Commonwealth Edison
One First National Plaza, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690

May 26, 1982

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: LaSalle County Station Units 1 and 2
Teledyne Open Item and Error/Deviation
Reports for the LaSalle Independent
Design Review, Supplemental Responses
NRC Docket Nos. 50-373 and 50-374

Reference (a): C. W. Schroeder letter to H. R. Denton dated March 16, 1982, "Independent Design Review Initial Status Report for the Period of February 11 through March 12, 1982."

(b): C. W. Schroeder letter to H. R. Denton dated May 7, 1982, "Teledyne Open Item and Error/Deviation Reports for the LaSalle Independent Design Review."

(c): C. W. Schroeder letter to H. R. Denton dated May 13, 1982, "Teledyne Open Item and Error/Deviation Report for the LaSalle Independent Design Review - Second Transmittal."

(d): C. W. Schroeder letter to H. R. Denton dated May 14, 1982, "Teledyne Open Item and Error/Deviation Reports for the LaSalle Independent Design Review - Final Transmittal; and 1st Transmittal of Responses."

(e): C. W. Schroeder letter to H. R. Denton dated May 20, 1982, "Teledyne Open Item and Error/Deviation Reports for the LaSalle Independent Design Review, Responses to Remaining Items."

Dear Mr. Denton:

Reference (a) provided you with an initial status report of the Independent Design Review being conducted at LaSalle County Station. References (b), (c), and (d) provided you with three sets of Teledyne Open Item and Error/Deviation Reports. References (d)

8205280105 A

B001
S:1|1

and (e) also transmitted our responses to the Open Item and Error/Deviation Reports. The purpose of this letter is to transmit to you a supplemental response to error/deviation No. 7 which provides additional information. Also enclosed are tables which were inadvertantly omitted from the response to error/deviation No. 12 which was transmitted to you in Reference (e).

Under separate cover, this material is being provided to Mr. James G. Keppler.

If there are any questions regarding this matter, please contact this office.

Very truly yours,

CW Schroeder 5/26/82

C. W. Schroeder
Nuclear Licensing Administrator

lm

Attachment

cc: NRC Resident Inspector - LSCS - 1/0

4216N

Denton

May 25, 1982

Mr. L.O. DelGeorge:

Subject: Supplemental Responses for the
LaSalle Independent Design Review

Enclosed are two supplemental responses to items identified by Teledyne. The supplemental response to error/deviation No. 7 provides additional information. The remaining pages are tables which were inadvertently omitted from the response to error/deviation No. 12 which I transmitted to you on May 19th.

You should transmit this information to Mr. Denton and Mr. Keppler.

B. R. Shelton 5/25

B.R. Shelton

BRS/bmb/1574L
cc: J. Flaherty (Teledyne)
R.H. Holyoak
T.E. Watts
C. Reed
J.J. Maley
B.B. Stephenson

SARGENT & LUNDY
ENGINEERS
55 EAST MONROE STREET
CHICAGO, ILLINOIS 60603
TELEPHONE 312-269-2000

May 24, 1982
Project No. 4266-24

Commonwealth Edison Company
LaSalle County Station - Units 1 & 2

Third Party Independent Review

Mr. B. R. Shelton
Project Engineering Manager
Commonwealth Edison Company
P. O. Box 767
Chicago, Illinois 60690

Dear Mr. Shelton:

Enclosed are 12 copies of Sargent & Lundy's supplemental response to Teledynes Error/Deviation Report 7. Also enclosed are pages E/D 12-4, 5, 6, 7, 8 and 9 which were inadvertantly left out from my letter to you of May 18, 1982.

It is our understanding that Commonwealth Edison Company will distribute these simultaneously to Teledyne, the NRC and internally.

If you have any questions, please do not hesitate to call me.

Yours very truly,

R. H. POLLOCK

R. H. Pollock
Mechanical Project Engineer

RHP:jam
Enclosures
Copies:

W. A. Chittenden	(1/1)
E. V. Abraham	(1/1)
G. C. Kuhlman	(1/1)
R. J. Mazza	(1/1)
E. B. Branch	(1/1)
D. C. Haan	(1/1)
W. G. Schwartz	(1/0)
E. R. Weaver	(1/0)
S. D. Killian	(1/1)

File 85

COPY

SARGENT & LUNDY
ENGINEERS
CHICAGO

SUPPLEMENTAL RESPONSE FOR ERROR REPORT 7

The question of incorporating code revisions in PIPSYS on projects subject to earlier code editions has been raised before and Sargent & Lundy has undertaken review of these changes in the past.

In the majority of cases, the Code revisions and associated PIPSYS modifications made since 1974 represent an analytical approach which more accurately reflects the physical characteristics of the piping components involved. In our view, this leads to a more reliable design. All of the code revisions issued since 1974 represent a significant effort on the part of the ASME through research and review, to accomplish that same goal.

In the same spirit, it is our policy with the PIPSYS Program to apply Code paragraph NA-1140 that allows Code addenda and editions, to be used that are published after the piping fabrication contract date. As Code analysis revisions are published, Sargent & Lundy reviews them for positive or negative impact on current designs. A revision is considered to have positive impact if it will not cause design changes and if it provides better methods or tools for analysis. A revision is considered to have negative impact if it has potential to cause design changes. Revisions that have positive impact are immediately incorporated into the PIPSYS Program. Those that have a negative impact are not incorporated unless a definite safety concern is generated by not doing so. Any revision causing a negative impact is reviewed with the Project team prior to implementation.

Current design documents specify piping design based on the 1974 Code. It is important to note that nearly all Code piping analysis revisions published since the 1974 Code was issued have been in the direction of either reducing unnecessary conservatism or providing better analytical techniques. On balance, the industry has benefited greatly from these changes.

The following discussion details the specific modifications to the PIPSYS stress analysis that have been incorporated since the 1974 Code. These items are the sum total of the differences between the PIPSYS analysis and the 1974 Code.

1. Class 1 Stress Analysis

The PIPSYS Class 1 stress analysis is based on the 1977 Code, up to and including the Summer of 1979 addenda. The differences from the 1974 Code are minor and, with the exception of Item C in the following list, the overall effect of all revisions was to reduce conservatism. This means that any reanalysis based on the later requirements will not generate system design changes. The specific revisions are as follows.

a) For branch connections, stress index B was reduced from 1.0 to 0.5, index C_1 was reduced from 2.0 to 1.5, and index K_1 was increased from 1.7 to 2.2.

b) For curved pipe or butt weld elbows, stress index B_1 was reduced from 1.0 to 0.5.

c) For butt weld reducers, stress indices $C_1 = 1.5$, $K_1 = 2.0$, $C_2 = 1.3$, and $K_2 = 1.0$ were replaced by index equations based on reducer geometry.

d) For butt weld tees (B16.9), index B_1 was reduced from 1.0 to 0.5. Indices B_{2b} and B_{2r} were revised as follows:

e) The allowable stress for Service Level B (Upset Condition) for equation (9) was increased from 1.5 Sm to 1.8 Sm.

f) The ΔT_1 stress term was eliminated from equation (10) and a thermal stress ratchet check was added in NB-3653.7.

2. Class 2 and 3 Stress Analysis

The PIPSYS Class 2 and 3 stress analysis is based on the 1977 Code, up to and including the Winter 1978 addenda. The latter analysis is essentially the same as that required in the 1974 Code except as follows:

a) A stress intensification factor (i) was added for brazed joints.

b) Equation (10a) was added to provide a criteria for single non-repeated anchor motions such as building settlements.

c) A Service Level D stress limit (Faulted Condition) was added where no criteria was previously given. The limit is 2.4 Sh.

None of these code changes were made as a result of changes in other sections of the Code (e.g. NB-4000) nor did they require that other sections be changed. Therefore, we believe the use of the 1977 Code with addenda identified as above is appropriate for the analysis of Class 1, 2 or 3 piping otherwise designed, fabricated and installed to the 1974 Code.

TABLE 1

RHR PUMPS	Class 2 Calculations		Class 1 Calculations	
	Calculated PSI	Allowable PSI	Calculated PSI	Allowable PSI
Discharge Column	21989	26250	21989	30000
Pump Casing	5878	8250	5878	26250
Suction Column	5368	16550	5368	32550
Discharge Head Hold-Down Bolt	σ=12623 τ= 2565	σ=37500 τ=15500	13124	61000
Motor Hold-Down Bolts	σ=22981 τ= 4005	σ=37500 τ=15550	23659	61000
Foundation Bolts	σ=24329 τ= 6373	σ=29000 τ=11950	25897	35000
Shaft Stresses	8314	15000	6149	17500
Junction Between Stuffing Box and Discharge Elbows	25763	28875	43600	45000

TABLE 2

HPCS Pump	Class 2 Calculations		Class 1 Calculations	
Description	Calculated PSI	Allowable PSI	Calculated PSI	Allowable PSI
Stresses on Shaft at minimum sections	7095	17500	9780	17500
Discharge Head Bolting	12912	55000	13333	60000
Thread Engagement	4159	25000	4974	30000
Stuffing Box-Discharge Elbow Interface	10202	27390	22345	63900
Foundation Load on Bolts	21829 (σ) 6701 (τ)	29000 11950	23743	35000
Motor Stand	1244	27390	1024	30000
Suction Barrel/Shell Interface	28300	28875	-	-
Motor Mounting Bolting	1877	55000	1879	60000
Minimum Thickness	required	supplied	required	supplied
Pump Shell	.242 in.	.75 in.	.197 in.	.75 in.
Discharge Nozzle	.81 in.	1.312 in.	.604 in.	1.312 in.
Suction Nozzle	.152 in.	.688 in.	.132 in.	.688 in.
Torispherical Head of Shell	.159 in.	.75 in.	.137 in.	.75 in.

EVALUATION AT CRITICAL LOCATIONS

LPCS Pump

TABLE 3

Location	Evaluated as Class 2		Evaluated as Class 1	
	Calculated	Allowable	Calculated	Allowable
Motor Stand	5221 psi	19250 psi	5211 psi	30000 psi
Motor Bolting	5587 psi (2) 2281 psi (2)	37500 psi 15500 psi	7449 psi	60000 psi
Suction Barrel Shell	–	–	3180 psi	37800 psi
Suction Barrel Shell at Inlet Nozzle	8195 psi	16500 psi	–	–
Suction Barrel Head/Pin Interface	5024 psi	16500 psi	5024 psi	21000 psi
Pump First Stage Casing Minimum Section	2446 psi	8250 psi	2446 psi	15000 psi
Pump Series Casing Minimum Section	3000 psi	8250 psi	3000 psi	15000 psi
Pump Series Casing Bolts	A_m= 7.73 in^2 (Required)	A_b=11.02 in^2 (Available)	5617 psi	30000 psi
Pump Top Casing Bolts	A_m= 7.65 in^2 (Required)	A_b=11.02 in^2 (Available)	5592 psi	30000 psi
Stuffing Box/ Discharge Elbow Interface	24170 psi	31500 psi	52900 psi	63900 psi
Discharge Head Bolts	A_m= 19.60 in^2 (Required)	A_b=19.84 in^2 (Available)	21676 psi	60000 psi
Foundation Bolts	12730 psi (2) 4129 psi (2)	29000 psi 11950 psi	12730 psi	35000 psi
Discharge Column	6101 psi	16500 psi	6101 psi	30000 psi
Discharge Column Bolts	A_m= 8.73 in^2 (Required)	A_b=11.02 in^2 (Available)	11112 psi	60000 psi
Pump Shaft at Minimum Section	5838 psi	15000 psi	5838 psi	17500 psi

RHR Pump

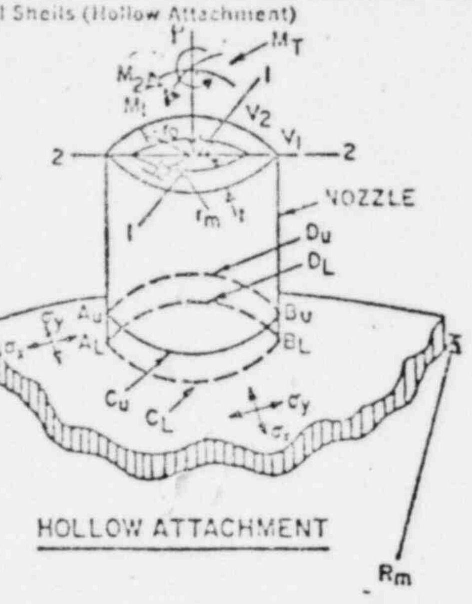
Analysis of Discharge Elbows at Stuffing Box Junction

The junction between the discharge elbow and the stuffing box is not a cylindrical nozzle but an intersection with two radii of curvature. The radius of curvature is in the transverse plane.

To accurately compute the local stresses at this junction under imposed piping loads, a detailed analysis using Bijlaard's stress tables was completed. (See attached sheets) From these calculations the worst combined stresses for the emergency loads are found to be 25763 psi at points A,B, and 19926 psi at points C,D. These stresses are well below the allowable value of 1.8S = 1.8 X17,5000 = 31500 psi for emergency and 1,65S = 1.65 X 17500 - 28875 psi for upset condition.

Table 3—Computation Sheet for Local Stresses in Spherical Shells (Hollow Attachment)

Prepared by: [illegible] 5-15-82
Reviewed by: D. [illegible] 5-15-82
Approved by: [illegible] 5-15-82



HOLLOW ATTACHMENT

1. Applied Loads*

Radial Load, P = 8103
Shear Load, V_1 = 18948
Shear Load, V_2 = 11602
Overturning Moment, M_1 = 141013
Overturning Moment, M_2 = 121264
Torsional Moment, M_T = 55

2. Geometry

Vessel Thickness, T = .475
Vessel Mean Radius, R_m = 6.781
Nozzle Thickness, t = .4675
Nozzle Mean Radius, r_m = 4.315
Nozzle Outside Radius, r_o = 4.6625

3. Geometric Parameters

$T = \frac{r_m}{t}$ = 4.9091
$\rho = \frac{T}{t}$ = .6371
$U = \frac{r_m}{\sqrt{R_mT}}$ = 2.2573

4. Stress Concentration Factors

due to:
membrene load, K_n = 1.0
bending load, K_b =
NOTE: Enter all force values in accordance with sign convention

From Fig.	Read curves for	Compute absolute values of stress and enter result •	STRESSES – if load is opposite that shown, reverse signs shown							
			Au	AL	Bu	BL	Cu	CL	Du	DL
SP-1 to 10	$\frac{N_xT}{P}$ = .016	$K_n\left(\frac{N_xT}{P}\right)\cdot\frac{P}{T^2}$ = 676	−	−	−	−	−676	−676	−676	−676
↓	$\frac{M_x}{P}$ =	$\cancel{K_b\left(\frac{M_x}{P}\right)\cdot\frac{6P}{T^2}}$ =	−	+	−	+	−	+	−	+
SM-1 to 10	$\frac{N_xT\sqrt{R_mT}}{M_1}$ = .011	$K_n\left(\frac{N_xT\sqrt{R_mT}}{M_1}\right)\cdot\frac{M_1}{T^2\sqrt{R_mT}}$ =					−9244	−9244	+9244	+9244
	$\frac{M_x\sqrt{R_mT}}{M_1}$ =	$\cancel{K_b\left(\frac{M_x\sqrt{R_mT}}{M_1}\right)}\cdot\frac{6M_1}{T^2\sqrt{R_mT}}$ =					−	+	+	−
	$\frac{N_xT\sqrt{R_mT}}{M_2}$ =	$K_n\left(\frac{N_xT\sqrt{R_mT}}{M_2}\right)\cdot\frac{M_2}{T^2\sqrt{R_mT}}$ =	−	−	+	+				
↓	$\frac{M_x\sqrt{R_mT}}{M_2}$ =	$\cancel{K_b\left(\frac{M_x\sqrt{R_mT}}{M_2}\right)}\cdot\frac{6M_2}{T^2\sqrt{R_mT}}$ =	−	+	+	−				
Add algebraically for summation of σ_x, =							−9920	−9920	8568	8568
SP-1 to 10	$\frac{N_yT}{P}$ = .018	$K_n\left(\frac{N_yT}{P}\right)\cdot\frac{P}{T^2}$ = 760	−	−	−	−	−760	−760	−760	−760
↓	$\frac{M_y}{P}$ =	$\cancel{K_b\left(\frac{M_y}{P}\right)\cdot\frac{6P}{T^2}}$ =	−	+	−	+	−	+	−	+
SM-1 to 10	$\frac{N_yT\sqrt{R_mT}}{M_1}$ = .011	$K_n\left(\frac{N_yT\sqrt{R_mT}}{M_1}\right)\cdot\frac{M_1}{T^2\sqrt{R_mT}}$ = 6355					−6355	−6355	+6355	+6355
	$\frac{M_y\sqrt{R_mT}}{M_1}$ =	$\cancel{K_b\left(\frac{M_y\sqrt{R_mT}}{M_1}\right)}\cdot\frac{6M_1}{T^2\sqrt{R_mT}}$ =					−	+	+	−
	$\frac{N_yT\sqrt{R_mT}}{M_2}$ =	$K_n\left(\frac{N_yT\sqrt{R_mT}}{M_2}\right)\cdot\frac{M_2}{T^2\sqrt{R_mT}}$ = 6497	−	−	+	+				
↓	$\frac{M_y\sqrt{R_mT}}{M_2}$ =	$\cancel{K_b\left(\frac{M_y\sqrt{R_mT}}{M_2}\right)}\cdot\frac{6M_2}{T^2\sqrt{R_mT}}$ =	−	+	+	−				
Add algebraically for summation of σ_y, =							−7115	−7115	5595	5595
Shear stress due to load, V_1		$\tau_1 = \frac{V_1}{\pi r_o T}$ = 3390					−3390	−3390	+3390	+3390
Shear stress due to load, V_2		$\tau_2 = \frac{V_2}{\pi r_o T}$ = 2076	+	+	+	−				
Shear stress due to torsion, M_T		$\tau_3 = \tau_4 = \frac{M_T}{2\pi r_o^2 T}$ = 1	+	+	+	+	+1	+1	+1	+1
Add algebraically for summation of τ,							−3389	3389	3391	3391
COMBINED STRESS INTENSITY, S										
When σ_x & σ_y have like signs: $S = \frac{1}{2}\left[\sigma_x + \sigma_y + \sqrt{(\sigma_x - \sigma_y)^2 + 4\tau^2}\right]$ When $\tau = 0$, S = largest of σ_x, σ_y or $\lvert\sigma_x - \sigma_y\rvert$ When σ_x & σ_y have unlike signs: $S = \sqrt{(\sigma_x - \sigma_y)^2 + 4\tau^2}$							12185			

Pr. stress = 7741 PSi

S = 12185 psi (Max. of C & D)

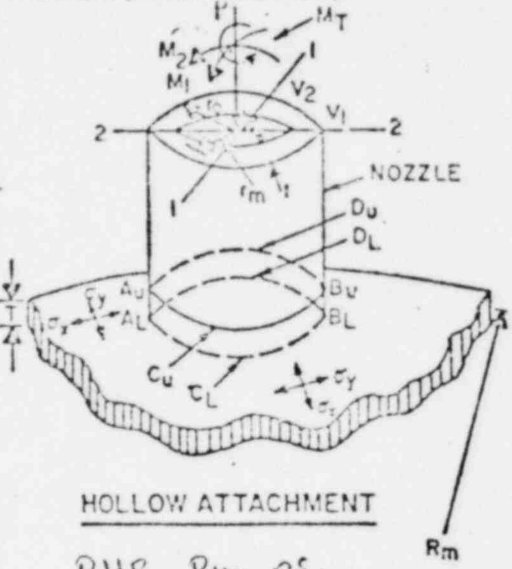
Total S = 19,926 PSi including Pr. stress

Table 3—Computation Sheet for Local Stresses in Spherical Shells (Hollow Attachment)

Prepared by: 5-15-82

Reviewed by: D B Hayes 5-15-82

Approved by: C J Harrell 5-15-82



HOLLOW ATTACHMENT

1. Applied Loads*

Radial Load, P = 8103
Shear Load, V_1 = [illegible]
Shear Load, V_2 = [illegible]
Overturning Moment, M_1 = [illegible]
Overturning Moment, M_2 = [illegible]
Torsional Moment, M_T = [illegible]

2. Geometry

Vessel Thickness, T = ·438
Vessel Mean Radius, Rm = 28
Nozzle Thickness, t = [illegible]
Nozzle Mean Radius, r_m = [illegible]
Nozzle Outside Radius, r_o = [illegible]

3. Geometric Parameters

$\gamma = \frac{r_m}{t}$ = 4·9091
$\rho = \frac{T}{t}$ = ·6371
$U = \frac{r_m}{\sqrt{R_mT}}$ = 1·16

4. Stress Concentration Factors

due to:
membrane load, K_n = 1.2
bending load, K_b =
NOTE: Enter all force values in accordance with sign convention

RHR Pumps.

From Fig.	Read curves for	Compute absolute values of stress and enter result →	Au	AL	Bu	BL	Cu	CL	Du	DL
			STRESSES – if load is opposite that shown, reverse signs shown							
SP-1 to 10	$\frac{N_xT}{P}$ = ·037	$K_n\left(\frac{N_xT}{P}\right)\cdot\frac{P}{T^2}$ = 1563	-1563	-1563	-1563	-1563	−	−	−	−
↓	$\frac{M_x}{P}$ =	$K_b\left(\frac{M_x}{P}\right)\cdot\frac{6P}{T^2}$ =	−	+	−	+	−	+	−	+
SM-1 to 10	$\frac{N_xT\sqrt{R_mT}}{M_1}$ = ·042	$K_n\left(\frac{N_xT\sqrt{R_mT}}{M_1}\right)\cdot\frac{M_1}{T^2\sqrt{R_mT}}$ = 11537					−	−	+	+
	$\frac{M_x\sqrt{R_mT}}{M_1}$ =	$K_b\left(\frac{M_x\sqrt{R_mT}}{M_1}\right)\cdot\frac{6M_1}{T^2\sqrt{R_mT}}$ =					−	+	+	−
	$\frac{N_xT\sqrt{R_mT}}{M_2}$ = ·03	$K_n\left(\frac{N_xT\sqrt{R_mT}}{M_2}\right)\cdot\frac{M_2}{T^2\sqrt{R_mT}}$ = 10703	-10703	-10703	+10703	+10703				
↓	$\frac{M_x\sqrt{R_mT}}{M_2}$ =	$K_b\left(\frac{M_x\sqrt{R_mT}}{M_2}\right)\cdot\frac{6M_2}{T^2\sqrt{R_mT}}$ =	−	+	+	−				
Add algebraically for summation of σ_x = −			12266	12266	9140	9140				
SP-1 to 10	$\frac{N_yT}{P}$ = ·059	$K_n\left(\frac{N_yT}{P}\right)\cdot\frac{P}{T^2}$ = 2492	-2492	-2492	-2492	-2492	−	−	−	−
↓	$\frac{M_y}{P}$ =	$K_b\left(\frac{M_y}{P}\right)\cdot\frac{6P}{T^2}$ =	−	+	−	+	−	+	−	+
SM-1 to 10	$\frac{N_yT\sqrt{R_mT}}{M_1}$ = ·05	$K_n\left(\frac{N_yT\sqrt{R_mT}}{M_1}\right)\cdot\frac{M_1}{T^2\sqrt{R_mT}}$ = 16435					−	−	+	+
	$\frac{M_y\sqrt{R_mT}}{M_1}$ =	$K_b\left(\frac{M_y\sqrt{R_mT}}{M_1}\right)\cdot\frac{6M_1}{T^2\sqrt{R_mT}}$ =					−	+	+	−
	$\frac{N_yT\sqrt{R_mT}}{M_2}$ = ·01	$K_n\left(\frac{N_yT\sqrt{R_mT}}{M_2}\right)\cdot\frac{M_2}{T^2\sqrt{R_mT}}$ = 14780	-14780	-14780	+14780	+14780				
↓	$\frac{M_y\sqrt{R_mT}}{M_2}$ =	$K_b\left(\frac{M_y\sqrt{R_mT}}{M_2}\right)\cdot\frac{6M_2}{T^2\sqrt{R_mT}}$ =	−	+	+	−				
Add algebraically for summation of σ_y = −			17272	17272	122[illegible]	122[illegible]				
Shear stress due to load, V_1		$\tau_1 = \frac{V_1}{\pi r_o T}$ = 3390					−	−	+	+
Shear stress due to load, V_2		$\tau_2 = \frac{V_2}{\pi r_o T}$ = 2076	+2076	+2076	+2076	-2076				
Shear stress due to torsion, M_T		$\tau_1 = \tau_2 = \frac{M_T}{2\pi r_o^2 T}$ = 1	+ 1	+ 1	+ 1	+ 1	+	+	+	+
Add algebraically for summation of τ =			2077	2077	2077	-2075				
COMBINED STRESS INTENSITY, S										
When σ_x & σ_y have like signs: $S = \frac{1}{2}\left[\sigma_x + \sigma_y + \sqrt{(\sigma_x - \sigma_y)^2 + 4\tau^2}\right]$ When $\tau = 0$, S = largest of σ_x, σ_y or $\lvert\sigma_x - \sigma_y\rvert$ When σ_x & σ_y have unlike signs: $S = \sqrt{(\sigma_x - \sigma_y)^2 + 4\tau^2}$				18022						

Max. Pr stress = 7741 psi

Stresses in Shells S = 18022 psi (max. of A & B) 7