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

August 2, 1996

MEMORANDUM TO: Goutam Bagchi, Chief
Civil Engineering and Geosciences Branch
Division of Engineering

FROM: Syed Ali, Structural Engineer
Civil Engineering and Geosciences Branch
Division of Engineering

SUBJECT: SURRY POWER STATION UNIT 1 PIPING STRUCTURAL RELIABILITY EVALUATION MEETING ON JULY 31, 1996

On July 31, 1996, Virginia Electric and Power Company (VEPCO) conducted a Structural Risk and Reliability Analysis (SRRA) subpanel meeting at its headquarter in Richmond, Virginia. This subpanel meeting is part of the Westinghouse Owners Group (WOG) methodology for the implementation of the risk-informed inservice inspection (RI-ISI) program for Surry Power Station Unit 1. NRC staff members Goutam Bagchi, Syed Ali, and Jack Guttmann, and PNNL contractor Fred Simonen observed the licensee's implementation of the SRRA subpanel meeting. The SRRA subpanel members prepared SRRA computer code input for several example piping segments and ran the program to obtain piping segment leakage and failure probabilities. A list of attendees is included as Attachment 1, and a list of subpanel members is included as Attachment 2. The presentation material used by VEPCO is included as Attachment 3.

As a result of the subpanel meeting and discussion with the staff members, following issues were identified for further consideration and resolution by VEPCO and WOG.

1. The term operating cycles in the definition of fatigue transients per operating cycles needs to be clarified.

2. WOG/VEPCO needs to clarify how laminations in pipe walls are addressed by the SRRA code.

3. Treatment of weld overlays and repairs in the SRRA code needs to be addressed.

4. WOG/VEPCO needs to provide the basis for dividing the seismic stress by a factor of two in calculating the design limiting stress ratio.

5. Documentation procedure to include calculations and sketches needs to be clarified.

6. Methodology to calculate seismic stresses for non-code piping needs to be addressed.

7. Treatment of known flaws needs to be addressed.

8. Resolve the issue that SRRA calculates a very small probability of failure or leakage without ISI when known corrosion rates would predict complete failure of pipe wall after only ten years - 0.3 inch thick pipe with an erosion rate of 30 mils per year would fail in ten years.

It was concluded that the meeting was useful and that further discussion of fracture mechanics will take place in Portland, OR on August 6 and 7 , and in future meetings.

Attachments:
1. Attendees
2. Subpanel members
3. Presentation material

DISTRIBUTION:

Central Files (T-5 C3)	PDR (LL-6)	ECGB r/f	NRR Mailroom
NRC Meeting Participants	BSheron	DJackson	
MMayfield	DJeng	GMillman	
GLainas	SDinsmore	LShao	
JStrosnider	EButcher	RYoungblood (Scientec)	

DOCUMENT NAME: G:\ALI\SUMJUL31

070044

DF01

ATTACHMENT 1

July 31 SRRA Meeting -
Attendance Sheet

Ernest W Throckmorton	V. Power	804-273-2125
Kennan R Bailey	Westinghouse/Fuel Assembly	412-374-6633
Syed A. Ali	NRR/NRC	301-415-2776
Goutam Bagchi	NRR/NRC	301-415-2733
Fred Simonen	PNNL	509-375-2087
Jack Guttmann	NRC/RES	(301) 415-7752
NITIN J. SHAH	Va. Power	804-273-3100
Leslie L. Spain	Va. Power	804-273-2602
Pat Naughton	Va Power	804-273-3707
Alex McNeill	VA. Power	804-273-2528

ATTACHMENT 2

SRRA Subpanel Members

Les Spain - Materials Engineering & Failure Analysis Laboratory

Nitin Shah - Engineering Mechanics

Pat Naughton - ISI/NDE Engineering

Alex McNeill - ISI/NDE Engineering

ATTACHMENT 3

Piping Risk Based Inspection Meeting with Virginia Power

Piping Structural Reliability Evaluation

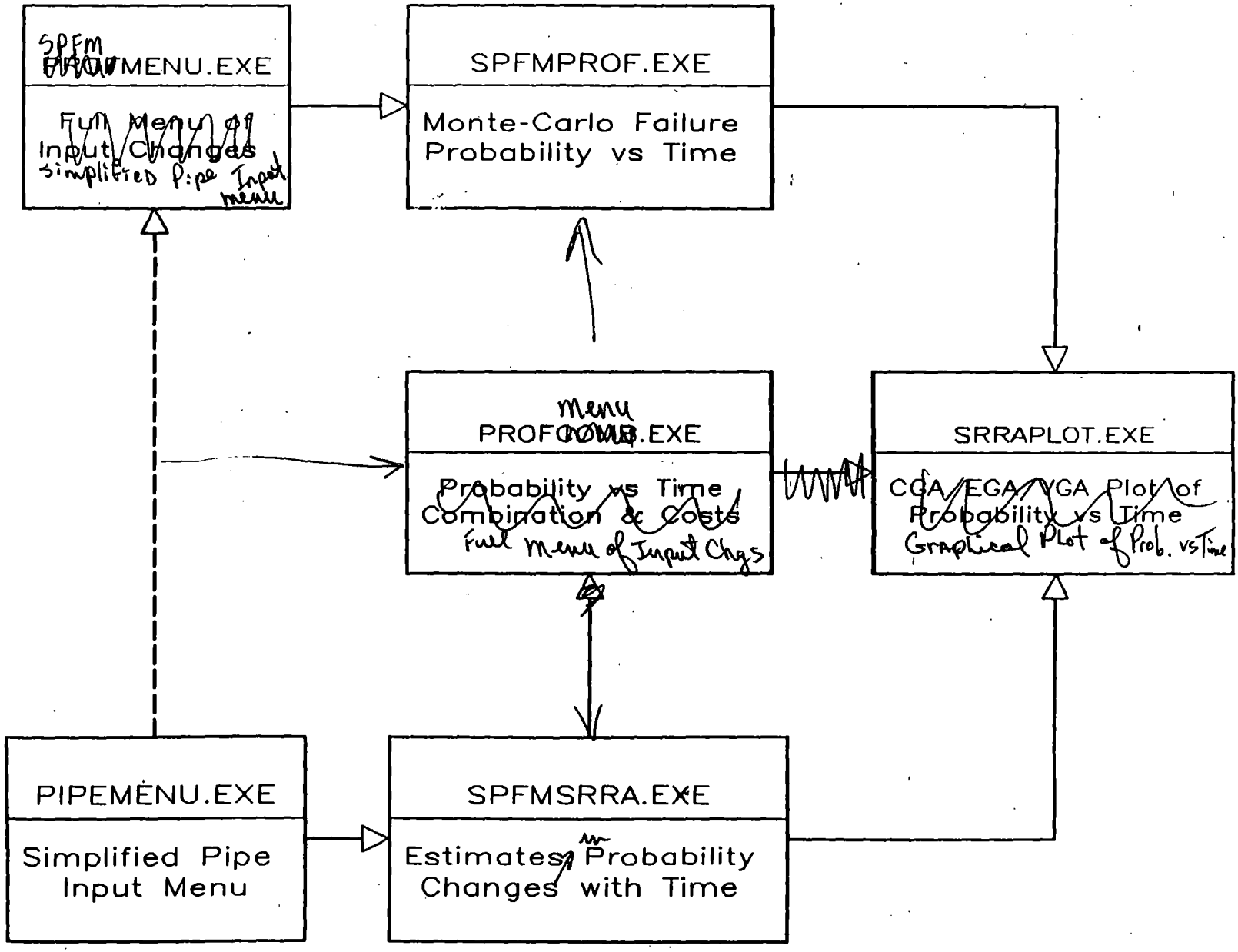
- **SRRA Background and Introduction**
- **Guidelines and Input Instructions**

Bruce A. Bishop
Reactor Equipment and Materials Engineering
Westinghouse Energy Systems
Pittsburgh, PA 15230-0355
(412) 374-4593

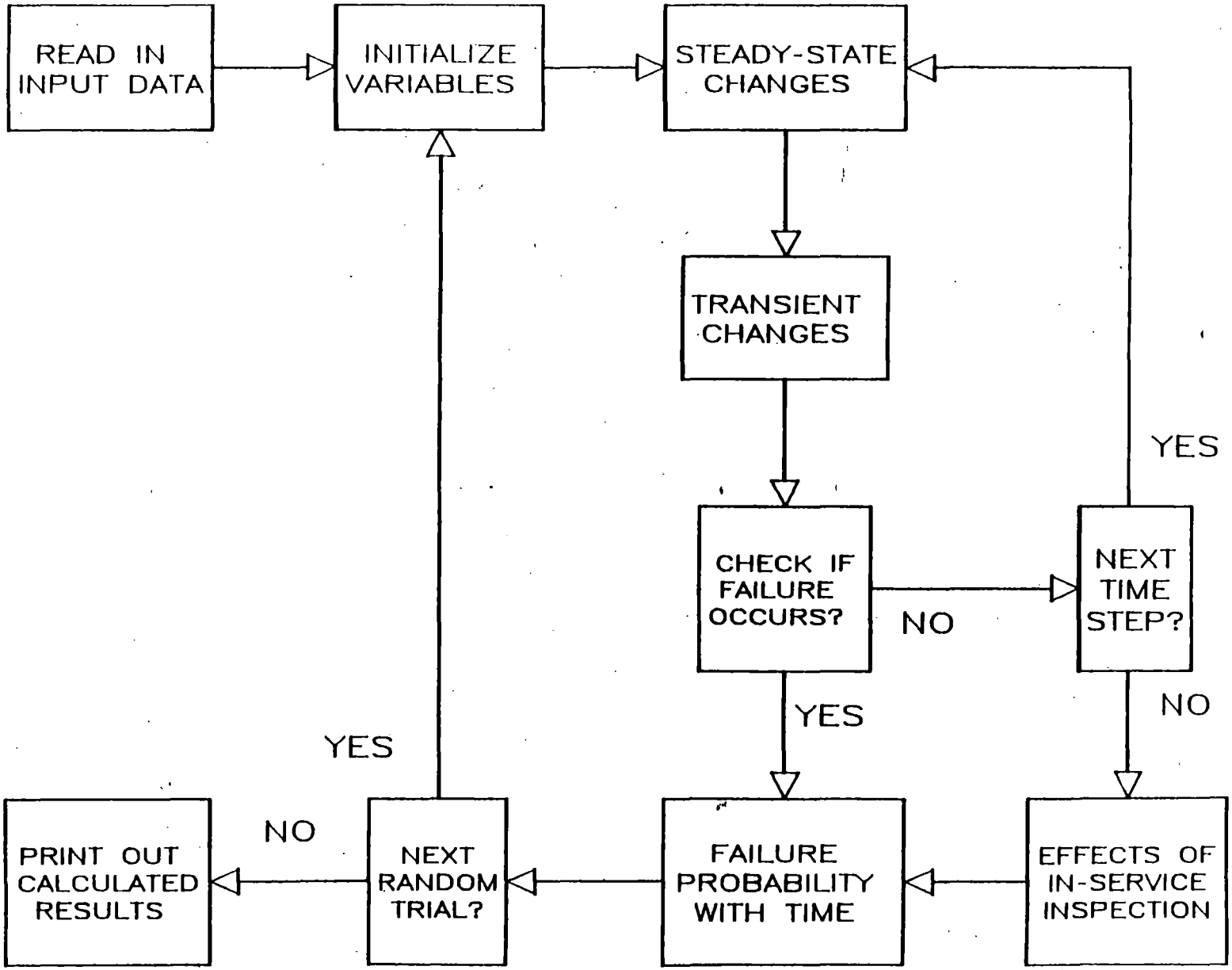
April 3 and 4, 1996

Evolution of Simplified SRRA Models

- Westinghouse Analytical Needs
  - Write New Probabilistic Codes
  - Optimize Input to PRAISE Code
  - Demonstrate SRRA Applications
- Support ASME RBI Guidelines
  - Probability for Ranking Process
  - Benefits of Inspection Strategies
- Use Prior Experience and Work
  - Expert Elicitation
  - Failure Data Trends
  - Failure Rate Correlations
  - EPRI Rate Factors
  - PRAISE Code Runs
  - PRAISE Result Trends
  - Chapman's Neural Network



Interaction of Piping SPFM and Westinghouse Programs



FLOW CHART FOR MONTE-CARLO ANALYSIS PROGRAM

Input Instructions for
Piping Structural Reliability Estimates

1. Prepare input sheet (shown on next page) for each system piping segment for weld location with highest failure probability. If location is not certain, fill out a range of values or use separate sheets for different locations and note such in the "comments."

2. Normally, the higher the value of the non-ISI input parameters, the higher the failure probability, all other things being equal. Since higher temperature gives a lower flow stress, stresses would be lower for the same input fraction and the leak (but not break) probability could be lower.

3. The stress of input item 14, is the maximum primary stress during the design limiting event, such as earthquake seismic loading or transient pressure loads.

4. For the optional in-service inspection input, the failure probability is higher for high intervals and low accuracy.

5. The number in parenthesis is the value of the corresponding parameter in Table 1 that is used for qualitative input (high, medium or low). If more precise input is know, it can be specified in the last column on the input sheet. Input to the computer is simplified if the standard range of values specified in Table 1 are used.

6. The probabilities at the bottom of the page will be calculated using the specified input by the SRRA software supplied for the WOG pilot study.

7. For additional questions, call Bruce Bishop of Westinghouse at (412) 374-4593.

Piping Structural Reliability Estimates for Plant: _____ Page ___ of ___

System : _____ **Segment:** _____

Total Number of Structural Elements: _____ **Number of Elements in ASME Section XI ISI Plan:** _____

No.	Input Parameter Description	Check Input Choice (for Table 1 Value)			Set Value *
1	Type of Piping Material	304 SS	316 SS	Carbon Steel	---
2	Temperature at Pipe Weld	Low (150)	Medium (350)	High (550)	
3	Nominal Pipe Size	Small (2)	Medium (5)	Large (16)	
4	Pipe Wall Thickness	Thin (.06)	Normal (.14)	Thick (.22)	
5	Normal Operating Pressure	Low (0.5)	Medium (1.3)	High (2.1)	
6	Residual Stress Level	None (0.0)	Moderate (0.1)	Maximum (0.2)	
7	Initial Flaw Size	Small (.05)	Medium (.11)	Large (.17)	
8	Steady-State Stress Level	Low (.05)	Medium (.11)	High (.17)	
9	Stress Corrosion Potential	None (0.0)	Moderate (0.5)	Maximum (1.0)	
10	Material Wastage Potential	None (0.0)	Moderate (0.5)	Maximum (1.0)	
11	High Cycle Fatigue Loads	None (0.0)	Moderate (.08)	Maximum (.16)	
12	Fatigue Transient Loads	Low (.10)	Medium (.22)	High (.34)	
13	Fatigue Transient Frequency	Low (5)	Medium (13)	High (21)	
14	Design-Limiting Stress (Break Only)	Low (.10)	Medium (.26)	High (.42)	
15	Optional Crack Inspection Interval	Low (6)	Medium (10)	High (14)	
16	Optional Crack Inspection Accuracy	High (.16)	Medium (.24)	Low (.32)	
* For optional numeric input, use a value (and associated units) from the standard range given in Table 1.					

Before operation ←

high for sensitized pipe →

pumps etc →

(Thermal) →

Small Leak Probability, No ISI: _____ **Optional Leak Probability With ISI:** _____

Full Break Probability, No ISI: _____ **Optional Break Probability With ISI:** _____

Comments: _____

_____

_____

Table 1
Range of Standard Numeric Input Values for Simplified Piping Structural Reliability Models

No.	Parameter Description	Range	Step Size
2	Degrees (F) at Pipe Weld	50 - 650	50
3	Pipe Outside Diameter (inch)	1 - 20	0.5, $D \leq 5$ 2.0, $D \geq 6$
4	Thickness to Diameter Ratio	0.02 - 0.26	0.02
5	Operating Pressure (ksi)	0.1 - 2.5	0.20
6	Ratio* of Residual to Flow Stress	0.0 - 0.2	0.05
7	Flaw Depth Fraction of Wall	0.02 - 0.20	0.03
8	Ratio* Steady-State to Flow Stress	0.02 - 0.20	0.03
9	Stress Corrosion Cracking Level	0.0 - 1.0	0.10
10	Erosion-Corrosion-Wear Level	0.0 - 1.0	0.10
11	Ratio* Stress Amplitude to Flow Stress for High Cycle Fatigue Loading	0.0 - 0.16	0.04
12	Ratio* Stress Amplitude to Flow Stress for Fatigue Transient Loading	0.04 - 0.40	0.03
13	Fatigue Transients per Operating Cycle	1 - 25	4
14	Ratio* Maximum Stress to Flow Stress for the Design-Limiting Condition	0.02 - 0.50	0.04
15	Operating Cycles Between Inspections	4 - 16	2
16	Wall Fraction for 50% Crack Detection	0.12 - 0.36	0.04

* The stress ratio is the value of the applied stress to the weld flow stress for the specified temperature and the type of material. See Table 2 for weld flow stresses.

Table 2
Value of Weld Flow Stress (ksi) Used for Simplified Piping Structural Reliability Models

Temperature (°F)	304 & 316 SS	Carbon Steel
50	74.32	80.92
100	72.23	78.83
150	70.14	76.74
200	68.05	74.65
250	65.96	72.56
300	63.87	70.47
350	61.78	68.38
400	59.69	66.29
450	57.60	64.20
500	55.51	62.11
550	53.42	60.02
600	51.33	57.93
650	49.24	55.84

Guidelines to Select Limiting Locations and Estimate Failure Probabilities - 1

• GENERAL CONSIDERATIONS

- **The purpose of the piping inspection is to detect a small flaw before it becomes big enough to be a potential problem during a postulated design-limiting event, such as a safe-shutdown earthquake or loss of coolant accident.**

- **Locations to be considered are not only those where a small flaw might occur (mechanistic), but also where you would want to know about it (break potential) if one did occur for an unexpected reason.**

- Also consider the effects of adjacent components not working properly on both the mechanistic approach (eg. snubber lockup or a leaking valve) and the break potential (eg. snubber not engaging).

- Since the initial flaw size is a fraction (11%) of the wall thickness, which is a specified fraction of the pipe size, larger and thicker pipes should have higher failure probabilities, all other factors being equal.

• MECHANISTIC APPROACH

- For *poor fabrication and pre-service inspection quality (initial flaws)*, look for field vs. shop welds and configurations that would be hard to maintain fabrication tolerances or to inspect. Lack of stress relief or cold springing could also lead to residual stresses for stress-corrosion cracking.

- For *stress-corrosion cracking*, high stresses (residual, steady-state, pressure), sensitized material (304 SS) and high coolant conductivity are all required.

- For *material wastage*, look for locations of relative support motion (wear), high pressure drop or turning losses (erosion-corrosion) or areas of stagnant coolant (microbiological attack) if the piping materials, especially at crevices, are susceptible to any of these wastage mechanisms.

- For *high cycle fatigue*, look for configurations susceptible to flow induced vibration and flow striping or for vibratory resonance with rotating equipment (pump) frequencies.

- For *low cycle fatigue*, look for areas with high loads due to thermal expansion (equipment nozzles and other anchor points, near snubbers, dissimilar metal joints) for heat-up and cool-down thermal cycling.

Guidelines to Select Limiting Locations and Estimate Failure Probabilities - 2

- BREAK POTENTIAL APPROACH

  - Identify source of potentially limiting loads (eg. seismic, water hammer) and then the location of maximum loading if the source was to occur.

  - If some new unexpected loading were to occur, what is the weakest point in the segment that would be inspected/checked for failure?

  - Look at locations identified in the mechanistic approach to see if potential source loadings would still be high enough to be of concern.

- REQUIRED INPUT DETAIL

  - In general, the level of input detail should be commensurate with the importance associted with how the probability estimates are used.

  - Qualitative values (high, medium or low) should be sufficient for ranking piping systems or segments.

  - Standard numerical input values should still be sufficient for ranking of potential inspection locations in risk-signifiant piping segments

  - Full menu input of median values or uncertainties should only be required for evaluating different inspection strategies or other mitigators for the most risk-significant locations.

  - Calculated stresses from design analyses (per ASME Code) are assumed to be upper bound values with the means (expected values) one-half those values.

Guidelines on Expertise Required to Select Limiting Locations and Estimate Failure Probabilities

- THERMAL-FLUIDS SYSTEM ANALYSIS
  - Potential sources and locations of thermal striping or stratification
  - Areas of high flow velocity or turning losses for vibration/wastage
  - Stagnant flow zones and coolant chemistry for wastage/corrosion
  - Location of high transient pressures or loads (eg. water hammer)
  - Steady-state and transient temperatures and gradients
- DESIGN STRESS ANALYSIS
  - Location of discontinuities, like snubbers, anchors, support lugs and dissimilar metal joints for high operating or cyclic stresses
  - Location of any field welds or cold springing (residual stress)
  - Areas of high thermal stress (low cycle fatigue)
  - Locations with high transient loads (seismic)
  - Sensitized material locations for potential stress corrosion
- IN-SERVICE INSPECTION
  - Locations with poor pre-service inspection (undetected flaws)
  - Inspection locations now required by ASME Code, Section XI
  - History of any indications in this or similar configurations
  - Results of applicable Section XI flaw evaluations
  - Accuracy of potential in-service inspection
- OPERATIONS AND MAINTENANCE
  - Any problems observed during fabrication, installation or hot functional testing of system
  - History of any leaks or repairs in this or similar configurations
  - Any observed failures or areas of high vibration
  - History of snubber retesting or other support problems
  - Any other maintenance problems of concern (valves, bellows, etc.)

Sample Input Screen for the SPFMMENU Program

Westinghouse | Program SPFMMENU | ESBU-NTD

Type of SPFMMENU Program Option	Set Input
Type of Piping Steel Material	Carbon
Pipe Weld Failure Mode	Small Leak
Crack Inspection Interval	Medium
Crack Inspection Accuracy	High
Temperature at Pipe Weld	Medium
Nominal Pipe Size	Medium
Pipe Wall Thickness	Normal
Normal Operating Pressure	Medium
Residual Stress Level	Moderate
Initial Flaw Size	Medium
Steady-State Stress Level	Medium
Stress Corrosion Potential	Moderate
Material Wastage Potential	Moderate
High Cycle Fatigue Loads	Moderate
Fatigue Transient Loads	Medium
Fatigue Transient Frequency	Low
Design-Limit Stress Level	Medium

Messages and Input	Use Up, Down, Right or Left Arrows, End, Esc, Enter or Insert Keys to Select Options\Values

Sample Output Screen for the SPFMMENU Program

Westinghouse | Program SPFMMENU | ESBU-NTD

Type of SPFMMENU Program Option	Run PROF
Type of Piping Steel Material	Carbon
Pipe Weld Failure Mode	Small Leak
Operating Cycles Between Inspections	10.0
Wall Fraction for 50% Detection	0.160
Degrees (F) at Pipe Weld	350.0
Pipe Outside Diameter (inch)	5.0
Thickness to Diameter Ratio	0.140
Operating Pressure (ksi)	1.30
Ratio of Residual to Flow Stress	0.10
Flaw Depth Fraction of Wall	0.110
Ratio Steady-State to Flow Stress	0.11
Stress Corrosion Cracking Level	0.50
Erosion-Corrosion-Wear Level	0.50
Ratio HCFL Amplitude to Flow Stress	0.080
Ratio FTL Amplitude to Flow Stress	0.220
Transients per Operating Cycle	5.0
Ratio Design-Limit to Flow Stress	0.260
Value of Weld Metal Flow Stress in Ksi	68.35

Messages and Input | Actual input values for current run are shown above. Do you wish to quit after run (Y/N):

VARIABLES FOR PIPING STRUCTURAL RELIABILITY MODEL

ORDER	NO.	NAME	DESCRIPTION OF MODEL VARIABLE	DISTRIBUTION
3rd	1	PIPE-DIA	PIPE OUTSIDE DIAMETER (INCH)	Normal
4th	2	WALL/DIA	PIPE WALL TO DIAMETER RATIO	Normal
6th	3	SRESIDUAL	WELD I.D. RESIDUAL STRESS (KSI)	Log-Normal
7th	4	INT%DEPTH	INITIAL CRACK DEPTH (% OF WALL)	Log-Normal
	5	L/D-RATIO	INITIAL CRACK LENGTH TO DEPTH RATIO	Log-Normal
	6	PROB/VOL	PROBABILITY OF CRACK PER CUBIC INCH	Constant
15th	7	FIRST-ISI	CYCLE NUMBER FOR FIRST INSPECTION (ISI)	Constant
15th	8	FREQ-ISI	FREQUENCY FOR SUBSEQUENT ISI'S (CYCLES)	Constant
	9	EPST-PND	MINIMUM ISI PROB. OF NONDETECTION (PND)	Constant
16th	10	ASTAR-PND	DEPTH FOR 50% PROB. OF NONDETECTION	Constant
	11	ANUU-PND	PND EXPONENTIAL SLOPE WITH CRACK DEPTH	Constant
	12	HOURS/CY	EFFECTIVE HOURS PER OPERATING CYCLE	Log-Normal
5th	13	PRESSURE	NORMAL OPERATING PRESSURE (KSI)	Normal
8th	14	STRESS-SS	STEADY-STATE OPERATING STRESS (KSI)	Log-Normal
9th	15	SCC-COEFF	STRESS-CORROSION COEFFICIENT (IN/HR)	Log-Normal
	16	SCC-EXPNT	SCC EXPONENT FOR STRESS INTENSITY	Constant
	17	SCC-TIMEI	TIME TO INITIATE STRESS-CORROSION (HRS)	Constant
10th	18	ECW-RATE	EROSION-CORROSION WEAR RATE (IN/HR)	Log-Normal
	19	NOFTRS/HR	NUMBER OF FAST TRANSIENTS PER HOUR	Constant
11th	20	STRESS-FT	FAST TRANSIENT STRESS AMPLITUDE (KSI)	Log-Normal
12th	21	NOSTRS/CY	NUMBER OF SLOW TRANSIENTS PER CYCLE	Constant
13th	22	STRESS-ST	SLOW TRANSIENT STRESS AMPLITUDE (KSI)	Log-Normal
1st	23	FCG-COEFF	FATIGUE CRACKING COEFFICIENT (IN/CYCLE)	Log-Normal
	24	FCG-EXPNT	FATIGUE CRACK GROWTH EXPONENT	Constant
	25	FCG-THOLD	FCG THRESHOLD IN KSI-SQRT(INCH)	Constant
	26	LIMIT-DSL	LIMIT CRACK DEPTH FOR SMALL LEAK (INCH)	Normal
2nd	27	LIMIT-PBS	LIMITING STRESS FOR PIPE BREAK (KSI)	Normal
14th	28	STRESS-DL	DESIGN LIMITING AXIAL STRESS (KSI)	Log-Normal
	29	FREQ-DLTR	FREQUECY OF DL TRANSIENT PER YEAR	Constant

DEFAULT MEDIAN VALUES* FOR
PIPING STRUCTURAL RELIABILITY MODEL

NO.	VARIABLE	CARBON STEEL	304 SS	316 SS
1	PIPE-DIA		5.000E+00	
2	WALL/DIA		1.400E-01	
3	SRESIDUAL	6.835E+00	6.178E+00	6.178E+00
4	INT%DEPTH		1.100E+01	
5	L/D-RATIO		6.000E+00	
6	PROB/VOL		1.000E-04	
7	FIRST-ISI		5.000E+00	
8	FREQ-ISI		1.000E+01	
9	EPST-PND	5.000E-03	1.000E-03	1.000E-03
10	ASTAR-PND	-2.400E-01	-4.800E-01	-4.800E-01
11	ANUU-PND	3.000E+00	1.600E+00	1.600E+00
12	HOURS/CY		7.447E+03	
13	PRESSURE		1.300E+00	
14	STRESS-SS	7.518E+00	6.796E+00	6.796E+00
15	SCC-COEFF	1.795E-10	1.795E-08	1.616E-09
16	SCC-EXPNT		2.161E+00	
17	SCC-TIMEI		1.000E+00	
18	ECW-RATE	6.370E-07	6.370E-09	6.370E-09
19	NOFTRS/HR		6.000E+01	
20	STRESS-FT	5.468E+00	4.943E+00	4.943E+00
21	NOSTRS/CY		5.000E+00	
22	STRESS-ST	1.504E+01	1.359E+01	1.359E+01
23	FCG-COEFF	1.202E-11	9.140E-12	9.140E-12
24	FCG-EXPNT	3.700E+00	4.000E+00	4.000E+00
25	FCG-THOLD	3.500E+00	4.600E+00	4.600E+00
26	LIMIT-DSL		-9.700E-01	
27	LIMIT-PBS	6.835E+01	6.178E+01	6.178E+01
28	STRESS-DL	1.777E+01	1.606E+01	1.606E+01
29	FREQ-DLTR		1.000E-03	

* Note: A negative number in this table indicates the absolute value is the specified fraction of the pipe wall thickness.

Sample Output from the SPFMPROF Program

STRUCTURAL RELIABILITY AND RISK ASSESSMENT (SRRA)

WESTINGHOUSE PROBABILITY OF FAILURE PROGRAM SPFMPROF ESBU-NTD

INPUT VARIABLES FOR CASE 1: CARBON STEEL PIPE WELD SMALL LEAK

NCYCLE = 40	NFAILS = 1000	NTRIAL = 5000
NOVARS = 29	NUMSET = 6	NUMISI = 5
NUMSSC = 7	NUMTRC = 7	NUMFMD = 4

VARIABLE NO.	NAME	DISTRIBUTION TYPE	LOG	MEDIAN VALUE	DEVIATION OR FACTOR	SHIFT MV/SD	USAGE NO.	SUB
1	PIPE-DIA	NORMAL	NO	5.0000D+00	2.5000D-02	.00	1	SET
2	WALL/DIA	NORMAL	NO	1.4000D-01	4.2000D-03	.00	2	SET
3	SRESIDUAL	NORMAL	YES	6.8349D+00	1.4125D+00	.00	3	SET
4	INT%DEPTH	NORMAL	YES	1.1000D+01	1.4125D+00	1.00	4	SET
5	L/D-RATIO	NORMAL	YES	6.0000D+00	1.4125D+00	1.00	5	SET
6	PROB/VOL	- CONSTANT -		1.0000D-04			6	SET
7	FIRST-ISI	- CONSTANT -		5.0000D+00			1	ISI
8	FREQ-ISI	- CONSTANT -		1.0000D+01			2	ISI
9	EPST-PND	- CONSTANT -		5.0000D-03			3	ISI
10	ASTAR-PND	- CONSTANT -		-1.6000D-01			4	ISI
11	ANUU-PND	- CONSTANT -		3.0000D+00			5	ISI
12	HOURS/CY	NORMAL	YES	7.4473D+03	1.0500D+00	1.00	1	SSC
13	PRESSURE	NORMAL	NO	1.3000D+00	1.5000D-02	.00	2	SSC
14	STRESS-SS	NORMAL	YES	7.5184D+00	1.2589D+00	.00	3	SSC
15	SCC-COEFF	NORMAL	YES	1.7950D-10	2.3714D+00	.00	4	SSC
16	SCC-EXPNT	- CONSTANT -		2.1610D+00			5	SSC
17	SCC-TIMEI	- CONSTANT -		1.0000D+00			6	SSC
18	ECW-RATE	NORMAL	YES	6.3700D-07	2.3714D+00	.00	7	SSC
19	NOFTRS/HR	- CONSTANT -		6.0000D+01			1	TRC
20	STRESS-FT	NORMAL	YES	5.4679D+00	1.4125D+00	.00	2	TRC
21	NOSTRS/CY	- CONSTANT -		5.0000D+00			3	TRC
22	STRESS-ST	NORMAL	YES	1.5037D+01	1.2589D+00	1.00	4	TRC
23	FCG-COEFF	NORMAL	YES	1.2017D-11	2.8508D+00	1.00	5	TRC
24	FCG-EXPNT	- CONSTANT -		3.7000D+00			6	TRC
25	FCG-THOLD	- CONSTANT -		3.5000D+00			7	TRC
26	LIMIT-DSL	NORMAL	NO	-9.7000D-01	1.0000D-02	.00	1	FMD
27	LIMIT-PBS	- CONSTANT -		0.0000D+00			2	FMD
28	STRESS-DL	- CONSTANT -		0.0000D+00			3	FMD
29	FREQ-DLTR	- CONSTANT -		0.0000D+00			4	FMD

Sample Output from the SPFMPROF Program (Continued)

PROBABILITIES OF FAILURE MODE: EXCEED LIMITING DEPTH FOR SMALL LEAK

NUMBER FAILED = 1000 NUMBER OF TRIALS = 1850

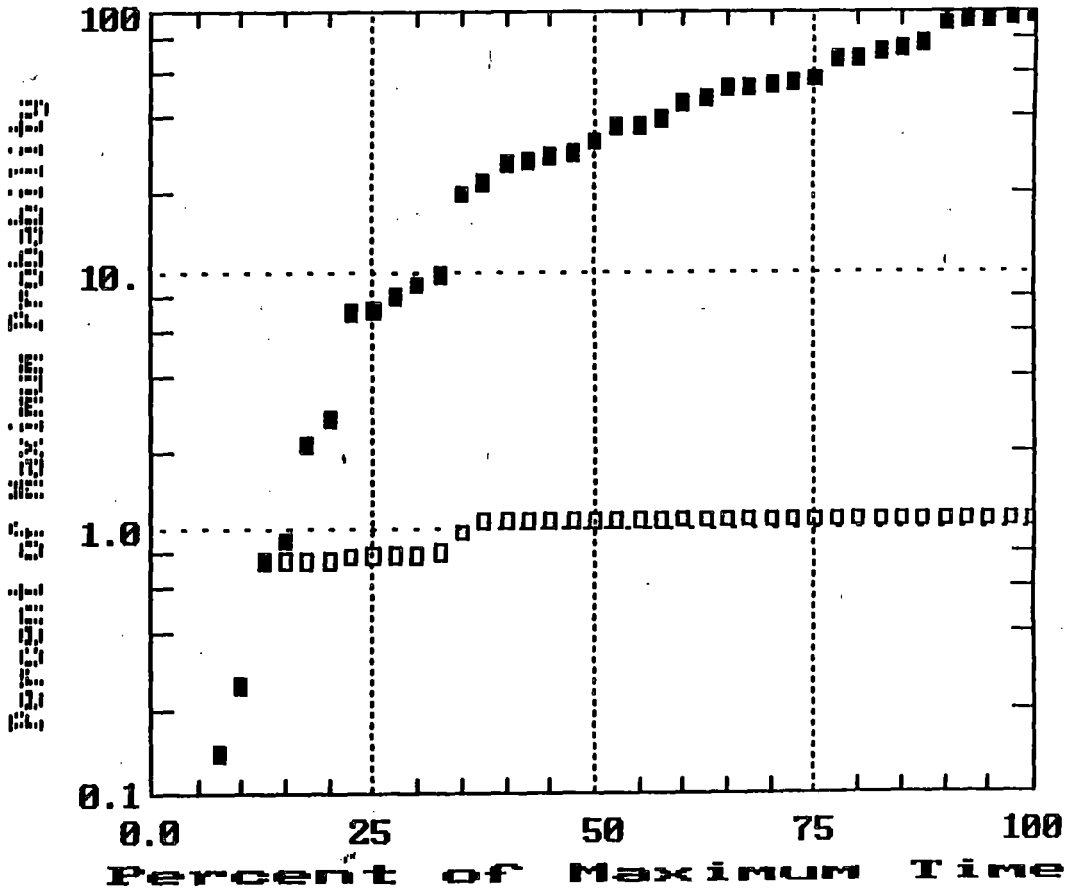
END OF CYCLE	FAILURE PROBABILITY WITHOUT AND WITH IN-SERVICE INSPECTION			
	FOR PERIOD	CUM. TOTAL	FOR PERIOD	CUM. TOTAL
1.0	1.36468D-10	1.36468D-10	1.36468D-10	1.36468D-10
2.0	1.71093D-07	1.71230D-07	1.71093D-07	1.71230D-07
3.0	2.34797D-07	4.06027D-07	2.34797D-07	4.06027D-07
4.0	3.28531D-07	7.34558D-07	3.28531D-07	7.34558D-07
5.0	1.47684D-06	2.21140D-06	1.47684D-06	2.21140D-06
6.0	4.37640D-07	2.64904D-06	2.18820D-09	2.21359D-06
7.0	3.76057D-06	6.40961D-06	1.88261D-08	2.23241D-06
8.0	1.60713D-06	8.01674D-06	8.08027D-09	2.24049D-06
9.0	1.27135D-05	2.07302D-05	6.38155D-08	2.30431D-06
10.0	6.91949D-07	2.14222D-05	3.64978D-09	2.30796D-06
11.0	2.67330D-06	2.40955D-05	2.83224D-08	2.33628D-06
12.0	2.41523D-06	2.65107D-05	1.38335D-08	2.35012D-06
13.0	2.43428D-06	2.89450D-05	4.40257D-08	2.39414D-06
14.0	3.00890D-05	5.90340D-05	4.49872D-07	2.84401D-06
15.0	6.13420D-06	6.51682D-05	2.88792D-07	3.13281D-06
16.0	1.20157D-05	7.71839D-05	7.30622D-09	3.14011D-06
17.0	2.36884D-06	7.95528D-05	1.72898D-09	3.14184D-06
18.0	2.89801D-06	8.24508D-05	8.73480D-10	3.14271D-06
19.0	2.83002D-06	8.52808D-05	3.06338D-09	3.14578D-06
20.0	9.09847D-06	9.43793D-05	5.08191D-09	3.15086D-06
21.0	1.25743D-05	1.06954D-04	1.03947D-08	3.16125D-06
22.0	1.23907D-06	1.08193D-04	2.54459D-09	3.16380D-06
23.0	7.60720D-06	1.15800D-04	4.33213D-09	3.16813D-06
24.0	1.80313D-05	1.33831D-04	2.95939D-08	3.19773D-06
25.0	5.36309D-06	1.39194D-04	4.21174D-09	3.20194D-06
26.0	1.19744D-05	1.51169D-04	1.56101D-10	3.20209D-06
27.0	2.01290D-06	1.53182D-04	3.44819D-11	3.20213D-06
28.0	2.90411D-06	1.56086D-04	6.68258D-12	3.20213D-06
29.0	5.02873D-06	1.61115D-04	2.20601D-10	3.20235D-06
30.0	4.64305D-06	1.65758D-04	7.03606D-11	3.20243D-06
31.0	3.06310D-05	1.96389D-04	6.15526D-10	3.20304D-06
32.0	5.97345D-07	1.96986D-04	1.99758D-12	3.20304D-06
33.0	1.61848D-05	2.13171D-04	5.52295D-10	3.20359D-06
34.0	2.48078D-06	2.15652D-04	5.45726D-11	3.20365D-06
35.0	1.27331D-05	2.28385D-04	4.20968D-10	3.20407D-06
36.0	4.30501D-05	2.71435D-04	1.55216D-11	3.20409D-06
37.0	7.10732D-06	2.78542D-04	3.04749D-12	3.20409D-06
38.0	4.21054D-06	2.82753D-04	1.64209D-12	3.20409D-06
39.0	4.81422D-06	2.87567D-04	5.95713D-12	3.20410D-06
40.0	7.28623D-06	2.94853D-04	1.93065D-12	3.20410D-06
DEVIATION ON CUMULATIVE TOTALS =			6.32189D-06	9.69380D-07

SRRA Plots

Westinghouse
ESBU - NTD

Maximum
Probability
of 0.2949E-03

Maximum Time
of 40 Cycles



Current Case 1 X 1.0

■ ■ ■ = No ISI
□ □ □ = With ISI

Case 1 Title: CARBON STEEL PIPE WELD SMALL LEAK

Piping Structural Reliability Estimates for Plant: Surry Unit 1 **Page** ___ **of** ___

System : MS **Segment:** 33, 34

Total Number of Structural Elements: _____ **Number of Elements in ASME Section XI ISI Plan:** _____

No.	Input Parameter Description	Check Input Choice (for Table 1 Value)			Set Value *
1	Type of Piping Material	304 SS	316 SS	(Carbon Steel)	---
2	Temperature at Pipe Weld	Low (150)	Medium (350)	High (550)	505
3	Nominal Pipe Size	Small (2)	Medium (5)	Large (16)	3
4	Pipe Wall Thickness	Thin (.06)	Normal (.14)	Thick (.22)	0.086
5	Normal Operating Pressure	Low (0.5)	Medium (1.3)	High (2.1)	.7
6	Residual Stress Level	None (0.0)	(Moderate (0.1))	Maximum (0.2)	
7	Initial Flaw Size	Small (.05)	Medium (.11)	(Large (.17))	
8	Steady-State Stress Level	Low (.05)	Medium (.11)	High (.17)	.312
9	Stress Corrosion Potential	(None (0.0))	Moderate (0.5)	Maximum (1.0)	
10	Material Wastage Potential	None (0.0)	Moderate (0.5)	Maximum (1.0)	.1
11	High Cycle Fatigue Loads	None (0.0)	(Moderate (.08))	Maximum (.16)	
12	Fatigue Transient Loads	Low (.10)	(Medium (.22))	High (.34)	
13	Fatigue Transient Frequency	Low (5)	(Medium (13))	High (21)	
14	Design-Limiting Stress (Break Only)	Low (.10)	Medium (.26)	High (.42)	.225
15	Optional Crack Inspection Interval	Low (6)	(Medium (10))	High (14)	
16	Optional Crack Inspection Accuracy	High (.16)	(Medium (.24))	(Low (.32))	
* For optional numeric input, use a value (and associated units) from the standard range given in Table 1.					

3A **Small Leak Probability, No ISI:** 1.38E-5 **Optional Leak Probability With ISI:** 2.69E-6

3B **Full Break Probability, No ISI:** (2.3E-9) **Optional Break Probability With ISI:** 1.57E-10

Comments: Large flaw no RT, Code allowable values used for E#14,
Stand by system, operated monthly set wastage to .1 and HCFL #11 to Moderate
Low accuracy - MT

7A Snubber lockup change 12 to High & /10 2.37E-9/10 = 2.37E-10 w/ISI 1.55E-11 w/ ISI

4B Snubber failure to lockup change 14 to 1 /10 2.39 E-9/10 = 2.39E-10 w/ ISI 6.05E-11 w/ ISI

Piping Structural Reliability Estimates for Plant: Surry Unit 1 **Page** ___ **of** ___

System : MS **Segment:** 1

Total Number of Structural Elements: _____ **Number of Elements in ASME Section XI ISI Plan:** _____

No.	Input Parameter Description	Check Input Choice (for Table 1 Value)			Set Value *
1	Type of Piping Material	304 SS	316 SS	(Carbon Steel)	---
2	Temperature at Pipe Weld	Low (150)	Medium (350)	High (550)	505
3	Nominal Pipe Size	Small (2)	Medium (5)	Large (16)	30
4	Pipe Wall Thickness	Thin (.06)	Normal (.14)	Thick (.22)	0.033
5	Normal Operating Pressure	Low (0.5)	Medium (1.3)	High (2.1)	.7
6	Residual Stress Level	None (0.0)	(Moderate (0.1))	Maximum (0.2)	
7	Initial Flaw Size	(Small (.05))	Medium (.11)	Large (.17)	
8	Steady-State Stress Level	Low (.05)	Medium (.11)	High (.17)	0.098
9	Stress Corrosion Potential	(None (0.0))	Moderate (0.5)	Maximum (1.0)	
10	Material Wastage Potential	None (0.0)	Moderate (0.5)	Maximum (1.0)	.1
11	High Cycle Fatigue Loads	(None (0.0))	Moderate (.08)	Maximum (.16)	
12	Fatigue Transient Loads	Low (.10)	(Medium (.22))	High (.34)	
13	Fatigue Transient Frequency	(Low (5))	Medium (13)	High (21)	
14	Design-Limiting Stress (Break Only)	Low (.10)	Medium (.26)	High (.42)	.0.2
15	Optional Crack Inspection Interval	Low (6)	(Medium (10))	High (14)	
16	Optional Crack Inspection Accuracy	High (.16)	(Medium (.24))	Low (.32)	

* For optional numeric input, use a value (and associated units) from the standard range given in Table 1.

1A **Small Leak Probability, No ISI:** 2.97 E-5 **Optional Leak Probability With ISI:** 1.08 E-9

1B **Full Break Probability, No ISI:** 5.21 E-11 **Optional Break Probability With ISI:** 5.21 E-11

Comments: Actual values used for E, ~~#~~ increased from 0.149 to .2 for turbine trip, Wastage .1 No history of erosion, 12 - Mod. # Thermal expansion high.

2A snubber lockup change item 12 to High & $\div 5$ 5.21 E-11 / 5 = 1.04 E-11 ~~5.21 E-12~~ w/o ISI & w/ ISI

2B snubber failure to lockup change item 14 to 0.5 & $\div 5$ 1.06 E-8 / 5 = ~~1.06 E-9~~ 2.12 E-9 w/o ISI & w/ ISI

Divide by 5 since large number of snubbers on this segment - 12 snubbers

INPUT VARIABLES FOR CASE 14 CARBON STEEL PIPE WELD SMALL LEAK

NCYCLE =	40	NFAILS =	1000	NTRIAL =	5000
NOVARS =	29	NUMSET =	6	NUMISI =	5
NUMSSC =	7	NUMTRC =	7	NUMFMD =	4

VARIABLE NO.	NAME	DISTRIBUTION TYPE	LOG	MEDIAN VALUE	DEVIATION OR FACTOR	SHIFT MV/SD	USAGE NO.	SUB
1	PIPE-DIA	NORMAL	NO	3.0000D+01	1.5000D-01	.00	1	SET
2	WALL/DIA	NORMAL	NO	3.3000D-02	9.9000D-04	.00	2	SET
3	SRESIDUAL	NORMAL	YES	6.1872D+00	1.4125D+00	.00	3	SET
4	INT%DEPTH	NORMAL	YES	5.0000D+00	1.4125D+00	1.00	4	SET
5	L/D-RATIO	NORMAL	YES	6.0000D+00	1.4125D+00	1.00	5	SET
6	PROB/VOL	- CONSTANT -		1.0000D-04			6	SET
7	FIRST-ISI	- CONSTANT -		5.0000D+00			1	ISI
8	FREQ-ISI	- CONSTANT -		1.0000D+01			2	ISI
9	EPST-PND	- CONSTANT -		5.0000D-03			3	ISI
10	ASTAR-PND	- CONSTANT -		-2.4000D-01			4	ISI
11	ANUU-PND	- CONSTANT -		3.0000D+00			5	ISI
12	HOURS/CY	NORMAL	YES	7.4473D+03	1.0500D+00	1.00	1	SSC
13	PRESSURE	NORMAL	NO	7.0000D-01	1.5000D-02	.00	2	SSC
14	STRESS-SS	NORMAL	YES	6.0634D+00	1.2589D+00	.00	3	SSC
15	SCC-COEFF	NORMAL	YES	3.5900D-13	2.3714D+00	.00	4	SSC
16	SCC-EXPNT	- CONSTANT -		2.1610D+00			5	SSC
17	SCC-TIMEI	- CONSTANT -		1.0000D+00			6	SSC
18	ECW-RATE	NORMAL	YES	1.2740D-07	2.3714D+00	.00	7	SSC
19	NOFTRS/HR	- CONSTANT -		6.0000D+01			1	TRC
20	STRESS-FT	NORMAL	YES	6.1872D-02	1.4125D+00	.00	2	TRC
21	NOSTRS/CY	- CONSTANT -		5.0000D+00			3	TRC
22	STRESS-ST	NORMAL	YES	1.3612D+01	1.2589D+00	1.00	4	TRC
23	FCG-COEFF	NORMAL	YES	1.2017D-11	2.8508D+00	1.00	5	TRC
24	FCG-EXPNT	- CONSTANT -		3.7000D+00			6	TRC
25	FCG-THOLD	- CONSTANT -		3.5000D+00			7	TRC
26	LIMIT-DSL	NORMAL	NO	-9.7000D-01	1.0000D-02	.00	1	FMD
27	LIMIT-PBS	- CONSTANT -		0.0000D+00			2	FMD
28	STRESS-DL	- CONSTANT -		0.0000D+00			3	FMD
29	FREQ-DLTR	- CONSTANT -		0.0000D+00			4	FMD

PROBABILITIES OF FAILURE MODE: EXCEED LIMITING DEPTH FOR SMALL LEAK

NUMBER FAILED = 10 NUMBER OF TRIALS = 5000

END OF CYCLE	FAILURE PROBABILITY WITHOUT AND FOR PERIOD	CUM. TOTAL	WITH IN-SERVICE INSPECTION FOR PERIOD	CUM. TOTAL
24.0	2.10281D-08	2.10281D-08	1.28102D-10	1.28102D-10
27.0	3.66165D-07	3.87193D-07	2.10938D-11	1.49196D-10
29.0	8.60021D-07	1.24721D-06	1.58195D-10	3.07391D-10
30.0	5.79822D-07	1.82704D-06	2.44683D-11	3.31859D-10
36.0	8.72122D-08	1.91425D-06	1.12609D-14	3.31870D-10
37.0	1.29280D-07	2.04353D-06	2.75785D-14	3.31898D-10
38.0	5.09976D-09	2.04863D-06	1.19192D-15	3.31899D-10
39.0	2.76443D-05	2.96929D-05	7.49040D-10	1.08094D-09
40.0	0.00000D+00	2.96929D-05	0.00000D+00	1.08094D-09
	DEVIATION ON CUMULATIVE TOTALS =		9.38128D-06	5.66592D-08

INPUT VARIABLES FOR CASE 2A CARBON STEEL PIPE WELD FULL BREAK

NCYCLE =	40	NFAILS =	1000	NTRIAL =	5000
NOVARS =	29	NUMSET =	6	NUMISI =	5
NUMSSC =	7	NUMTRC =	7	NUMFMD =	4

VARIABLE NO.	NAME	DISTRIBUTION TYPE	LOG	MEDIAN VALUE	DEVIATION OR FACTOR	SHIFT MV/SD	USAGE NO.	SUB
1	PIPE-DIA	NORMAL	NO	3.0000D+01	1.5000D-01	.00	1	SET
2	WALL/DIA	NORMAL	NO	3.3000D-02	9.9000D-04	.00	2	SET
3	SRESIDUAL	NORMAL	YES	6.1872D+00	1.4125D+00	.00	3	SET
4	INT%DEPTH	NORMAL	YES	5.0000D+00	1.4125D+00	1.00	4	SET
5	L/D-RATIO	NORMAL	YES	6.0000D+00	1.4125D+00	1.00	5	SET
6	PROB/VOL	- CONSTANT -		1.0000D-04			6	SET
7	FIRST-ISI	- CONSTANT -		5.0000D+00			1	ISI
8	FREQ-ISI	- CONSTANT -		1.0000D+01			2	ISI
9	EPST-PND	- CONSTANT -		5.0000D-03			3	ISI
10	ASTAR-PND	- CONSTANT -		-2.4000D-01			4	ISI
11	ANUU-PND	- CONSTANT -		3.0000D+00			5	ISI
12	HOURS/CY	NORMAL	YES	7.4473D+03	1.0500D+00	1.00	1	SSC
13	PRESSURE	NORMAL	NO	7.0000D-01	1.5000D-02	.00	2	SSC
14	STRESS-SS	NORMAL	YES	6.0634D+00	1.2589D+00	.00	3	SSC
15	SCC-COEFF	NORMAL	YES	3.5900D-13	2.3714D+00	.00	4	SSC
16	SCC-EXPNT	- CONSTANT -		2.1610D+00			5	SSC
17	SCC-TIMEI	- CONSTANT -		1.0000D+00			6	SSC
18	ECW-RATE	NORMAL	YES	1.2740D-07	2.3714D+00	.00	7	SSC
19	NOFTRS/HR	- CONSTANT -		6.0000D+01			1	TRC
20	STRESS-FT	NORMAL	YES	6.1872D-02	1.4125D+00	.00	2	TRC
21	NOSTRS/CY	- CONSTANT -		5.0000D+00			3	TRC
22	STRESS-ST	NORMAL	YES	2.1036D+01	1.2589D+00	1.00	4	TRC
23	FCG-COEFF	NORMAL	YES	1.2017D-11	2.8508D+00	1.00	5	TRC
24	FCG-EXPNT	- CONSTANT -		3.7000D+00			6	TRC
25	FCG-THOLD	- CONSTANT -		3.5000D+00			7	TRC
26	LIMIT-DSL	- CONSTANT -		0.0000D+00			1	FMD
27	LIMIT-PBS	NORMAL	NO	6.1872D+01	3.2000D+00	-1.00	2	FMD
28	STRESS-DL	NORMAL	YES	1.2374D+01	1.4125D+00	1.00	3	FMD
29	FREQ-DLTR	- CONSTANT -		1.0000D-03			4	FMD

PROBABILITIES OF FAILURE MODE: EXCEED FLOW STRESS LIMIT FOR FULL BREAK

NUMBER FAILED = 0 NUMBER OF TRIALS = 5000

END OF CYCLE	FAILURE PROBABILITY WITHOUT AND FOR PERIOD	CUM. TOTAL	WITH IN-SERVICE INSPECTION FOR PERIOD	CUM. TOTAL
.0	5.21060D-11	5.21060D-11	5.21060D-11	5.21060D-11
40.0	0.00000D+00	5.21060D-11	0.00000D+00	5.21060D-11

STRUCTURAL RELIABILITY AND RISK ASSESSMENT (SRRA)

WESTINGHOUSE PROBABILITY OF FAILURE PROGRAM SPFMPROF ESBU-NTD

INPUT VARIABLES FOR CASE 3A CARBON STEEL PIPE WELD SMALL LEAK

NCYCLE =	40	NFAILS =	1000	NTRIAL =	5000
NOVARS =	29	NUMSET =	6	NUMISI =	5
NUMSSC =	7	NUMTRC =	7	NUMFMD =	4

VARIABLE NO.	NAME	DISTRIBUTION TYPE	LOG	MEDIAN VALUE	DEVIATION OR FACTOR	SHIFT MV/SD	USAGE NO.	SUB
1	PIPE-DIA	NORMAL	NO	3.0000D+00	1.5000D-02	.00	1	SET
2	WALL/DIA	NORMAL	NO	8.6000D-02	2.5800D-03	.00	2	SET
3	SRESIDUAL	NORMAL	YES	6.1872D+00	1.4125D+00	.00	3	SET
4	INT%DEPTH	NORMAL	YES	1.7000D+01	1.4125D+00	1.00	4	SET
5	L/D-RATIO	NORMAL	YES	6.0000D+00	1.4125D+00	1.00	5	SET
6	PROB/VOL	- CONSTANT -		1.0000D-04			6	SET
7	FIRST-ISI	- CONSTANT -		5.0000D+00			1	ISI
8	FREQ-ISI	- CONSTANT -		1.0000D+01			2	ISI
9	EPST-PND	- CONSTANT -		5.0000D-03			3	ISI
10	ASTAR-PND	- CONSTANT -		-3.2000D-01			4	ISI
11	ANUU-PND	- CONSTANT -		3.0000D+00			5	ISI
12	HOURS/CY	NORMAL	YES	7.4473D+03	1.0500D+00	1.00	1	SSC
13	PRESSURE	NORMAL	NO	7.0000D-01	1.5000D-02	.00	2	SSC
14	STRESS-SS	NORMAL	YES	1.9304D+01	1.2589D+00	.00	3	SSC
15	SCC-COEFF	NORMAL	YES	3.5900D-13	2.3714D+00	.00	4	SSC
16	SCC-EXPNT	- CONSTANT -		2.1610D+00			5	SSC
17	SCC-TIMEI	- CONSTANT -		1.0000D+00			6	SSC
18	ECW-RATE	NORMAL	YES	1.2740D-07	2.3714D+00	.00	7	SSC
19	NOFTRS/HR	- CONSTANT -		6.0000D+01			1	TRC
20	STRESS-FT	NORMAL	YES	4.9497D+00	1.4125D+00	.00	2	TRC
21	NOSTRS/CY	- CONSTANT -		1.3000D+01			3	TRC
22	STRESS-ST	NORMAL	YES	1.3612D+01	1.2589D+00	1.00	4	TRC
23	FCG-COEFF	NORMAL	YES	1.2017D-11	2.8508D+00	1.00	5	TRC
24	FCG-EXPNT	- CONSTANT -		3.7000D+00			6	TRC
25	FCG-THOLD	- CONSTANT -		3.5000D+00			7	TRC
26	LIMIT-DSL	NORMAL	NO	-9.7000D-01	1.0000D-02	.00	1	FMD
27	LIMIT-PBS	- CONSTANT -		0.0000D+00			2	FMD
28	STRESS-DL	- CONSTANT -		0.0000D+00			3	FMD
29	FREQ-DLTR	- CONSTANT -		0.0000D+00			4	FMD

PROBABILITIES OF FAILURE MODE: EXCEED LIMITING DEPTH FOR SMALL LEAK

NUMBER FAILED = 1000 NUMBER OF TRIALS = 4001

END OF CYCLE	FAILURE PROBABILITY WITHOUT IN-SERVICE INSPECTION FOR PERIOD	CUM. TOTAL	AND WITH IN-SERVICE INSPECTION FOR PERIOD	CUM. TOTAL
1.0	5.33621D-09	5.33621D-09	5.33621D-09	5.33621D-09
2.0	2.82790D-08	3.36152D-08	2.82790D-08	3.36152D-08
3.0	9.99994D-09	4.36151D-08	9.99994D-09	4.36151D-08
4.0	1.98672D-08	6.34823D-08	1.98672D-08	6.34823D-08
5.0	3.02691D-08	9.37514D-08	3.02691D-08	9.37514D-08
6.0	2.01516D-08	1.13903D-07	1.06226D-10	9.38576D-08
7.0	4.53731D-08	1.59276D-07	7.14375D-09	1.01001D-07
8.0	1.16573D-07	2.75849D-07	2.94568D-08	1.30458D-07
9.0	3.65160D-08	3.12365D-07	5.31718D-09	1.35775D-07
10.0	2.93348D-07	6.05713D-07	2.08838D-07	3.44613D-07
11.0	9.01800D-08	6.95893D-07	5.50401D-08	3.99653D-07

12.0	2.37006D-07	9.32899D-07	1.40745D-07	5.40398D-07
13.0	4.32973D-08	9.76196D-07	1.28095D-08	5.53207D-07
14.0	4.85964D-07	1.46216D-06	1.43868D-07	6.97075D-07
15.0	2.73085D-08	1.48947D-06	9.11311D-09	7.06188D-07
16.0	4.04441D-08	1.52991D-06	6.34888D-11	7.06251D-07
17.0	3.74264D-08	1.56734D-06	1.13687D-10	7.06365D-07
18.0	5.55489D-07	2.12283D-06	2.79140D-09	7.09156D-07
19.0	2.20199D-07	-2.34303D-06	1.00298D-07	8.09455D-07
20.0	1.47548D-07	2.49058D-06	9.69207D-08	9.06375D-07
21.0	1.66138D-07	2.65671D-06	4.73590D-09	9.11111D-07
22.0	7.20435D-08	2.72876D-06	1.16631D-09	9.12278D-07
23.0	2.21087D-07	2.94984D-06	1.98339D-08	9.32111D-07
24.0	9.67381D-07	3.91722D-06	8.10869D-07	1.74298D-06
25.0	6.67833D-08	3.98401D-06	6.44789D-09	1.74943D-06
26.0	1.28057D-06	5.26457D-06	4.93863D-10	1.74992D-06
27.0	1.52683D-06	6.79141D-06	7.16555D-09	1.75709D-06
28.0	1.75026D-07	6.96643D-06	1.18641D-08	1.76895D-06
29.0	1.29176D-07	7.09561D-06	3.44552D-10	1.76930D-06
30.0	1.12873D-06	8.22433D-06	8.72226D-09	1.77802D-06
31.0	2.90523D-06	1.11296D-05	3.63828D-07	2.14185D-06
32.0	2.20295D-07	1.13499D-05	2.99189D-10	2.14215D-06
33.0	4.42942D-07	1.17928D-05	3.58858D-07	2.50100D-06
34.0	7.57293D-08	1.18685D-05	3.76356D-09	2.50477D-06
35.0	2.03409D-07	1.20719D-05	9.03504D-08	2.59512D-06
36.0	1.89506D-07	1.22614D-05	4.12266D-11	2.59516D-06
37.0	3.82998D-07	1.26444D-05	3.80649D-10	2.59554D-06
38.0	4.60444D-07	1.31049D-05	1.66546D-08	2.61219D-06
39.0	5.77702D-07	1.36826D-05	8.15700D-08	2.69376D-06
40.0	1.28028D-07	1.38106D-05	2.22040D-10	2.69399D-06
	DEVIATION ON CUMULATIVE TOTALS =		3.78282D-07	1.88150D-07

INPUT VARIABLES FOR CASE 4A CARBON STEEL PIPE WELD SMALL LEAK

NCYCLE =	40	NFAILS =	1000	NTRIAL =	5000
NOVARS =	29	NUMSET =	6	NUMISI =	5
NUMSSC =	7	NUMTRC =	7	NUMFMD =	4

VARIABLE NO.	NAME	DISTRIBUTION TYPE	LOG	MEDIAN VALUE	DEVIATION OR FACTOR	SHIFT MV/SD	USAGE NO.	SUB
1	PIPE-DIA	NORMAL	NO	3.0000D+00	1.5000D-02	.00	1	SET
2	WALL/DIA	NORMAL	NO	8.6000D-02	2.5800D-03	.00	2	SET
3	SRESIDUAL	NORMAL	YES	6.1872D+00	1.4125D+00	.00	3	SET
4	INT%DEPTH	NORMAL	YES	1.7000D+01	1.4125D+00	1.00	4	SET
5	L/D-RATIO	NORMAL	YES	6.0000D+00	1.4125D+00	1.00	5	SET
6	PROB/VOL	- CONSTANT -		1.0000D-04			6	SET
7	FIRST-ISI	- CONSTANT -		5.0000D+00			1	ISI
8	FREQ-ISI	- CONSTANT -		1.0000D+01			2	ISI
9	EPST-PND	- CONSTANT -		5.0000D-03			3	ISI
10	ASTAR-PND	- CONSTANT -		-3.2000D-01			4	ISI
11	ANUU-PND	- CONSTANT -		3.0000D+00			5	ISI
12	HOURS/CY	NORMAL	YES	7.4473D+03	1.0500D+00	1.00	1	SSC
13	PRESSURE	NORMAL	NO	7.0000D-01	1.5000D-02	.00	2	SSC
14	STRESS-SS	NORMAL	YES	1.9304D+01	1.2589D+00	.00	3	SSC
15	SCC-COEFF	NORMAL	YES	3.5900D-13	2.3714D+00	.00	4	SSC
16	SCC-EXPNT	- CONSTANT -		2.1610D+00			5	SSC
17	SCC-TIMEI	- CONSTANT -		1.0000D+00			6	SSC
18	ECW-RATE	NORMAL	YES	1.2740D-07	2.3714D+00	.00	7	SSC
19	NOFTRS/HR	- CONSTANT -		6.0000D+01			1	TRC
20	STRESS-FT	NORMAL	YES	6.1872D-02	1.4125D+00	.00	2	TRC
21	NOSTRS/CY	- CONSTANT -		1.3000D+01			3	TRC
22	STRESS-ST	NORMAL	YES	1.3612D+01	1.2589D+00	1.00	4	TRC
23	FCG-COEFF	NORMAL	YES	1.2017D-11	2.8508D+00	1.00	5	TRC
24	FCG-EXPNT	- CONSTANT -		3.7000D+00			6	TRC
25	FCG-THOLD	- CONSTANT -		3.5000D+00			7	TRC
26	LIMIT-DSL	NORMAL	NO	-9.7000D-01	1.0000D-02	.00	1	FMD
27	LIMIT-PBS	- CONSTANT -		0.0000D+00			2	FMD
28	STRESS-DL	- CONSTANT -		0.0000D+00			3	FMD
29	FREQ-DLTR	- CONSTANT -		0.0000D+00			4	FMD

PROBABILITIES OF FAILURE MODE: EXCEED LIMITING DEPTH FOR SMALL LEAK

NUMBER FAILED = 212 NUMBER OF TRIALS = 5000

END OF CYCLE	FAILURE PROBABILITY WITHOUT IN-SERVICE INSPECTION FOR PERIOD	CUM. TOTAL	WITH IN-SERVICE INSPECTION FOR PERIOD	CUM. TOTAL
1.0	1.76082D-12	1.76082D-12	1.76082D-12	1.76082D-12
7.0	1.09289D-09	1.09465D-09	5.49121D-12	7.25202D-12
8.0	5.34339D-09	6.43804D-09	2.81845D-11	3.54366D-11
9.0	2.59125D-09	9.02929D-09	1.66662D-11	5.21028D-11
10.0	4.26094D-09	1.32902D-08	6.20295D-11	1.14132D-10
11.0	1.45571D-09	1.47459D-08	1.15176D-11	1.25650D-10
12.0	1.65809D-07	1.80555D-07	1.52012D-07	1.52137D-07
13.0	9.00222D-10	1.81456D-07	1.52838D-11	1.52153D-07
14.0	1.12454D-08	1.92701D-07	6.45330D-10	1.52798D-07
15.0	2.20617D-07	4.13318D-07	4.61196D-08	1.98918D-07
16.0	7.46818D-09	4.20787D-07	5.91284D-12	1.98924D-07

17.0	2.82734D-10	4.21069D-07	7.09622D-15	1.98924D-07
18.0	2.79411D-08	4.49010D-07	1.97737D-09	2.00901D-07
19.0	8.85232D-10	4.49896D-07	2.59251D-13	2.00901D-07
20.0	8.77729D-08	5.37669D-07	1.51693D-10	2.01053D-07
21.0	6.32410D-09	5.43993D-07	2.69612D-11	2.01080D-07
22.0	1.36435D-07	6.80428D-07	4.79188D-09	2.05872D-07
23.0	1.67732D-07	8.48160D-07	8.01992D-08	2.86071D-07
24.0	2.74418D-08	8.75601D-07	1.16735D-10	2.86188D-07
25.0	3.75165D-07	1.25077D-06	2.20248D-09	2.88390D-07
26.0	8.71373D-09	1.25948D-06	9.59812D-13	2.88391D-07
27.0	6.49087D-08	1.32439D-06	2.83763D-12	2.88394D-07
28.0	7.53753D-08	1.39976D-06	3.98994D-11	2.88434D-07
29.0	8.43775D-07	2.24354D-06	3.29445D-10	2.88763D-07
30.0	1.63419D-06	3.87772D-06	4.63364D-08	3.35100D-07
31.0	2.90218D-08	3.90675D-06	9.24233D-12	3.35109D-07
32.0	1.23540D-07	4.03029D-06	6.27466D-12	3.35115D-07
33.0	4.18127D-08	4.07210D-06	8.71362D-11	3.35202D-07
34.0	1.38674D-07	4.21077D-06	4.40549D-10	3.35643D-07
35.0	1.12562D-07	4.32334D-06	8.67580D-11	3.35730D-07
36.0	2.07653D-08	4.34410D-06	1.14623D-14	3.35730D-07
37.0	5.33808D-07	4.87791D-06	3.22663D-08	3.67996D-07
38.0	8.84622D-08	4.96637D-06	2.29820D-08	3.90978D-07
39.0	2.15771D-06	7.12408D-06	2.36458D-10	3.91215D-07
40.0	8.76001D-07	8.00008D-06	3.56712D-11	3.91250D-07
	DEVIATION ON CUMULATIVE TOTALS =		5.37727D-07	1.21395D-07

INPUT VARIABLES FOR CASE 5A CARBON STEEL PIPE WELD FULL BREAK

NCYCLE =	40	NFAILS =	1000	NTRIAL =	5000
NOVARS =	29	NUMSET =	6	NUMISI =	5
NUMSSC =	7	NUMTRC =	7	NUMFMD =	4

VARIABLE NO.	NAME	DISTRIBUTION TYPE	LOG	MEDIAN VALUE	DEVIATION OR FACTOR	SHIFT MV/SD	USAGE NO.	SUB
1	PIPE-DIA	NORMAL	NO	3.0000D+00	1.5000D-02	.00	1	SET
2	WALL/DIA	NORMAL	NO	8.6000D-02	2.5800D-03	.00	2	SET
3	SRESIDUAL	NORMAL	YES	6.1872D+00	1.4125D+00	.00	3	SET
4	INT%DEPTH	NORMAL	YES	1.7000D+01	1.4125D+00	1.00	4	SET
5	L/D-RATIO	NORMAL	YES	6.0000D+00	1.4125D+00	1.00	5	SET
6	PROB/VOL	- CONSTANT -		1.0000D-04			6	SET
7	FIRST-ISI	- CONSTANT -		5.0000D+00			1	ISI
8	FREQ-ISI	- CONSTANT -		1.0000D+01			2	ISI
9	EPST-PND	- CONSTANT -		5.0000D-03			3	ISI
10	ASTAR-PND	- CONSTANT -		-3.2000D-01			4	ISI
11	ANUU-PND	- CONSTANT -		3.0000D+00			5	ISI
12	HOURS/CY	NORMAL	YES	7.4473D+03	1.0500D+00	1.00	1	SSC
13	PRESSURE	NORMAL	NO	7.0000D-01	1.5000D-02	.00	2	SSC
14	STRESS-SS	NORMAL	YES	1.9304D+01	1.2589D+00	.00	3	SSC
15	SCC-COEFF	NORMAL	YES	3.5900D-13	2.3714D+00	.00	4	SSC
16	SCC-EXPNT	- CONSTANT -		2.1610D+00			5	SSC
17	SCC-TIMEI	- CONSTANT -		1.0000D+00			6	SSC
18	ECW-RATE	NORMAL	YES	1.2740D-07	2.3714D+00	.00	7	SSC
19	NOFTRS/HR	- CONSTANT -		6.0000D+01			1	TRC
20	STRESS-FT	NORMAL	YES	6.1872D-02	1.4125D+00	.00	2	TRC
21	NOSTRS/CY	- CONSTANT -		1.3000D+01			3	TRC
22	STRESS-ST	NORMAL	YES	1.3612D+01	1.2589D+00	1.00	4	TRC
23	FCG-COEFF	NORMAL	YES	1.2017D-11	2.8508D+00	1.00	5	TRC
24	FCG-EXPNT	- CONSTANT -		3.7000D+00			6	TRC
25	FCG-THOLD	- CONSTANT -		3.5000D+00			7	TRC
26	LIMIT-DSL	- CONSTANT -		0.0000D+00			1	FMD
27	LIMIT-PBS	NORMAL	NO	6.1872D+01	3.2000D+00	-1.00	2	FMD
28	STRESS-DL	NORMAL	YES	1.3921D+01	1.4125D+00	1.00	3	FMD
29	FREQ-DLTR	- CONSTANT -		1.0000D-03			4	FMD

PROBABILITIES OF FAILURE MODE: EXCEED FLOW STRESS LIMIT FOR FULL BREAK

NUMBER FAILED = 4 NUMBER OF TRIALS = 5000

END OF CYCLE	FAILURE PROBABILITY WITHOUT AND FOR PERIOD	CUM. TOTAL	WITH IN-SERVICE INSPECTION FOR PERIOD	CUM. TOTAL
1.0	5.77248D-13	5.77248D-13	5.77248D-13	5.77248D-13
40.0	0.00000D+00	5.77248D-13	0.00000D+00	5.77248D-13
	DEVIATION ON CUMULATIVE TOTALS =		2.88537D-13	2.88537D-13

INPUT VARIABLES FOR CASE 6 CARBON STEEL PIPE WELD FULL BREAK

NCYCLE =	40	NFAILS =	1000	NTRIAL =	5000
NOVARS =	29	NUMSET =	6	NUMISI =	5
NUMSSC =	7	NUMTRC =	7	NUMFMD =	4

VARIABLE NO.	NAME	DISTRIBUTION TYPE	LOG	MEDIAN VALUE	DEVIATION OR FACTOR	SHIFT MV/SD	USAGE NO.	SUB
1	PIPE-DIA	NORMAL	NO	3.0000D+00	1.5000D-02	.00	1	SET
2	WALL/DIA	NORMAL	NO	8.6000D-02	2.5800D-03	.00	2	SET
3	SRESIDUAL	NORMAL	YES	6.1872D+00	1.4125D+00	.00	3	SET
4	INT%DEPTH	NORMAL	YES	1.7000D+01	1.4125D+00	1.00	4	SET
5	L/D-RATIO	NORMAL	YES	6.0000D+00	1.4125D+00	1.00	5	SET
6	PROB/VOL	- CONSTANT -		1.0000D-04			6	SET
7	FIRST-ISI	- CONSTANT -		5.0000D+00			1	ISI
8	FREQ-ISI	- CONSTANT -		1.0000D+01			2	ISI
9	EPST-PND	- CONSTANT -		5.0000D-03			3	ISI
10	ASTAR-PND	- CONSTANT -		-3.2000D-01			4	ISI
11	ANUU-PND	- CONSTANT -		3.0000D+00			5	ISI
12	HOURS/CY	NORMAL	YES	7.4473D+03	1.0500D+00	1.00	1	SSC
13	PRESSURE	NORMAL	NO	7.0000D-01	1.5000D-02	.00	2	SSC
14	STRESS-SS	NORMAL	YES	1.9304D+01	1.2589D+00	.00	3	SSC
15	SCC-COEFF	NORMAL	YES	3.5900D-13	2.3714D+00	.00	4	SSC
16	SCC-EXPNT	- CONSTANT -		2.1610D+00			5	SSC
17	SCC-TIMEI	- CONSTANT -		1.0000D+00			6	SSC
18	ECW-RATE	NORMAL	YES	1.2740D-07	2.3714D+00	.00	7	SSC
19	NOFTRS/HR	- CONSTANT -		6.0000D+01			1	TRC
20	STRESS-FT	NORMAL	YES	4.9497D+00	1.4125D+00	.00	2	TRC
21	NOSTRS/CY	- CONSTANT -		1.3000D+01			3	TRC
22	STRESS-ST	NORMAL	YES	6.1872D+00	1.2589D+00	1.00	4	TRC
23	FCG-COEFF	NORMAL	YES	1.2017D-11	2.8508D+00	1.00	5	TRC
24	FCG-EXPNT	- CONSTANT -		3.7000D+00			6	TRC
25	FCG-THOLD	- CONSTANT -		3.5000D+00			7	TRC
26	LIMIT-DSL	- CONSTANT -		0.0000D+00			1	FMD
27	LIMIT-PBS	NORMAL	NO	6.1872D+01	3.2000D+00	-1.00	2	FMD
28	STRESS-DL	NORMAL	YES	1.3921D+01	1.4125D+00	1.00	3	FMD
29	FREQ-DLTR	- CONSTANT -		1.0000D-03			4	FMD

PROBABILITIES OF FAILURE MODE: EXCEED FLOW STRESS LIMIT FOR FULL BREAK

NUMBER FAILED = 730 NUMBER OF TRIALS = 5000

END OF CYCLE	FAILURE PROBABILITY WITHOUT IN-SERVICE INSPECTION FOR PERIOD	CUM. TOTAL	AND WITH IN-SERVICE INSPECTION FOR PERIOD	CUM. TOTAL
1.0	5.77248D-13	5.77248D-13	5.77248D-13	5.77248D-13
2.0	5.46153D-13	1.12340D-12	5.46153D-13	1.12340D-12
3.0	1.39346D-12	2.51686D-12	1.39346D-12	2.51686D-12
4.0	2.37371D-11	2.62540D-11	2.37371D-11	2.62540D-11
5.0	1.19330D-11	3.81869D-11	1.19330D-11	3.81869D-11
6.0	5.62425D-12	4.38112D-11	2.81250D-14	3.82151D-11
7.0	1.48387D-11	5.86499D-11	7.42040D-14	3.82893D-11
8.0	1.01711D-11	6.88210D-11	5.23619D-14	3.83416D-11
9.0	2.93011D-11	9.81220D-11	1.94262D-13	3.85359D-11
10.0	6.29237D-11	1.61046D-10	2.17582D-11	6.02941D-11
11.0	1.78406D-11	1.78886D-10	5.83083D-12	6.61249D-11

12.0	1.66696D-10	3.45582D-10	1.68619D-11	8.29898D-11
13.0	1.66445D-10	5.12026D-10	5.64067D-11	1.39397D-10
14.0	1.45492D-11	5.26576D-10	2.13708D-12	1.41534D-10
15.0	1.61584D-11	5.42734D-10	8.92588D-12	1.50460D-10
16.0	2.40726D-10	7.83460D-10	5.96682D-13	1.51056D-10
17.0	7.00046D-12	7.90460D-10	1.17445D-14	1.51068D-10
18.0	6.78854D-11	8.58346D-10	2.51857D-13	1.51320D-10
19.0	3.71188D-11	-8.95464D-10	1.39496D-13	1.51459D-10
20.0	6.92899D-11	9.64754D-10	1.36109D-13	1.51595D-10
21.0	4.95187D-11	1.01427D-09	1.56944D-13	1.51752D-10
22.0	2.79004D-11	1.04217D-09	9.59814D-14	1.51848D-10
23.0	6.50975D-12	1.04868D-09	8.42256D-15	1.51857D-10
24.0	8.05422D-12	1.05674D-09	7.38584D-14	1.51931D-10
25.0	2.70071D-11	1.08374D-09	4.68541D-13	1.52399D-10
26.0	1.53808D-11	1.09913D-09	1.45769D-15	1.52401D-10
27.0	1.62739D-11	1.11540D-09	1.14662D-15	1.52402D-10
28.0	1.43926D-11	1.12979D-09	1.17260D-15	1.52403D-10
29.0	4.44132D-11	1.17421D-09	1.18046D-14	1.52415D-10
30.0	7.09100D-10	1.88331D-09	2.62784D-12	1.55043D-10
31.0	1.11706D-10	1.99501D-09	1.00495D-13	1.55143D-10
32.0	2.03892D-11	2.01540D-09	2.35063D-13	1.55378D-10
33.0	4.21995D-11	2.05760D-09	7.44558D-14	1.55453D-10
34.0	2.61749D-10	2.31935D-09	2.33811D-13	1.55686D-10
35.0	3.57910D-12	2.32293D-09	2.12942D-15	1.55689D-10
36.0	1.73833D-12	2.32467D-09	3.26496D-17	1.55689D-10
37.0	1.06903D-11	2.33536D-09	6.90731D-16	1.55689D-10
38.0	9.69264D-12	2.34505D-09	9.61244D-17	1.55689D-10
39.0	1.88258D-11	2.36387D-09	6.81776D-15	1.55696D-10
40.0	1.77373D-11	2.38161D-09	8.73537D-15	1.55705D-10
	DEVIATION ON CUMULATIVE TOTALS =		8.14670D-11	2.24329D-11

INPUT VARIABLES FOR CASE 7A CARBON STEEL PIPE WELD FULL BREAK

NCYCLE =	40	NFAILS =	1000	NTRIAL =	5000
NOVARS =	29	NUMSET =	6	NUMISI =	5
NUMSSC =	7	NUMTRC =	7	NUMFMD =	4

VARIABLE NO.	NAME	DISTRIBUTION TYPE	LOG	MEDIAN VALUE	DEVIATION OR FACTOR	SHIFT MV/SD	USAGE NO.	SUB
1	PIPE-DIA	NORMAL	NO	3.0000D+00	1.5000D-02	.00	1	SET
2	WALL/DIA	NORMAL	NO	8.6000D-02	2.5800D-03	.00	2	SET
3	SRESIDUAL	NORMAL	YES	6.1872D+00	1.4125D+00	.00	3	SET
4	INT%DEPTH	NORMAL	YES	1.7000D+01	1.4125D+00	1.00	4	SET
5	L/D-RATIO	NORMAL	YES	6.0000D+00	1.4125D+00	1.00	5	SET
6	PROB/VOL	- CONSTANT -		1.0000D-04			6	SET
7	FIRST-ISI	- CONSTANT -		5.0000D+00			1	ISI
8	FREQ-ISI	- CONSTANT -		1.0000D+01			2	ISI
9	EPST-PND	- CONSTANT -		5.0000D-03			3	ISI
10	ASTAR-PND	- CONSTANT -		3.2000D-01			4	ISI
11	ANUU-PND	- CONSTANT -		3.0000D+00			5	ISI
12	HOURS/CY	NORMAL	YES	7.4473D+03	1.0500D+00	1.00	1	SSC
13	PRESSURE	NORMAL	NO	7.0000D-01	1.5000D-02	.00	2	SSC
14	STRESS-SS	NORMAL	YES	1.9304D+01	1.2589D+00	.00	3	SSC
15	SCC-COEFF	NORMAL	YES	3.5900D-13	2.3714D+00	.00	4	SSC
16	SCC-EXPNT	- CONSTANT -		2.1610D+00			5	SSC
17	SCC-TIMEI	- CONSTANT -		1.0000D+00			6	SSC
18	ECW-RATE	NORMAL	YES	1.2740D-07	2.3714D+00	.00	7	SSC
19	NOFTRS/HR	- CONSTANT -		6.0000D+01			1	TRC
20	STRESS-FT	NORMAL	YES	4.9497D+00	1.4125D+00	.00	2	TRC
21	NOSTRS/CY	- CONSTANT -		1.3000D+01			3	TRC
22	STRESS-ST	NORMAL	YES	2.1036D+01	1.2589D+00	1.00	4	TRC
23	FCG-COEFF	NORMAL	YES	1.2017D-11	2.8508D+00	1.00	5	TRC
24	FCG-EXPNT	- CONSTANT -		3.7000D+00			6	TRC
25	FCG-THOLD	- CONSTANT -		3.5000D+00			7	TRC
26	LIMIT-DSL	- CONSTANT -		0.0000D+00			1	FMD
27	LIMIT-PBS	NORMAL	NO	6.1872D+01	3.2000D+00	-1.00	2	FMD
28	STRESS-DL	NORMAL	YES	1.3921D+01	1.4125D+00	1.00	3	FMD
29	FREQ-DLTR	- CONSTANT -		1.0000D-03			4	FMD

PROBABILITIES OF FAILURE MODE: EXCEED FLOW STRESS LIMIT FOR FULL BREAK

NUMBER FAILED = 742 NUMBER OF TRIALS = 5000

END OF CYCLE	FAILURE PROBABILITY WITHOUT IN-SERVICE INSPECTION FOR PERIOD	CUM. TOTAL	AND WITH IN-SERVICE INSPECTION FOR PERIOD	CUM. TOTAL
1.0	5.77248D-13	5.77248D-13	5.77248D-13	5.77248D-13
2.0	5.27153D-13	1.10440D-12	5.27153D-13	1.10440D-12
3.0	1.41246D-12	2.51686D-12	1.41246D-12	2.51686D-12
4.0	2.37371D-11	2.62540D-11	2.37371D-11	2.62540D-11
5.0	1.19330D-11	3.81869D-11	1.19330D-11	3.81869D-11
6.0	6.41034D-12	4.45973D-11	3.20560D-14	3.82190D-11
7.0	1.40526D-11	5.86499D-11	7.02731D-14	3.82893D-11
8.0	1.01710D-11	6.88210D-11	5.22842D-14	3.83416D-11
9.0	2.96783D-11	9.84993D-11	2.84414D-13	3.86260D-11
10.0	6.26327D-11	1.61132D-10	2.16181D-11	6.02441D-11
11.0	1.81621D-11	1.79294D-10	5.86861D-12	6.61127D-11

12.0	3.16820D-10	4.96114D-10	7.11891D-11	1.37302D-10
13.0	1.60015D-11	5.12116D-10	1.91032D-12	1.39212D-10
14.0	1.72906D-11	5.29407D-10	4.53963D-12	1.43752D-10
15.0	1.29079D-11	5.42315D-10	5.95043D-12	1.49702D-10
16.0	2.40860D-10	7.83175D-10	5.98645D-13	1.50301D-10
17.0	9.62828D-12	7.92803D-10	1.20406D-14	1.50313D-10
18.0	6.78205D-11	8.60624D-10	2.51962D-13	1.50565D-10
19.0	3.67569D-11	-8.97380D-10	1.39556D-13	1.50704D-10
20.0	6.80901D-11	9.65471D-10	1.35743D-13	1.50840D-10
21.0	4.29629D-11	1.00843D-09	1.14109D-13	1.50954D-10
22.0	3.31071D-11	1.04154D-09	1.41032D-13	1.51095D-10
23.0	5.06784D-12	1.04661D-09	3.21689D-15	1.51098D-10
24.0	7.06097D-12	1.05367D-09	8.04801D-14	1.51179D-10
25.0	2.93174D-11	1.08299D-09	4.40943D-13	1.51620D-10
26.0	2.84728D-11	1.11146D-09	1.85962D-15	1.51622D-10
27.0	4.48151D-12	1.11594D-09	4.04580D-16	1.51622D-10
28.0	3.19237D-11	1.14786D-09	1.06253D-14	1.51633D-10
29.0	3.32899D-11	1.18115D-09	3.84674D-15	1.51637D-10
30.0	7.11025D-10	1.89218D-09	2.85091D-12	1.54487D-10
31.0	1.03563D-10	1.99574D-09	7.91392D-14	1.54567D-10
32.0	2.03032D-11	2.01605D-09	2.48618D-14	1.54591D-10
33.0	4.92013D-11	2.06525D-09	6.66456D-14	1.54658D-10
34.0	2.53717D-10	2.31896D-09	2.21075D-13	1.54879D-10
35.0	2.21783D-12	2.32118D-09	4.68031D-15	1.54884D-10
36.0	1.82517D-12	2.32301D-09	1.71718D-17	1.54884D-10
37.0	1.70251D-11	2.34003D-09	3.17397D-16	1.54884D-10
38.0	9.76349D-12	2.34980D-09	7.69217D-16	1.54885D-10
39.0	7.17845D-12	2.35697D-09	7.66355D-15	1.54893D-10
40.0	1.11461D-11	2.36812D-09	1.10406D-14	1.54904D-10
	DEVIATION ON CUMULATIVE TOTALS =		8.02349D-11	2.21287D-11

STRUCTURAL RELIABILITY AND RISK ASSESSMENT (SRRA)

WESTINGHOUSE PROBABILITY OF FAILURE PROGRAM SPFMPROF ESBU-NTD

INPUT VARIABLES FOR CASE 18 CARBON STEEL PIPE WELD FULL BREAK

NCYCLE =	40	NFAILS =	1000	NTRIAL =	5000
NOVARS =	29	NUMSET =	6	NUMISI =	5
NUMSSC =	7	NUMTRC =	7	NUMFMD =	4

VARIABLE NO.	NAME	DISTRIBUTION TYPE	LOG	MEDIAN VALUE	DEVIATION OR FACTOR	SHIFT MV/SD	USAGE NO.	SUB
1	PIPE-DIA	NORMAL	NO	3.0000D+01	1.5000D-01	.00	1	SET
2	WALL/DIA	NORMAL	NO	3.3000D-02	9.9000D-04	.00	2	SET
3	SRESIDUAL	NORMAL	YES	6.1872D+00	1.4125D+00	.00	3	SET
4	INT%DEPTH	NORMAL	YES	5.0000D+00	1.4125D+00	1.00	4	SET
5	L/D-RATIO	NORMAL	YES	6.0000D+00	1.4125D+00	1.00	5	SET
6	PROB/VOL	- CONSTANT -		1.0000D-04			6	SET
7	FIRST-ISI	- CONSTANT -		5.0000D+00			1	ISI
8	FREQ-ISI	- CONSTANT -		1.0000D+01			2	ISI
9	EPST-PND	- CONSTANT -		5.0000D-03			3	ISI
10	ASTAR-PND	- CONSTANT -		-2.4000D-01			4	ISI
11	ANUU-PND	- CONSTANT -		3.0000D+00			5	ISI
12	HOURS/CY	NORMAL	YES	7.4473D+03	1.0500D+00	1.00	1	SSC
13	PRESSURE	NORMAL	NO	7.0000D-01	1.5000D-02	.00	2	SSC
14	STRESS-SS	NORMAL	YES	6.0634D+00	1.2589D+00	.00	3	SSC
15	SCC-COEFF	NORMAL	YES	3.5900D-13	2.3714D+00	.00	4	SSC
16	SCC-EXPNT	- CONSTANT -		2.1610D+00			5	SSC
17	SCC-TIMEI	- CONSTANT -		1.0000D+00			6	SSC
18	ECW-RATE	NORMAL	YES	1.2740D-07	2.3714D+00	.00	7	SSC
19	NOFTRS/HR	- CONSTANT -		6.0000D+01			1	TRC
20	STRESS-FT	NORMAL	YES	6.1872D-02	1.4125D+00	.00	2	TRC
21	NOSTRS/CY	- CONSTANT -		5.0000D+00			3	TRC
22	STRESS-ST	NORMAL	YES	1.3612D+01	1.2589D+00	1.00	4	TRC
23	FCG-COEFF	NORMAL	YES	1.2017D-11	2.8508D+00	1.00	5	TRC
24	FCG-EXPNT	- CONSTANT -		3.7000D+00			6	TRC
25	FCG-THOLD	- CONSTANT -		3.5000D+00			7	TRC
26	LIMIT-DSL	- CONSTANT -		0.0000D+00			1	FMD
27	LIMIT-PBS	NORMAL	NO	6.1872D+01	3.2000D+00	-1.00	2	FMD
28	STRESS-DL	NORMAL	YES	1.2374D+01	1.4125D+00	1.00	3	FMD
29	FREQ-DLTR	- CONSTANT -		1.0000D-03			4	FMD

PROBABILITIES OF FAILURE MODE: EXCEED FLOW STRESS LIMIT FOR FULL BREAK

NUMBER FAILED = 0 NUMBER OF TRIALS = 5000

END OF CYCLE	FAILURE PROBABILITY WITHOUT AND WITH IN-SERVICE INSPECTION FOR PERIOD	CUM. TOTAL	FOR PERIOD	CUM. TOTAL
.0	5.21060D-11	5.21060D-11	5.21060D-11	5.21060D-11
40.0	0.00000D+00	5.21060D-11	0.00000D+00	5.21060D-11

INPUT VARIABLES FOR CASE 25 CARBON STEEL PIPE WELD FULL BREAK

NCYCLE =	40	NFAILS =	1000	NTRIAL =	5000
NOVARS =	29	NUMSET =	6	NUMISI =	5
NUMSSC =	7	NUMTRC =	7	NUMFMD =	4

VARIABLE NO.	NAME	DISTRIBUTION TYPE	LOG	MEDIAN VALUE	DEVIATION OR FACTOR	SHIFT MV/SD	USAGE NO.	SUB
1	PIPE-DIA	NORMAL	NO	3.0000D+01	1.5000D-01	.00	1	SET
2	WALL/DIA	NORMAL	NO	3.3000D-02	9.9000D-04	.00	2	SET
3	SRESIDUAL	NORMAL	YES	6.1872D+00	1.4125D+00	.00	3	SET
4	INT%DEPTH	NORMAL	YES	5.0000D+00	1.4125D+00	1.00	4	SET
5	L/D-RATIO	NORMAL	YES	6.0000D+00	1.4125D+00	1.00	5	SET
6	PROB/VOL	- CONSTANT -		1.0000D-04			6	SET
7	FIRST-ISI	- CONSTANT -		5.0000D+00			1	ISI
8	FREQ-ISI	- CONSTANT -		1.0000D+01			2	ISI
9	EPST-PND	- CONSTANT -		5.0000D-03			3	ISI
10	ASTAR-PND	- CONSTANT -		-2.4000D-01			4	ISI
11	ANUU-PND	- CONSTANT -		3.0000D+00			5	ISI
12	HOURS/CY	NORMAL	YES	7.4473D+03	1.0500D+00	1.00	1	SSC
13	PRESSURE	NORMAL	NO	7.0000D-01	1.5000D-02	.00	2	SSC
14	STRESS-SS	NORMAL	YES	6.0634D+00	1.2589D+00	.00	3	SSC
15	SCC-COEFF	NORMAL	YES	3.5900D-13	2.3714D+00	.00	4	SSC
16	SCC-EXPNT	- CONSTANT -		2.1610D+00			5	SSC
17	SCC-TIMEI	- CONSTANT -		1.0000D+00			6	SSC
18	ECW-RATE	NORMAL	YES	1.2740D-07	2.3714D+00	.00	7	SSC
19	NOFTRS/HR	- CONSTANT -		6.0000D+01			1	TRC
20	STRESS-FT	NORMAL	YES	6.1872D-02	1.4125D+00	.00	2	TRC
21	NOSTRS/CY	- CONSTANT -		5.0000D+00			3	TRC
22	STRESS-ST	NORMAL	YES	1.3612D+01	1.2589D+00	1.00	4	TRC
23	FCG-COEFF	NORMAL	YES	1.2017D-11	2.8508D+00	1.00	5	TRC
24	FCG-EXPNT	- CONSTANT -		3.7000D+00			6	TRC
25	FCG-THOLD	- CONSTANT -		3.5000D+00			7	TRC
26	LIMIT-DSL	- CONSTANT -		0.0000D+00			1	FMD
27	LIMIT-PBS	NORMAL	NO	6.1872D+01	3.2000D+00	-1.00	2	FMD
28	STRESS-DL	NORMAL	YES	3.0936D+01	1.4125D+00	1.00	3	FMD
29	FREQ-DLTR	- CONSTANT -		1.0000D-03			4	FMD

PROBABILITIES OF FAILURE MODE: EXCEED FLOW STRESS LIMIT FOR FULL BREAK

NUMBER FAILED = 34 NUMBER OF TRIALS = 5000

END OF CYCLE	FAILURE PROBABILITY WITHOUT AND FOR PERIOD	CUM. TOTAL	WITH IN-SERVICE INSPECTION FOR PERIOD	CUM. TOTAL
1.0	1.05945D-08	1.05945D-08	1.05945D-08	1.05945D-08
40.0	0.00000D+00	1.05945D-08	0.00000D+00	1.05945D-08
	DEVIATION ON CUMULATIVE TOTALS =		1.81093D-09	1.81093D-09

INPUT VARIABLES FOR CASE 35 CARBON STEEL PIPE WELD FULL BREAK

NCYCLE =	40	NFAILS =	1000	NTRIAL =	5000
NOVARS =	29	NUMSET =	6	NUMISI =	5
NUMSSC =	7	NUMTRC =	7	NUMFMD =	4

VARIABLE NO.	NAME	DISTRIBUTION TYPE	LOG	MEDIAN VALUE	DEVIATION OR FACTOR	SHIFT MV/SD	USAGE NO.	SUB
1	PIPE-DIA	NORMAL	NO	3.0000D+00	1.5000D-02	.00	1	SET
2	WALL/DIA	NORMAL	NO	8.6000D-02	2.5800D-03	.00	2	SET
3	SRESIDUAL	NORMAL	YES	6.1872D+00	1.4125D+00	.00	3	SET
4	INT%DEPTH	NORMAL	YES	1.7000D+01	1.4125D+00	1.00	4	SET
5	L/D-RATIO	NORMAL	YES	6.0000D+00	1.4125D+00	1.00	5	SET
6	PROB/VOL	- CONSTANT -		1.0000D-04			6	SET
7	FIRST-ISI	- CONSTANT -		5.0000D+00			1	ISI
8	FREQ-ISI	- CONSTANT -		1.0000D+01			2	ISI
9	EPST-PND	- CONSTANT -		5.0000D-03			3	ISI
10	ASTAR-PND	- CONSTANT -		-3.2000D-01			4	ISI
11	ANUU-PND	- CONSTANT -		3.0000D+00			5	ISI
12	HOURS/CY	NORMAL	YES	7.4473D+03	1.0500D+00	1.00	1	SSC
13	PRESSURE	NORMAL	NO	7.0000D-01	1.5000D-02	.00	2	SSC
14	STRESS-SS	NORMAL	YES	1.9304D+01	1.2589D+00	.00	3	SSC
15	SCC-COEFF	NORMAL	YES	3.5900D-13	2.3714D+00	.00	4	SSC
16	SCC-EXPNT	- CONSTANT -		2.1610D+00			5	SSC
17	SCC-TIMEI	- CONSTANT -		1.0000D+00			6	SSC
18	ECW-RATE	NORMAL	YES	1.2740D-07	2.3714D+00	.00	7	SSC
19	NOFTRS/HR	- CONSTANT -		6.0000D+01			1	TRC
20	STRESS-FT	NORMAL	YES	4.9497D+00	1.4125D+00	.00	2	TRC
21	NOSTRS/CY	- CONSTANT -		1.3000D+01			3	TRC
22	STRESS-ST	NORMAL	YES	1.3612D+01	1.2589D+00	1.00	4	TRC
23	FCG-COEFF	NORMAL	YES	1.2017D-11	2.8508D+00	1.00	5	TRC
24	FCG-EXPNT	- CONSTANT -		3.7000D+00			6	TRC
25	FCG-THOLD	- CONSTANT -		3.5000D+00			7	TRC
26	LIMIT-DSL	- CONSTANT -		0.0000D+00			1	FMD
27	LIMIT-PBS	NORMAL	NO	6.1872D+01	3.2000D+00	-1.00	2	FMD
28	STRESS-DL	NORMAL	YES	1.3921D+01	1.4125D+00	1.00	3	FMD
29	FREQ-DLTR	- CONSTANT -		1.0000D-03			4	FMD

PROBABILITIES OF FAILURE MODE: EXCEED FLOW STRESS LIMIT FOR FULL BREAK

NUMBER FAILED = 731 NUMBER OF TRIALS = 5000

END OF CYCLE	FAILURE PROBABILITY WITHOUT AND FOR PERIOD	CUM. TOTAL	WITH IN-SERVICE INSPECTION FOR PERIOD	CUM. TOTAL
1.0	5.77248D-13	5.77248D-13	5.77248D-13	5.77248D-13
2.0	5.46153D-13	1.12340D-12	5.46153D-13	1.12340D-12
3.0	1.39346D-12	2.51686D-12	1.39346D-12	2.51686D-12
4.0	2.37371D-11	2.62540D-11	2.37371D-11	2.62540D-11
5.0	1.19330D-11	3.81869D-11	1.19330D-11	3.81869D-11
6.0	5.62425D-12	4.38112D-11	2.81250D-14	3.82151D-11
7.0	1.48387D-11	5.86499D-11	7.42042D-14	3.82893D-11
8.0	1.01710D-11	6.88210D-11	5.23467D-14	3.83416D-11
9.0	2.96670D-11	9.84879D-11	2.85058D-13	3.86267D-11
10.0	6.25578D-11	1.61046D-10	2.16573D-11	6.02840D-11
11.0	1.78412D-11	1.78887D-10	5.82779D-12	6.61118D-11

12.0	3.16543D-10	4.95430D-10	7.12874D-11	1.37399D-10
13.0	1.62990D-11	5.11729D-10	1.91481D-12	1.39314D-10
14.0	1.45539D-11	5.26283D-10	2.13603D-12	1.41450D-10
15.0	1.61537D-11	5.42437D-10	8.92237D-12	1.50372D-10
16.0	2.40733D-10	7.83170D-10	5.97122D-13	1.50969D-10
17.0	7.25721D-12	7.90427D-10	1.17482D-14	1.50981D-10
18.0	6.79336D-11	8.58360D-10	2.51834D-13	1.51233D-10
19.0	3.70697D-11	8.95430D-10	1.39477D-13	1.51373D-10
20.0	6.94872D-11	9.64917D-10	1.36212D-13	1.51509D-10
21.0	3.93729D-11	1.00429D-09	9.19925D-14	1.51601D-10
22.0	3.77725D-11	1.04206D-09	1.59810D-13	1.51761D-10
23.0	7.43169D-12	1.04949D-09	1.98743D-14	1.51780D-10
24.0	7.29545D-12	1.05679D-09	5.62441D-14	1.51837D-10
25.0	2.70088D-11	1.08380D-09	4.99322D-13	1.52336D-10
26.0	1.53961D-11	1.09919D-09	1.45080D-15	1.52337D-10
27.0	1.63852D-11	1.11558D-09	9.84884D-16	1.52338D-10
28.0	1.42895D-11	1.12987D-09	1.17533D-15	1.52340D-10
29.0	4.66282D-11	1.17650D-09	1.19120D-14	1.52352D-10
30.0	7.06984D-10	1.88348D-09	2.62670D-12	1.54978D-10
31.0	1.11649D-10	1.99513D-09	9.95682D-14	1.55078D-10
32.0	2.03857D-11	2.01552D-09	2.34920D-13	1.55313D-10
33.0	4.25871D-11	2.05810D-09	7.35489D-14	1.55386D-10
34.0	2.62944D-10	2.32105D-09	2.34860D-13	1.55621D-10
35.0	2.33644D-12	2.32338D-09	4.30508D-16	1.55622D-10
36.0	1.76054D-12	2.32514D-09	3.12480D-17	1.55622D-10
37.0	1.01221D-11	2.33527D-09	6.89680D-16	1.55622D-10
38.0	1.05803D-11	2.34585D-09	1.06711D-16	1.55622D-10
39.0	1.82876D-11	2.36413D-09	6.82076D-15	1.55629D-10
40.0	1.76575D-11	2.38179D-09	8.69247D-15	1.55638D-10
	DEVIATION ON CUMULATIVE TOTALS =		8.14079D-11	2.24135D-11

INPUT VARIABLES FOR CASE 48 CARBON STEEL PIPE WELD FULL BREAK

NCYCLE = 40 NFAILS = 1000 NTRIAL = 5000
NOVARS = 29 NUMSET = 6 NUMISI = 5
NUMSSC = 7 NUMTRC = 7 NUMFMD = 4

VARIABLE NO.	NAME	DISTRIBUTION TYPE	LOG	MEDIAN VALUE	DEVIATION OR FACTOR	SHIFT MV/SD	USAGE NO.	SUB
1	PIPE-DIA	NORMAL	NO	3.0000D+00	1.5000D-02	.00	1	SET
2	WALL/DIA	NORMAL	NO	8.6000D-02	2.5800D-03	.00	2	SET
3	SRESIDUAL	NORMAL	YES	6.1872D+00	1.4125D+00	.00	3	SET
4	INT%DEPTH	NORMAL	YES	1.7000D+01	1.4125D+00	1.00	4	SET
5	L/D-RATIO	NORMAL	YES	6.0000D+00	1.4125D+00	1.00	5	SET
6	PROB/VOL	- CONSTANT -		1.0000D-04			6	SET
7	FIRST-ISI	- CONSTANT -		5.0000D+00			1	ISI
8	FREQ-ISI	- CONSTANT -		1.0000D+01			2	ISI
9	EPST-PND	- CONSTANT -		5.0000D-03			3	ISI
10	ASTAR-PND	- CONSTANT -		-3.2000D-01			4	ISI
11	ANUU-PND	- CONSTANT -		3.0000D+00			5	ISI
12	HOURS/CY	NORMAL	YES	7.4473D+03	1.0500D+00	1.00	1	SSC
13	PRESSURE	NORMAL	NO	7.0000D-01	1.5000D-02	.00	2	SSC
14	STRESS-SS	NORMAL	YES	1.9304D+01	1.2589D+00	.00	3	SSC
15	SCC-COEFF	NORMAL	YES	3.5900D-13	2.3714D+00	.00	4	SSC
16	SCC-EXPNT	- CONSTANT -		2.1610D+00			5	SSC
17	SCC-TIMEI	- CONSTANT -		1.0000D+00			6	SSC
18	ECW-RATE	NORMAL	YES	1.2740D-07	2.3714D+00	.00	7	SSC
19	NOFTRS/HR	- CONSTANT -		6.0000D+01			1	TRC
20	STRESS-FT	NORMAL	YES	4.9497D+00	1.4125D+00	.00	2	TRC
21	NOSTRS/CY	- CONSTANT -		1.3000D+01			3	TRC
22	STRESS-ST	NORMAL	YES	1.3612D+01	1.2589D+00	1.00	4	TRC
23	FCG-COEFF	NORMAL	YES	1.2017D-11	2.8508D+00	1.00	5	TRC
24	FCG-EXPNT	- CONSTANT -		3.7000D+00			6	TRC
25	FCG-THOLD	- CONSTANT -		3.5000D+00			7	TRC
26	LIMIT-DSL	- CONSTANT -		0.0000D+00			1	FMD
27	LIMIT-PBS	NORMAL	NO	6.1872D+01	3.2000D+00	-1.00	2	FMD
28	STRESS-DL	NORMAL	YES	3.0936D+01	1.4125D+00	1.00	3	FMD
29	FREQ-DLTR	- CONSTANT -		1.0000D-03			4	FMD

PROBABILITIES OF FAILURE MODE: EXCEED FLOW STRESS LIMIT FOR FULL BREAK

NUMBER FAILED = 895 NUMBER OF TRIALS = 5000

END OF CYCLE	FAILURE PROBABILITY WITHOUT AND FOR PERIOD	CUM. TOTAL	WITH IN-SERVICE INSPECTION FOR PERIOD	CUM. TOTAL
1.0	4.47561D-10	4.47561D-10	4.47561D-10	4.47561D-10
2.0	6.86783D-13	4.48248D-10	6.86783D-13	4.48248D-10
3.0	2.46801D-12	4.50716D-10	2.46801D-12	4.50716D-10
4.0	1.94851D-11	4.70201D-10	1.94851D-11	4.70201D-10
5.0	1.05012D-11	4.80702D-10	1.05012D-11	4.80702D-10
6.0	1.83739D-11	4.99076D-10	2.04669D-13	4.80907D-10
7.0	2.60510D-12	5.01681D-10	1.30273D-14	4.80920D-10
8.0	1.09514D-11	5.12633D-10	8.74708D-14	4.81007D-10
9.0	2.78818D-11	5.40514D-10	1.43068D-13	4.81150D-10
10.0	7.91984D-11	6.19713D-10	3.32974D-11	5.14448D-10
11.0	1.62607D-10	7.82320D-10	1.68764D-11	5.31324D-10

12.0	1.69234D-10	9.51554D-10	5.94535D-11	5.90778D-10
13.0	1.17406D-11	9.63295D-10	2.55402D-12	5.93332D-10
14.0	1.33203D-11	9.76615D-10	1.62328D-12	5.94955D-10
15.0	8.98691D-12	9.85602D-10	3.85801D-12	5.98813D-10
16.0	2.43235D-10	1.22884D-09	6.07509D-13	5.99421D-10
17.0	6.20159D-11	1.29085D-09	2.40810D-13	5.99661D-10
18.0	2.64508D-11	1.31730D-09	7.95832D-14	5.99741D-10
19.0	3.01800D-11	1.34748D-09	7.07725D-14	5.99812D-10
20.0	7.92535D-11	1.42674D-09	1.60809D-13	5.99973D-10
21.0	5.14865D-11	1.47822D-09	1.81338D-13	6.00154D-10
22.0	5.62889D-12	1.48385D-09	9.87365D-15	6.00164D-10
23.0	1.12821D-11	1.49513D-09	3.62679D-13	6.00526D-10
24.0	1.37413D-11	1.50888D-09	4.31181D-13	6.00958D-10
25.0	1.55013D-11	1.52438D-09	5.23241D-13	6.01481D-10
26.0	3.39481D-11	1.55833D-09	1.04944D-14	6.01491D-10
27.0	4.65625D-11	1.60489D-09	1.49792D-15	6.01493D-10
28.0	1.83716D-11	1.62326D-09	1.39206D-14	6.01507D-10
29.0	7.26815D-10	2.35007D-09	2.63238D-12	6.04139D-10
30.0	8.91303D-11	2.43920D-09	5.75170D-14	6.04197D-10
31.0	1.08618D-11	2.45007D-09	2.17091D-13	6.04414D-10
32.0	1.73167D-11	2.46738D-09	2.78304D-13	6.04692D-10
33.0	2.47435D-10	2.71482D-09	1.28615D-13	6.04821D-10
34.0	3.37694D-12	2.71819D-09	1.13717D-15	6.04822D-10
35.0	2.69967D-12	2.72089D-09	5.42121D-15	6.04827D-10
36.0	2.12089D-11	2.74210D-09	4.16823D-16	6.04828D-10
37.0	2.59440D-11	2.76805D-09	2.43594D-15	6.04830D-10
38.0	1.76900D-11	2.78574D-09	6.55586D-15	6.04837D-10
39.0	8.85263D-12	2.79459D-09	1.12634D-15	6.04838D-10
40.0	2.39260D-11	2.81852D-09	2.79960D-14	6.04866D-10
	DEVIATION ON CUMULATIVE TOTALS =		8.53737D-11	4.28022D-11

PB FAILURE PROB	SEGMENT ID	SEGMENT DESCRIPTION	PB FAILURE MECHANISM
1.57E-06	RC-012	From RCP 1-RC-P-1C to 1-RC-MOV-1595	Fatigue
1.57E-06	RC-010	From RCP 1-RC-P-1A to 1-RC-MOV-1591	Fatigue
1.57E-06	RC-011	From RCP 1-RC-P-1B to 1-RC-MOV-1593	Fatigue
1.01E-06	RC-008	From steam generator 1-RC-E-1B to RCP 1-RC-P-1B	Fatigue
1.01E-06	RC-007	From steam generator 1-RC-E-1A to RCP 1-RC-P-1A	Fatigue
1.01E-06	RC-009	From steam generator 1-RC-E-1C to RCP 1-RC-P-1C	Fatigue
8.70E-07	RC-019	From Loop 3 hot leg to pressurizer	Thermal Fatigue
7.30E-07	ECC-000	From RWST to CV 1-SI-410 (to CVCS) to CV 1-SI-46B (LPI) and CV 1-SI-46A (LPI)	Stress corrosion cracking
7.01E-07	CC-007	Discharge header from CCW pumps 1A and 1B from the pumps upto CCW HEX common header	Fatigue
7.01E-07	CC-008	Discharge header from CCW pumps 1D and 1C from the pumps upto CCW HEX common header	Fatigue
5.50E-07	RH-002	RHR suction isolation valves, 1-RH-MOV-1700 to 1-RH-MOV-1701	Stress corrosion cracking,
5.46E-07	LHI-001	From CV 1-SI-46B to CV 1-SI-47 (from sump) to CV 1-SI-50 (pump discharge)	Stress corrosion cracking
5.46E-07	LHI-002	From CV 1-SI-46A to CV 1-SI-56 (from sump) to CV 1-SI-58 (pump discharge)	Stress corrosion cracking
5.16E-07	RC-015	From Loop 3 1-RC-MOV-1595 to reactor vessel	Fatigue
5.16E-07	RC-013	From Loop 1 1-RC-MOV-1591 to reactor vessel	Fatigue
5.16E-07	RC-014	From Loop 2 1-RC-MOV-1593 to reactor vessel	Fatigue
4.44E-07	RS-005	Pipe section 12"-RS-24-153, cross connecting supply headers of ORS 2B and 2A pumps	Stress corrosion cracking
4.28E-07	RS-001	12"-RS-8-153 header from Containment sump to Containment penetration	Stress corrosion cracking
4.28E-07	RS-002	12"-RS-7-153 header from Containment sump to Containment penetration	Stress corrosion cracking
4.01E-07	RH-003	RHR suction isolation valve, 1-RH-MOV-1701 through both pumps and both heat	Stress corrosion cracking,
3.88E-07	CH-029	Letdown path between 1-CH-RV-1203, 3x4 Reducer between CH and RC designated headers	Fatique, Stress corrosion
3.59E-07	AFW-011	From manual valves 236 and 140, 237 and 155, and 239 and 170 and MOV 260B to check	Corrosion assisted fatigue
3.59E-07	AFW-010	From manual valves 235 and 141, 238 and 156, and 240 and 171 and MOV 260A to check	Corrosion assisted fatigue
3.59E-07	AFW-007	From check valve 142 to manual valves 235, 141, 236, and 140 and check valve 628	Corrosion
2.90E-07	LHI-008	Train A CV SI-58 to HPI suction SI-MOV-1863A, RWST recirc CV SI-61, Hot leg inject	Stress corrosion cracking

2.37E-07	CH-025	Letdown path between 1-CH-LCV-1460B, 3x2 Reducer before Regen. HEX	Stress corrosion cracking
2.15E-07	CH-021	Normal charging path between Regen. HEX (1-CH-E-3), 1-CH-HCV-1310A, 1-CH-HCV-1311	Stress corrosion cracking
1.74E-07	AFW-020	From check valve 27 and 10 to SG1A	Corrosion assisted fatigue
1.74E-07	AFW-022	From check valve 89 and 72 to SG1C	Corrosion assisted fatigue
1.74E-07	AFW-021	From check valve 58 and 41 to SG1B	Corrosion assisted fatigue
1.73E-07	CS-004	RWST flow to Containment Spray pump 1A from 1-CS-MOV-100A to normally closed manual	Stress corrosion cracking
1.64E-07	CS-003	RWST flow to Containment Spray pump 1B from 1-CS-MOV-100B to normally closed manual	Stress corrosion cracking
1.38E-07	CH-028B	Letdown path between 1-CH-TV-1204A containment	Stress corrosion cracking
1.38E-07	CH-030A	Letdown path between containment, 1-CH-TV-1204B	Stress corrosion cracking
1.38E-07	CH-030B	Letdown path beyween 1-CH-TV-1204B, Non-Regen HEX	Stress corrosion cracking
1.38E-07	AFW-004	From manual valve 153 and manual valves 283 and 154 and check valve 144 through	Corrosion assisted fatigue
1.38E-07	AFW-006	From manual valve 183 and manual valves 285 and 184 and check valve 174 through	Corrosion assisted fatigue
1.38E-07	AFW-005	From manual valve 168 and manual valves 284 and 169 and check valve 159 through	Corrosion assisted fatigue
1.37E-07	AFW-012	From check valves 628, 629, and 630 to manual valve 631 on full flow recirc line	Corrosion assisted fatigue
1.37E-07	AFW-008	From check valve 157 to manual valves 238, 156, 237, and 155 and check valve 629	Corrosion assisted fatigue
1.37E-07	AFW-009	From check valve 172 to manual valves 240, 171, 239, and 170 and check valve 630	Corrosion assisted fatigue
1.26E-07	CH-009	To RCP seals between pump case for 1-RCP-P-1B check valve 1-CH-334	Stress corrosion cracking,
1.26E-07	CH-008	To RCP seals between pump case for 1-RCP-P-1A check valve 1-CH-324	Stress corrosion cracking,
1.26E-07	CH-010	To RCP seals between pump case for 1-RCP-P-1C check valve 1-CH-350	Stress corrosion cracking,
7.66E-08	CC-005	Supply header to 1-CC-P-1D from manual valve 1-CC-566 to the pump	Fatigue
7.66E-08	CC-006	Supply header to 1-CC-P-1C from manual valve 1-CC-575 to the pump	Fatigue
7.66E-08	CC-003	Supply header to 1-CC-P-1A from manual valve 1-CC-554 to the pump	Fatigue
7.66E-08	CC-004	Supply header to 1-CC-P-1B from manual valve 1-CC-560 to the pump	Fatigue
7.03E-08	ECC-004	Hot leg LPI CV 1-SI-228 and CV 1-SI-229 and HPI 1-SI-226 and SI-227 to CV SI-239,	Stress corrosion cracking
6.28E-08	RS-003A	From Containment penetration up to 1-RS-MOV-155B	Stress corrosion cracking
6.28E-08	RS-004A	From Containment penetration up to 1-RS-MOV-155A	Stress corrosion cracking

5.48E-08	CH-018	Normal charging path between 1-CH-MOV-1289B, 1-CH-MOV-1289A	Stress corrosion cracking
4.85E-08	BD-001	1-RC-E-1A to 1-BD-TV-100A	Vibration, Wastage
4.85E-08	BD-004	1-RC-E-1B to 1-BD-TV-100C	Vibration, Wastage
4.85E-08	BD-007	1-RC-E-1C to 1-BD-TV-100E	Wastage, Vibration
3.98E-08	RH-009	RHR supply to C hot leg from 1-RH-MOV-1720B to 12"-RC-24-1502	Stress corrosion cracking
3.98E-08	RH-008	RHR supply to B hot leg from 1-RH-MOV-1720A to 12"-RC-23-1502	Stress corrosion cracking
3.78E-08	AFW-001	From Emergency Condensate Storage Tank to manual valve 153 on turbine driven pump	Corrosion assisted fatigue
3.76E-08	AFW-025	From manual valve 277 to manual valves 279 and 293	Corrosion assisted fatigue
3.76E-08	AFW-024	From manual valves 280 to manual valves 282 and 294	Corrosion assisted fatigue
3.75E-08	RH-003A	2"-RH-3-602 header from the intersection of the header with 12"-RH-12-602 to	Stress corrosion cracking
3.42E-08	CH-032	Letdown path between 1-CH-PCV 1145, 1-CH-164 (Normally closed manual valve),	Stress corrosion cracking,
3.42E-08	CH-033	Letdown path between 1-CH-TCV-1143, 1-CH-478 (Check valve)	Stress corrosion cracking,
3.35E-08	CH-034	Letdown path between 1-CH-478 (Check valve), Mixed bed Deminerlizer (1A) 1-CH-68,	Stress corrosion cracking
3.35E-08	CH-031	Letdown path between Non-Regen HEX, 1-CH-PCV-1145, 1-CH-164 (Normally closed manual	Stress corrosion cracking
3.17E-08	CH-020	Normal charging path between containment Regen. HEX (1-CH-E-3)	Stress corrosion cracking
3.08E-08	CH-019	Normal charging path between 1-CH-MOV-1289A containment	Stress corrosion cracking
2.81E-08	CS-009	CS flow to spray nozzles between check valve 1-CS-127 and 1-CS-105	Stress corrosion cracking
2.81E-08	CS-007	Flow to spray nozzles from penetration seal to check valve 1-CS-127	Stress corrosion cracking
2.81E-08	CS-008	Flow to spray nozzles from penetration seal to check valve 1-CS-105	Stress corrosion cracking
2.46E-08	RC-020	From Loop 1 hot leg to 1-RH-MOV-1700	Fatigue
2.36E-08	VS-002	The remaining piping associated with the 1-VS-E-4A/B/C/D/E chillers between	Vibration
2.36E-08	RC-041	SI from CV 1-SI-79 to Loop 1 cold leg	Thermal Fatigue
2.35E-08	RC-042	SI from CV 1-SI-82 to Loop 2 cold leg	Thermal Fatigue
2.35E-08	RC-043	SI from CV 1-SI-85 to Loop 3 cold leg	Thermal Fatigue
2.34E-08	RC-018	SI from CV 1-SI-94 to RCS Loop 3 hot leg	Thermal Fatigue
1.99E-08	AFW-003	From Emergency Condensate Storage Tank to manual valve 183 on motor driven pum P-3B	Corrosion assisted fatigue

1.99E-08	AFW-002	From Emergency Condensate Storage Tank to manual valve 168 on motor driven pum P-3A	Corrosion assisted fatigue
1.98E-08	AFW-026	From emergency makeup tank to manual valves 277 and 280	Corrosion assisted fatigue
1.98E-08	AFW-023	From manual valves 279 and 282 to manual valves 283, 284, and 285	Corrosion assisted fatigue
1.91E-08	RH-010	Recirculation line 1 1/2"-RH-11-602	Stress corrosion cracking
1.75E-08	CH-011	Seal injection path, between 1-CH-324 containment	Fatique, Stress corrosion
1.75E-08	CH-013	Seal injection path, between 1-CH-350 containment	Fatique, Stress corrosion
1.75E-08	CH-037	Lines connecting Deborating Deminerlizers to the letdown path (drawing	Stress corrosion cracking
1.75E-08	CH-012	Seal injection path, between 1-CH-334 containment	Stress corrosion cracking,
1.70E-08	CH-002	Piping used for CVT level measurement and indication	Stress corrosion cracking
1.66E-08	RC-017	SI from CV 1-SI-88 to RCS Loop 2 hot leg	Thermal Fatigue
1.66E-08	RC-016	SI from CV 1-SI-91 to RCS Loop 1 hot leg	Thermal Fatigue
1.47E-08	RS-010	From containment penetration to spray nozzles for path A	Stress corrosion cracking
1.27E-08	CC-042	CCW for Unit 1 reactor containment air recirc. cooler 1-VS-E-2A from Containment	Vibration
1.27E-08	CC-043	CCW for Unit 1 reactor containment air recirc. cooler 1-VS-E-2B from Containment	Vibration
1.27E-08	CC-044	CCW for Unit 1 reactor containment air recirc. cooler 1-VS-E-2C from Containment	Vibration
1.27E-08	CC-033	CCW for the 1C RCP from the Unit 1 containment penetration 1-PEN-PN-16 to:	Vibration
1.27E-08	CC-030	CCW for the 1B RCP from the Unit 1 containment penetration 1-PEN-PN-17 to:	Vibration
1.27E-08	CC-025	CCW for the 1A RCP from Unit 1 containment penetration 1-PEN-PN-18 to: 1-PEN-PN-25	Vibration
1.17E-08	CH-016	Alternate "charging" path between 1-CH-FCV-1160 containment	Stress corrosion cracking
1.17E-08	CH-017	Alternate "charging" path between containment, 1-RC-P-HCV-1556A/B/C	Stress corrosion cracking
1.17E-08	CH-040	All other piping to VCT	Stress corrosion cracking
1.09E-08	RS-009	From containment penetration to spray nozzles for path B	Stress corrosion cracking
9.79E-09	RH-003B	6"-RH-14-602 header from the intersection of the header with 12"-RH-12-602 to	Stress corrosion cracking
7.52E-09	AFW-027	From fire main manual valve 185 to manual valves 154, 169 and 184 and check valves	Corrosion assisted fatigue
7.21E-09	CH-038	Boric Acid supply line between 1-CH-MOV-1350, 1-CH-84, 1-CH-88	Stress corrosion cracking,
7.21E-09	CH-039	All other Boric Acid supply lines	Stress corrosion cracking,

6.94E-09	CH-028A	Letdown path between 3x2 Reducer on the discharger of side of the Regen. HEX,	Stress corrosion cracking
6.71E-09	CH-027	Letdown path between Regen. HEX and 3x2 Reducer on the discharger of side of the	Stress corrosion cracking
6.30E-09	RC-024	From tee on 8"-RC-11-2501R to Loop 1 cold leg	Fatigue
6.30E-09	RC-025	From tee on 8"-RC-12-2501R to Loop 2 cold leg	Fatigue
6.30E-09	RC-026	From tee on 8"-RC-13-2501R to Loop 3 cold leg	Fatigue
5.98E-09	CH-003	Discharge of CVT between 1-CH-MOV-1115C, 1-CH-MOV-1115E	Stress corrosion cracking
5.83E-09	CH-022	Normal charging path between 1-CH-HCV-1310A, 1-CH-312 (check valve)	Stress corrosion cracking
5.46E-09	CH-006	To charging pump suction from RCP seals between Containment, 1-CH-HCV-1303A,	Stress corrosion cracking
5.28E-09	CH-024	Letdown path between 1-CH-LCV-1460A, 1-CH-LCV-1460B	Stress corrosion cracking,
5.28E-09	CH-026	Letdown path between 3x2 Reducer before Regen. HEX, Regen. HEX	Stress corrosion cracking
4.91E-09	CH-007	To charging pump suction from RCP seals between, 1-CH-HCV-1303A, 1-CH-HCV-1303B,	Vibration, Stress corrosion
3.85E-09	BD-008A	Containment isolation valve 1-BD-TV-100E to Containment penetration 40	Vibration, Wastage
3.85E-09	BD-005A	Containment isolation valve 1-BD-TV-100C to Containment penetration 41	Vibration, Wastage
3.85E-09	BD-002A	Containment isolation valve 1-BD-TV-100A to Containment penetration 39	Vibration, Wastage
3.72E-09	AFW-032	From Check valve 174 and 179 to manual valves 176 and 607	Vibration
3.72E-09	AFW-030	From Check valve 144 and 149 to manual valves 146 and 609	Vibration
3.72E-09	AFW-031	From Check valve 159 and 164 to manual valves 161 and 608	Vibration
3.47E-09	RC-045	Pressurizer spray from Loop 3 cold leg to 1-RC-PCV-1455B	Stress corrosion cracking,
3.47E-09	RC-044	Pressurizer spray from Loop 1 cold leg to 1-RC-PCV-1455A	Stress corrosion cracking,
3.47E-09	RC-051	Pressurizer spray header from 1-RC-PCV-1455A&B to pressurizer	Stress corrosion cracking,
2.76E-09	RC-004	From 1-RC-MOV-1590 to steam generator 1-RC-E-1A	Fatigue
2.76E-09	RC-006	From 1-RC-MOV-1594 to steam generator 1-RC-E-1C	Fatigue
2.76E-09	RC-005	From 1-RC-MOV-1592 to steam generator 1-RC-E-1B	Fatigue
2.38E-09	RH-011	Containment pentration 24 between 1-RH-29 and 1-RH-100	Stress corrosion cracking,
2.31E-09	CH-023	Normal charging path between 1-CH-HCV-1311, 1-CH-313 (check valve)	Stress corrosion cracking
2.18E-09	CH-036	Letdown path between 1-CH-HCV-1244, VCT, 1-CH-FCV-1114B	Stress corrosion cracking

2.13E-09	CH-001	Discharge of VCT between 1-CH-MOV-1115C at flow reducer after manual valve 1-CH-203,	Stress corrosion cracking
2.01E-09	CH-005	To charging pumps suction from RCP seals between Containment and 1-CH-MOV 1381	Stress corrosion cracking
2.01E-09	CH-004	Discharge of CVT between, 1-CH-MOV-1115E, 1-CH-230 (Check valve), 1-CH-MOV-1373,	Stress corrosion cracking
1.93E-09	CC-040	CCW to Unit 1 reactor containment air recirc. cooler from the intersection of	Snubber failure to lock up
1.75E-09	ACC-011	1-SI-TK-1C to 1-SI-147, Loop 3 cold leg.	Snubber failure to lock up
1.75E-09	ACC-001	1-SI-TK-1A to 1-SI-109, Loop 1 cold leg.	Snubber failure to lock up
1.75E-09	ACC-006	1-SI-TK-1B to 1-SI-130, Loop 2 cold leg.	Snubber failure to lock up
1.65E-09	CH-035A	Letdown path between Mixed bed Deminerlizer 1A, 1-CH-24 (Normally closed manual	Stress corrosion cracking
1.65E-09	CH-035B	Mixed bed Deminerlizer 1-CH-1-1B line for letdown path from 1-CH-24 (manual closed	Stress corrosion cracking
1.21E-09	FC-006	Purification headers from the intersection of 16"-FP-18-152 with 2.5"-FP-26-152 to	Vibration
9.07E-10	CH-014	Seal injection path, between containment 1-CH-HCV-1186, normally closed 1-CH-278	Stress corrosion cracking
8.48E-10	CC-039	CCW to 1-RH-P-1B seal cooler between the following normally closed manual valves	Vibration
8.48E-10	CC-038	CCW to 1-RH-P-1A seal cooler between the following normally closed manual valves	Vibration
8.48E-10	CC-055	Discharge path of CCW to Instrument Air Compressor HEXs from HEXs to the	Fatique
8.48E-10	CC-054	CCW to Instrument Air Compressor HEXs from the intersection of 1.5"-CC-501-151 with	Fatique
7.22E-10	FC-004	1-FC-P-1A discharge header from 1-FC-11 (check valve) to spent fuel pit, 1-FC-41	Vibration
7.22E-10	FC-003	1-FC-P-1B header from 1-FC-35 (normally closed man. valve) to 1-FC-9 (check valve)	Vibration
7.22E-10	FC-001	1-FC-P-1A header from Spent Fuel Pit to 1-FC-11 (check valve)	Vibration
7.22E-10	FC-005	1-FC-P-1B discharge header from 1-FC-9 (check valve) back to 1-FC-41 (normally	Vibration
6.44E-10	CH-015	Normal seal cooling path, between 1-CH-MOV-1370, 1-CH-HCV-1186	Stress corrosion cracking
4.47E-10	ACC-004	1"-SI-100-602 from 1-SI-TK-1A to 1-SI-HCV-1853A and the line from 1-SI-TK-1A to	Fatique
4.47E-10	ACC-015	1"-SI-61-602 from 1"-SI-TK-1C to 1-SI-HCV-1851C	Fatique
4.47E-10	ACC-014	1"-SI-99-602 from 1-SI-TK-1C to 1-SI-HCV-1853C and the line from 1-SI-TK-1C to	Fatique
4.47E-10	ACC-010	1"-SI-12-602 from 1"-SI-TK-1B to 1-SI-HCV-1851B	Fatique
4.47E-10	ACC-009	1"-SI-97-602 from 1-SI-TK-1B to 1-SI-HCV-1853B and the line from 1-SI-TK-1B to	Fatique
4.47E-10	ACC-005	1"-SI-11-602 from 1"-SI-TK-1B to 1-SI-HCV-1851A	Fatique

3.18E-10	RC-039	Loop 3 fill header from 1-RC-HCV-1556C to cold leg	Fatigue
3.18E-10	RC-038	Loop 2 fill header from 1-RC-HCV-1556B to cold leg	Fatigue
3.18E-10	RC-032	Loop 2 drain line from cold leg to 1-RC-HCV-1557B	Fatigue
3.18E-10	RC-037	Loop 1 fill header from 1-RC-HCV-1556A to cold leg	Fatigue
3.18E-10	RC-040	Letdown line from Loop 1 cold leg to 1-CH-LCV-1460A	Fatigue
3.18E-10	RC-033	Loop 3 drain line from cold leg to 1-RC-HCV-1557C	Fatigue
3.18E-10	RC-031	Loop 1 drain line from cold leg to 1-RC-HCV-1557A	Fatigue
2.62E-10	EE-5-1A,B,	500 gal. tanks to base tanks.	Fatigue
2.46E-10	CS-012	Flow from Refueling Water Chemical Addition Tank	Vibration
1.83E-10	CC-013	Discharge header of 1C and 1D CCW HEXs from the body of HEXs to: normally closed	Snubber failure to lock up
1.83E-10	CC-016B	Supply line to RHR HEX A from containment to normally closed manual valve 1-CC-178	Snubber failure to lock up
1.83E-10	CC-012	Discharge header of 1A and 1B CCW HEXs from the body of HEXs to: normally closed	Snubber failure to lock up
1.83E-10	CC-016A	Supply line to RHR HEX A from the intersection of 24"-CC-235-121 and 18"-CC-8-121 to	Snubber failure to lock up
1.83E-10	CC-014	Crosstie piping for the outlet of CCW HEXs between manual valves: 1-CC-558 (normally	Snubber failure to lock up
1.72E-10	RC-001	Reactor vessel to Loop 1 isolation valve 1-RC-MOV-1590	No postulated failure
1.72E-10	RC-002	Reactor vessel to Loop 2 isolation valve 1-RC-MOV-1592	No postulated failure
1.72E-10	RC-003	Reactor vessel to Loop 3 isolation valve 1-RC-MOV-1594	No postulated failure
1.69E-10	AFW-014	From check valve 133 to check valve 131	Snubber overload, fatigue
1.69E-10	AFW-015	From check valve 136 and check valve 309 to MOVs 151E, 151C and 151A	Snubber overload, fatigue
1.69E-10	AFW-016	From check valve 131 and check valve 310 to MOVs 151F, 151D, and 151B	Snubber overload, fatigue
1.69E-10	AFW-013	From check valve 138 to check valve 136	Snubber overload, fatigue
1.31E-10	RC-030	RCS drain header from valves 1-RC-11, 1-RC-HCV-1557A, 1-RC-50, 1-RC-HCV-1557B,	Fatigue
6.68E-11	RC-057	From pressurizer to PORV block valves 1-RC-MOV-1535 and 1-RC-MOV-1536	Fatigue
6.68E-11	RC-058	From block valve 1-RC-MOV-1535 to PORV 1-RC-PCV-1456	Fatigue
6.68E-11	RC-059	From block valve 1-RC-MOV-1536 to PORV 1-RC-PCV-1455C	Fatigue
5.08E-11	AFW-019	From MOVs 151B and 151A to check valve 89	Overload

5.08E-11	AFW-018	From MOVs 151D and 151C to check valve 58	Overload
5.08E-11	AFW-017	From MOVs 151F and 151E to check valve 27	Overload
3.69E-11	RC-060	From tee on 4"-RC-15-1502 to blind flange (line 1 1/2"-RC-105-1502)	Fatigue
3.48E-11	RC-028	Loop 2 drain line from hot leg to valve 1-RC-50	Fatigue
3.48E-11	RC-029	Loop 3 drain line from hot leg to valve 1-RC-82	Fatigue
3.48E-11	RC-027	Loop 1 drain line from hot leg to valve 1-RC-11	Fatigue
3.12E-11	RC-056	From pressurizer safety valves 1-RC-SV-1551A,B,C and PORVs 1-RC-PCV-1456 and	Fatigue
2.77E-11	RC-023	From Loop 3 isolation valve 1-RC-MOV-1594 to 1-RC-MOV-1595	No postulated failure
2.77E-11	RC-021	From Loop 1 isolation valve 1-RC-MOV-1590 to 1-RC-MOV-1591	No postulated failure
2.77E-11	RC-022	From Loop 2 isolation valve 1-RC-MOV-1592 to 1-RC-MOV-1593	No postulated failure
1.97E-11	LHI-006	Containment sump MOV 1860A to CV SI-57	No postulated failure
1.97E-11	LHI-005	Containment sump MOV 1860B to CV SI-47	No postulated failure
1.97E-11	LHI-004	Containment sump to MOV 1860A	No postulated failure
1.97E-11	LHI-003	Containment sump to MOV 1860B	No postulated failure
1.92E-11	LHI-010	Cold leg injection from SI-MOV-1890C to CV SI-241, SI-242, and SI-243	Snubber failure to lock up
1.91E-11	CS-002	RWST flow to CS pump 1A from Tank to: 1-CS-MOV-100A	pitting
1.91E-11	CS-001	RWST flow to CS pump 1B from Tank to: 1-CS-MOV-100B	pitting
1.90E-11	CC-037	CCW to Excess Letdown HEX, Primary Drain Cooler, RHR pumps seal coolers and other	Snubber failure to lock up
1.32E-11	RC-046	Accumulator injection from CV 1-SI-109 to Loop 1 cold leg	No postulated failure
1.32E-11	RC-047	Accumulator injection from CV 1-SI-130 to Loop 2 cold leg	No postulated failure
1.32E-11	RC-048	Accumulator injection from CV 1-SI-147 to Loop 3 cold leg	No postulated failure
1.19E-11	LHI-009	Cold leg inject from SI-MOV-1864A and SI-MOV-1864B to SI-MOV-1890C	No postulated failure
1.13E-11	CS-006	RWST flow to Containment Spray pump 1A from 1-CS-MOV-101A (normally closed),	Fatique
1.13E-11	CS-005	RWST flow to Containment Spray pump 1B from: 1-CS-MOV-101C (normally closed),	Fatique
9.01E-12	LHI-007	Train B CV SI-50 to HPI suction SI-MOV-1863B, RWST recirc CV SI-53, Hot leg inject	Snubber failure to lock up
7.83E-12	RS-011	All IRS-related piping sections from containment sump to the nozzles (path B) (Does	No postulated failure

7.83E-12	RS-012	All IRS-related piping sections from containment sump to the nozzles (path B) (Does	No postulated failure
6.75E-12	RS-004B	From 1-RS-MOV-155A to Containment penetration and manual valve 1-RS-15	Vibration
6.75E-12	RS-003B	From 1-RS-MOV-155B to Containment penetration and manual valve 1-RS-6	Vibration
6.50E-12	ACC-013	2" level taps from 1-SI-TK-1C to reducer in the lines to 1-SI-LT-1928 and	Fatique
6.50E-12	ACC-002	2"-SI-63-602 from 12"-SI-45-1502 to 1-SI-103, 1-SI-HCV-1852A and 1-SI-104	Fatique
6.50E-12	ACC-007	2"-SI-65-602 from 12"-SI-23-1502 to 1-SI-125, 1-SI-HCV-1852B and 1-SI-123	Fatique
6.50E-12	ACC-012	2"-SI-67-602 from 12"-SI-24-1502 to 1-SI-142, 1-SI-HCV-1852C and 1-SI-140	Fatique
6.50E-12	ACC-003	2" level taps from 1-SI-TK-1A to reducer in the lines to 1-SI-LT-1920 and	Fatique
6.50E-12	ACC-008	2" level taps from 1-SI-TK-1B to reducer in the lines to 1-SI-LT-1924 and	Fatique
4.67E-12	CC-009	Discharge header of CCW pumps between normally closed manual valves: 1-CC-573,	No postulated failure
4.67E-12	CC-002	CCW pumps supply header from intersection point with the following pipes:	Fatigue
4.67E-12	CC-010	Inlet piping to CCW HEXs 1A and 1B from intersection point with 18"-CC-227-121 and	No postulated failure
4.67E-12	CC-020B	CCW supply line to RHR 1B HEX from Unit 1 Containment Building to 1-CC-182 (normally	No postulated failure
4.67E-12	CC-023	RHR 1B HEX discharge piping from 1-CC-TV-109B to CCW pumps supply header upto the	Fatigue
4.67E-12	CC-017	RHR 1A supply and discharge piping from normally closed manual valve 1-CC-178 to	Fatigue
4.67E-12	CC-022B	RHR 1B HEX discharge piping from Unit 1 containment penetration to 1-CC-TV-109B	Fatigue
4.67E-12	CC-011	Inlet piping to CCW HEXs 1C and 1D from intersection point with 18"-CC-229-121 and	No postulated failure
4.67E-12	CC-018A	RHR 1A HEX discharge piping from normally closed 1-CC-181 to Unit 1 containment	Fatigue
4.67E-12	CC-018B	RHR 1A HEX discharge piping from Unit 1 containment penetration to 1-CC-TV-109A	Fatigue
4.67E-12	CC-019	RHR 1A HEX discharge piping from 1-CC-TV-109A to CCW pumps supply header upto the	Fatigue
4.67E-12	CC-021	RHR 1B supply and discharge piping from normally closed manual valve 1-CC-182 to	Fatigue
4.67E-12	CC-022A	RHR 1B HEX discharge piping from normally closed 1-CC-185 to Unit 1 containment	Fatigue
4.67E-12	CC-020A	CCW supply line to RHR 1B HEX from intersection of 24"-CC-235-121 and 18"-CC-10-121	No postulated failure
4.62E-12	FC-002	1-FC-P-1B header from Spent Fuel Pit to 1-FC-35 (normally closed man. valve)	Fatique
4.24E-12	RC-055	From safety valve loop seals to pressurizer	Fatique
3.92E-12	RC-061	Auxiliary pressurizer spray line from CV 1-CH-313 to tee on 4' line	Fatique

3.34E-12	CC-035	CCW to the Unit 1 Fuel Pit Coolers, Non Regen. HEX and Seal Water HEX from the	Fatique
2.59E-12	CC-015B	CCW discharge header to Misc. Boron Evaporator components from 1-BR-TCV-111B,	Failure of nonseismic line
2.59E-12	CC-015A	CCW discharge header to Misc. Boron Evaporator components from intersection of	Failure of nonsiesmic line
2.04E-12	CC-034	CCW pipe on the 1-RC-P-1C discharge path from the containment penetration	No postulated failure
2.04E-12	CC-024	CCW to 1A and 1B RCPs from intersection of 10"-CC-89-121 pipe with 18"-CC-10-121	No postulated failure
2.04E-12	CC-026	CCW pipe on the 1-RC-P-1A discharge path from the containment penetration	No postulated failure
2.04E-12	CC-027	CCW pipe on the 1A/1B/1C RCP discharge path from 1-CC-TV-105A/B/C to the	No postulated failure
2.04E-12	CC-031	CCW pipe on the 1-RC-P-1B discharge path from the containment penetration	No postulated failure
2.04E-12	CC-032	CCW to the Unit 1 1C RCPs from intersection of 10"-CC-81-121 pipe with 18"-CC-10-121	No postulated failure
1.70E-12	ECC-001	Cold leg loop 1 from CV 1-SI-241 and CV 1-SI-235 to CV 1-SI-79	Thermal Fatigue
1.70E-12	ECC-002	Cold leg loop 2 from CV 1-SI-242 and CV 1-SI-236 to CV 1-SI-82	Thermal Fatigue
1.70E-12	ECC-003	Cold leg loop 3 from CV 1-SI-243 and CV 1-SI-237 to CV 1-SI-85	Thermal Fatigue
1.65E-12	ECC-005	Hot leg loop 1 CV SI-239 to CV SI-91	Thermal Fatigue
1.65E-12	ECC-007	Hot leg loop 3 CV SI-240 to CV SI-94	Thermal Fatigue
1.65E-12	ECC-006	Hot leg loop 2 CV SI-238 to CV SI-88	Thermal Fatigue
1.51E-12	AFW-028	From MOVs 160A and 160B to check valves 309 and 310 (from opposite unit aux feed	Corrosion assisted fatigue
1.49E-12	RC-053	Pressurizer to safety valve 1-RC-SV-1551B	Fatigue
1.49E-12	RC-054	Pressurizer to safety valve 1-RC-SV-1551C	Fatigue
1.49E-12	RC-052	Pressurizer to safety valve 1-RC-SV-1551A	Fatigue
1.46E-12	RC-049	Charging from CV 1-CH-430 to Loop 2 cold leg	Fatigue
1.23E-12	CC-053	Discharge of CCW for Unit 1 reactor containment air recirc. coolers and neutron	No postulated failure
1.23E-12	CC-056	CCW for Misc. Boron Stripper subcomponents from the intersection of 8"-CC-32-151	Nonsiesmic portion failing
1.16E-12	CS-016	The remaining portions of the RWST cooling unit piping not covered in segment 1CS-11	No postulated failure
8.22E-13	LHI-018	From 1-SI-MOV-1863A to 1-CH-MOV-1267B, 1-CH-MOV-1269B, and 1-CH-MOV1270B	Vibration
7.37E-13	CS-014	Flow from CS piping to the containment sump (2.5"-CS-94-153)	No postulated failure
7.37E-13	CS-013	Flow from CS piping to the containment sump (2.5"-CS-95-153)	No postulated failure

6.62E-13	AFW-029	From Manual valve 150 from conedensate makeup and manual valve 631 and manual valve	Corrosion assisted fatigue
6.62E-13	CC-041	CCW for Unit 1 reactor containment air recirc. cooler from 1-CC-TV-101A to: Unit 1	Overload
6.62E-13	CC-052	Discharge of CCW for Unit 1 reactor containment air recirc. coolers and neutron	Fatique
6.60E-13	CC-001A	From CCW Surge Tank to CCW pumps supply header up to the following intersection	Fatigue
6.19E-13	CS-010	CS flow test lines between normally closed manual valves 1-CS-8/15 and manual,	No postulated failure
6.19E-13	CS-011	CS flow test lines between normally closed manual valves 1-CS-18 and the RWST tank.	No postulated failure
4.91E-13	BD-008B	Containment penetration 40 between 1-BD-TV-100E and 1-BD-TV-100F	Wastage
4.91E-13	BD-005B	Containment penetration 41 to and 1-BD-TV-100D	Wastage
4.91E-13	BD-009	Everything beyond the outside containment isolation valve 1-BD-TV-100F	Wastage
4.91E-13	BD-003	Everything beyond the outside containment isolation valve 1-BD-TV-100B	Wastage
4.91E-13	BD-006	Everything beyond the outside containment isolation valve 1-BD-TV-100D	Wastage
4.91E-13	BD-002B	Containment penetration 39 to Containment isolation valve 1-BD-TV-100B	Wastage
3.64E-13	RC-035	Loop 2 cold leg 3" capped line	Fatigue
3.64E-13	RC-036	Loop 3 cold leg 3" capped line	Fatigue
3.64E-13	RC-034	Loop 1 cold leg 3" capped line	Fatigue
3.51E-13	FC-009	Header from 1-FC-I-1 (Fuel Pit Ion Exchanger) normally closed man. valves 1-FC-1,	No postulated failure
3.51E-13	FC-008	Header from 1-FC-I-1 (Fuel Pit Ion Exchanger) to 1-FC-2 (normally closed man. vlv.)	No postulated failure
1.57E-13	RS-007	Pipe section between normally closed manual valve 1-RS-6 and ORS sump	No postulated failure
1.57E-13	RS-008	Pipe section between normally closed manual valve 1-RS-15 and ORS sump	No postulated failure
1.35E-13	EE-001	5,000 barrel tank to 20,000 gal. tank including recirc.	Wastage
1.21E-13	EE-6-1A,B,	Base tank to injector header, 'A' pump motor driven (secondary source), 'B' pump	Vibration
1.21E-13	EE-007-1,	Injector header	Vibration
1.00E-13	EE-003	20,000 gal. tank, 1-EE-TK-2B, to stand by fuel pumps to 500 gal. tanks	Wastage
1.00E-13	EE-002	20,000 gal. tank, 1-EE-TK-2A, to valve 1-EE-1, the ready fuel pumps and the 500 gal	Wastage
9.27E-14	LHI-011	Hot leg MOV 1890B to CV 228	No postulated failure
9.27E-14	LHI-012	Hot leg MOV 1890A to CV 229	No postulated failure

8.94E-14	CS-015	Flow from RWST to the closed valve 1-CS-27	No postulated failure
4.37E-14	EE-004	Cross connect between 1-EE-TK-1A and 1B, bypass for underground tanks.	Wastage
2.02E-14	VS-001	Makeup supply from check valve 1-VS-975 to 1-VS-PCV-533	No postulated failure
1.97E-14	CC-001B	Assorted of 2" and 1.5" diameter connected to the CCW surge tank	Fatigue
1.97E-14	CC-001C	From unit 1 and 2 SG blowdown coolers and Condensate system from check valve	Fatigue
2.02E-15	LHI-013	Recirc to RWST from Train B from CV SI-53 to SI-MOV-1885B	No postulated failure
2.02E-15	LHI-014	Recirc to RWST from Train A from CV SI-61 to SI-MOV-1885A	No postulated failure
2.02E-15	LHI-016	Recirc to RWST from Train A from SI-MOV-1885A to SI-MOV-1885D	No postulated failure
2.02E-15	LHI-015	Recirc to RWST from Train B from SI-MOV-1885B to SI-MOV-1885C	No postulated failure
2.02E-15	LHI-017	Recirc to RWST from Trains A and B from SI-MOV-1885C and SI-MOV-1885D to RWST	No postulated failure
2.00E-15	FC-007	Header from 1-FC-I-1 (Fuel Pit Ion Exchanger) to 1-FC-3 (normally closed man. vlv.)	No postulated failure
5.05E-16	RC-050	Reactor vessel head vent from vessel to 1-RC-SOV-100A1 and 1-RC-SOV-100B1	Fatigue
6.07E-17	CC-028B	CCW pipe on the Unit 1 RCPs thermal barrier discharge paths from 1-CC-TV-140A to the	No postulated failure
6.07E-17	CC-020C	CCW for pipe penetration cooling coils from the intersection of 18"-CC-10-121 with	No postulated failure
6.07E-17	CC-029	CCW pipe on the Unit 1 RCPs thermal barrier discharge paths from the Unit 1	No postulated failure
6.07E-17	CC-036	CCW to Misc. component from the intersection of 3"-CC-39-151 with 14"-CC-67-121 to	No postulated failure
4.51E-17	CC-028A	CCW pipe on the discharge of Unit 1 RCPs from 1-CC-TV-120A/B/C (RCP 1A/1B/1C	No postulated failure
1.96E-17	CC-045	CCW for the neutron shield tank cooler (1-NS-E-1A) from the intersection of	Fatigue
1.96E-17	CC-046	CCW for the neutron shield tank cooler 1-NS-E-1A from 1-CC-FCV-112A to 1-CC-112B,	Fatigue
1.96E-17	CC-047	CCW for the neutron shield tank cooler 1-NS-E-1A from normally closed man. vlv	Fatigue
1.96E-17	CC-048	Discharge of CCW for the neutron shield tank cooler 1-NS-E-1A from 1-CC-FCV-112B to	Fatigue
1.96E-17	CC-049	CCW for the neutron shield tank cooler 1-NS-E-1B from normally closed man. vlv	No postulated failure
1.96E-17	CC-051	CCW for the neutron shield tank cooler 1-NS-E-1B from normally closed 1-CC-FCV-113B	Fatigue
1.96E-17	CC-050	CCW for the neutron shield tank cooler 1-NS-E-1B from normally closed 1-CC-FCV-113A	Fatigue