs are current by utilizing one of the following methods:

3.1.1 Check it against a controlled copy and any TCNs;

3.1.2 Access an SCE Document Configuration System (SDCS);

3.0 PREREQUISITES (Continued)

3.1.3 Contact CDM by telephone or through counter inquiry;

3.1.4 Obtain a user-controlled (pink) copy of this procedure from CDM;

3.1.5 Reference a current (within one week) Destination Configuration Control Log and associated daily update.

4.0 PRECAUTIONS

4.1 The person or persons conducting work under this procedure must take steps to protect themselves from contact with any piping, valves, heaters or other components from which thermal insulation has been removed as severe burns may result. Should steam or high pressure water leakage be detected, immediately leave the area and notify the Control Room.

5.0 CHECKLIST

5.1 None

6.0 PROCEDURE

6.1 Surveillance Scope

6.1.1 Identification of Lines and Areas to be Inspected

.1 All high-energy (greater than 200 degrees fahrenheit) water systems with carbon steel pipe materials were evaluated (Reference 2.1.7). Those lines which were determined to be susceptible to erosion-corrosion have been included in this program. Attachments 1 and 2.

.2 Examination locations should be selected at points in the lines where high local velocities or turbulent flow conditions are expected based on configuration. Piping system configurations which are expected to create turbulent flow conditions are listed in Attachment 3.

6.2 Surveillance Frequency

6.2.1 A baseline shall be established by examination of areas, with the highest susceptibility ratings as described in Attachment 3, on those lines having the greatest susceptibility (temperature/velocity rating) as listed in Attachments 1 and 2. At least one area (having the highest susceptibility rating) on each of those lines should be examined. This baseline should be performed during fuel cycle 10 for Unit 1, cycle 4 for Unit 2 and cycle 3 for Unit 3 (including the refueling outage if necessary). TCN

6.0 PROCEDURE (Continued)

6.2.2 Except as modified by 6.2.4 and 6.2.5 below, the frequency of subsequent examinations should be based on the susceptibility rating of the area as listed in Attachment 3. All of those examination areas rated 10 or greater (most susceptible) on those lines having the greatest susceptibility (temperature/velocity rating) as listed in Attachments 1 and 2 shall be examined once during each fuel cycle.

6.2.3 Identification and rating of examination areas and preparation of examination sketches for subsequent use, should be performed during the baseline examination period described in 6.2.1.

6.2.4 Areas in which erosion-corrosion has progressed sufficiently to decrease the wall thickness of the piping or fitting below the minimum thickness specified for that size and schedule, shall be scheduled for re-examination during the next fuel cycle (if it was not already so scheduled), unless the measured erosion rate, based on previous examinations may be justified. Also, additional similar areas (based on Attachment 3) shall be examined during the same fuel cycle as necessary to determine if the same condition exists elsewhere.

6.2.5 If it is determine by the methods described in 6.5 below that the material loss in an area is sufficient to require a repair or replacement areas having the next highest susceptibility rating on the same line shall also be examined.

6.3 Periodic Review and Revision

6.3.1 This procedure will be reviewed as necessary to determine what revisions, if any, are necessary to assure that the examination frequencies are adequate based on measured rates of erosion-corrosion and that design changes, affecting lines identified for monitoring in this program, are incorporated to the extent necessary.

6.4 Nondestructive Examination (NDE)

6.4.1 Monitoring of feedwater/condensate piping in accordance with this procedure shall be performed using nondestructive examination (NDE) methods and techniques in accordance with procedures which have been approved by a Southern California Edison Level III in the applicable NDE method.

6.0 PROCEDURE (Continued)

6.4.2 The personnel performing the nondestructive examinations shall demonstrate their proficiency to the satisfaction of a Southern California Edison Level III. Surveillance of the work by the Level III is sufficient to satisfy this requirement.

6.4.3 Ultrasonic and/or radiographic examination methods may be used to determine the wall thickness in piping systems at the locations selected.

6.4.4 The Radiographic method shall not be used as the primary examination method for piping having a Nominal Pipe Size greater than 8".

6.4.5 When the ultrasonic method is used, readings should be taken in the circumferential direction at approximately every 22.5 degrees or 3 inches, whichever is greater, as a minimum. In the longitudinal direction, readings shall be taken every 3 inches, as a minimum. Partial grids, such as those shown in Figures 1, 2, 3, and 4 of Attachment 5, may be used. A description or sketch of the grid pattern used should be included in the examination report. In addition, areas shall be scanned 100% to detect any local areas of severe wall thinning which may not have been covered by the grid. TCN

6.5 Evaluation of NDE Data/Evaluation for Repair or Replacement

6.5.1 When an area is identified on a pipe or fitting which is below the minimum wall thickness specified for that size schedule, it shall be subject to engineering evaluation.

6.5.2 The engineering evaluation shall consist of three parts (1) determination of the minimum design wall thickness, (2) estimation of the material loss rate and (3) estimation of the remaining service life of the pipe segment or fitting.

6.5.3 The minimum design wall thickness shall be calculated in accordance with the edition and Addenda of the Construction Code, applicable to the installation of the pipe, fitting or component. A later Edition and/or Addenda of the Construction Code may be used for non-safety related lines or portions of lines.

6.5.4 The material loss rate shall be estimated based on previous examination (thickness measurement) results, or, if previous examination results are not available, may be calculated using methods such as those described in Reference 2.1.8.

6.0 PROCEDURE (Continued)

6.5.5 The remaining service life shall be defined as that period of time during which, based on the material loss rate of 6.5.4, the pipe or fitting shall remain at or above the minimum design wall thickness calculated in 6.5.3, plus 5 percent. The 5 percent factor is a margin of safety added to compensate for any inaccuracies in the NDE measurements.

6.5.6 The pipe or fitting shall not remain in service beyond its remaining service lift as determined in 6.5.5, unless the material loss rate is shown by subsequent examination to be less than originally estimted.

.1 Where the material loss rate is shown by a single subsequent examination to be less than that estimated in 6.5.5, subsequent examinations shall be performed to compensate for inaccuracies in the NDE measurements. The number and frequency of the subsequent examinations shall be determined on a case-by-case basis by the engineer cognizant of this program with the concurrence of an SCE Level III in the applicable examination method.

6.5.7 Where the pipe segment is replaced or repaired, 6.2.4, 6.5.6 and 6.5.6.1 above do not apply.

7.0 RECORDS

7.1 Copies of all examination results generated in accordance with this procedure shall be maintained in CDM.

7.2 A report summarizing the findings of the examination program shall be prepared by the program cognizant engineer once during each fuel cycle, as a minimum. The report shall include references to any documents, such as Maintenance Orders or Construction Work Orders, which were used for replacement of pipe or fittings, as a result of erosion-corrosion damage. A copy of this report shall be maintained in CDM.

7.3 All documents in 7.1 and 7.2 above shall be maintained in CDM for the life of the applicable Unit.

UNIT 1 EROSION/CORROSION MONITORING PROGRAM LINE LIST

Line	Rating	
CND-318-14"-GG	6	
FWS-320-12"-EG	8	
FWS-322-12"-EG	5	
CND-317-14"-GG	6	
FWS-317-16"-GG	6	
FWS-319-12"-EG	8	
FWS-321-12"-EG	5	
FWS-325-18"-EG	5	
FWH-100-4"-EG	1	
FWH-11093-4"-EG	2	
FWH-12643-4"-EG	2	
FWH-100A-4"-EG	1	
FWH-11099-4"-EG	2	
FWH-103A-4"-EG	2	
FWH-121-8"-HH	4	
FWH-121-6"-HH	5	
FWH-123-8"-HH	4	
FWH-127-10"-HHX	4	
FWH-127-6"-HHX	5	
FWH-102-4"-EG	1	
FWH-11094-4"-EG	2	TCN
FWH-104-4"-EG	2	
FWH-102A-4"-EG	1	
FWH-11100-4"-EG	2	
FWH-104A-4"-EGX	4	
FWH-122-8"-HH	4	
FWH-122-6"-HH	5	
FWH-124-8"-HH	4	
FWH-128-6"-HHX	5	
FWH-128-10"-HH	4	
FWS-325-10"-EG	4	
FWS-326-10"-EG	4	
FWS-329-10"-EG	4	
FWS-391-10"-EG	4	
FWS-391-8"-EG	7	
FWS-392-8"-EG	7	
FWS-392-10"-EG	4	
FWS-393-8"-EG	7	
FWS-393-10"-EG	4	
FWH-105-10"-GG	4	
FWH-105-6"-GG	6	
FWH-107-4"-GGX	9	
FWH-107-8"-GGX	5	
FWH-109-8"-HH	6	
FWH-109-14"-HH	5	

UNIT 1 EROSION/CORROSION MONITORING PROGRAM LINE LIST (Continued)

Line	Rating	
FWH-111-6"-HHX	8	TCN
FWH-111-10"-HHX	6	
FWH-111-14"-HHX	5	
FWH-113-14"-HH	5	
FWH-113-18"-HH	5	
FWH-115-8"-GG	7	
FWH-115-10"-GG	6	
FWH-106-6"-GG	6	
FWH-106-10"-GG	4	
FWH-108-4"-GG	9	
FWH-108-8"-GGX	5	
FWH-110-8"-HH	6	
FWH-110-14"-HH	5	
FWH-112-6"-HHX	8	
FWH-112-10"-HHX	6	
FWH-112-10"-HH	10	
FWH-112-14"-HHX	5	
FWH-114-14"-HH	5	
FWH-114-18"-HH	5	
FWH-114-10"-HH	6	
FWH-116-8"-GG	7	
FWH-116-10"-GG	6	
FSE-252-3"-HH	9	

UNITS 2/3 EROSION/CORROSION MONITORING PROGRAM LINE LIST

Line	Rating
1305-045-20"-R-KK1	7
1305-045-22"-R-KK1	6
1305-043-22"-R-KK1	3
1305-043-22"-R-KK1	4
1305-020-22"-R-KK1	6
1305-020-20"-R-KK1	7
1305-020-26"-R-KK1	7
1305-020-24"-R-KK1	7
1305-019-20"-R-KK1	4
1305-019-22"-R-KK1	3
1305-211-20"-R-KK1	6
1305-163-14"-R-KK1	7
1305-212-20"-R-LL1	6
1305-162-14"-R-KK1	7
1305-046-26"-R-KK1	5
1305-046-24"-R-KK1	5
1305-045-26"-R-KK1	7
1305-045-24"-R-KK1	7
1305-045-20"-R-KK1	7
1305-021-24"-R-KK1	5
1305-021-26"-R-KK1	5
1305-028-28"-R-GKO	2
1305-028-20"-R-GKO	4
1305-022-28"-R-GKO	5
1305-022-20"-R-GKO	7
1305-025-28"-R-GKO	2
1305-025-20"-R-GKO	4
1305-024-28"-R-GKO	5
1305-024-20"-R-GKO	7
1305-540-14"-R-ZZO	4
1305-540-16"-R-ZZO	3
1305-541-16"-R-ZZO	3
1305-541-14"-R-ZZO	4
1301-085-12"-R-KK1	4
1301-086-12"-R-KK1	4
1301-080-24"-R-KK2	3
1301-080-12"-R-KK2	8
1301-079-12"-R-KK2	8
1301-079-24"-R-KK2	3
1305-041-24"-R-GK2	6
1305-041-20"-R-GK2	7
1305-038-24"-R-GK2	6
1305-038-20"-R-GK2	7
1305-025-20"-R-GKO	4
1305-026-20"-R-GKO	4
1305-082-30"-R-LL1	5
1305-082-20"-R-LL1	6

UNITS 2/3 EROSION/CORROSION MONITORING PROGRAM LINE LIST
(CONTINUED)

Line	Rating
1305-081-30"-R-LL1	5
1305-081-20"-R-LL1	6
1305-189-20"-R-GK1	4
1305-190-20"-R-GK1	4

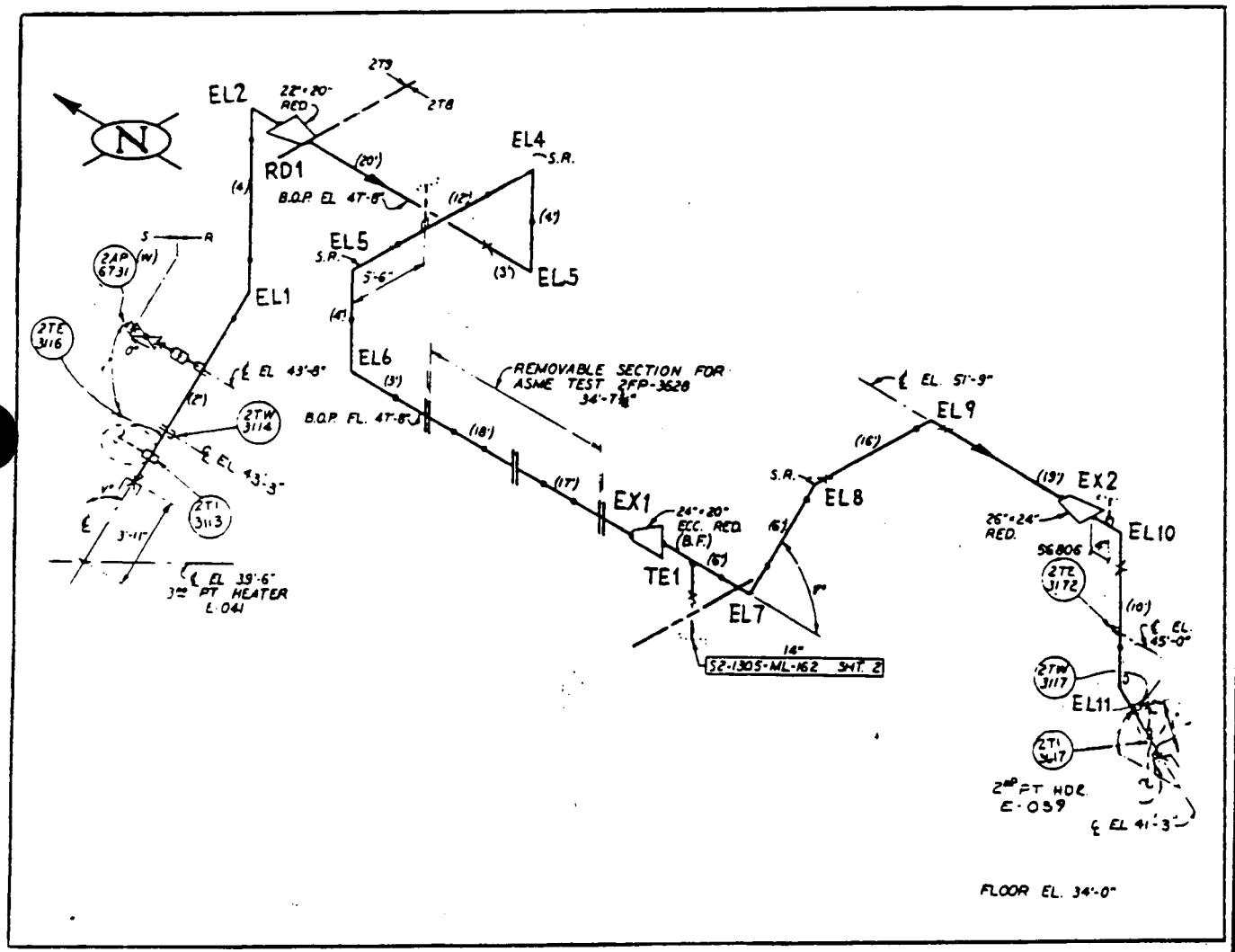
Piping System Configuration and Rating for Susceptibility

Piping and fittings as listed below or in the area of components as listed below are rated as a function of susceptibility to erosion-corrosion damage. Higher numbers (ratings) indicate increased susceptibility. Where the distance between items listed below is less than three pipe diameters, add the numbers together to obtain the rating. For purposes of determining examination frequency a rating of 10 (100% of these items shall be examined each fuel cycle) is the highest obtainable.

Configuration	Rating
Control Valve	10
Splitting Tee	10
180 degree bends	10
Check Valves	8
Globe Valves	8
Branch Tee	8
Flow Orifice	8
Components (rated less than 8) Spaced Within 10 Pipe Diameters of each other	8
90 degree bend	6
Elbows	6
Reducing Elbow	6
Butterfly Valve	4
Instrument taps	4
Reducers	4
Gate Valve	2
Welds in Straight Pipe (with backing ring)	2

UNIT 2/3 ISOMETRIC DRAWINGS FOR HIGH EROSION SUSCEPTIBLE LINES

LINE 020 SYSTEM 1305



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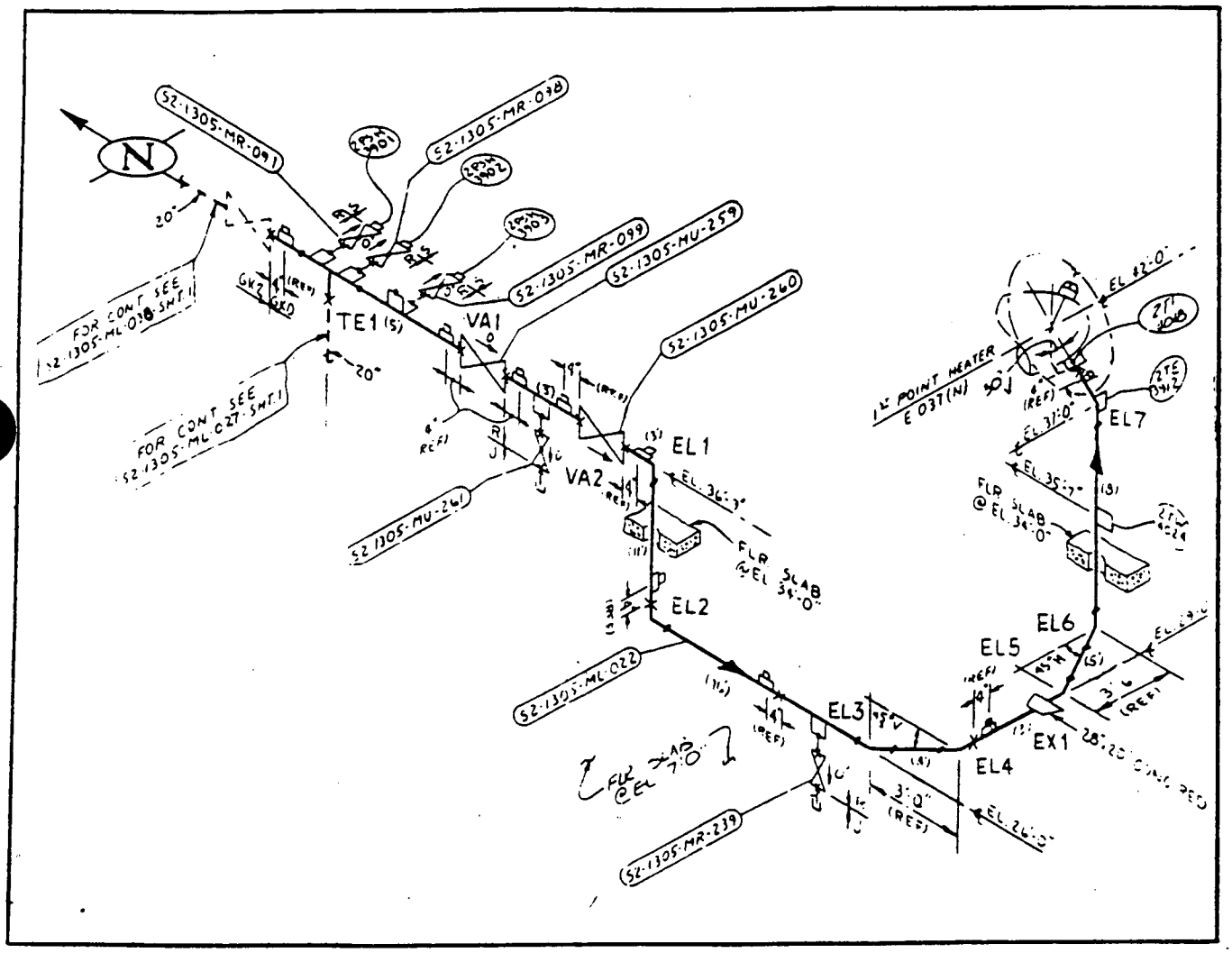
UNIT 2/3 ISOMETRIC DRAWINGS FOR HIGH EROSION SUSCEPTIBLE LINES

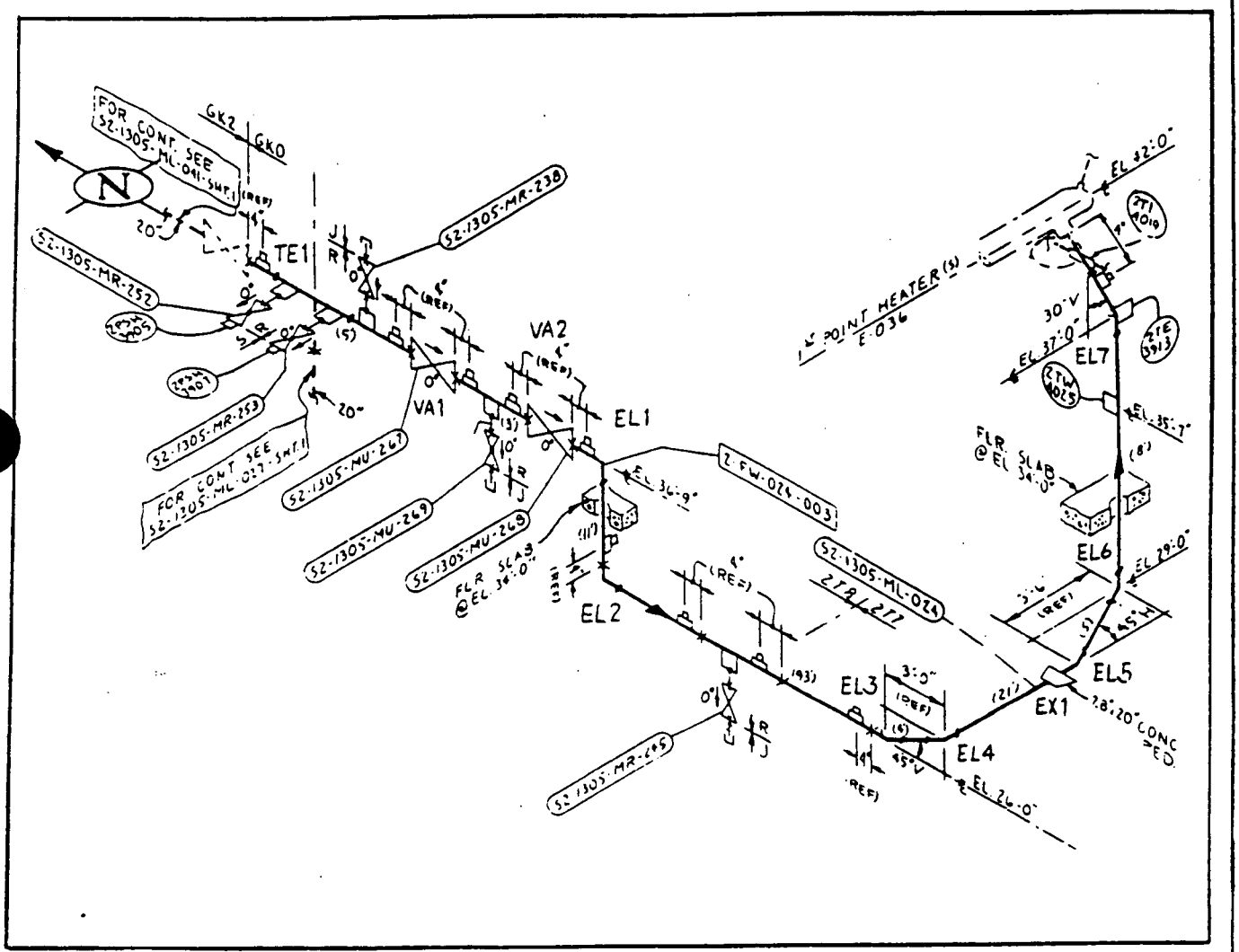
LINE 022 SYSTEM 1305



TCN

UNIT 2/3 ISOMETRIC DRAWINGS FOR HIGH EROSION SUSCEPTIBLE LINES

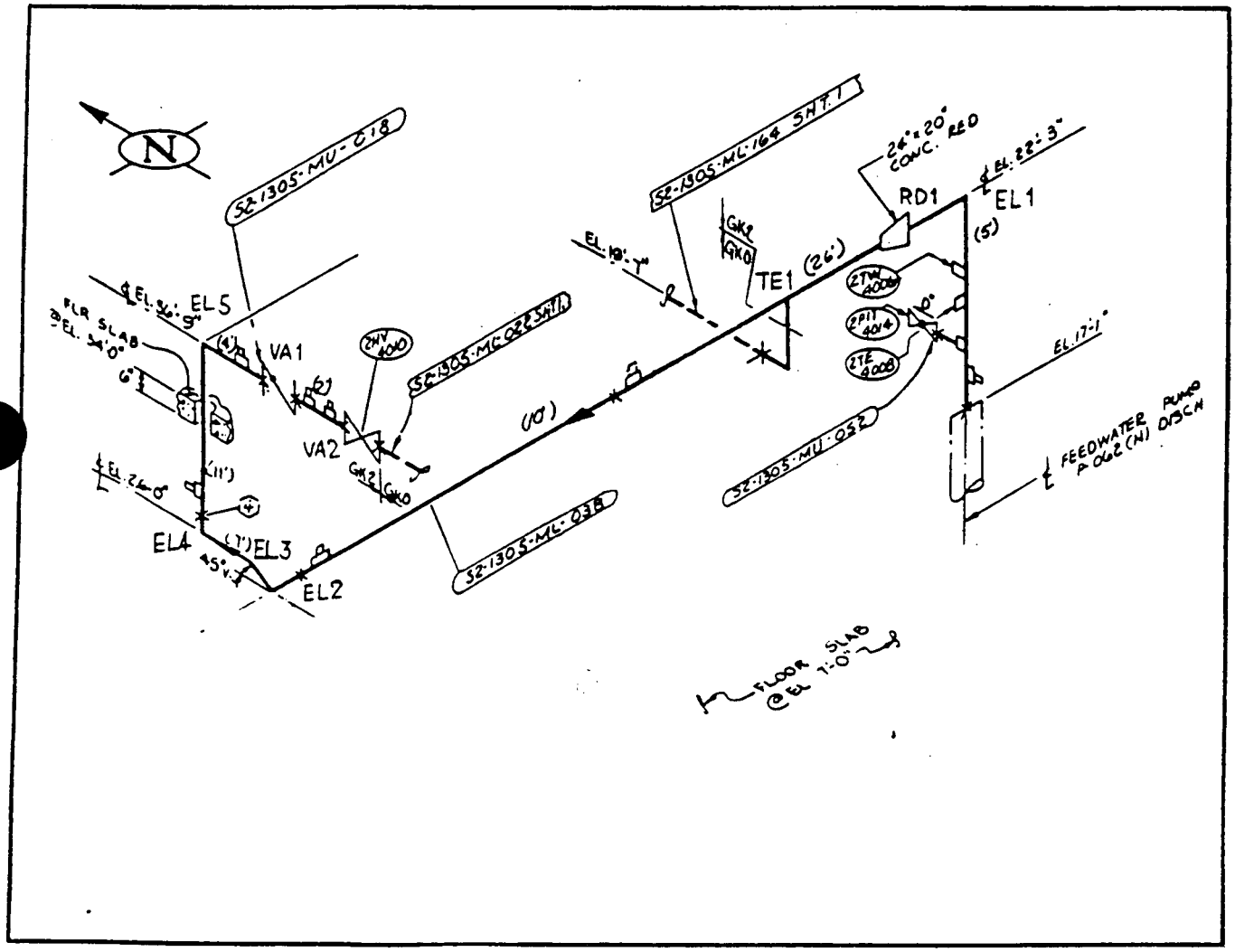
LINE 024 SYSTEM 1305



TCN

UNIT 2/3 ISOMETRIC DRAWINGS FOR HIGH EROSION SUSCEPTIBLE LINES

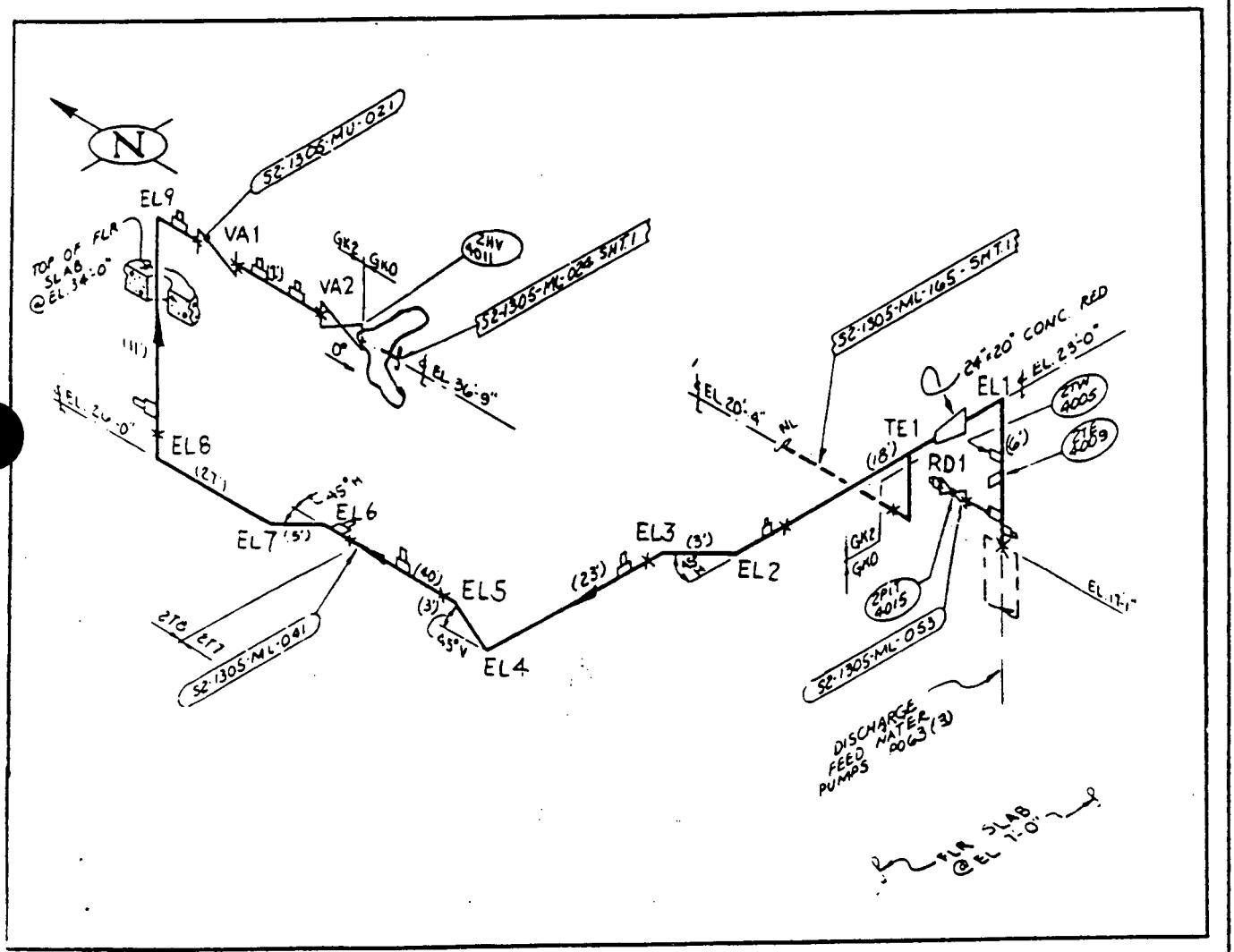
LINE 038 SYSTEM 1305



TCN

UNIT 2/3 ISOMETRIC DRAWINGS FOR HIGH EROSION SUSCEPTIBLE LINES

LINE 041 SYSTEM 1305



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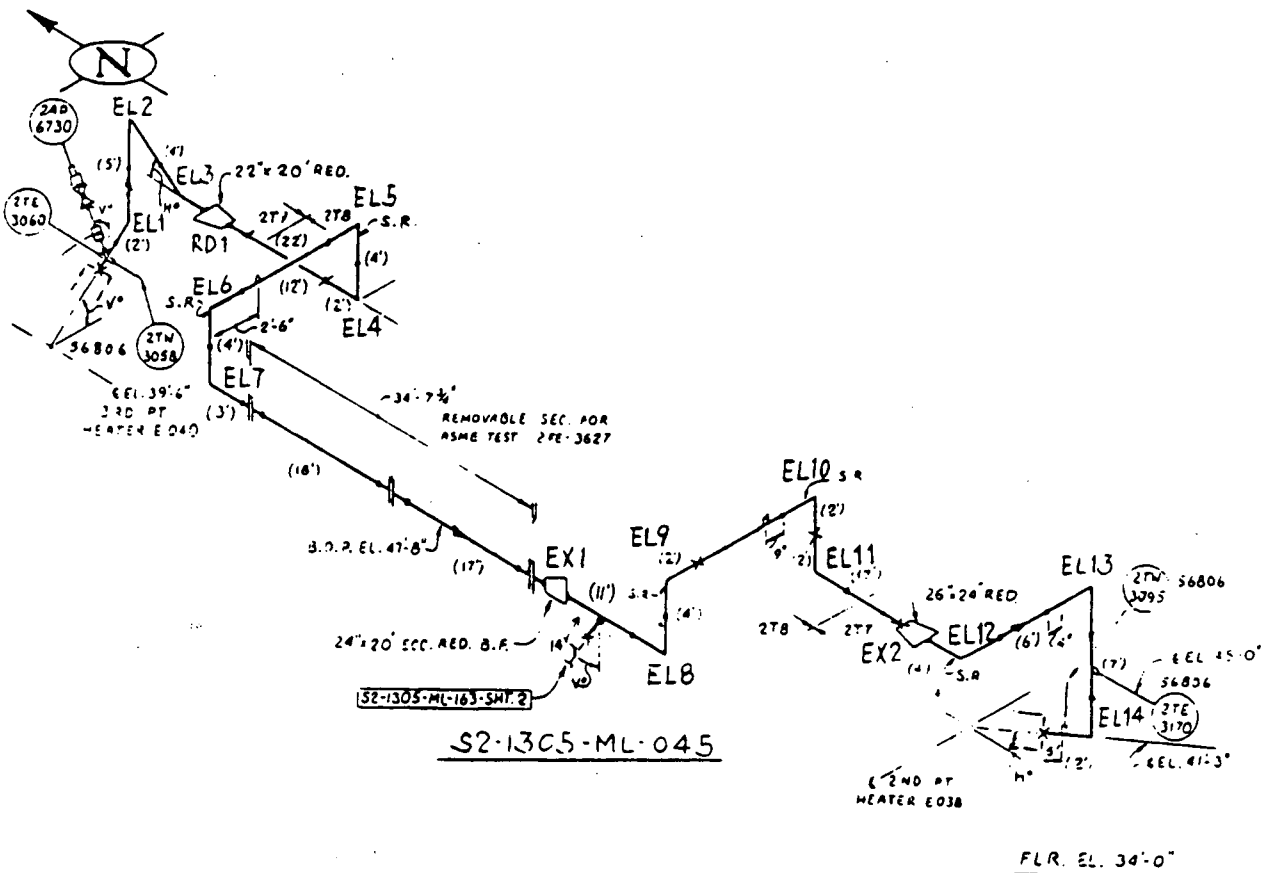
UNIT 2/3 ISOMETRIC DRAWINGS FOR HIGH EROSION SUSCEPTIBLE LINES

LINE 045 SYSTEM 1305



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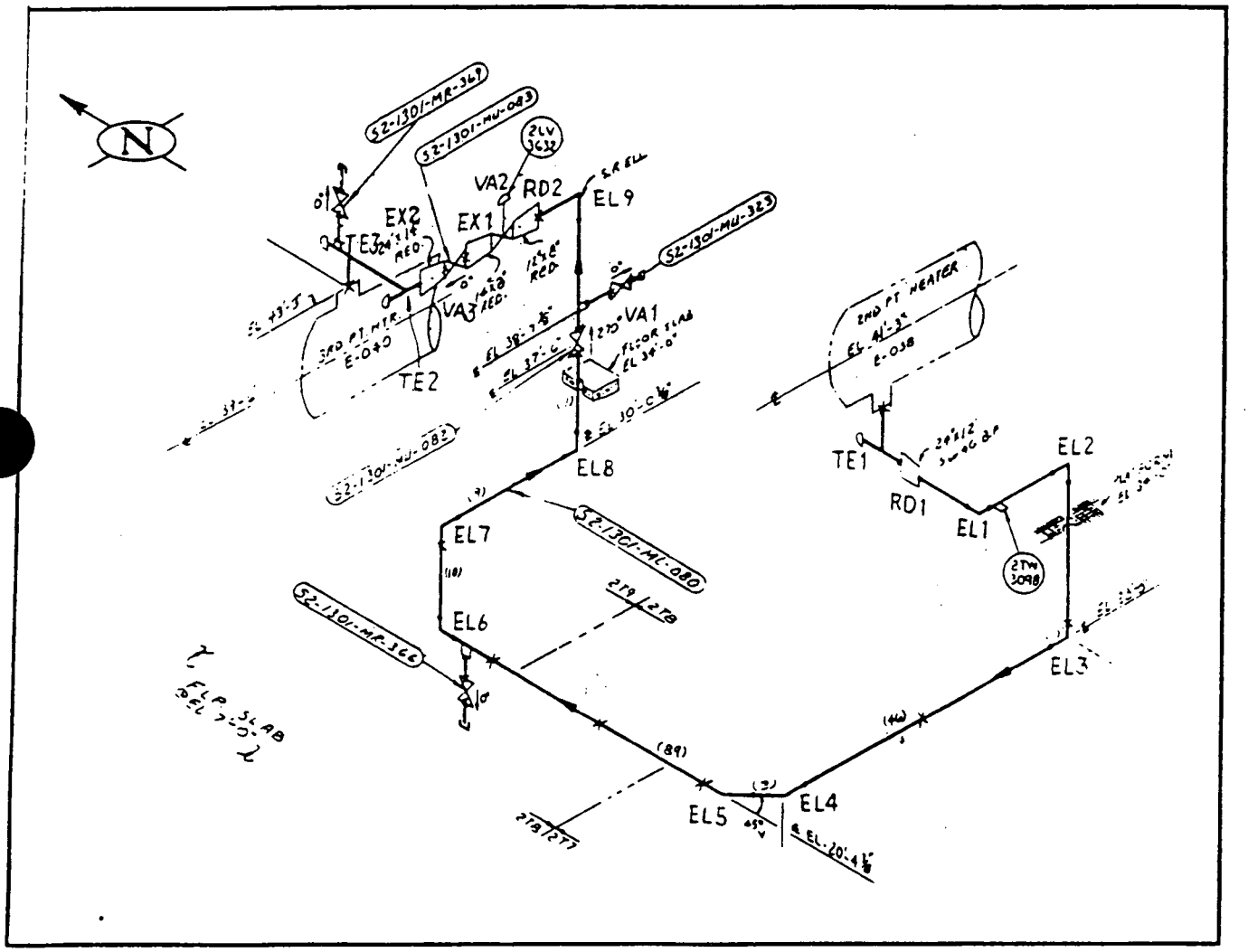
UNIT 2/3 ISOMETRIC DRAWINGS FOR HIGH EROSION SUSCEPTIBLE LINES

LINE 080 SYSTEM 1301



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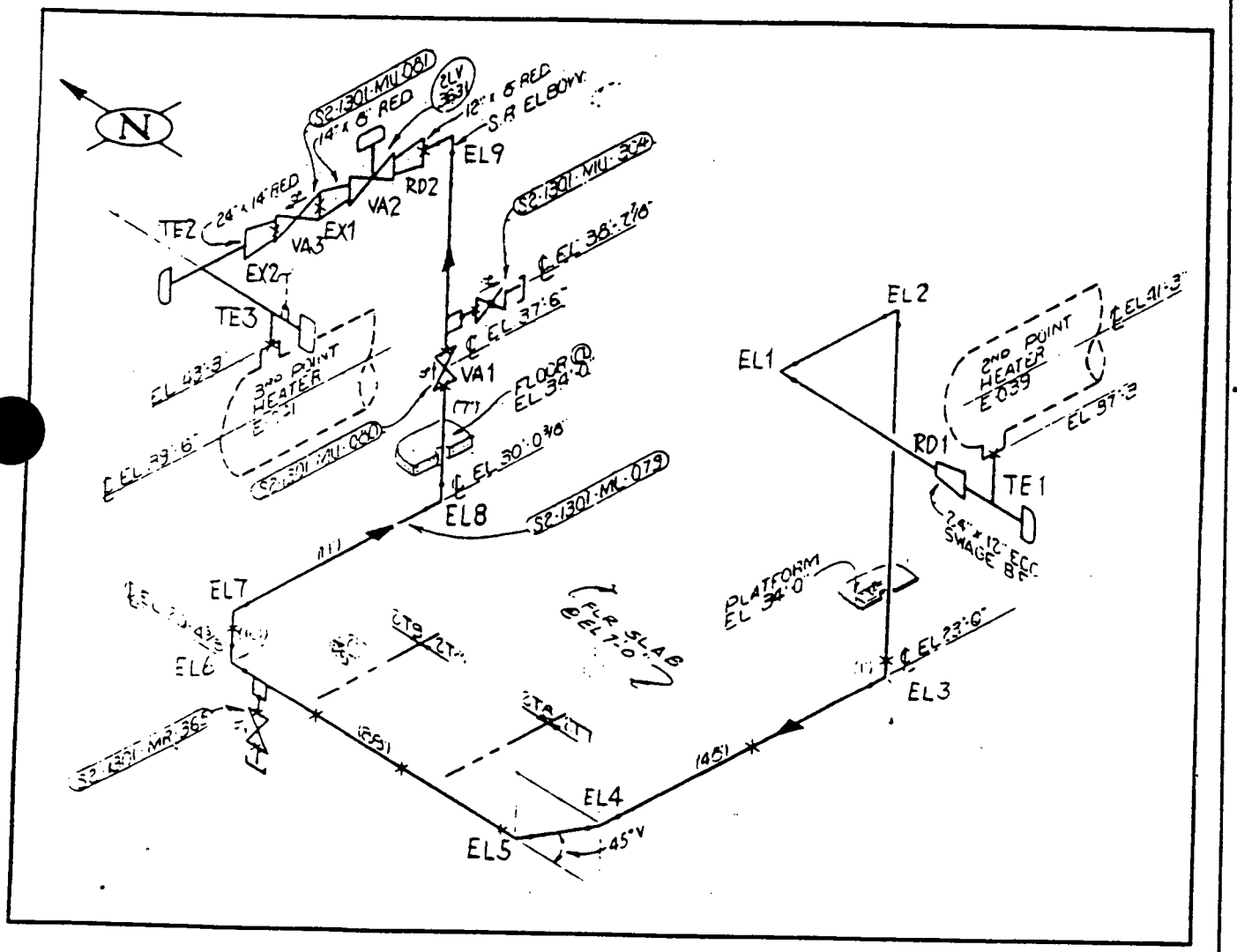
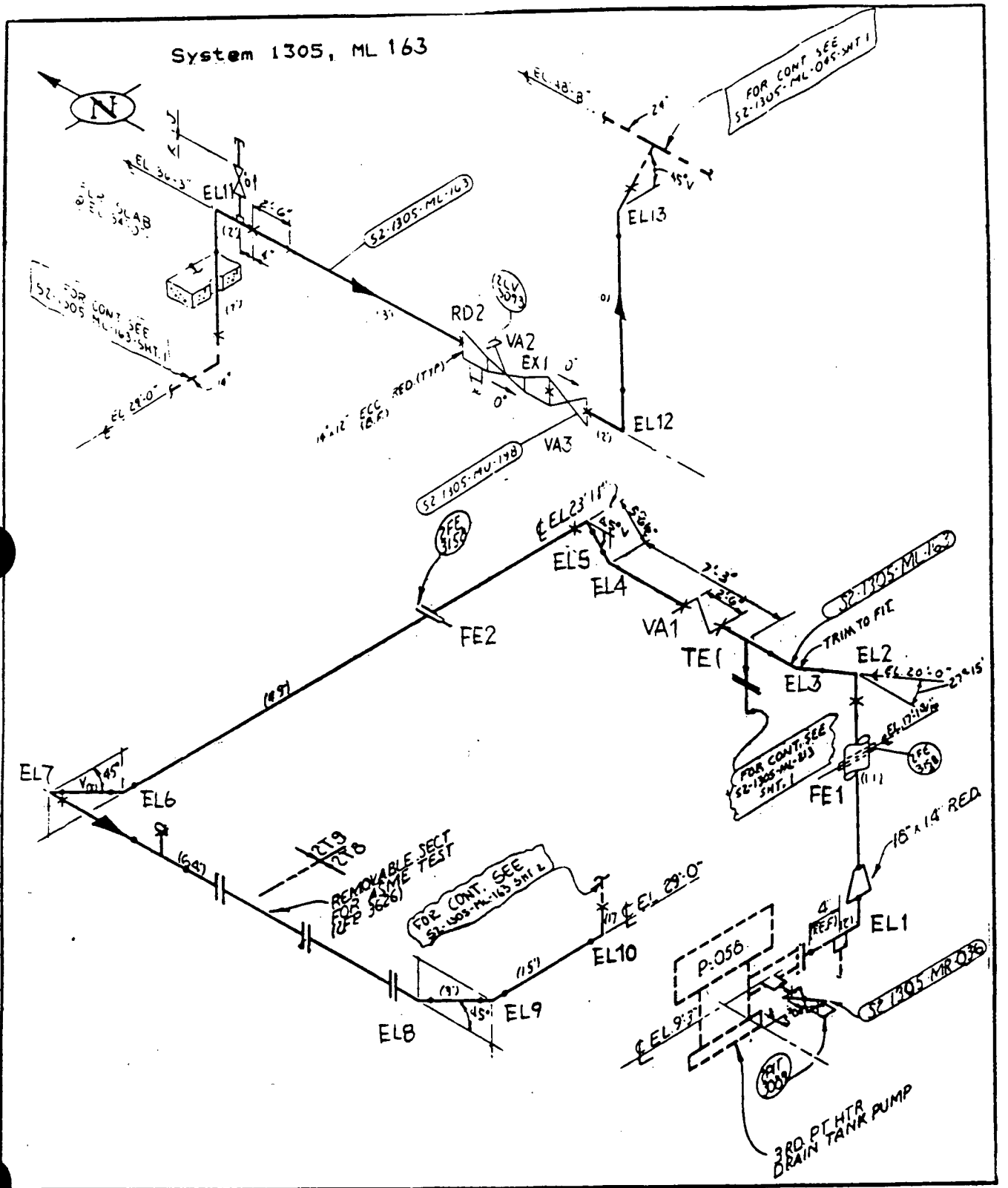
UNIT 2/3 ISOMETRIC DRAWINGS FOR HIGH EROSION SUSCEPTIBLE LINES

LINE 079 SYSTEM 1301



UNIT 2/3 ISOMETRIC DRAWINGS FOR HIGH EROSION SUSCEPTIBLE LINES



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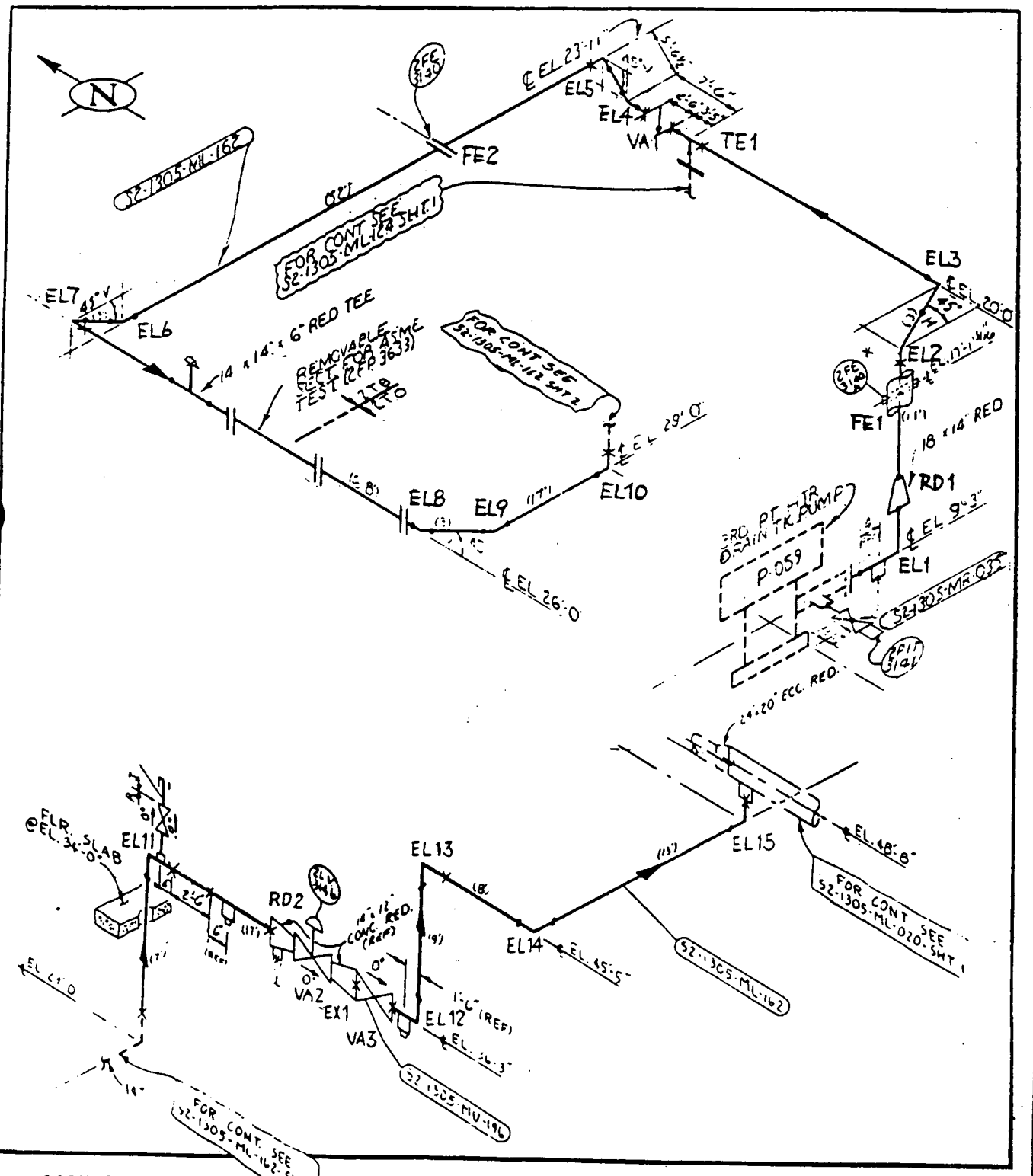
UNIT 2/3 ISOMETRIC DRAWINGS FOR HIGH EROSION SUSCEPTIBLE LINES

LINE 162 SYSTEM 1305



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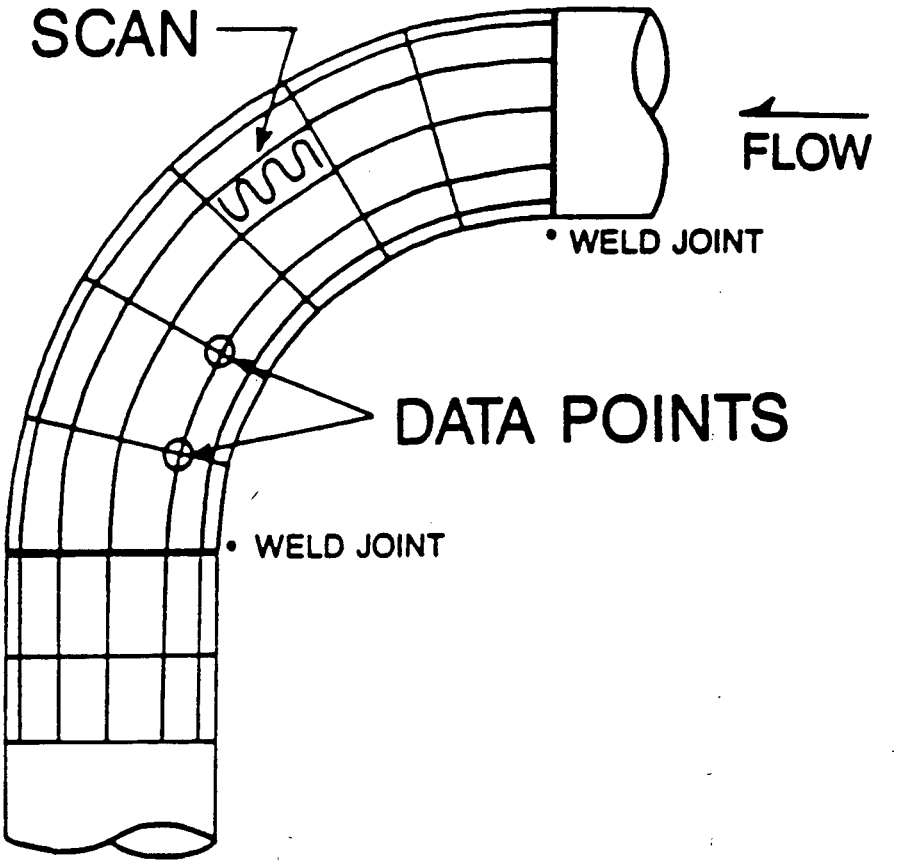
GRID LAYOUT SKETCHES



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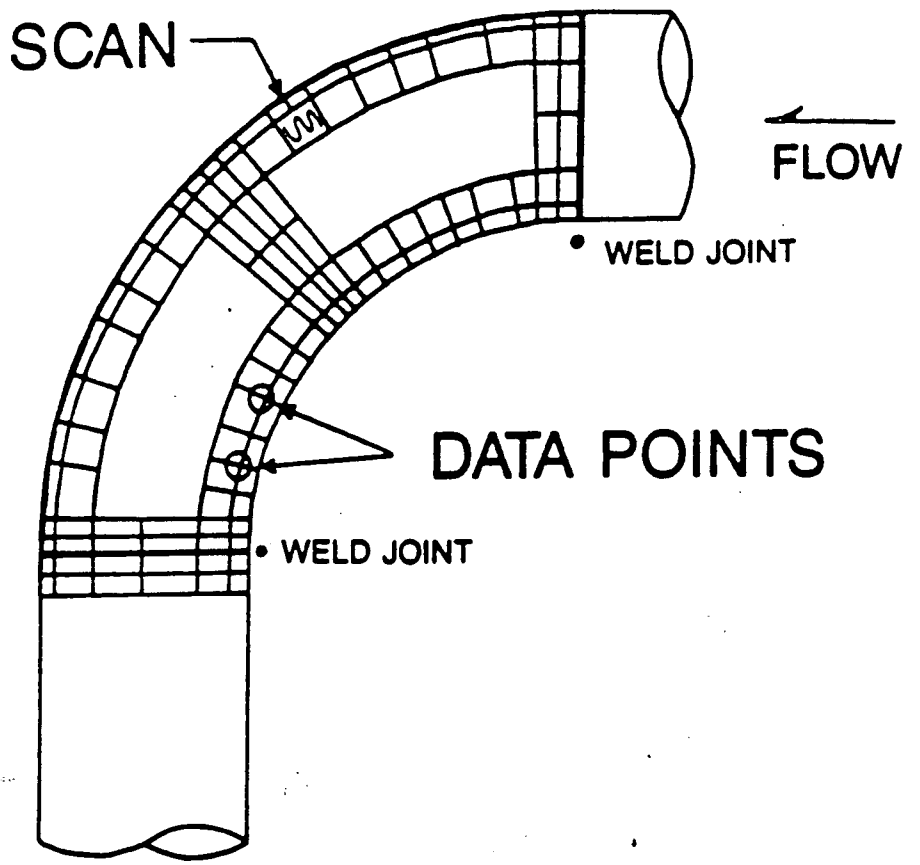
Grid-Type Inspection

FIGURE 1

GRID LAYOUT SKETCHES



Partial Grid Inspection Of An Elbow

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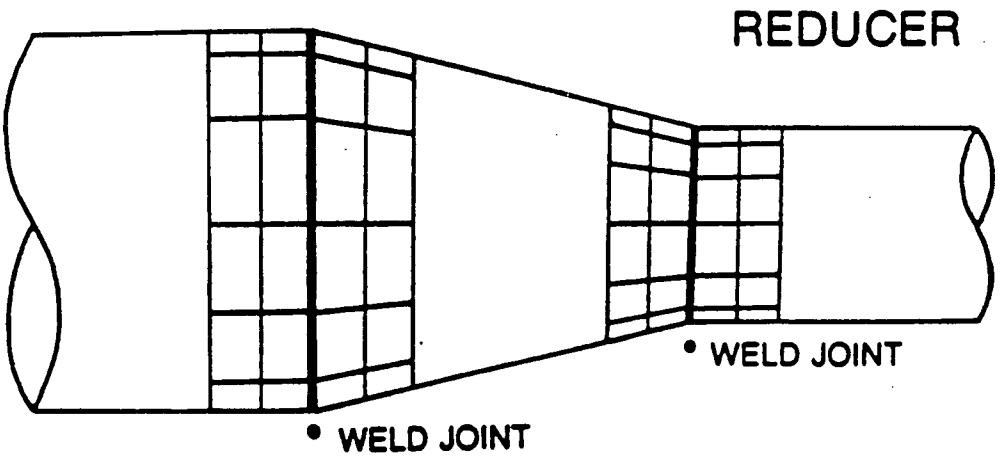
FIGURE 2

GRID LAYOUT SKETCHES



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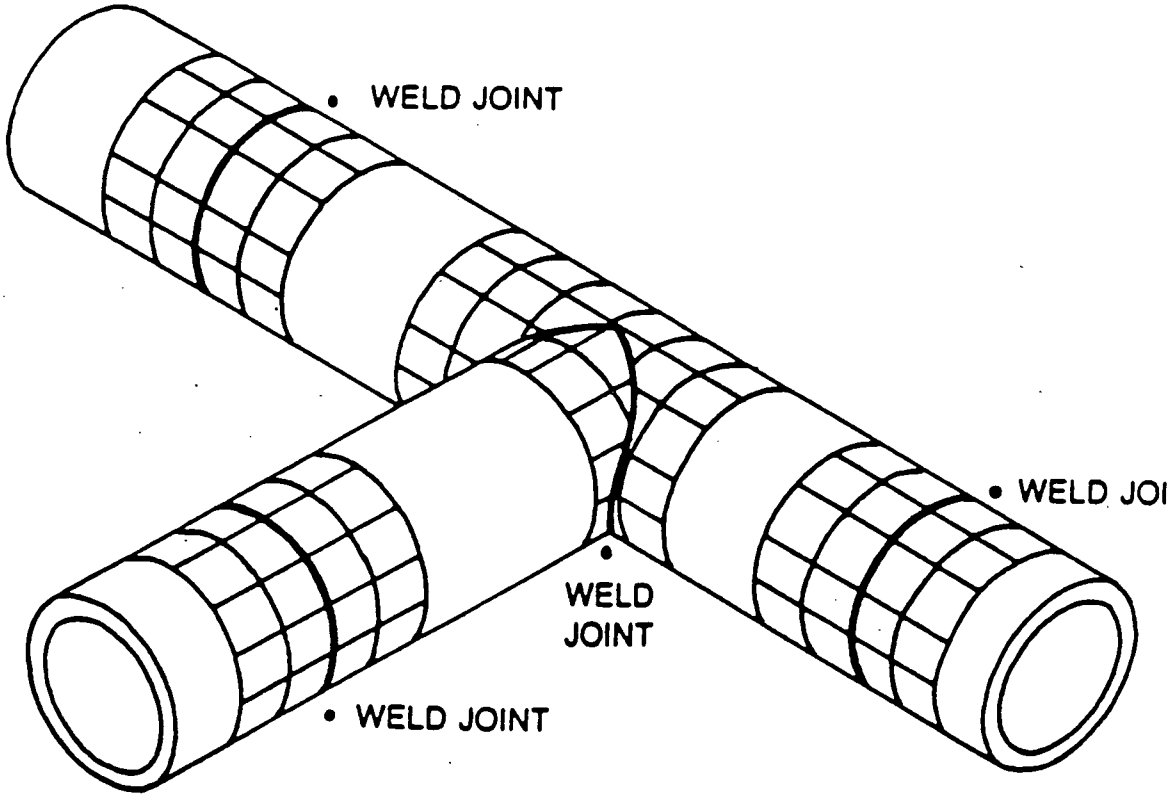
Other Applications Of The Partial Grid Method

FIGURE 3

GRID LAYOUT SKETCHES



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Other Applications Of The Partial Grid Method

FIGURE 4