

# MARYLAND UNIVERSITY TRAINING REACTOR

Sheet No 1 of 22

Project: \_\_\_\_\_ Task: \_\_\_\_\_ Prepared by: J. E. Floyd Date: 10/30/93

Calc File No: \_\_\_\_\_ Reviewed by: W. J. Chappas Date: \_\_\_\_\_

Title: Ar-41 Production Calculations for Annual Report and 10CFR20 Requirements

## 1.0 INTRODUCTION

This calculation file documents work done to determine the release of  $^{41}\text{Ar}$  by the Maryland University Training Reactor (MUTR), Docket # 50-166, during the operational period beginning July 1, 1992, and ending June 30, 1993. Assumptions made for this calculation are documented herein. These calculations were performed for inclusion in the Annual Operating Report.

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## 2.0 10CFR20 REQUIREMENTS

10CFR20 [20.1001 - 20.2402] Appendix B, Table 2 documents the maximum permissible effluent concentrations of radionuclides.  $^{41}\text{Ar}$  has a maximum effluent concentration of  $1 \times 10^{-8}$   $\mu\text{Ci/ml}$  in air. The calculations contained in this document will show that in the worst case scenario, the  $^{41}\text{Ar}$  released by MUTR is well below the requirement stated above.

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## 3.0 SOURCES OF $^{41}\text{Ar}$

There are five possible sources of  $^{41}\text{Ar}$  at the MUTR. The sources and their contribution to  $^{41}\text{Ar}$  production and release are as follows:

1. Pneumatic Transfer System: This system has an air hose which extends down into the fueled region of the core. However, the system is pressurized with  $\text{CO}_2$  during operation and its overall volume is small. Thus when the system is idle the amount of  $^{41}\text{Ar}$  produced is limited to the amount of  $^{40}\text{Ar}$  that manages to diffuse into the system when it is not in use. Furthermore any  $^{41}\text{Ar}$  that is created by activation of  $^{40}\text{Ar}$  must diffuse through over 50 feet of hose before it can enter the reactor building. The time required for such diffusion combined with the negligible amounts of production means that the Pneumatic Transfer System does not contribute to  $^{41}\text{Ar}$  production and release.
2. Pool Tank: A small amount of air is dissolved in the pool tank. The  $^{40}\text{Ar}$  contained in this air can be activated and diffuse back into the reactor building at the pool surface. This amount is not insignificant.
3. Thermal Column:  $^{40}\text{Ar}$  contained in the small amounts of air trapped in the Thermal Column can be activated. However, this air is assumed not to diffuse out into the reactor building. The Thermal Column is not a source of  $^{41}\text{Ar}$ .
4. Beam Tubes: When plugged there is no mechanism via which  $^{41}\text{Ar}$  produced inside the Beam Tubes can leave the pool tank region. However, if the plugs are removed during operation  $^{41}\text{Ar}$  will diffuse through the tube and reach the reactor building. The Beam Tubes are only source of  $^{41}\text{Ar}$  if they are unplugged during operation.
5. Through Tube: As for the Beam Tubes it is not a source of  $^{41}\text{Ar}$  when the tube is plugged. When unplugged, however, it is a source.

For the operational period covered by the annual report, only items 2 and 5 must be accounted for, see sections 4 and 5. Items 1 and 3 are not a source, and the Beam Tubes were never unplugged during operation.

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## 4.0 POOL TANK $^{41}\text{Ar}$ PRODUCTION AND RELEASE

The SER, page 11-2, states that the  $^{41}\text{Ar}$  release into the reactor building during an operational year of 30 MWh is less than 0.1 Ci. During the time period covered by the annual report the reactor was operated for 31.5 MWh. Thus  $^{41}\text{Ar}$  release from the pool tank is 0.1 Ci. It was also determined in the SER that such a release amounts to less than 1 mrem of dose to the general public. If the MUTR were operated for 400 MWh the dose to the general public would still be less than 1 mrem.

A 0.1 Ci release over a continuous run of 31.5 MWh would correspond to an equilibrium value of approximately 1 mCi of  $^{41}\text{Ar}$  in the reactor building or a concentration of  $6 \times 10^{-7} \mu\text{Ci/ml}$ . When exhausted by the exhaust fans through the upper portion of the reactor building, the  $^{41}\text{Ar}$  levels will be well below 10CFR20 requirements by the time the  $^{41}\text{Ar}$  diffuses down to unrestricted areas.

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## 5.0 THROUGH TUBE $^{41}\text{Ar}$ PRODUCTION AND RELEASE

$^{41}\text{Ar}$  in the Through Tube is produced by activation of  $^{40}\text{Ar}$  by the Through Tube flux. The flux in the through tube can be considered a cosine shaped flux whose amplitude is equal to the peak flux seen in the Through Tube. Once produced the  $^{41}\text{Ar}$  will only be released in to the reactor building if it diffuses through the tube to the open end before it decays.

The flux in the Through Tube at any one cross sectional location can be considered constant, the air in the tube is a vacuum to the neutron flux. Thus the production and diffusion in the tube can be handled with a 1D approximation. The 1D values at any point in the tube when multiplied by the cross sectional area will then yield the total value for that portion of the tube. The equation governing  $^{41}\text{Ar}$  concentration in one dimension is:

$$\frac{dN_{41}(x,t)}{dt} = \Sigma_a^{40} \phi(x,t) + D \frac{d^2 N_{41}(x,t)}{dx^2} - \lambda_{41} N_{41}(x,t)$$

Transforming the equation into a form suitable for a finite difference analysis yields:

$$\frac{N_{41}(x_i, t+1) - N_{41}(x_i, t)}{\Delta t} = \Sigma_a^{40} \phi_{\max} \cos\left(\frac{\pi x_i}{2a}\right) + D \frac{N_{41}(x_{i+1}, t) - 2N_{41}(x_i, t) + N_{41}(x_{i-1}, t)}{\Delta x^2} - \lambda_{41} N_{41}(x_i, t)$$

Rearranging terms gives:

$$N_{41}(x_i, t+1) = \Delta t \Sigma_a^{40} \phi_{\max} \cos\left(\frac{\pi x_i}{2a}\right) + \frac{D \Delta t}{\Delta x^2} [N_{41}(x_{i+1}, t) + N_{41}(x_{i-1}, t)] + N_{41}(x_i, t) \left[ 1 - \Delta t \left( \lambda_{41} + \frac{2D}{\Delta x^2} \right) \right]$$

By segmenting the Through tube into a equal number of nodes the  $^{41}\text{Ar}$  released into the building can be calculated. There are three conditions required for this problem, an initial and two boundary conditions. The initial condition is that  $N_{41}(x, 0) = 0$ . The first boundary condition is that  $N_{41}(x_0, t) = 0$ , where  $x_0$  is an extrapolated boundary at the open end of the tube. The second boundary condition is  $dN_{41}(x_n, t)/dt = 0$ , where  $x_n$  is the final node position at the closed end of the tube. It was also assumed that any  $^{41}\text{Ar}$  that makes it to the open end of the tube is instantaneously diffused through out the reactor building free air volume. A FORTRAN program called AR41CAL was written to do this calculation. The program listing can be found in Appendix A of this document.

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Three cases were run using this code. The first case represents a typical reactor run of 1 hour at full power. The second case represents a 10 hour run at full power to represent an equilibrium activation of  $^{41}\text{Ar}$  in the through tube. The third case is a 100 hour run at full power. This run condition can not be reached at the MUTR do to the buildup of Xenon. Each case was run for 10 hours beyond the reactor run. This was done to account for the Through Tube plug not being replaced immediately at the end of a run. The value of 10 hours allows for 5  $^{41}\text{Ar}$  half-lives to pass; therefore, any  $^{41}\text{Ar}$  remaining in the Through Tube after 10 hours will be insignificant compared to the original levels and will not affect the end results. The case outputs are given in Appendix B. The following table shows the results of these three cases.

Case	Production (mCi)	Release (mCi)	Maximum Level (mCi/ml)
1 hour	2.408	0.014	$3.07 \times 10^{-12}$
10 hours	24.08	0.164	$8.33 \times 10^{-12}$
100 hours	240.8	1.705	$8.70 \times 10^{-12}$

From these cases it can be seen that less than 0.02 mCi of  $^{41}\text{Ar}$  are released into the reactor building for every hour of full power run with the Through Tube unplugged. Furthermore, the concentration levels inside the reactor building are well below 10CFR20 requirements.

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## 6.0 CONCLUSIONS

During the worst case scenario, operating the reactor for over 10 hours at full power with the Through Tube unplugged, the  $^{41}\text{Ar}$  exhausted from the reactor building will be below 10CFR20 requirements in unrestricted areas. Even if the run time approached 100 hours of continuous operation, the  $^{41}\text{Ar}$  levels will still be below 10CFR20 requirements in unrestricted areas. Since it is unlikely that the reactor will ever be operated for a continuous period of time longer than 100 hours, it can be said that  $^{41}\text{Ar}$  releases from the MUTR will never be greater than 10CFR20 requirements in unrestricted areas.



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## APPENDIX A

### AR41CAL FORTRAN LISTING

```

PROGRAM AR41CAL
*****
C      PROGRAM      AR41CAL (Argon-41 Calculation)
C
C      PURPOSE      This program calculates the Argon-41 production in the
C                   MUTR reactor building with one through tube plug open.
C                   The net results are given in mCi/ml in the building.
C                   The levels are given in 1/2 hour time steps from the
C                   beginning of the run. Also the max level is given. The
C                   program calculates the level using a 1D diffusion calc
C                   assuming a cosine flux distribution across the active
C                   length of the through tube.
C
C      AUTHOR       Jason E. Floyd
C*****
COMMON/CASEINF/POWER,RTIME,DELT,DELX,OUTINT,MAXTIME
COMMON/TUBEDIM/TUBEEND,COREBEG,COREEND,MAXPOS,CORELEN,EXB
COMMON/AR41/NAR41,MAXFLUX,SIGMAAR,LAMBDA,DIFF,PI,PROD
DOUBLE PRECISION MAXFLUX,SIGMAAR,LAMBDA,POWER,PROD,RELEASE,
/      DELX,DELT,DIFF,RADIUS,VOLUME,BLEVEL,CI,MAXLEVEL,ACTVTY,
/      NAR41(402.2),CORELEN,EXB,PI
INTEGER TUBEEND,COREBEG,COREEND,MAXPOS,RTIME,MAXTIME,
/      OUTTIME,OUTINT,TIME,NTSTEP
*****
C      VARIABLE LIST FOR AR41CAL
C
C      ACTVTY: ACTIVITY LEVEL IN mCi/ml
C      BLEVEL: BUILDING AR-41 LEVELS IN ATOMS/ml
C      CI: 1 CURIE
C      COREBEG: NODE LOCATION OF BEGINNING OF ACTIVE TUBE LENGTH
C      COREEND: NODE LOCATION OF END OF ACTIVE TUBE LENGTH
C      CORELEN: ACTIVE CORE LENGTH
C      DELX: NODE SPACING FOR 1D CALCULATION
C      DELT: TIME STEP
C      DIFF: AR-41 DIFFUSION COEFFICIENT
C      EXB: EXTRAPOLATED CORE BOUNDARY
C      LAMBDA: ARGON-41 DECAY CONSTANT
C      MAXFLUX: PEAK THROUGH TUBE FLUX (n/cm^2 kW)
C      MAXLEVEL: MAXIMUM AR-41 LEVELS IN BUILDING
C      MAXPOS: MAXIMUM NODE POSITION
C      MAXTIME: TIME TO END CALCULATION AT
C      NAR41(X,T): ARGON-41 NUMBER DENSITY AT TUBE CENTERLINE FOR NODE X
C                  T = 1/2 CURRENT TIME STEP/NEXT TIME STEP
C      NTSTEP: NUMBER OF TIME STEPS IN CASE
C      OUTINT: TIME INTERVAL BETWEEN LEVEL OUTPUTS
C      OUTTIME: TIME OF NEXT OUTPUT
C      POSIT: CURRENT NODE
C      POWER: CORE POWER LEVEL DURING RUN
C      RADIUS: THROUGH TUBE RADIUS
C      RTIME: RUN TIME
C      SIGMAAR: MACROSCOPIC ABSORPTION CX FOR AR40
C      TIME: CURRENT TIME
C      TUBEEND: NODE POSITION OF OPEN TUBE END
C      TUBEEND: NODE POSITION OF CLOSED TUBE END
C      VOLUME: FREE AIR VOLUME OF BUILDING
*****
C      LOAD CONSTANTS AND INITIALIZE ARRAY
C
C      CI = 3.7E+10

```



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```
DELX = 2.
DELT = 4.
DIFF = .25
EXB = -306 - 1/DIFF
LAMBDA = 0.000105
MAXFLUX = 1.6E+09
MAXPOS = 309
OUTINT = 900
OUTTIME = 900
PROD = 0.
RELEASE = 0.
SIGMAAR = 1.6306E-07
RADIUS = 7.62
PI = 3.14159
TIME = 0
TUBEEND = 401
TUBEEND = 401
COREBEG = 136
COREEND = 308
CORELEN = 72
VOLUME = 1.700E+09
DO 100 POSIT = 1,MAXPOS
    NAR41(POSIT,1)=0
    NAR41(POSIT,2)=0
```

100 CONTINUE

C\*\*\*\*\*

C OBTAIN POWER LEVEL AND RUNTIME FROM USER. PREPARE OUTPUT HEADER

C

CALL CASINIT

C\*\*\*\*\*

C CALCULATE NUMBER OF TIME STEPS AND BEGIN CACULATION

C

NTSTEP = INT(MAXTIME/DELT)

TIME = 0

DO 200 I = 1,NTSTEP

TIME = TIME + DELT

C\*\*\*\*\*

C CALL NUMCAL TO CALCULATE ARGON-41 FOR THE CURRENT TIME STEP

C

CALL NUMCAL(TIME)

C\*\*\*\*\*

C CALCULATE BUILDING CONCENTRATION AND UPDATE RELEASE AND ALSO

C

MAX LEVEL IF NEEDED

C

BLEVEL = BLEVEL \* (1 - LAMBDA \* BLEVEL \* DELT)

BLEVEL = BLEVEL+NAR41(TUBEEND,1)\*PI\*RADIUS \*\* 2 / VOLUME

RELEASE = RELEASE+NAR41(TUBEEND,1)

IF (BLEVEL.GE.MAXLEVEL) THEN

MAXLEVEL = BLEVEL

ENDIF

C\*\*\*\*\*

C UPDATE OUPUT FILE IF NEEDED

C

IF (TIME.EQ.OUTTIME) THEN

OUTTIME = OUTTIME + OUTINT

ACTVTY = BLEVEL \* LAMBDA / CI \* 1000

WRITE(6,900) TIME,ACTVTY

WRITE(7,900) TIME,ACTVTY

ENDIF

200 CONTINUE

C\*\*\*\*\*

C WRITE MAXLEVEL, TOTAL PRODUCTION, AND RELEASE TO OUTPUT FILE

C

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```
ACTVTY = MAXLEVEL * LAMBDA / CI * 1000
RELEASE = RELEASE * PI * RADIUS**2 * LAMBDA / CI * 1000
PROD = PROD * PI * RADIUS**2 * LAMBDA / CI * 1000
WRITE(6,910) ACTVTY
WRITE(7,910) ACTVTY
WRITE(6,920) PROD
WRITE(7,920) PROD
WRITE(6,930) RELEASE
WRITE(7,930) RELEASE
CLOSE(7)
STOP
```

```
900 FORMAT(17.7,10X,E18.10)
910 FORMAT('MAXIMUM AR-41 CONCENTRATION IS: ',E18.10,' mCi/ml ')
920 FORMAT('TOTAL AR-41 PRODUCTION IS: ',E18.10,' mCi')
930 FORMAT('TOTAL AR-41 RELEASE: ',E18.10,' mCi')
END
SUBROUTINE CASINIT
```

```
C*****
C ROUTINE CASEINT (CASE INITIALIZATION)
C
C PURPOSE Gets input data from user on runtime and power level.
C Opens output file and prints header.
C
C AUTHOR Jason E. Floyd
```

```
C*****
COMMON/CASEINF/POWER,RTIME,DELT,DELX,OUTINT,MAXTIME
DOUBLE PRECISION POWER,DELX,DELT
INTEGER RTIME,OUTINT,MAXTIME
```

```
C
C WRITE(6,900)
C READ(5,*) POWER
C WRITE(6,910)
C READ(5,*) RTIME
```

```
C*****
C DETERMINE TIME TO END CASE
C
C MAXTIME = 1800 + 1800 * INT((RTIME+36000)/1800)
```

```
C*****
C OPEN OUTPUT FILE AND WRITE CASE HEADER
C
```

```
OPEN(7,FILE='ARGON41.OUT',STATUS='UNKNOWN')
WRITE(6,920) POWER,RTIME
WRITE(7,920) POWER,RTIME
WRITE(6,930) MAXTIME
WRITE(7,930) MAXTIME
WRITE(6,940) DELX,DELT,OUTINT
WRITE(7,940) DELX,DELT,OUTINT
WRITE(6,950)
WRITE(7,950)
```

```
C*****
C RETURN TO AR41CAL
C
```

RETURN

```
900 FORMAT('CORE POWER LEVEL IN KW')
910 FORMAT('RUNTIME IN SECONDS')
920 FORMAT('ARGON-41 FOR POWER=',F10.5,' KW FOR ',I6.6,' SECONDS')
930 FORMAT('CASE WILL BE RUN UNTIL TIME ',I7.7,' SECONDS')
940 FORMAT('NODE SPACING=',F5.2,' CM, TIME STEP=',F5.2,' S, OUTPUT INTER
/VAL=',I5.5,' S')
950 FORMAT(' TIME ACTIVITY IN mCi/ml')
END
SUBROUTINE NUMCAL(TIME)
```

C\*\*\*\*\*

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```

C ROUTINE NUMCAL (Number Density Calculation)
C
C PURPOSE This routine uses a 1D nodal diffusion calculation to
C determine Ar-41 concentrations in the through tube. A
C zero boundary condition is at the extrapolated boundary
C of the open end of the tube, and a reflection boundary
C condition is set at the open end of the tube.
C Production of Ar-41 assumes a cosine flux shape over
C the active length of the tube for the duration of the
C run.
C
C AUTHOR Jason E. Floyd
C *****
COMMON/CASEINF/POWER,RTIME,DELT,DELX,OUTINT,MAXTIME
COMMON/TUBEDIM/TUBEEND,TUBEEND,COREBEG,COREEND,MAXPOS,CORELEN,EXB
COMMON/AR41/NAR41,MAXFLUX,SIGMAAR,LAMBDA,DIFF,PI,PROD
DOUBLE PRECISION MAXFLUX,SIGMAAR,LAMBDA,POWER,PROD,
/ DELX,DELT,DIFF,RADIUS,VOLUME,BLEVEL,CI,MAXLEVEL,ACTVTY,
/ NAR41(402,2),CORELEN,EXB,PI
INTEGER TUBEEND,TUBEEND,COREBEG,COREEND,MAXPOS,RTIME,MAXTIME,
/ OUTTIME,OUTINT,TIME
C *****
C ZERO CONCENTRATION AT EXTRAPOLATED BOUNDARY CONDITION
C
C NAR41(1,2) = 0
DO 100 POSIT = 2,TUBEEND
  NAR41(POSIT,2) = DELT / DELX**2 * DIFF * (NAR41(POSIT-1,1) +
/ NAR41(POSIT+1,1)) + NAR41(POSIT,1) * (1 - DELT *
/ (LAMBDA + 2 * DIFF / DELX**2))
C *****
C IF IN THE ACTIVE REGION OF THE THRU TUBE AND THE REACTOR IS AT
C POWER CALCULATE THE AR-41 PRODUCTION
C
C IF ((POSIT.GE.COREBEG).AND.(POSIT.LE.COREEND).AND.(TIME.LE.
/ RTIME)) THEN
  NAR41(POSIT,2) = NAR41(POSIT,2) + DELT * POWER * MAXFLUX *
/ SIGMAAR * COS(PI*(EXB+POSIT*DELX)/CORELEN)
  PROD = PROD + DELT * POWER * MAXFLUX * SIGMAAR *
/ COS(PI*(EXB+POSIT*DELX)/CORELEN)
  ENDIF
C *****
C MAKE THE NODE AFTER THE LAST NODE EQUAL TO THE NODE BEFORE THE
C LAST NODE TO MEET THE REFLECTION BOUNDARY CONDITION
C
C IF (POSIT.EQ.TUBEEND-1) THEN
  NAR41(MAXPOS,2) = NAR41(POSIT,2)
  ENDIF
100 CONTINUE
DO 200 POSIT = 1,TUBEEND
  NAR41(POSIT,1) = NAR41(POSIT,2)
200 CONTINUE
C *****
C RETURN TO AR41CAL
C
C RETURN
END

```

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## APPENDIX B AR41CAL CASE OUTPUTS

1 Hour at Full Power

ARGON-41 FOR POWER= 250.00000 KW FOR 003600 SECONDS  
CASE WILL BE RUN UNTIL TIME 0041400 SECONDS  
NODE SPACING= 2.00 CM, TIME STEP= 4.00 S, OUTPUT INTERVAL=00900 S

TIME	ACTIVITY IN mCi/ml
0000900	-0.1070969988E-51
0001800	0.5162039140E-32
0002700	0.1867650207E-24
0003600	0.7298393504E-21
0004500	0.1133527619E-18
0005400	0.3519077431E-17
0006300	0.4307693578E-16
0007200	0.2920954381E-15
0008100	0.1327047791E-14
0009000	0.4531208049E-14
0009900	0.1250763710E-13
0010800	0.2928986189E-13
0011700	0.6016728670E-13
0012600	0.1110881687E-12
0013500	0.1877688714E-12
0014400	0.2947226932E-12
0015300	0.4344135621E-12
0016200	0.6066857717E-12
0017100	0.8085598381E-12
0018000	0.1034426223E-11
0018900	0.1276607432E-11
0019800	0.1526194370E-11
0020700	0.1774008479E-11
0021600	0.2011518147E-11
0022500	0.2231559265E-11
0023400	0.2428769672E-11
0024300	0.2599722588E-11
0025200	0.2742808224E-11
0026100	0.2857948308E-11
0027000	0.2946233184E-11
0027900	0.3009554426E-11
0028800	0.3050280186E-11
0029700	0.3070995730E-11
0030600	0.3074313207E-11
0031500	0.3062743624E-11
0032400	0.3038619087E-11
0033300	0.3004052530E-11
0034200	0.2960923557E-11
0035100	0.2910881217E-11
0036000	0.2855356952E-11
0036900	0.2795582900E-11
0037800	0.2732612417E-11
0038700	0.2667340801E-11
0039600	0.2600525069E-11
0040500	0.2532802155E-11
0041400	0.2464705284E-11

MAXIMUM AR-41 CONCENTRATION IS: 0.3074992466E-11 mCi/ml  
TOTAL AR-41 PRODUCTION IS: 0.2408635586E+01 mCi  
TOTAL AR-41 RELEASE: 0.1463356457E-01 mCi

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10 Hours at Full Power

ARGON-41 FOR POWER= 250.00000 KW FOR 036000 SECONDS

CASE WILL BE RUN UNTIL TIME 0073800 SECONDS

NODE SPACING= 2.00 CM, TIME STEP= 4.00 S, OUTPUT INTERVAL=00900 S

TIME	ACTIVITY IN mCi/ml
0000900	-0.1070969988E-51
0001800	0.5162039140E-32
0002700	0.1867650207E-24
0003600	0.7298393504E-21
0004500	0.1133527619E-18
0005400	0.3519077431E-17
0006300	0.4307693597E-16
0007200	0.2920961679E-15
0008100	0.1327161142E-14
0009000	0.4534726880E-14
0009900	0.1255070334E-13
0010800	0.2958174648E-13
0011700	0.6149204934E-13
0012600	0.1156048686E-12
0013500	0.2002206799E-12
0014400	0.3238812076E-12
0015300	0.4944238875E-12
0016200	0.7178968866E-12
0017100	0.9974553735E-12
0018000	0.1332428969E-11
0018900	0.1717804008E-11
0019800	0.2144349318E-11
0020700	0.2599490629E-11
0021600	0.3068822342E-11
0022500	0.3537924044E-11
0023400	0.3994039746E-11
0024300	0.4427244412E-11
0025200	0.4830925919E-11
0026100	0.5201639490E-11
0027000	0.5538542944E-11
0027900	0.5842658081E-11
0028800	0.6116153837E-11
0029700	0.6361763149E-11
0030600	0.6582369770E-11
0031500	0.6780752161E-11
0032400	0.6959449287E-11
0033300	0.7120709432E-11
0034200	0.7266488972E-11
0035100	0.7398477059E-11
0036000	0.7518130600E-11
0036900	0.7626710530E-11
0037800	0.7725314848E-11
0038700	0.7814906703E-11
0039600	0.7896337291E-11
0040500	0.7970364016E-11
0041400	0.8037662377E-11
0042300	0.8098816191E-11
0043200	0.8154246718E-11
0044100	0.8204055517E-11
0045000	0.8247828825E-11
0045900	0.8284508465E-11
0046800	0.8312413768E-11
0047700	0.8329425020E-11
0048600	0.8333271506E-11
0049500	0.8321840202E-11

# MARYLAND UNIVERSITY TRAINING REACTOR

Sheet No 14 of 22Project: \_\_\_\_\_ Task: \_\_\_\_\_ Prepared by: J. E. Floyd Date: 10/30/93Calc File No: \_\_\_\_\_ Reviewed by: W. J. Chappas Date: \_\_\_\_\_Title: Ar-41 Production Calculations for Annual Report and 10CFR20 Requirements

0050400	0.8293433021E-11
0051300	0.8246932190E-11
0052200	0.8181865951E-11
0053100	0.8098389736E-11
0054000	0.7997208670E-11
0054900	0.7879468182E-11
0055800	0.7746634848E-11
0056700	0.7600382767E-11
0057600	0.7442494404E-11
0058500	0.7274779718E-11
0059400	0.7099014009E-11
0060300	0.6916892923E-11
0061200	0.6730002078E-11
0062100	0.6539798531E-11
0063000	0.6347601436E-11
0063900	0.6154589553E-11
0064800	0.5961803670E-11
0065700	0.5770152401E-11
0066600	0.5580420143E-11
0067500	0.5393276299E-11
0068400	0.5209285100E-11
0069300	0.5028915546E-11
0070200	0.4852551144E-11
0071100	0.4680499216E-11
0072000	0.4512999648E-11
0072900	0.4350233005E-11
0073800	0.4192327968E-11

MAXIMUM AR-41 CONCENTRATION IS: 0.8333668028E-11 mCi/ml  
TOTAL AR-41 PRODUCTION IS: 0.2408635586E+02 mCi  
TOTAL AR-41 RELEASE: 0.1636378986E+00 mCi

# MARYLAND UNIVERSITY TRAINING REACTOR

Sheet No 15 of 22

Project: \_\_\_\_\_ Task: \_\_\_\_\_ Prepared by: J. E. Floyd Date: 10/30/93  
Calc File No: \_\_\_\_\_ Reviewed by: W. J. Chappas Date: \_\_\_\_\_  
Title: Ar-41 Production Calculations for Annual Report and 10CFR20 Requirements

100 Hours at Full Power

ARGON-41 FOR POWER= 250.00000 KW FOR 360000 SECONDS  
CASE WILL BE RUN UNTIL TIME 0397800 SECONDS  
NODE SPACING= 2.00 CM, TIME STEP= 4.00 S, OUTPUT INTERVAL=00900 S

TIME	ACTIVITY IN mCi/ml
0000900	-0.1070969988E-51
0001800	0.5162039140E-32
0002700	0.1867650207E-24
0003600	0.7298393504E-21
0004500	0.1133527619E-18
0005400	0.3519077431E-17
0006300	0.4307693597E-16
0007200	0.2920961679E-15
0008100	0.1327161142E-14
0009000	0.4534726880E-14
0009900	0.1255070334E-13
0010800	0.2958174648E-13
0011700	0.6149204934E-13
0012600	0.1156048686E-12
0013500	0.2002206799E-12
0014400	0.3238812076E-12
0015300	0.4944238875E-12
0016200	0.7178968866E-12
0017100	0.9974553735E-12
0018000	0.1332428969E-11
0018900	0.1717804008E-11
0019800	0.2144349318E-11
0020700	0.2599490629E-11
0021600	0.3068822342E-11
0022500	0.3537924044E-11
0023400	0.3994039746E-11
0024300	0.4427244412E-11
0025200	0.4830925919E-11
0026100	0.5201639490E-11
0027000	0.5538542944E-11
0027900	0.5842658081E-11
0028800	0.6116153837E-11
0029700	0.6361763149E-11
0030600	0.6582369770E-11
0031500	0.6780752161E-11
0032400	0.6959449287E-11
0033300	0.7120709432E-11
0034200	0.7266488972E-11
0035100	0.7398477059E-11
0036000	0.7518130600E-11
0036900	0.7626710530E-11
0037800	0.7725314848E-11
0038700	0.7814906703E-11
0039600	0.7896337292E-11
0040500	0.7970364117E-11
0041400	0.8037665389E-11
0042300	0.8098851363E-11
0043200	0.8154473330E-11
0044100	0.8205030838E-11
0045000	0.8250977572E-11
0045900	0.8292726239E-11
0046800	0.8330652694E-11
0047700	0.8365099491E-11
0048600	0.8396378975E-11
0049500	0.8424776014E-11



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Sheet No 16 of 22Project: \_\_\_\_\_ Task: \_\_\_\_\_ Prepared by: J. E. Floyd Date: 10/30/93Calc File No: \_\_\_\_\_ Reviewed by: W. J. Chappas Date: \_\_\_\_\_Title: Ar-41 Production Calculations for Annual Report and 10CFR20 Requirements

0050400	0.8450550440E-11
0051300	0.8473939239E-11
0052200	0.8495158533E-11
0053100	0.8514405380E-11
0054000	0.8531859415E-11
0054900	0.8547684346E-11
0055800	0.8562029324E-11
0056700	0.8575030198E-11
0057600	0.8586810660E-11
0058500	0.8597483302E-11
0059400	0.8607150576E-11
0060300	0.8615905682E-11
0061200	0.8623833372E-11
0062100	0.8631010696E-11
0063000	0.8637507681E-11
0063900	0.8643387948E-11
0064800	0.8648709289E-11
0065700	0.8653524177E-11
0066600	0.8657880250E-11
0067500	0.8661820742E-11
0068400	0.8665384879E-11
0069300	0.8668608244E-11
0070200	0.8671523106E-11
0071100	0.8674158724E-11
0072000	0.8676541617E-11
0072900	0.8678695821E-11
0073800	0.8680643115E-11
0074700	0.8682403226E-11
0075600	0.8683994024E-11
0076500	0.8685431689E-11
0077400	0.8686730873E-11
0078300	0.8687904837E-11
0079200	0.8688965587E-11
0080100	0.8689923984E-11
0081000	0.8690789859E-11
0081900	0.8691572103E-11
0082800	0.8692278761E-11
0083700	0.8692917109E-11
0084600	0.8693493727E-11
0085500	0.8694014564E-11
0086400	0.8694485001E-11
0087300	0.8694909900E-11
0088200	0.8695293659E-11
0089100	0.8695640251E-11
0090000	0.8695953268E-11
0090900	0.8696235957E-11
0091800	0.8696491251E-11
0092700	0.8696721801E-11
0093600	0.8696930002E-11
0094500	0.8697118017E-11
0095400	0.8697287801E-11
0096300	0.8697441122E-11
0097200	0.8697579573E-11
0098100	0.8697704596E-11
0099000	0.8697817493E-11
0099900	0.8697919440E-11
0100800	0.8698011498E-11
0101700	0.8698094626E-11
0102600	0.8698169691E-11
0103500	0.8698237475E-11
0104400	0.8698298684E-11
0105300	0.8698353956E-11
0106200	0.8698403867E-11

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Sheet No 17 of 22Project: \_\_\_\_\_ Task: \_\_\_\_\_ Prepared by: J. E. Floyd Date: 10/30/93Calc File No: \_\_\_\_\_ Reviewed by: W. J. Chappas Date: \_\_\_\_\_Title: Ar-41 Production Calculations for Annual Report and 10CFR20 Requirements

0107100	0.8698448937E-11
0108000	0.8698489636E-11
0108900	0.8698526389E-11
0109800	0.8698559577E-11
0110700	0.8698589547E-11
0111600	0.8698616612E-11
0112500	0.8698641053E-11
0113400	0.8698663124E-11
0114300	0.8698683056E-11
0115200	0.8698701056E-11
0116100	0.8698717312E-11
0117000	0.8698731993E-11
0117900	0.8698745251E-11
0118800	0.8698757225E-11
0119700	0.8698768039E-11
0120600	0.8698777806E-11
0121500	0.8698786627E-11
0122400	0.8698794593E-11
0123300	0.8698801789E-11
0124200	0.8698808287E-11
0125100	0.8698814157E-11
0126000	0.8698819459E-11
0126900	0.8698824248E-11
0127800	0.8698828573E-11
0128700	0.8698832480E-11
0129600	0.8698836009E-11
0130500	0.8698839197E-11
0131400	0.8698842076E-11
0132300	0.8698844678E-11
0133200	0.8698847027E-11
0134100	0.8698849150E-11
0135000	0.8698851067E-11
0135900	0.8698852799E-11
0136800	0.8698854364E-11
0137700	0.8698855778E-11
0138600	0.8698857055E-11
0139500	0.8698858209E-11
0140400	0.8698859251E-11
0141300	0.8698860193E-11
0142200	0.8698861044E-11
0143100	0.8698861812E-11
0144000	0.8698862507E-11
0144900	0.8698863134E-11
0145800	0.8698863701E-11
0146700	0.8698864214E-11
0147600	0.8698864676E-11
0148500	0.8698865095E-11
0149400	0.8698865473E-11
0150300	0.8698865814E-11
0151200	0.8698866123E-11
0152100	0.8698866401E-11
0153000	0.8698866653E-11
0153900	0.8698866881E-11
0154800	0.8698867087E-11
0155700	0.8698867273E-11
0156600	0.8698867441E-11
0157500	0.8698867592E-11
0158400	0.8698867730E-11
0159300	0.8698867854E-11
0160200	0.8698867966E-11
0161100	0.8698868067E-11
0162000	0.8698868158E-11
0162900	0.8698868241E-11

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Project: \_\_\_\_\_ Task: \_\_\_\_\_ Prepared by: J. E. Floyd Date: 10/30/93

Calc File No: \_\_\_\_\_ Reviewed by: W. J. Chappas Date: \_\_\_\_\_

Title: Ar-41 Production Calculations for Annual Report and 10CFR20 Requirements

0163800	0.8698868316E-11
0164700	0.8698868383E-11
0165600	0.8698868445E-11
0166500	0.8698868500E-11
0167400	0.8698868550E-11
0168300	0.8698868595E-11
0169200	0.8698868635E-11
0170100	0.8698868672E-11
0171000	0.8698868706E-11
0171900	0.8698868736E-11
0172800	0.8698868763E-11
0173700	0.8698868787E-11
0174600	0.8698868810E-11
0175500	0.8698868830E-11
0176400	0.8698868848E-11
0177300	0.8698868864E-11
0178200	0.8698868879E-11
0179100	0.8698868892E-11
0180000	0.8698868905E-11
0180900	0.8698868916E-11
0181800	0.8698868925E-11
0182700	0.8698868934E-11
0183600	0.8698868943E-11
0184500	0.8698868950E-11
0185400	0.8698868956E-11
0186300	0.8698868962E-11
0187200	0.8698868968E-11
0188100	0.8698868973E-11
0189000	0.8698868977E-11
0189900	0.8698868981E-11
0190800	0.8698868985E-11
0191700	0.8698868988E-11
0192600	0.8698868991E-11
0193500	0.8698868994E-11
0194400	0.8698868996E-11
0195300	0.8698868998E-11
0196200	0.8698869000E-11
0197100	0.8698869002E-11
0198000	0.8698869004E-11
0198900	0.8698869005E-11
0199800	0.8698869006E-11
0200700	0.8698869008E-11
0201600	0.8698869009E-11
0202500	0.8698869010E-11
0203400	0.8698869010E-11
0204300	0.8698869011E-11
0205200	0.8698869012E-11
0206100	0.8698869013E-11
0207000	0.8698869013E-11
0207900	0.8698869014E-11
0208800	0.8698869014E-11
0209700	0.8698869015E-11
0210600	0.8698869015E-11
0211500	0.8698869015E-11
0212400	0.8698869016E-11
0213300	0.8698869016E-11
0214200	0.8698869016E-11
0215100	0.8698869017E-11
0216000	0.8698869017E-11
0216900	0.8698869017E-11
0217800	0.8698869017E-11
0218700	0.8698869017E-11
0219600	0.8698869017E-11

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Sheet No 19 of 22Project: \_\_\_\_\_ Task: \_\_\_\_\_ Prepared by: J. E. Floyd Date: 10/30/93Calc File No: \_\_\_\_\_ Reviewed by: W. J. Chappas Date: \_\_\_\_\_Title: Ar-41 Production Calculations for Annual Report and 10CFR20 Requirements

0220500	0.8698869018E-11
0221400	0.8698869018E-11
0222300	0.8698869018E-11
0223200	0.8698869018E-11
0224100	0.8698869018E-11
0225000	0.8698869018E-11
0225900	0.8698869018E-11
0226800	0.8698869018E-11
0227700	0.8698869018E-11
0228600	0.8698869018E-11
0229500	0.8698869018E-11
0230400	0.8698869018E-11
0231300	0.8698869018E-11
0232200	0.8698869018E-11
0233100	0.8698869018E-11
0234000	0.8698869019E-11
0234900	0.8698869019E-11
0235800	0.8698869019E-11
0236700	0.8698869019E-11
0237600	0.8698869019E-11
0238500	0.8698869019E-11
0239400	0.8698869019E-11
0240300	0.8698869019E-11
0241200	0.8698869019E-11
0242100	0.8698869019E-11
0243000	0.8698869019E-11
0243900	0.8698869019E-11
0244800	0.8698869019E-11
0245700	0.8698869019E-11
0246600	0.8698869019E-11
0247500	0.8698869019E-11
0248400	0.8698869019E-11
0249300	0.8698869019E-11
0250200	0.8698869019E-11
0251100	0.8698869019E-11
0252000	0.8698869019E-11
0252900	0.8698869019E-11
0253800	0.8698869019E-11
0254700	0.8698869019E-11
0255600	0.8698869019E-11
0256500	0.8698869019E-11
0257400	0.8698869019E-11
0258300	0.8698869019E-11
0259200	0.8698869019E-11
0260100	0.8698869019E-11
0261000	0.8698869019E-11
0261900	0.8698869019E-11
0262800	0.8698869019E-11
0263700	0.8698869019E-11
0264600	0.8698869019E-11
0265500	0.8698869019E-11
0266400	0.8698869019E-11
0267300	0.8698869019E-11
0268200	0.8698869019E-11
0269100	0.8698869019E-11
0270000	0.8698869019E-11
0270900	0.8698869019E-11
0271800	0.8698869019E-11
0272700	0.8698869019E-11
0273600	0.8698869019E-11
0274500	0.8698869019E-11
0275400	0.8698869019E-11
0276300	0.8698869019E-11

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Sheet No 20 of 22Project: \_\_\_\_\_ Task: \_\_\_\_\_ Prepared by: J. E. Floyd Date: 10/30/93Calc File No: \_\_\_\_\_ Reviewed by: W. J. Chappas Date: \_\_\_\_\_Title: Ar-41 Production Calculations for Annual Report and 10CFR20 Requirements

0277200	0.8698869019E-11
0278100	0.8698869019E-11
0279000	0.8698869019E-11
0279900	0.8698869019E-11
0280800	0.8698869019E-11
0281700	0.8698869019E-11
0282600	0.8698869019E-11
0283500	0.8698869019E-11
0284400	0.8698869019E-11
0285300	0.8698869019E-11
0286200	0.8698869019E-11
0287100	0.8698869019E-11
0288000	0.8698869019E-11
0288900	0.8698869019E-11
0289800	0.8698869019E-11
0290700	0.8698869019E-11
0291600	0.8698869019E-11
0292500	0.8698869019E-11
0293400	0.8698869019E-11
0294300	0.8698869019E-11
0295200	0.8698869019E-11
0296100	0.8698869019E-11
0297000	0.8698869019E-11
0297900	0.8698869019E-11
0298800	0.8698869019E-11
0299700	0.8698869019E-11
0300600	0.8698869019E-11
0301500	0.8698869019E-11
0302400	0.8698869019E-11
0303300	0.8698869019E-11
0304200	0.8698869019E-11
0305100	0.8698869019E-11
0306000	0.8698869019E-11
0306900	0.8698869019E-11
0307800	0.8698869019E-11
0308700	0.8698869019E-11
0309600	0.8698869019E-11
0310500	0.8698869019E-11
0311400	0.8698869019E-11
0312300	0.8698869019E-11
0313200	0.8698869019E-11
0314100	0.8698869019E-11
0315000	0.8698869019E-11
0315900	0.8698869019E-11
0316800	0.8698869019E-11
0317700	0.8698869019E-11
0318600	0.8698869019E-11
0319500	0.8698869019E-11
0320400	0.8698869019E-11
0321300	0.8698869019E-11
0322200	0.8698869019E-11
0323100	0.8698869019E-11
0324000	0.8698869019E-11
0324900	0.8698869019E-11
0325800	0.8698869019E-11
0326700	0.8698869019E-11
0327600	0.8698869019E-11
0328500	0.8698869019E-11
0329400	0.8698869019E-11
0330300	0.8698869019E-11
0331200	0.8698869019E-11
0332100	0.8698869019E-11
0333000	0.8698869019E-11

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Project: \_\_\_\_\_ Task: \_\_\_\_\_ Prepared by: J. E. Floyd Date: 10/30/93  
Calc File No: \_\_\_\_\_ Reviewed by: W. J. Chappas Date: \_\_\_\_\_  
Title: Ar-41 Production Calculations for Annual Report and 10CFR20 Requirements

0333900	0.8698869019E-11
0334800	0.8698869019E-11
0335700	0.8698869019E-11
0336600	0.8698869019E-11
0337500	0.8698869019E-11
0338400	0.8698869019E-11
0339300	0.8698869019E-11
0340200	0.8698869019E-11
0341100	0.8698869019E-11
0342000	0.8698869019E-11
0342900	0.8698869019E-11
0343800	0.8698869019E-11
0344700	0.8698869019E-11
0345600	0.8698869019E-11
0346500	0.8698869019E-11
0347400	0.8698869019E-11
0348300	0.8698869019E-11
0349200	0.8698869019E-11
0350100	0.8698869019E-11
0351000	0.8698869019E-11
0351900	0.8698869019E-11
0352800	0.8698869019E-11
0353700	0.8698869019E-11
0354600	0.8698869019E-11
0355500	0.8698869019E-11
0356400	0.8698869019E-11
0357300	0.8698869019E-11
0358200	0.8698869019E-11
0359100	0.8698869019E-11
0360000	0.8698869019E-11
0360900	0.8698869019E-11
0361800	0.8698869019E-11
0362700	0.8698869019E-11
0363600	0.8698869018E-11
0364500	0.8698868918E-11
0365400	0.8698866043E-11
0366300	0.8698834343E-11
0367200	0.8698645961E-11
0368100	0.8697910189E-11
0369000	0.8695776277E-11
0369900	0.8690802033E-11
0370800	0.8680969885E-11
0371700	0.8663860519E-11
0372600	0.8636929173E-11
0373500	0.8597803632E-11
0374400	0.8544534133E-11
0375300	0.8475755572E-11
0376200	0.8390753647E-11
0377100	0.8289448756E-11
0378000	0.8172322084E-11
0378900	0.8040309559E-11
0379800	0.7894685126E-11
0380700	0.7736948470E-11
0381600	0.7568726137E-11
0382500	0.7391690121E-11
0383400	0.7207494591E-11
0384300	0.7017729434E-11
0385200	0.6823888276E-11
0386100	0.6627348334E-11
0387000	0.6429359524E-11
0387900	0.6231040553E-11
0388800	0.6033380072E-11
0389700	0.5837241363E-11



# MARYLAND UNIVERSITY TRAINING REACTOR

Sheet No 22 of 22

Project: \_\_\_\_\_ Task: \_\_\_\_\_ Prepared by: J. E. Floyd Date: 10/30/93

Calc File No: \_\_\_\_\_ Reviewed by: W. J. Chappas Date: \_\_\_\_\_

Title: Ar-41 Production Calculations for Annual Report and 10CFR20 Requirements

0390600	0.5643369274E-11
0391500	0.5452398711E-11
0392400	0.5264863641E-11
0393300	0.5081206474E-11
0394200	0.4901787279E-11
0395100	0.4726892648E-11
0396000	0.4556744077E-11
0396900	0.4391505762E-11
0397800	0.4231291772E-11

MAXIMUM AR-41 CONCENTRATION IS: 0.8698869019E-11 mCi/ml

TOTAL AR-41 PRODUCTION IS: 0.2408635586E+03 mCi

TOTAL AR-41 RELEASE: 0.1705623475E+01 mCi



ENCLOSURE 2:

Ar-41 Production Calculation for This Reporting Period

CORE POWER LEVEL IN KW

RUNTIME IN SECONDS

ARGON-41 FOR POWER= 250.00000 KW FOR 138456 SECONDS

CASE WILL BE RUN UNTIL TIME 0174600 SECONDS

NODE SPACING= 2.00 CM, TIME STEP= 4.00 S, OUTPUT INTERVAL=00900 S

TIME	ACTIVITY IN mCi/ml
0000900	-0.1070969988E-51
0001800	0.5162039140E-32
0002700	0.1867650207E-24
0003600	0.7298393504E-21
0004500	0.1133527619E-18
0005400	0.3519077431E-17
0006300	0.4307693597E-16
0007200	0.2920961679E-15
0008100	0.1327161142E-14
0009000	0.4534726880E-14
0009900	0.1255070334E-13
0010800	0.2958174648E-13
0011700	0.6149204934E-13
0012600	0.1156048686E-12
0013500	0.2002206799E-12
0014400	0.3238812076E-12
0015300	0.4944238875E-12
0016200	0.7178968866E-12
0017100	0.9974553735E-12
0018000	0.1332428969E-11
0018900	0.1717804008E-11
0019800	0.2144349318E-11
0020700	0.2599490629E-11
0021600	0.3068822342E-11
0022500	0.3537924044E-11
0023400	0.3994039746E-11
0024300	0.4427244412E-11
0025200	0.4830925919E-11
0026100	0.5201639490E-11
0027000	0.5538542944E-11
0027900	0.5842658081E-11
0028800	0.6116153837E-11
0029700	0.6361763149E-11
0030600	0.6582369770E-11
0031500	0.6780752161E-11
0032400	0.6959449287E-11
0033300	0.7120709432E-11
0034200	0.7266488072E-11
0035100	0.7398477059E-11
0036000	0.7518130600E-11
0036900	0.7626710530E-11
0037800	0.7725314848E-11
0038700	0.7814906703E-11
0039600	0.7896337292E-11
0040500	0.7970364117E-11
0041400	0.8037665389E-11
0042300	0.8098851363E-11
0043200	0.8154473330E-11
0044100	0.8205030838E-11
0045000	0.8250977572E-11
0045900	0.8292726239E-11
0046800	0.8330652694E-11
0047700	0.8365099491E-11
0048600	0.8396378975E-11
0049500	0.8424776014E-11
0050400	0.8450550440E-11
0051300	0.8473939239E-11
0052200	0.8495158533E-11
0053100	0.8514405380E-11
0054000	0.8531859415E-11
0054900	0.8547684346E-11
0055800	0.8562029324E-11
0056700	0.8575030198E-11
0057600	0.8586810660E-11
0058500	0.8597483302E-11
0059400	0.8607150576E-11
0060300	0.8615905682E-11
0061200	0.8623833372E-11
0062100	0.8631010696E-11

0063000	0.8637507681E-11
0063900	0.8643387948E-11
0064800	0.8648709289E-11
0065700	0.8653524177E-11
0066600	0.8657880250E-11
0067500	0.8661820742E-11
0068400	0.8665384879E-11
0069300	0.8668608244E-11
0070200	0.8671523106E-11
0071100	0.8674158724E-11
0072000	0.8676541617E-11
0072900	0.8678695821E-11
0073800	0.8680643115E-11
0074700	0.8682403226E-11
0075600	0.8683994024E-11
0076500	0.8685431689E-11
0077400	0.8686730873E-11
0078300	0.8687904837E-11
0079200	0.8688965587E-11
0080100	0.8689923984E-11
0081000	0.8690789859E-11
0081900	0.8691572103E-11
0082800	0.8692278761E-11
0083700	0.8692917109E-11
0084600	0.8693493727E-11
0085500	0.8694014564E-11
0086400	0.8694485001E-11
0087300	0.8694909900E-11
0088200	0.8695293659E-11
0089100	0.8695640251E-11
0090000	0.8695953268E-11
0090900	0.8696235957E-11
0091800	0.8696491251E-11
0092700	0.8696721801E-11
0093600	0.8696930002E-11
0094500	0.8697118017E-11
0095400	0.8697287801E-11
0096300	0.8697441122E-11
0097200	0.8697579573E-11
0098100	0.8697704596E-11
0099000	0.8697817493E-11
0099900	0.8697919440E-11
0100800	0.8698011498E-11
0101700	0.8698094626E-11
0102600	0.8698169691E-11
0103500	0.8698237475E-11
0104400	0.8698298684E-11
0105300	0.8698353956E-11
0106200	0.8698403867E-11
0107100	0.8698448937E-11
0108000	0.8698489636E-11
0108900	0.8698526389E-11
0109800	0.8698559577E-11
0110700	0.8698589547E-11
0111600	0.8698616612E-11
0112500	0.8698641053E-11
0113400	0.8698663124E-11
0114300	0.8698683056E-11
0115200	0.8698701056E-11
0116100	0.8698717312E-11
0117000	0.8698731993E-11
0117900	0.8698745251E-11
0118800	0.8698757225E-11
0119700	0.8698768039E-11
0120600	0.8698777806E-11
0121500	0.8698786627E-11
0122400	0.8698794593E-11
0123300	0.8698801789E-11
0124200	0.8698808287E-11
0125100	0.8698814157E-11
0126000	0.8698819459E-11
0126900	0.8698824248E-11
0127800	0.8698828573E-11
0128700	0.8698832480E-11
0129600	0.8698836009E-11

0130500  
0131400  
0132300  
0133200  
0134100  
0135000  
0135900  
0136800  
0137700  
0138600  
0139500  
0140400  
0141300  
0142200  
0143100  
0144000  
0144900  
0145800  
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0147600  
0148500  
0149400  
0150300  
0151200  
0152100  
0153000  
0153900  
0154800  
0155700  
0156600  
0157500  
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0159300  
0160200  
0161100  
0162000  
0162900  
0163800  
0164700  
0165600  
0166500  
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0168300  
0169200  
0170100  
0171000  
0171900  
0172800  
0173700  
0174600

0.8698839197E-11  
0.8698842076E-11  
0.8698844678E-11  
0.8698847027E-11  
0.8698849150E-11  
0.8698851067E-11  
0.8698852799E-11  
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0.8698855778E-11  
0.8698857055E-11  
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0.8698860193E-11  
0.8698861042E-11  
0.8698861625E-11  
0.8698857866E-11  
0.8698814828E-11  
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0.8631542416E-11  
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0.8534595811E-11  
0.8463252682E-11  
0.8375632144E-11  
0.8271750420E-11  
0.8152169087E-11  
0.8017886030E-11  
0.7870218592E-11  
0.7710692974E-11  
0.7540947991E-11  
0.7362656578E-11  
0.7177465334E-11  
0.6986950555E-11  
0.6792588328E-11  
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0.6397622681E-11  
0.6199346010E-11  
0.6001874214E-11  
0.5806051107E-11  
0.5612603379E-11  
0.5422149138E-11  
0.5235207084E-11  
0.5052205840E-11  
0.4873493134E-11  
0.4699344593E-11  
0.4529972039E-11

MAXIMUM AR-41 CONCENTRATION IS: 0.8698861625E-11 mCi/ml  
TOTAL AR-41 PRODUCTION IS: 0.9263612463E+00 mCi  
TOTAL AR-41 RELEASE: 0.6496577167E+00 mCi