VIRGINIA ELECTRIC AND POWER COMPANY

SURRY POWER STATION

UNITS 1 AND 2

SNUBBER REPORT

RESPONSE TO USNRC INSPECTION REPORT

NOS. 50-280/83-32 and 50-281/83-33

Date: January 25, 1984

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I. INTRODUCTION

As a result of the NRC inspection of the Surry Unit 1 and 2 snubber program conducted by J. J. Lenahan on November 14 - 17, 1983 (reference Report No.'s 5-280/83-32 and 50-281/83-33), the Commission requested clarification and explanation of Surry's basis for snubber functional test selection criteria. Subsequent discussion resulted in a Vepco commitment to provide a detailed report describing the snubber program by January 30, 1984. This report provides that information.

This report is limited to describing the programs and history for mechanical snubbers and small bore hydraulic snubbers (6" bore and less). Large bore snubbers (including 6" pathon snubbers) are not discussed because Technical Specifications provide special retest exemption criteria for large bore snubbers (T. S. 4.17.c.7) and Surry has completely overhauled, refurbished and tested all large bore snubbers during the Unit 1 and 2 SGR Project outages.

II. PURPOSE

The purpose of this report is to:

1. Describe the evolution of the snubber test programs from 1978 through 1983.
2. Correlate historical functional test data to the overall condition of the snubbers.
3. Describe the existing snubber program and planned changes.

III. DISCUSSION

A. Program Evolution

NOTE: Changes described in the following report are displayed chronologically on Figure 1.

In 1978, snubber selection for functional testing was performed utilizing PT-39, Snubber Inspection. The PT required that at refueling outages, a representative sample of 10 snubbers (not larger than five inch bore) be removed and functionally tested in accordance with the appropriate Mechanical Maintenance Procedures (MMP). Selection of the snubbers was done by identifying every fifth snubber on the PT-39 listing. If the snubber fell in the proper size category, it was removed and tested. If a snubber failed the test, an additional 10 snubbers were pulled and tested. The acceptance criteria in effect was 6 to 30 in./min. for lockup and 2 to 10 in./min. for bleed. This criteria was established by Stone and Webster Engineering.

In late 1978, a new functional testing procedure, PT-39.2 was generated to provide better control of the functional testing program. This procedure added three key elements to the functional test program. First, it utilized a computer generated random list of snubbers to be tested. This ensured a more representative sample was selected. Second, it provided tables, to record all snubbers that were tested and test results achieved. Third, the MMP's required snubbers be reset to optimum design setpoints prior to reinstallation. This provided for better tracking and analysis of the data. The computer was also utilized to track snubber status, i.e. when changed out, overhauled, etc. Prior to functionally testing snubbers during the 1979 Unit 1 Showcause outage and the Unit 2 SGRP outage, the PT was changed to incorporate the actual testing procedure.

The next change in the program occurred in August of 1979. As a result of an analysis performed by Stone and Webster Engineering, the acceptance criteria for both lockup and bleed was changed to 4.6 to 30 in./min. and 1.8 to 20 in./min. respectively. Snubbers tested during the Unit 1 SGRP outage in 1980 - 1981 and the Unit 2 1981 refueling outage were subject to this new criteria.

In 1983, an effort was made to upgrade the Surry Technical Specifications to conform to Standard Technical Specifications. Guidance used for the update was the ASME draft standard, <u>Examination and Performance Testing of Nuclear Power Plant Dynamic Restraints (Snubbers) O & M - 4</u>. The change to Technical Specifications was issued as Amendments No. 79 and 80. This change brought surveillance specifications in line with Standard Technical Specifications except for the post failure functional test selection methodology. In lieu of the formula presented in Standard Technical Specifications and O & M - 4, Surry chose what was considered to be a more conservative approach. This consisted of selecting an additional 10% to be tested for each failure experienced. Included with the new Technical Specification was the requirement to functionally test mechanical snubbers. The overall snubber program was then modified to conform to the new Technical Specification requirements.

The latest change made to the snubber program modified the functional testing acceptance criteria to 4.0 to 30 in./min. for lockup and 1.0 to 20 in./min. for bleed. This new criteria was developed utilizing manufacturer's recommended ranges and a Stone and Webster Engineering evaluation of temperature effects and site specific piping thermal growth rates. The functional testing done during the 1983 refueling outages was performed under this new criteria.

In addition to the items described above, the following program changes were initiated:

1. Analysis of piping systems is performed whenever snubbers have been declared inoperable to determine the effect on the system design function or operability.
2. Tracking of snubber service life.

More detailed information on the existing program and scheduled changes are provided later in this report.

B. Analysis of Historical Data

1. Hydraulic Snubbers

Test data was reviewed from functional testing performed in 1978 through the present. The following categories were reviewed.

a. (Table 1) - Total Snubbers Tested and Failed.

b. (Table 2) - Total Number Snubbers Tested by Size and Year Vs. Total Failures

c. (Table 3 and Figure 2) - Bleed Failures by Range

d. (Table 4 and Figure 3) - Lockup Failures by Range

e. (Figure 4) - Total Number of Failures Under Acceptance Criteria in Effect at Time of Test Vs. Total Number of Failures Under Existing Acceptance Criteria By Mode of Failure

Note: A specific breakdown by manufacturer's type (i.e. Miller vs. Lynair vs. Tompkins Johnson) was not performed. Records prior to 1983 did not always contain manufacture's type, therefore reliable number, percentage, etc. could not be produced. Testing data for Unit 2 in 1978 could not be collated in the format necessary for this report (specific breakdown of range and mode of failures was not available) and is not included.

As shown in Table 1, the overall failure rate for the entire period is 30.3% (128 of 423). Assuming present day acceptance criteria is applied to all functional testing the rate becomes 16.8% (71 of 423). By discounting bleed related failure - a valid assumption, considering bleed rate failures do not prevent a snubber from performing its intended function, the failure rate decreases to 5.9% (25 of 423). This failure rate could be reduced further by discounting lockup failures between the range of 2 to 4 in./min. The basis for the existing acceptance criteria results from the worst case system thermal growth rate which is in the range of 3.7 to 4.0 in./min. Most system thermal growth rates are less than 2.0 in./min. As shown in Figure 3, a significant number of failures fall in the 2 to 4 in./min. range. If the failures in this range are discounted, the overall rate would reduce to 2.8% (12 of 423).

The conclusion drawn from the above discussion is that the overall failure rate, accounting only for failures where the intended function of the snubber is compromised, is low and indicates that the overall functional condition of the snubbers has been acceptable.

Further, Figure 4 shows that the failure mode is spread evenly between lockup and bleed, under both tension and compression. This applies to failures under the acceptance criteria in effect at time of testing. The application of presentday acceptance criteria serves to equalize the failure mode to an even greater degree. Therefore, a generic failure mode has not been determined to exist.

Figure 2 indicates that most bleed failures are due to rates less than 1.8 in./min. However, as stated previously, bleed failures do not prevent snubbers from performing their intended function.

Conversely, Figure 3 indicates most lockup failures occur in the higher range of 3 to 6 in./min. A number of failures in this range could be eliminated if specific acceptance criteria were generated for each snubber installation.

The failure rate of snubbers tested in 1983 is 32.4%. This is approximately the same failure rate of all snubbers when utilizing past acceptance criteria. However, eliminating bleed failures and lockup failures in the 2 to 4 in./min. range, the modified failure rate is 5.9% which is considered to be acceptable.

During the 1983 Unit 2 Refueling outage, all snubbers tested were disassembled, and overhauled regardless of test results. All of the ITT Grinnell Lynair type snubbers exhibited cylinder and piston scoring of varying degrees. Of the 16 Lynair type snubbers tested 8 failed, 3 in bleed and 5 in lockup. This, in conjunction with the actual values of bleed or lockup failure, indicate that the scoring was not causing a generic type failure. All Lynairs tested were replaced with ITT Grinnell Miller snubbers. These snubbers are provided with a piston bearing device which should serve to reduce or eliminate the scoring.

2. Mechanical Snubbers

Prior to the 1983 refueling outages, no mechanical snubbers were functionally tested since the Technical Specifications in effect at the time did not require mechanical snubber functional testing. Thus, a historical data base dose not exist. The discussions below will be limited to the data obtained in 1983.

A total of 32 mechanical snubbers were tested between Unit 1 and 2, with 16 failures. The breakdown is as follows:

Size	# Tested	# Failed	Cause of Failure
¼	5	4	High Drag
½	9	3	1 High Drag, 1 Accel., 1 Locked up
1	4	3	High Drag
3	12	6	4 High Drag, 2 Locked up
10	1	0	NA
35	1	0	NA
	32	16	12 High Drag, 1 Accel., 3 Locked up

NOTE: All failed snubbers were replaced with stock spares.

As a result of the Unit 1 failures, a representative sample of the failed snubbers (3 snubbers - 2 High drag and one Locked up), was sent to PSA for evaluation. PSA tested the snubbers and found no problems, i.e. all passed the functional test. For Unit 2, all 7 failed snubbers were sent to Wyle Labs for evaluation. The snubbers were tested and only two (both PSA ¼) of the seven failed the test. These snubbers were disassembled to determine cause of failure. Both snubbers had a white gritty material (believed to be insulation paste) on the inside of the housing and the outside surface of the inertia mass. The presence of the gritty material appears to have increased mechanism friction thus increasing the drag force. Also a bent guide rod and bearing assembly contributed to one snubber failure.

The combination of failures in both units and subsequent testing and acceptance by PSA and Wyle resulted in a review of the functional test procedure. It was discovered that the manufacturer's (PSA) recommended test method included performing acceleration testing before drag tests are conducted. The Vepco, Wyle and ITT Grinnell procedures require the drag test be performed first then the acceleration tests. It appears that running the acceleration test first tends to free up the mechanism thus resulting in lower drag forces. Vepco considers the manufacturer's test method to be less conservative and will continue to perform drag tests before acceleration tests.

The drag failures experienced were generally within 5% of the acceptance criteria of 1% of rated load. An evaluation will be conducted to determine if the acceptance criteria can be expanded.

The identification of the testing discrepancies noted above provides some explanation for the high failure rate on Unit 1. However, the Unit 2 failed snubbers sent to Wyle were tested on a Wyle machine and in accordance with a Wyle procedure. As with the Vepco procedures, the test sequence was in reverse of the PSA procedure, yet 5 of the failed snubbers tested by Wyle during the outage, passed when retested at the Wyle facilities in Alabama on the same type test machine. The only explanation is that the initial failures were due to drag values slightly off from the acceptable setpoint and the transportation and handling of the snubbers caused the values to drop when retested. (Same could have applied to the drag failure snubbers sent to PSA for Unit 1).

Until such time that the mechanical snubbers can be replaced or more detailed failure explanations can be provided, Surry will continue to replace any failed mechanical snubber with a new or refurbished snubber. In addition post-failure selection will be in accordance with an updated program as discussed in the next section.

C. Program Description and Planned Changes

Present functional testing selection criteria is taken from a combination of O & M - 4 and Technical Specifications 4.17.C. The following requirements were used as a basis for the selection of snubbers for functional testing:

1. 10% of each type of snubber tested.
2. Various configuration, environments, and sizes selected.
3. 25% of the snubbers in the representative sample will include:
   a. First snubber away from each Reactor vessel nozzle.
   b. Snubbers within 5 feet of heavy equipment.
   c. Snubbers within 10 feet of discharge from a safety relief valve.

To comply with the above requirements, snubbers were divided into categories based on their sizes and locations. There are 29 categories for Unit 1 and 24 categories for Unit 2. Eleven of 29 categories for Unit 1 and 10 of 24 categories for Unit 2 are near heavy equipment, pump discharge, safety relief valves, steam generators and reactor vessel nozzles. Thus selecting any snubber from each of these categories will meet the minimum 25% requirements as stated above.

At the development of Surry's program, snubbers were divided into three groups: 1) mechanical, 2) large bore (including 6" pathon) and 3) small bore hydraulic snubbers prior to the categorization. This would ensure 10% of each group of snubbers on the initial selection.

In the present program, if there is a snubber failure, an additional 10% of the snubbers in same category are tested. Testing would continue until no more failures are found in the category. If a generic failure is found that would cause snubbers not to function properly, a large sample size by manufacturer or design deficiency is selected. This additional selection over a 10% resample would be independent of the requirements for snubbers not meeting the functional test criteria.

The intent of O & M - 4 and Standard Technical Specifications is to ensure snubbers are functionally operable and generic problems are identified and bounded such that corrective action can be implemented. Although the Surry selection method, which used a literal interpretation of O & M - 4 and Technical Specifications, is conservative and provides a large and representative initial sample, the use of the same categories for follow up testing could possibly produce a non-conservative retest sample. Historical testing data for snubbers at Surry has proven that no generic problems, relating to operability, exist. However, to ensure snubbers

remain in an optimum condition, the following changes are planned and will be implemented prior to and during the next refueling outages.

1. The snubber selection method will be modified to conform to the intent of O & M 4 and Standard Technical Specifications. The existing groupings will be modified to ensure a sample of all sizes in all categories are tested initially. For additional testing, all small bore snubbers will be subject to selection and not just those in a particular grouping.
2. The cause of failure, if it can be determined, will be required on the PT data sheets.
3. The ITT Grinnell Lynair snubbers will be replaced with the Miller type snubbers. Note: This will be subject to availability of replacement units.
4. An evaluation will be performed on Mechanical snubber functional test acceptance criteria and the effects of high drag on piping systems.
5. All small bore testing will be performed on the new computer controlled Wyle test machine.

In addition, the following long range modifications will be made as manpower and funding are available.

1. All snubber installations will be reviewed to determine if the snubber can be removed.
2. All PSA mechanical snubbers will be replaced with hydraulic snubbers or mechanical snubbers of a different design.

IV. CONCLUSIONS

The following conclusions are drawn from this report:

1. Based on an analysis of test data, no generic problems affecting operability exist with Surry snubbers.
2. Since no generic problems exist and program upgrades will be made, additional testing prior to the next refueling outages is not required.

As shown in this report, a large number of snubbers have been tested at Surry Power Station with a resultant low failure rate in terms of failures affecting true snubber operability. In addition, a large amount of manpower and funds have been expended in resolving problems as they arose and ensuring they do not reoccur. The overall snubber program has evolved to a well documented, procedurally controlled program. Surry is committed to continually improving this program with the intent of maintaining snubbers in a fully functional condition.

TABLE 1

TOTAL NUMBER SNUBBERS TESTED AND FAILED

	TOTAL TESTED	ORIGINAL CRITERIA		USING NEW CRITERIA		NO BLEED FAILURES NEW CRITERIA		NO BLEED FAILURES WITH NEW CRITERIA & NO LOCKUP FAILURES BETWEEN 2-4 IN./MIN.	
UNIT 1		FAILED	% FAILED	FAILED	% FAILED	FAILED	% FAILED	FAILED	% FAILED
1978	78	6	7.7	2	2.6	0	0.0	0	0.0
1979	130	35	25.9	13	10.0	6	4.6	4	3.1
1980-81	10	0	0.0	0	0.0	0	0.0	0	0.0
1983	32	9	28.1	9	28.1	4	12.5	3	9.4
Mechanical	21	9	42.9	-	-				
Total Hydraulic	250	50	20.0	33	13.2	10	4	7	2.8
UNIT 2									
1979	127	65	51.1	18	14.2	7	5.5	3	2.4
1981	10	0	0.0	0	0.0	0	0.0	0	0.0
1983	36	13	36.0	13	36.1	8	22.2	2	5.6
Mechanical	11	7	63.6						
Total Hydraulic	173	78	45.1	38	22.0	15	8.6	5	2.9
Total Both Units	423	128	30.3	71	16.8	25	5.9	12	2.8
Mechanical	31	16	51.6						

TABLE 2

TOTAL NUMBER SNUBBERS TESTED AND FAILED BY SIZE

UNIT 1

SIZE 1½	TESTED	FAILED	POST ON NEW CRITERIA
1978	33	2	
1979	*	13	6
1980	1	0	
1983	16	5	
	50	20	6
SIZE 2½			
1978	16	3	3
1979	*	5	3
1980	3	0	
1983	7	1	
	26	9	6
SIZE 3¼			
1978	5	0	
1979	*	1	1
1980	0	0	
1983	1	0	
	6	1	1

SIZE 4	TESTED	FAILED	POST ON NEW CRITERIA
1978	20	1	1
1979	*	8	8
1980	5	0	
1983	3	0	
	28	9	9
SIZE 5			
1978	4	0	
1979	*	0	
1980	1	0	
1983	2	2	
	7	2	
SIZE 6			
1983	3	1	
UNKNOWN			
*	130	8	4

TABLE 2

TOTAL NUMBER SNUBBERS TESTED AND FAILED BY SIZE

UNIT 2

SIZE 1½	TESTED	FAILED	POST ON NEW CRITERIA
1979	50	33	22
1981	1	0	
1983	19	11	
	70	44	22
SIZE 2½			
1979	31	18	12
1981	3	0	
1983	5	0	
	39	18	12
SIZE 3¼			
1979	7	0	
1981	0	0	
1983	3	1	
	10	1	
SIZE 4			
1979	30	12	11
1981	4	0	
1983	5	1	
	39	13	11

SIZE 5	TESTED	FAILED	POST ON NEW CRITERIA
1979	9	2	2
1981	2	0	
1983	2	0	
	13	2	2

SIZE 6			
1983	2	0	

TABLE 3

TOTAL NUMBER BLEED FAILURES BY RANGE

TENSION

	YEAR	0.-0.99	1-1.79	1.80-2.0	10.01-20.0	>20
UNIT 1	1978	8	5	3	1	-
	1979	-	3	-	-	-
	1980	-	-	-	-	-
	1983	4	-	-	-	2
	TOTAL	12	8	3	1	2
UNIT 2	1979	13	10	3	1	-
	1981	-	-	-	-	-
	1983	2	-	-	-	2
	TOTAL	15	10	3	1	2
TOTAL BOTH UNITS		27	18	6	2	4

TOTAL BLEED TENSION 57

NEW CRITERIA 26

TABLE 3

TOTAL NUMBER BLEED FAILURES BY RANGE

COMPRESSION

	YEAR	0.-0.99	1-1.79	1.80-2.00	10.01-20.00	>20
UNIT 1	1978	2	-	-	-	-
	1979	6	4	1	-	-
	1980	-	-	-	-	-
	1983	3	1	-	-	1
	TOTAL	11	5	1	-	1
UNIT 2	1979	8	14	6	1	-
	1981	-	-	-	-	-
	1983	3	-	-	-	1
	TOTAL	11	14	6	1	1
TOTAL BOTH UNITS		22	19	7	1	1

TOTAL BLEED COMPRESSION - 50

NEW CRITERIA-27

TABLE 4

TOTAL NUMBER LOCKUP FAILURES BY RANGE

TENSION

	YEAR	0-.99	1-1.99	2-2.99	3-3.99	4-4.99	5-5.99	20.1-30.0	>30
UNIT 1	1978	0	0	0	0	0	0	0	1
	1979	1	0	0	2	0	3	0	0
	1980		0	0	0	0	0	0	0
	1983	1	0	0	1	0	0	0	2
	TOTAL	2	0	0	3	0	3	0	3
UNIT 2	1979	1	1	3	3	6	13	0	0
	1981	0	0	0	0	0	0	0	0
	1983	0	0	0	2	0	0	0	0
	TOTAL	1	1	3	5	6	13	0	0
TOTAL BOTH UNITS		3	1	3	8	6	16	0	3

LOCKUP TENSION TOTAL - 40

NEW CRITERIA - 15

TABLE 4

TOTAL NUMBER LOCKUP FAILURES BY RANGE

		COMPRESSION							
	YEAR	0-.99	1-1.99	2-2.99	3-3.99	4-4.99	5-5.99	20.1-30.0	>30
UNIT 1	1978	0	0	0	0	1	1	0	0
	1979	1	0	0	2	7	1	0	1
	1980	-	0	0	0	0	0	0	0
	1983	0	0	0	1	0	0	0	0
	TOTAL	1	0	0	3	8	2	0	2
UNIT 2	1979	2	2	2	1	1	8	0	0
	1981	0	0	0	0	0	0	0	0
	1983	0	1	3	3	0	0	0	0
	TOTAL	2	3	5	4	1	8	0	0
TOTAL BOTH UNITS		3	3	5	7	9	10	0	1

LOCKUP COMPRESSION TOTAL - 38

NEW CRITERIA - 18

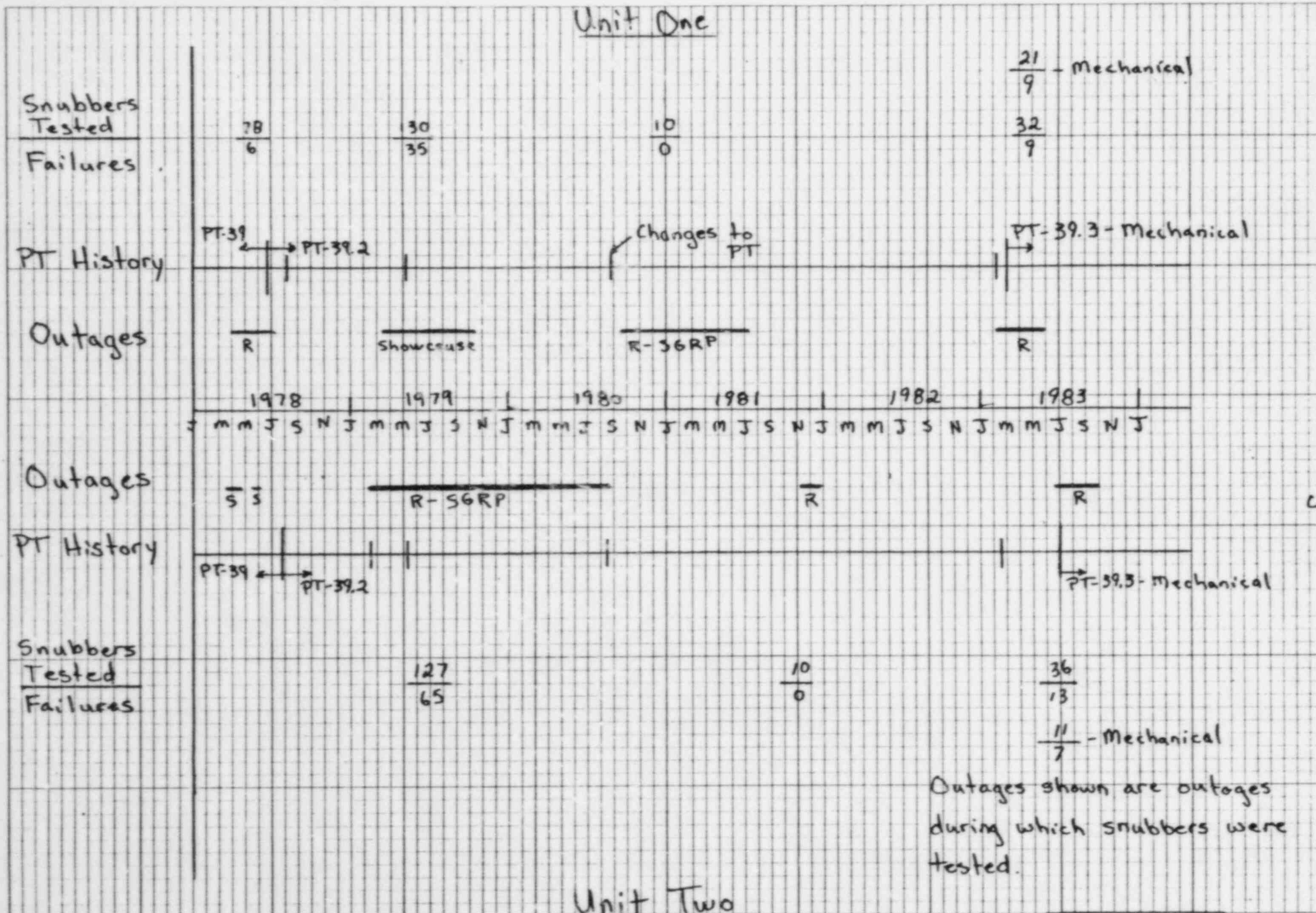
Unit One
Snubber Histogram
Snubbers Tested
Failures
28/6
130/35
10/0
32/9
21/9 - Mechanical
PT History
PT-39
PT-39.2
Changes to PT
PT-39.3 - Mechanical
Outages
R
Showcase
R-SGRP
R
1978
1979
1980
1981
1982
1983
J M M J S N J M M J S N J M M J S N J M M J S N J M M J S N J M M J S N J
Outages
S S
R-SGRP
R
R
PT History
PT-39
PT-39.2
PT-39.3 - Mechanical
Snubbers Tested
Failures
127/65
10/0
36/13
11/7 - Mechanical
Outages shown are outages during which snubbers were tested.
Unit Two

Figure One

Number of Bleed Failures VS. Range

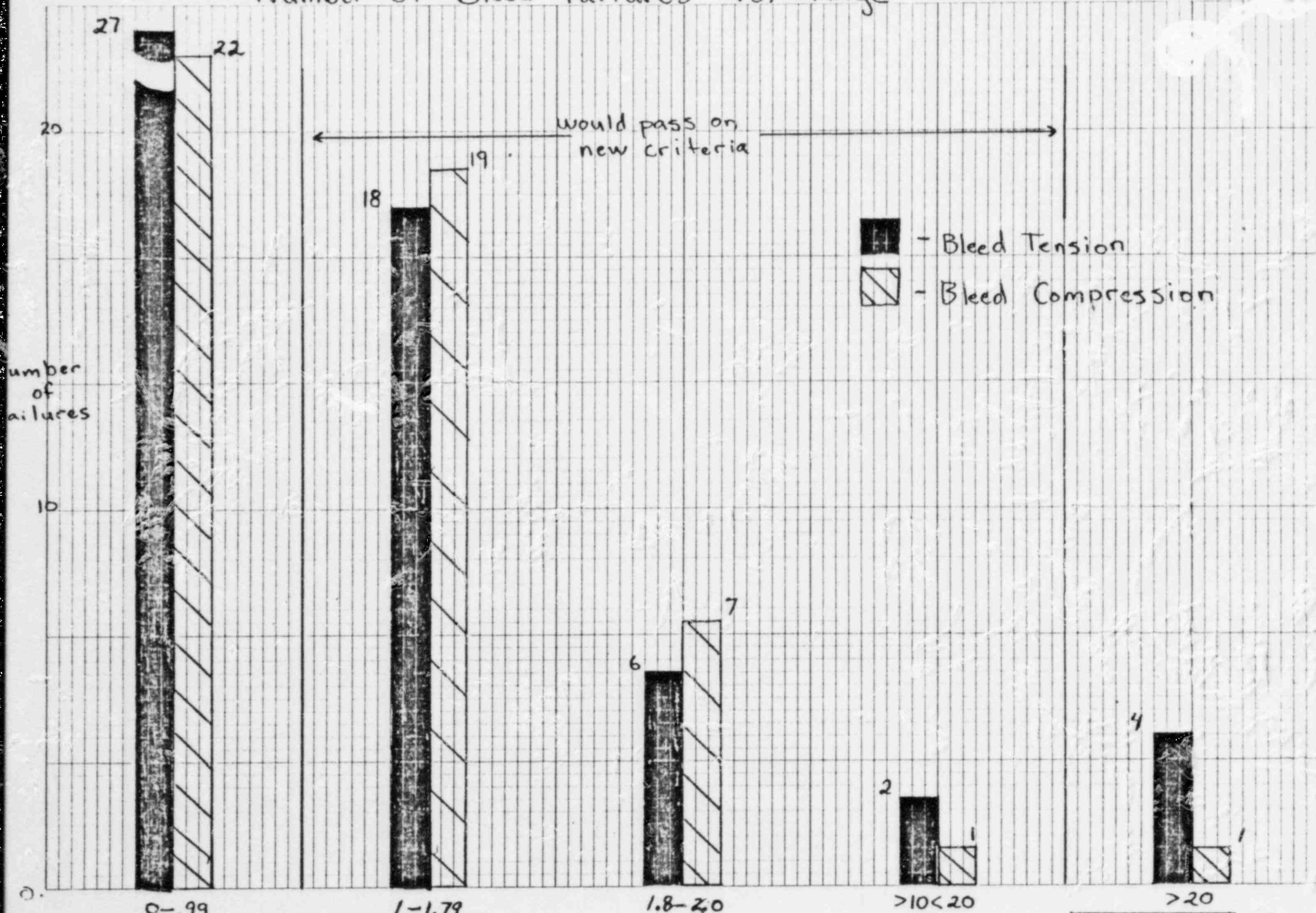

Figure Two

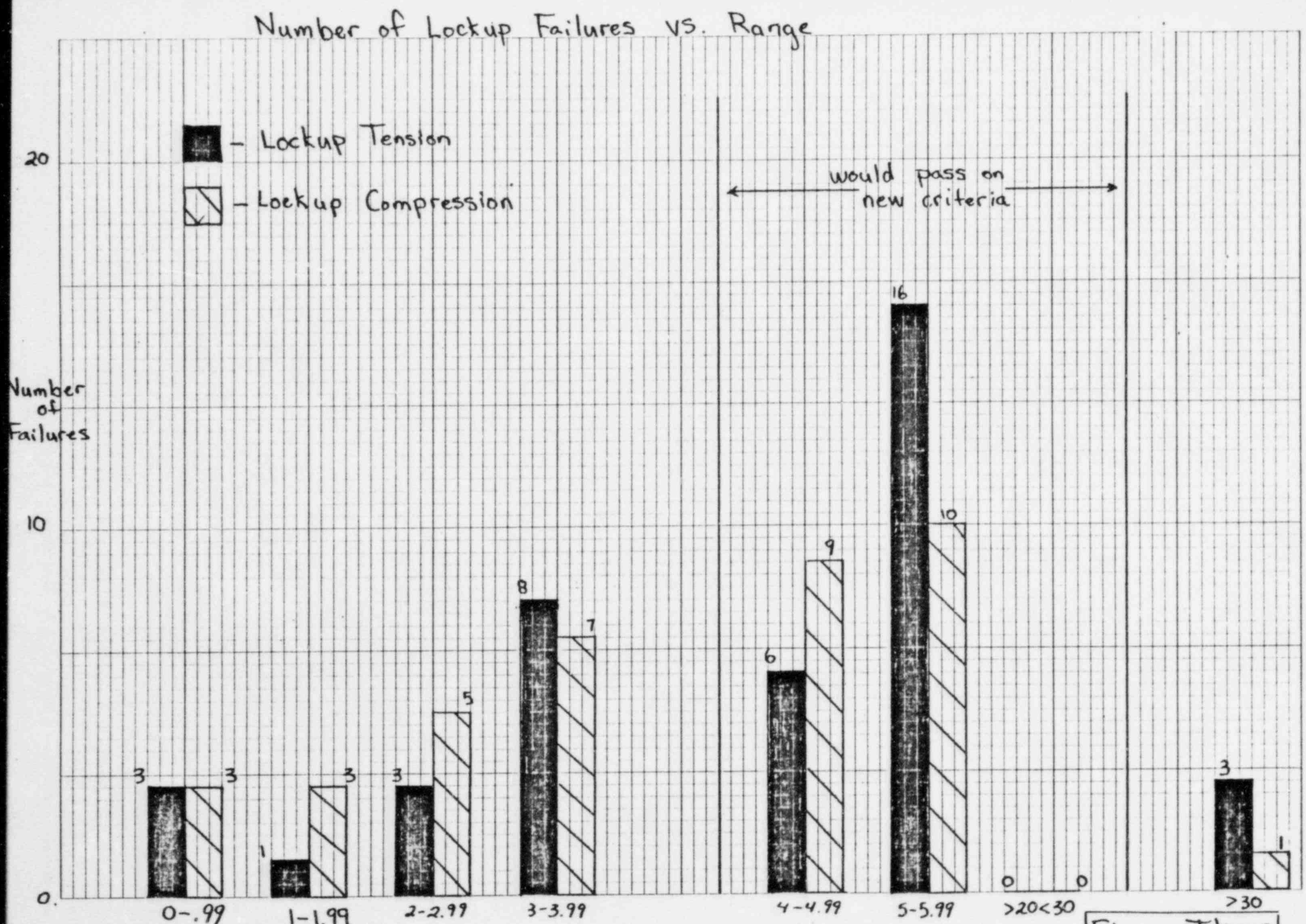

Figure Three

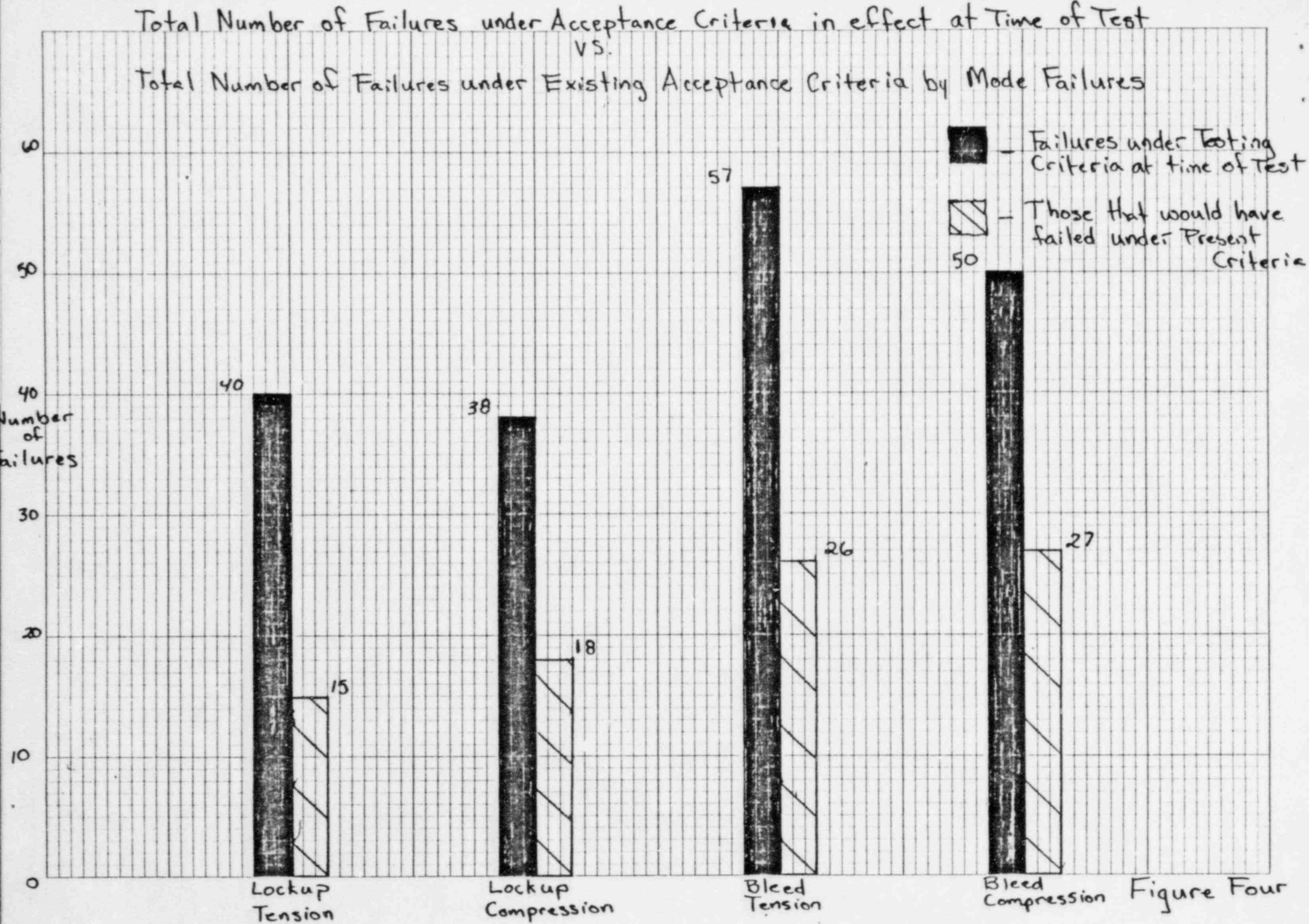
Total Number of Failures under Acceptance Criteria in effect at Time of Test
VS.
Total Number of Failures under Existing Acceptance Criteria by Mode Failures
Failures under Testing Criteria at time of Test
Those that would have failed under Present Criteria
Number of Failures
0
10
20
30
40
50
60
40
15
38
18
57
26
50
27
Lockup Tension
Lockup Compression
Bleed Tension
Bleed Compression

Figure Four