GPU Nuclear

TECHNICAL DATA REPORT

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Mechanical Integrity Analysis of TMI-1 OTSG Unplugged Tubes

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ABSTRACT

PURPOSE:

Small I.D. circumferential defects have been identified in many steam generator tubes. A fracture mechanics evaluation has been conducted to ascertain the stability of tube cracks under steady-state and anticipated transient conditions. Crack opening displacement (COD) for through wall cracks is also identified. COD permits the calculation of leakage rates.

RESULTS:

Cracks that may have escaped detection by ECT will not jeopardize tube integrity during normal cooldown unless these cracks are greater than 180° in extent. Large non-through wall cracks that would jeopardize tube integrity are not expected to evolve because in axi-symmetric tensile stress fields cracks propagate preferentially through the tube wall rather than around the circumference. Tube integrity can be demonstrated for mid-span tube regions and for the transition region as well.

The as-repaired transition geometry is a design no less adequate than the original. The as-repaired condition represents an improvement in the state of stress due to mechanical and thermal loads as compared to the original.

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TITLE Mechanical Integrity Analysis of TMI-1 OTSG Unplugged Tubes

REV	SUMMARY OF CHANGE	APPROVAL	DATE
1	This revision incorporates many additional analyses performed since the release of Rev. 0	S. D. Leshnoff / [signature]	3/1/83
2	Reworded statement of results on abstract page.	S. D. Leshnoff / [signature]	3/29/83
3	Abstract page; Section 2.3 completely rewritten, New Section 2.4 added.	S. D. Leshnoff / [signature]	5/11/83

1.0
RESULTS

With reference to Figure 1, line segment (A) for a $(\Delta K)_{Th}$ = 4.0 KSI $\sqrt{in}$, - 40 years of stable crack growth can be anticipated. Only heat-up and shut-down cycles propagate cracks. Line segment (A) represents that locus of initial crack sizes that will propagate through the walls of the tube in a stable manner. Leakage occurs at 100% through-wall extent. The tube will not part into two pieces unless the postulated MSLB accident intercedes, line segment (B) or, if the flaw is very large, cooldown leads to ductile failure, (C). Curves (B) and (C) apply to tubes at the center of the tube bundle. Leakage occurs at point #1. This point represents the through-wall crack which will potentially part the tube in two during a MSLB Statements concerning tube rupture are made in the interest of conservatism. Rupture is not likely to occur in strain controlled problems. This is the manner of OTSG loading.

Leakage as a function of crack circumferential length is shown in Figure 2. Leakage will not be zero because parted faces of through wall cracks do not fully close because of plastic strain at the crack tip. Cracks will propagate circumferentially as indicated in Figure 1 by increasing arc length at 100% through wall extent. At point #2, with intersection of line segment (C) tube integrity is jeopardized by an interceding 100°F/hr shutdown cycle.

2.0
Bases and Methods

2.1
Mechanical Integrity Evaluation

Tube mechanical integrity is evaluated by conservatively establishing the mechanical and thermal loads acting on the OTSG tubes during anticipated

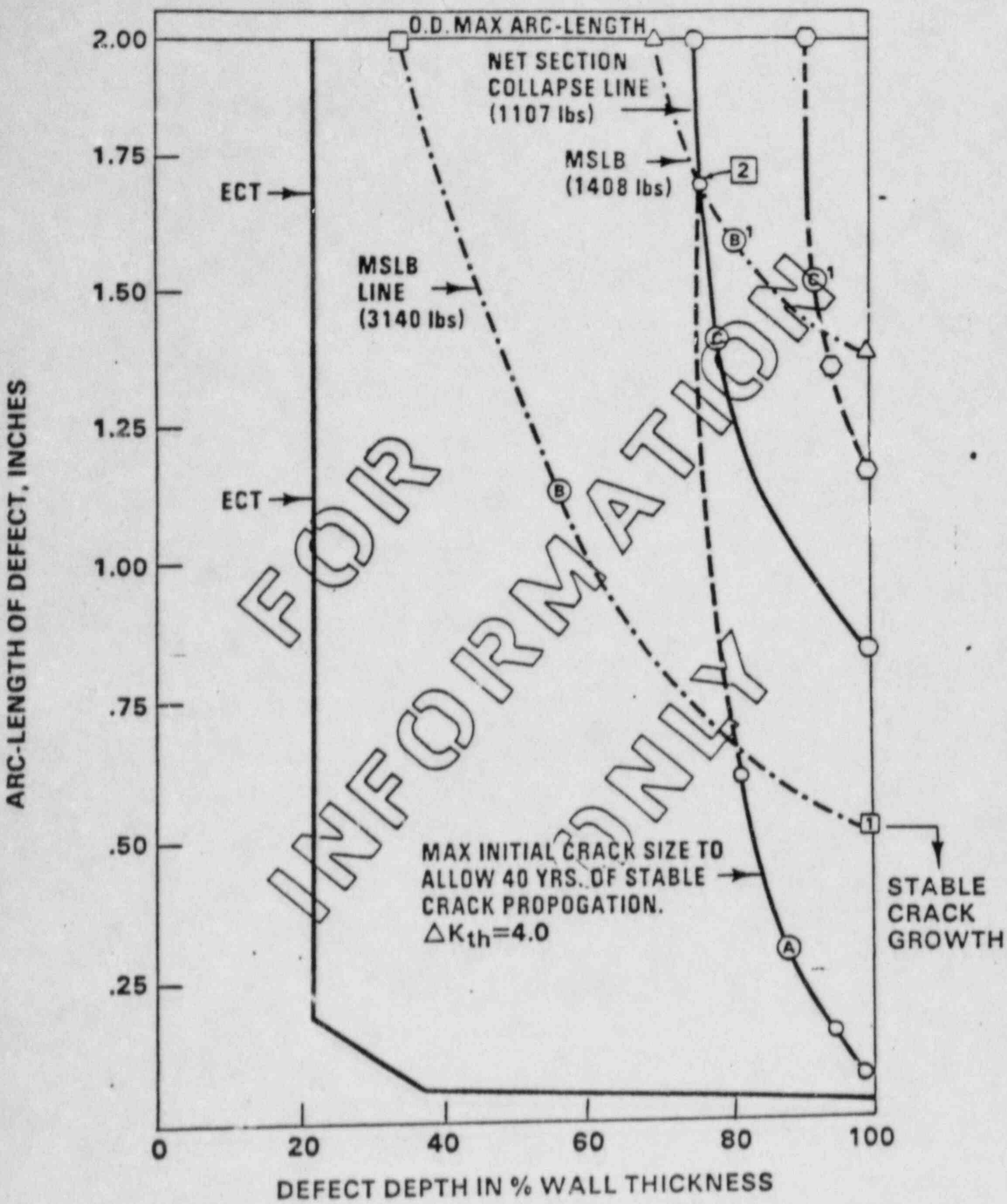

FIGURE 1

TDR - [illegible]
REV. 1

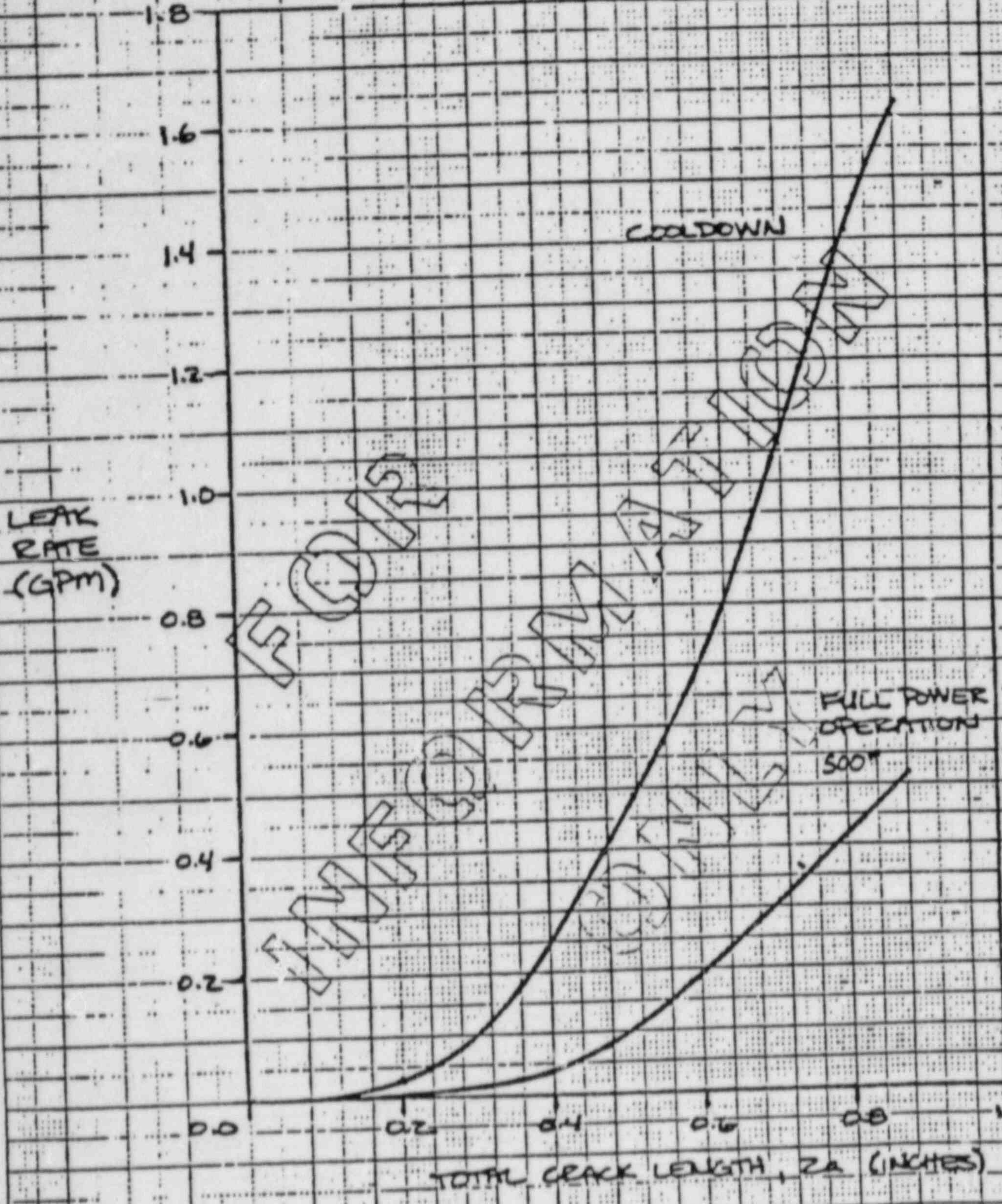

Figure 2 *Leak Rate Curves as a Function of Crack Length*

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transient and steady-state conditions. Possible in-dwelling cracks are interacted with the stress fields due to these loads by means of fracture mechanics to determine the impact that the propagation of these cracks has on the structural integrity of the tubes.

OTSG Tube Loads

2.1.2

Axial Membrane Loads

The maximum possible tube load due to differential thermal expansion of shell and tube, pressure effects, and the effect of tube pretension is 585# for peripheral tubes (Refs. 1a, and 1b). A minimum of 195# can be expected for core tubes. Central to the development of an analytical model used to establish these values was that center-line, ambient tubesheet deflection predicted was identical to that reported by B&W. This condition was met. A parted tube of TMI-1, B 22-30, showed a spring back of approximately 0.090". This indicates a tube pre-load of 290#, assuming that the tube doesn't "hang-up" after load reduction due to residual contact pressure. The analytical model predicts a tube preload of 650# for a peripheral tube and 460# for a tube at the unit center-line. One measurement for a peripheral tube does not prove or disprove the analytical model. The spring-back distance will be remeasured in order to establish the validity of the analytical model.

Certain other facts are necessary to establish the tube operatng load. EPRI, NP-2146, Static Strain Gauge Measurements for TMI-2 OTSG Tubes Ref. 2), shows that for plant heat-up to 530°F a compressive load of 265#, as a average, will develop. The strain gauges do not reflect preload since

they were attached after generator fabrication. Additional compression can be expected in going to 0% power conditions. The increase is small and can be shown in B&W calculations (Ref. 3). Both the strain gauge measurement - and the B&W calculation include pressure effects, such as Poisson's contraction of the tube, shell elongation due to secondary side pressurization, and shell-to-tube temperature differences. Each neglects preload.

An additional experimental data point comes from EPRI, NR1876, Vibration Analysis of TMI-2 OTSG Tubes (Ref. 4). The natural frequency of peripheral lane tubes increased 16 Hz from 40-97% power. This is a clear trend. Tube natural frequency will increase as increasing axial load is applied. The trend correlates to axial load changes of approximately 400# in the direction of increasing tension. This trend has an error band associated in the manner of tube end fixity. A tube at 60 Hz could be in axial tension of 400#.

The strain gauge data presents the fact that the tubes see compressive loads during heat-up which are nearly the same as at 0% power. The trend is clear that increasing power brings with it significant tension loads. Using the factual strain gauge data for heat-up and the preload calculation the representative tube load during operation can be identified:

850#	Calc., for tube pre-load, max.	460#	Calc. from pre-lod, min.
-265#	Measured, from heat-up	-265#	
585#	Max.	195#	Min.

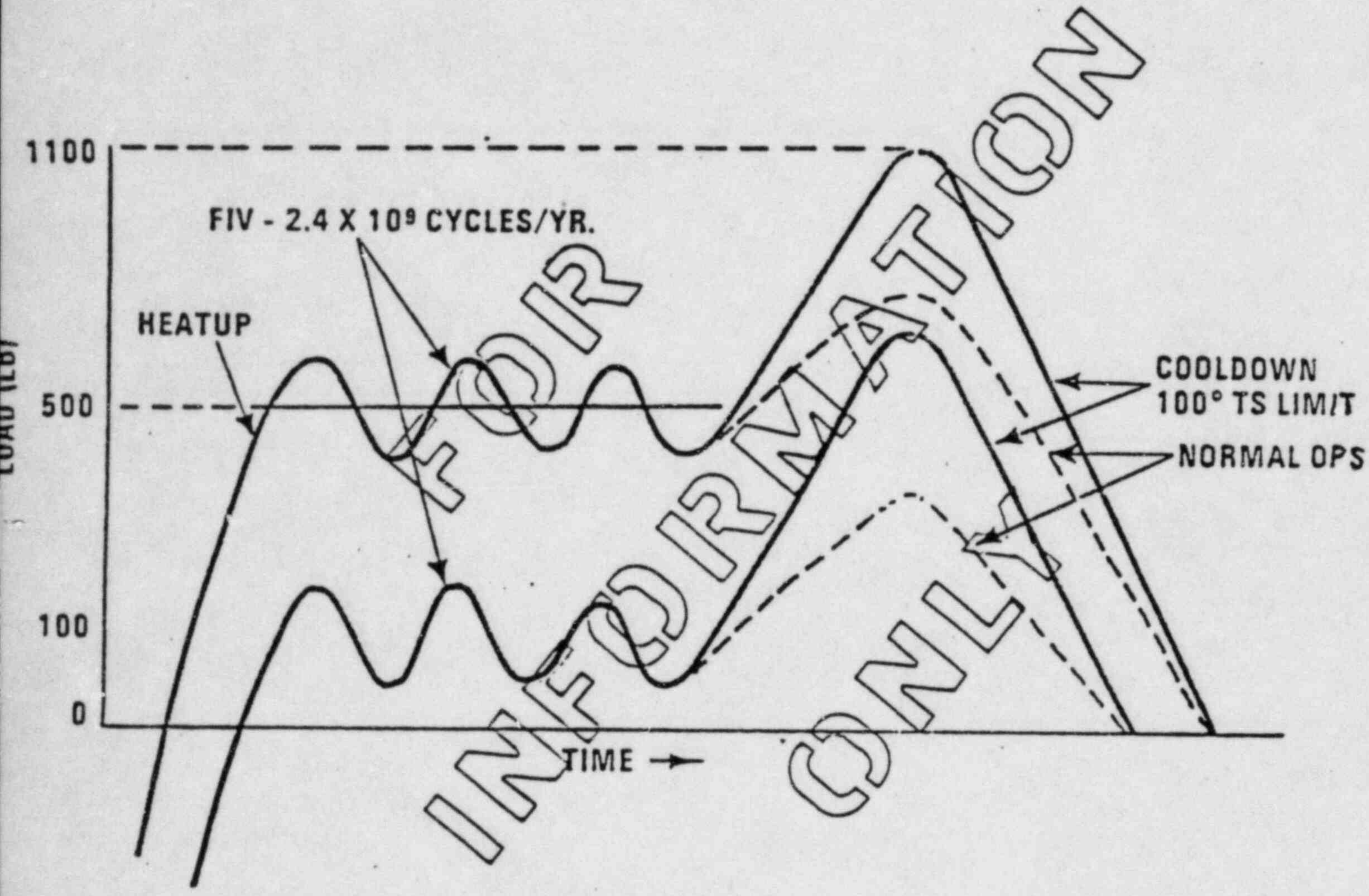
The additional compresion at 0% power and the trend to increasing tension at higher power are taken as approximately compensating trends, while the bias is toward tension.

In addition, a first principle evaluation (GPUN Calc., Ref. 5) establishes a load of 480-507# tension for peripheral tubes during full power operation and 200# tension for core tubes. This analysis takes into account pressure affects, shell-to-tube temperatures differences, flexure of the tubesheet, and preload of 290# taken from the measured spring-back of tube B-22-30. The mechanical analysis of tube integrity which follows uses as a conservative upper bound of 500# as the tube axial loading during steady state operation.

Tube axial loads for an anticipated 100°F/hr cooldown and for the MSLB are taken from a generic design basis document (Ref. 5a). These loads are 1107# tension for the 100°F/hr cooldown and 3140# for the MSLB.

An accurate model of the load cycle (see Fig. 3) must reflect the mean load, on which the flow induced vibration (FIV) load is superimposed. An axial tension of 500# was chosen as a reasonable and conservative approximation. In fracture mechanics, $R = K_{min}/K_{max}$. As the axial load is increased the R value approaches 1.0. From Fig 4, Ref. 6, at R=1.0, crack growth rate, da/dN, is greater and the $(\Delta K)_{Th}$ is lower than for R=0.0. A higher R value yields more conservative mechanical analysis. On the other hand, use of very large axial load will introduce error in leakage based on crack opening displacement (COD) which is a function of axial load.

OTSG Loading Cycle for Tube Mechanical Evaluation



- FIV ALTERNATING LOAD, REGION I ~ ± 550 PSI, .003" MAX. DISP.
- HEATUP/COOLDOWN, 6 CYCLES/YR.
- 40 YEAR LIFE
- MAXIMUM AMPLITUDES

FIG. 3

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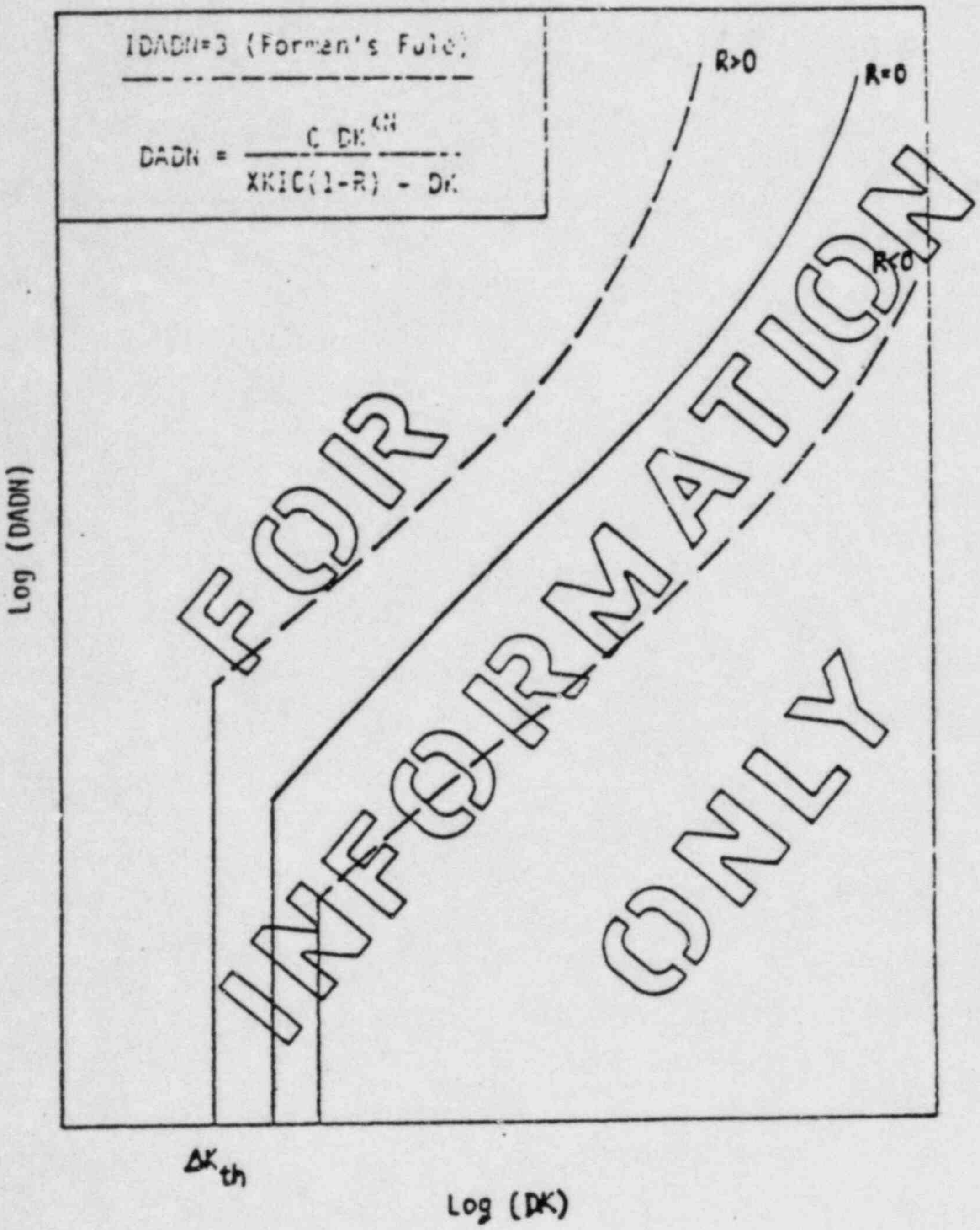


FIG 4 SHIFT OF ΔK_{th} WITH CHANGING R RATIO

2.1.3
Bending Loads (FIV)

The OTSG, while a counter current heat exchanger, has several regions of cross-flow. The most significant of these is the tube span between the 15th lateral support plate and the upper tubesheet. At this region, superheated steam turns into the steam dome annulus prior to exiting at the main-steam nozzle.

Turbulent wake shedding produces a wide spectrum of excitation frequency. Lateral deflection is due to lift rather than drag forces. The tubes select their natural frequencies from the spectrum of excitation.

NP-1876 provides measured tube deflection at TMI-2 (Ref. 4) Fig. 5. At 97% full power, 1 mil (RMS) was measured. This corresponds to [illegible] mils peak displacement. Using Fig. 5.4-1 from Ref. 4, the bending stress can be estimated to be ± 540 psi.

2.1.4
Crack Propagation by Fracture Mechanics

2.1.4.1
Stress Intensity

Stress intensity is used when evaluating stable crack growth. It is an analytical convenience, a parameter. The severity of the crack is measured in terms of stress intensity, in the following form (Ref. 7):

$$K = \sigma Q \sqrt{\pi a} \qquad \text{Eq. 1}$$

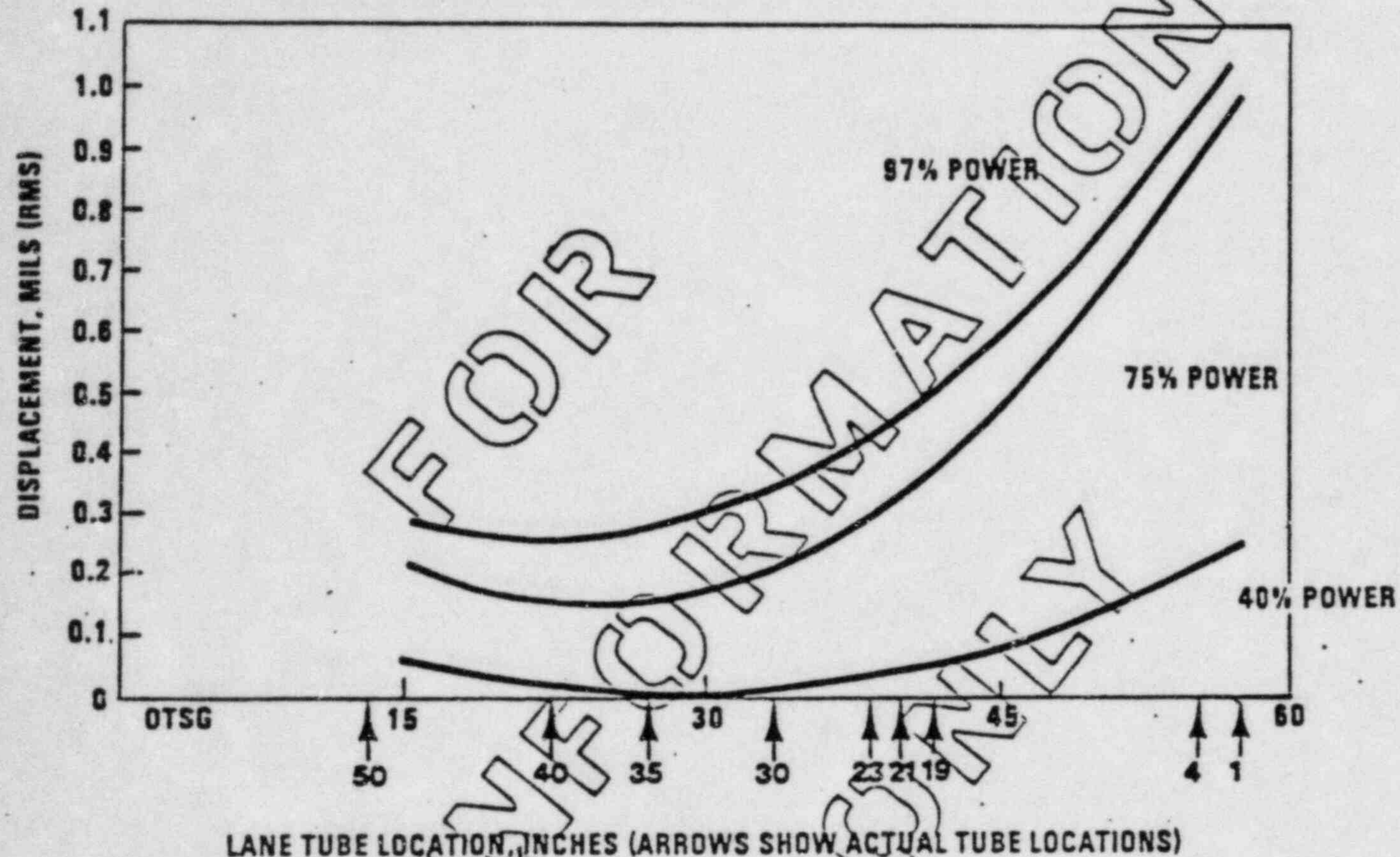
where K = stress intensity, KSI $\sqrt{in}$

σ = stress, KSI

Q = shape factor

a = crack depth, in.

TMI-2 FIV INSTRUMENTATION RESULTS - STEADY STATE TANGENTIAL DISPLACEMENT



- STEADY STATE DEFLECTION FOR FRACTURE MECHANICS ANALYSIS = 3 x MAX RMS VALUE = 3 MILS.
- ONE CAN SAY WITH A CONFIDENCE LEVEL OF 98% THAT FOR A GAUSSIAN DISTRIBUTION THE MAXIMUM AMPLITUDE WILL NOT EXCEED THREE TIMES THE RMS.

FIG. 5

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Stress intensity reflects the state of stress at the flaw, the flaw size, and the relationship of the flaw to the boundaries of the body. Stable crack growth can be described by the following equation:

$da/dN = C\,(\Delta K)^n$ where da/dN, crack extension, in/cycle

C, a material property

ΔK, stress intensity range

n, a material property

Crack growth can be calculated by integrating the stress intensity range over the number of load cycles. The EPRI linear elastic fracture mechanics code 'BIGIF' (Ref. 6) performs this task.

The stress intensities used here (Ref. 8) are expressly for ID cracks in tubes. No approximate solutions are involved. The stress intensity solution admits of the combined loading from four components: axial membrane load, bending load, pressure loads, and tube internal pressure acting on the parting faces of the crack.

Table 1 identifies the final stress intensities used. The results of this evaluation for $(\Delta K)_{Th} = 4.0$ is shown in Fig. 1, line segment Ⓐ (Ref. 9).

2.1.4.8

Threshold Stress Intensity, $(\Delta K)_{Th}$

There is a point at which small in-dwelling cracks have no effect on fatigue resistance (the endurance limit). The value of the stress intensity below which cracks do not propagate is the stress intensity threshold. Figure 6 establishes this threshold for INCO 600. Data from two investigators is plotted in the figure showing a common trend and identifies a 'knee' pointing away from linearity. The intercept at the abcissa is the threshold for propagation. To the left of this value there is no crack propagation, while to the right there is propagation. A value of $(\Delta K)_{Th} = 4.0\ KSI\sqrt{in}$ is conservatively taken.

An effective $(\Delta K)_{Th}$ is used to link the condition under which the threshold is identified experimentally to the R ratio under applied loads, in the following manner:

$$\text{eff. } (\Delta K)_{Th} = \frac{A - R}{A - R_o} (\Delta K)_{Th} \qquad \text{(Ref. 6)}$$

R_o, ratio at which $(\Delta K)_{Th}$ is defined, usually $R_o = 0.05$

R , ratio under applied loading

A , constant for titanium or steel, $= 1.41$

Applicable to nickel alloys, by inspection

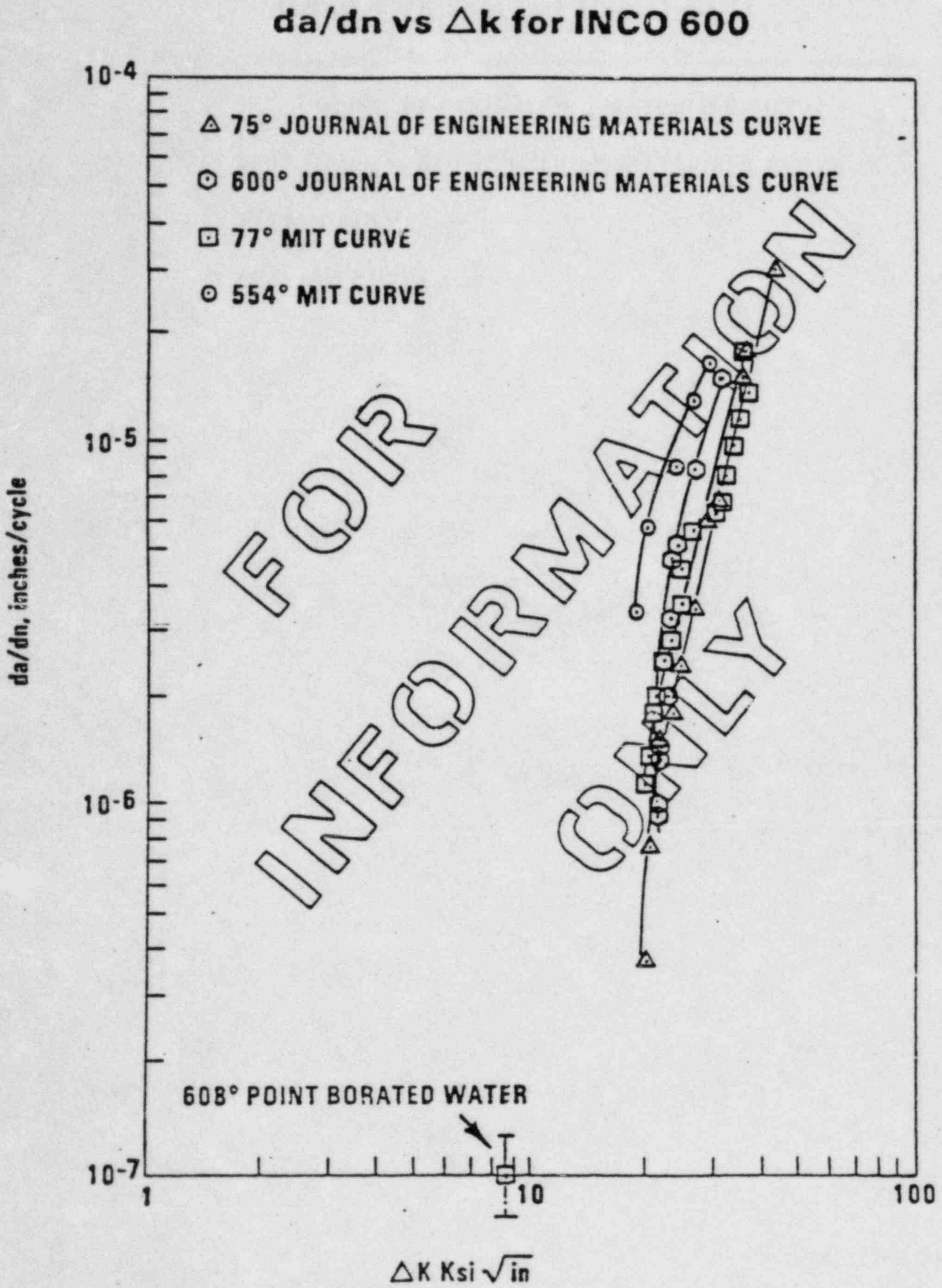

FIG. 6

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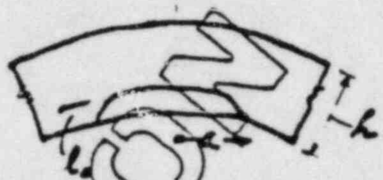
REV 1

Table 1

The stress intensity factor ratio $K_1/6_m$ in the tube containing an inner circumferential semi-elliptic crack, and subjected to a uniform axial membrane stress 6_m, OD = 0.625 in. h = 0.034 in.



	Lo/h								
a/h	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1.0	0.115	0.161	0.193	0.215	0.231	0.243	0.249	0.255	0.293
2.0	0.118	0.173	0.218	0.258	0.290	0.319	0.336	0.354	0.428
3.0	0.119	0.177	0.230	0.279	0.323	0.363	0.392	0.421	0.526
4.0	0.119	0.180	0.236	0.291	0.343	0.393	0.433	0.473	0.608
5.0	0.119	0.181	0.240	0.299	0.357	0.414	0.463	0.514	0.678
6.0	0.119	0.182	0.243	0.304	0.367	0.430	0.487	0.548	0.740
7.0	0.120	0.182	0.244	0.308	0.374	0.443	0.507	0.577	0.794
8.0	0.120	0.182	0.246	0.311	0.380	0.453	0.523	0.602	0.842

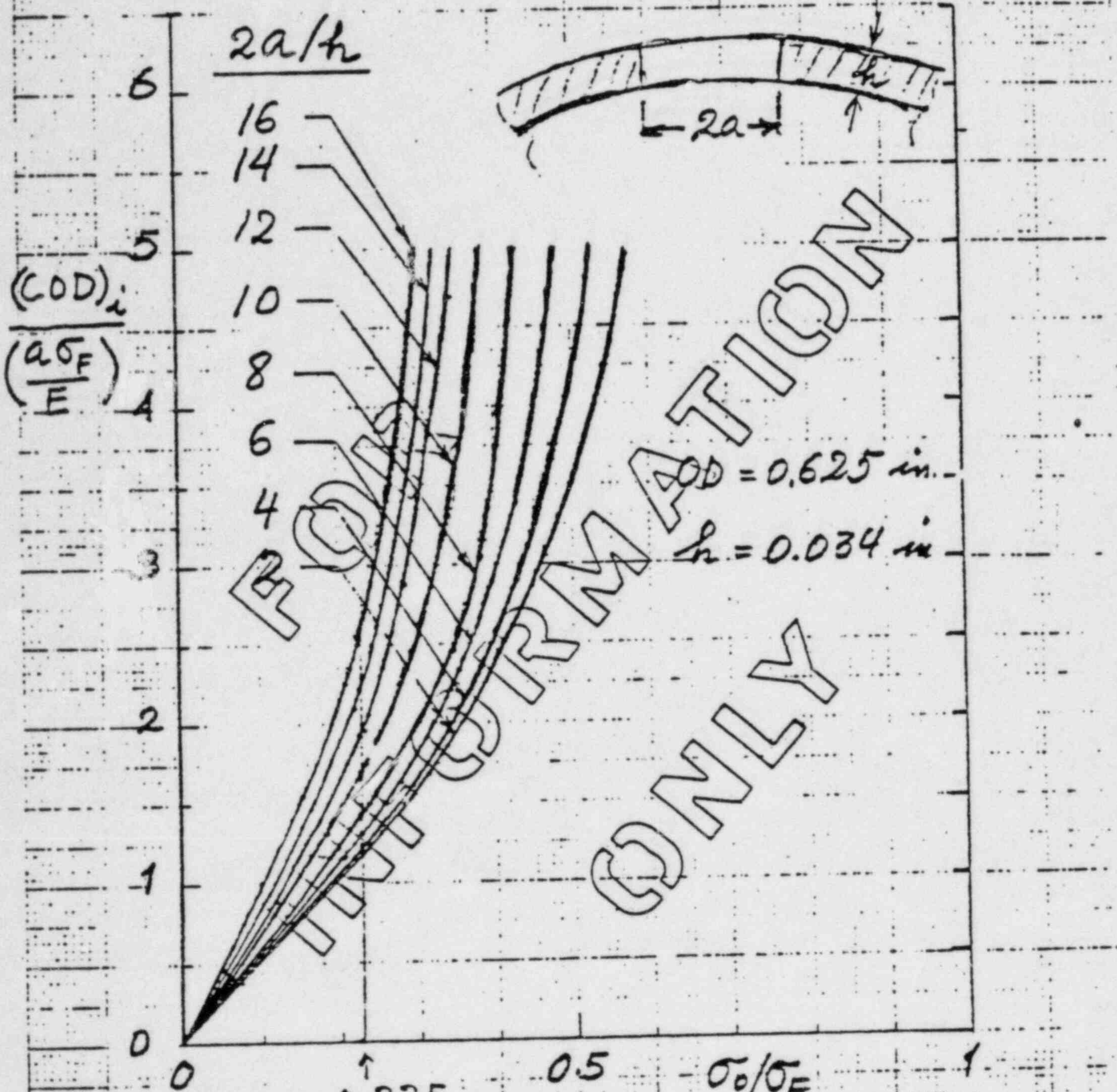


Fig. 7 $(COD)_i$ vs. the stress ratio in the tube under uniform axial stress σ_0 and gross bending moment M_0, ($M_0 = A\sigma_0/24$).

22 Leakage

221 COD

Crack opening displacement increases linearly at first, up to where the membrane stress is about 22.5% of the flow stress, then non-linearly until becoming asymptotic at 40 to 60 percent of flow stress depending on crack circumferential extent (Fig. 7, from Ref. 8).

In the neighborhood of a certain value of σ_o, a small increase in σ_o causes a large increase in COD. Physically this can be interpreted as the onset of ductile fracture instability. This process is self-limiting because real world conditions put grips on tube ends that form restoring bending monuments, as in the following figure, Fig. 8.

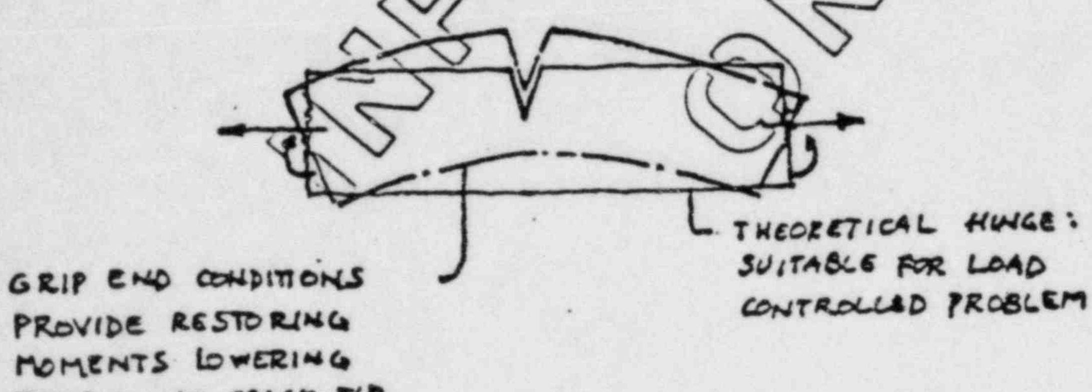


FIG. 8

An axial load will move the cracked tube laterally to line up the centroids of the unaffected and cracked cross-sections. This tendency is limited by the end conditions of the tube. COD is reduced and section ultimate strength is increased. Fig. 8 shows this increase in section ultimate strength per grip end conditions (Ref. 10). Very large COD occurs at higher σ_o.

2.2.1
Leak Rate Calculation

The NSAC/EPRI analysis Ref. 11 shows that a phase change occurs for leakage through the crack. The NSAC/EPRI analytical method is supported by matching experimental data taken at Battelle (Ref. 8).

Pressure drop is due to

1) Entrance affects: formation of jet in vena contracta.
2) Acceleration of fluid due to vaporization in the crack: decreased density forces velocity to increase within steady flow conditions.
3) Acceleration of fluid due to area change: decreased throat area at crack exit forces velocity to increase within steady flow conditions.
4) Friction: surface roughness may be 25% of the throat dimension.

Leak rate is shown as a function of crack arc length in Fig. 2, Ref. 11. The axial loads acting on the crack are 500# during steady-state operation and 1107# during an anticipated 100°F/hr cooldown.

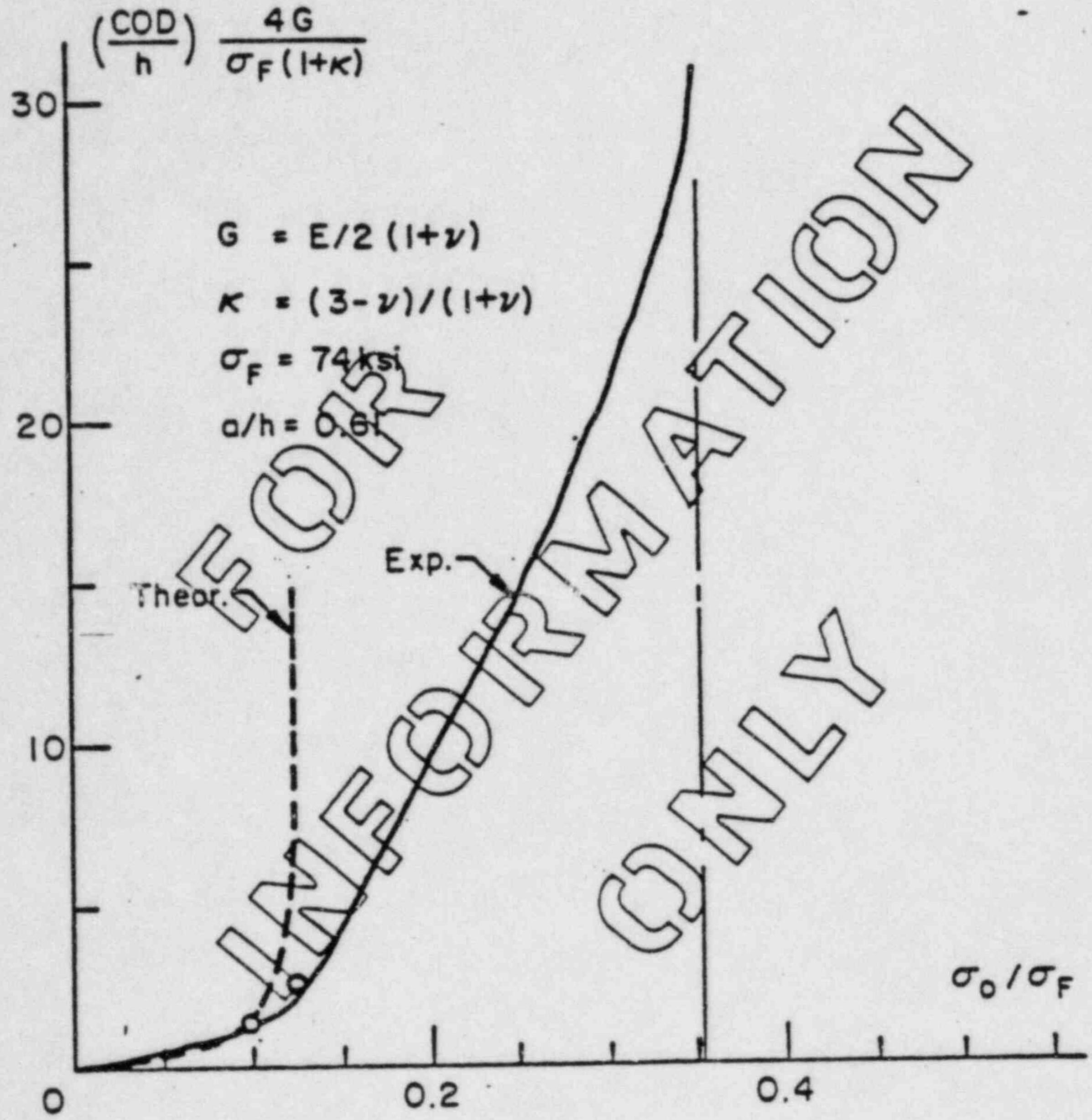


Figure 8. Normalized COD vs. stress ratio

2.3 Comparison of As-built and As-repaired Transition Region Geometries.

The object of this evaluation is to compare the as-built and as-repaired transition geometries in order to determine if the repair represents a design no less adequate than the original, and moreover, that the as-repaired transition represents an improvement in the state of stress as compared to the original.

With the assistance of Prof. A. Kalnins, Professor of Mechanics, Dept. of Mechanical Engineering and Mechanics, Lehigh University, a detailed stress analysis of the transition region has been performed for both the as-built and as-repaired geometries. The computer code "KSHELL", a general purpose structural analysis program for shells of revolution developed by Prof. Kalnins, was used to perform the evaluation.

Model

The model of the transition zone is shown in Figure 9a, b & c, for three load cases. Results are linearly superimposable since stresses are first order with load. The model captures the transition geometry as identified in Topical Report 007 Figure 2-12, (Ref.12), for the 30° bevel on the plastic insert for the as-repaired condition. Upper and lower boundary conditions are the same for all load cases. The upper boundary condition permits a vertical reaction with lateral freedom. The lower boundary conditions serve to analytically replace the lower section of tube that was cut away. The section can move laterally freely but no slope change can take place. This type of behavior can be expected for free span regions of long, flexible tubes. A vertical reaction is also permitted at the lower end.

One additional boundary condition finds application, the "ring-spring" shown in Figure 9,b. The "ring-spring" offers radial resistance while permitting structural rotation at the point of contact with the tube. The "ring-spring" boundary condition was used only when considering a specific loading condition, the pressure difference, Δp, across the tube wall. Here a unique structural response was anticipated. It was recognized that the tube wall might lift off the tubesheet (move radially inward) under the action of the Δp. "KSHELL" output identifies that this motion occurs (discussed below).

Load Cases

Three load cases were considered: 1) contact pressure 2) Δp, and 3) axial load. Contact pressure is the compressive radial pressure exerted by the tubesheet on the tube as a result of plastic deformation of the tube and elastic rebound of the tubesheet to capture the tube as a result of the fabrication process, be it mechanical or kinetic (Figure 9 a). The contact pressure for the as-built condition is 3350 psi as per TR007 (Ref.12), and that for the as-repaired condition is 1123 psi, by virtue of a 6" contact length for the latter and a 1" contact length for the former.

The Δp load case (Figure 9b) treats the pressure gradient as applicable only away from the contact length. No pressure gradient exists across the wall where the tubesheet is in contact with the wall. During operation a 1300 psi pressure drop acts across the wall while during 100°F/hr cooldown there is no primary-to-secondary pressure difference. The MSLB Δp is 2500 psi.

The axial load case treats tube axial load as evenly distributed on the circumference of the cut lower section. The normal steady-state operating load is 500#, that for the 100°F/hr cooldown is 1107#, and that for the MSLB is 3140#.

Transition Stresses and Structural Response

"KSHELL" shows significant advantage of the as-repaired transition over the as-built transition in terms of stress-s during a MSLB will all factors considered, Table 2. Longitudinal bending and membrane stresses are shown, with stress components identified in Figure 10. The location of maximum tension at the ID is in the upper part of the transition region where the radius of curvature blends into the contact length, shown at cut A-A, Figure 9a.

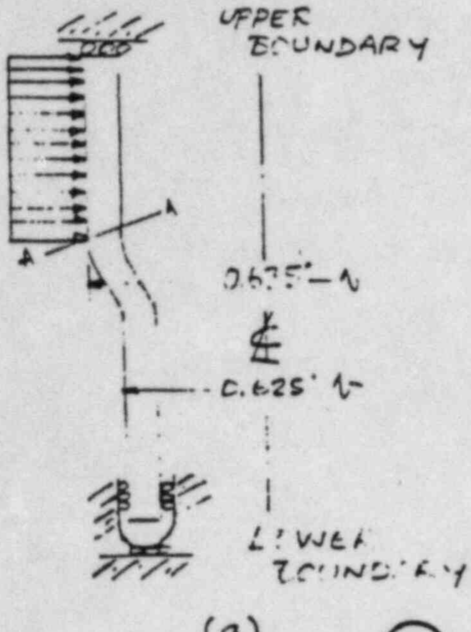
The benefit of the 6" contact length, as-repaired, appears when comparing stresses with the 1" contact length, as-built. The stresses are reduced by two-thirds. Further benefit is gleaned from the longer transition region which substantially reduces bending stress when axial load is applied. During MSLB maximum stresses due to axial load are reduced from 62831 psi to 50742 psi. The as-repaired transition is 0.5 in. long, as given in Ref. 12, Fig. 2-12. The as-built transition is 0.0625 in. long. The total stress, from all factors, is reduced 24%, from 91209 to 73712, in the as-repaired condition. During 100°F/hr cooldown, the maximum stress for the as-repaired transition is less than the code allowable (ASME BPVC, Sect III, Appendices, 1980).

The structural response mentioned above (under Model), namely that the tube lifts off the contact zone due to the p in the neighborhood of the highest stressed region can be seen in the "KSHELL" output. The inward displacement is about 0.1 mil. The use of the "ring-spring" boundary condition in "KSHELL" permitted this response.

CONTACT PRESSURE

UNIT LOAD

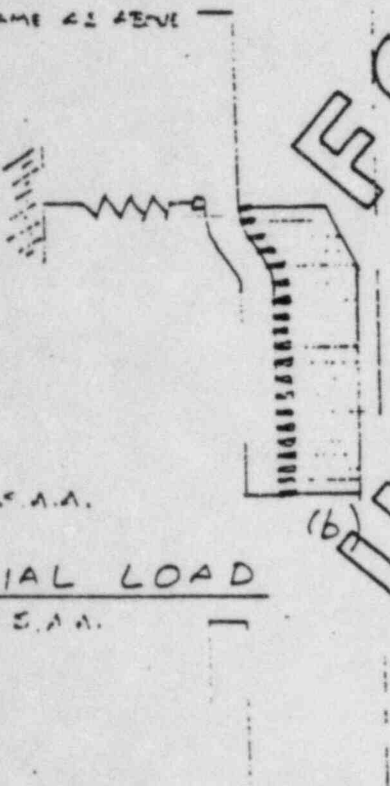
100 psi



(a)

A_F

SAME AS ABOVE



S.A.A.

(b)

AXIAL LOAD

S.A.A.

S.A.A.

(C)

FIG. 9, a, b, c.

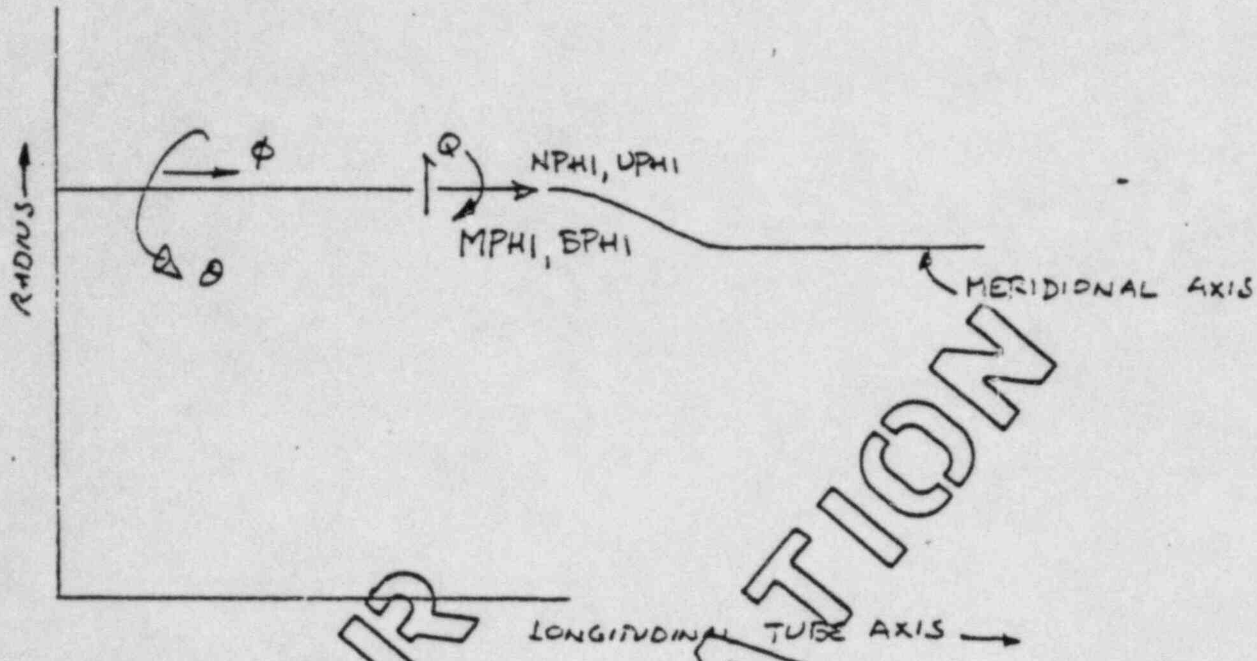


FIG. 6
DISPLACEMENT AND LOADING CONVENTIONS

TABLE 2

LOAD CASE	AS-BUILT $\sigma_{\phi in}$	AS-BUILT $\sigma_{\phi out}$	AS-REPAIRED $\sigma_{\phi in}$	AS-REPAIRED $\sigma_{\phi out}$	COMMENTS
1) Contact Pressure	+8586	-8586	+2865	-2865	As-repaired joint has 6" contact length as opposed to 1" for as-built.
2) Δp	+19792	-19060	+20105	-19372	
3) Axial Load					
a) Unit Load, 1000*	+20010	+11140	+16160	+14990	σ_m = 19840; significant bending occurs in as-built condition
b) MSLB, 3140*	+62831	34979	+50742	47069	σ_m = 49738; pronounced bending occurs in as-built condition
Summation	91209	7333	73712	24832	As-repaired $\sigma_{\phi in}$ < as-built $\sigma_{\phi in}$; $\sigma_{\phi in}$ for as repaired < σ_{flow} = 75500
100^{o}F/hr Cooldown					Note: Comparison of performance for shut-down load case should not include Δp term.
1) Contact Press.	+8586	-8586	+2865	-2865	
2) Δp	-0-		-0-		
3) Axial Load	22151	12332	17889	16594	
Summation 100^{o}F/hr. Cooldown	30737	3746	20754	13729	$P_L < .67S_y$; $P_b + P_L \leq 1.5\ S_m$ = 34950 psi

2.4 Residual Stresses Caused by Formation of the Transition Zone.

Tube expansion causes residual meridional bending stresses. It can be shown (below) that compressive stresses pertain at the center-line. This is advantageous because compressive stresses arrest cracks.

Consider the following bending stress distribution achieved at the end of the expansion process, Fig. 11.

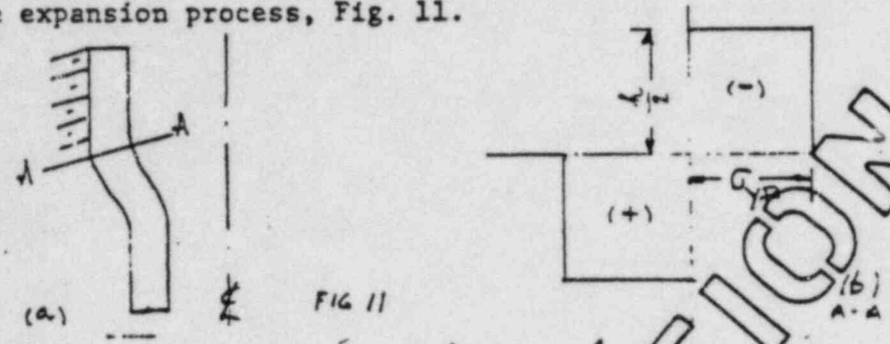


FIG 11

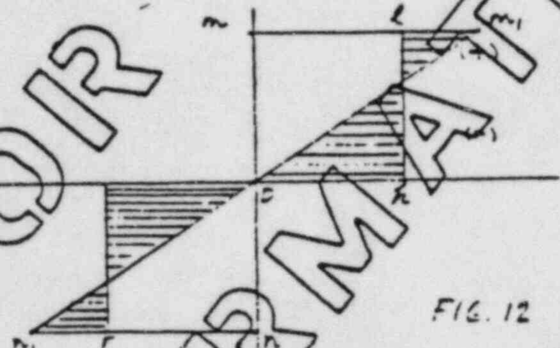


FIG. 12

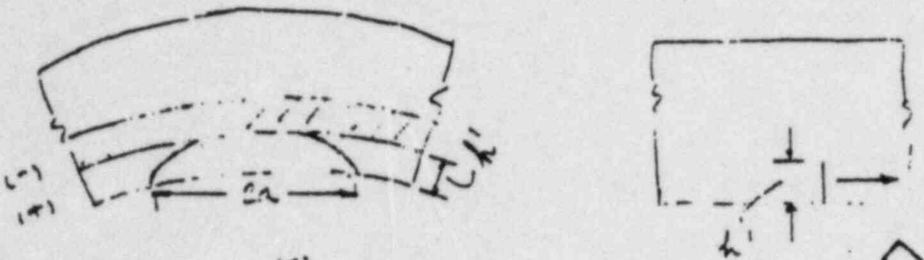
When the applied load is removed, for either the as-built or as-repaired condition, plane sections will remain plane. The applied moment is equal to the unloading moment. The stress distribution, after unloading, will be linear (Figure 12, m, o, n). The superposition of the two stress distributions, rectangular while loading and triangular while unloading (shaded area), represents the stresses which remain in the tube after unloading. From equilibrium, after unloading, the sum of moments on the section must be zero. The shaded areas (Figure 12) provide that equilibrium and are the residual stresses.

Fibers at the neutral axis will have a residual stress equal to yield while the outermost fibers will have a residual stress equal to $\frac{1}{2}\sigma_{yp}$. This development is substantiated by evaluation of unloaded curvature as described in Timoshenko, Vol. II (Ref. 13).

These residual stresses are consistent with x-ray defraction measurements (TR007, Ref. 12).

The presence of the residual stresses does not jeapordize the region during a MSLB. Application of a membrane stress at the near yield stress, as from the MSLB load, would not result in the entire section having a residual stress equal to yield. This conclusion is evident by linear superposition of stresses within the condition that the material is approximately elastic-perfectly plastic when loaded.

Compression at mid wall is advantageous because it is a crack arrest condition with respect to radial propagation. Circumferential propagation could occur without radial propagation but at a very slow rate.



(a) (b)

FIG. 13

This can be qualitatively demonstrated in the following way. Figure 13a, depicts a part through-wall crack arrested by forward compression. Circumferential propagation occurs as the crack runs tangent to the compressive field. Shut-down tension is the exercising force. The alternating through-wall stresses are as a result of residual stresses from transition fabrication, as repaired or as-built.

The severity of a crack is a function of the length of the propagating edge, among other things. For tangential propagation the circumferential extent of the crack is no longer appropriate. The depth h' is the propagating edge. Since the compressive field will occur before mid wall h' will be significantly less than the circumferential extent, 2a (Fig. 13 a & b). A magnifying effect on stress intensity is the decreasing ligament size remaining before the crack goes through-wall. This magnifying effect does not occur for circumferential propagation.

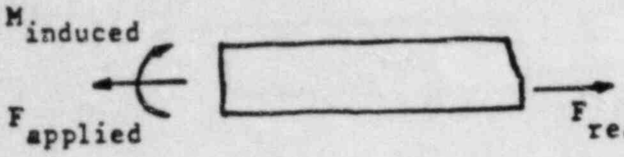
Relative shallowness, small h' dimension, relative constancy of stress intensity, because through wall dimension will not increase, are factors which mitigate circumferential growth rate.

2.5 MSLB

The following analysis is based on work performed by MPR associates (Ref. 14).

Free Span

A flawed section will move laterally under an axial load in order that the c.g.'s of all sections line up to reduce the induced bending moment generated at the flaw.

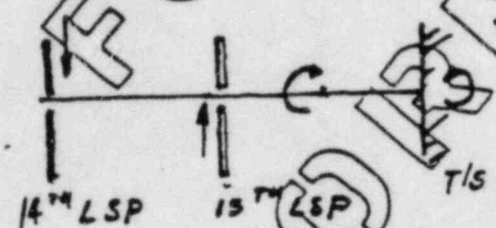


$M_{induced} = F\,(e-\delta)$ (ref. 14)

e = eccentricity

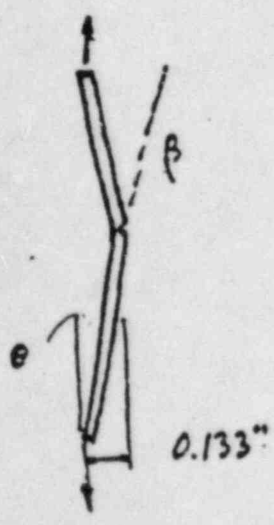
δ = deflection at cracked section

Several spans away, this moment is reacted by couples created at the lateral support plates. Uniform bending characterizes curvature.



The restoring moment and remaining tube stiffeners will not permit $e = \delta$.

Hence the tube looks like:



θ = [.133 in/23 in] radians

θ = .00578 radians

$\beta = 2\theta$ = .01156 radians

For fixed/fixed conditions, half the tube is treated separately. Uniform bending pertains to this length.

Therefore, from beam theory.

$$\frac{d^2y}{dx^2} = \frac{M}{EI}$$

Since the M is constant along the span,

$$\frac{dy}{dx} = \theta = \frac{Mx^2}{EI} \quad \text{and } y = \frac{Mx^2}{2EI}$$

Thus $\delta = \frac{M\ell^2}{2EI}$

and $\delta = \frac{F(e+\delta)\ell^2}{2EI}$

Solving gives $\delta = \frac{F\ell^2}{2EI}e \Big/ \left[1 + \frac{Fl^2}{2EI}\right]$

$$= \frac{(3130\ \text{lb})(23\ \text{in})^2(.133\ \text{in})}{(2)(30.1\text{x}10^6\ \frac{\text{lbf}}{\text{in}^2})(.00283\ \text{in}^4)} \Big/ 1 + \frac{(3130\ \text{lb})(23\ \text{in})^2}{2(30.1\text{x}10^6\ \frac{\text{lb}}{\text{in}^2})(.00283\ \text{in}^4)}$$

δ = 0.1206 in

Thus $M = F(e - \delta) = (3130 \text{ lb})(.133 - .1206) = 38.8$ in-lb.

$$\theta = \frac{Ml}{EI} = \frac{(38.8 \text{ in-lb.})(23 \text{ in.})}{(30.1 \times 10^6 \frac{\text{lb}}{\text{in}^2}) \; (.00283 \text{ in}^4)} \quad 2 = .0105 \text{ radian}$$

$$\beta = 2(.0105) \text{ radian}$$

$$= \underline{.021 \text{ radian}} \qquad (1.2032°)$$

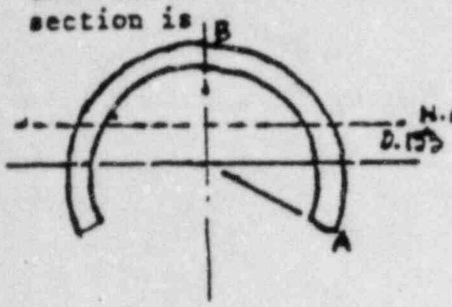
Tube specimen A-13-63, from TMI-1, containing a 25% area flaw,. exhibited a 1.5° rotation when taken to failure (Ref. 15). This is the limiting condition.

It will be assumed that the strain in the plastic hinge at the location of the crack is absorbed over a very short length, 0.1 inch.

Hence the strain is given by

$$\epsilon = \frac{\text{Axial Growth}}{.1} = \frac{\text{(Hinge Rotation) (Dist from Neutral Axis to Extr. Fiber)}}{.1}$$

The distance from the neutral axis to the extreme fiber at the cracked section is



$Y_A = 1/2\ D_o \sin 25°$

$= -1/2\ (.625\text{ in.})(.423) = -.132\text{ in.}$

$Y_B = 1/2\ (.625\text{ in.}) = .3125\text{ in.}$

Y_B — neut axis = .3125 - .133 = 0.1795 in.

$Y_{neut\ axis}$ — A = .133 - (-.132) = 0.265 in.

Hence use 0.265 in.

$$= \frac{(.021\text{ radians})(0.265\text{ in})}{.1} = 0.0557 = 5.57\%$$

When 5.57% bending strain is added to the 7% strain from the membrane load, the total strain is 12.6%. This corresponds to a stress of 85 KSI. This is a stress increase above flow stress of

$$\frac{85-75.5}{75.5} = 0.126 = 12.6\%$$

Therefore, in order not to exceed the flow stress, the intact area requirement is increased by 12.6%. The intact area required becomes 72% of the total. The defect size is .52".

Results are shown in Figure 1 for a peripheral tube (3140#) and for a core tube at the centerline (1408#).

2.5
Net Section Collapse

Net section collapse has as its failure criteria the formation of a hinge at th flawed elevation when flaw stress, σ_f ($\sigma_f = \frac{\sigma_y + \sigma_{UTS}}{2}$) is reached both in tension and compression.

It is arrived at (Ref. 16) very conservatively. Unlike the method for MSLB, previously discussed, no account is made of the fact that a section moves laterally at the flaw. The section bending moment is maximized. Results are shown in Fig. 1 for the 100°F/hr normal cooldown and a 50°F/hr administratively limited cooldown.

3.0 REFERENCES

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PRIORITY ATTENTION REQUIRED | MORNING REPORT - REGION I 5-13-83 | PRIORITY ATTENTION REQUIRED

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TO: James Blaha, Chief, Program Support Branch, IE
FROM: James M. Allan, Region I

Licensee/Facility	Notification/Subject	Description of Items or Events
DPRP		
Three Mile Island Unit 1 DN 50-289	Fax from RI 5/12 OTSG Tube Repair Process	Once Through Steam Generator (OTSG) Tube Repair Process Update. The licensee is in the process of evaluating drip and bubble test data conducted on both OTSG's. These tests were performed to verify the leak tightness of the Kinetic Expansion process, new tube plugging and stabilization repair. The drip and bubble test are being performed to supplement Eddy Current Testing (ECT) data. Preliminary data indicated approximately 30 tubes (by the drip test) and 40 tubes (by bubble test) are leaking. The video tapes of the bubble tests are being reevaluated for correlation with the drip tests and ECT data. The licensee is identifying small pin hole leaks that are below the threshold for ECT detection. After final evaluation, it is expected that tubes with indications of leaks will be removed from service. A final bubble and drip test will be performed to verify these repairs.

GENERAL PUBLIC UTILITIES
OTSG REPAIRS

DATE 5/18/83

ITEM	DESCRIPTION	RESPONSIBILITY	DATE REQUIRED
1.	Restoration Secondary Side		
	. Temp. Chem. System	S. Levin	TBD
	. Remove Flush System	S. Levin	TBD
	. Remove Air Compressor	S. Levin	TBD
2.	Ops OTSG Status		
	. OTSG Level "A" 511"		
	. OTSG Level "B" 519"		
3.	Drip Test @ "A"		5/18
4.	Eddy Current Test		5/13
	50 tubes to go		
5.	Tube Plugging & Stabilization		TBD
	. Issue FCA	B&W	5/19
	. Issue DRF for Repairs	T. Functions	5/20
6.	Miscellaneous Items to Resolve		
	. Hydrogen Peroxide Tube Soak (TMM)		5/2
	. Decon of Equip		In Progress
	. Revised Spec for Flushing Rev. 5		
	. Dissolved O_2 Analyzer TMM		TBD

7. Waiting Documentation

MNCR		Responsibility
215-82	Plug Exploded at Wrong Area of Tube	QC
426-82	Wire Brush B6-1	QC
094-83	Weld Repairs in "A"	QC
091-83	Feltplug Blowing	QC
111-83	Misplugged Tubes	QC
119-83	Misplugged Tubes	QC

8. Rad Con Exposure Data (Based on SRDs) as of 5/13
   - . Total OTSG Exposure since 1st Blast - 95[illegible].[illegible] Man Rem
   - . Total OTSG Exposure since Nov 1981 - 11[illegible].[illegible] Man Rem
   - . Final Estimate Exposure Since Nov 1981 - 1204 Man Rem

9. Anticipated Jumps

Date	Description		Responsibility
5/18	A - Upper -	Eddy Current	Levin/Catalytic
	A - Lower -		
5/18	B - Upper -		
	B - Lower -		

GENERAL PUBLIC UTILITIES
OTSG REPAIRS

DATE 5/20/83

ITEM	DESCRIPTION	RESPONSIBILITY	DATE REQUIRED
1.	Restoration Secondary Side		
	. Temp. Chem. System	S. Levin	TBD
	. Remove Flush System	S. Levin	In Progress
	. Remove Air Compressor	S. Levin	TBD
2.	Ops OTSG Status		
	. OTSG Level "A" 511" or		
	. OTSG Level "B" 519"		
	Pmp A 7 (W) leaking 19 10 7 2		
	B 1 leaking W (86-50) fiberoptics		
3.	Results of Drip Test @ "A" & "B"		5/18
122-47	. Snoop Test 50 tubes out of services		5/20
225+12W 4.	Eddy Current Test Done		5/13
	. Resolve Blocked Tube in "A" 17-59		40 stablizers
	No more Eddy Current test.		
	B example 5 (W) 7 stablilize		
5.	Tube Plugging & Stabilization		TBD
	. Issue FCA preliminary	B&W	5/19
	. Issue DRF for Repairs	T. Functions	5/20
	. Issue New J.O. & IP	G. Kull	5/23
6.	Miscellaneous Items to Resolve		
	. Hydrogen Peroxide Tube Soak (TMM)		5/2
	. Decon of Equip		In Progress
	. Revised Spec for Flushing Rev. 5		
	. Dissolved O_2 Analyzer TMM		TBD
	Westinghouse will be here Monday		

7. Waiting Documentation

MNCR		Responsibility
215-82	Plug Exploded at Wrong Area of Tube	QC
426-82	Wire Brush B6-1	QC
091-83	Feltplug Blowing	QC
111-83	Misplugged Tubes	QC
119-83	Misplugged Tubes	QC

8. Rad Con Exposure Data (Based on SRDs) as of 5/18
   - . Total OTSG Exposure since 1st Blast - 955.5 Man Rem
   - . Total OTSG Exposure since Nov 1981 - 1132.7 Man Rem
   - . Final Estimate Exposure Since Nov 1981 - 1204 Man Rem

9. Anticipated Jumps

Date	Description	Responsibility
5/20	A - Upper - eddy current removal	Levin/Catalytic
	A - Lower -	
5/20	B - Upper -	
	B - Lower -	

SP-1101-12-030
Rev. 10 5/23/83

ATTACHMENT 1

PART VIII (B)

OTSG B	ROW	TUBE		DEFECT LOCATION	0.540 H.G. % T.W.
1.	32	6	(L_0)	US+01	95
2.	41	5	(L)	US-02	40
3.	41	7	(L)	US+04	50
4.	41	8	(L)	US-02	95
5.	100	6	(L)	US-0	95
6.	110	6		US+02	50
7.	127	2	(L)	US+0	95

OTSG B ADDITIONAL TUBES TO BE PLUGGED WITH WESTINGHOUSE ROLLED PLUG

			Eddy Current Data			
Item	Row	Tube	Elevation	%TW	Volts	Plug Location
1	13	47	US+06	95	3	Both UTS & LTS
2	38	8	US+06	80	2	Both UTS & LTS
3	55	15	US+07	95	1	Both UTS & LTS
4	58	12	US+06	95	2	Both UTS & LTS
5	99	10	US+06	95	3	Both UTS & LTS
6	32	6	US+01	95	1	LTS Only
7	41	5	US-02	40	1	LTS Only
8	41	7	US+04	50	<1	LTS Only
9	41	8	US-02	95	2	LTS Only
10	100	6	US-0	95	2	LTS Only
11	127	2	US	95	5	LTS Only
12	110	6	US+02	50	<1	LTS Only
13	13	48	US+05	95	2 coils	Both UTS & LTS
14	51	16	US+05	95	1 coil	Both UTS & LTS

SP-1101-12-030
Rev. 11 5/25/83

ATTACHMENT 1

PART VIII (A)

ADDITIONAL TUBES TO BE STABILIZED AFTER BUBBLE TESTS

OTSG A	ROW	TUBE	DEFECT LOCATION	0.540 H.G. % TW.
1.	2	7	US-02	28-50
2.	5	39	15 TSP +13	95
3.	70	129 (L)	US+03, US-12	95/35
4.	73	122 (L)	US+04	95
5.	79	126 (L)	US+02	65
6.	98	31	US-10	50
7.	109	106 (L)	US+04	95
8.	120	100	US+02, +04	95
9.	120	107	US+02	95
10.	126	94	US-10	25
11.	139	54 (L)	US+02	95
12.	126	92	US+03	95
13.	130	92	US-12	95
14.	140	62	US-03	80
15.	147	37	US+02	95
16.	148	7 (L)	US+04	95
17.	148	37 (L)	US-01, -02	95
18.	149	6	15+02	95
19.	4	4	US+03, +05	60/50 PLUG UTS ONLY

OTSG A ADDITIONAL TUBES TO BE PLUGGED WITH WESTINGHOUSE ROLLED PLUG

Item	Row	Tube	Eddy Current Data: Elev.	%TW	No. of Coils	Plug Location
1.	5	40	15-3	40	1	Both UTS & LTS
2.	35	41	14-3	50	1	Both UTS & LTS
3.	64	2	01-20 09+05	50	1	BOTH UTS & LTS
4.	72	59	06+0	90	1	Both UTS & LTS
5.	126	86	US+6	50	1	Both UTS & LTS
6.	126	5 (L)	US+7	95	2	Both UTS & LTS
7.	125	88 (L)	US+5	95	2	Both UTS & LTS
8.	127	91 (L)	US+5	95	2	Both UTS & LTS
9.	140	52 (L)	US+5	95	1	Both UTS & LTS
10.	2	7	US-02	28-50	1	LTS Only
11.	5	39	15+13	95	1	LTS Only
12.	70	129 (L)	US+03-12	95/35	1	LTS Only
13.	73	122 (L)	US+04	95	1	LTS Only
14.	79	126 (L)	US+02	65	1	LTS Only
15.	98	31	US-10	50	1	LTS Only
16.	109	106 (L)	US+04	95	2	LTS Only
17.	120	100	US+02+04	95	1/2	LTS Only
18.	120	107	US+02	95	2	LTS Only
19.	126	94	US-10	25	1	LTS Only
20.	139	54 (L)	US+02	95	1	LTS Only
21.	126	92	US+03	95	1	LTS Only
22.	130	92	US-12	95	2	LTS Only
23.	140	62	US-03	80	2	LTS Only
24.	147	37	US+02	95	1	LTS Only
25.	148	7 (L)	US+04	95	2	LTS Only
26.	148	37 (L)	US-01-02	95	2/1	LTS Only
27.	149	6	15+02	95	1	LTS Only
28.	4	4	US+03+05	60/50	1	LTS Only

GENERAL PUBLIC UTILITIES
OTSG REPAIRS

DATE 5/23/83

ITEM	DESCRIPTION	RESPONSIBILITY	DATE REQUIRED
1.	Restoration Secondary Side		
	. Temp. Chem. System	S. Levin	TBD
	. Remove Flush System	S. Levin	In Progress
	. Remove Air Compressor (on hold)	S. Levin	TBD
2.	Ops OTSG Status		
	. OTSG Level "A" 511"		
	. OTSG Level "B" 519"		
3.	Results of Snoop Test @ "A" & "B"		5/20
	A		
	B		
4.	Eddy Current Test		5/13
	. Resolve Blocked Tubes in "A" 17-59; A5-9 (4 tubes)		
	"B" 122-7; 148-23		
	Not to do any more Eddy Current		
5.	Tube Plugging & Stabilization		5/23
	. Issue Final FCA	B&W	5/20
	. Issue DRF for Repairs	T. Functions	5/21
	. Issue New J.O. & IP	G. Kull	5/23
6.	Miscellaneous Items to Resolve		
	. Hydrogen Peroxide Tube Soak (TMM) being fabricated		5/2
	. Decon of Equip		In Progress
	. Revised Spec for Flushing Rev. 5		
	. Dissolved O_2 Analyzer TMM		TBD
	. RCS/OTSG Pressurization TMM		

7. Waiting Documentation

MNCR		Responsibility
215-82	Plug Exploded at Wrong Area of Tube	QC
426-82	Wire Brush B6-1	QC
091-83	Feltplug Blowing	QC
111-83	Misplugged Tubes	QC
119-83	Misplugged Tubes	QC

8. Rad Con Exposure Data (Based on SRDs) as of 5/19
. Total OTSG Exposure since 1st Blast - 956.5 Man Rem
. Total OTSG Exposure since Nov 1981 - 1132.7 Man Rem
. Final Estimate Exposure Since Nov 1981 - 1204 Man Rem

9. Anticipated Jumps

Date	Description	Responsibility
5/23	A - Upper - Snoop Test	Levin/Catalytic
	A - Lower -	
5/23	B - Upper -	
	B - Lower -	

Plugging by Wednesday

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GENERAL PUBLIC UTILITIES
OTSG REPAIRS

DATE 5/24/83

ITEM	DESCRIPTION	RESPONSIBILITY	DATE REQUIRED
1.	Restoration Secondary Side		
	. Temp. Chem. System	S. Levin	TBD
	. Remove Flush System	S. Levin	In Progress
	. Remove Air Compressor	S. Levin	TBD
2.	Ops OTSG Status		
	. OTSG Level "A" 500" — 7 tubes in A upper B&W		
	. OTSG Level "B" 451" — 7 tubes in B upper		
3.	Results of Snoop Test @ "A" — this morning		5/23
4.	Eddy Current Test		5/13
	. Resolve Blocked Tubes in "A" 17-59; A5-9		
	. Resolve Blocked Tubes in "B" 122-7; 148-23		
	Eddy Current Equipment to out		
5.	Tube Plugging & Stabilization		5/23
	. Issue Final FCA	B&W	5/20
	. Issue DRF for Repairs	T. Functions	5/21
	. Issue New J.O. & IP	G. Kull	5/23
6.	Miscellaneous Items to Resolve		
	. Hydrogen Peroxide Tube Soak (TMM)		5/2
	. Decon of Equip		In Progress
	. Revised Spec for Flushing Rev. 5		
	. Dissolved O_2 Analyzer TMM		TBD
	. RCS/OTSG Pressurization TMM		

7. Waiting Documentation

MNCR		Responsibility
215-82	Plug Exploded at Wrong Area of Tube	QC
(closed) 426-82	Wire Brush B6-1	QC
091-83	Feltplug Blowing	QC
(closed) 111-83	Misplugged Tubes	QC
119-83	Misplugged Tubes	QC

8. Rad Con Exposure Data (Based on SRDs) as of 5/19
   . Total OTSG Exposure since 1st Blast - 956.5 Man Rem
   . Total OTSG Exposure since Nov 1981 - 1132.7 Man Rem 1136.2
   . Final Estimate Exposure Since Nov 1981 - 1204 Man Rem

Light

9. Anticipated Jumps

Date	Description	Responsibility
5/24	A - Upper - snoop test / Tube id	Levin/Catalytic
	A - Lower -	
5/24	B - Upper - Tube iden	
	B - Lower -	

GENERAL PUBLIC UTILITIES
OTSG REPAIRS

DATE 5/26/83

ITEM	DESCRIPTION	RESPONSIBILITY	DATE REQUIRED
1.	Restoration Secondary Side		
	. Temp. Chem. System	S. Levin	TBD
	. Remove Flush System	S. Levin	In Progress
	. Remove Air Compressor	S. Levin	TBD
2.	Ops OTSG Status		
	. OTSG Level "A" 540"		
	. OTSG Level "B" 450"		
3.	Eddy Current Test		5/13
	. Resolve Blocked Tubes in "A" 17-59; A5-9 candle debris		
	. Resolve Blocked Tubes in "B" 122-7; 148-23		
4.	Tube Plugging & Stabilization		5/23
	. Issue New J.O. & IP	G. Kull	5/25
	B 7 UPPER Ⓦ 7 B&W 14 LOWER Ⓦ A OTSG has 40 on the lower		
5.	Miscellaneous Items to Resolve		
	. Hydrogen Peroxide Tube Soak (TMM)	Plt. Maint.	Being Fab.
	. Decon of Equip		In Progress
	. Revised Spec for Flushing Rev. 5	T. Functions	TBD
	. Dissolved O_2 Analyzer TMM	Plt. Eng.	TBD
	. RCS/OTSG Pressurization TMM	Plt. Eng.	TBD
	. GAP Growth Measurement STP	Plt. Eng.	5/24

6. Waiting Documentation

MNCR		Responsibility
215-82	Plug Exploded at Wrong Area of Tube	QC
091-83	Feltplug Blowing	QC
119-83	Misplugged Tubes	QC

7. Rad Con Exposure Data (Based on SRDs) as of 5/24
   . Total OTSG Exposure since 1st Blast - 960.8 Man Rem 963
   . Total OTSG Exposure since Nov 1981 - 1137 Man Rem 1139
   . Final Estimate Exposure Since Nov 1981 - 1204 Man Rem

8. Anticipated Jumps

Date	Description	Responsibility
5/26	A - Upper - Block Tubes	Levin/Catalytic
	A - Lower -	
5/26	B - Upper - Ⓦ	
	B - Lower - Ⓦ	

Ⓦ done today

GENERAL PUBLIC UTILITIES
OTSG REPAIRS

DATE 5/31/83

ITEM	DESCRIPTION	RESPONSIBILITY	DATE REQUIRED
1.	Restoration Secondary Side		
	. Temp. Chem. System	S. Levin	6/3
	. Remove Air Compressor	S. Levin	TBD
2.	Ops OTSG Status		
	. OTSG Level "A" 540"		
	. OTSG Level "B" 450"		
3.	Drip Test @ "B" Snoop 7 @ 7 BEW in the B OTSG this morning drip test 15 in the lower 150		5/31
4.	Eddy Current Test		5/13
	. Resolve Blocked Tubes in "A" 17-59; A5-9		
5.	Tube Plugging & Stabilization		5/23
	. Issue New J.O. & IP	G. Kull	5/25
	Work in the B completed A - 6/8/83		
6.	Miscellaneous Items to Resolve		
	. Hydrogen Peroxide Tube Soak (TMM)	Plt. Maint.	Being Fab.
	. Hydrogen Peroxide Tube Soak (STP)	F. Paulewicz	TBD
	. Decon of Equip	G. Reed	In Progress
	. Revised Spec for Flushing Rev. 5	~~T. Functions~~	TBD
	. Dissolved O_2 Analyzer TMM (MS-U84)	Plt. Eng.	TBD
	. Dissolved O_2 Analyzer STP	F. Paulewicz	TBD
	. RCS/OTSG Pressurization TMM	Plt. Eng.	TBD
	. RCS/OTSG Pressurization STP	OPS	TBD
	. GAP Growth Measurement STP	Plt. Eng.	5/24

7. Waiting Documentation

MNCR		Responsibility
215-82	Plug Exploded at Wrong Area of Tube	QC
091-83	Feltplug Blowing	QC
119-83	Misplugged Tubes	QC
142-83		

Miller

8. Rad Con Exposure Data (Based on SRDs) as of 5/26
   . Total OTSG Exposure since 1st Blast - 967.5 Man Rem
   . Total OTSG Exposure since Nov 1981 - 1143.7 Man Rem
   . Final Estimate Exposure Since Nov 1981 - 1204 Man Rem

9. Anticipated Jumps

Date	Description	Responsibility
5/31	A - Upper - 6 in ~~[illegible]~~ plug remove (2)	Levin/Catalytic
	A - Lower - 8 removal	(2 Stabilize
5/31	B - Upper - Snoop test/light rings	
	B - Lower - drip test install light rings in lower for	

My

GENERAL PUBLIC UTILITIES
OTSG REPAIRS

DATE 6/1/83

ITEM	DESCRIPTION	RESPONSIBILITY	DATE REQUIRED
1.	Restoration Secondary Side		
	. Temp. Chem. System	S. Levin	6/10
	. Remove Air Compressor	S. Levin	TBD
2.	Ops OTSG Status		
	. OTSG Level "A" 570"		
	. OTSG Level "B" 590"		
3.	Results of Drip Test @ "B"		5/31
4.	Results of Snoop Test @ "B"		6/1
5.	Eddy Current Test		5/13
	. Resolve Blocked Tubes in "A" 17-59; A5-9		
6.	Tube Plugging & Stabilization 103-1 (working on the A 39 plugs to be installed)		5/23
7.	Miscellaneous Items to Resolve		
	. Hydrogen Peroxide Tube Soak (TMM) (HOT IL SHOP)	Plt. Maint.	Being Fab.
	. Hydrogen Peroxide Tube Soak (STP)	F. Paulewicz	TBD
	. Decon of Equip		In Progress
	. Revised Spec for Flushing Rev. 5	G. Reed	TBD
	. Dissolved O_2 Analyzer TMM	Plt. Eng.	5/31
	. Dissolved O_2 Analyzer STP ← GARY RIED	F. Paulewicz	TBD
	. RCS/OTSG Pressurization TMM (N_2)	Plt. Eng.	6/1
	. RCS/OTSG Pressurization STP (N_2)	OPS	6/2
	. GAP Growth Measurement STP (10)	Plt. Eng.	6/2

8. Waiting Documentation

MNCR		Responsibility
215-82	Plug Exploded at Wrong Area of Tube	QC
091-83	Feltplug Blowing	QC
119-83	Misplugged Tubes	QC
142-83	Documentation Discrepencies (Mylar test)	QC
143-83	Documentation Discrepencies	QC

9. Rad Con Exposure Data (Based on SRDs) as of 5/27
   . Total OTSG Exposure since 1st Blast - 967.8 Man Rem 973.1
   . Total OTSG Exposure since Nov 1981 - 1144.0 Man Rem 1149.
   . Final Estimate Exposure Since Nov 1981 - 1204 Man Rem

10. Anticipated Jumps

Date	Description	Responsibility
6/1	A - Upper - @ = 2 / install 2 / 10 500 min / stabilization on Friday / Snoop Monday A OTSG Done	Levin/Catalytic
	A - Lower - 39 new plugs	
6/1	B - Upper - snoop test / remove lights	
	B - Lower - drip test / install lights	

manway goes on Friday

GENERAL PUBLIC UTILITIES
OTSG REPAIRS

DATE 6/3/83

ITEM	DESCRIPTION	RESPONSIBILITY	DATE REQUIRED
1.	Restoration Secondary Side		
	. Temp. Chem. System	S. Levin	6/3
	. Remove Air Compressor	S. Levin	TBD
2.	Ops OTSG Status		
	. OTSG Level "A" 570" ms-V94		
	. OTSG Level "B" 470"		
3.	Mylar Light Test @ "B"		6/2
	Quarantz lights		
4.	Eddy Current Test		5/13
	. Resolve Blocked Tubes in "A" 17-59; A5-9		
	. Resolve Blocked Tubes in "B" 103-1		
5.	Tube Plugging & Stabilization		5/23
	2 @ pull 1 @ plug may have to be drilled out		
6.	Miscellaneous Items to Resolve		
	→ . Hydrogen Peroxide Tube Soak (TMM)	Plt. Maint.	Being Fab.
	Monday → . Hydrogen Peroxide Tube Soak (STP)	F. Paulewicz	6/6
	. Decon of Equip		In Progress
	Revised Spec for Flushing Rev. 5	G. Reed	TBD
	Install this week . Dissolved O_2 Analyzer TMM	Plt. Eng.	5/31
	. Dissolved O_2 Analyzer STP	G. Reed	TBD
	. RCS/OTSG Pressurization TMM > feed line	Plt. Eng.	6/1
	middle next week . RCS/OTSG Pressurization STP	OPS	6/2
	. GAP Growth Measurement STP < (83-79) tubes are identified	Plt. Eng.	6/2
	(1) shipment		

7. Waiting Documentation

MNCR		Responsibility
215-82	Plug Exploded at Wrong Area of Tube	QC
091-83	Feltplug Blowing	QC
119-83	Misplugged Tubes	QC
142-83	Documentation Discrepencies	QC
143-83	Documentation Discrepencies ← accepted	QC
146-83	B&W Plug Leaks (127-2)	

8. Rad Con Exposure Data (Based on SRDs) as of 6/1
  . Total OTSG Exposure since 1st Blast - 976.7 Man Rem 980.5
  . Total OTSG Exposure since Nov 1981 - 1152.9 Man Rem 1156.7
  . Final Estimate Exposure Since Nov 1981 - 1204 Man Rem

Tube plugging 30 man rem

9. Anticipated Jumps

Date	Description	Responsibility
6/3	A - Upper - B&W stabilization	Levin/Catalytic
	A - Lower - to complete	
6/3	B - Upper - 127-2 restab/ mylar test	
	B - Lower -	

Weekend blow to clean the OTSG
1) Remove J covers

(W)

18 plugged

A upper ~~with~~ one will require
an addition
still working

(B)

B&W 127-2
failed
Mylar test the afternoon

Westinghouse will be done today
B&W will be done on both on Sunday

GENERAL PUBLIC UTILITIES
OTSG REPAIRS

DATE 6/6/83

ITEM	DESCRIPTION	RESPONSIBILITY	DATE REQUIRED
1.	Restoration Secondary Side		
	. Temp. Chem. System	S. Levin	6/10
	. Remove Air Compressor	S. Levin	TBD
2.	Ops OTSG Status		
	. OTSG Level "A" 570" 5 1/2		
	. OTSG Level "B" 470" 5 1/2		
3.	Mylar Light Test @ "B"		6/2
	No more mylar test		
4.	Eddy Current Test		5/13
	. Resolve Blocked Tubes in "A" 17-59; A5-9		
	. Resolve Blocked Tubes in "B" 103-1		
5.	Tube Plugging & Stabilization		6/5
	3 1/2 out 4 1/2 to go		
6.	Miscellaneous Items to Resolve		
	. Hydrogen Peroxide Tube Soak (STP)	F. Paulewicz	6/6
	. Decon of Equip		In Progress
	. Revised Spec for Flushing Rev. 5	G. Reed	TBD
	. Dissolved O_2 Analyzer TMM	Plt. Eng.	5/31
	. Dissolved O_2 Analyzer STP	G. Reed	TBD
	. RCS/OTSG Pressurization TMM	Plt. Eng.	6/8
	. RCS/OTSG Pressurization STP	OPS	6/2
	. GAP Growth Measurement STP	Plt. Eng.	6/2

7. Waiting Documentation

MNCR		Responsibility
215-82	Plug Exploded at Wrong Area of Tube	QC
091-83	Feltplug Blowing	QC
119-83	Misplugged Tubes	QC
142-83	Documentation Discrepencies	QC
143-83	Documentation Discrepencies	QC
146-83	B&W Plug Leaks (127-2)	QC

8. Rad Con Exposure Data (Based on SRDs) as of 6/2
. Total OTSG Exposure since 1st Blast - 980.5 Man Rem 984
. Total OTSG Exposure since Nov 1981 - 1156.7 Man Rem 1161
. Final Estimate Exposure Since Nov 1981 - 1204 Man Rem

9. Anticipated Jumps

Date	Description		Responsibility
6/6	A - Upper -	B&W Removal Stab	Levin/Catalytic
	A - Lower -		
6/6	B - Upper -	LIGHT RINGS	
	B - Lower -	RECORDING	

(W) was done saturday
(B&W) will be done Wednesday

GENERAL PUBLIC UTILITIES
OTSG REPAIRS

DATE 6/7/83

ITEM	DESCRIPTION	RESPONSIBILITY	DATE REQUIRED
1.	Restoration Secondary Side		
	. Temp. Chem. System	S. Levin	6/10
	. Remove Air Compressor	S. Levin	TBD
2.	Ops OTSG Status		
	. OTSG Level "A" 575"		
	. OTSG Level "B" 456"		
3.	Snoop & Drip Test @ "A"		6/10
4.	Eddy Current Test		5/13
	. Resolve Blocked Tubes in "A" 17-59; A5-9		
5.	Install Permanent Manways @ "B"		6/7
6.	Tube Plugging & Stabilization		6/5
	1½ to do 8+20		
7.	Miscellaneous Items to Resolve		
	. Decon of Equip		In Progress
	. Revised Spec for Flushing Rev. 5	G. Reed	TBD
	. Dissolved O_2 Analyzer TMM	Plt. Eng.	5/31
	. Dissolved O_2 Analyzer STP	G. Reed	TBD
	. RCS/OTSG Pressurization TMM	Plt. Eng.	6/8
	. RCS/OTSG Pressurization STP	OPS	6/2
	. GAP Growth Measurement STP	Plt. Eng.	6/2

8. Waiting Documentation

MNCR		Responsibility
215-82	Plug Exploded at Wrong Area of Tube	QC
091-83	Feltplug Blowing	QC
119-83	Misplugged Tubes	QC
142-83	Documentation Discrepencies	QC
143-83	Documentation Discrepencies	QC
146-83	B&W Plug Leaks (127-2)	QC

9. Rad Con Exposure Data (Based on SRDs) as of 6/6
   . Total OTSG Exposure since 1st Blast - 984.7 Man Rem 995
   . Total OTSG Exposure since Nov 1981 - 1161.0 Man Rem 1171.3
   . Final Estimate Exposure Since Nov 1981 - 1204 Man Rem

10. Anticipated Jumps

Date	Description	Responsibility
6/7	A - Upper - } 28 to go	Levin/Catalytic
	A - Lower -	
6/7	B - Upper -	
	B - Lower -	