UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

February 25, 1994

MEMORANDUM FOR: Bruce A. Boger, Director
Division of Reactor Controls
and Human Factors

FROM: Jared S. Wermiel, Chief
Instrumentation and Controls Branch

SUBJECT: MEETING WITH ROSEMOUNT, INC., TO DISCUSS ISSUES PERTAINING TO ROSEMOUNT TRANSMITTER MODELS 1151, 1152, 1153A/B/D, AND 1154

On Thursday, February 17, 1993, a meeting was held with Rosemount, Incorporated, to discuss issues pertaining to Rosemount transmitter models 1151, 1152, 1153A/B/D and 1154 that have arisen since March 9, 1990. NRC staff was specifically interested in being apprised of any issues, problems, and concerns that Rosemount has experienced, or is aware of, with respect to the aforementioned transmitter models. The meeting was held in response to a recommendation made by the Rosemount Transmitter Review Group (RTRG) as an input to confirming that actions taken by the staff to address loss of fill oil in Rosemount transmitters are sufficient.

The meeting consisted of an introduction of the participants (Enclosure 1), opening remarks, an overview on NPRDS data findings on Rosemount transmitter performance by NRC staff, an overview of new information of Rosemount transmitter performance by Rosemount, Inc., a question and answer period, and closing remarks.

Opening remarks were made by Cecil Thomas and Jared Wermiel. The purpose and objectives of the RTRG were explained and the conclusions that this group reached were discussed. The RTRG concluded that staff actions to date are sufficient to resolve the fill oil loss concern, but additional followup actions should be taken to confirm this determination. Ken Ewald (Rosemount, Inc.) voiced the feelings of Rosemount that this type of interaction, consisting of continuing dialogue and meetings to discuss issues, was welcomed.

Jim Houghton (AEOD) presented the NRC staff's NPRDS data findings on Rosemount transmitters (Enclosure 2). He indicated that the staff's data search covered the entire population of Rosemount transmitter information in the NPRDS database over a five year period from 1988 through 1993. The data indicated that there had been a significant decrease in the number of Rosemount transmitter failures since 1990. Additionally, no new significant safety issues or failure modes were identified.

Contact: Deirdre Spaulding, HICB
504-2928

In addition to providing an update of NPRDS data approximately every six months, Jim Houghton indicated that AEOD would be looking at Rosemount transmitters as part of a general study of transmitters used in nuclear power plants.

Ken Ewald presented the results of a review of all Rosemount transmitters that failed for any reason (Enclosure 3), not just fill-oil loss. Of the six Rosemount model 1153B/D and 1154 transmitters manufactured after July 1989 (post-1989s) that failed, three were due to broken fill tubes, and three were due to glass to metal seal failures (one confirmed and two assumed). Rosemount has not been able to replicate a glass to metal seal failure in those transmitters. Five of the failures were in the US and one was in Spain. Through February 4, 1994, a total of 175 failed transmitters were returned to Rosemount. No post-1989's have been confirmed as failing due to loss of fill-oil. From 1989 to July 1992, there were 4649 model 1153B/D and 1154 transmitters shipped by Rosemount.

A good correlation between Rosemount's graph and AEOD's graph of failures was seen. Ken Ewald indicated that while low oil failures occurred, they were not the result of oil leakage, but were due to other causes such as improper filling. Although the level of oil is low enough to be perceived as a loss of fill oil, no leakage mechanism could be found. Fill tube failures, due to additional handling, has been a Rosemount concern. These types of failures have decreased lately due to increased awareness and sensitivity, as they usually occur in 30 to 90 days of manufacture.

Ken Ewald continued his presentation with a discussion on 1152 and 1153A oil loss failures. 1983 was the last year in which glass to metal seal failures were found.

A question and answer period was then held, followed by closing remarks. Jerry Mauck pointed out that the NRC staff wants to make sure that post-1989 transmitters continue to demonstrate a very low failure rate. During the closing remarks, it was agreed that the next meeting would be held around August/September 1994 at the Rosemount facility. Jared Wermiel indicated that the meeting would be publicly noticed, and stressed that dialogue between the staff and Rosemount should be ongoing, so that if issues arise they can be promptly addressed and not held until the time subsequent meetings occur. Jared Wermiel also briefly described the additional followup actions planned by the staff to confirm the adequacy of actions taken to date. He specifically described the planned inspections at all plants to verify licensee compliance with commitments to Supplement 1 to Bulletin 90-01 and gather available plant specific information on Rosemount transmitters.

The NRC staff agreed to provide Rosemount a copy of the temporary instruction for the inspections, and to keep Rosemount informed of the inspection findings. The inspections are planned to begin in April 1994.

original signed by:
Jared S. Wermiel, Chief
Instrumentation and Controls Branch
Division of Reactor Controls
and Human Factors

Enclosures:
List of Attendees
AEOD Report dated January 1994
Rosemount Presentation

cc w/enclosures:
K. Ewald
A. Udy

DISTRIBUTION:
PDR
Central File
HICB R/F
AEOD
OGC
OI
ACRS
RVIB
J. Mauck
D. Spaulding
J. Wermiel
C. Thomas
J. Petrosino
P. O'Reilly
J. Houghton
B. Hayes
P. Blanch

OFC	HICB	SC:HICB	BC:HICB:DRCH
NAME	DSpaulding:lsh	JMauck	JWermiel
DATE	2/25/94	2/25/94	2/25/94
COPY	YES NO	YES NO	YES NO

DOCUMENT NAME: ROSMETSU.RT

Enclosure 1

Meeting Between NRC & Rosemount - 2/17/94

OWFN 1F17

Deirdre Spaulding	NRC/DRCH/HICB	301-504-2928
Jerry Mauck	NRC/DRCH/HICB	301-504-3248
Jared (Jerry) Wermiel	NRC/DRCH/HICB	301-504-2821
Cecil Thomas	NRC/DRCH	301-504-2548
Ken Ewald	RNII	612-681-5814
Stuart Brown	RNII	612-681-5804
Tim Layer	RNII	612-681-5830
Mark Van Sloun	RNII	612-828-3484
Jerry Valley	RNII	612-681-5825
Russ Bell	NUMARC	202-872-1280
Jeff Hansen	INEL	208-526-8721
Alan Udy	INEL	208-526-9138
Christina Antonescu	NRC/RES	301-492-3824
Joe Petrosino	NRC/NRR/DRIL/VIB	301-504-2979
James R. Houghton	NRC/AEOD/DSP/TPAS	301-492-7430

Enclosure 2

DATA SEARCH AND SCREENING REVIEW

ROSEMOUNT TRANSMITTERS - LOSS OF FILL-OIL FAILURES

JANUARY 1994

Prepared By:

James R. Houghton

Trends and Patterns Analysis Branch
Division of Safety Programs
Office for Analysis and Evaluation of Operational Data
U. S. Nuclear Regulatory Commission

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ROSEMOUNT TRANSMITTERS - LOSS OF FILL-OIL FAILURES

1. INTRODUCTION

1.1 Purpose of Work

This work was performed as the first semi-annual search and screening review of Nuclear Plant Reliability Data System (NPRDS) data related to fill-oil leakage (i.e., loss of silicon fill-oil) in selected models of Rosemount transmitters, subsequent to the industry response to NRC Bulletin 90-01, Supplement 1 (Reference 1). In addition to this review, other follow-on reviews will be performed about every six months for the next two years to identify: (1) whether or not a significant increase in the number of reported fill-oil failures has occurred and (2) whether specific plants have experienced a significant number of failures.

1.2 Background

On March 9, 1990, the NRC issued Bulletin 90-01, in which it requested that licensees take appropriate corrective actions for Model 1153, Series B and D and Model 1154 transmitters manufactured by Rosemount, that may have a potential for leaking fill-oil.

On December 22, 1992, the NRC issued Bulletin 90-01, Supplement 1 (Reference 1) as an update to Bulletin 90-01. This supplement identified actions for replacement or monitoring of the specific Model 1153 and Model 1154 transmitters, manufactured before July 11, 1989, that are used or may be used in the future in either safety-related systems or systems installed in accordance with 10 CFR 50.62 (the ATWS rule).

Subsequently, the "Rosemount Transmitter Review Group Report (RTRG) on the Loss-of-Fill-Oil Issue" issued recommendations for a semi-annual review of fill-oil leakage failures for the selected Model 1153 and Model 1154 Rosemount transmitters. On November 22, 1993, the Office of Nuclear Reactor Regulation (NRR) requested AEOD assistance in addressing the RTRG recommendations (Reference 2). During a subsequent meeting with AEOD staff, similar information was requested by NRR staff for Rosemount Models 1151, 1152, and 1153, Series A. The NRR staff also agreed that all data requested for the update review start on 04/01/91.

2. SCOPE OF WORK

2.1 Description of Components

The Rosemount transmitters, Models 1153 series B and D and 1154 are pressure transmitter assemblies made up of a silicon oil-filled sensing module mounted in a pressure retaining housing, with an attached electronic housing containing circuit boards. The process pressure is translated through an isolating diaphragm and silicon oil fill fluid to a sensing diaphragm in the center of the sensing module cell. The

reference pressure is transmitted in like manner to the other side of the sensing diaphragm. Displacement of the sensing diaphragm, a maximum motion of 0.004 inches, is proportional to the pressure differential across it. The position of the sensing diaphragm is detected by the capacitor plates on both sides of the sensing diaphragm. Differential capacitance between the sensing diaphragm and capacitor plates is converted electronically to a 2 wire 4-20 MADC signal.

According to published vendor information, the Models 1153, Series A and D and 1154 transmitters were designed, but not specifically limited to, the following safety-related applications (IEEE standards are included to identify the environmental and seismic qualification requirements):

- 1153, Series B: IEEE 323-1974 and IEEE 344-1975; designed for boiling water reactor (BWR) and outside containment installation for pressurized water reactor (PWR) plants.

- 1153, Series D: IEEE 323-1974 and IEEE 344-1975; designed for in-containment use for PWR plants (transmitter has stainless steel housing).

- 1154: IEEE 323-1974 and IEEE 344-1975; designed to improve performance under high radiation and high temperature conditions.

Similarly, the second group of Rosemount transmitter models, which were also included in the scope of this study, were designed to earlier editions of industry standards and for the following applications:

- 1153, Series A: IEEE 323-1971 and IEEE 344-1975; PWR use, obsolete June 1, 1984.

- 1151: Nonsafety-related applications; no nuclear qualification; 10 CFR 21 not applicable.

- 1152: IEEE 323-1971 and IEEE 344-1975; used mostly where only seismic qualification is required

2.2 Data Sources

The NPRDS was used as the data source for identifying: (1) the number of safety-related Rosemount transmitters in two groups as requested by NRR: (a) Models 1151, 1152, and 1153, Series A and (b) Models 1153, Series B and D and 1154 and (2) the failures due to fill-oil leakage for all of the models in both groups during a 5 year period [(a) 07/01/88 - 03/31/91 and (b) 04/01/88 - 06/30/93].

The NRR request specified a desire for the following data items, most of which are contained in the NPRDS database and reported in the failure master: (1) model number, (2) transmitter serial number, (3) module serial number, (4) system in which installed, (5) safety classification,

(6) application description, (7) normal operating pressure, (8) pressure times time in service (psi-months) when failure was discovered, (9) age of transmitter, (10) installation date, (11) discovery date, (12) licensee and utility name, (13) failure symptoms observed, (14) whether suspected failure due to fill oil leakage was/was not confirmed, (15) corrective actions, and (16) disposition of the failed transmitter. Of the requested data items, items (2), (3), (6), and (7) are optional NPRDS data fields for which information may not have been provided by the licensee in the specific failure report. In addition, under current NPRDS reporting guidance, the age of a component at failure cannot be accurately determined from the data. However, the need for this information was discussed with cognizant NRR staff, and how it might be approximated using the installation date and the discovery date.

Operating event data in the form of Licensee Event Reports (LERs) was obtained from the Oak Ridge National Laboratory's (ORNL) Sequence Coding and Search System (SCSS) database for identifying the number of failures due to fill-oil leakage, but limited to Models 1153, Series B and D and 1154 for the shorter period 04/01/91 through 06/30/93.

3. APPROACH AND METHODOLOGY

3.1 Number of Components

To determine the number of failures per component per year for the selected models, the determination of the number of components used in each of the plants was necessary. This determination was performed using the NPRDS database for the following model groups: (a) Models 1151 and 1152, 1153, Series A, and (b) Models 1153, Series B and D and 1154. The results obtained allowed calculation of the number of failures per component for each specific group of transmitter model/series. The following exclusions were made for all models to determine the number of components in each group:

(1) Three units were excluded: Shoreham, Fort St. Vrain, and Rancho Seco.
(2) "Non-safety-related" class and "Other" class were excluded from the NPRDS safety class category.

The number of components for each model group was assumed constant for this review, using the latest NPRDS database counts.

3.2 Number of Fill-Oil Failures for Selected Models of Rosemount Transmitters

The number of loss of fill-oil failures due to leakage was determined through the NPRDS database, using the following and NPRDS General Report 5 (the Component Master Failure Report with Unit information):

(1) Three units were excluded: Shoreham, Fort St. Vrain, and Rancho Seco.
(2) "Non-safety-related" class and "Other" class were excluded from the NPRDS safety class category.
(3) The selected severity levels were immediate and degraded.

From the SCSS database, all LERs were reviewed for applicability to failure of Rosemount transmitters due to fill-oil leakage for the latter (update) period 04/01/91 through 06/30/93.

3.3 Average Number of Failures per Component per Year for Selected Models of Rosemount Transmitters

The number of failures per component was determined during the 5 year period, using the failures for each group of transmitter models and total number of components for each model group on a yearly basis. Both the number of failures and the average number of failures per component per year were plotted over the 5 year period.

3.4 Candidate Plants for More Detailed Review

Candidate plants which experienced a higher number of failures, both prior to and subsequent to 04/01/91 were identified, with the latter period specifically applicable to the NRR request, and the former period - 07/01/88 through 03/31/91 - included for consistency over the 5 year period.

4. RESULTS

4.1 Number of Fill-Oil Failures for Selected Models of Rosemount Transmitters

- The total number of failures due to fill-oil leakage over the 5 year period (07/01/88 - 06/30/93) was 73, with 23 of these failures occurring during the update period (04/01/91 - 06/30/93).
- All of the failures during the 5 year period involved one model group only: Models 1153, Series B and D, and 1154.
- No fill-oil leakage failures were identified from the review of LER data over the update period.
- The number of failures sharply decreased subsequent to 1990. (see Figure 1 and Table I).

4.2 Average Number of Failures per Component per Year for Selected Models of Rosemount Transmitters

- The plot of the average number of failures per component per year is a corollary of the number of failures plot, but also

provides identification of issue dates for NRC Bulletin 90-01; 90-01, Supplement 1; and the start date for the subsequent review (04/01/91) (see Figure 2 and Table I).

- The average number of failures per component per year over the 5 year period was 3.6E-3. The peak of 5E-3 occurred in 1990, with the lowest value (9E-4) occurring in the first quarter of 1993.

4.3 Listing of Candidate Plants for More Detailed Review

- For the updated portion of the 5 year period (i.e., 04/01/91 - 06/30/93), only one plant (No. 77) exhibited an increase in the number of failures. The average number of failures per component per year for that plant was .020 (2E-2) or more than a decade higher than the average for all plants over the 5 year period (see Table II). For this plant, no failures were reported prior to 04/01/91, while 4 failures (of the total of 23 for all plants during this period) were reported subsequent to 04/01/91.

- Between 07/01/88 and 03/31/91, there were 3 plants (Nos 5, 69, and 102) that had a relatively high number of failures and a corollary high average number of failures per component per year. However, the average number of failures per component per year for these plants decreased significantly during the period subsequent to 04/01/91 (see Table II).

5. SUMMARY

- Since 1990, there has been a significant decrease in the number of failures and corollary number of failures per component of Rosemount transmitters due to leakage of fill oil.

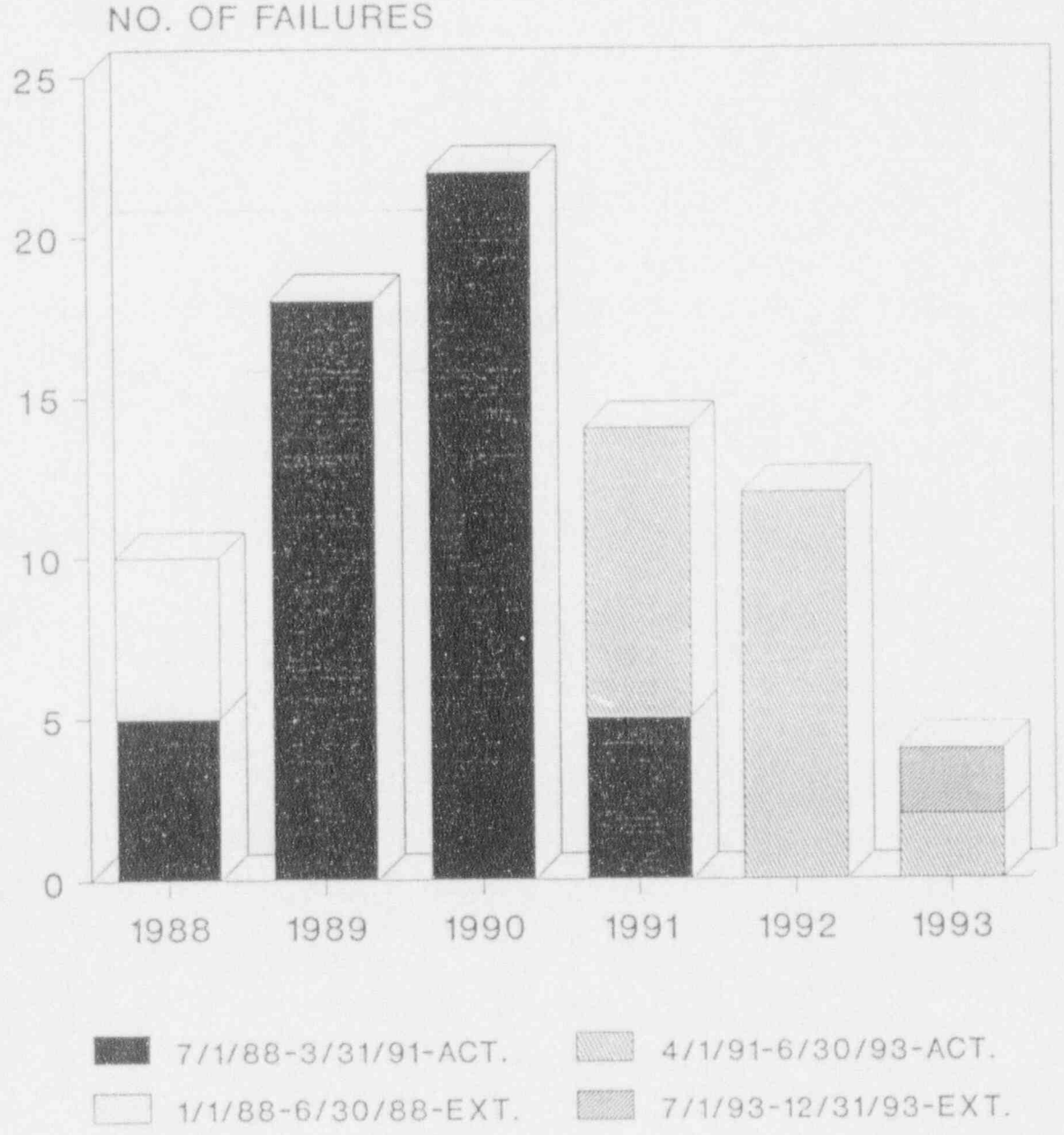
- With the exception of one plant, there was no increase in the plant-specific value of the average number of failures per component per year for Rosemount transmitters due to fill oil leakage subsequent to 04/01/91. The value for this one plant was 2%, which is approximately a decade higher than the 5 year average for all plants. No failures were reported for this plant prior to 04/01/91.

6. REFERENCES

1. NRC Bulletin No. 90-01, Supplement 1, "Loss of Fill-Oil in Transmitters Manufactured by Rosemount," dated December 22, 1992.

2. USNRC Memorandum from Bruce A. Boger to Gary M. Holahan, "Request for AEOD Assistance Regarding the Rosemount Transmitter Issue," dated November 22, 1993.

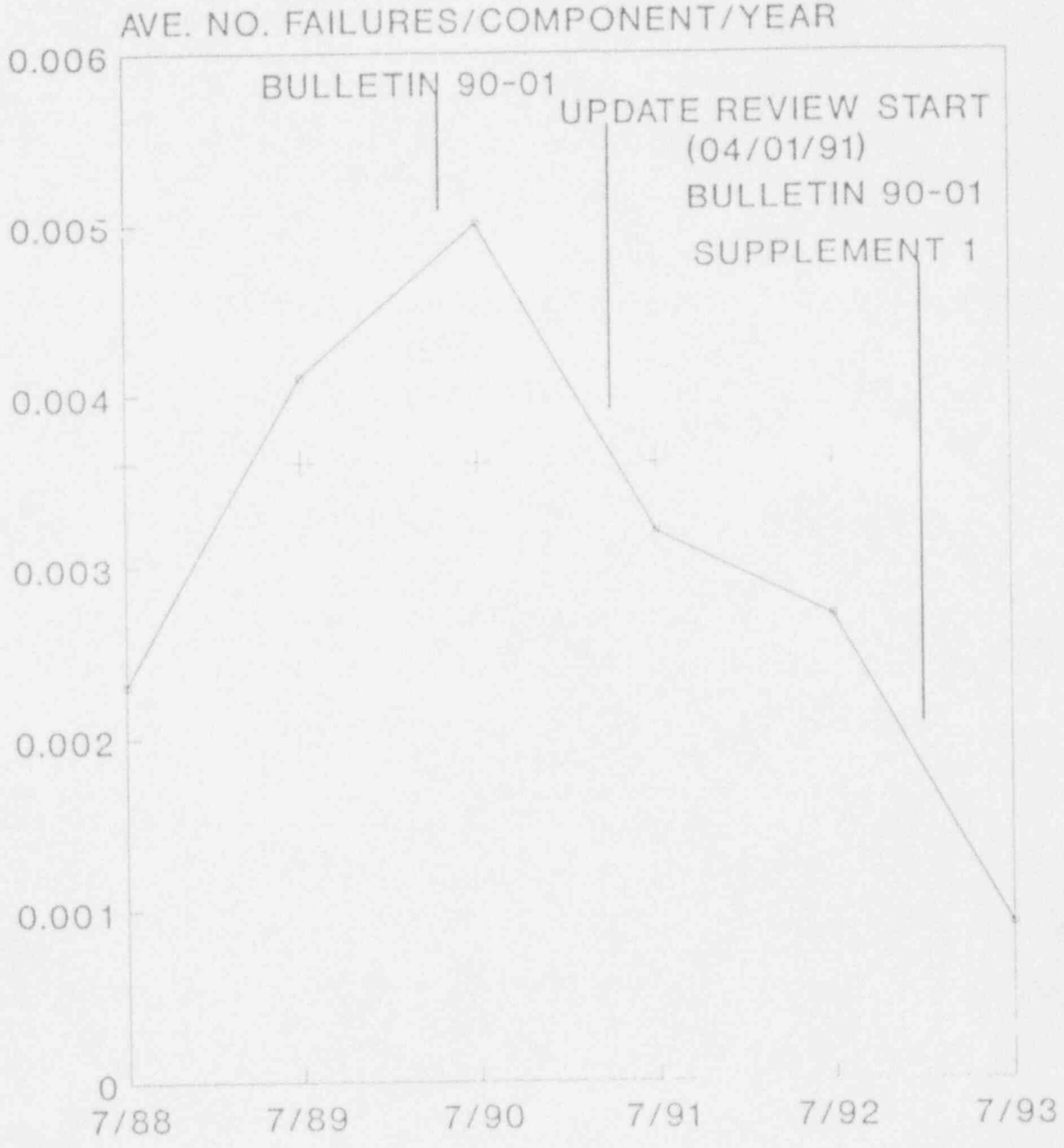
ROSEMOUNT TRANSMITTERS
LOSS OF FILL-OIL FAILURES



TOTAL NO. FAILURES: 73
"EXT" signifies extrapolated data

FIGURE 1

ROSEMOUNT TRANSMITTERS
LOSS OF FILL-OIL FAILURES



5 YR Period: 07/01/88-06/30/93
No. Failures: 73

FIGURE 2

TABLE I

Rosemount Transmitters - Loss of Fill-Oil Failures and Average Number of Failures per Component per Year

MODELS 1153, "B" &"D" and 1154	1988	1989	1990	1991	1992	1993	Totals
No. NPRDS Failures:							
1) 07/01/88-03/31/91:	5	18	22	5	-	-	50
2) 04/01/91-06/30/93:	-	-	-	9	12	2	23
No. LER Failures:	-	-	-	0	0	0	0
Total No. Failures:	5	18	22	14	12	2	73
No. Transmitters:	----------4369----------						
Failures Per Component	.0023	.0041	.0050	.0032	.0027	.0009	
Average Failures Per Component	----------.0036 (3.6E-3)----------						

Notes:

(1) See Figures 1 and 2

(2) The number of transmitters in the other model group (e.g., Models 1151, 1152, and 1153, Series A) is 2252.

TABLE II

Rosemount Transmitters - Loss of Fill-Oil Failures and Average Number of Failures per Component per Year

Candidate Plants for More Detailed Review

Plant No.	PERIOD	NO. FAILURES	NO. COMPONENTS	AVERAGE NO. OF FAILURES/COMPONENT /YR
77	04/01/91-06/30/93	4	90	.020 (2%)
102	07/01/88-03/31/91	7	167	.015 (1.5%)
102	04/01/91-06/30/93	2	167	.005 (0.5%)
69	07/01/88-03/31/91	4	122	.012 (1.2%)
69	04/01/91 06/30/93	2	122	.007 (0.7%)
5	07/01/88-03/31/91	11	28	.143 (14.3%)
5	04/01/91-06/30/93	0	28	0

NOTES:

(1) Only Plant No. 77 showed a higher average number of failures per component per year subsequent to 04/01/91.

(2) This table is for transmitters in the model group for Models 1153, Series B and D, and Model 1154.

NRC
ROSEMOUNT NUCLEAR INSTRUMENTS, INC.
MEETING

FEBRUARY 17, 1994

ROSEMOUNT NUCLEAR INSTRUMENTS, INC.

RECENT TRANSMITTER PERFORMANCE INFORMATION AGENDA

I. Introductions

II. Loss of Oil Summary 1153B/D & 1154 Information

III. Loss of Oil Summary 1152/1153A Information

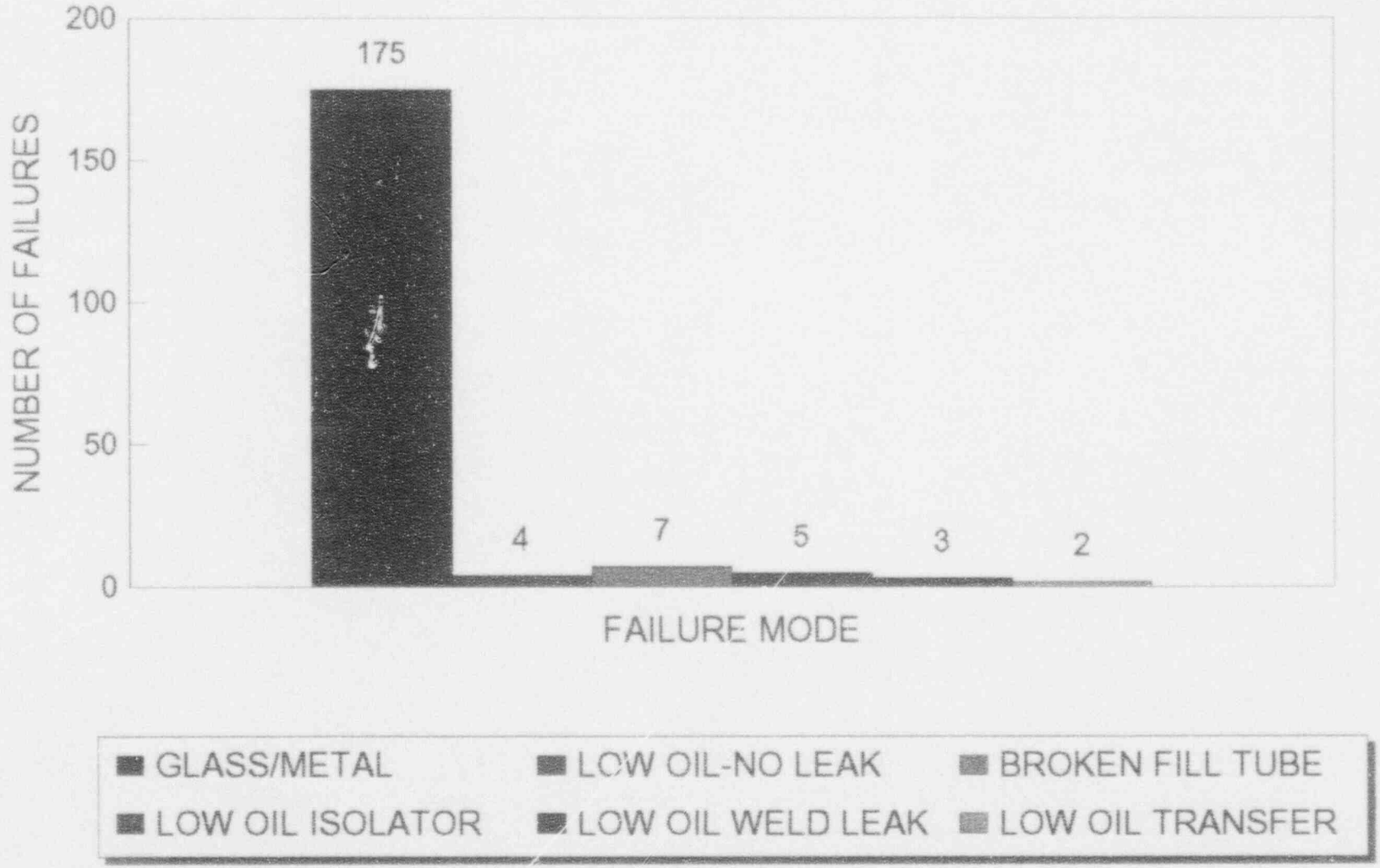
IV. Loss of Oil Information on 1151 in Nuclear Faciilities

V. Concluding remarks

ROSEMOUNT
NUCLEAR INSTRUMENTS INC.

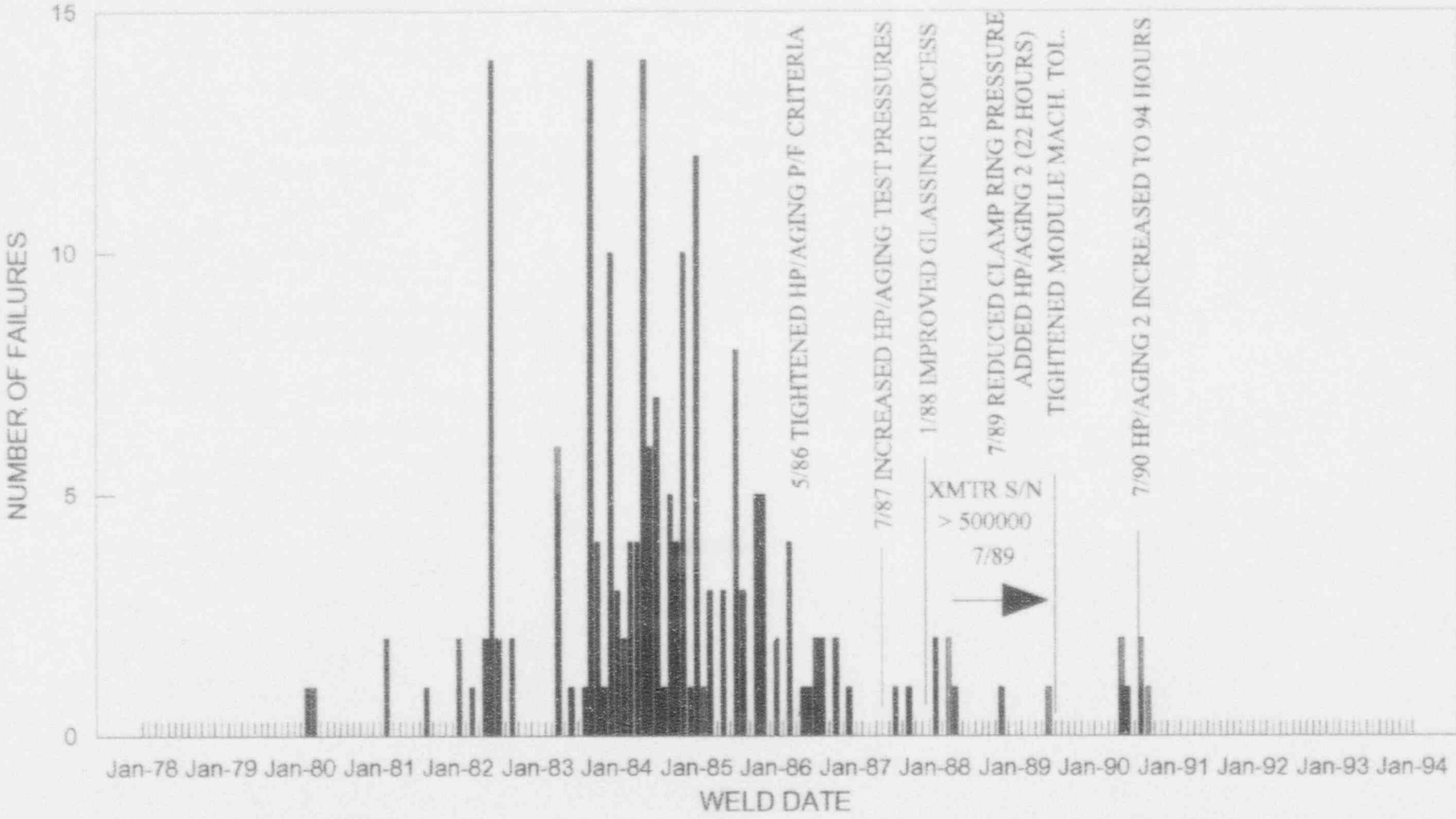
1153B/D & 1154 OIL LOSS FAILURES

NUCLEAR RETURN DATA BASE FROM 1978 TO 2/17/94



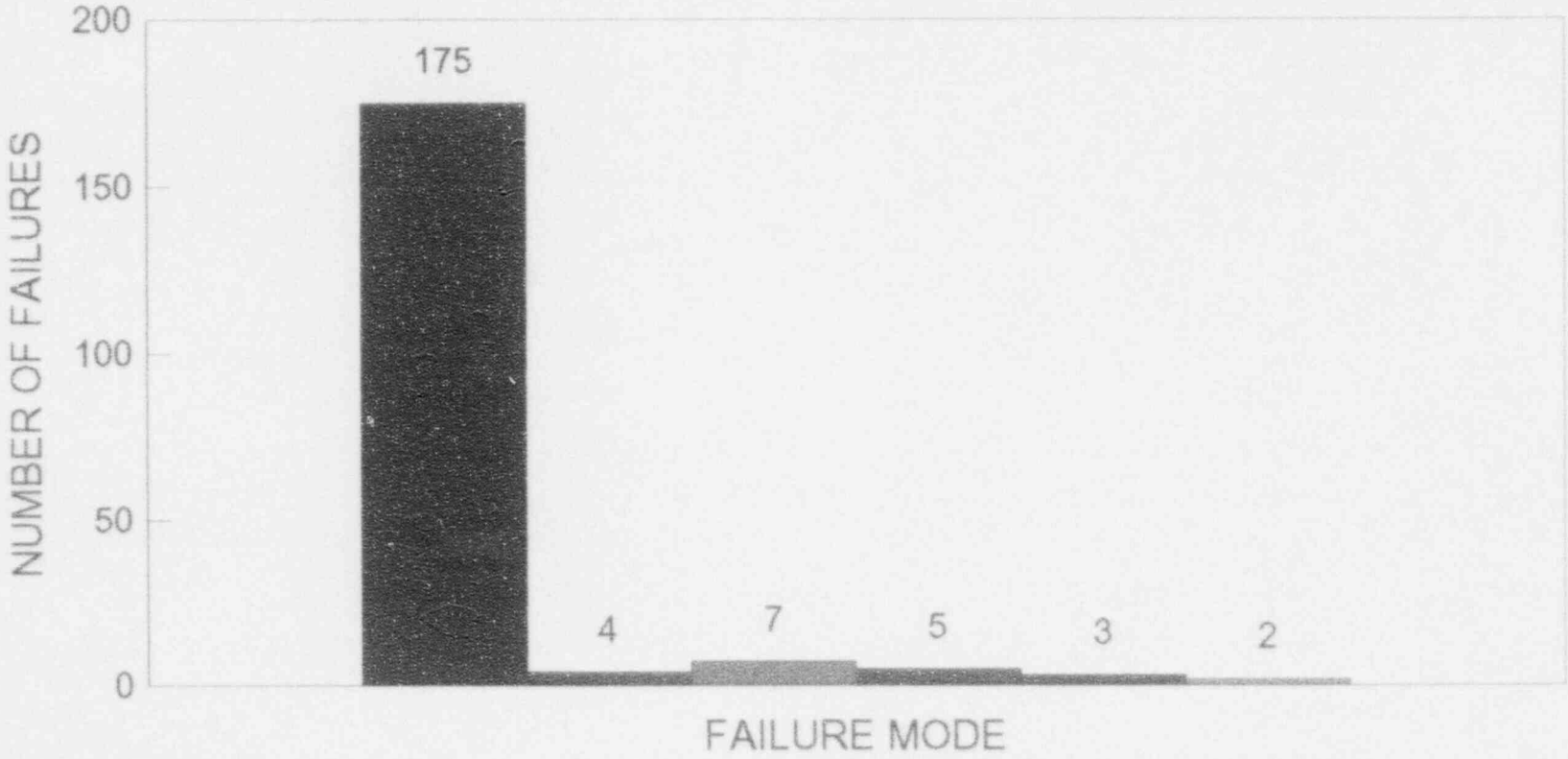
1153B/D & 1154 LOW OIL FAILURES - ALL CAUSES

FROM 1978 THROUGH 2/17/94 BY WELD DATE



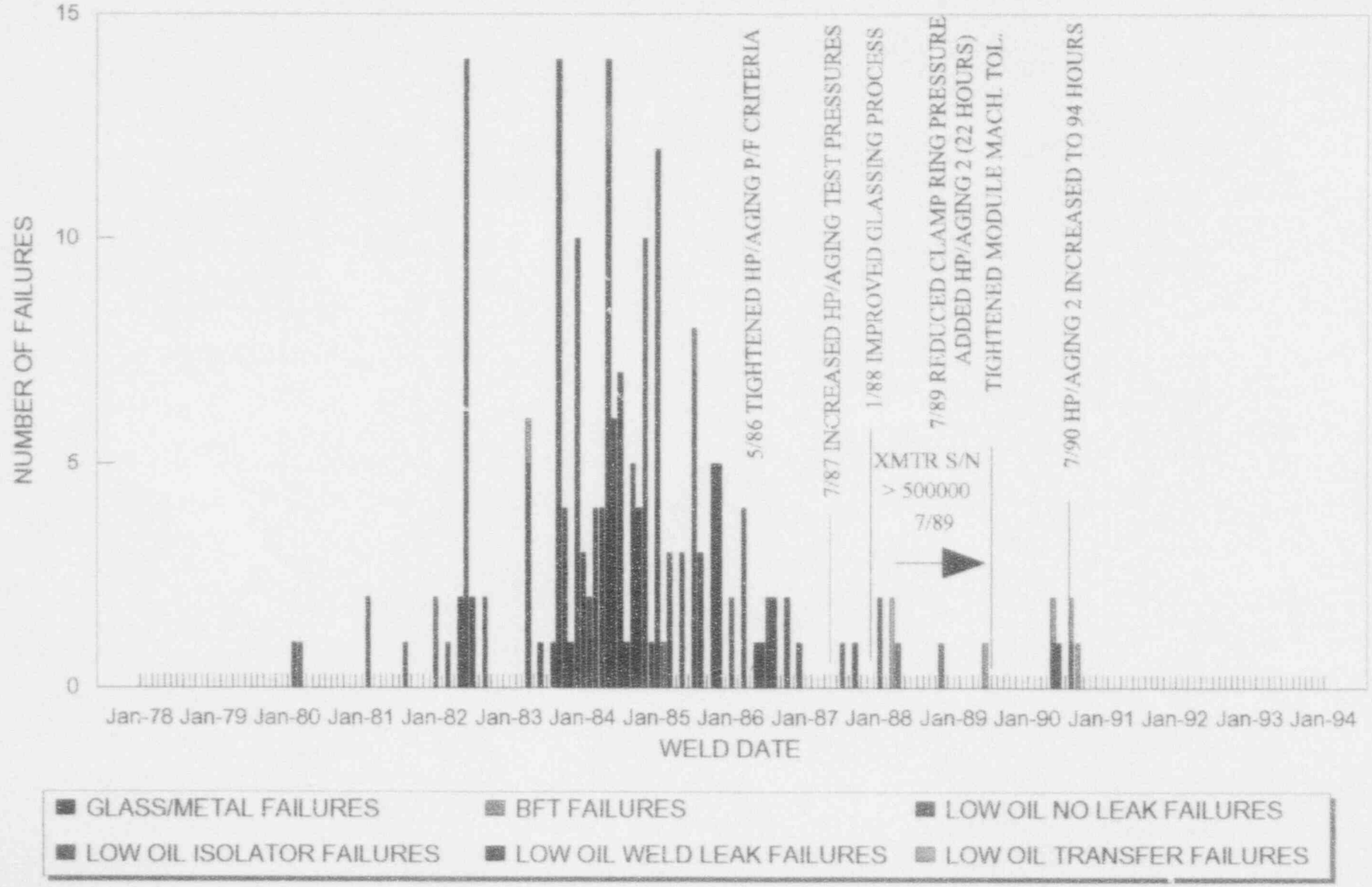
1153B/D & 1154 OIL LOSS FAILURES

NUCLEAR RETURN DATA BASE FROM 1978 TO 2/17/94



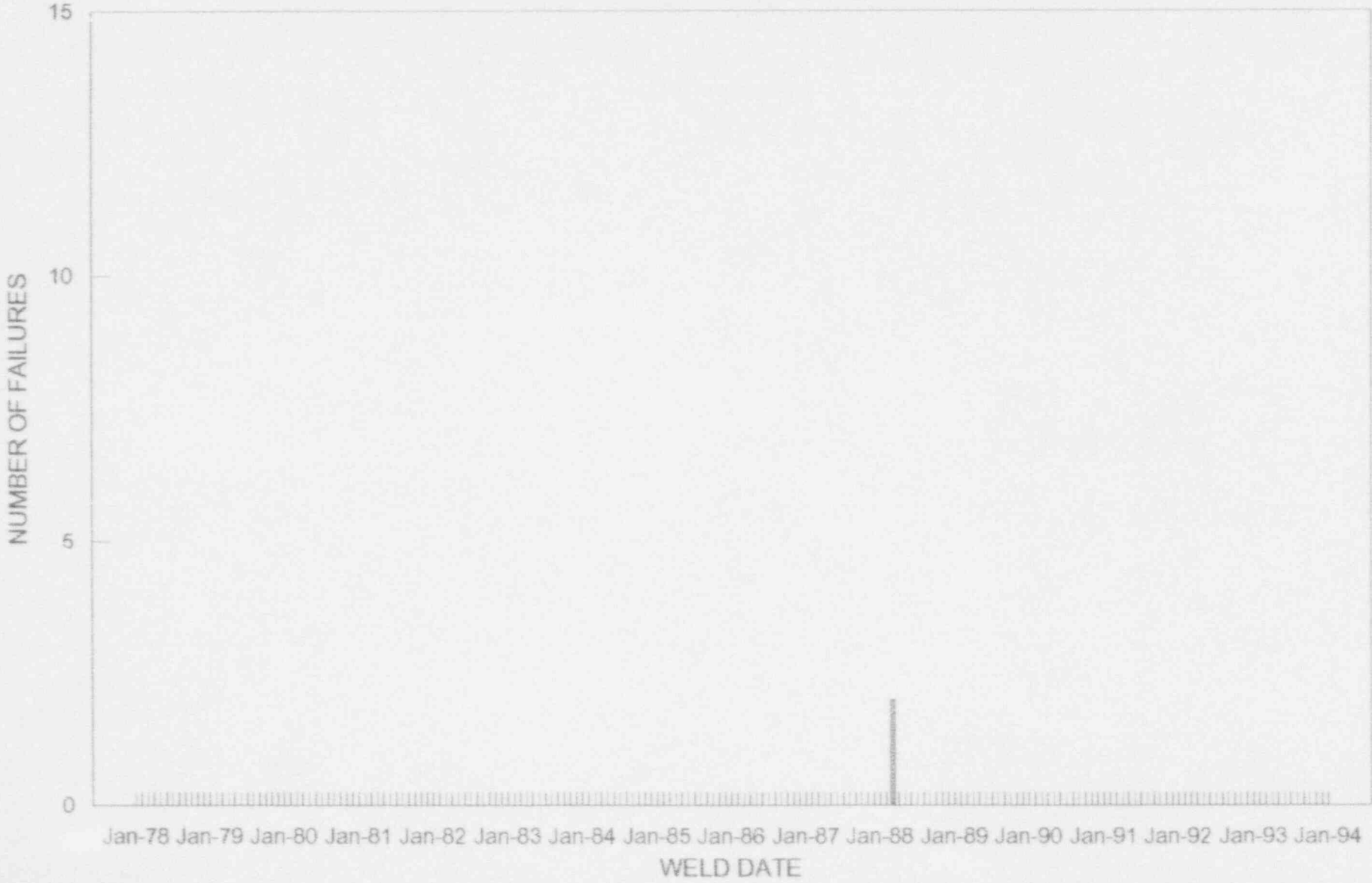
1153B/D & 1154 LOW OIL FAILURES - ALL CAUSES

FROM 1978 THROUGH 2/17/94 BY WELD DATE



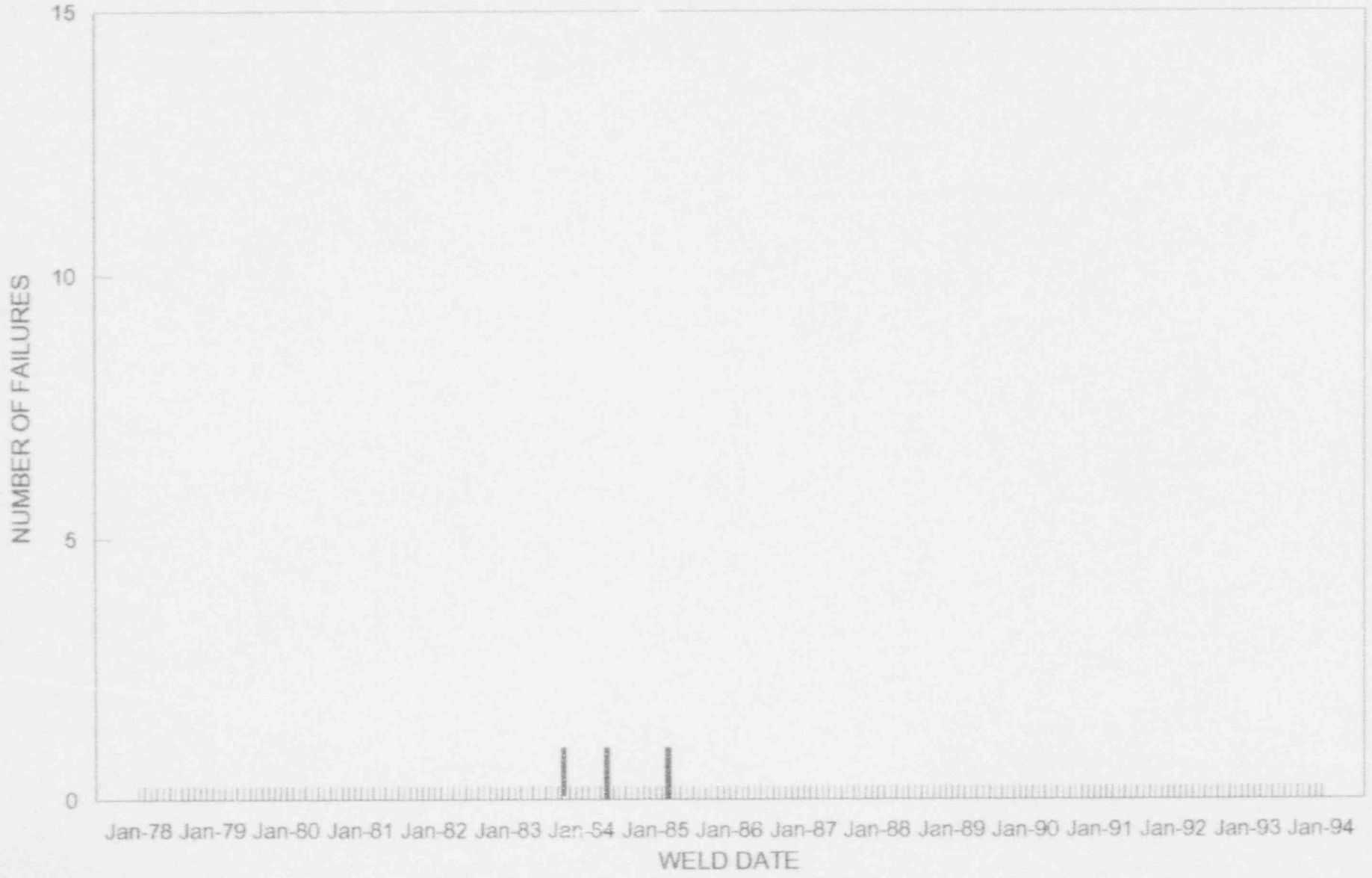
1153B/D &1154 LOW OIL - TRANSFER FAILURES

FROM 1978 THROUGH 2/17/94 BY WELD DATE



1153B/D & 1154 LOW OIL - WELD LEAK FAILURES

FROM 1978 THROUGH 2/17/94 BY WELD DATE



1153B/D & 1154 LOW OIL - ISOLATOR FAILURES

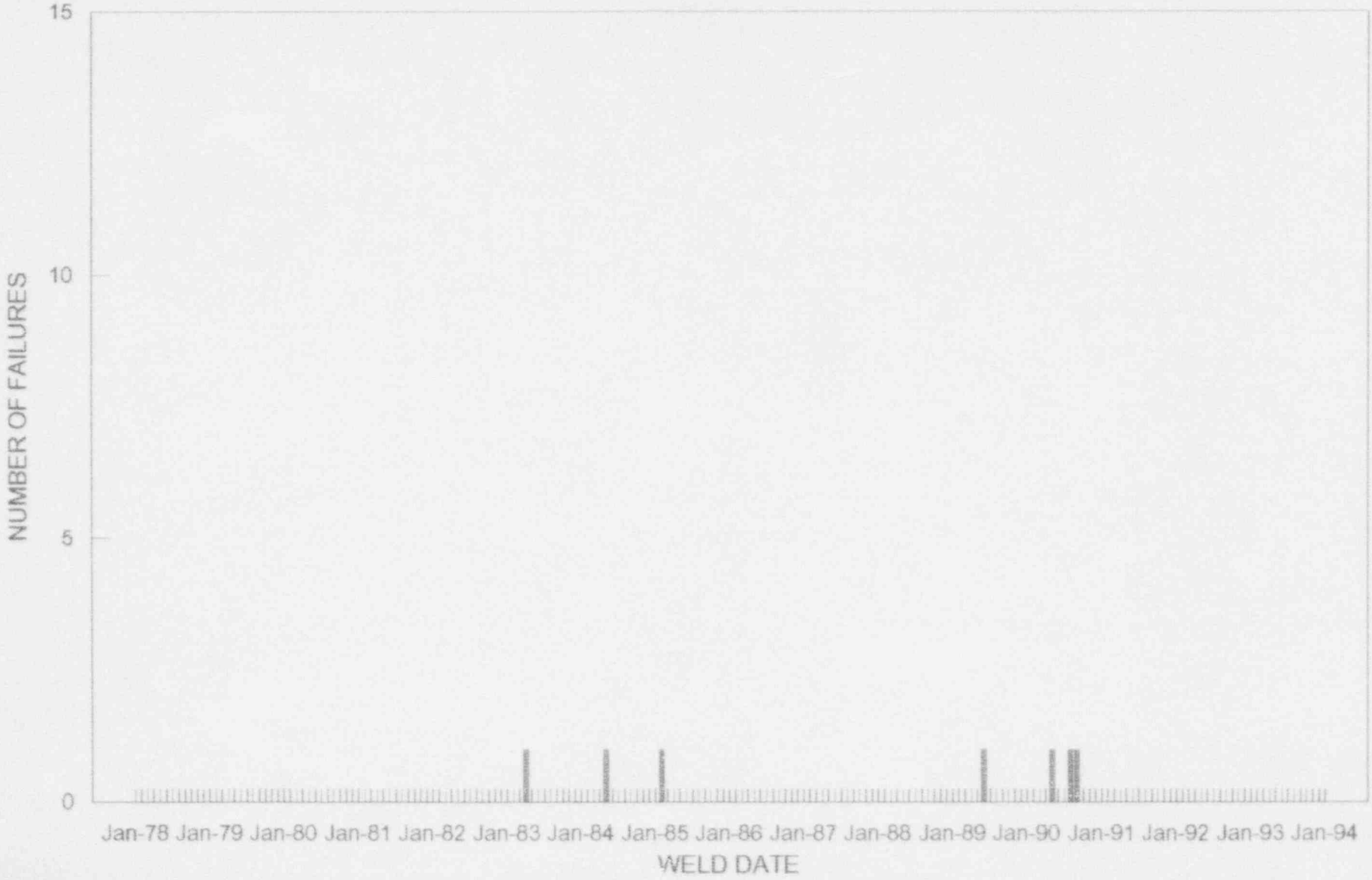
FROM 1978 THROUGH 2/17/94 BY WELD DATE

1153B/D & 1154 LOW OIL - NO LEAK FAILURES

FROM 1978 THROUGH 2/17/94 BY WELD DATE

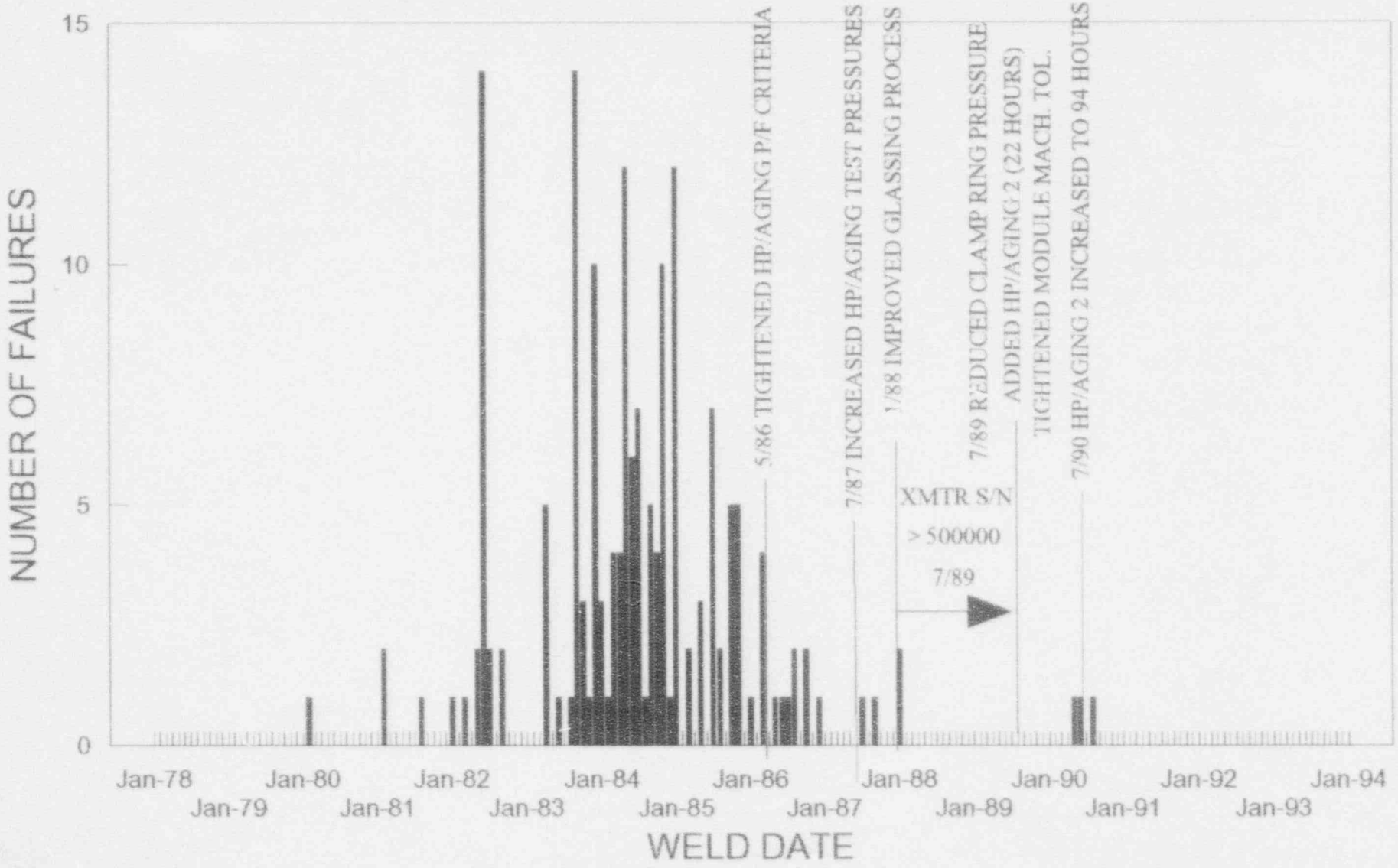
1153B/D & 1154 BROKEN FILL TUBE FAILURES

FROM 1978 THROUGH 2/17/94 BY WELD DATE



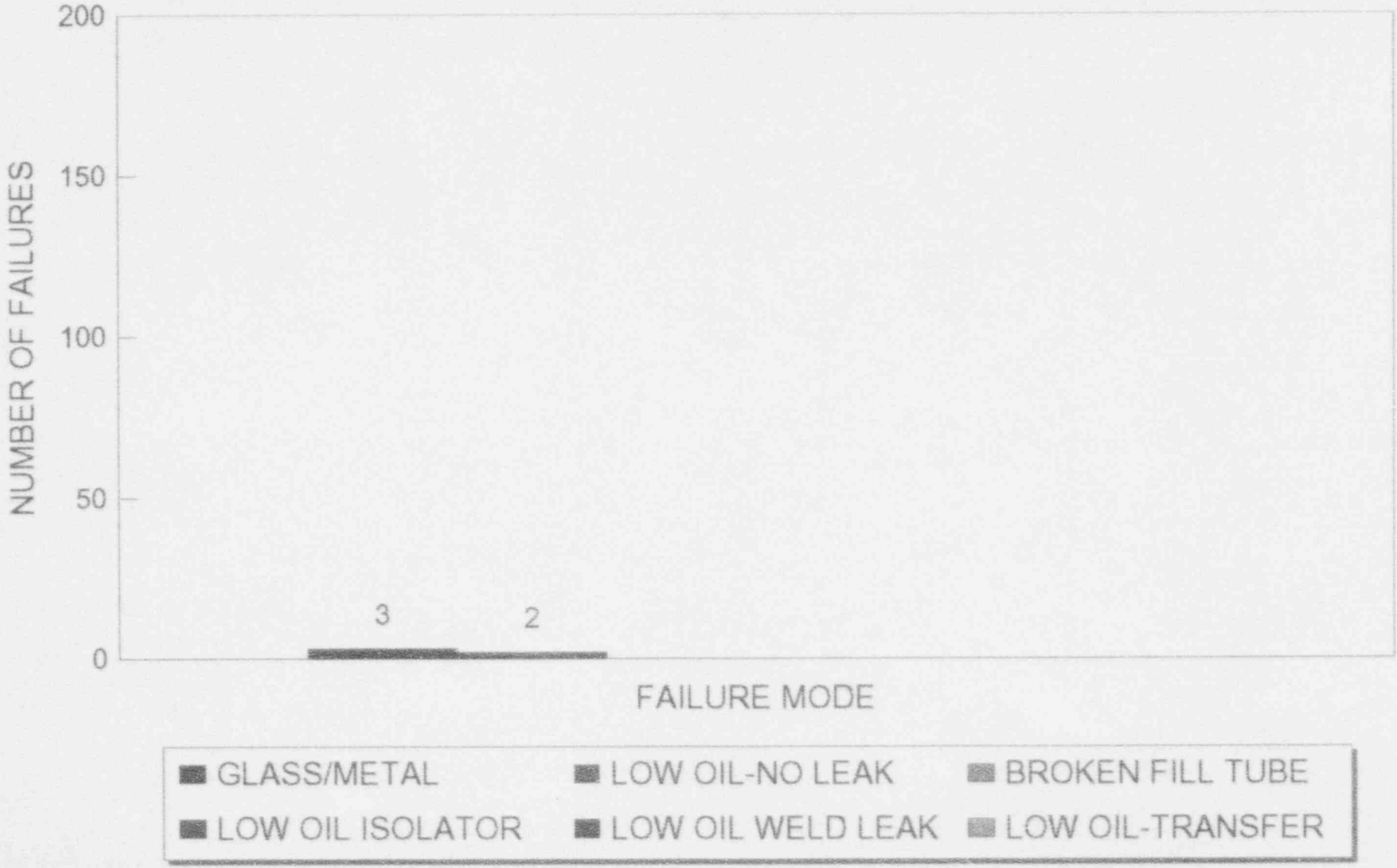
1153B/D & 1154 GLASS TO METAL FAILURES

FROM 1978 THROUGH 2/17/94 BY WELD DATE



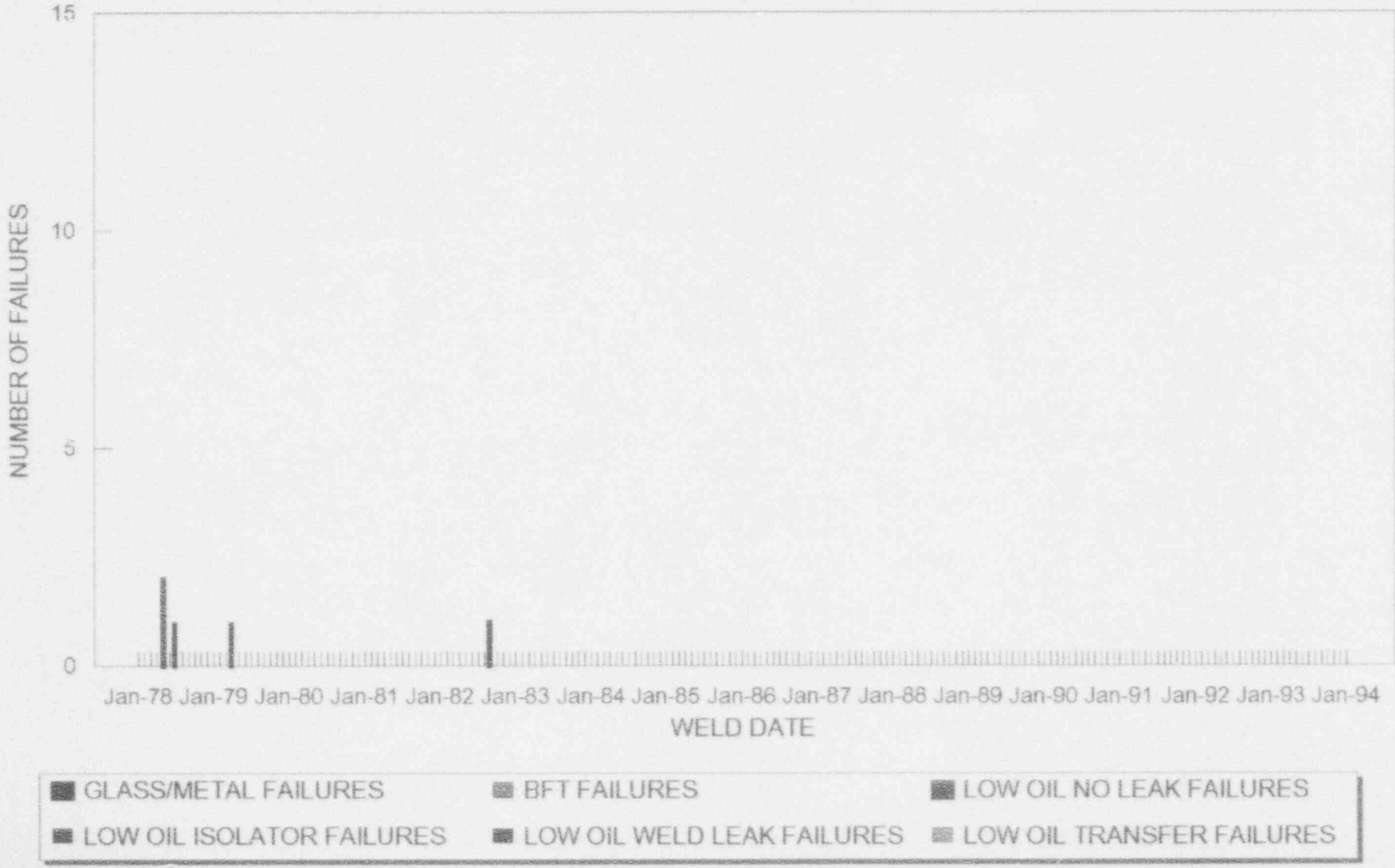
1152 & 1153A OIL LOSS FAILURES

NUCLEAR RETURN DATA BASE FROM 1978 TO 2/17/94



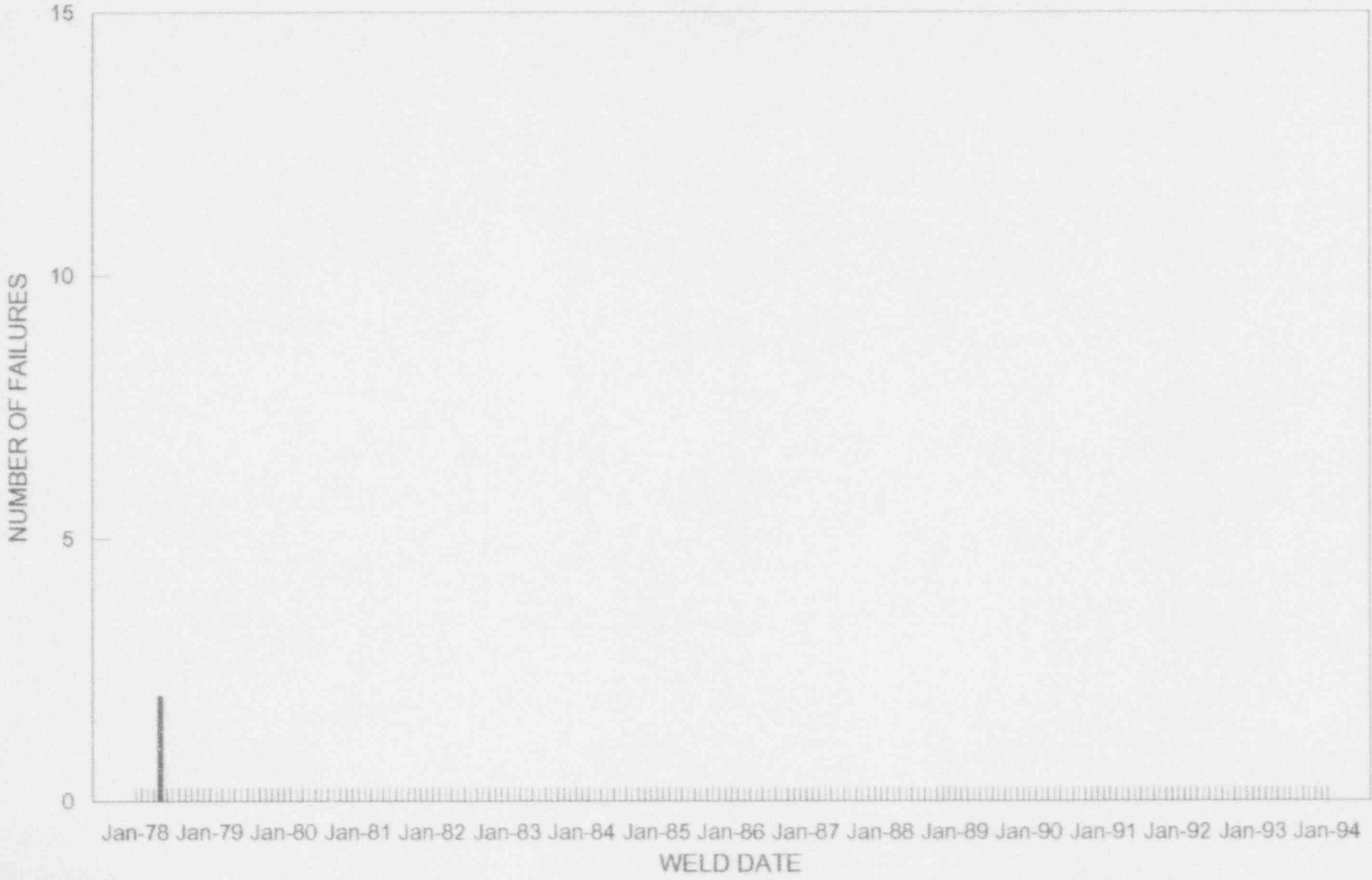
1152 & 1153A LOW OIL FAILURES - ALL CAUSES

FROM 1978 THROUGH 2/17/94 BY WELD DATE



1152 & 1153A LOW OIL - NO LEAK FAILURES

FROM 1978 THROUGH 2/17/94 BY WELD DATE



1152 & 1153A GLASS TO METAL FAILURES

FROM 1978 THROUGH 2/17/94 BY WELD DATE

1151 COMMERCIAL GRADE TRANSMITTERS

NUCLEAR FACILITIES

- There are 5 total confirmed failures in U.S. facilities
- There is no changes to report since our August 1993 to RTRG

ROSEMOUNT
NUCLEAR INSTRUMENTS INC.

CONCLUDING REMARKS

- Confirmed Oil Loss Failures of 1153B/D and 1154 totals 196
  - Confirmed Oil Loss Failures of Post July '89 1153B/D and 1154 totals 6
  - There has been no change since the Aug '93 submission to the RTRG in post July '89
- Confirmed Oil Loss Failures of 1152/1153A totals 5
  - There is no change since the Aug '93 submission to the RTRG
- Confirmed Oil Loss Failures of 1151 commercial grade in U.S. facilities totals 5
  - There is no change since the Aug '93 submission to the RTRG
- Rosemount is continuing to analyze and trend all product returned from Nuclear Facilities