NUMARC

NUCLEAR MANAGEMENT AND RESOURCES COUNCIL

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ENCLOSURE 1

November 5, 1990

Mr. John Craig, Director
License Renewal Project Directorate
Division of Reactor Projects - III,IV, V, and Special Projects
U.S. Nuclear Regulatory Commission
Office of Nuclear Regulatory Regulation
Washington, D.C. 20555

Dear Mr. Craig:

In preparation for the "fatigue" meeting with the NRC Staff on November 14, 1990, NUMARC is pleased to provide you with a copy of the industry position on fatigue, adopted by the NUMARC NUPLEX Working Group (NNWG), as guidance for the ten Industry Reports (IR). This position emphasizes flexibility of approach, in order to permit each IR to select or omit particular steps, while remaining consistent with the overall methodology.

All of the steps outlined are based on current established practice, as will be illustrated in more detailed presentations on November 14th. The sequence of steps is intended to screen out those components for which fatigue damage is not significant on a generic basis, while concentrating the resources of the industry and the NRC on those components for which fatigue is potentially significant for the license renewal term. The latter are referred to as fatigue critical components. The presentations on November 14th will use particular IR's to illustrate: (1) methodology for classifying components into fatigue-critical or non-fatigue-critical categories; and (2) effective programs for evaluating fatigue-critical components.

NUMARC looks forward to the opportunity to discuss this issue. We anticipate that any questions which you may have with regards to this position will be discussed at the upcoming meeting.

Sincerely,

Edward P. Griffing

Edward P. Griffing
Manager, Technical Division

KOC\

Attachment: As Noted

cc:	Warren Minners, NRC/RES/DSIR	Dennis Harrison, DOE
	Jeff Byron, EPRI	John Carey, EPRI
	Larry Bustard, SNL	Rich Burke, EPRI
	P.T. Kuo, NRC/NRR/LRPD	Ajoy Moonka, SNL
	Hugh Bundy, SNL	

TECHNICAL POSITION ON FATIGUE

I. For those systems, structures and components that have an explicit fatigue design basis for the current license period, such as numerical or experimental fatigue analysis referenced to the ASME Code, Section III, Subsections NB, NE, NG, or their equivalent, the steps listed below should be followed in order to extend that fatigue design basis for the license renewal term.

A. The adequacy of the fatigue design basis should be verified for the license renewal term. For this determination, the assumed design basis transients may be altered to reflect actual plant operating data and experience. If the fatigue design basis is found to be adequate for the license renewal term, no further fatigue evaluation of that particular system, structure or component is required. For system, structure or component evaluations that are unable to show that the calculated fatigue usage factors are less than unity for the license renewal term, or where operational history has shown that the fatigue design basis is inadequate, further evaluation is required.

B. For systems, structures and components with an operational history that invalidates their fatigue design analysis, or for which the adequacy of the fatigue design basis for the license renewal term cannot be verified, periodic inservice inspection of fatigue-critical regions, using ASME Code Section XI inservice inspection and flaw evaluation criteria, can be used to assure the timely detection and assessment of fatigue damage. If the existing Section XI inspection coverage assures the timely detection and assessment of fatigue damage, no further evaluation is required. If not, additional actions for assessing fatigue damage are required.

C. For those systems, structures and components requiring further evaluation of fatigue for the license renewal term, a number of fatigue damage assessment options are each representing a currently established procedure. The options are listed below.

1. The potential for fatigue damage can be reassessed, using more precise monitoring of plant operating data, together with ASME Code, Section III fatigue evaluation procedures. This includes full or partial cycle counting, in order to refine the Section III fatigue design basis transients. This option also covers the measurement of selected system or component

transient response that provides more precise stress or strain ranges corresponding to plant operating cycles.

2. For those cases such that ASME Code, Section XI, inservice inspection coverage cannot be shown to assure the timely detection and assessment of fatigue damage that leads to crack initiation and subsequent growth, flaw tolerance evaluation techniques can be used to determine appropriate frequencies of extended coverage periodic inservice examinations. The bases for these techniques is provided by the methodologies of Section XI, Appendices A (ferritic steels) and C (austenitic stainless steels).

3. For those cases where fatigue damage exceeds the acceptance criteria on size provided by the ASME Code, Section XI, the component can be repaired or replaced.

II. For those systems, structures and components without an explicit fatigue design basis for the current license period, the following sequential evaluation procedure should be used.

A. First, the current design basis should be evaluated to determine any inherent resistance to fatigue damage implied by the design limits. This evaluation may include a reference to ANSI B31.1 requirements for piping and piping components, or to similar requirements contained in ASME Code Section III, Subsections NC and ND, or to some other requirement. For example, the NRC's review of Systematic Evaluation Program plants, Task III-1, which accepts the inherent resistance to low-cycle fatigue damage of piping and piping components designed to ANSI B31.1 rules, can be cited. In the absence of local geometric features that are not adequately compensated for by the piping and piping component stress intensification factors used in the analysis, the stress range reduction factor approach provides inherent low-cycle fatigue resistance. In such a case, the ANSI B31.1 design basis should have its adequacy verified for the license renewal term, accounting for any needed changes to the original stress range reduction factors. If the ANSI B31.1 design basis can be shown to be adequate, no further evaluation of fatigue damage for these particular components is required. Any components whose supporting analysis does not compensate for local geometric features with conservative stress intensification factors is deemed to be fatigue-critical, and requires further evaluation.

B. Second, for those systems, structures and components for which the current design basis cannot be shown directly to have inherent resistance to fatigue damage, an indirect procedure--using similarity of design and operation--should be followed. A list of fatigue-critical components should be developed by reviewing fatigue design analyses for similar components that have an ASME Code Section III, Subsection NB, NE, NG, or equivalent fatigue design basis. Such a list should be conservative, in terms of fatigue usage factor threshold used to define "critical," to encompass differences in component design or plant operation. In addition, the list should be augmented by components with an operational history of fatigue damage or observed fatigue crack initiation/growth. Components that are not fatigue-critical need not be evaluated further, by analogy with components having similar design features and similar operating history. Fatigue critical components require further evaluation.

C. For fatigue-critical components, a number of evaluation options are available, each representing a currently acceptable procedure for determining the potential significance of fatigue damage for the license renewal term. The options are listed below.

1. Fatigue damage can be evaluated at fatigue-critical locations, using established procedures of the ASME Code, Section III, Subsections NB, NE, or NG. Actual plant operating data and experience can be used to generate design basis transients, and fatigue monitoring can be used to determine the stress ranges corresponding to actual plant cycles.

2. Fatigue damage can be detected and evaluated at potential fatigue crack initiation sites, using established procedures and acceptance criteria given in the ASME Code, Section XI. Flaw tolerance evaluation procedures can be used to confirm or establish appropriate inspection intervals.

3. For fatigue damage that exceeds ASME Code, Section XI acceptance criteria on flaw size, the fatigue-critical component can be repaired or replaced.

ENCLOSURE 2

ATTENDEE LIST

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ENCLOSURE 3

AGENDA

November 14, 1990

MEETING TO DISCUSS POSITION ON FATIGUE FOR LICENSE RENEWAL INDUSTRY REPORTS

Topic	Presented By
I. Opening Remarks	
A. Industry	Sol Burstein
B. NRC (OPTIONAL)	TBD
II. NUMARC NUPLEX Working Group Fatigue Position	
A. Section III Components	Bob Nickell
B. Non-Section III Components	Bob Nickell
C. Industry Report Implementation	Kurt Cozens
III. Specific IR Implementation Elements	
A. Representative Fatigue Usage Factor Screening	Marcos Herrera
B. Fatigue Reanalysis/Similitude	George Vames
C. Fatigue Strength Reduction Factor Approach	Don Landers
D. Contained Operation of Fatigue-Critical Components	Matt Kupinski
IV. Summary of NRC Comments on Fatigue in the IRs	Bob Nickell
V. Closing Remarks	
A. NRC Remarks (OPTIONAL)	TBD
B. Industry Remarks	Sol Burstein

NUMARC NUPLEX WORKING GROUP

TECHNICAL POSITION ON FATIGUE

PRESENTATION TO STAFF OF THE

U.S. NUCLEAR REGULATORY COMMISSION

NOVEMBER 14, 1990

ENCLOSURE 4

NUMARC NUPLEX WORKING GROUP

TECHNICAL POSITION ON FATIGUE

PURPOSE: TO PROVIDE GUIDANCE IN THE AREA OF FATIGUE EVALUATION METHODOLOGY FOR THE TEN INDUSTRY REPORTS (IRS)

CONTENT:

o OUTLINE FORMAT

o FLEXIBILITY OF METHODOLOGY

o SECTION III AND NON-SECTION III COMPONENTS

o EQUIVALENCE TO SECTION III ACKNOWLEDGED

o BASED ON CURRENT METHODOLOGY AND CURRENT PRACTICE (I.E., CURRENT WAY OF DOING BUSINESS)

NUMARC NUPLEX WORKING GROUP

TECHNICAL POSITION ON FATIGUE

SECTION III PLANTS (COMPONENTS)

o VERIFY FATIGUE DESIGN BASIS FOR THE LICENSE RENEWAL TERM

[IF NOT]

o VERIFY ADEQUACY OF SECTION XI INSERVICE INSPECTION COVERAGE AND FREQUENCY

[IF NOT]

o IMPLEMENT AUGMENTED, BUT ACCEPTABLE, PROGRAM OF

- MONITORING/REANALYSIS

OR

- INSPECTION

OR

- REPAIR/REPLACEMENT

NUMARC NUPLEX WORKING GROUP

TECHNICAL POSITION ON FATIGUE

NON-SECTION III PLANTS (COMPONENTS)

- VERIFY INHERENT FATIGUE RESISTANCE DESIGNED INTO COMPONENT FOR THE LICENSE RENEWAL TERM

[IF NOT]

- USE DESIGN FEATURES AND SIMILARITY WITH SECTION III COMPONENT FATIGUE RESULTS TO IDENTIFY FATIGUE-CRITICAL COMPONENTS/LOCATIONS

[FOR FATIGUE-CRITICAL]

- IMPLEMENT AUGMENTED, BUT ACCEPTABLE, PROGRAM OF
  - SECTION III FATIGUE ANALYSIS (EXEMPTION)

    OR

  - SECTION XI INSERVICE INSPECTION

    OR

  - MONITORING/REANALYSIS

    OR

  - REPAIR/REPLACEMENT

NUMARC NUPLEX WORKING GROUP

TECHNICAL POSITION ON FATIGUE

GOAL OF PRESENTATIONS

- REACH AN AGREEMENT-IN-PRINCIPLE ON AN ACCEPTABLE METHODOLOGY TO EVALUATE FATIGUE IN IR'S
  - EACH IR WILL PROVIDE THE JUSTIFICATION TO SUBSTANTIATE THE METHODOLOGY USED IN THE IR
  - AN SER WILL BE USED TO APPROVE THE IR

NUMARC NUPLEX WORKING GROUP

Technical Position on Fatigue

IMPLEMENTATION OF METHODOLOGY

- Technical position provides options
- Methodology options are based upon currently utilized methods
- Permits equivalent methods
    - Equivalent methodologies to be substantiated by applicant
- Justifications may be based upon representative data
- All options are not intended to be used in each IR

NUMARC NUPLEX WORKING GROUP

TECHNICAL POSITION ON FATIGUE

PRESENTATION OF EXAMPLES

o EXAMPLES OF PROPOSED METHODOLOGY OPTIONS

- REPRESENTATIVE FATIGUE USAGE FACTORS
  PRESENTED BY: MARCOS HERRERA

- FATIGUE REANALYSIS/SIMILITUDE
  PRESENTED BY: GEORGE VAMES

- INHERENT FATIGUE-RESISTANT DESIGN
  PRESENTED BY: DON LANDERS

- CONTINUED OPERATION OF FATIGUE-CRITICAL COMPONENTS
  PRESENTED BY: MATTHEW KUPINSKI

FATIGUE ASSESSMENT

NOVEMBER 14, 1990

MARCOS L. HERRERA
GE NUCLEAR ENERGY

OVERVIEW

LICENSE RENEWAL VALID FOR
COMPONENTS WITH LOW USAGE FACTORS

- FIELD HISTORY
- COUNTER MEASURES
- CYCLIC LOADING BASIS
- USAGE CALCULATIONS

- SUMMARY

FIELD HISTORY

- o EXCELLENT FIELD PERFORMANCE OF ORIGINAL DESIGNS
- o LIMITED CRACKING CAUSED BY UNANALYZED CYCLIC LOADS
  - BWR FEEDWATER NOZZLES
  - BWR JET PUMP SENSING LINES
- o EFFECTIVE PLANT PROGRAMS RESOLVE FATIGUE ISSUES
  - INSPECTIONS
  - MONITORING
  - REPAIR & REPLACEMENT

FATIGUE CRACKING LIMITED

EFFECTIVE PLANT PROGRAMS

FATIGUE COUNTERMEASURES

- o ASME III OR EQUIVALENT
  - VESSEL
  - PIPING
- o B31.1
  - PIPING
- o STARTUP VIBRATION TESTING
  - INTERNALS
  - PIPING
- o INSPECTIONS
  - ASME
  - SPECIAL (NUREG-0619)

DESIGN, TESTING AND INSPECTION
ASSURE GOOD FIELD PERFORMANCE

CYCLIC LOADING BASIS

- BASED ON
  - OPERATING EXPERIENCE
  - ENGINEERING JUDGEMENT
  - MARGIN
- BASIS SIMILAR FROM PLANT TO PLANT
  - DESIGN AND OPERATION SIMILAR
  - CONFIRMED BY EXPERIENCE
- EXAMPLE: LOSS OF FEEDWATER PUMPS
  - 10 CYCLES IN 40 YEAR LIFE ASSUMED
  - ACTUAL CYCLES WELL BELOW 10 FOR 40 YEAR LIFE

LOADING BASIS INTELLIGENTLY
ENVELOPES OPERATION

FATIGUE USAGE CALCULATIONS

- MARGIN IN USAGE CALCULATIONS DUE TO:
  - AMPLITUDE OF TRANSIENT TEMPERATURE CHANGES
  - GROUPING OF TRANSIENTS
- USAGE CRITERION IS LESS THAN 1.0

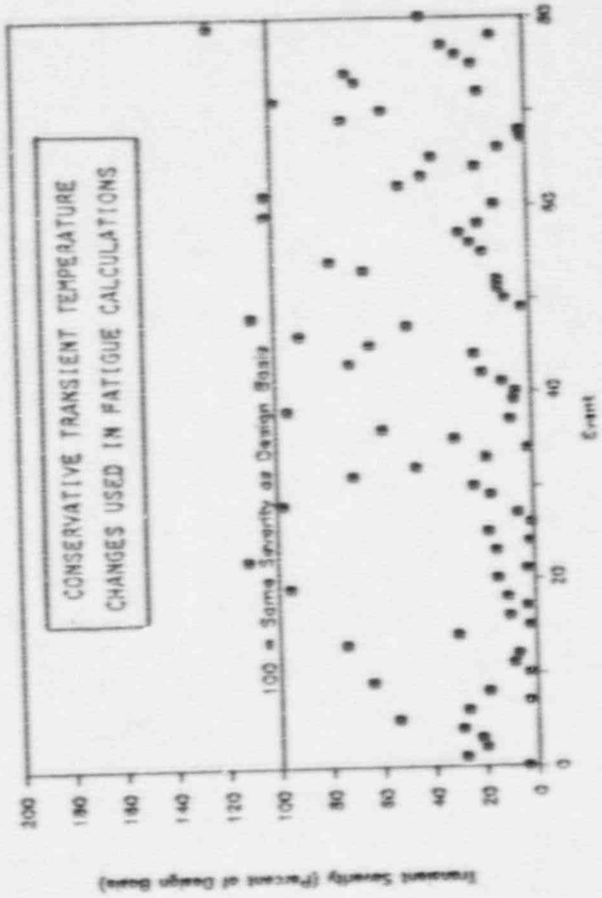
RECIRCULATION INLET NOZZLE
GROUPING

- FATIGUE USAGE = 0.012

- NUMBER OF MAXIMUM STRESS CYCLES USED = 465

	CYCLES
DESIGN HYDROTEST	130
STARTUP-SHUTDOWN	117
TURBINE GENERATOR TRIP	40
ALL OTHER SCRAMS	140
PRE-OP BLOW DOWN	10
NAT. RECIRC STARTUP	3
LOSS OF AC POWER	15
DESIGN SEISMIC + NORMAL OPERATION	10
	465

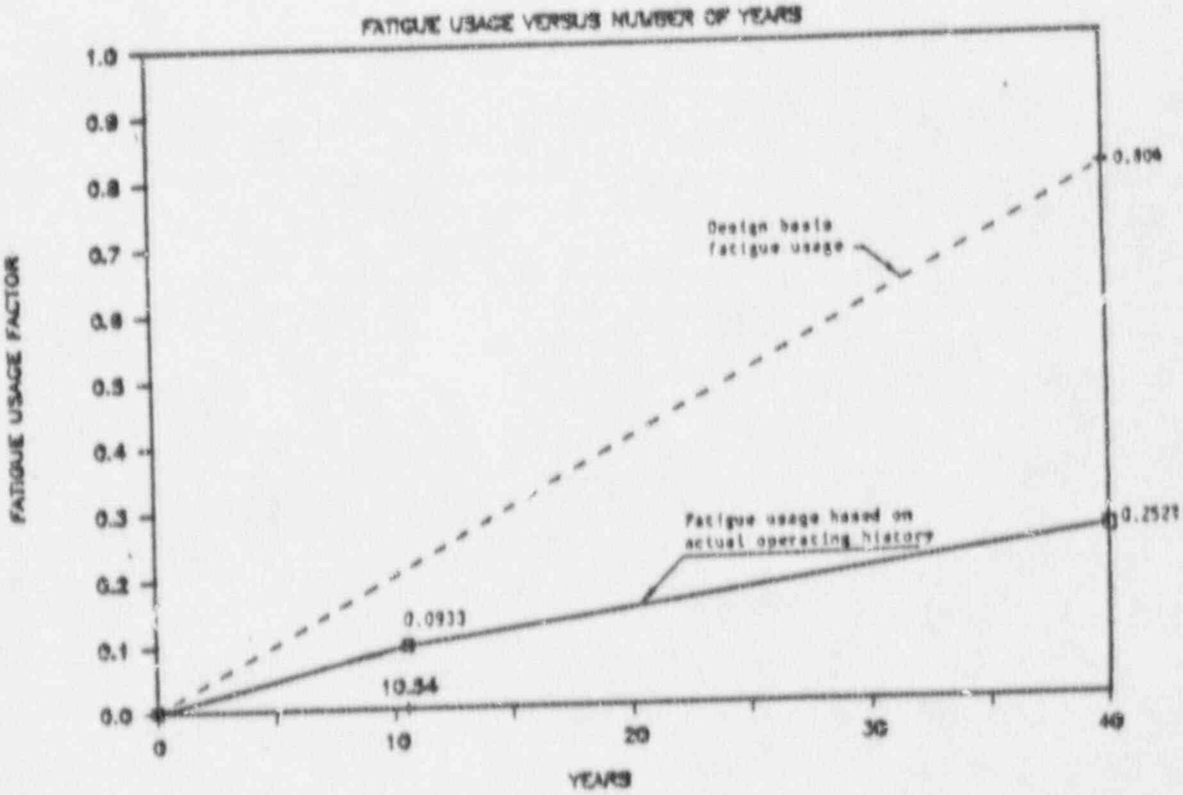
- MAXIMUM STRESS RANGE USED FOR 465 CYCLES



MLH-9

FEEDWATER NOZZLE

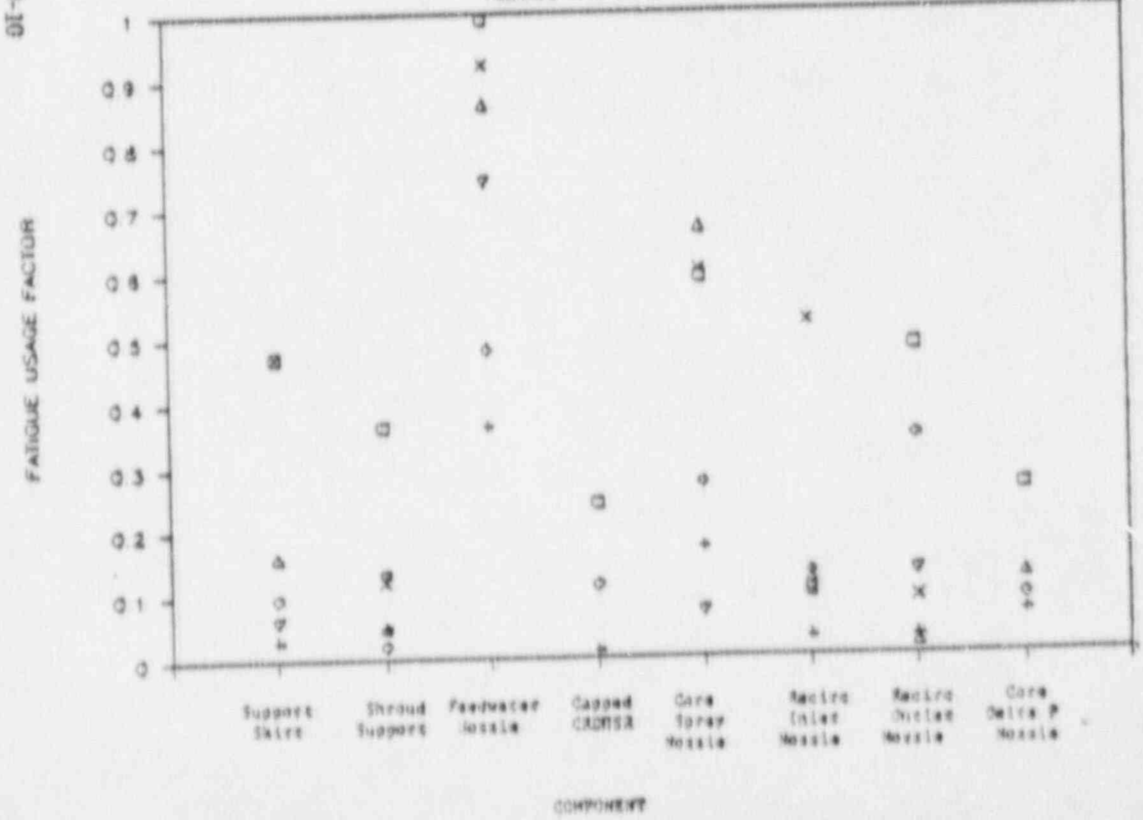
FATIGUE USAGE VERSUS NUMBER OF YEARS



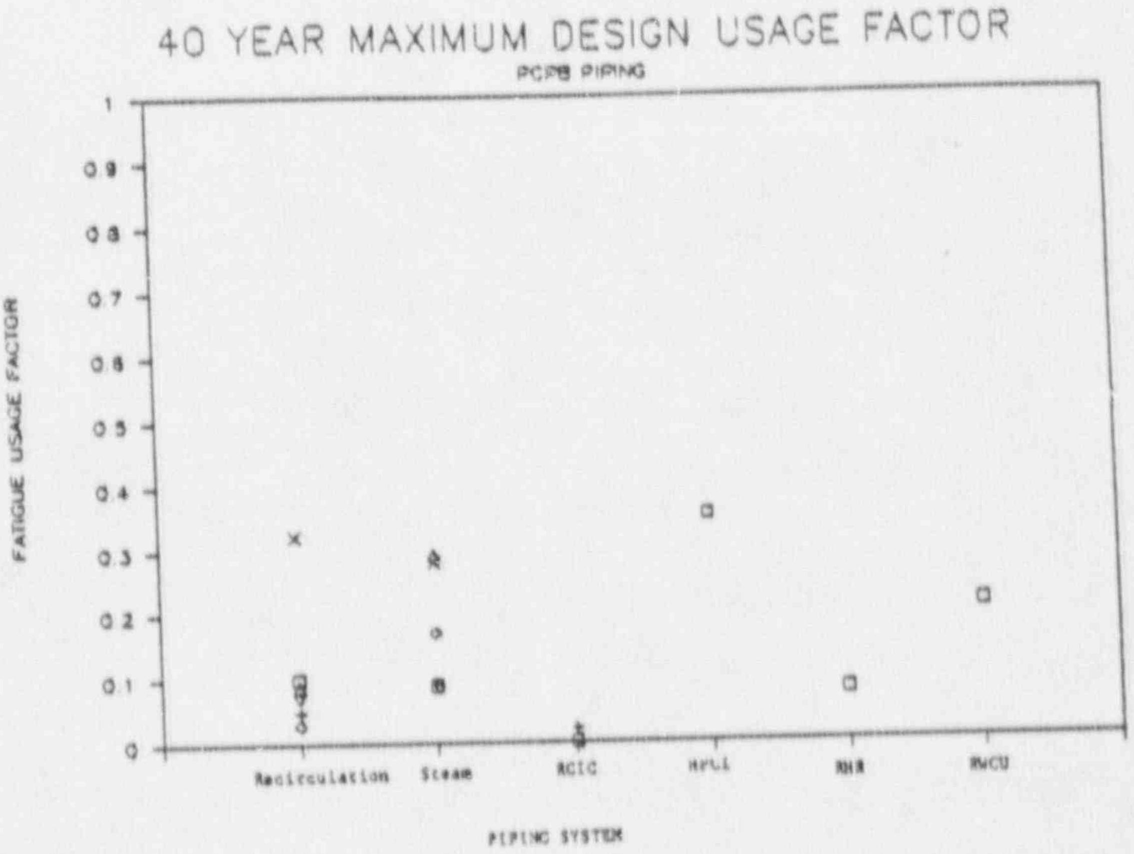
MLH-10

40 YEAR MAXIMUM DESIGN USAGE FACTOR

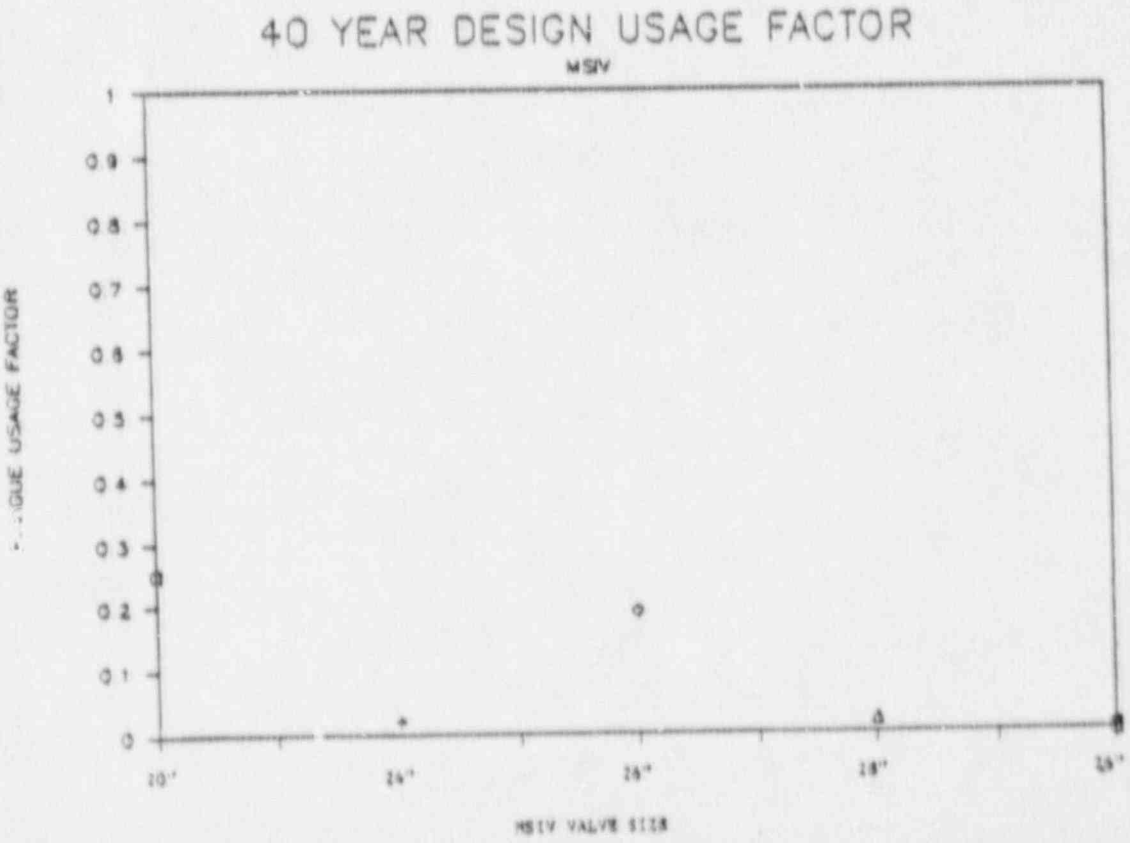
VESSEL AND INTERNALS



MLH-11


40 YEAR MAXIMUM DESIGN USAGE FACTOR
PCPB PIPING
FATIGUE USAGE FACTOR
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Recirculation
Steam
RCIC
HPCI
RHR
RWCU
PIPING SYSTEM

MLH-12


40 YEAR DESIGN USAGE FACTOR
MSIV
..IGUE USAGE FACTOR
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
20"
24"
26"
28"
26"
MSIV VALVE SIZE

SUMMARY

- EXCELLENT FIELD PERFORMANCE OF ORIGINAL DESIGNS
- EFFECTIVE PLANT PROGRAMS HAVE RESOLVED FATIGUE ISSUES
- MARGIN IN USAGE CALCULATIONS
- OPERATION IN LICENSE RENEWAL TERM FOR MANY COMPONENTS BASED ON:
  - LOW USAGE
  - MARGIN IN USAGE CALCULATIONS
  - FIELD EXPERIENCE
  - INSPECTION

LICENSE RENEWAL VALID FOR
COMPONENTS WITH LOW USAGE
FACTORS

REACTOR VESSEL INTERNALS

O DUKE WANTED RVI LIFE EXTENSION EVALUATION IN 1987

O DUKE (900 MW PLANT) INTERNALS WERE DESIGNED IN LATE 1960's TO B&W CRITERIA

O 1200 MW PLANT INTERNALS WERE DESIGNED IN MID-1970's TO ASME SECTION III, SUB-SECTION NG CRITERIA

DUKE RVI LIFEX PROGRAM

O LOOK AT 1200 MW INTERNALS USAGE FACTORS

O REFINE ANALYSIS FOR ANY GREATER THAN 1.0 FOR 60 YEARS

O COMPARE 1200 MW TO DUKE AND RECONCILE ANY DIFFERENCES

  - GEOMETRY
  - TRANSIENT
  - ETC...

1200 MW RVI FATIGUE ANALYSIS

INITIAL ANALYSIS SHOWS FOLLOWING AREAS WOULD NOT LAST 60 YEARS:

- PLENUM COVER SPOKES
- UPPER CORE SUPPORT CYLINDER
- LOWER CORE SUPPORT CYLINDER
- PLENUM CYLINDER/UPPER GRID BOLTS
- COLUMN WELDMENT/UPPER GRID BOLTS
- UPPER GRID
- FORMER BOLTS

1200 MW USAGE FACTOR CONTRIBUTION

PART	40 YEAR USAGE FACTOR LOW CYCLE	 HIGH CYCLE	 TOTAL
P. COVER	.89	0	.89
UPPER CSC	.86	0	.86
LOWER CSC	.98	0	.98
PC/UG BOLTS	.73	0	.73
CW/UG BOLTS	.46	.27	.73
UPPER GRID	.72	0	.72
FORMER BOLTS	.17	.51	.68

CONSIDERATION IN FATIGUE ANALYSIS

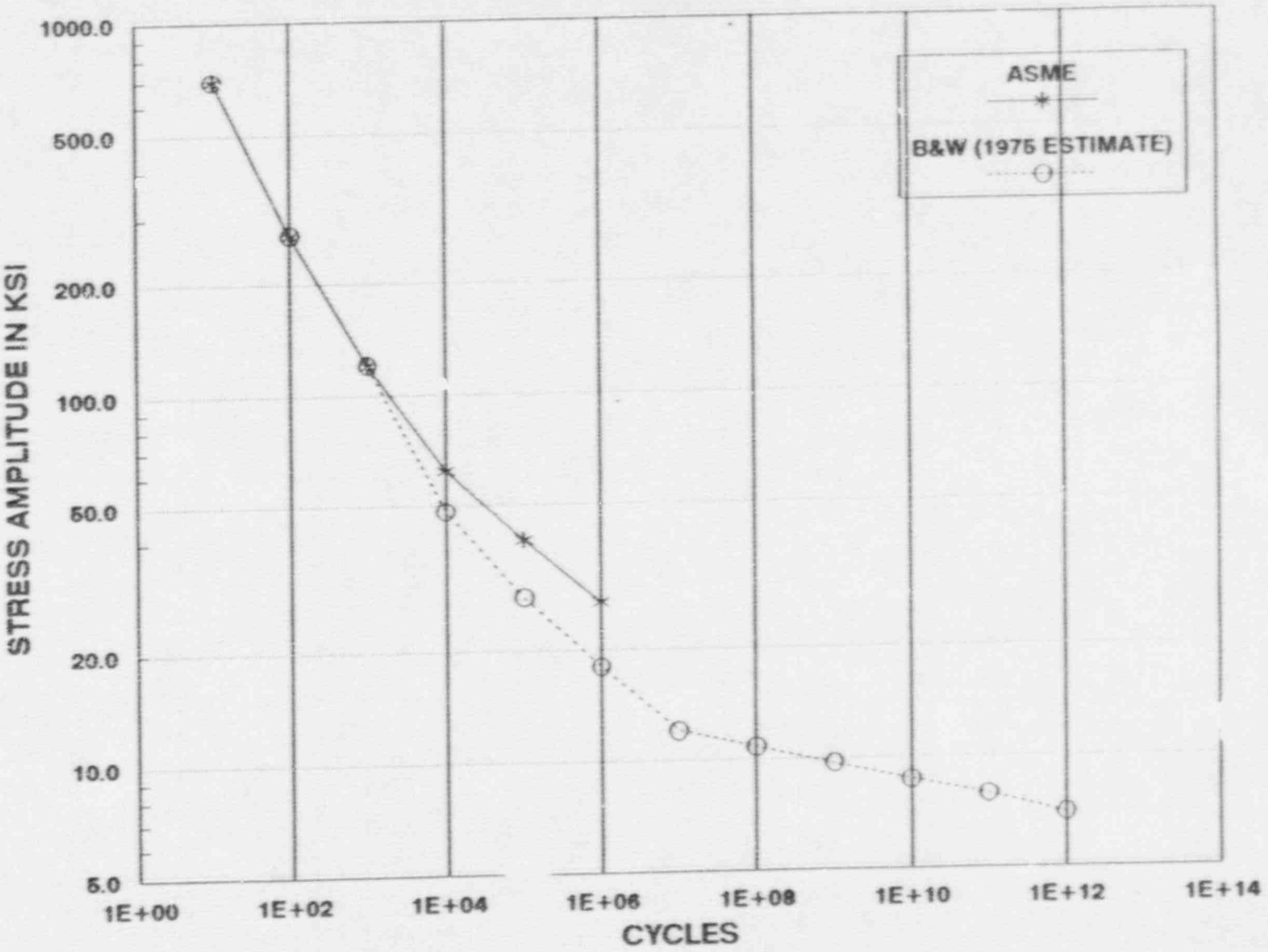
O FATIGUE CURVES

  - HIGH CYCLE
  - LOW CYCLE

O ACTUAL vs. DESIGN CYCLES

O RANDOM vs. DETERMINISTIC

FATIGUE DESIGN CURVES FOR SS



DESIGN TRANSIENT CYCLES AND
LOGGED TRANSIENTS AT OCONEE UNIT 1

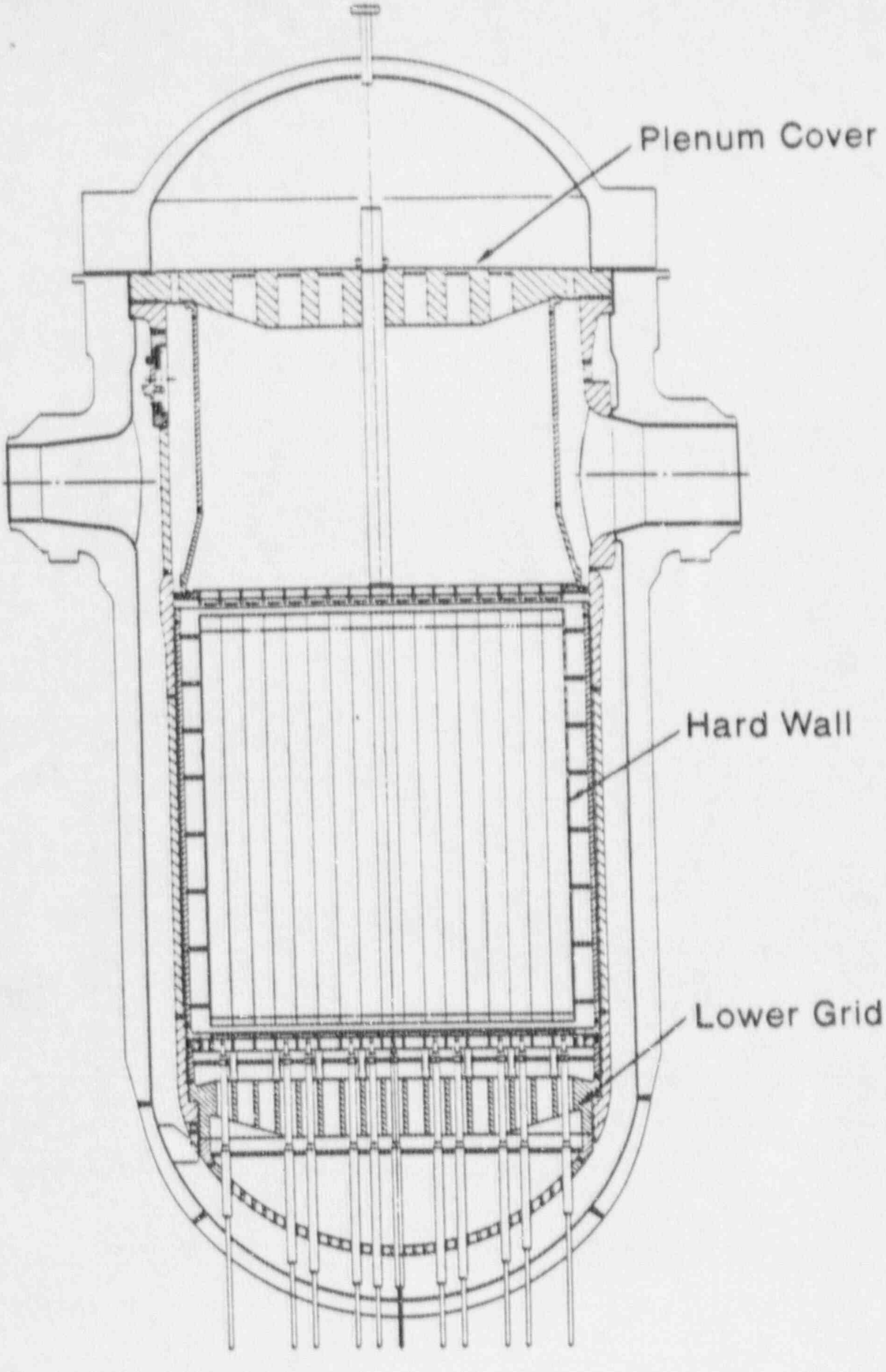
	TRANSIENT	DESIGN CYCLES	ACTUAL CYCLES	FRACTION USED
1A	Heatup			
	0- 35 °F/Hr	30	19	0.63
	35- 60 °F/Hr (with decay heat)	270	54	0.20
	35-600 °F/Hr (without decay heat)	40	4	0.10
	60-100 °F/Hr	20	3	0.15
1B	Cooldown			
	60 °F/Hr	170	32	0.09
	100 °F/Hr	190	44	0.23
2A	0 - 15% Full Power	1440	170	0.12
2B	15 - 0% Full Power	440	102	0.07
7A	Turbine Trip (with runback)	160	6	0.04
7B	Load Rejection	150	19	0.03
8A	Reactor Trip (flow transient)	30	3	0.10
8A	Reactor Trip (with cooldown)	10	1	0.10
8B	Reactor Trip (turbine trip w/o runback)	130	22	0.17
8B	Reactor Trip (with cooldown)	30	1	0.03
8C	Reactor Trip (loss of feedwater)	72	22	0.30
8C	Reactor Trip (with cooldown)	18	2	0.11
8D	Reactor Trip (others)	122	56	0.46
8E	Reactor Trip (HPI actuation)	70	0	0.00
9	Rapid Depressurization	40	0	0.00
10	Change of Flow	412	0	0.00
11	Rod Withdrawal	40	0	0.00
14	Rod Drop	60	14	0.23
15	Loss of Station Power	40	0	0.00
17A	Loss of Feedwater to One Steam Generator	30	11	0.37
17B	Stuck Open Main Steam Valve	10	0	0.00
18A&B	Feedwater Temperature Reduction	620	222	0.36
22A	High Pressure Injection	40	20	0.50

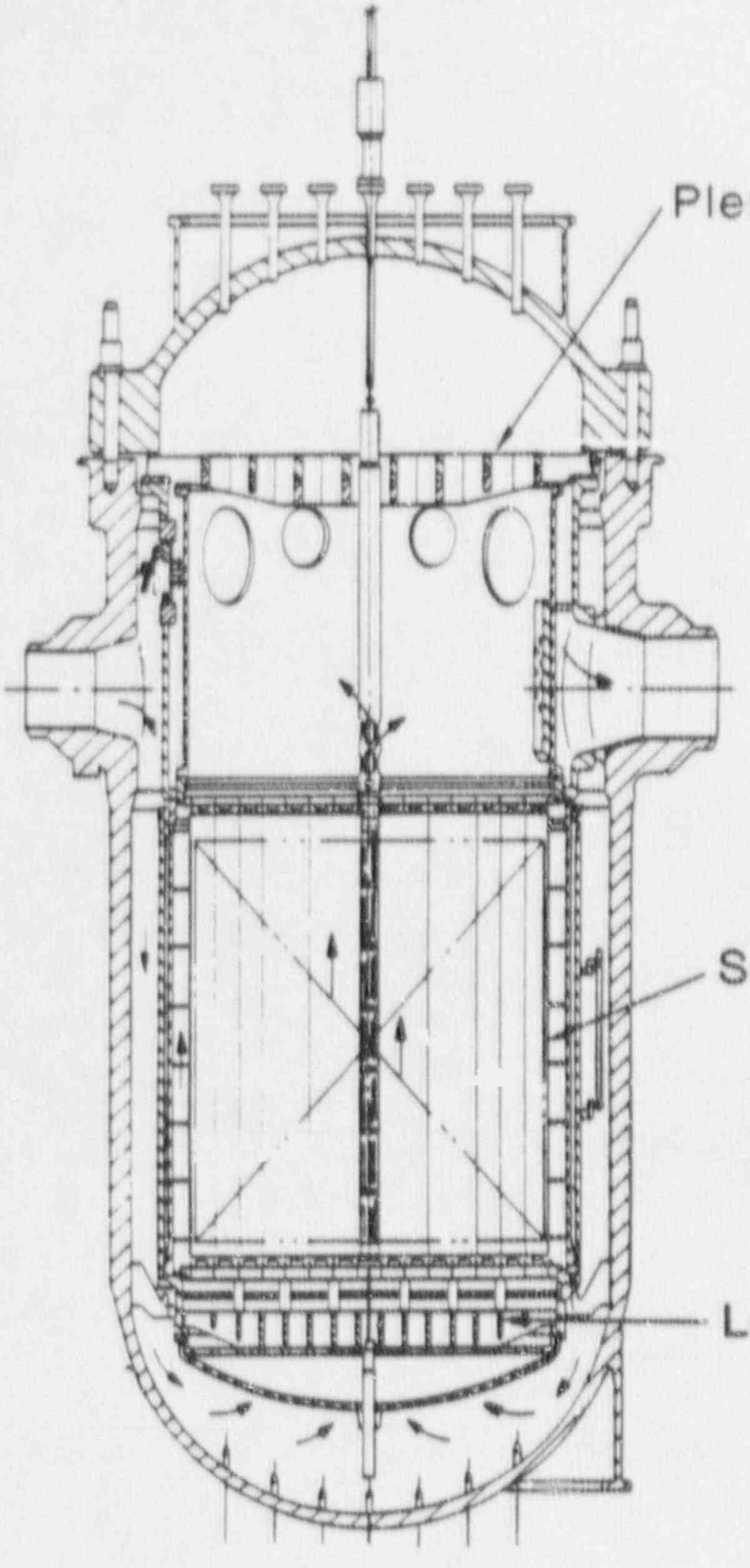
UPDATED 1200 MW 40 YEAR USAGE FACTORS

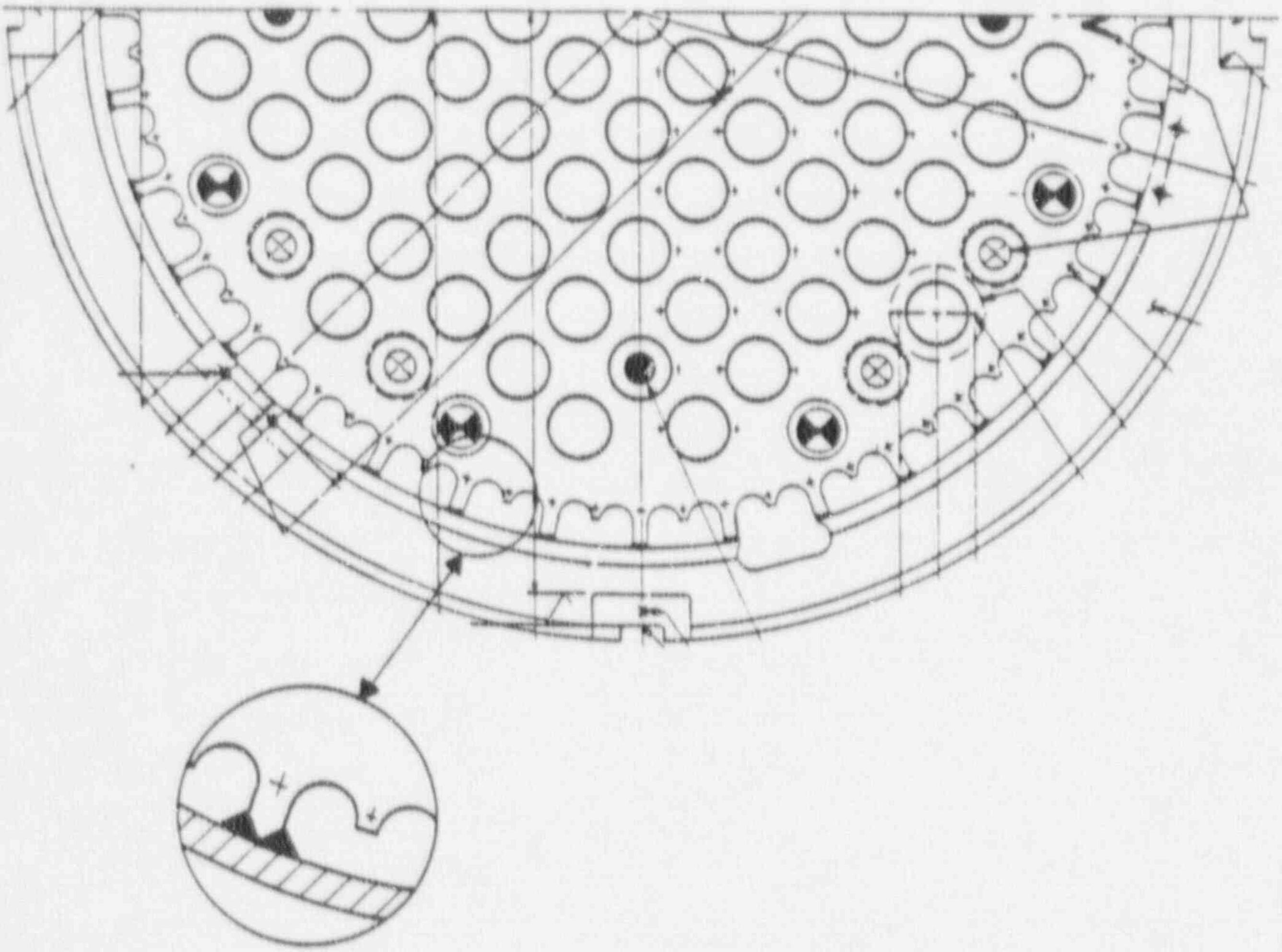
PART	LOW CYCLE	HIGH CYCLE	TOTAL	LOW CYCLE	HIGH CYCLE	TOTAL
P. COVER	.89	0	.89	.75	0	.75
UPPER CSC	.86	0	.86	.13	0	.13
LOWER CSC	.98	0	.98	.21	0	.21
PC/UG BOLTS	.73	0	.73	.21	0	.21
CW/UG BOLTS	.46	.27	.73	.03	0	.03
UPPER GRID	.72	0	.72	.34	0	.34
FORMER BOLT	.17	.51	.68	.17	0	.17

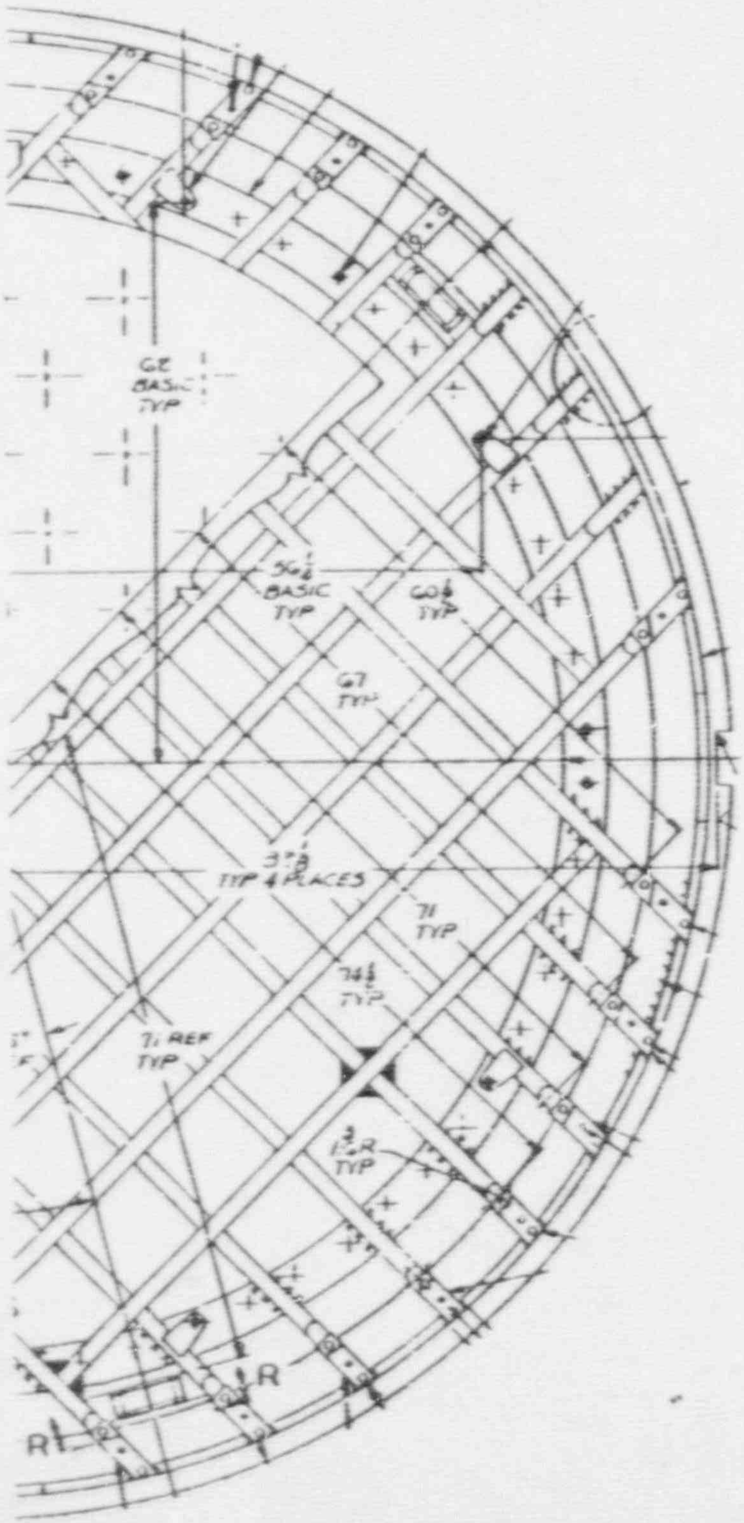
900 MW vs. 1200 MW DESIGNS

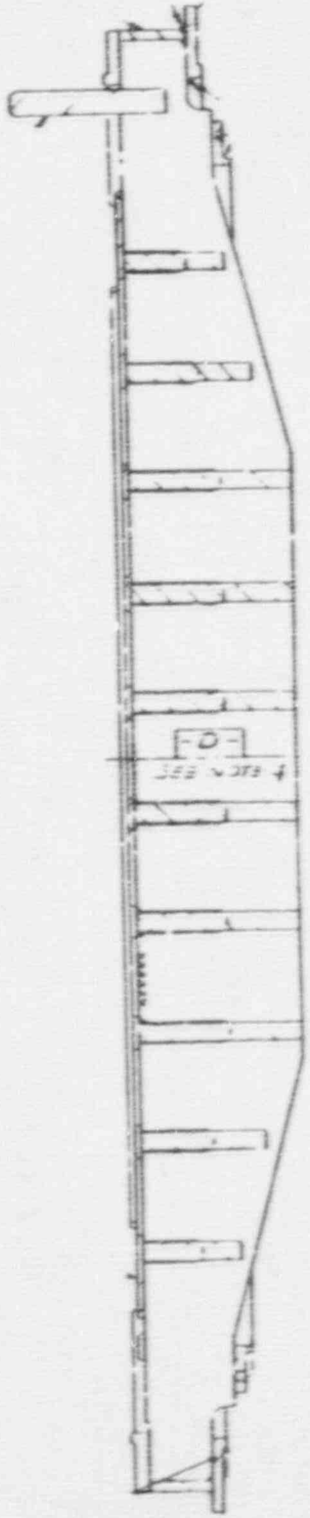
COMPONENT	900 MW	1200 MW
PLENUM COVER	GRILLAGE 0.003" CLAMPING NO SPOKES	SOLID FORGING 0.058" CLAMPING SPOKES
CORE BASKET	SOFT WALL	HARD WALL
LOWER GRID	GRILLAGE	SOLID FORGING
CORE	LESS GAMMA HEATING	MORE GAMMA HEATING


Plenum Cover
Hard Wall
Lower Grid


Plenum Cover
Soft Wall
Lower Grid




62
BASIC
TYP
56 1/4
BASIC
TYP
60 1/4
TYP
67
TYP
37 1/2
TYP 4 PLACES
71
TYP
74 1/2
TYP
71 REF
TYP
1 3/4 R
TYP
R
R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SEE NOTE 4

CONCLUSIONS

- USAGE FACTORS FOR 900 MW INTERNALS WILL BE LOWER THAN THOSE FOR 1200 MW INTERNALS IN ALL CASES

- 1200 MW INTERNALS ARE GOOD FOR 60 YEAR LIFE EXCEPT FOR PLENUM COVER

- 900 MW PLENUM COVER NOT SUBJECTED TO LOW CYCLE THERMAL STRESSES

THEREFORE:

- 900 MW INTERNAL WILL NOT FATIGUE DURING 60 YEARS OF OPERATION

ACCEPTABILITY OF B31.1 DESIGNS

1.0 BACKGROUND

1.1 DEMONSTRATE THAT PIPING DESIGN TO B31.1 DOES NOT INCREASE NOR DECREASE LOCATIONS OF CONCERN

1.2 EXISTING SYSTEMS - KNOWN GEOMETRIES AND OPERATING HISTORY

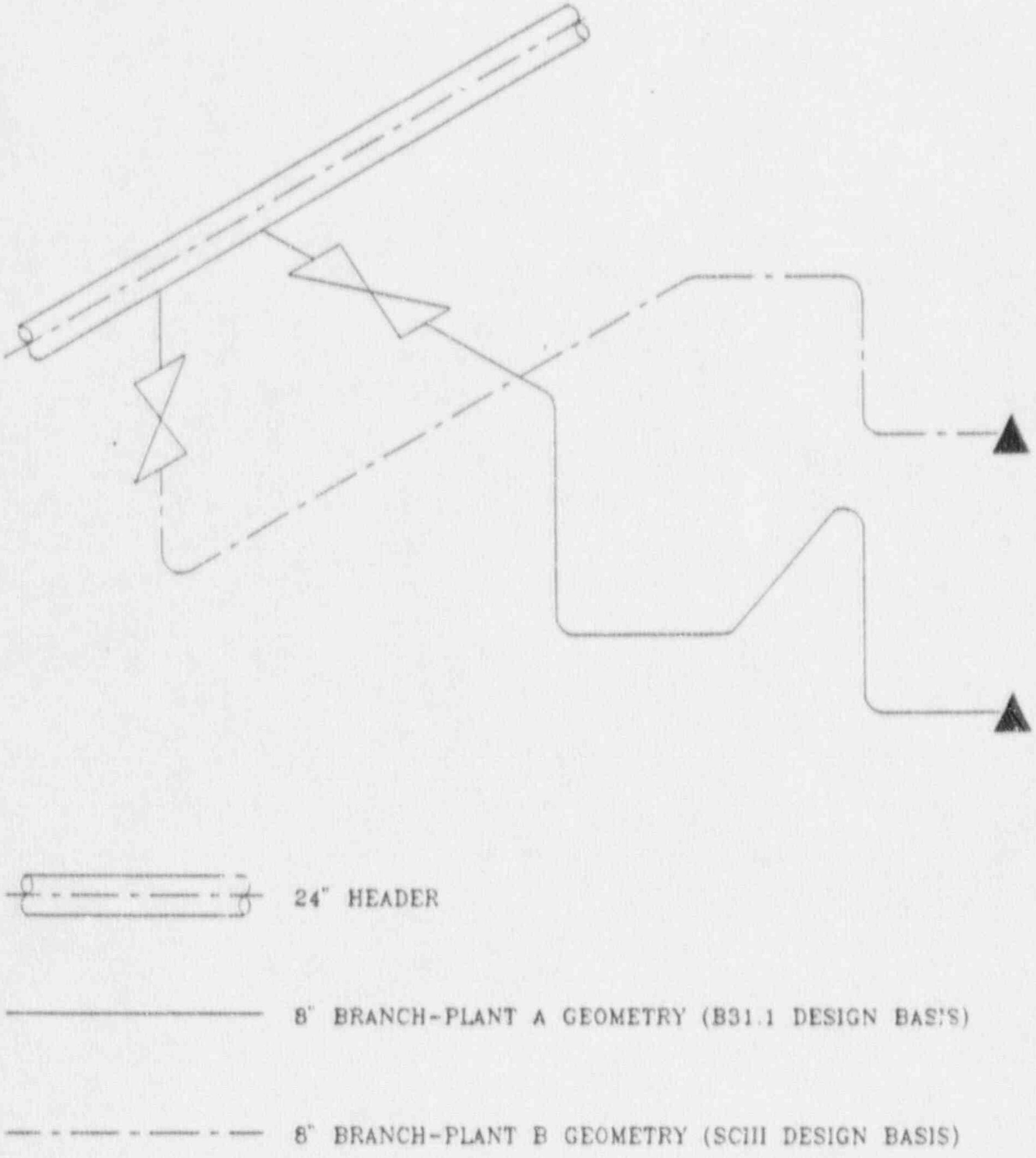
1.3 AVAILABLE SECTION III FATIGUE EVALUATIONS FOR SECTION III PLANT

1.4 OPERATING HISTORY AND EXISTING FATIGUE EVALUATIONS DEFINE LOCATIONS OF CONCERN

2.0 i VERSUS C_2K_2

WITH THE EXCEPTION OF SOCKET WELDS, THE i FACTOR FROM ANSI B31.1 PROVIDES ESSENTIALLY THE SAME VALUE OF THE ALTERNATING STRESS COMPONENT FOR MOMENT LOADING AS CALCULATED USING THE CLASS 1 RULES OF NB-3600 OF SECTION III.

3.0 SYSTEM COMPARISON



3.1 FATIGUE LOADING - MOMENT EFFECTS

(1) LIMITED TO 1.5 S ($\leq$ 7000 CYCLES) BY B31.1

(2) IN PRACTICE MOST DESIGNS, INCLUDING SECTION III, LIMIT EXPANSION STRESSES TO STANDARD B31.1 LEVELS AS PART OF THE PRELIMINARY LAYOUT

(3) LIMITED TO 1.5 S BY SECTION III IF SHAKEDOWN LIMITS ARE NOT SATISFIED

(4) WITH VERY FEW EXCEPTIONS THE BENDING MOMENT IS THE ONLY LOAD CONTRIBUTOR TO FATIGUE THAT IS AFFECTED BY GEOMETRY

3.2 FATIGUE LOADING - OTHER EFFECTS

(1) THE RESPONSE OF PIPE FITTINGS DUE TO APPLIED LOADING (PRESSURE, MOMENT, T_a-T_b, ΔT_1 AND ΔT_2) IS KNOWN (PREDICTED BY CK INDICES).

(2) THE MAJOR VARIABLE IN THE SYSTEMS FOR PLANTS A AND B IS PIPE ROUTING RESULTING IN DIFFERENT THERMAL EXPANSION AND ANCHOR MOTION STRESSES.

(3) THE OPERATING REQUIREMENTS AND SPECIFICATIONS FOR BOTH SYSTEMS ARE ESSENTIALLY THE SAME, THEREFORE EACH FITTING IS SUBJECTED TO ESSENTIALLY THE SAME CYCLIC PRESSURE AND TEMPERATURE FLUCTUATIONS

- A FITTING THAT IS ACCEPTABLE FOR THESE CONDITIONS ON THE PLANT B GEOMETRY IS ALSO ACCEPTABLE ON THE PLANT A GEOMETRY

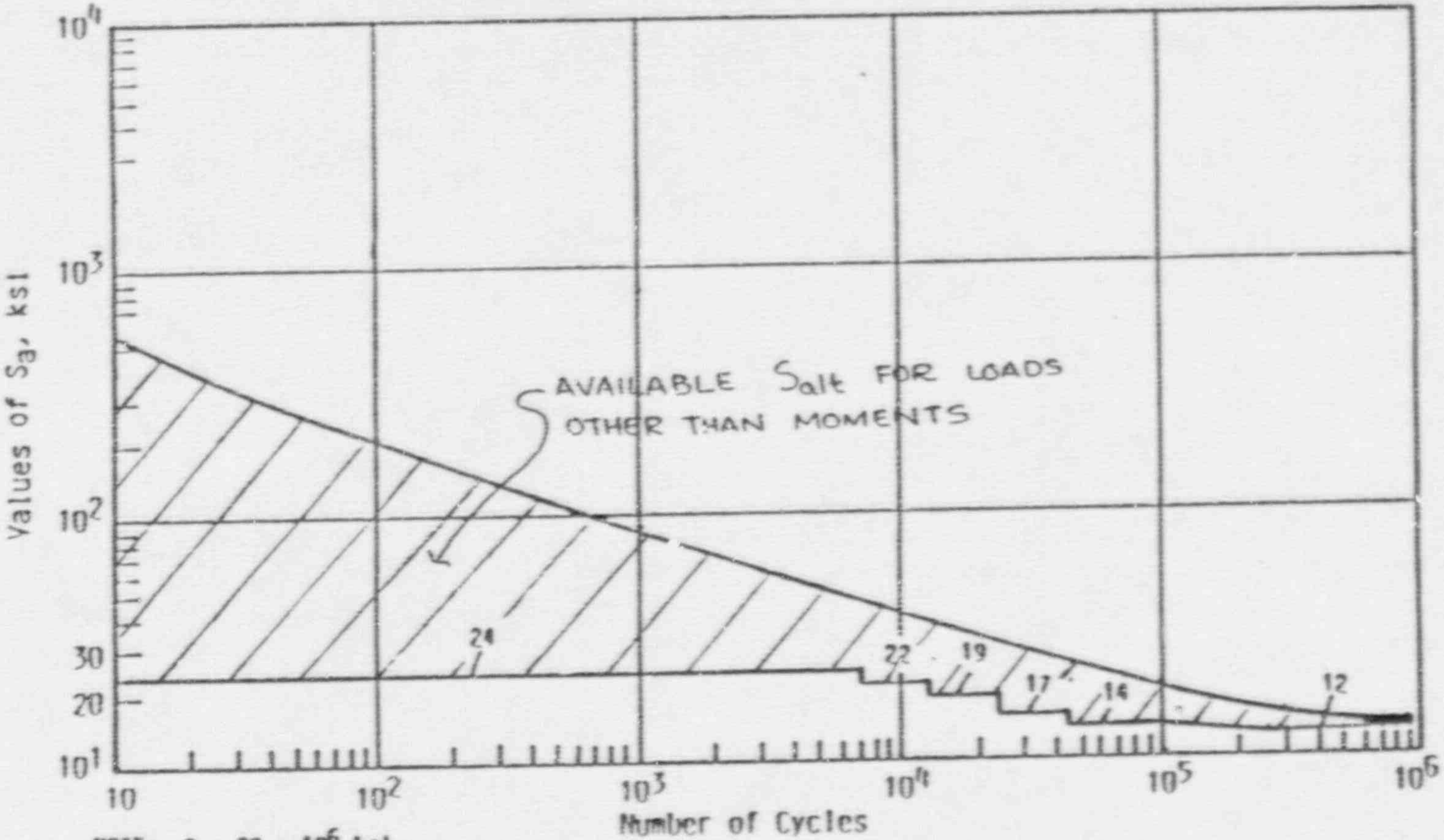
- CONVERSELY, AN UNACCEPTABLE FITTING ON PLANT B IS ALSO UNACCEPTABLE ON PLANT A

3.3 POSSIBLE EXCEPTIONS

(1) THE <u>ONLY</u> LOCATION WHERE THIS APPROACH MAY NOT BE APPROPRIATE IS AT BRANCH CONNECTIONS WHERE THE LOCAL PIPING ROUTING COULD EFFECT THERMAL MIXING AND THEREFORE LOCAL THERMAL STRESSES.

(2) A CONCERN EXISTS FOR SOCKET WELD FITTINGS BUT NOT BECAUSE OF B31.1 VERSUS SECTION III. THE SOCKET WELD CONCERN IS RELATED TO VIBRATION FAILURES WHICH ARE ADDRESSED BY THE INDUSTRY.

COMPARISON OF SECTION III AND B31.1 FATIGUE "CURVES"



NOTE: $E = 30 \times 10^6$ ksi
—— UTS <80.0 ksi

CONTINUED OPERATION OF FATIGUE CRITICAL COMPONENTS

M. KUPINSKI

NORTHEAST UTILITIES

NOVEMBER 14, 1990

OBJECTIVES: TO DISCUSS

- CURRENT PRACTICES
  - KNOWN FATIGUE DAMAGE,
  - SUSPECTED FATIGUE DAMAGE.
- FUTURE CONSIDERATIONS
  - DISPOSITION OF FATIGUE CRITICAL COMPONENTS

CURRENT PRACTICES

o ISI FINDINGS/KNOWN FATIGUE DAMAGE

- ASME SECTION XI FLAW EVALUATION (IWA, B, C-3000),
- ACCEPTANCE OF INSERVICE FLAWS/(IWB-3132)

  (1) BY EXAMINATION (TABLE-IWB-3410-1),

  (2) BY REPAIR TO MEET IWB-3000,

  (3) BY REPLACEMENT

  (4) BY ANALYTICAL EVALUATION/IWB-3132.3.

    - ACCEPTANCE CRITERIA PER IWB-3600
    - SUBSEQUENT REEXAMINATION PER IWB-2420
    - REVIEW BY REGULATORY AUTHORITIES (IWB-3134)

CURRENT PRACTICES

- o **SUSPECTED FATIGUE DAMAGE**

(1) NOTIFICATION

- I&E BULLETINS,
- VENDOR BULLETINS,
- INPO NOTIFICATIONS,
- PLANT SPECIFIC EVALUATIONS.

(2) RESPONSE

- INSPECTION AND/OR
- MONITORING AND/OR
- ANALYTICAL EVALUATION

  (a) ASME III (USAGE FACTOR)

  AND/OR

  (b)ASME XI (APPENDIX A)
- REPAIRS OR REPLACEMENT
- FUTURE AUGMENTED ISI

COMPONENT FATIGUE ASSESSMENT PROGRAMS/PRACTICES

- EPRI PROGRAM "FATIGUE EVALUATION FOR OPERATING LWRs",
- ASME CODE CASE N-481 "ALTERNATIVE EXAMINATION REQUIREMENTS FOR CAST AUSTENITIC PUMP CASINGS",
- ASME SECTION XI TASK GROUP ON OPERATING PLANT FATIGUE,
- NRC PROGRAMS

EPRI PROGRAM

- o ASME III DESIGN BASIS RECONCILIATION

AND/OR

- o FATIGUE DAMAGE AVOIDANCE PROGRAM

  (1) ASME SECTION XI EVALUATION

  (2) ACCEPTANCE BY REPAIR/REPLACEMENT, INSPECTION, AND/OR EVALUATION.

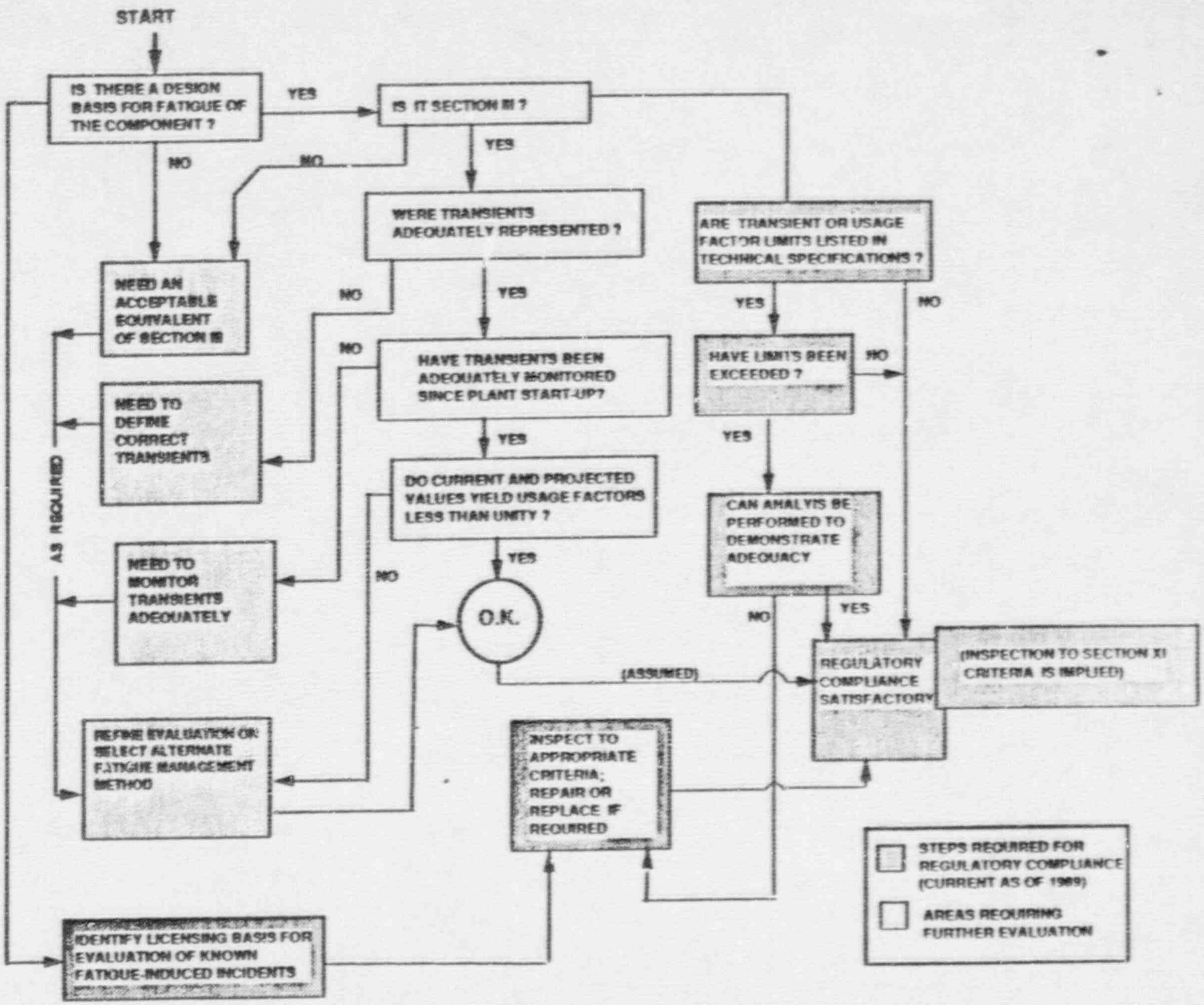


FIG.1.0 FATIGUE EVALUATION REQUIREMENTS AND OPTIONS FOR LWR UNITS

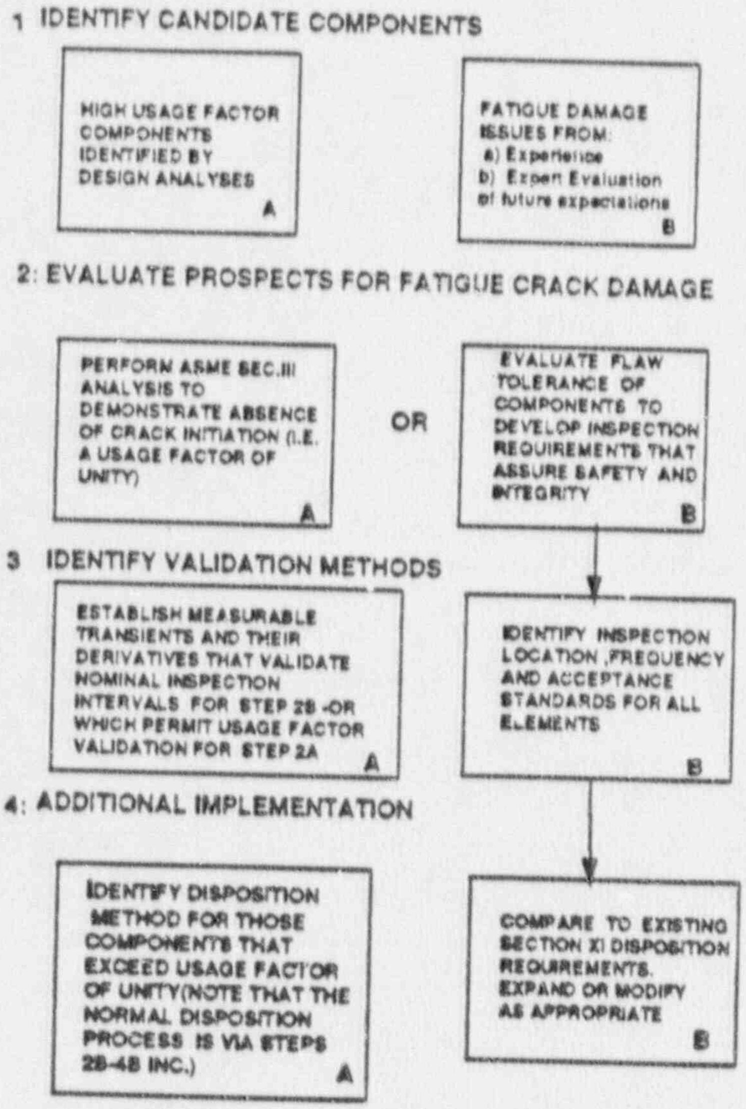


FIG.1.1 : GENERAL FORMAT FOR FATIGUE EVALUATION

ASME NUCLEAR CODE CASE

N-481

ALTERNATIVE EXAMINATION REQUIREMENTS FOR CAST AUSTENITIC PUMP CASINGS

IN LIEU OF THE VOLUMETRIC EXAMINATION SPECIFIED IN TABLE IWB-2500-1, EXAMINATION CATEGORY B-L-1, ITEM B12.10:

- VT-2 VISUAL EXAMINATION OF THE EXTERIOR OF ALL PUMPS DURING HYDROSTATIC PRESSURE TESTS.
- VT-1 VISUAL EXAMINATION OF THE EXTERNAL SURFACES OF THE WELD OF ONE PUMP CASING.
- VT-3 VISUAL EXAMINATION OF THE INTERNAL SURFACES WHENEVER A PUMP IS DISASSEMBLED FOR MAINTENANCE.
- FLAW TOLERANCE EVALUATION TO DEMONSTRATE SAFETY AND SERVICEABILITY OF THE PUMP CASING.

FLAW TOLERANCE EVALUATION

ASME CODE CASE N-481

- EVALUATE MATERIAL PROPERTIES, INCLUDING FRACTURE TOUGHNESS.
- PERFORM STRESS ANALYSIS OF THE PUMP CASING.
- REVIEW THE OPERATING HISTORY OF THE PUMP.
- SELECT LOCATIONS FOR POSTULATING FLAWS.
- POSTULATE 1/4 T FLAW WITH ASPECT RATIO = 6.
- ESTABLISH FLAW STABILITY.
- CONSIDER THERMAL AGING EMBRITTLEMENT AND ANY OTHER PROCESSES THAT MAY DEGRADE THE PROPERTIES OF THE PUMP CASING DURING SERVICE.

SUMMARY/CONCLUSIONS

- CURRENT PRACTICES INCLUDE BOTH ASME III AND/OR ASME XI GUIDELINES IN ADDRESSING COMPONENT FATIGUE.
- CONTINUED OPERATION WITH KNOWN FATIGUE DAMAGE IS BASED ON ASME SECTION XI EVALUATION AND ACCEPTANCE.
- FUTURE PRACTICES SHOULD BE CONSISTENT WITH CURRENT APPROACHES.