ARD ADVANCED RESOURCE DEVELOPMENT CORPORATION

NMP-2 ZONE BANDING STUDY

Submitted To:

Niagara Mohawk Power Corporation
Nine Mile Point Unit 2

Submitted By:

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1.0 INTRODUCTION

Niagara Mohawk Power Corporation's Nine Mile Point Unit 2 (NMP-2) has performed a Zone Banding Study as a result of observations made during the Detailed Control Room Design Review (DCRDR). Zone banding (also called color banding) consists of marking zones on display scales with colors to indicate functional limits. When properly implemented, zone banding enables an operator to determine the status of a given parameter at a glance, without having to read the exact value that the meter is indicating.

2.0 ZONE BANDING PHILOSOPHY

For zone banding to be effective, a consistent philosophy must be developed and made known to all who deal with it. The following factors were considered in developing the NMP-2 zone banding philosophy:

- Which meters to zone band
- Assigned meanings of zone bands
- Colors to be used
- Specific zones to be banded
- Implementation

2.1 Selection of Meters

NMP-2 selected only the most critical, safety related meters for zone banding, these are listed in Table 2-1. This selection establishes the priority of the zone banded meters. The intended operational outcome is that the operator can look at a group of meters from across the control room and immediately identify any parameter indicated by colored zones. This operational advantage loses its effectiveness when many or most control room parameters are zone banded. When too many displays are banded the presence

Table 2-1. Meters Selected for Zone Banding

PANEL	EID NUMBER	LABEL	RANGES BANDED
601	12 002	RX WTR LEVEL FUEL ZONE	Red: 0 to 35 Red and White: -165 to 0
601	13 002	CONTAINMENT DRWL PRESS B	Red: -5 to -4.7 Yellow: -4.7 to -0.5 Yellow: 0.75 to 1.68 Red: 1.68 to 5
601	13 003	SUPPR CHAMBER PRESS	Yellow: 0.75 to 1.68 Red: 1.68 to 5
601	13 004	SUPPR POOL LEVEL	Red: 198 to 199.5 Red: 201 to 202
601	13 005	SUPPR POOL WATER TEMP	Yellow: 90 to 120 Red: 120 to 250
601	13 006	SUPPR POOL WATER TEMP	Yellow: 90 to 120 Red: 120 to 250
601	19 002	CONTAINMENT DRWL PRESS A	Red: 1.68 to 45 Red and White: 45 to 150
601	19 003	CONTAINMENT DRWL PRESS A	Red: -5.0 to -4.7 Yellow: -4.7 to -0.5 Yellow: 0.75 to 1.68 Red: 1.68 to 5.0
601	19 006	SUPPR CHAMBER PRESSURE A	Red: 1.68 to 45 Red and White: 45 to 150
601	19 007	SUPPR POOL LEVEL A	Red: 192 to 199.5 Red: 201 to 217
601	19 008	SUPPR POOL LEVEL A	Red: 198 to 199.5 Red: 201 to 202
601	19 009	SUPPR POOL WATER TEMP	Yellow: 90 to 120 Red: 120 to 250
601	19 010	SUPPR POOL WATER TEMP	Yellow: 90 to 120 Red: 120 to 250
603	11 001	RX PRESSURE WIDE RANGE	Red: 1037 to 1200
603	11 002	RX LEVEL NARROW RANGE A	Red: 145 to 159.3 Yellow: 159.3 to 178.3 Yellow: 187.3 to 202.3 Red: 202.3 to 205

Table 2-1: Meters Selected for Zone Banding (con't)

PANEL	EID NUMBER	LABEL	RANGES BANDED
603	11 003	RX LEVEL NARROW RANGE B	Red: 145 to 159.3 Yellow: 159.3 to 178.3 Yellow: 187.3 to 202.3 Red: 202.3 to 205
603	11 004	RX LEVEL NARROW RANGE C	Red: 145 to 159.3 Yellow: 159.3 to 178.3 Yellow: 187.3 to 202.3 Red: 202.3 to 205
603	15 008	RX WATER LEVEL WIDE RANGE	Red: -5 to 1159.3 Yellow: 159.3 to 178.3 Yellow: 187.3 to 202.3 Red: 202.3 to 205
873 875	14 001 11 001	DRYWELL AREA TEMP HIGH	Yellow: 150 to 340 Red: 340 to 350
873 875	14 002 11 002	DRYWELL AREA TEMP LOW	Yellow: 150 to 340 Red: 340 to 350
873 875	14 003 11 003	SUPPR CHAMBER TEMP HIGH	Yellow: 150 to 212 Red: 212 to 350
873 875	14 004 11 004	SUPPR CHAMBER TEMP LOW	Yellow: 150 to 212 Red: 212 to 350

of a color band becomes commonplace and, under certain modes of operation, some parameters routinely operate within a colored band. The parameters selected by NMP-2 are of the highest priority. When a meter is indicating in a colored band, the operator will be immediately aware that an important parameter is not operating at normal status.

2.2 Assigned Meaning

A consistent code for zone banding has been established and will be maintained to ensure effectiveness. The following conventions are to be used to zone band the selected meters and are to be documented in the NMP-2 Human Factors Manual.

Red Band - Trip or actuation point has been exceeded.

Yellow Band - Alarm setpoint has been exceeded.

Black and White Cross-Hatch Band - An accurate reading can not be provided at that range of values. This is used at the extreme range of a scale when the meter cannot measure accurately. For example, when a 0-100 foot scale is used to represent the level of a 96 foot tank, the area from 96 to 100 is given a cross-hatched band. Due to tap constraints, the lowest useable level may be 8 feet; the area below 8 feet is cross-hatched also.

Red and White Cross-Hatch Band - Design limit has been exceeded.

2.3 Zones to be Banded

NMP-2 operations has established the specific zones to be banded for the selected meters by examining technical specifications and alarm setpoints for each parameter. Appendix A shows the meters and ranges to be zone banded.

2.4 Implementation

Zone bands will be applied on the graduation portion of the meter scales. The color bands are made of colored transparent tape, 1/8 inch wide. The color band will not obscure the numerals, units, or pointer; the graduation marks are visible behind the transparent tape. The cross-hatch bands cover the graduations, this is preferable because the graduations at the cross-hatched portion of the scale are meaningless.

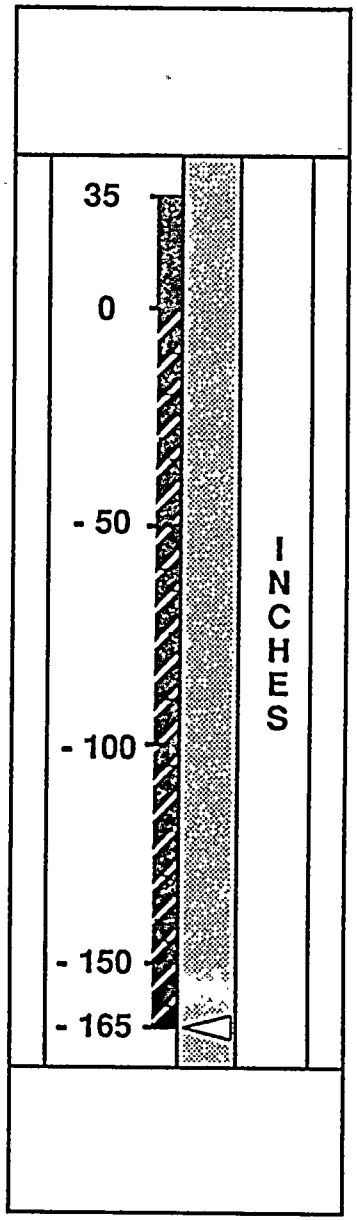
Zone banding will be implemented in two stages. Initially (prior to 5 percent power), the colorbands will be placed on the plastic meter face covers. The color bands will be installed directly on the meter scales during the first refuel outage.

3.0 HEDS ADDRESSED BY ZONE BANDING

Two Human Engineering Discrepancies (HEDs) regarding zone banding resulted from the DCRDR, these are shown in Appendix B. HED 104 was generated from the checklist survey. HED 137 comes from an operator request for zone banding during the operator question- naire. These HEDs are addressed by establishment of a zone banding philosophy and by zone banding the appropriate meters.

APPENDIX A

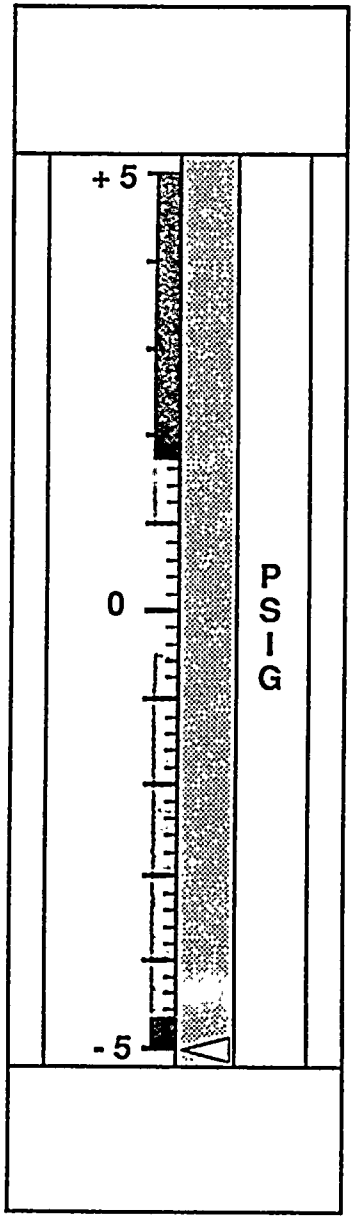
METERS TO BE ZONE BANDED



RX WTR LEVEL
FUEL ZONE

12 002

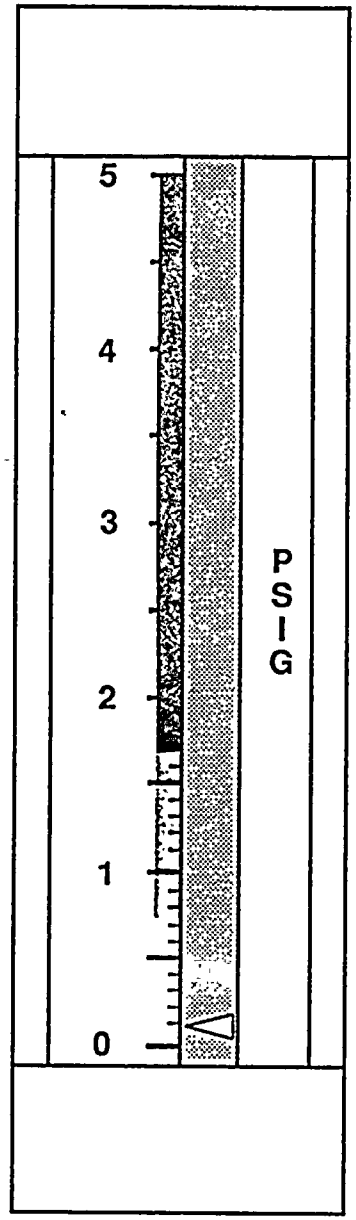
(B22 - R610)



CONTAINMENT
DRWL PRESS B

13 002

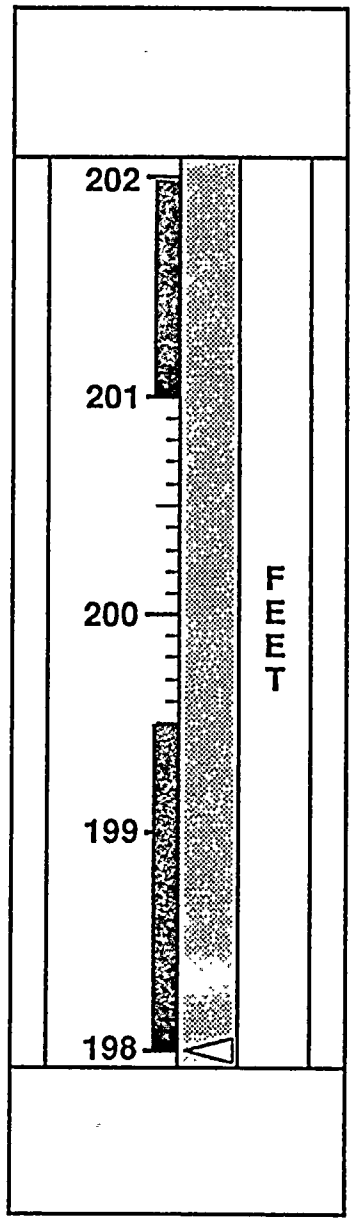
(2 CMS * PI1B)



SUPPR CHAMBER PRESS

13 003

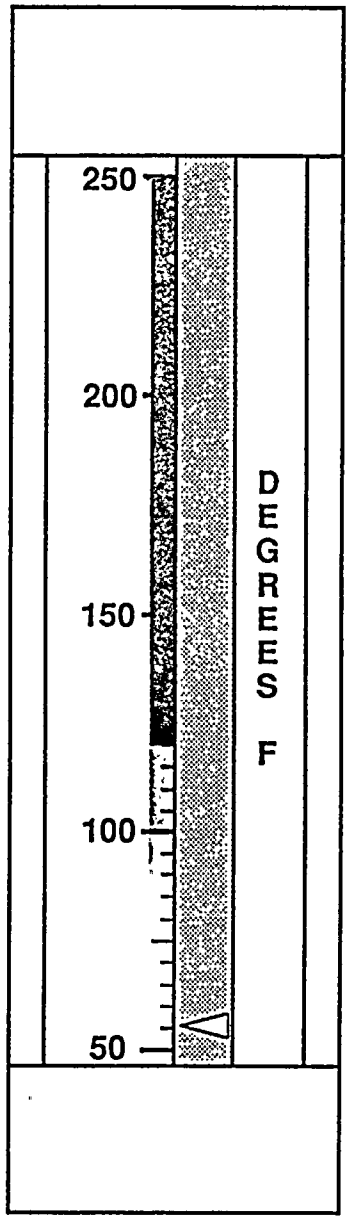
(2 CMS * PI16B)



SUPPR POOL LEVEL

13 004

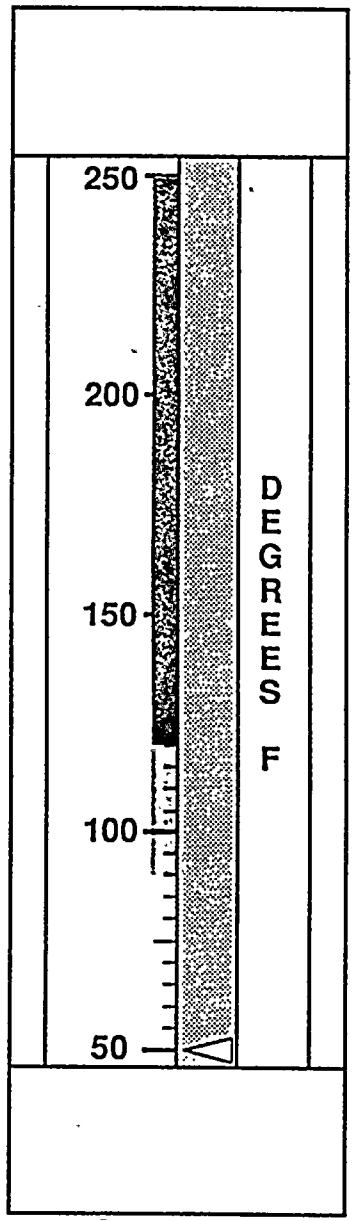
(2 CMS * LI11B)



SUPPR POOL
WATER TEMP

13 005

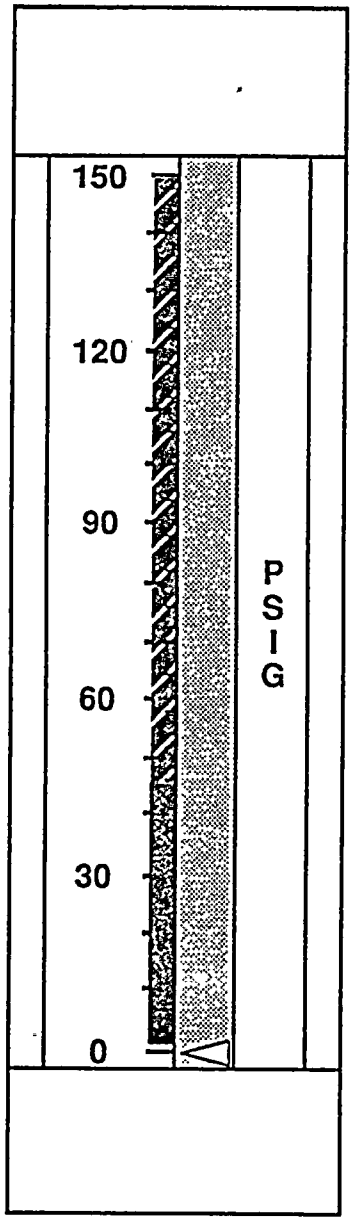
(2 CMS * TI172)



SUPPR POOL
WATER TEMP

13 006

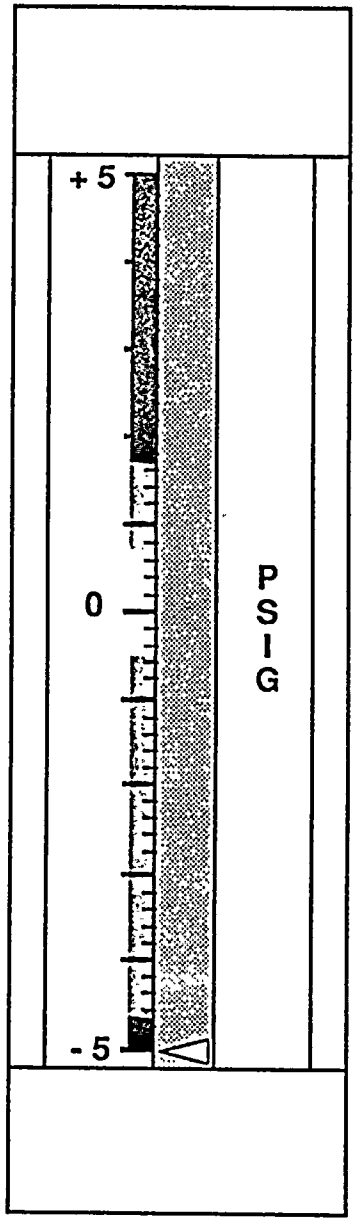
(2 CMS * TI174)



CONTAINMENT
DRWL PRESS A

19 002

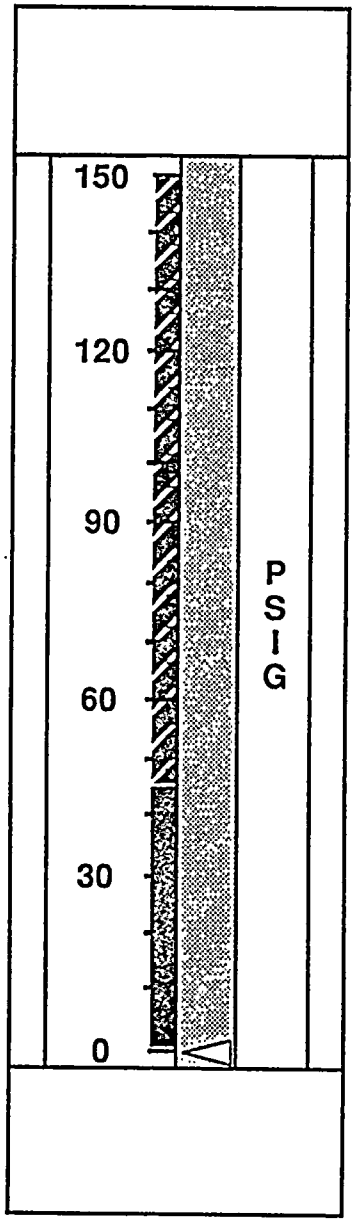
(2 CMS * PI2A)



CONTAINMENT
DRWL PRESS A

19 003

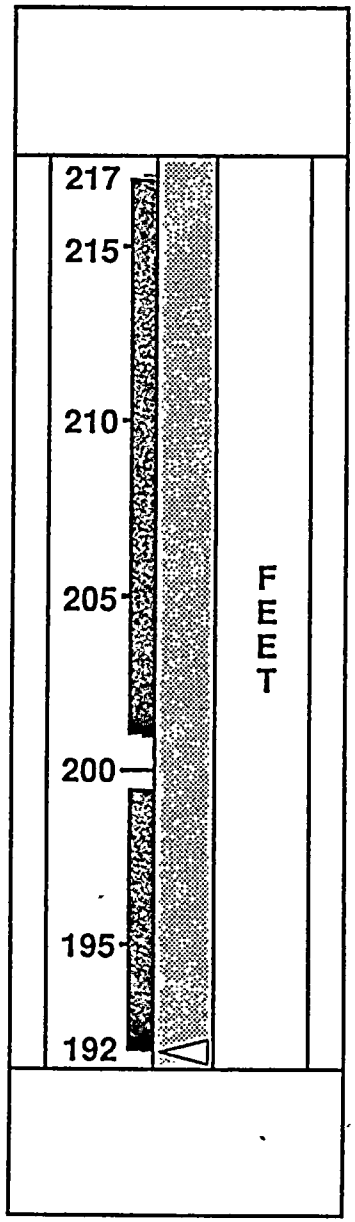
(2 CMS * PI1A)



SUPPR CHAMBER
PRESSURE A

19 006

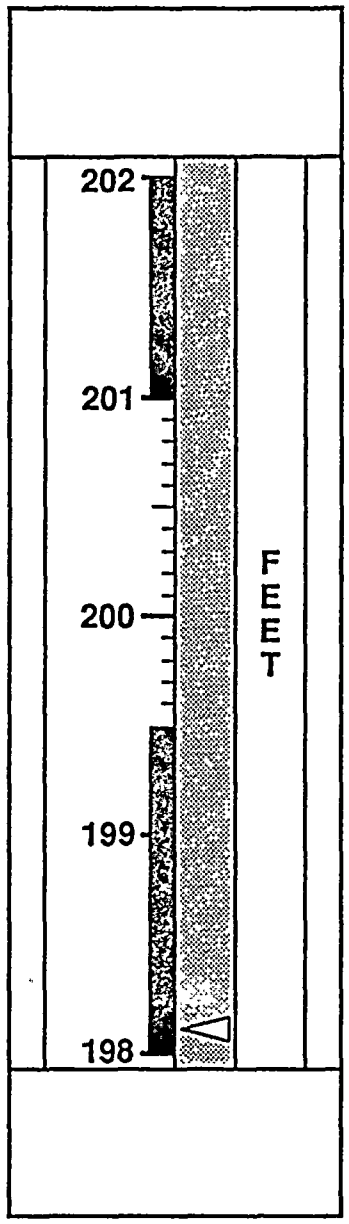
(2 CMS * PI7A)



SUPPR POOL
LEVEL A

19 007

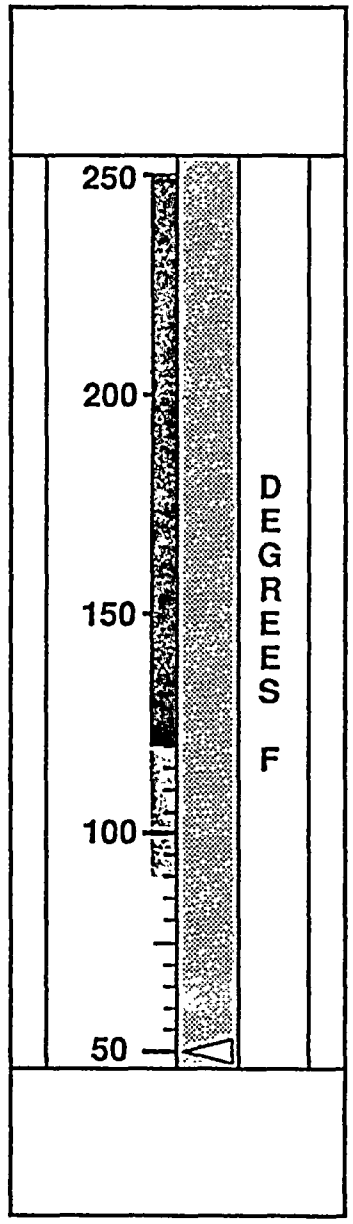
(2 CMS * PI9A)



SUPPR POOL
LEVEL A

19 008

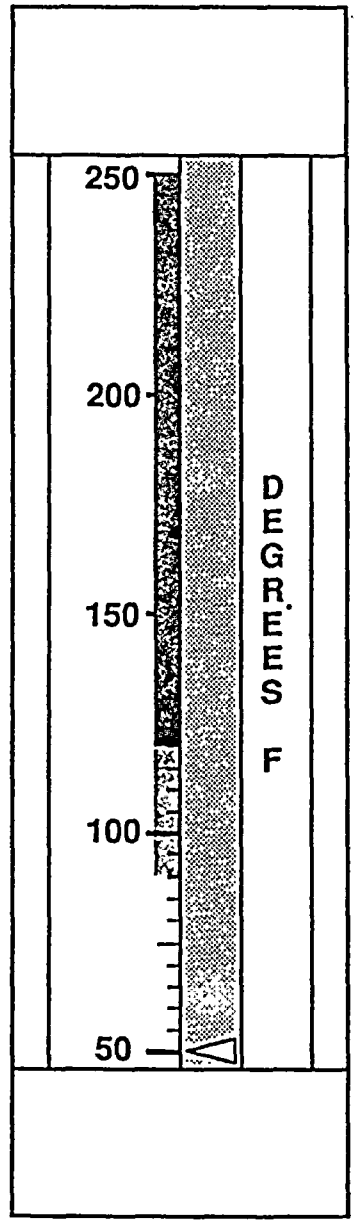
(2 CMS * LI11A)



SUPPR POOL
WATER TEMP

19 009

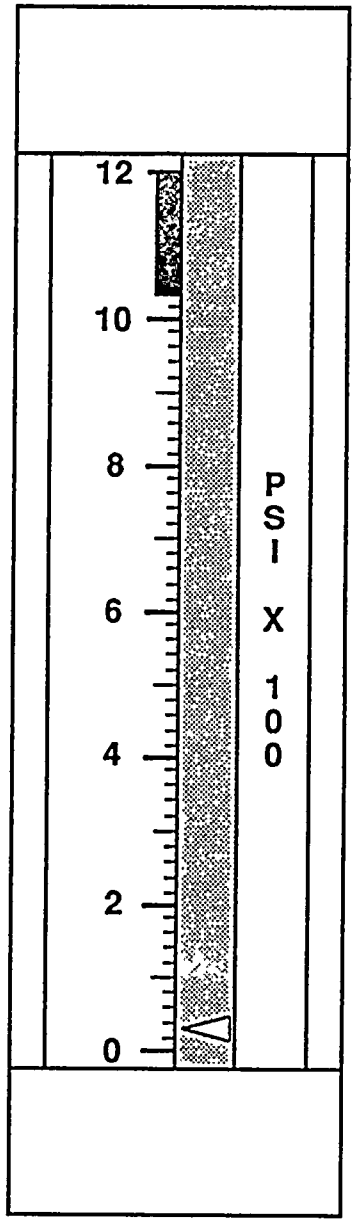
(2 CMS * TI171)



SUPPR POOL
WATER TEMP

19 010

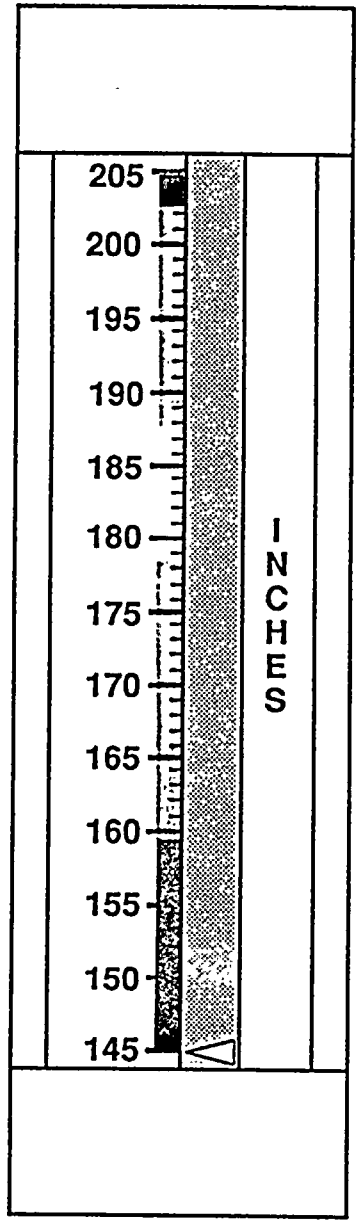
(2 CMS * TI175)



RX PRESSURE
WIDE RANGE

11 001

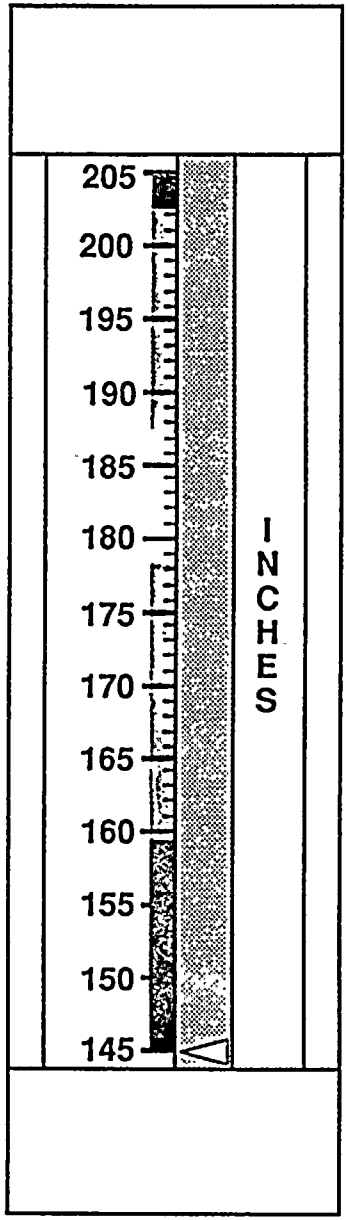
(C33 - R605)



RX LEVEL
NARROW RANGE A

11 002

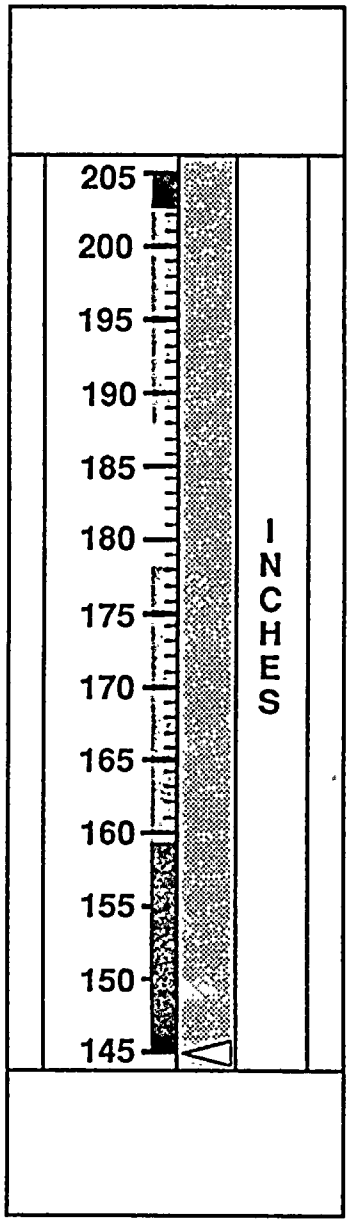
(C33 - R606A)



RX LEVEL
NARROW RANGE B

11 003

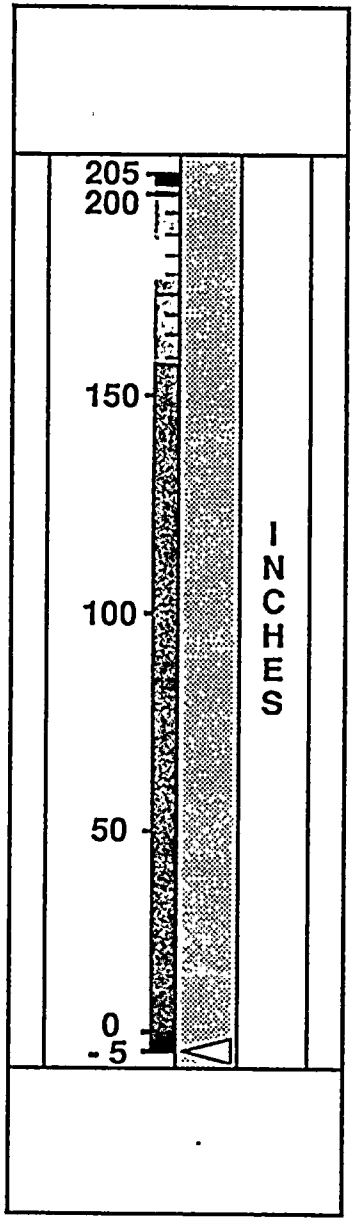
(C33 - R606B)



RX LEVEL
NARROW RANGE C

11 004

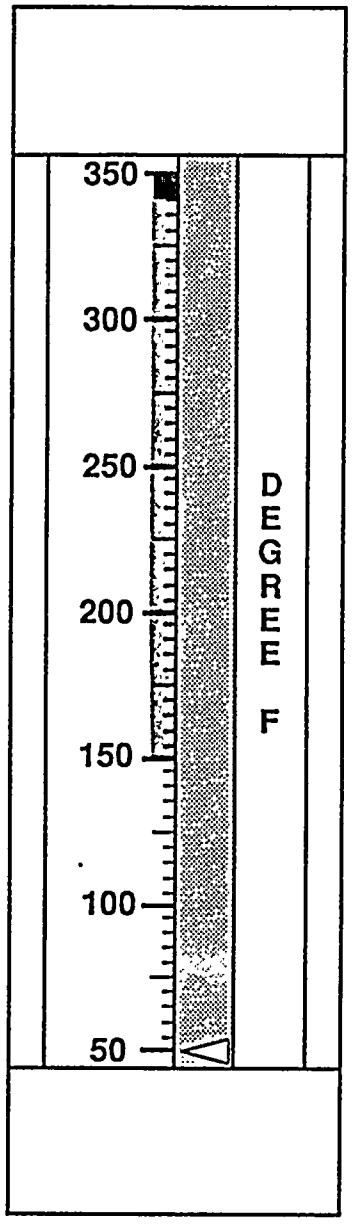
(C33 - R606C)



RX WATER LEVEL
WIDE RANGE

15 008

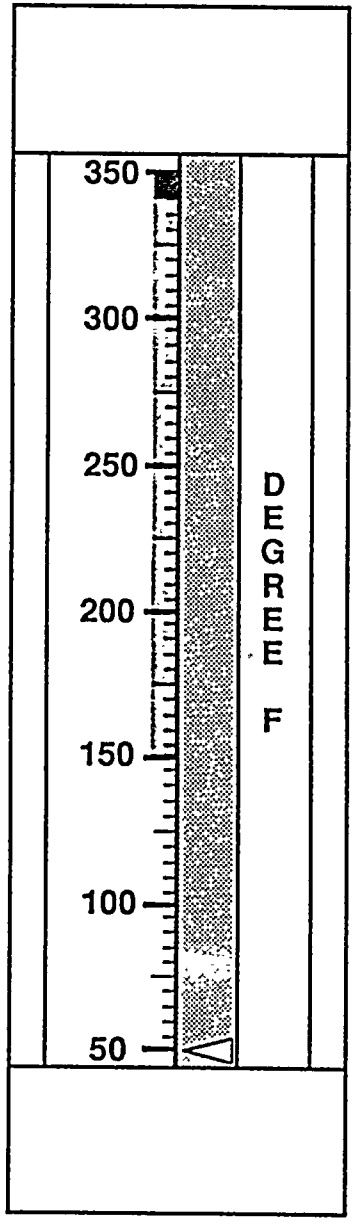
(B22 - R604)



DRYWELL AREA
TEMP HIGH

873 14 001

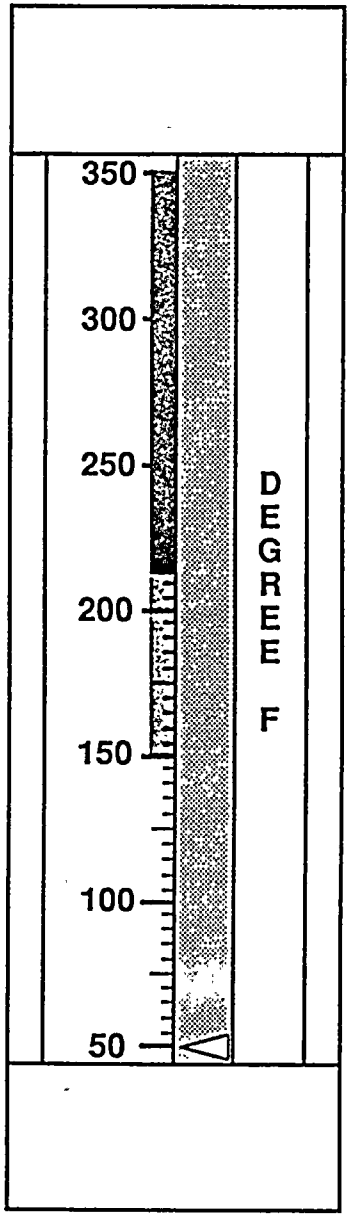
875 11 001



DRYWELL AREA
TEMP LOW

873 14 002

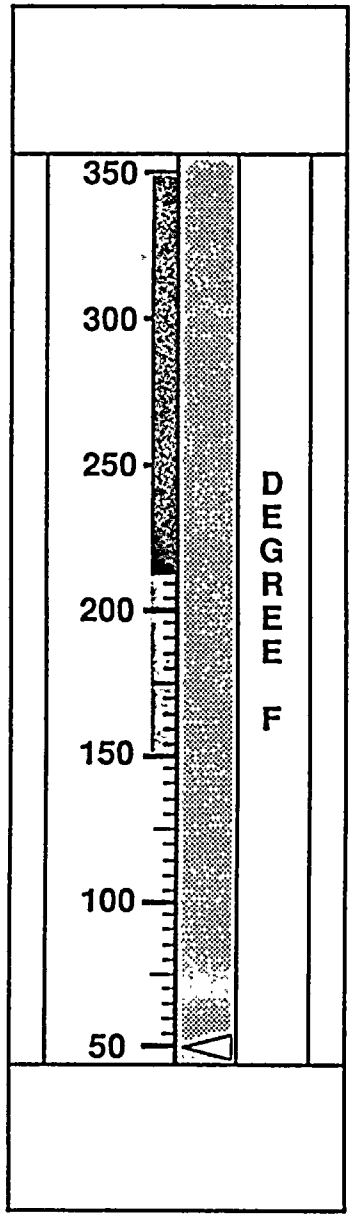
875 11 002



SUPPR CHAMBER
TEMP HIGH

873 14 003

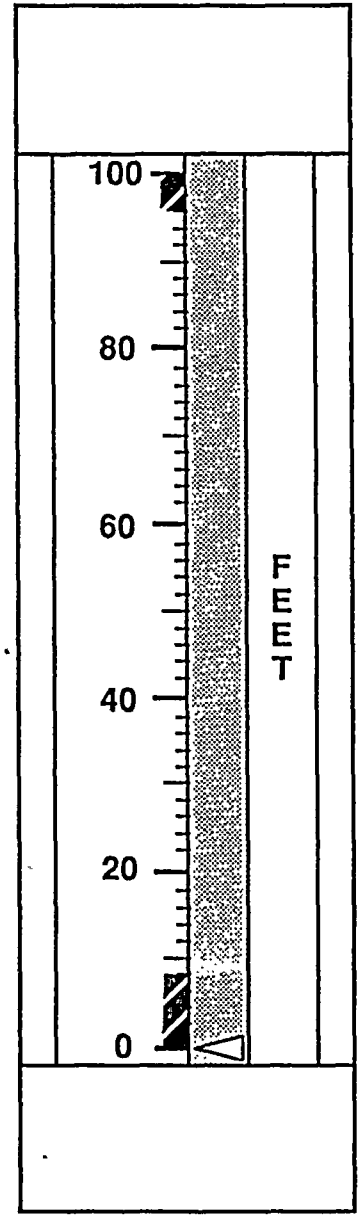
875 11 003



SUPPR CHAMBER
TEMP LOW

873 14 004

875 11 004



EXAMPLE OF BLACK AND WHITE
CROSS HATCH ZONE BAND

APPENDIX B

HEDS ADDRESSED BY THIS STUDY

HUMAN ENGINEERING DISCREPANCY

HED NUMBER: 104.00 ORIGINATOR: RK DATE: 1/ 9/1985
UTILITY: NMP PLANT: NMP UNIT: 2

DESCRIPTION OF DISCREPANCY

ZONE MARKINGS ON DISPLAYS ARE NOT USED.

COMMENTS

A SYSTEM OF ZONE MARKINGS SHOULD BE USED TO INDICATE WHEN DISPLAYS ARE READING IN OPERATING RANGE, UPPER LIMITS, LOWER LIMITS, OR DANGER RANGE. THIS CAN BE DONE BY COLOR BANDING DISPLAYS FOR DIFFERENT RANGES.

ASSESSMENT CATEGORY: 3C

DISPOSITION: FIX

EXPLANATION

INVESTIGATE WHICH PARAMETERS SHOULD BE ZONE BANDED IN A ZONE BANDING SURVEY. SET UP A PROGRAM TO DETERMINE APPROPRIATE BANDING RANGES DURING HOT TESTING AND STARTUP. USE THE COLOR BANDING SCHEME AND APPLICATION TECHNIQUES PROVIDED IN THE HF MANUAL.

IMPLEMENTATION: FIRST REFUEL OUTAGE

SOURCE OF DISCREPANCY	EXPLANATORY INFORMATION
CHECKLIST	5.2.3.A

PANEL	EQUIPMENT ID NUMBER	EQUIPMENT NAME	OTHER
		ALL DISPLAYS	

HUMAN ENGINEERING DISCREPANCY

HED NUMBER: 137.00 ORIGINATOR: RD DATE: 3/10/1985
UTILITY: NMP PLANT: NMP UNIT: 2

DESCRIPTION OF DISCREPANCY

RESPONSE TO THE OPERATOR SURVEY INDICATED THAT GREEN/YELLOW/RED BANDS SHOULD BE MARKED ON ALL CONTROL ROOM METER SCALES TO INDICATED NORMAL OPERATING BANDS/CAUTION BANDS/ALARM BANDS.

COMMENTS

USE OF COLOR AS A CODING MEDIUM IN CONTROL ROOMS CAN AID IN PERCEPTION OF WARNING SIGNALS. IT SHOULD BE REDUNDANT WITH SCALE INDICATIONS. RED, GREEN AND AMBER ARE RESUMED FOR FOLLOWING STATUS INDICATIONS. RED=UNSAFE, DANGER, IMMEDIATE OPERATOR ACTION REQUIRED, OR CRITICAL PARAMETER OUT OF TOLERANCE. GREEN=SAFE, NO OPERATION REQUIRED, OR PARAMETER WITHIN TOLERANCE. AMBER (YELLOW)=HAZARD, POTENTIALLY UNSAFE, CAUTION, ATTENTION REQUIRED, OR MARGINAL VALUE OF PARAMETER EXISTS.

ASSESSMENT CATEGORY: 3C

DISPOSITION: FIX

EXPLANATION

INVESTIGATE WHICH PARAMETERS SHOULD BE ZONE BANDED IN A ZONE BANDING SURVEY. SET UP A PROGRAM TO DETERMINE APPROPRIATE BANDING RANGES DURING HOT TESTING AND STARTUP. USE THE COLOR BANDING SCHEME AND APPLICATION TECHNIQUES PROVIDED IN THE HF MANUAL.

IMPLEMENTATION: FIRST REFUEL OUTAGE

SOURCE OF DISCREPANCY	EXPLANATORY INFORMATION
OPERATOR SURVEY	A3.27

PANEL	EQUIPMENT ID NUMBER	EQUIPMENT NAME	OTHER