ENCLOSURE 3

STRUCTURAL INTEGRITY ASSOCIATES CALCULATION PBCH-09Q-302
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STRUCTURAL INTEGRITY Associates, Inc.	CALCULATION PACKAGE	FILE No.: PBCH-09Q-302 PROJECT No.: PBCH-09Q

PROJECT NAME: Point Beach Unit 1 CRDM Top Head Analysis

CLIENT: NMC Point Beach Nuclear Plant

CALCULATION TITLE: PWSCC Crack Growth Correlations and Fatigue Crack Growth Calculations for Point Beach Unit 1

Document Revision	Affected Pages	Revision Description	Project Mgr. Approval Signature & Date	Preparer(s) & Checker(s) Signatures & Date
0	1-7 A1 – A19	Original Issue	H. L. GUSTIN 2/17/04	H. L. GUSTIN 2/17/04 G. L. STEVENS 2/17/04
1	1-7 A1-A19	Incorporates actual overlap measurements for nozzle 26. Appendix A is not affected.	H. L. GUSTIN 5/12/04	H. L. GUSTIN 5/12/04 MING QIN 5/12/04
2	1-8 A1-A19	Addresses hypothetical growth in Alloy 82 material, as a conservative representation for Alloy 52	H. L. GUSTIN 5/15/04	H. L. GUSTIN 5/15/04 P. C. RICCARDELLA 5/15/04
3	1-8 A1-A19	Revised service temperature used in crack growth calculations	H. L. GUSTIN 6/03/05 H L Gustin	H. L. GUSTIN 6/03/05 H L Gustin P. C. RICCARDELLA 6/03/05

1.0 STATEMENT OF PROBLEM

Point Beach Unit 1 repaired RPV top head CRDM Nozzle 26 during the Spring 2004 refueling outage. Because of the steepness of this nozzle, and the relatively small head diameter and thickness, the standard Framatome repair process resulted in a portion of the new attachment weld overlapping the original Alloy 82/182 weld over a portion of the circumference (see Figure 1).

This calculation evaluates the growth of hypothetical flaws in the original alloy 82/182 weld through the weld repair fusion line with the low alloy steel base material. Earlier revisions of this calculation assumed a crack growth rate applicable to Alloy-600 base metal and Alloy 82 weld metal at 592 °F. The calculation is revised herein to incorporate crack growth rates applicable to both materials at a revised temperature of 593.9 °F per [7]

Note that the repair weld through which the hypothetical crack is assumed to be propagating is Alloy 52, which has generally been shown to be highly resistant to PWSCC cracking and crack growth. The only potential crack growth region is at the fusion line between the low alloy steel nozzle and the Alloy 52 weld metal, in which some dilution of the weld metal may occur. Both the Alloy-600 and Alloy 82 crack growth curves are believed to be conservative approximations of the expected crack growth rate in this dilution zone.

2.0 METHODOLOGY

Stress intensity factors at the interface of the new, Alloy 52 repair weld and the original, Alloy 82/182 J-groove weld have been computed in Ref [5] assuming the entire original J-groove weld to be cracked. These K levels are based on operating plus residual stresses resulting from the original J-groove weld plus the new repair weld, at normal operating conditions. The resulting K levels are assumed to remain constant for the small amount of crack extension through the interface region, since the cracking will be confined to a narrow region of diluted material.

The resulting K levels are then inserted into a stress corrosion crack growth law (see section 3.0 below) to determine the rate of crack propagation versus time, and to predict the time necessary for the assumed initial crack to grow through the new repair weld diluted zone and thus cause potential leakage during the upcoming fuel cycle.

3.0 MATERIAL CRACK GROWTH RATE

The industry has established a panel of experts on stress corrosion cracking to review available data on PWSCC growth in components such as the CRDM penetration tubes and associated nickel-based weld metals. The panel is comprised of international experts, including representatives from NRC research and its contractors. This panel has established a recommended crack growth law for Alloy 600 base material [1], and more recently recommended crack growth curves for Alloy 82 and 182 weld metals [2]. The correlation of available crack growth data from [2] is shown in Figure 2, normalized to a service temperature of 617 °F. The reported top head temperature for Point Beach Unit 1 is 593.9°F [7]. The crack growth rate is a strong function of temperature, and so to represent the Point Beach condition, it is necessary to adjust the Alloy 82 crack growth correlation for the lower temperature. References 1 and 2 also provide an activation energy equation for temperature adjustment of the crack growth curves.

For Alloy 600 weld material the PWSCC crack growth correlation reported in [1], adjusted to the Point Beach head temperature of 593.9 °F is

$$da/dt = 2.37 \times 10^{-07} (K-K_{th})^{1.16}$$

where:

da/dt = crack growth rate at temperature T in in/hr
K = crack tip stress intensity factor (ksi√in)
K_{th} = crack tip stress intensity factor threshold
= 8.19 (ksi√in)

For Alloy 82 weld material the PWSCC crack growth correlation reported in [2], adjusted to the Point Beach head temperature of 593.9 °F is

$$da/dt = 5.36 \times 10^{-08} (K-K_{th})^{1.6}$$

where:

da/dt = crack growth rate at temperature T in in/hr
K = crack tip stress intensity factor (ksi√in)
K_{th} = crack tip stress intensity factor threshold
= 0 (ksi√in)

This correlation is applicable to evaluating the growth of ID connected flaws in Alloy 82 GTAW weld material. Since the diluted zone being evaluated in this calculation is Alloy 52, also a GTAW welding process, the Alloy 82 curve is conservatively applied.

As noted above, the repair material is Alloy 52. Since chromium content has been shown to be a key contributor to nickel-based alloy PWSCC resistance, this material (Alloy 52, with a chromium content of 28-31%) will have significantly higher PWSCC resistance than will Alloy 600 (chromium content 14-17%) or its associated weld materials Alloy 182 (chromium content 13-17%) or Alloy 82 (chromium content 18-22 %). The lower chromium content of the Alloy 82 material is deemed sufficient to account for the potential effects of dilution of the Alloy 52 material in the interface region with the low alloy steel head.

4.0 CRACK GROWTH CALCULATIONS

The objective of the calculation is to determine the time that would be required for a crack at the interface of the Alloy 52 repair material, the low alloy steel head material, and the underlying J-groove material to propagate parallel to the repair weld by a PWSCC mechanism through a distance defined by the repair weld ligament. If the time for such propagation is greater than the remaining service life of the head, no penetration of the pressure boundary due to such a crack would be predicted.

The above crack growth correlations were used with the SI program pc-CRACK [3] to perform PWSCC crack growth calculations. A hypothetical flaw was considered, which represents the bounds on geometries that may be encountered. This hypothetical flaw was a flaw in the axial-radial plane, across the entire remaining J-groove + butter. Such a flaw would be opened by hoop stresses, resulting in a tunnel crack under the repair weld.

PWSCC is driven by both applied and weld residual stresses. Based on analyses performed by Dominion Engineering [3], as summarized in another SI calculation [5], the normal operating stresses plus the weld residual stresses in the hoop direction can reasonably be represented by a constant through-wall stress intensity factor of 57 ksi$\sqrt{\text{in}}$, at the junction of the Alloy-52 repair weld and the low alloy steel head material.

The analysis assumed that the entire original J-groove weld material was degraded (cracked), so no credit was taken for any flaw initiation or growth time in the remaining J-groove material. Because a constant applied K is assumed, starting flaw size has no effect on crack growth rate.

The flaw located in the axial-radial plane (opened by hoop stresses) was determined to be the governing flaw case, since the applied plus residual stresses in the hoop direction are greater than

those in the radial direction by a factor of two to four at the location of the postulated crack, based upon review of Dominion Engineering results [3] for nodes in this location. As a result, crack growth in a radial-circumferential plane would be slower by a comparable factor.

Nozzle 26 is being repaired during the Spring 2004 outage. The repair of this nozzle has a minimum remaining ligament of 0.5 inch [6]. The repair may also contain a weld root defect of 0.1 inch based on Framatome analyses. Both cases (with and without a postulated root defect) are considered here, with pc-CRACK results contained in Appendix A.

This analysis took no credit for the portion of the repair weld that overlapped the Alloy 182 material, and so as a result the repair weld ligament was considered to be reduced in length from the design value. The repair weld is Alloy 52 weld material applied by a GTAW process.

4.1 Fatigue crack growth

Fatigue crack growth is driven by cyclic stresses. For the present case, the stress state for the assumed flaws is dominated by weld residual stresses (conservatively estimated as a constant 60 ksi) which are steady state secondary stresses. These residual stresses will not vary with heat-up/cooldown and other plant cycles, and will therefore have only a limited effect on fatigue crack growth (that is, they will have some effect on R-ratio, but none on delta K values due to cyclic plant operation. For the limited period of remaining plant operation with the current vessel head (estimated at less than 100 heat-up/cooldown cycles, producing a cyclic stress of 20 ksi), propagation of the hypothetical cracks considered herein by a fatigue mechanism is estimated at approximately 0.0002 inch, and is therefore considered negligible compared to PWSCC propagation discussed above.

5.0 RESULTS

The above analysis produces the following results. These results assume that an initial radial-axial flaw is present in the original J-groove weld, equal to the entire size of that weld. The growth is then calculated for the indicated remaining ligament length of potentially diluted Alloy 52 weld metal in the repair weld.

For the nozzle 26 repair (0.4 inch with an assumed root defect), the time required for the assumed flaw to propagate through the remaining ligament is 2.11 EFPY (18500 EFPH) assuming a crack growth law for Alloy 600 base material, and 1.31 EFPY (11500 EFPH) assuming a crack growth law

for Alloy 82 weld material. A crack would have to propagate through this remaining ligament before leakage and possible wastage of the vessel head material could occur.

The conclusion of this calculation is that, even with the very conservative assumption of using Alloy 82 crack growth rates for Alloy 52 weld material, a hypothetical remnant weld crack will not grow through the repair weld ligament for essentially all of the remaining cycle of operation before the reactor vessel head is replaced during the next scheduled refueling outage.

6.0 REFERENCES

1. Materials Reliability Program, "Crack Growth Rates for Evaluating Primary Water Stress Corrosion Cracking (PWSCC) of Thick-Wall Alloy 600 Material," MRP-55, Revision 1, November 2002. EPRI Proprietary .

2. Materials Reliability Program (MRP) Crack Growth Rates for Evaluating Primary Water Stress Corrosion Cracking (PWSCC) of Alloy 82, 182, and 132 Welds (MRP-115), EPRI, Palo Alto, CA: 2004. EPRI Report 1006696.

3. Dominion Engineering, "Point Beach Unit 1 CRDM Nozzle Repair Weld Analysis" Calculation C-4430-00-2, Revision 1, SI File PBCH-09Q-204.

4. Structural Integrity Associates, **pc-CRACK^{tm} for Windows**, version 3.1-98348.

5. Calculation, "Fracture Mechanics Evaluation of Point Beach Unit 1 Top Head CRDM 43.5 Degree Azimuth Penetration Weld Repair," PBCH-09Q-301, Revision 0.

6. E-mail from Brian Kemp (NMC) to Hal Gustin (SI) 5/12/04

7. Letter from Robert Chapman (NMC) to Hal Gustin (SI), "Transmittal of design information relating to purchase order P304715 for Point Beach Unit 1 reactor vessel closure head nozzle #26 repair PWSCC analysis", NPL 2005-0102, dated May 24, 2005.

Figure 1 – Illustration of Nozzle 26 Repair and Associated Overlap Region

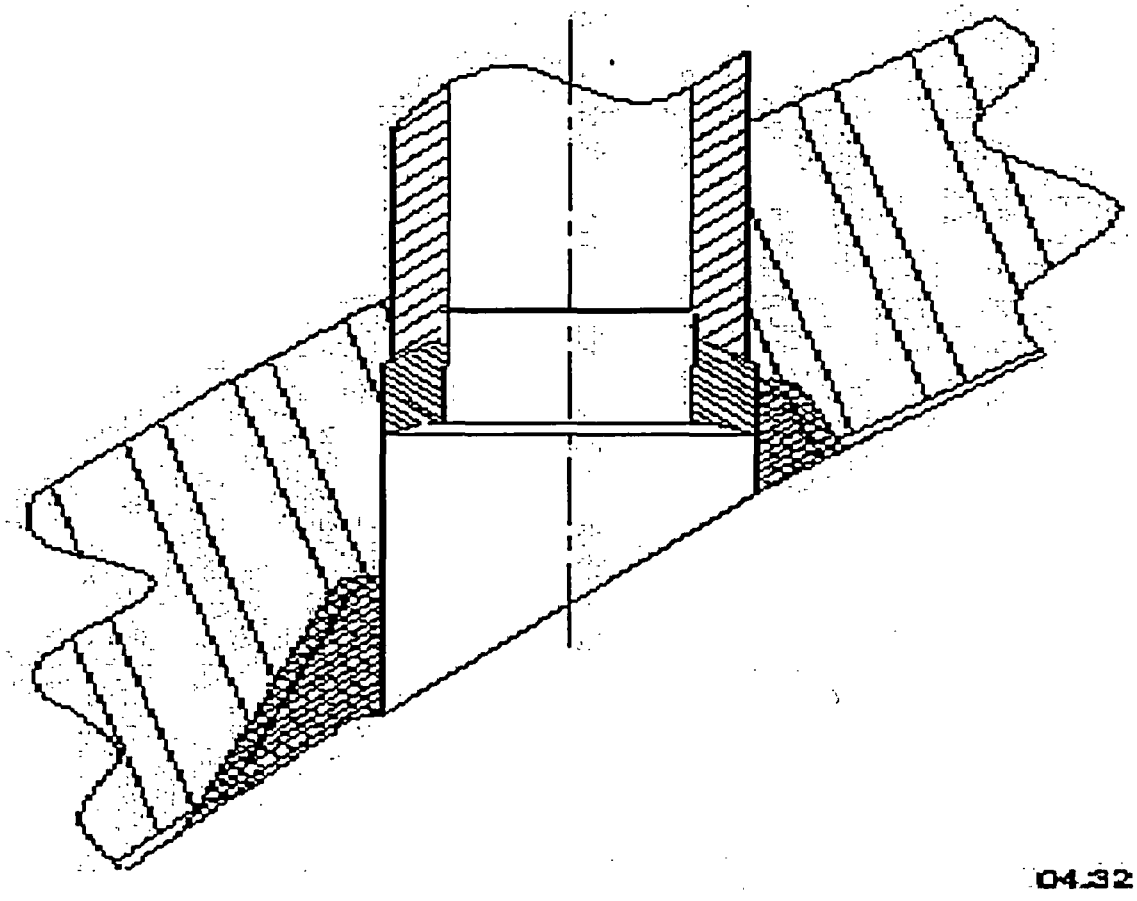
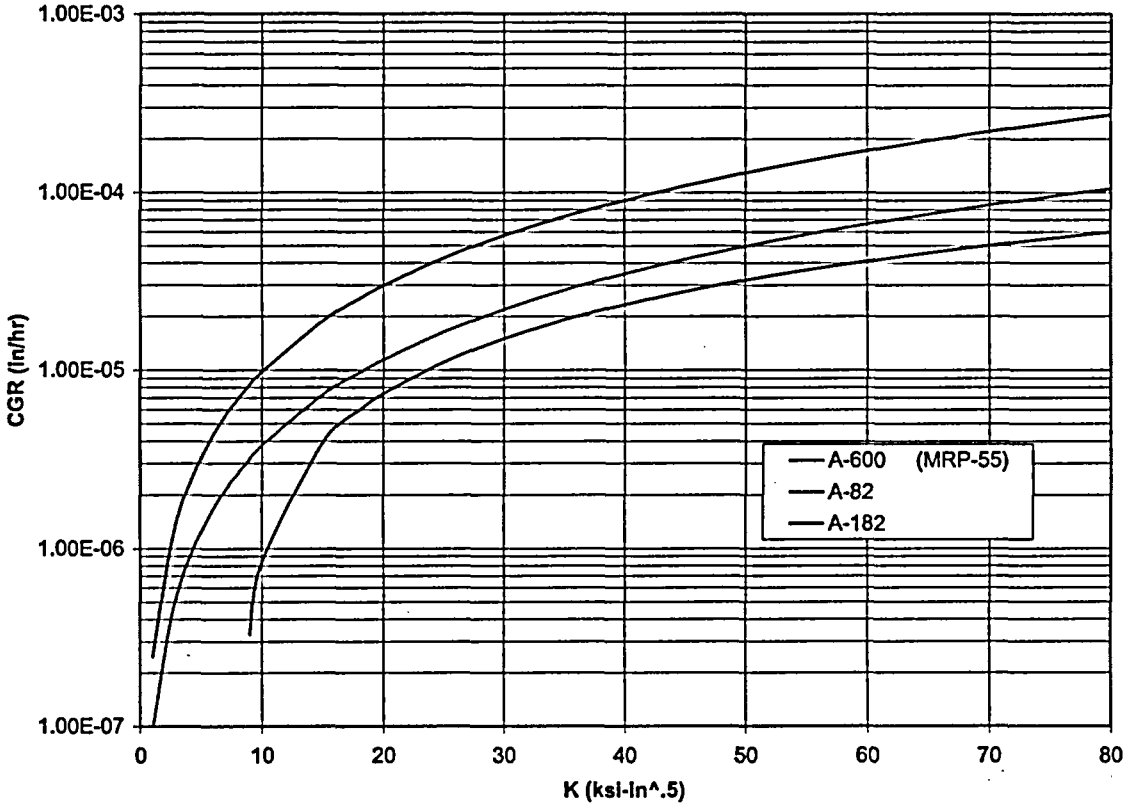


Figure 2 – Alloy-82 and -182 Crack Growth Rate Correlations at 617 °F, from Reference [2]



APPENDIX A
FLAW GROWTH CALCULATIONS: PC-CRACK OUTPUT

tm
pc-CRACK for Windows
Version 3.1-98348
(C) Copyright '84 - '98
Structural Integrity Associates, Inc.
3315 Almaden Expressway, Suite 24
San Jose, CA 95118-1557

Linear Elastic Fracture Mechanics

Date: Wed Jun 01 14:30:54 2005
Input Data and Results File: 60060105.LFM

Title: PBCH-13Q: PWSCC Calculation using Alloy 600

Load Cases:

Case ID: PWSCC --- K vs a

Depth	K
0.0000	57.0000
0.5000	57.0000
2.0000	57.0000

Case ID: Thresh --- K vs a

Depth	K
0.0000	8.1900
0.5000	8.1900
2.0000	8.1900

	Stress Coefficients				
Case ID	C0	C1	C2	C3	Type
PWSCC	0	0	0	0	K vs a
Thresh	0	0	0	0	K vs a

Crack Model: User Input K Versus Crack Size

Crack Parameters:
Max. crack size: 0.5000

Crack Size	Stress Intensity Factor: Case PWSCC	Stress Intensity Factor: Case Thresh
0.0100	57	8.19
0.0200	57	8.19
0.0300	57	8.19
0.0400	57	8.19
0.0500	57	8.19
0.0600	57	8.19
0.0700	57	8.19
0.0800	57	8.19
0.0900	57	8.19
0.1000	57	8.19
0.1100	57	8.19
0.1200	57	8.19
0.1300	57	8.19
0.1400	57	8.19
0.1500	57	8.19
0.1600	57	8.19
0.1700	57	8.19
0.1800	57	8.19
0.1900	57	8.19
0.2000	57	8.19
0.2100	57	8.19
0.2200	57	8.19
0.2300	57	8.19
0.2400	57	8.19
0.2500	57	8.19
0.2600	57	8.19
0.2700	57	8.19
0.2800	57	8.19

0.2900	57	8.19
0.3000	57	8.19
0.3100	57	8.19
0.3200	57	8.19
0.3300	57	8.19
0.3400	57	8.19
0.3500	57	8.19
0.3600	57	8.19
0.3700	57	8.19
0.3800	57	8.19
0.3900	57	8.19
0.4000	57	8.19
0.4100	57	8.19
0.4200	57	8.19
0.4300	57	8.19
0.4400	57	8.19
0.4500	57	8.19
0.4600	57	8.19
0.4700	57	8.19
0.4800	57	8.19
0.4900	57	8.19
0.5000	57	8.19

Crack Growth Laws:

Law ID: PWSCC
Type: Fatigue
Model: Paris

da/dN = c * (dK)^n
where
dK = Kmax - Kmin
dK > Kthres
Kmax < K1c

Material parameters:
c = 2.3700e-007
n = 1.1600
Kthres = 8.1900

Material Fracture Toughness KIc:

Material ID: Alloy 52

Depth	KIc
0.0000	200.0000
0.5000	200.0000
2.0000	200.0000

Initial crack size= 0.0100
Max. crack size= 0.5000

Number of blocks= 1
Print increment of block= 1

Subblock	Cycles /Time	Calc. incre.	Print incre.	Crk. Grw. Law	Mat. KIc
PWSCC	40000	100	100	PWSCC	Alloy 52

Subblock	Kmax Case ID	Kmax Scale Factor	Kmin Case ID	Kmin Scale Factor
PWSCC	PWSCC	1.0000	Thresh	1.0000

Crack growth results:

/Time	Total Cycles /Time	Subblock Cycles	Kmax	Kmin	DeltaK	R	DaDn /DaDt	Da	a	a/thk
				–						
				Block: 1						
100	100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.01215	0.00	
200	200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.01431	0.00	

300	300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.01646	0.00
400	400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.01862	0.00
500	500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.02077	0.00
600	600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.02293	0.00
700	700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.02508	0.00
800	800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.02724	0.00
900	900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.02939	0.00
1000	1000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.03155	0.00
1100	1100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.0337	0.00
1200	1200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.03586	0.00
1300	1300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.03801	0.00
1400	1400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.04017	0.00
1500	1500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.04232	0.00
1600	1600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.04448	0.00
1700	1700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.04663	0.00
1800	1800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.04879	0.00
1900	1900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.05094	0.00
2000	2000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.0531	0.00
2100	2100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.05525	0.00
2200	2200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.05741	0.00
2300	2300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.05956	0.00
2400	2400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.06172	0.00
2500	2500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.06387	0.00
2600	2600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.06603	0.00
2700	2700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.06818	0.00
2800	2800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.07034	0.00
2900	2900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.07249	0.00
3000	3000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.07465	0.00
3100	3100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.0768	0.00
3200	3200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.07896	0.00
3300	3300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.08111	0.00
3400	3400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.08327	0.00
3500	3500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.08542	0.00
3600	3600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.08757	0.00
3700	3700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.08973	0.00
3800	3800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.09188	0.00
3900	3900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.09404	0.00
4000	4000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.09619	0.00
4100	4100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.09835	0.00
4200	4200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1005	0.00
4300	4300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1027	0.00

4400	4400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1048	0.00
4500	4500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.107	0.00
4600	4600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1091	0.00
4700	4700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1113	0.00
4800	4800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1134	0.00
4900	4900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1156	0.00
5000	5000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1177	0.00
5100	5100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1199	0.00
5200	5200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1221	0.00
5300	5300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1242	0.00
5400	5400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1264	0.00
5500	5500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1285	0.00
5600	5600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1307	0.00
5700	5700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1328	0.00
5800	5800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.135	0.00
5900	5900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1371	0.00
6000	6000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1393	0.00
6100	6100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1414	0.00
6200	6200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1436	0.00
6300	6300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1458	0.00
6400	6400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1479	0.00
6500	6500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1501	0.00
6600	6600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1522	0.00
6700	6700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1544	0.00
6800	6800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1565	0.00
6900	6900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1587	0.00
7000	7000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1608	0.00
7100	7100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.163	0.00
7200	7200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1651	0.00
7300	7300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1673	0.00
7400	7400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1695	0.00
7500	7500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1716	0.00
7600	7600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1738	0.00
7700	7700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1759	0.00
7800	7800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1781	0.00
7900	7900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1802	0.00
8000	8000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1824	0.00
8100	8100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1845	0.00
8200	8200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1867	0.00
8300	8300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1889	0.00
8400	8400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.191	0.00

8500	8500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1932	0.00
8600	8600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1953	0.00
8700	8700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1975	0.00
8800	8800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.1996	0.00
8900	8900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2018	0.00
9000	9000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2039	0.00
9100	9100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2061	0.00
9200	9200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2082	0.00
9300	9300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2104	0.00
9400	9400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2126	0.00
9500	9500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2147	0.00
9600	9600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2169	0.00
9700	9700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.219	0.00
9800	9800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2212	0.00
9900	9900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2233	0.00
10000	10000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2255	0.00
10100	10100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2276	0.00
10200	10200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2298	0.00
10300	10300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.232	0.00
10400	10400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2341	0.00
10500	10500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2363	0.00
10600	10600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2384	0.00
10700	10700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2406	0.00
10800	10800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2427	0.00
10900	10900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2449	0.00
11000	11000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.247	0.00
11100	11100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2492	0.00
11200	11200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2513	0.00
11300	11300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2535	0.00
11400	11400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2557	0.00
11500	11500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2578	0.00
11600	11600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.26	0.00
11700	11700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2621	0.00
11800	11800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2643	0.00
11900	11900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2664	0.00
12000	12000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2686	0.00
12100	12100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2707	0.00
12200	12200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2729	0.00
12300	12300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.275	0.00
12400	12400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2772	0.00
12500	12500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2794	0.00

12600	12600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2815	0.00
12700	12700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2837	0.00
12800	12800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2858	0.00
12900	12900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.288	0.00
13000	13000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2901	0.00
13100	13100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2923	0.00
13200	13200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2944	0.00
13300	13300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2966	0.00
13400	13400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.2988	0.00
13500	13500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3009	0.00
13600	13600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3031	0.00
13700	13700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3052	0.00
13800	13800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3074	0.00
13900	13900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3095	0.00
14000	14000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3117	0.00
14100	14100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3138	0.00
14200	14200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.316	0.00
14300	14300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3181	0.00
14400	14400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3203	0.00
14500	14500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3225	0.00
14600	14600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3246	0.00
14700	14700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3268	0.00
14800	14800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3289	0.00
14900	14900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3311	0.00
15000	15000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3332	0.00
15100	15100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3354	0.00
15200	15200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3375	0.00
15300	15300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3397	0.00
15400	15400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3418	0.00
15500	15500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.344	0.00
15600	15600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3462	0.00
15700	15700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3483	0.00
15800	15800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3505	0.00
15900	15900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3526	0.00
16000	16000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3548	0.00
16100	16100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3569	0.00
16200	16200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3591	0.00
16300	16300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3612	0.00
16400	16400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3634	0.00
16500	16500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3656	0.00
16600	16600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3677	0.00

16700	16700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3699	0.00
16800	16800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.372	0.00
16900	16900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3742	0.00
17000	17000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3763	0.00
17100	17100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3785	0.00
17200	17200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3806	0.00
17300	17300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3828	0.00
17400	17400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3849	0.00
17500	17500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3871	0.00
17600	17600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3893	0.00
17700	17700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3914	0.00
17800	17800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3936	0.00
17900	17900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3957	0.00
18000	18000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.3979	0.00
18100	18100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4	0.00
18200	18200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4022	0.00
18300	18300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4043	0.00
18400	18400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4065	0.00
18500	18500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4086	0.00
18600	18600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4108	0.00
18700	18700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.413	0.00
18800	18800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4151	0.00
18900	18900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4173	0.00
19000	19000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4194	0.00
19100	19100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4216	0.00
19200	19200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4237	0.00
19300	19300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4259	0.00
19400	19400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.428	0.00
19500	19500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4302	0.00
19600	19600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4324	0.00
19700	19700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4345	0.00
19800	19800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4367	0.00
19900	19900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4388	0.00
20000	20000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.441	0.00
20100	20100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4431	0.00
20200	20200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4453	0.00
20300	20300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4474	0.00
20400	20400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4496	0.00
20500	20500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4517	0.00
20600	20600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4539	0.00
20700	20700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4561	0.00

20800	20800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4582	0.00
20900	20900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4604	0.00
21000	21000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4625	0.00
21100	21100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4647	0.00
21200	21200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4668	0.00
21300	21300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.469	0.00
21400	21400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4711	0.00
21500	21500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4733	0.00
21600	21600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4754	0.00
21700	21700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4776	0.00
21800	21800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4798	0.00
21900	21900	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4819	0.00
22000	22000	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4841	0.00
22100	22100	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4862	0.00
22200	22200	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4884	0.00
22300	22300	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4905	0.00
22400	22400	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4927	0.00
22500	22500	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4948	0.00
22600	22600	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.497	0.00
22700	22700	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.4992	0.00
22800	22800	5.70e+001	8.19e+000	4.88e+001	0.14	2.15e-005	2.15e-003	0.5013	0.00

Crack size exceeded 0.5000 at cycle/time 22800

End of pc-CRACK Output

tm
pc-CRACK for Windows
Version 3.1-98348
(C) Copyright '84 - '98
Structural Integrity Associates, Inc.
3315 Almaden Expressway, Suite 24
San Jose, CA 95118-1557

Linear Elastic Fracture Mechanics

Date: Wed Jun 01 14:32:23 2005
Input Data and Results File: 82-60105.LFM

Title: PBCH-13Q: PWSCC Calculation using Alloy 82

Load Cases:

Case ID: PWSCC --- K vs a

Depth	K
0.0000	57.0000
0.5000	57.0000
2.0000	57.0000

	Stress Coefficients				
Case ID	C0	C1	C2	C3	Type
PWSCC	0	0	0	0	K vs a

Crack Model: User Input K Versus Crack Size

Crack Parameters:
Max. crack size: 0.5000

----------Stress Intensity Factor----------

Crack Size	Case PWSCC
0.0100	57
0.0200	57
0.0300	57
0.0400	57
0.0500	57
0.0600	57
0.0700	57
0.0800	57
0.0900	57
0.1000	57
0.1100	57
0.1200	57
0.1300	57
0.1400	57
0.1500	57
0.1600	57
0.1700	57
0.1800	57
0.1900	57
0.2000	57
0.2100	57
0.2200	57
0.2300	57
0.2400	57
0.2500	57
0.2600	57
0.2700	57
0.2800	57
0.2900	57
0.3000	57
0.3100	57
0.3200	57
0.3300	57
0.3400	57
0.3500	57
0.3600	57

0.3700	57
0.3800	57
0.3900	57
0.4000	57
0.4100	57
0.4200	57
0.4300	57
0.4400	57
0.4500	57
0.4600	57
0.4700	57
0.4800	57
0.4900	57
0.5000	57

Crack Growth Laws:

Law ID: Alloy 82
Type: Corrosion
Model: Paris

da/dN = c * (dK)^n
where
dK = Kmax - Kmin
dK > Kthres
Kmax < K1c

Material parameters:
c = 5.3600e-008
n = 1.6000
Kthres = 0.0000

Material Fracture Toughness KIc:

Material ID: Alloy 52

Depth	KIc
0.0000	200.0000

0.5000 200.0000
2.0000 200.0000

Initial crack size= 0.0100
Max. crack size= 0.5000

Number of blocks= 1
Print increment of block= 1

Subblock	Cycles /Time	Calc. incre.	Print incre.	Crk. Grw. Law	Mat. K1c
PWSCC	40000	100	100	Alloy 82	Alloy 52

Subblock	Kmax Case ID	Kmax Scale Factor	Kmin Case ID	Kmin Scale Factor
PWSCC	PWSCC	1.0000		

Crack growth results:

/Time	Total Cycles /Time	Subblock Cycles	Kmax	Kmin	DeltaK	R	DaDn /DaDt	Da	a	a/thk
				Block: 1						
100	100	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.01346	0.00	
200	200	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.01691	0.00	
300	300	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.02037	0.00	
400	400	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.02382	0.00	
500	500	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.02728	0.00	
600	600	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.03074	0.00	
700	700	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.03419	0.00	
800	800	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.03765	0.00	
900	900	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.0411	0.00	
1000	1000	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.04456	0.00	

1100	1100	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.04802	0.00
1200	1200	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.05147	0.00
1300	1300	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.05493	0.00
1400	1400	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.05838	0.00
1500	1500	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.06184	0.00
1600	1600	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.06529	0.00
1700	1700	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.06875	0.00
1800	1800	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.07221	0.00
1900	1900	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.07566	0.00
2000	2000	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.07912	0.00
2100	2100	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.08257	0.00
2200	2200	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.08603	0.00
2300	2300	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.08949	0.00
2400	2400	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.09294	0.00
2500	2500	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.0964	0.00
2600	2600	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.09985	0.00
2700	2700	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1033	0.00
2800	2800	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1068	0.00
2900	2900	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1102	0.00
3000	3000	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1137	0.00
3100	3100	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1171	0.00
3200	3200	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1206	0.00
3300	3300	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.124	0.00
3400	3400	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1275	0.00
3500	3500	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.131	0.00
3600	3600	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1344	0.00
3700	3700	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1379	0.00
3800	3800	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1413	0.00
3900	3900	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1448	0.00
4000	4000	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1482	0.00
4100	4100	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1517	0.00
4200	4200	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1551	0.00
4300	4300	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1586	0.00
4400	4400	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1621	0.00
4500	4500	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1655	0.00
4600	4600	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.169	0.00
4700	4700	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1724	0.00
4800	4800	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1759	0.00
4900	4900	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1793	0.00
5000	5000	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1828	0.00
5100	5100	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1863	0.00

5200	5200	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1897	0.00
5300	5300	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1932	0.00
5400	5400	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.1966	0.00
5500	5500	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2001	0.00
5600	5600	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2035	0.00
5700	5700	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.207	0.00
5800	5800	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2104	0.00
5900	5900	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2139	0.00
6000	6000	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2174	0.00
6100	6100	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2208	0.00
6200	6200	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2243	0.00
6300	6300	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2277	0.00
6400	6400	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2312	0.00
6500	6500	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2346	0.00
6600	6600	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2381	0.00
6700	6700	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2415	0.00
6800	6800	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.245	0.00
6900	6900	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2485	0.00
7000	7000	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2519	0.00
7100	7100	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2554	0.00
7200	7200	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2588	0.00
7300	7300	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2623	0.00
7400	7400	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2657	0.00
7500	7500	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2692	0.00
7600	7600	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2727	0.00
7700	7700	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2761	0.00
7800	7800	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2796	0.00
7900	7900	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.283	0.00
8000	8000	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2865	0.00
8100	8100	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2899	0.00
8200	8200	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2934	0.00
8300	8300	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.2968	0.00
8400	8400	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3003	0.00
8500	8500	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3038	0.00
8600	8600	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3072	0.00
8700	8700	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3107	0.00
8800	8800	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3141	0.00
8900	8900	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3176	0.00
9000	9000	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.321	0.00
9100	9100	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3245	0.00
9200	9200	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3279	0.00

9300	9300	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3314	0.00
9400	9400	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3349	0.00
9500	9500	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3383	0.00
9600	9600	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3418	0.00
9700	9700	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3452	0.00
9800	9800	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3487	0.00
9900	9900	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3521	0.00
10000	10000	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3556	0.00
10100	10100	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.359	0.00
10200	10200	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3625	0.00
10300	10300	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.366	0.00
10400	10400	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3694	0.00
10500	10500	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3729	0.00
10600	10600	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3763	0.00
10700	10700	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3798	0.00
10800	10800	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3832	0.00
10900	10900	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3867	0.00
11000	11000	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3902	0.00
11100	11100	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3936	0.00
11200	11200	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.3971	0.00
11300	11300	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4005	0.00
11400	11400	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.404	0.00
11500	11500	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4074	0.00
11600	11600	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4109	0.00
11700	11700	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4143	0.00
11800	11800	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4178	0.00
11900	11900	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4213	0.00
12000	12000	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4247	0.00
12100	12100	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4282	0.00
12200	12200	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4316	0.00
12300	12300	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4351	0.00
12400	12400	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4385	0.00
12500	12500	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.442	0.00
12600	12600	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4454	0.00
12700	12700	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4489	0.00
12800	12800	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4524	0.00
12900	12900	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4558	0.00
13000	13000	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4593	0.00
13100	13100	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4627	0.00
13200	13200	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4662	0.00
13300	13300	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4696	0.00

13400	13400	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4731	0.00
13500	13500	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4766	0.00
13600	13600	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.48	0.00
13700	13700	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4835	0.00
13800	13800	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4869	0.00
13900	13900	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4904	0.00
14000	14000	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4938	0.00
14100	14100	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.4973	0.00
14200	14200	5.70e+001	0.00e+000	5.70e+001	0.00	3.46e-005	3.46e-003	0.5007	0.00

Crack size exceeded 0.5000 at cycle/time 14200

End of pc-CRACK Output