# APPENDIX C - ORIGEN2 CALCULATIONS

ORIGEN2 is the latest version of the **O**ak **R**idge **I**sotope **GEN**eration and Depletion code [B-1] developed by Oak Ridge National Laboratory for calculating the burnup, decay and processing of radioactive materials. ORIGEN uses a matrix exponential method to solve a large system of coupled linear first-order differential equations with constant coefficients.

Presented below are the four ORIGEN2 input files used to generate the burnup and radionuclide inventories for the analysis. The inventories were calculated using the ORIGEN2 code to generate accident source terms, to provide an analytical basis for revalidation of the spent fuel shipment risk estimates originally documented in NUREG-0170. Four burnup configurations were calculated, two each for boiling water reactor (BWR) and pressurized water reactor (PWR) Light Water Reactor systems. The Latin Hypercube Sample (LHS) analysis method will be applied to derive distributions should increased granularity be required. A series of decay intervals of interest consisting of 0.5, 1, 2, 4, 8, and 16 year periods were selected, based upon "standard" reactor fuel uranium-235 isotope enrichments. Related ratios for uranium-238 and uranium-233, which arise as a by-product of the enrichment process, were calculated using derived empirical equations that are a function of reactor type. Due to the 150 maximum IRP+IRF+DEC input card limitation imposed by ORIGEN2, it was necessary to recalculate standardized burnup periods by extending the irradiation time. The remaining nuclide isotopic compositions were directly excerpted from a set of key tables specifically developed to model uranium and plutonium cycle reactors using the ORIGEN computer code [B-2].

Construction of the ORIGEN2 input files generally proceeded in a two-step process. Initially, unit quantities of fuel and assembly materials are subjected to an appropriate reactor irradiation profile for a specific burnup and subsequent decay period for the desired sequence of time periods. Once the unit quantities have completed the burnup and decay cycles, the materials are then mathematically apportioned and integrated to model the reactor assembly of interest. The General Electric BWR/6 8×8 fuel assembly was used to model the BWR systems, and the Westinghouse 17×17 array was selected to represent the PWR designs. The two Light Water Reactor systems constitute the predominant designs currently operating in the United States, for which the assembly key characteristics [B-3] are summarized below.

**Characteristics of BWR and PWR Fuel Assemblies**

| Light Water Reactor (design) | BWR | PWR |
|---|---|---|
| Assembly Geometry (array) | 8×8 | 17×17 |
| Overall Assembly Length (m) | 4.470 | 4.059 |
| Cross Section (cm) | 13.9×13.9 | 21.4×21.4 |
| Fuel Rod Length (m) | 4.064 | 3.851 |
| Active Fuel Height (m) | 3.759 | 3.658 |
| Fuel Rod Outside Diameter (cm) | 1.252 | 0.950 |
| Fuel Rods Per Assembly (number) | 63 | 264 |
| Uranium Per Assembly (kg) | 183.3 | 461.4 |
| Uranium Oxide Per Assembly (kg) | 208.0 | 523.4 |
| Assembly Total Weight (kg) | 319.9 | 657.9 |

## References

[B-1] A.G. Croff, A User's Manual for the ORIGEN2 Computer Code, ORNL/TM-7175, Oak Ridge National Laboratory, Oak Ridge TN, July 1980.

[B-2] A.G. Croff, M.A. Bjerke, G.W. Morrison and L.M. Petrie, Revised Uranium-Plutonium Cycle PWR and BWR Models for the ORIGEN Computer Code, ORNL/TM-6051, Oak Ridge National Laboratory, Oak Ridge TN, September 1978.

[B-3] J.W. Roddy, H.C. Claiborne, R.C. Ashline, P.J. Johnson and B.T. Rhyne, Physical and Decay Characteristics of Commercial LWR Spent Fuel, ORNL/TM-9591/V1&R1, Oak Ridge National Laboratory, Oak Ridge TN, January 1986

## ORIGEN2 Input Files

### bwr267.inp

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-1
-1
-1
RDA * 30,044 MWD/MT BURNUP OF GE BWR/6 2.67% UO2 FUEL & ASSEMBLY
RDA ** CROSS SECTION LIBRARY = BWRUS, 4 CYCLE
RDA *** JD SMITH, SANDIA NATIONAL LABORATORIES
RDA **** (505) 844-0531, FAX 844-2057
RDA     -1 = FRESH BWR FUEL WITH IMPURITIES (1 MT = 1000 KG)
RDA     -2 = FRESH ZIRCALOY-4 COMPOSITION (1 KG)
RDA     -3 = FRESH ZIRCALOY-2 COMPOSITION (1 KG)
RDA     -4 = FRESH SS 304 COMPOSITION (1 KG)
RDA     -5 = FRESH SS 302 COMPOSITION (1 KG)
RDA     -6 = FRESH INCONEL X-750 COMPOSITION (1 KG)
RDA     WARNING:  VECTORS ARE CHANGED WITH RESPECT TO CONTENT
RDA               CHANGES ARE NOTED ON RDA CARDS
CUT     5 1.0E-10 7 1.0E-10 9 1.0E-10 -1
LIP     0 0 0
RDA        DECAY LIB    XSECT LIB                      VAR. XSECT
LIB     0    1 2 3     651 652 653    9   50   0   1       40
RDA      PHOTON LIB
PHO     101 102 103  10
TIT  INITIAL COMPOSITION OF FUEL AND STRUCTURAL MATERIAL UNIT QUANTITIES
RDA     READ FUEL COMPOSITION INCLUDING IMPURITIES (1000 KG)
INP     -1   1  -1  -1  1  1
RDA     READ ZIRCALOY-4 COMPOSITION (1.0 KG)
INP     -2   1  -1  -1  1  1
RDA     READ ZIRCALOY-2 COMPOSITION (1.0 KG)
INP     -3   1  -1  -1  1  1
RDA     READ SS304 COMPOSITION (1.0 KG)
INP     -4   1  -1  -1  1  1
RDA     READ SS302 COMPOSITION (1.0 KG)
INP     -5   1  -1  -1  1  1
RDA     READ INCONEL X-750 COMPOSITION (1.0 KG)
INP     -6   1  -1  -1  1  1
TIT     IRRADIATION OF ONE METRIC TON OF BWRU FUEL
MOV     -1   1   0   1.0
PCH      1   1   1
HED      1                                CHARGE
BUP
IRP      96.66   25.90   1   2   4  2   BURNUP= 2,504 MWD/MTIHM
IRP     193.33   25.90   2   3   4  0   BURNUP= 5,007 MWD/MTIHM
IRP        290   25.90   3   4   4  0   BURNUP= 7,511 MWD/MTIHM
DEC        396           4   5   4  0    DECAY FOR 106.0 DAYS
IRP     492.66   25.90   5   6   4  0   BURNUP=10,015 MWD/MTIHM
IRP     589.33   25.90   6   7   4  0   BURNUP=12,518 MWD/MTIHM
IRP        686   25.90   7   8   4  0   BURNUP=15,022 MWD/MTIHM
DEC        792           8   9   4  0    DECAY FOR 106.0 DAYS
IRP     888.66   25.90   9  10   4  0   BURNUP=17,526 MWD/MTIHM
IRP     985.33   25.90  10  11   4  0   BURNUP=20,029 MWD/MTIHM
IRP       1082   25.90  11  12   4  0   BURNUP=22,533 MWD/MTIHM
DEC       1188          12   1   4  0    DECAY FOR 106.0 DAYS
IRP    1284.66   25.90   1   2   4  0   BURNUP=25,037 MWD/MTIHM
IRP    1381.33   25.90   2   3   4  0   BURNUP=27,540 MWD/MTIHM
IRP       1478   25.90   3   4   4  0   BURNUP=30,044 MWD/MTIHM
BUP
RDA     -10 = IRRADIATED U FUEL AT DISCHARGE
MOV       4   -10     0     1.0
PCH     -10   -10   -10
RDA     IRRADIATION OF ZIRCALOY-2 CLADDING AT 1.000 FLUX
TIT     IRRADIATION OF ZIRCALOY-2 CLADDING AT 1.000 FLUX
MOV      -3     1     0   279.50       ZIRCALOY-2 CLAD
HED       1                                CHARGE
IRF      96.66   -1.0    1   2   4  2   BURNUP= 2,504 MWD/MTIHM
IRF     193.33   -1.0    2   3   4  0   BURNUP= 5,007 MWD/MTIHM
IRF        290   -1.0    3   4   4  0   BURNUP= 7,511 MWD/MTIHM
DEC        396           4   5   4  0    DECAY FOR 106.0 DAYS
IRF     492.66   -1.0    5   6   4  0   BURNUP=10,015 MWD/MTIHM
IRF     589.33   -1.0    6   7   4  0   BURNUP=12,518 MWD/MTIHM
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 69      IRF        686   -1.0    7   8   4  0   BURNUP=15,022 MWD/MTIHM
 70      DEC        792           8   9   4  0    DECAY FOR 106.0 DAYS
 71      IRF     888.66   -1.0    9  10   4  0   BURNUP=17,526 MWD/MTIHM
 72      IRF     985.33   -1.0   10  11   4  0   BURNUP=20,029 MWD/MTIHM
 73      IRF       1082   -1.0   11  12   4  0   BURNUP=22,533 MWD/MTIHM
 74      DEC       1188          12   1   4  0    DECAY FOR 106.0 DAYS
 75      IRF    1284.66   -1.0    1   2   4  0   BURNUP=25,037 MWD/MTIHM
 76      IRF    1381.33   -1.0    2   3   4  0   BURNUP=27,540 MWD/MTIHM
 77      IRF       1478   -1.0    3   4   4  0   BURNUP=30,044 MWD/MTIHM
 78      RDA      -9 = IRRADIATED ZIRCALOY-2 CLADDING AT DISCHARGE
 79      MOV       4     -9      0      1.0
 80      RDA      IRRADIATION OF ZIRCALOY CLADDING AT 0.500 FLUX
 81      TIT      IRRADIATION OF ZIRCALOY CLADDING AT 0.500 FLUX
 82      MOV      -3      1      0     25.4     ZIRCALOY-2 CLAD
 83      MOV      -3      2      0    304.90    TOTAL ZIRC-2 CLAD
 84      PCH       2      2      2
 85      HED       1                              CHARGE
 86      IRF      96.66   -0.5    1   2   4  2   BURNUP= 2,504 MWD/MTIHM
 87      IRF     193.33   -0.5    2   3   4  0   BURNUP= 5,007 MWD/MTIHM
 88      IRF        290   -0.5    3   4   4  0   BURNUP= 7,511 MWD/MTIHM
 89      DEC        396           4   5   4  0    DECAY FOR 106.0 DAYS
 90      IRF     492.66   -0.5    5   6   4  0   BURNUP=10,015 MWD/MTIHM
 91      IRF     589.33   -0.5    6   7   4  0   BURNUP=12,518 MWD/MTIHM
 92      IRF        686   -0.5    7   8   4  0   BURNUP=15,022 MWD/MTIHM
 93      DEC        792           8   9   4  0    DECAY FOR 106.0 DAYS
 94      IRF     888.66   -0.5    9  10   4  0   BURNUP=17,526 MWD/MTIHM
 95      IRF     985.33   -0.5   10  11   4  0   BURNUP=20,029 MWD/MTIHM
 96      IRF       1082   -0.5   11  12   4  0   BURNUP=22,533 MWD/MTIHM
 97      DEC       1188          12   1   4  0    DECAY FOR 106.0 DAYS
 98      IRF    1284.66   -0.5    1   2   4  0   BURNUP=25,037 MWD/MTIHM
 99      IRF    1381.33   -0.5    2   3   4  0   BURNUP=27,540 MWD/MTIHM
100      IRF       1478   -0.5    3   4   4  0   BURNUP=30,044 MWD/MTIHM
101      RDA      -9 = IRRADIATED ZIRCALOY CLADDING AT DISCHARGE
102      ADD       4     -9      0      1.0    TOTAL IRRAD ZIRC-2 CLAD
103      PCH      -9     -9     -9
104      RDA       IRRADIATION OF ZIRCALOY-4 CHANNEL AT 1.000 FLUX
105      TIT       IRRADIATION OF ZIRCALOY-4 CHANNEL AT 1.000 FLUX
106      MOV      -2      1      0    227.50     ZIRCALOY-4 CHANNEL
107      HED       1                              CHARGE
108      IRF      96.66   -1.0    1   2   4  2   BURNUP= 2,504 MWD/MTIHM
109      IRF     193.33   -1.0    2   3   4  0   BURNUP= 5,007 MWD/MTIHM
110      IRF        290   -1.0    3   4   4  0   BURNUP= 7,511 MWD/MTIHM
111      DEC        396           4   5   4  0    DECAY FOR 106.0 DAYS
112      IRF     492.66   -1.0    5   6   4  0   BURNUP=10,015 MWD/MTIHM
113      IRF     589.33   -1.0    6   7   4  0   BURNUP=12,518 MWD/MTIHM
114      IRF        686   -1.0    7   8   4  0   BURNUP=15,022 MWD/MTIHM
115      DEC        792           8   9   4  0    DECAY FOR 106.0 DAYS
116      IRF     888.66   -1.0    9  10   4  0   BURNUP=17,526 MWD/MTIHM
117      IRF     985.33   -1.0   10  11   4  0   BURNUP=20,029 MWD/MTIHM
118      IRF       1082   -1.0   11  12   4  0   BURNUP=22,533 MWD/MTIHM
119      DEC       1188          12   1   4  0    DECAY FOR 106.0 DAYS
120      IRF    1284.66   -1.0    1   2   4  0   BURNUP=25,037 MWD/MTIHM
121      IRF    1381.33   -1.0    2   3   4  0   BURNUP=27,540 MWD/MTIHM
122      IRF       1478   -1.0    3   4   4  0   BURNUP=30,044 MWD/MTIHM
123      RDA      -8 = IRRADIATED ZIRCALOY CHANNEL AT DISCHARGE
124      MOV       4     -8     0      1.0
125      RDA       IRRADIATION OF ZIRCALOY-4 CHANNEL AT 0.500 FLUX
126      TIT       IRRADIATION OF ZIRCALOY-4 CHANNEL AT 0.500 FLUX
127      MOV      -2      1    0     20.70     ZIRCALOY-4 CHANNEL
128      MOV      -2      2    0    248.20     TOTAL ZIRCALOY-4 CHANNEL
129      PCH       2      2    2
130      HED       1                              CHARGE
131      IRF      96.66   -0.5    1   2   4  2   BURNUP= 2,504 MWD/MTIHM
132      IRF     193.33   -0.5    2   3   4  0   BURNUP= 5,007 MWD/MTIHM
133      IRF        290   -0.5    3   4   4  0   BURNUP= 7,511 MWD/MTIHM
134      DEC        396           4   5   4  0    DECAY FOR 106.0 DAYS
135      IRF     492.66   -0.5    5   6   4  0   BURNUP=10,015 MWD/MTIHM
136      IRF     589.33   -0.5    6   7   4  0   BURNUP=12,518 MWD/MTIHM
137      IRF        686   -0.5    7   8   4  0   BURNUP=15,022 MWD/MTIHM
138      DEC        792           8   9   4  0    DECAY FOR 106.0 DAYS
139      IRF     888.66   -0.5    9  10   4  0   BURNUP=17,526 MWD/MTIHM
140      IRF     985.33   -0.5   10  11   4  0   BURNUP=20,029 MWD/MTIHM
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141      IRF       1082   -0.5   11  12   4  0   BURNUP=22,533 MWD/MTIHM
142      DEC       1188          12   1   4  0    DECAY FOR 106.0 DAYS
143      IRF    1284.66   -0.5    1   2   4  0   BURNUP=25,037 MWD/MTIHM
144      IRF    1381.33   -0.5    2   3   4  0   BURNUP=27,540 MWD/MTIHM
145      IRF       1478   -0.5    3   4   4  0   BURNUP=30,044 MWD/MTIHM
146      RDA      -8 = IRRADIATED ZIRCALOY CHANNEL AT DISCHARGE
147      ADD       4     -8      0      1.0
148      PCH      -8     -8     -8
149      RDA    IRRADIATION OF ZIRCALOY GRID SPACERS AND INCONEL SPRINGS
150      TIT    IRRADIATION OF ZIRCALOY GRID SPACERS AND INCONEL SPRINGS
151      MOV      -2      1      0     10.60     ZIRCALOY GRIDS
152      ADD      -6      1      0      1.80     INCONEL SPRINGS
153      PCH       1      1      1
154      HED       1                              CHARGE
155      IRF      96.66   -1.0    1   2   4  2   BURNUP= 2,504 MWD/MTIHM
156      IRF     193.33   -1.0    2   3   4  0   BURNUP= 5,007 MWD/MTIHM
157      IRF        290   -1.0    3   4   4  0   BURNUP= 7,511 MWD/MTIHM
158      DEC        396           4   5   4  0    DECAY FOR 106.0 DAYS
159      IRF     492.66   -1.0    5   6   4  0   BURNUP=10,015 MWD/MTIHM
160      IRF     589.33   -1.0    6   7   4  0   BURNUP=12,518 MWD/MTIHM
161      IRF        686   -1.0    7   8   4  0   BURNUP=15,022 MWD/MTIHM
162      DEC        792           8   9   4  0    DECAY FOR 106.0 DAYS
163      IRF     888.66   -1.0    9  10   4  0   BURNUP=17,526 MWD/MTIHM
164      IRF     985.33   -1.0   10  11   4  0   BURNUP=20,029 MWD/MTIHM
165      IRF       1082   -1.0   11  12   4  0   BURNUP=22,533 MWD/MTIHM
166      DEC       1188          12   1   4  0    DECAY FOR 106.0 DAYS
167      IRF    1284.66   -1.0    1   2   4  0   BURNUP=25,037 MWD/MTIHM
168      IRF    1381.33   -1.0    2   3   4  0   BURNUP=27,540 MWD/MTIHM
169      IRF       1478   -1.0    3   4   4  0   BURNUP=30,044 MWD/MTIHM
170      RDA      -7 = IRRADIATED ZIRCALOY GRID SPACERS
171      RDA           AND INCONCEL SPRINGS AT DISCHARGE
172      MOV       4     -7     0     1.0
173      PCH      -7     -7    -7
174      RDA  IRRAD. OF SS 304 END PIECES & INCONEL SPRINGS AT 0.130 FLUX
175      TIT  IRRAD. OF SS 304 END PIECES & INCONEL SPRINGS AT 0.130 FLUX
176      MOV      -4     1     0    37.00      SS 304 IN END PIECES
177      ADD      -6     1     0     2.10  INCONEL X-750 EXPANSION SPRINGS
178      PCH       1     1     1
179      HED       1                              CHARGE
180      IRF      96.66   -0.13   1   2   4  2   BURNUP= 2,504 MWD/MTIHM
181      IRF     193.33   -0.13   2   3   4  0   BURNUP= 5,007 MWD/MTIHM
182      IRF        290   -0.13   3   4   4  0   BURNUP= 7,511 MWD/MTIHM
183      DEC        396           4   5   4  0    DECAY FOR 106.0 DAYS
184      IRF     492.66   -0.13   5   6   4  0   BURNUP=10,015 MWD/MTIHM
185      IRF     589.33   -0.13   6   7   4  0   BURNUP=12,518 MWD/MTIHM
186      IRF        686   -0.13   7   8   4  0   BURNUP=15,022 MWD/MTIHM
187      DEC        792           8   9   4  0    DECAY FOR 106.0 DAYS
188      IRF     888.66   -0.13   9  10   4  0   BURNUP=17,526 MWD/MTIHM
189      IRF     985.33   -0.13  10  11   4  0   BURNUP=20,029 MWD/MTIHM
190      IRF       1082   -0.13  11  12   4  0   BURNUP=22,533 MWD/MTIHM
191      DEC       1188          12   1   4  0    DECAY FOR 106.0 DAYS
192      IRF    1284.66   -0.13   1   2   4  0   BURNUP=25,037 MWD/MTIHM
193      IRF    1381.33   -0.13   2   3   4  0   BURNUP=27,540 MWD/MTIHM
194      IRF       1478   -0.13   3   4   4  0   BURNUP=30,044 MWD/MTIHM
195      RDA      -6 = IRRADIATED SS 304 END PIECES & INCONEL SPRINGS @ DISCH.
196      MOV       4    -6    0    1.0
197      PCH      -6    -6    -6
198      RDA      IRRADIATION OF SS 302 IN PLENUM SPRINGS AT 0.500 FLUX
199      TIT      IRRADIATION OF SS 302 IN PLENUM SPRINGS AT 0.500 FLUX
200      MOV      -5     1     0     6.00       SS302
201      PCH       1     1     1
202      HED       1                              CHARGE
203      IRF      96.66   -0.5    1   2   4  2   BURNUP= 2,504 MWD/MTIHM
204      IRF     193.33   -0.5    2   3   4  0   BURNUP= 5,007 MWD/MTIHM
205      IRF        290   -0.5    3   4   4  0   BURNUP= 7,511 MWD/MTIHM
206      DEC        396           4   5   4  0    DECAY FOR 106.0 DAYS
207      IRF     492.66   -0.5    5   6   4  0   BURNUP=10,015 MWD/MTIHM
208      IRF     589.33   -0.5    6   7   4  0   BURNUP=12,518 MWD/MTIHM
209      IRF        686   -0.5    7   8   4  0   BURNUP=15,022 MWD/MTIHM
210      DEC        792           8   9   4  0    DECAY FOR 106.0 DAYS
211      IRF     888.66   -0.5    9  10   4  0   BURNUP=17,526 MWD/MTIHM
212      IRF     985.33   -0.5   10  11   4  0   BURNUP=20,029 MWD/MTIHM
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213      IRF       1082   -0.5   11  12   4  0   BURNUP=22,533 MWD/MTIHM
214      DEC       1188          12   1   4  0    DECAY FOR 106.0 DAYS
215      IRF    1284.66   -0.5    1   2   4  0   BURNUP=25,037 MWD/MTIHM
216      IRF    1381.33   -0.5    2   3   4  0   BURNUP=27,540 MWD/MTIHM
217      IRF       1478   -0.5    3   4   4  0   BURNUP=30,044 MWD/MTIHM
218      RDA      -5 = IRRADIATED SS 302 IN PLENUM SPRINGS AT DISCHARGE
219      MOV      4    -5   0   1.0
220      PCH     -5    -5   -5
221      RDA     ***** OUTPUT MODULE *****
222      TIT   ORIGEN2 V2.1 - BWR FUEL ONLY - STANDARD BURNUP (BWRUS)
223      BAS      1 MTIHM 2.67% UO2;BURNUP=30,044 MWD/MTIHM, 4 CYCLE
224      HED    -10     FUEL DIS
225      HED     -1     FUEL CHG
226      MOV     -1    1   0   1.0
227      MOV    -10    2   0   1.0
228      RDA     ***** DECAY MODULE *****
229      DEC     0.5   2   3   5   2
230      DEC     1.0   3   4   5   0
231      DEC     3.0   4   5   5   0
232      DEC     5.0   5   6   5   0
233      DEC    10.0   6   7   5   0
234      DEC    30.0   7   8   5   0
235      OPTL      4*8  7  8  7  8  7  8  8*8  5*7  8
236      OPTA      4*8  7  8  7  8  7  8  8*8  5*7  8
237      OPTF      4*8  7  8  7  8  7  8  8*8  5*7  8
238      OUT      8    1     -1    0
239      RDA     ***** OUTPUT MODULE *****
240      TIT ORIGEN2 V2.1 - BWR FUEL & ASSEMBLY - STANDARD BURNUP (BWRUS)
241      BAS  1 MTIHM 2.67% UO2 FUEL ASSY;BURNUP=30,044 MWD/MTIHM, 4 CYCLE
242      OPTL      6*8  7  8  7  8  14*8
243      OPTA      6*8  7  8  7  8  14*8
244      OPTF      6*8  7  8  7  8  14*8
245      MOV     -10    1    0   0.1833
246      ADD      -9    1    0   0.1833
247      ADD      -8    1    0   0.1833
248      ADD      -7    1    0   0.1833
249      ADD      -6    1    0   0.1833
250      ADD      -5    1    0   0.1833
251      HED       1  ASSY DIS
252      RDA     ***** DECAY MODULE *****
253      DEC     0.5   1   2   5   2
254      DEC     1.0   2   3   5   0
255      DEC     3.0   3   4   5   0
256      DEC     5.0   4   5   5   0
257      DEC    10.0   5   6   5   0
258      DEC    30.0   6   7   5   0
259      OUT       7   1  -1   0
260      END
261    2 922340 240.    922350 26700. 922380 973060. 0       0.0        FUEL 2.67%
262    4 030000 1.0     050000 1.0    060000 89.4    070000 25.0    FUEL IMPU
263    4 080000 134454. 090000 10.7   110000 15.0    120000 2.0     FUEL IMPU
264    4 130000 16.7    140000 12.1   150000 35.0    170000 5.3     FUEL IMPU
265    4 200000 2.0     220000 1.0    230000 3.0     240000 4.0     FUEL IMPU
266    4 250000 1.7     260000 18.0   270000 1.0     280000 24.0    FUEL IMPU
267    4 290000 1.0     300000 40.3   420000 10.0    470000 0.1     FUEL IMPU
268    4 480000 25.0    490000 2.0    500000 4.0     640000 1573.   FUEL IMPU
269    4 740000 2.0     820000 1.0    830000 0.4     0      0.0     FUEL IMPU
270    0
271    4 400000 979.11  500000 16.0   260000 2.25    240000 1.25    ZIRC-4
272    4 280000 0.02    130000 0.024  050000 0.00033 480000 0.00025 ZIRC-4
273    4 060000 0.120   270000 0.010  290000 0.020   720000 0.078   ZIRC-4
274    4 010000 0.013   250000 0.020  070000 0.080   080000 0.950   ZIRC-4
275    4 160000 0.035   220000 0.020  740000 0.020   230000 0.020   ZIRC-4
276    5 920000 0.0002  0      0.0                                  ZIRC-4
277    0
278    4 400000 979.63  500000 16.0   260000 1.5     240000 1.00    ZIRC-2
279    4 280000 0.5     130000 0.024  050000 0.00033 480000 0.00025 ZIRC-2
280    4 060000 0.120   270000 0.010  290000 0.020   720000 0.078   ZIRC-2
281    4 010000 0.013   250000 0.020  070000 0.080   080000 0.950   ZIRC-2
282    4 160000 0.035   220000 0.020  740000 0.020   230000 0.020   ZIRC-2
283    5 920000 0.0002  0      0.0                                  ZIRC-2
284    0
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285    4 260000 688.44  240000 190.0  280000 89.2    250000 20.0    SS-304
286    4 060000 0.8     150000 0.45   160000 0.3     140000 10.0    SS-304
287    4 070000 1.3     270000 0.8    0      0.0                    SS-304
288    0
289    4 260000 697.74  240000 180.0  280000 89.2    250000 20.0    SS-302
290    4 060000 1.5     150000 0.45   160000 0.3     140000 10.0    SS-302
291    4 070000 1.3     270000 0.8    0      0.0                    SS-302
292    0
293    4 260000 67.846  240000 149.66 280000 721.861 130000 7.982   INC-X-750
294    4 060000 0.399   270000 6.485  290000 0.499   250000 6.984   INC-X-750
295    4 070000 1.3     410000 8.98   160000 0.07    140000 2.993   INC-X-750
296    4 220000 24.943  0      0.0                                  INC-X-750
297    0
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## bwr331.inp

```
  1      -1
  2      -1
  3      -1
  4      RDA  * GENERAL ELECTRIC BWR/6 8x8 ASSEMBLY
  5      RDA  ** 3.31% UO2 FUEL & ASSEMBLY HARDWARE, 50,008 MWD/MT BURNUP
  6      RDA  *** CROSS SECTION LIBRARY = BWRUE, 4 CYCLE
  7      RDA  **** JD SMITH, SANDIA NATIONAL LABORATORIES
  8      RDA  ***** TELEPHONE: (505) 844-0531, FACSIMILE: 844-2057
  9      RDA     -1 = FRESH BWR FUEL WITH IMPURITIES (1 MT = 1000 KG)
 10      RDA     -2 = FRESH ZIRCALOY-4 COMPOSITION (1 KG)
 11      RDA     -3 = FRESH ZIRCALOY-2 COMPOSITION (1 KG)
 12      RDA     -4 = FRESH SS 304 COMPOSITION (1 KG)
 13      RDA     -5 = FRESH SS 302 COMPOSITION (1 KG)
 14      RDA     -6 = FRESH INCONEL X-750 COMPOSITION (1 KG)
 15      RDA  WARNING: VECTORS CHANGE CONTENT AS NOTED ON RDA CARDS
 16      CUT     5 1.0E-10 7 1.0E-10 9 1.0E-10 -1
 17      LIP     0 0 0
 18      RDA        DECAY LIB    XSECT LIB                      VAR. XSECT
 19      LIB     0    1 2 3     657 658 659    9   50   0   1       42
 20      RDA      PHOTON LIB
 21      PHO     101 102 103  10
 22      TIT  INITIAL UNIT QUANTITY FUEL & STRUCTURAL MATERIAL COMPOSITIONS
 23      RDA   READ FUEL COMPOSITION INCLUDING IMPURITIES (1000 KG)
 24      INP     -1   1  -1  -1  1  1
 25      RDA   READ ZIRCALOY-4 COMPOSITION (1.0 KG)
 26      INP     -2   1  -1  -1  1  1
 27      RDA   READ ZIRCALOY-2 COMPOSITION (1.0 KG)
 28      INP     -3   1  -1  -1  1  1
 29      RDA   READ SS304 COMPOSITION (1.0 KG)
 30      INP     -4   1  -1  -1  1  1
 31      RDA   READ SS302 COMPOSITION (1.0 KG)
 32      INP     -5   1  -1  -1  1  1
 33      RDA   READ INCONEL X-750 COMPOSITION (1.0 KG)
 34      INP     -6   1  -1  -1  1  1
 35      TIT  IRRADIATION (EXTENDED) OF ONE METRIC TON OF BWR UO2 FUEL
 36      MOV     -1   1   0   1.0
 37      PCH      1   1   1
 38      HED      1                                          CHARGE
 39      BUP
 40      IRP     160.9   25.9   1   2   4  2   BURNUP= 4,167 MWD/MTIHM
 41      IRP     321.8   25.9   2   3   4  0   BURNUP= 8,335 MWD/MTIHM
 42      IRP     482.7   25.9   3   4   4  0   BURNUP=12,502 MWD/MTIHM
 43      DEC     588.7          4   5   4  0    DECAY FOR 106.0 DAYS
 44      IRP     749.6   25.9   5   6   4  0   BURNUP=16,669 MWD/MTIHM
 45      IRP     910.5   25.9   6   7   4  0   BURNUP=20,837 MWD/MTIHM
 46      IRP    1071.4   25.9   7   8   4  0   BURNUP=25,004 MWD/MTIHM
 47      DEC    1177.4          8   9   4  0    DECAY FOR 106.0 DAYS
 48      IRP    1338.3   25.9   9  10   4  0   BURNUP=29,171 MWD/MTIHM
 49      IRP    1499.2   25.9  10  11   4  0   BURNUP=33,338 MWD/MTIHM
 50      IRP    1660.1   25.9  11  12   4  0   BURNUP=37,506 MWD/MTIHM
 51      DEC    1766.1         12   1   4  0    DECAY FOR 106.0 DAYS
 52      IRP    1927     25.9   1   2   4  0   BURNUP=41,673 MWD/MTIHM
 53      IRP    2087.9   25.9   2   3   4  0   BURNUP=45,840 MWD/MTIHM
 54      IRP    2248.8   25.9   3   4   4  0   BURNUP=50,008 MWD/MTIHM
 55      BUP
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 56      RDA     -10 = IRRADIATED 1000 KG URANIUM DIOXIDE FUEL AT DISCHARGE
 57      MOV       4  -10     0     1.0
 58      PCH     -10  -10   -10
 59      RDA  IRRADIATION OF ZIRCALOY-2 CLADDING AT 1.000 FLUX
 60      TIT  IRRADIATION OF ZIRCALOY-2 CLADDING AT 1.000 FLUX (FUEL ZONE)
 61      MOV      -3     1     0   279.50       ZIRCALOY-2 CLADDING
 62      HED       1                                          CHARGE
 63      IRF     160.9   -1.0   1   2   4  2   BURNUP= 4,167 MWD/MTIHM
 64      IRF     321.8   -1.0   2   3   4  0   BURNUP= 8,335 MWD/MTIHM
 65      IRF     482.7   -1.0   3   4   4  0   BURNUP=12,502 MWD/MTIHM
 66      DEC     588.7          4   5   4  0    DECAY FOR 106.0 DAYS
 67      IRF     749.6   -1.0   5   6   4  0   BURNUP=16,669 MWD/MTIHM
 68      IRF     910.5   -1.0   6   7   4  0   BURNUP=20,837 MWD/MTIHM
 69      IRF    1071.4   -1.0   7   8   4  0   BURNUP=25,004 MWD/MTIHM
 70      DEC    1177.4          8   9   4  0    DECAY FOR 106.0 DAYS
 71      IRF    1338.3   -1.0   9  10   4  0   BURNUP=29,171 MWD/MTIHM
 72      IRF    1499.2   -1.0  10  11   4  0   BURNUP=33,338 MWD/MTIHM
 73      IRF    1660.1   -1.0  11  12   4  0   BURNUP=37,506 MWD/MTIHM
 74      DEC    1766.1         12   1   4  0    DECAY FOR 106.0 DAYS
 75      IRF    1927     -1.0   1   2   4  0   BURNUP=41,673 MWD/MTIHM
 76      IRF    2087.9   -1.0   2   3   4  0   BURNUP=45,840 MWD/MTIHM
 77      IRF    2248.8   -1.0   3   5   4  0   BURNUP=50,008 MWD/MTIHM
 78      RDA      -9 = IRRADIATED ZIRCALOY-2 CLADDING AT DISCHARGE
 79      MOV       5     -9      0      1.0
 80      RDA  IRRADIATION OF ZIRCALOY-2 CLADDING AT 0.500 FLUX
 81      TIT  IRRAD OF ZIRCALOY-2 CLAD AT 0.500 FLUX (FUEL-GAS PLENUM ZONE)
 82      MOV      -3      1      0     25.4     ZIRCALOY-2 CLADDING
 83      MOV      -3      2      0    304.90    TOTAL ZIRC-2 CLAD (UNIRRAD)
 84      PCH       2      2      2
 85      HED       1                                          CHARGE
 86      IRF     160.9   -0.5   1   2   4  2   BURNUP= 4,167 MWD/MTIHM
 87      IRF     321.8   -0.5   2   3   4  0   BURNUP= 8,335 MWD/MTIHM
 88      IRF     482.7   -0.5   3   4   4  0   BURNUP=12,502 MWD/MTIHM
 89      DEC     588.7          4   5   4  0    DECAY FOR 106.0 DAYS
 90      IRF     749.6   -0.5   5   6   4  0   BURNUP=16,669 MWD/MTIHM
 91      IRF     910.5   -0.5   6   7   4  0   BURNUP=20,837 MWD/MTIHM
 92      IRF    1071.4   -0.5   7   8   4  0   BURNUP=25,004 MWD/MTIHM
 93      DEC    1177.4          8   9   4  0    DECAY FOR 106.0 DAYS
 94      IRF    1338.3   -0.5   9  10   4  0   BURNUP=29,171 MWD/MTIHM
 95      IRF    1499.2   -0.5  10  11   4  0   BURNUP=33,338 MWD/MTIHM
 96      IRF    1660.1   -0.5  11  12   4  0   BURNUP=37,506 MWD/MTIHM
 97      DEC    1766.1         12   1   4  0    DECAY FOR 106.0 DAYS
 98      IRF    1927     -0.5   1   2   4  0   BURNUP=41,673 MWD/MTIHM
 99      IRF    2087.9   -0.5   2   3   4  0   BURNUP=45,840 MWD/MTIHM
100      IRF    2248.8   -0.5   3   6   4  0   BURNUP=50,008 MWD/MTIHM
101      RDA      -9 = IRRADIATED ZIRCALOY-2 CLADDING AT DISCHARGE
102      ADD       6     -9      0      1.0    TOTAL IRRAD ZIRC-2 CLAD
103      PCH      -9     -9     -9
104      RDA  IRRADIATION OF ZIRCALOY-4 CHANNEL AT 1.000 FLUX
105      TIT  IRRADIATION OF ZIRCALOY-4 CHANNEL AT 1.000 FLUX (FUEL ZONE)
106      MOV      -2      1      0    227.50     ZIRCALOY-4 CHANNEL
107      HED       1                                          CHARGE
108      IRF     160.9   -1.0   1   2   4  2   BURNUP= 4,167 MWD/MTIHM
109      IRF     321.8   -1.0   2   3   4  0   BURNUP= 8,335 MWD/MTIHM
110      IRF     482.7   -1.0   3   4   4  0   BURNUP=12,502 MWD/MTIHM
111      DEC     588.7          4   5   4  0    DECAY FOR 106.0 DAYS
112      IRF     749.6   -1.0   5   6   4  0   BURNUP=16,669 MWD/MTIHM
113      IRF     910.5   -1.0   6   7   4  0   BURNUP=20,837 MWD/MTIHM
114      IRF    1071.4   -1.0   7   8   4  0   BURNUP=25,004 MWD/MTIHM
115      DEC    1177.4          8   9   4  0    DECAY FOR 106.0 DAYS
116      IRF    1338.3   -1.0   9  10   4  0   BURNUP=29,171 MWD/MTIHM
117      IRF    1499.2   -1.0  10  11   4  0   BURNUP=33,338 MWD/MTIHM
118      IRF    1660.1   -1.0  11  12   4  0   BURNUP=37,506 MWD/MTIHM
119      DEC    1766.1         12   1   4  0    DECAY FOR 106.0 DAYS
120      IRF    1927     -1.0   1   2   4  0   BURNUP=41,673 MWD/MTIHM
121      IRF    2087.9   -1.0   2   3   4  0   BURNUP=45,840 MWD/MTIHM
122      IRF    2248.8   -1.0   3   7   4  0   BURNUP=50,008 MWD/MTIHM
123      RDA      -8 = IRRADIATED ZIRCALOY-4 CHANNEL AT DISCHARGE
124      MOV       7     -8      0      1.0
125      RDA  IRRADIATION OF ZIRCALOY-4 CHANNEL AT 0.500 FLUX
126      TIT  IRRAD OF ZIRC-4 CHANNEL AT 0.500 FLUX (FUEL-GAS PLENUM ZONE)
127      MOV      -2      1     0     20.70     ZIRCALOY-4 CHANNEL
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128      MOV      -2      2    0    248.20     TOTAL ZIRC-4 CHANNEL (UNIRR)
129      PCH       2      2    2
130      HED       1                                          CHARGE
131      IRF     160.9   -0.5   1   2   4  2   BURNUP= 4,167 MWD/MTIHM
132      IRF     321.8   -0.5   2   3   4  0   BURNUP= 8,335 MWD/MTIHM
133      IRF     482.7   -0.5   3   4   4  0   BURNUP=12,502 MWD/MTIHM
134      DEC     588.7          4   5   4  0    DECAY FOR 106.0 DAYS
135      IRF     749.6   -0.5   5   6   4  0   BURNUP=16,669 MWD/MTIHM
136      IRF     910.5   -0.5   6   7   4  0   BURNUP=20,837 MWD/MTIHM
137      IRF    1071.4   -0.5   7   8   4  0   BURNUP=25,004 MWD/MTIHM
138      DEC    1177.4          8   9   4  0    DECAY FOR 106.0 DAYS
139      IRF    1338.3   -0.5   9  10   4  0   BURNUP=29,171 MWD/MTIHM
140      IRF    1499.2   -0.5  10  11   4  0   BURNUP=33,338 MWD/MTIHM
141      IRF    1660.1   -0.5  11  12   4  0   BURNUP=37,506 MWD/MTIHM
142      DEC    1766.1         12   1   4  0    DECAY FOR 106.0 DAYS
143      IRF    1927     -0.5   1   2   4  0   BURNUP=41,673 MWD/MTIHM
144      IRF    2087.9   -0.5   2   3   4  0   BURNUP=45,840 MWD/MTIHM
145      IRF    2248.8   -0.5   3   8   4  0   BURNUP=50,008 MWD/MTIHM
146      RDA      -8 = IRRAD ZIRC-4 CHANNEL AT DISCHARGE (FUEL+FUEL-GAS)
147      ADD       8     -8      0      1.0
148      PCH      -8     -8     -8
149      RDA  IRRADIATION OF ZIRCALOY-4 GRID SPACERS & INCONEL SPRINGS
150      TIT  IRRAD OF ZIRC-4 GRID SPACERS & INCONEL SPRINGS (FUEL ZONE)
151      MOV      -2      1      0     10.60   ZIRCALOY-4 GRID SPACERS
152      ADD      -6      1      0      1.80   INCONEL X-750 SPRINGS
153      PCH       1      1      1
154      HED       1                                          CHARGE
155      IRF     160.9   -1.0   1   2   4  2   BURNUP= 4,167 MWD/MTIHM
156      IRF     321.8   -1.0   2   3   4  0   BURNUP= 8,335 MWD/MTIHM
157      IRF     482.7   -1.0   3   4   4  0   BURNUP=12,502 MWD/MTIHM
158      DEC     588.7          4   5   4  0    DECAY FOR 106.0 DAYS
159      IRF     749.6   -1.0   5   6   4  0   BURNUP=16,669 MWD/MTIHM
160      IRF     910.5   -1.0   6   7   4  0   BURNUP=20,837 MWD/MTIHM
161      IRF    1071.4   -1.0   7   8   4  0   BURNUP=25,004 MWD/MTIHM
162      DEC    1177.4          8   9   4  0    DECAY FOR 106.0 DAYS
163      IRF    1338.3   -1.0   9  10   4  0   BURNUP=29,171 MWD/MTIHM
164      IRF    1499.2   -1.0  10  11   4  0   BURNUP=33,338 MWD/MTIHM
165      IRF    1660.1   -1.0  11  12   4  0   BURNUP=37,506 MWD/MTIHM
166      DEC    1766.1         12   1   4  0    DECAY FOR 106.0 DAYS
167      IRF    1927     -1.0   1   2   4  0   BURNUP=41,673 MWD/MTIHM
168      IRF    2087.9   -1.0   2   3   4  0   BURNUP=45,840 MWD/MTIHM
169      IRF    2248.8   -1.0   3   9   4  0   BURNUP=50,008 MWD/MTIHM
170      RDA      -7 = IRRADIATED ZIRCALOY-4 GRID SPACERS AND
171      RDA             INCONEL X-750 SPRINGS AT DISCHARGE (FUEL ZONE)
172      MOV       9     -7      0      1.0
173      PCH      -7     -7     -7
174      RDA  IRRAD OF SS 304 END PIECES AND INCONEL SPRINGS AT 0.130 FLUX
175      TIT  IRRAD OF SS304 ENDS & INCX750 SPRINGS AT 0.13 FLUX (END ZONE)
176      MOV      -4      1      0     37.00  SS 304 ENDS (BOTH TOP & BOTTOM)
177      ADD      -6      1      0      2.10  INCONEL X-750 EXPANSION SPRINGS
178      PCH       1      1      1
179      HED       1                                          CHARGE
180      IRF     160.9   -0.13  1   2   4  2   BURNUP= 4,167 MWD/MTIHM
181      IRF     321.8   -0.13  2   3   4  0   BURNUP= 8,335 MWD/MTIHM
182      IRF     482.7   -0.13  3   4   4  0   BURNUP=12,502 MWD/MTIHM
183      DEC     588.7          4   5   4  0    DECAY FOR 106.0 DAYS
184      IRF     749.6   -0.13  5   6   4  0   BURNUP=16,669 MWD/MTIHM
185      IRF     910.5   -0.13  6   7   4  0   BURNUP=20,837 MWD/MTIHM
186      IRF    1071.4   -0.13  7   8   4  0   BURNUP=25,004 MWD/MTIHM
187      DEC    1177.4          8   9   4  0    DECAY FOR 106.0 DAYS
188      IRF    1338.3   -0.13  9  10   4  0   BURNUP=29,171 MWD/MTIHM
189      IRF    1499.2   -0.13 10  11   4  0   BURNUP=33,338 MWD/MTIHM
190      IRF    1660.1   -0.13 11  12   4  0   BURNUP=37,506 MWD/MTIHM
191      DEC    1766.1         12   1   4  0    DECAY FOR 106.0 DAYS
192      IRF    1927     -0.13  1   2   4  0   BURNUP=41,673 MWD/MTIHM
193      IRF    2087.9   -0.13  2   3   4  0   BURNUP=45,840 MWD/MTIHM
194      IRF    2248.8   -0.13  3  10   4  0   BURNUP=50,008 MWD/MTIHM
195      RDA  -6 = IRRAD SS 304 ENDS & INCONEL SPRINGS AT DISCH (END ZONE)
196      MOV      10    -6      0    1.0
197      PCH      -6    -6     -6
198      RDA  IRRADIATION OF SS 302 IN PLENUM SPRINGS AT 0.500 FLUX
199      TIT  IRRAD OF SS302 PLENUM SPRINGS AT 0.5 FLUX (FUEL-GAS PLENUM)
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200      MOV      -5     1     0    6.00       SS302
201      PCH       1     1     1
202      HED       1                                          CHARGE
203      IRF     160.9   -0.5   1   2   4  2   BURNUP= 4,167 MWD/MTIHM
204      IRF     321.8   -0.5   2   3   4  0   BURNUP= 8,335 MWD/MTIHM
205      IRF     482.7   -0.5   3   4   4  0   BURNUP=12,502 MWD/MTIHM
206      DEC     588.7          4   5   4  0    DECAY FOR 106.0 DAYS
207      IRF     749.6   -0.5   5   6   4  0   BURNUP=16,669 MWD/MTIHM
208      IRF     910.5   -0.5   6   7   4  0   BURNUP=20,837 MWD/MTIHM
209      IRF    1071.4   -0.5   7   8   4  0   BURNUP=25,004 MWD/MTIHM
210      DEC    1177.4          8   9   4  0    DECAY FOR 106.0 DAYS
211      IRF    1338.3   -0.5   9  10   4  0   BURNUP=29,171 MWD/MTIHM
212      IRF    1499.2   -0.5  10  11   4  0   BURNUP=33,338 MWD/MTIHM
213      IRF    1660.1   -0.5  11  12   4  0   BURNUP=37,506 MWD/MTIHM
214      DEC    1766.1         12   1   4  0    DECAY FOR 106.0 DAYS
215      IRF    1927     -0.5   1   2   4  0   BURNUP=41,673 MWD/MTIHM
216      IRF    2087.9   -0.5   2   3   4  0   BURNUP=45,840 MWD/MTIHM
217      IRF    2248.8   -0.5   3  11   4  0   BURNUP=50,008 MWD/MTIHM
218      RDA     -5 = IRRAD SS302 PLENUM SPRINGS AT DISC (FUEL-GAS PLENUM)
219      MOV     11    -5    0   1.0
220      PCH     -5    -5   -5
221      RDA  ***** OUTPUT MODULE *****
222      TIT  ORIGEN2 V2.1 - UO2 FUEL ONLY - EXTENDED BURNUP (BWRUE)
223      BAS  1 MTIHM 3.31% UO2; BURNUP=50,008 MWD/MTIHM (4 CYCLE)
224      HED     -10    FUEL DIS
225      HED      -1    FUEL CHG
226      MOV      -1   1   0   1.0
227      MOV     -10   2   0   1.0
228      RDA  ***** DECAY MODULE *****
229      DEC     0.5   2   3   5   2
230      DEC     1.0   3   4   5   0
231      DEC     3.0   4   5   5   0
232      DEC     5.0   5   6   5   0
233      DEC    10.0   6   7   5   0
234      DEC    30.0   7   8   5   0
235      OPTL      6*8  7  8  7  8  14*8
236      OPTA      6*8  7  8  7  8  14*8
237      OPTF      6*8  7  8  7  8  14*8
238      OUT       8   1  -1   0
239      TIT  ORIGEN2 V2.1 - BWR/6 FUEL ASSEMBLY - EXTENDED BURNUP (BWRUE)
240      BAS  1 MTIHM 3.31% ENRICHMENT UO2 * 0.1833 BWR/6 ASSEMBLY/1 MTIHM
241      OPTL      6*8  7  8  7  8  14*8
242      OPTA      6*8  7  8  7  8  14*8
243      OPTF      6*8  7  8  7  8  14*8
244      MOV     -10   1   0   0.1833
245      ADD      -9   1   0   0.1833
246      ADD      -8   1   0   0.1833
247      ADD      -7   1   0   0.1833
248      ADD      -6   1   0   0.1833
249      ADD      -5   1   0   0.1833
250      HED     1    ASSY DIS
251      RDA  ***** DECAY MODULE *****
252      DEC     0.5   1   2   5   2
253      DEC     1.0   2   3   5   0
254      DEC     3.0   3   4   5   0
255      DEC     5.0   4   5   5   0
256      DEC    10.0   5   6   5   0
257      DEC    30.0   6   7   5   0
258      OUT       7   1  -1   0
259      END
260    2 922340 297.0   922350 33100. 922380 966603. 0      0.0   FUEL 3.31
261    4 030000 1.0     050000 1.0    060000 89.4    070000 25.0  FUEL IMPU
262    4 080000 134454. 090000 10.7   110000 15.0    120000 2.0   FUEL IMPU
263    4 130000 16.7    140000 12.1   150000 35.0    170000 5.3   FUEL IMPU
264    4 200000 2.0     220000 1.0    230000 3.0     240000 4.0   FUEL IMPU
265    4 250000 1.7     260000 18.0   270000 1.0     280000 24.0  FUEL IMPU
266    4 290000 1.0     300000 40.3   420000 10.0    470000 0.1   FUEL IMPU
267    4 480000 25.0    490000 2.0    500000 4.0     640000 1573. FUEL IMPU
268    4 740000 2.0     820000 1.0    830000 0.4     0      0.0   FUEL IMPU
269    0
270    4 400000 979.11  500000 16.0   260000 2.25    240000 1.25     ZIRC-4
271    4 280000 0.02    130000 0.024  050000 0.00033 480000 0.00025  ZIRC-4
```

```
272    4 060000 0.120   270000 0.010  290000 0.020   720000 0.078    ZIRC-4
273    4 010000 0.013   250000 0.020  070000 0.080   080000 0.950    ZIRC-4
274    4 160000 0.035   220000 0.020  740000 0.020   230000 0.020    ZIRC-4
275    5 920000 0.0002       0 0.0                                   ZIRC-4
276    0
277    4 400000 979.63  500000 16.0   260000 1.5     240000 1.00     ZIRC-2
278    4 280000 0.5     130000 0.024  050000 0.00033 480000 0.00025  ZIRC-2
279    4 060000 0.120   270000 0.010  290000 0.020   720000 0.078    ZIRC-2
280    4 010000 0.013   250000 0.020  070000 0.080   080000 0.950    ZIRC-2
281    4 160000 0.035   220000 0.020  740000 0.020   230000 0.020    ZIRC-2
282    5 920000 0.0002       0 0.0                                   ZIRC-2
283    0
284    4 260000 688.44  240000 190.0  280000 89.2    250000 20.0     SS-304
285    4 060000 0.8     150000 0.45   160000 0.3     140000 10.0     SS-304
286    4 070000 1.3     270000 0.8         0 0.0                     SS-304
287    0
288    4 260000 697.74  240000 180.0  280000 89.2    250000 20.0     SS-302
289    4 060000 1.5     150000 0.45   160000 0.3     140000 10.0     SS-302
290    4 070000 1.3     270000 0.8         0 0.0                     SS-302
291    0
292    4 260000 67.846  240000 149.66 280000 721.861 130000 7.982 INC-X-750
293    4 060000 0.399   270000 6.485  290000 0.499   250000 6.984 INC-X-750
294    4 070000 1.3     410000 8.98   160000 0.07    140000 2.993 INC-X-750
295    4 220000 24.943       0 0.0                                INC-X-750
296    0
```

## pwr343.inp

```
  1      -1
  2      -1
  3      -1
  4      RDA *  WESTINGHOUSE STANDARD 17X17 ARRAY PWR ASSEMBLY
  5      RDA **  3.43% ENRICHMENT UO2 FUEL, 35,000 MWD/MTIHM BURNUP
  6      RDA ***  CROSS SECTION LIBRARY = PWRUS, 3 CYCLE
  7      RDA ****  KEY REFERENCE: ORNL/TM-9591/V1&R1, TABLES 3.1-3.4
  8      RDA *****  J.D. SMITH, SNL/6524, (505) 844-0531
  9      RDA     -1 = FRESH PWR FUEL WITH IMPURITIES (1 MT = 1000 KG)
 10      RDA     -2 = FRESH ZIRCALOY-4 COMPOSITION (1 KG)
 11      RDA     -3 = FRESH SS-304 COMPOSITION (1 KG)
 12      RDA     -4 = FRESH SS-302 COMPOSITION (1 KG)
 13      RDA     -5 = FRESH INCONEL-718 COMPOSITION (1 KG)
 14      RDA     -6 = FRESH NICROBRAZE-50 COMPOSITION (1 KG)
 15      RDA     NOTE:  VECTOR CONTENT CHANGES INDICATED ON RDA CARDS.
 16      CUT     5 1.0E-10 7 1.0E-10 9 1.0E-10 -1
 17      LIP     0 0 0
 18      RDA        DECAY LIB    XSECT LIB                      VAR. XSECT
 19      LIB     0    1 2 3     601 602 603    9   50   0   1       38
 20      RDA      PHOTON LIB
 21      PHO     101 102 103  10
 22      TIT   INITIAL FUEL AND STRUCTURAL COMPOSITION UNIT QUANTITIES
 23      RDA     READ FUEL COMPOSITION INCLUDING IMPURITIES (1000 KG)
 24      INP     -1  1  -1  -1  1  1
 25      RDA     READ  ZIRCALOY-4 COMPOSITION (1.0 KG)
 26      INP     -2  1  -1  -1  1  1
 27      RDA     READ  SS-304 COMPOSITION (1.0 KG)
 28      INP     -3  1  -1  -1  1  1
 29      RDA     READ  SS-302 COMPOSITION (1.0 KG)
 30      INP     -4  1  -1  -1  1  1
 31      RDA     READ  INCONEL-718 COMPOSITION (1.0 KG)
 32      INP     -5  1  -1  -1  1  1
 33      RDA     READ  NICROBRAZE-50 COMPOSITION (1.0 KG)
 34      INP     -6  1  -1  -1  1  1
 35      TIT     IRRADIATION OF 1 MTIHM OF 3.43% ENRICHMENT UO2 PWR FUEL
 36      MOV     -1 1 0 1.0
 37      PCH     1  1  1
 38      HED     1                                                CHARGE
 39      BUP
 40      IRP       97.3    32.0    1   2   4 2  BURNUP=  3,113.6 MWD/MTIHM
 41      IRP      194.7    32.0    2   3   4 0  BURNUP=  6,230.4 MWD/MTIHM
 42      IRP      292.0    32.0    3   4   4 0  BURNUP=  9,344.0 MWD/MTIHM
 43      DEC      322.0            4   5   4 0   DECAY FOR 30.0 DAYS
```

```
 44      IRP      419.3    40.0    5   6   4 0  BURNUP= 13,236.0 MWD/MTIHM
 45      IRP      516.7    40.0    6   7   4 0  BURNUP= 17,132.0 MWD/MTIHM
 46      IRP      614.0    40.0    7   8   4 0  BURNUP= 21,024.0 MWD/MTIHM
 47      DEC      644.0            8   9   4 0   DECAY FOR 30.0 DAYS
 48      IRP      741.3    48.0    9  10   4 0  BURNUP= 25,694.4 MWD/MTIHM
 49      IRP      838.6    48.0   10  11   4 0  BURNUP= 30,364.8 MWD/MTIHM
 50      IRP      936.0    48.0   11  12   4 0  BURNUP= 35,040.0 MWD/MTIHM
 51      BUP
 52      RDA     -10 = IRRADIATED FUEL AT DISCHARGE
 53      MOV     12 -10  0 1.0
 54      PCH     -10  -10  -10
 55      RDA     IRRADIATION OF ZIRCALOY-4 AT 1.000 FLUX (FUEL ZONE)
 56      TIT     IRRADIATION OF ZIRCALOY-4 CLADDING AT 1.000 FLUX
 57      MOV     -2 1 0 223.0 ZIRCALOY-4 CLADDING (KG/MTHM), TABLE 3.2
 58      PCH     1  1  1
 59      HED     1                                                  CHARGE
 60      IRF       97.3    -1.0    1   2   4 2  BURNUP=  3,113.6 MWD/MTIHM
 61      IRF      194.7    -1.0    2   3   4 0  BURNUP=  6,230.4 MWD/MTIHM
 62      IRF      292.0    -1.0    3   4   4 0  BURNUP=  9,344.0 MWD/MTIHM
 63      DEC      322.0            4   5   4 0   DECAY FOR 30.0 DAYS
 64      IRF      419.3    -1.0    5   6   4 0  BURNUP= 13,236.0 MWD/MTIHM
 65      IRF      516.7    -1.0    6   7   4 0  BURNUP= 17,132.0 MWD/MTIHM
 66      IRF      614.0    -1.0    7   8   4 0  BURNUP= 21,024.0 MWD/MTIHM
 67      DEC      644.0            8   9   4 0   DECAY FOR 30.0 DAYS
 68      IRF      741.3    -1.0    9  10   4 0  BURNUP= 25,694.4 MWD/MTIHM
 69      IRF      838.6    -1.0   10  11   4 0  BURNUP= 30,364.8 MWD/MTIHM
 70      IRF      936.0    -1.0   11  12   4 0  BURNUP= 35,040.0 MWD/MTIHM
 71      RDA     -9 = IRRADIATED ZIRCALOY-4 AT DISCHARGE
 72      MOV     12  -9  0  1.0
 73      PCH     -9  -9  -9
 74      RDA     IRRADIATION OF INC-718+NICR-50 AT 1.000 FLUX (FUEL ZONE)
 75      TIT     IRRADIATION OF INCONEL-718+NICROBRAZE-50 AT 1.000 FLUX
 76      MOV     -5 1 0 12.8 INCONEL-718 GRID SPACERS (KG/MTHM), TABLE 3.2
 77      ADD     -6 1 0 2.6 NICROBRAZE-50 GRID-BRAZING (KG/MTHM), TABLE 3.2
 78      PCH     1  1  1
 79      HED     1                                                  CHARGE
 80      IRF       97.3    -1.0    1   2   4 2  BURNUP=  3,113.6 MWD/MTIHM
 81      IRF      194.7    -1.0    2   3   4 0  BURNUP=  6,230.4 MWD/MTIHM
 82      IRF      292.0    -1.0    3   4   4 0  BURNUP=  9,344.0 MWD/MTIHM
 83      DEC      322.0            4   5   4 0   DECAY FOR 30.0 DAYS
 84      IRF      419.3    -1.0    5   6   4 0  BURNUP= 13,236.0 MWD/MTIHM
 85      IRF      516.7    -1.0    6   7   4 0  BURNUP= 17,132.0 MWD/MTIHM
 86      IRF      614.0    -1.0    7   8   4 0  BURNUP= 21,024.0 MWD/MTIHM
 87      DEC      644.0            8   9   4 0   DECAY FOR 30.0 DAYS
 88      IRF      741.3    -1.0    9  10   4 0  BURNUP= 25,694.4 MWD/MTIHM
 89      IRF      838.6    -1.0   10  11   4 0  BURNUP= 30,364.8 MWD/MTIHM
 90      IRF      936.0    -1.0   11  12   4 0  BURNUP= 35,040.0 MWD/MTIHM
 91      RDA     -8 = IRRADIATED INCONEL-718 AND NICROBRAZE-50 AT DISCHARGE
 92      MOV     12  -8  0  1.0
 93      PCH     -8  -8  -8
 94      RDA     IRRADIATION OF SS-304 CHANNEL AT 1.000 FLUX (FUEL ZONE)
 95      TIT     IRRADIATION OF SS-304 MISCELLANEOUS/CHANNEL AT 1.000 FLUX
 96      MOV     -3 1 0 9.9 SS-304 CHANNEL (KG/MTHM), TABLE 3.2
 97      PCH     1  1  1
 98      HED     1                                                  CHARGE
 99      IRF       97.3    -1.0    1   2   4 2  BURNUP=  3,113.6 MWD/MTIHM
100      IRF      194.7    -1.0    2   3   4 0  BURNUP=  6,230.4 MWD/MTIHM
101      IRF      292.0    -1.0    3   4   4 0  BURNUP=  9,344.0 MWD/MTIHM
102      DEC      322.0            4   5   4 0   DECAY FOR 30.0 DAYS
103      IRF      419.3    -1.0    5   6   4 0  BURNUP= 13,236.0 MWD/MTIHM
104      IRF      516.7    -1.0    6   7   4 0  BURNUP= 17,132.0 MWD/MTIHM
105      IRF      614.0    -1.0    7   8   4 0  BURNUP= 21,024.0 MWD/MTIHM
106      DEC      644.0            8   9   4 0   DECAY FOR 30.0 DAYS
107      IRF      741.3    -1.0    9  10   4 0  BURNUP= 25,694.4 MWD/MTIHM
108      IRF      838.6    -1.0   10  11   4 0  BURNUP= 30,364.8 MWD/MTIHM
109      IRF      936.0    -1.0   11  12   4 0  BURNUP= 35,040.0 MWD/MTIHM
110      RDA     -7 = IRRADIATED SS-304 AT DISCHARGE
111      MOV     12  -7  0  1.0
112      PCH     -7  -7  -7
113      RDA     IRRADIATION OF SS-304 AT 0.011 FLUX (END FITTING ZONE)
114      TIT     IRRADIATION OF SS-304 END FITTINGS (BOTH) AT 0.011 FLUX
115      MOV     -3 1 0 27.2  SS-304 END FITTINGS (KG/MTHM), TABLE 3.4
```

```
116      PCH     1  1  1
117      HED     1                                                  CHARGE
118      IRF       97.3    -0.011  1   2   4 2  BURNUP=  3,113.6 MWD/MTIHM
119      IRF      194.7    -0.011  2   3   4 0  BURNUP=  6,230.4 MWD/MTIHM
120      IRF      292.0    -0.011  3   4   4 0  BURNUP=  9,344.0 MWD/MTIHM
121      DEC      322.0            4   5   4 0   DECAY FOR 30.0 DAYS
122      IRF      419.3    -0.011  5   6   4 0  BURNUP= 13,236.0 MWD/MTIHM
123      IRF      516.7    -0.011  6   7   4 0  BURNUP= 17,132.0 MWD/MTIHM
124      IRF      614.0    -0.011  7   8   4 0  BURNUP= 21,024.0 MWD/MTIHM
125      DEC      644.0            8   9   4 0   DECAY FOR 30.0 DAYS
126      IRF      741.3    -0.011  9  10   4 0  BURNUP= 25,694.4 MWD/MTIHM
127      IRF      838.6    -0.011 10  11   4 0  BURNUP= 30,364.8 MWD/MTIHM
128      IRF      936.0    -0.011 11  12   4 0  BURNUP= 35,040.0 MWD/MTIHM
129      RDA     -6 = IRRADIATED SS-304 END PIECES AT DISCHARGE
130      MOV     12 -6 0 1.0
131      PCH     -6  -6  -6
132      RDA     IRRADIATION OF SS-302 AT 0.042 FLUX (FUEL-GAS PLENUM ZONE)
133      TIT     IRRADIATION OF SS-302 PLENUM SPRINGS AT 0.042 FLUX
134      MOV     -4 1 0 4.2  SS-302 PLENUM SPRING (KG/MTIHM), TABLE 3.2
135      ADD     -2 1 0 12.0  ZIRCALOY-4 CLADDING (KG/MTIHM), TABLE 3.2
136      PCH     1  1  1
137      HED     1                                                  CHARGE
138      IRF       97.3    -0.042  1   2   4 2  BURNUP=  3,113.6 MWD/MTIHM
139      IRF      194.7    -0.042  2   3   4 0  BURNUP=  6,230.4 MWD/MTIHM
140      IRF      292.0    -0.042  3   4   4 0  BURNUP=  9,344.0 MWD/MTIHM
141      DEC      322.0            4   5   4 0   DECAY FOR 30.0 DAYS
142      IRF      419.3    -0.042  5   6   4 0  BURNUP= 13,236.0 MWD/MTIHM
143      IRF      516.7    -0.042  6   7   4 0  BURNUP= 17,132.0 MWD/MTIHM
144      IRF      614.0    -0.042  7   8   4 0  BURNUP= 21,024.0 MWD/MTIHM
145      DEC      644.0            8   9   4 0   DECAY FOR 30.0 DAYS
146      IRF      741.3    -0.042  9  10   4 0  BURNUP= 25,694.4 MWD/MTIHM
147      IRF      838.6    -0.042 10  11   4 0  BURNUP= 30,364.8 MWD/MTIHM
148      IRF      936.0    -0.042 11  12   4 0  BURNUP= 35,040.0 MWD/MTIHM
149      RDA     -5 = IRRADIATED SS-302 PLENUM SPRINGS AT DISCHARGE
150      MOV     12 -5 0 1.0
151      PCH     -5  -5  -5
152      RDA     ***** OUTPUT MODULE *****
153      TIT     ORIGEN2 V2.1 - PWR (FUEL ONLY) - STANDARD BURNUP (PWRU)
154      BAS      1 MTIHM 3.5% UO2; BURNUP=35,000 MWD/MTIHM, 3 CYCLE
155      HED      -10    FUEL DIS
156      HED      -1     FUEL CHG
157      MOV      -1    1    0   1.0
158      MOV     -10    2    0   1.0
159      RDA     ***** DECAY MODULE *****
160      DEC     0.5   2   3   5   2
161      DEC     1.0   3   4   5   0
162      DEC     3.0   4   5   5   0
163      DEC     5.0   5   6   5   0
164      DEC    10.0   6   7   5   0
165      DEC    30.0   7   8   5   0
166      OPTL    4*8   7   8   3*7 19*8
167      OPTA    4*8   7   8   3*7 19*8
168      OPTF    4*8   7   8   3*7 19*8
169      OUT      8    1     -1    0
170      TIT   ORIGEN2 V2.1 - PWR ASSEMBLY-STANDARD BURNUP (PWRU)
171      BAS   1 17X17 PWR ASSEMBLY; 3.43% UO2, BURNUP=35,000 MWD/MTIHM, 3 CYCLE
172      OPTL    4*8   7   8   3*7 19*8
173      OPTA    4*8   7   8   3*7 19*8
174      OPTF    4*8   7   8   3*7 19*8
175      MOV     -10   1   0  0.4614
176      ADD      -9   1   0  0.4614
177      ADD      -8   1   0  0.4614
178      ADD      -7   1   0  0.4614
179      ADD      -6   1   0  0.4614
180      ADD      -5   1   0  0.4614
181      HED     1    ASSY DIS
182      RDA     ***** DECAY MODULE *****
183      DEC     0.5   1   2   5   2
184      DEC     1.0   2   3   5   0
185      DEC     3.0   3   4   5   0
186      DEC     5.0   4   5   5   0
187      DEC    10.0   5   6   5   0
```

```
 DEC    30.0   6   7   5   0
 OUT      7    1     -1    0
 END
2 922340 310.8   922350 34300.  922380 965389.2     0 0.0    UO2 3.43%
4 030000 1.0     050000 1.0     060000 89.6    070000 25.0   IMPURITY
4 080000 134454. 090000 10.7    110000 15.0    120000 20.0   IMPURITY
4 130000 16.7    140000 12.1    150000 35.0    170000 5.3    IMPURITY
4 200000 2.0     220000 1.0     230000 3.0     240000 4.0    IMPURITY
4 250000 1.7     260000 18.0    270000 1.0     280000 24.0   IMPURITY
4 290000 1.0     300000 40.3    420000 10.0    470000 0.1    IMPURITY
4 480000 25.0    490000 2.0     500000 4.0     640000 2.5    IMPURITY
4 740000 2.0     820000 1.0     830000 0.4     0      0.0    IMPURITY
 0
4 010000 0.013   050000 0.00033 060000 0.120   070000 0.080    ZIRC-4
4 080000 0.950   130000 0.024   140000 0.0     150000 0.0      ZIRC-4
4 160000 0.035   220000 0.020   230000 0.020   240000 1.25     ZIRC-4
4 250000 0.020   260000 2.25    270000 0.010   280000 0.02     ZIRC-4
4 290000 0.020   400000 979.11  410000 0.0     420000 0.0      ZIRC-4
4 480000 0.00025 500000 16.0    720000 0.078   740000 0.020    ZIRC-4
5 920000 0.0002       0 0.0                                   ZIRC-4
 0
4 010000 0.0     050000 0.0     060000 0.8     070000 1.3      SS-304
4 080000 0.0     130000 0.0     140000 10.0    150000 0.45     SS-304
4 160000 0.3     220000 0.0     230000 0.0     240000 190.0    SS-304
4 250000 20.0    260000 688.44  270000 0.8     280000 89.2     SS-304
4 290000 0.0     400000 0.0     410000 0.0     420000 0.0      SS-304
4 480000 0.0     500000 0.0     720000 0.0     740000 0.0      SS-304
5 920000 0.0          0 0.0                                   SS-304
 0
4 010000 0.0     050000 0.0     060000 1.5     070000 1.3      SS-302
4 080000 0.0     130000 0.0     140000 10.0    150000 0.45     SS-302
4 160000 0.3     220000 0.0     230000 0.0     240000 180.0    SS-302
4 250000 20.0    260000 697.74  270000 0.8     280000 89.2     SS-302
4 290000 0.0     400000 0.0     410000 0.0     420000 0.0      SS-302
4 480000 0.0     500000 0.0     720000 0.0     740000 0.0      SS-302
5 920000 0.0          0 0.0                                   SS-302
 0
4 010000 0.0     050000 0.0     060000 0.4     070000 1.3     INC-718
4 080000 0.0     130000 5.992   140000 1.997   150000 0.0     INC-718
4 160000 0.07    220000 7.99    230000 0.0     240000 189.753 INC-718
4 250000 1.997   260000 179.766 270000 4.694   280000 519.625 INC-718
4 290000 0.999   400000 0.0     410000 55.458  420000 29.961  INC-718
4 480000 0.0     500000 0.0     720000 0.0     740000 0.0     INC-718
5 920000 0.0          0 0.0                                  INC-718
 0
4 010000 0.0     050000 0.05    060000 0.1     070000 0.066   NICR-50
4 080000 0.043   130000 0.1     140000 0.511   150000 103.244 NICR-50
4 160000 0.1     220000 0.1     230000 0.0     240000 149.709 NICR-50
4 250000 0.1     260000 0.471   270000 0.381   280000 744.438 NICR-50
4 290000 0.0     400000 0.1     410000 0.0     420000 0.0     NICR-50
4 480000 0.0     500000 0.0     720000 0.0     740000 0.1     NICR-50
5 920000 0.0          0 0.0                                  NICR-50
 0
```

## pwr473.inp

```
 -1
 -1
 -1
 RDA *  WESTINGHOUSE STANDARD 17X17 ARRAY PWR ASSEMBLY
 RDA **  4.73% ENRICHMENT UO2 FUEL, 60,000 MWD/MTIHM BURNUP
 RDA ***  CROSS SECTION LIBRARY = PWRUE, 3 CYCLE
 RDA ****  KEY REFERENCE: ORNL/TM-9591/V1&R1, TABLES 3.1-3.4
 RDA *****  J.D. SMITH, SNL/6524, (505) 844-0531
 RDA     -1 = FRESH PWR FUEL WITH IMPURITIES (1 MT = 1000 KG)
 RDA     -2 = FRESH ZIRCALOY-4 COMPOSITION (1 KG)
 RDA     -3 = FRESH SS-304 COMPOSITION (1 KG)
 RDA     -4 = FRESH SS-302 COMPOSITION (1 KG)
 RDA     -5 = FRESH INCONEL-718 COMPOSITION (1 KG)
 RDA     -6 = FRESH NICROBRAZE-50 COMPOSITION (1 KG)
```

```
RDA     NOTE:  VECTOR CONTENT CHANGES INDICATED ON RDA CARDS.
CUT     5 1.0E-10 7 1.0E-10 9 1.0E-10 -1
LIP     0 0 0
RDA        DECAY LIB    XSECT LIB                      VAR. XSECT
LIB     0    1 2 3     604 605 606    9   50   0   1       39
RDA      PHOTON LIB
PHO     101 102 103  10
TIT   INITIAL FUEL AND STRUCTURAL COMPOSITION UNIT QUANTITIES
RDA     READ FUEL COMPOSITION INCLUDING IMPURITIES (1000 KG)
INP     -1  1  -1  -1  1  1
RDA     READ  ZIRCALOY-4 COMPOSITION (1.0 KG)
INP     -2  1  -1  -1  1  1
RDA     READ  SS-304 COMPOSITION (1.0 KG)
INP     -3  1  -1  -1  1  1
RDA     READ  SS-302 COMPOSITION (1.0 KG)
INP     -4  1  -1  -1  1  1
RDA     READ  INCONEL-718 COMPOSITION (1.0 KG)
INP     -5  1  -1  -1  1  1
RDA     READ  NICROBRAZE-50 COMPOSITION (1.0 KG)
INP     -6  1  -1  -1  1  1
TIT     IRRADIATION OF 1 MTIHM OF 4.73% ENRICHMENT UO2 PWR FUEL
MOV     -1 1 0 1.0
PCH     1  1  1
HED     1                                       FUEL ONLY CHARGE
BUP
IRP      133.5    37.5    1   2   4 2  BURNUP=  5,006.3 MWD/MTIHM
IRP      267.0    37.5    2   3   4 0  BURNUP= 10,012.5 MWD/MTIHM
IRP      400.5    37.5    3   4   4 0  BURNUP= 15,018.8 MWD/MTIHM
IRP      534.0    37.5    4   5   4 0  BURNUP= 20,025.0 MWD/MTIHM
DEC      667.5            5   6   4 0   DECAY FOR 133.5 DAYS
IRP      801.0    37.5    6   7   4 0  BURNUP= 25,031.3 MWD/MTIHM
IRP      934.5    37.5    7   8   4 0  BURNUP= 30,037.5 MWD/MTIHM
IRP     1068.0    37.5    8   9   4 0  BURNUP= 35,043.8 MWD/MTIHM
IRP     1201.5    37.5    9  10   4 0  BURNUP= 40,050.0 MWD/MTIHM
DEC     1335.0           10  11   4 0   DECAY FOR 133.5 DAYS
IRP     1468.5    37.5   11  12   4 0  BURNUP= 45,056.3 MWD/MTIHM
IRP     1602.0    37.5   12   1   4 0  BURNUP= 50,062.5 MWD/MTIHM
IRP     1735.5    37.5    1   2   4 0  BURNUP= 55,068.8 MWD/MTIHM
IRP     1869.0    37.5    2   3   4 0  BURNUP= 60,075.0 MWD/MTIHM
BUP
RDA     -10 = IRRADIATED FUEL AT DISCHARGE
MOV       3  -10    0  1.0
PCH     -10  -10  -10
RDA     IRRADIATION OF ZIRCALOY-4 AT 1.000 FLUX (FUEL ZONE)
TIT     IRRADIATION OF ZIRCALOY-4 CLADDING AT 1.000 FLUX
MOV     -2 1 0 223.0 ZIRCALOY-4 CLADDING (KG/MTHM), TABLE 3.2
PCH     1  1  1
HED     1                                     ZIRCALOY-4 CHARGE
IRF      133.5    -1.0    1   2   4 2  BURNUP=  5,006.3 MWD/MTIHM
IRF      267.0    -1.0    2   3   4 0  BURNUP= 10,012.5 MWD/MTIHM
IRF      400.5    -1.0    3   4   4 0  BURNUP= 15,018.8 MWD/MTIHM
IRF      534.0    -1.0    4   5   4 0  BURNUP= 20,025.0 MWD/MTIHM
DEC      667.5            5   6   4 0   DECAY FOR 133.5 DAYS
IRF      801.0    -1.0    6   7   4 0  BURNUP= 25,031.3 MWD/MTIHM
IRF      934.5    -1.0    7   8   4 0  BURNUP= 30,037.5 MWD/MTIHM
IRF     1068.0    -1.0    8   9   4 0  BURNUP= 35,043.8 MWD/MTIHM
IRF     1201.5    -1.0    9  10   4 0  BURNUP= 40,050.0 MWD/MTIHM
DEC     1335.0           10  11   4 0   DECAY FOR 133.5 DAYS
IRF     1468.5    -1.0   11  12   4 0  BURNUP= 45,056.3 MWD/MTIHM
IRF     1602.0    -1.0   12   1   4 0  BURNUP= 50,062.5 MWD/MTIHM
IRF     1735.5    -1.0    1   2   4 0  BURNUP= 55,068.8 MWD/MTIHM
IRF     1869.0    -1.0    2   3   4 0  BURNUP= 60,075.0 MWD/MTIHM
RDA     -9 = IRRADIATED ZIRCALOY-4 AT DISCHARGE
MOV      3  -9   0 1.0
PCH     -9  -9  -9
RDA     IRRADIATION OF INC-718+NICR-50 AT 1.000 FLUX (FUEL ZONE)
TIT     IRRADIATION OF INCONEL-718+NICROBRAZE-50 AT 1.000 FLUX
MOV     -5 1 0 12.8 INCONEL-718 GRID SPACERS (KG/MTHM), TABLE 3.2
ADD     -6 1 0 2.6 NICROBRAZE-50 GRID-BRAZING (KG/MTHM), TABLE 3.2
PCH     1  1  1
HED     1                                 INC-718+NICR-50 CHARGE
IRF      133.5    -1.0    1   2   4 2  BURNUP=  5,006.3 MWD/MTIHM
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 87      IRF      267.0    -1.0    2   3   4 0  BURNUP= 10,012.5 MWD/MTIHM
 88      IRF      400.5    -1.0    3   4   4 0  BURNUP= 15,018.8 MWD/MTIHM
 89      IRF      534.0    -1.0    4   5   4 0  BURNUP= 20,025.0 MWD/MTIHM
 90      DEC      667.5            5   6   4 0   DECAY FOR 133.5 DAYS
 91      IRF      801.0    -1.0    6   7   4 0  BURNUP= 25,031.3 MWD/MTIHM
 92      IRF      934.5    -1.0    7   8   4 0  BURNUP= 30,037.5 MWD/MTIHM
 93      IRF     1068.0    -1.0    8   9   4 0  BURNUP= 35,043.8 MWD/MTIHM
 94      IRF     1201.5    -1.0    9  10   4 0  BURNUP= 40,050.0 MWD/MTIHM
 95      DEC     1335.0           10  11   4 0   DECAY FOR 133.5 DAYS
 96      IRF     1468.5    -1.0   11  12   4 0  BURNUP= 45,056.3 MWD/MTIHM
 97      IRF     1602.0    -1.0   12   1   4 0  BURNUP= 50,062.5 MWD/MTIHM
 98      IRF     1735.5    -1.0    1   2   4 0  BURNUP= 55,068.8 MWD/MTIHM
 99      IRF     1869.0    -1.0    2   3   4 0  BURNUP= 60,075.0 MWD/MTIHM
100      RDA     -8 = IRRADIATED INCONEL-718 AND NICROBRAZE-50 AT DISCHARGE
101      MOV      3  -8   0 1.0
102      PCH     -8  -8  -8
103      RDA     IRRADIATION OF SS-304 CHANNEL AT 1.000 FLUX (FUEL ZONE)
104      TIT     IRRADIATION OF SS-304 MISCELLANEOUS/CHANNEL AT 1.000 FLUX
105      MOV     -3 1 0 9.9 SS-304 CHANNEL (KG/MTHM), TABLE 3.2
106      PCH     1  1  1
107      HED     1                                   SS-304 CHANNEL CHARGE
108      IRF      133.5    -1.0    1   2   4 2  BURNUP=  5,006.3 MWD/MTIHM
109      IRF      267.0    -1.0    2   3   4 0  BURNUP= 10,012.5 MWD/MTIHM
110      IRF      400.5    -1.0    3   4   4 0  BURNUP= 15,018.8 MWD/MTIHM
111      IRF      534.0    -1.0    4   5   4 0  BURNUP= 20,025.0 MWD/MTIHM
112      DEC      667.5            5   6   4 0   DECAY FOR 133.5 DAYS
113      IRF      801.0    -1.0    6   7   4 0  BURNUP= 25,031.3 MWD/MTIHM
114      IRF      934.5    -1.0    7   8   4 0  BURNUP= 30,037.5 MWD/MTIHM
115      IRF     1068.0    -1.0    8   9   4 0  BURNUP= 35,043.8 MWD/MTIHM
116      IRF     1201.5    -1.0    9  10   4 0  BURNUP= 40,050.0 MWD/MTIHM
117      DEC     1335.0           10  11   4 0   DECAY FOR 133.5 DAYS
118      IRF     1468.5    -1.0   11  12   4 0  BURNUP= 45,056.3 MWD/MTIHM
119      IRF     1602.0    -1.0   12   1   4 0  BURNUP= 50,062.5 MWD/MTIHM
120      IRF     1735.5    -1.0    1   2   4 0  BURNUP= 55,068.8 MWD/MTIHM
121      IRF     1869.0    -1.0    2   3   4 0  BURNUP= 60,075.0 MWD/MTIHM
122      RDA     -7 = IRRADIATED SS-304 AT DISCHARGE
123      MOV      3  -7   0 1.0
124      PCH     -7  -7  -7
125      RDA     IRRADIATION OF SS-304 AT 0.011 FLUX (END FITTING ZONE)
126      TIT     IRRADIATION OF SS-304 END FITTINGS (BOTH) AT 0.011 FLUX
127      MOV     -3 1 0 27.2  SS-304 END FITTINGS (KG/MTHM), TABLE 3.4
128      PCH     1  1  1
129      HED     1                                       SS-304 ENDS CHARGE
130      IRF      133.5    -0.011  1   2   4 2  BURNUP=  5,006.3 MWD/MTIHM
131      IRF      267.0    -0.011  2   3   4 0  BURNUP= 10,012.5 MWD/MTIHM
132      IRF      400.5    -0.011  3   4   4 0  BURNUP= 15,018.8 MWD/MTIHM
133      IRF      534.0    -0.011  4   5   4 0  BURNUP= 20,025.0 MWD/MTIHM
134      DEC      667.5            5   6   4 0   DECAY FOR 133.5 DAYS
135      IRF      801.0    -0.011  6   7   4 0  BURNUP= 25,031.3 MWD/MTIHM
136      IRF      934.5    -0.011  7   8   4 0  BURNUP= 30,037.5 MWD/MTIHM
137      IRF     1068.0    -0.011  8   9   4 0  BURNUP= 35,043.8 MWD/MTIHM
138      IRF     1201.5    -0.011  9  10   4 0  BURNUP= 40,050.0 MWD/MTIHM
139      DEC     1335.0           10  11   4 0   DECAY FOR 133.5 DAYS
140      IRF     1468.5    -0.011 11  12   4 0  BURNUP= 45,056.3 MWD/MTIHM
141      IRF     1602.0    -0.011 12   1   4 0  BURNUP= 50,062.5 MWD/MTIHM
142      IRF     1735.5    -0.011  1   2   4 0  BURNUP= 55,068.8 MWD/MTIHM
143      IRF     1869.0    -0.011  2   3   4 0  BURNUP= 60,075.0 MWD/MTIHM
144      RDA     -6 = IRRADIATED SS-304 END PIECES AT DISCHARGE
145      MOV      3  -6   0 1.0
146      PCH     -6  -6  -6
147      RDA     IRRADIATION OF SS-302 AT 0.042 FLUX (FUEL-GAS PLENUM ZONE)
148      TIT     IRRADIATION OF SS-302 PLENUM SPRINGS AT 0.042 FLUX
149      MOV     -4 1 0 4.2  SS-302 PLENUM SPRING (KG/MTIHM), TABLE 3.2
150      ADD     -2 1 0 12.0  ZIRCALOY-4 CLADDING (KG/MTIHM), TABLE 3.2
151      PCH     1  1  1
152      HED     1                                     SS-302+ZIRC-4 CHARGE
153      IRF      133.5    -0.042  1   2   4 2  BURNUP=  5,006.3 MWD/MTIHM
154      IRF      267.0    -0.042  2   3   4 0  BURNUP= 10,012.5 MWD/MTIHM
155      IRF      400.5    -0.042  3   4   4 0  BURNUP= 15,018.8 MWD/MTIHM
156      IRF      534.0    -0.042  4   5   4 0  BURNUP= 20,025.0 MWD/MTIHM
157      DEC      667.5            5   6   4 0   DECAY FOR 133.5 DAYS
158      IRF      801.0    -0.042  6   7   4 0  BURNUP= 25,031.3 MWD/MTIHM
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159      IRF      934.5    -0.042  7   8   4 0  BURNUP= 30,037.5 MWD/MTIHM
160      IRF     1068.0    -0.042  8   9   4 0  BURNUP= 35,043.8 MWD/MTIHM
161      IRF     1201.5    -0.042  9  10   4 0  BURNUP= 40,050.0 MWD/MTIHM
162      DEC     1335.0           10  11   4 0   DECAY FOR 133.5 DAYS
163      IRF     1468.5    -0.042 11  12   4 0  BURNUP= 45,056.3 MWD/MTIHM
164      IRF     1602.0    -0.042 12   1   4 0  BURNUP= 50,062.5 MWD/MTIHM
165      IRF     1735.5    -0.042  1   2   4 0  BURNUP= 55,068.8 MWD/MTIHM
166      IRF     1869.0    -0.042  2   3   4 0  BURNUP= 60,075.0 MWD/MTIHM
167      RDA     -5 = IRRADIATED SS-302 PLENUM SPRINGS AT DISCHARGE
168      MOV      3  -5   0 1.0
169      PCH     -5  -5  -5
170      RDA     ***** OUTPUT MODULE *****
171      TIT     ORIGEN2 V2.1 - PWR FUEL ONLY - EXTENDED BURNUP (PWRUE)
172      BAS      1 MTIHM 4.73% UO2; BURNUP=60,000 MWD/MTIHM, 3 CYCLE
173      HED      -10    FUEL DIS
174      HED      -1     FUEL CHG
175      MOV      -1    1    0   1.0
176      MOV     -10    2    0   1.0
177      RDA     ***** DECAY MODULE *****
178      DEC     0.5   2   3   5   2
179      DEC     1.0   3   4   5   0
180      DEC     3.0   4   5   5   0
181      DEC     5.0   5   6   5   0
182      DEC    10.0   6   7   5   0
183      DEC    30.0   7   8   5   0
184      OPTL    4*8   7   8   3*7 19*8
185      OPTA    4*8   7   8   3*7 19*8
186      OPTF    4*8   7   8   3*7 19*8
187      OUT      8    1     -1    0
188      TIT   ORIGEN2 V2.1 - PWR ASSEMBLY - EXTENDED BURNUP (PWRUE)
189      BAS   1 17X17 PWR ASSEMBLY; 4.73% UO2, BURNUP=60,000 MWD/MTIHM, 3 CYCLE
190      OPTL    4*8   7   8   3*7 19*8
191      OPTA    4*8   7   8   3*7 19*8
192      OPTF    4*8   7   8   3*7 19*8
193      MOV     -10   1   0  0.4614
194      ADD      -9   1   0  0.4614
195      ADD      -8   1   0  0.4614
196      ADD      -7   1   0  0.4614
197      ADD      -6   1   0  0.4614
198      ADD      -5   1   0  0.4614
199      HED     1    ASSY DIS
200      RDA     ***** DECAY MODULE *****
201      DEC     0.5   1   2   5   2
202      DEC     1.0   2   3   5   0
203      DEC     3.0   3   4   5   0
204      DEC     5.0   4   5   5   0
205      DEC    10.0   5   6   5   0
206      DEC    30.0   6   7   5   0
207      OUT      7    1     -1    0
208      END
209     2 922340 428.5   922350 47300.  922380 952271.5     0 0.0    UO2 4.73%
210     4 030000 1.0     050000 1.0     060000 89.6    070000 25.0   IMPURITY
211     4 080000 134454. 090000 10.7    110000 15.0    120000 20.0   IMPURITY
212     4 130000 16.7    140000 12.1    150000 35.0    170000 5.3    IMPURITY
213     4 200000 2.0     220000 1.0     230000 3.0     240000 4.0    IMPURITY
214     4 250000 1.7     260000 18.0    270000 1.0     280000 24.0   IMPURITY
215     4 290000 1.0     300000 40.3    420000 10.0    470000 0.1    IMPURITY
216     4 480000 25.0    490000 2.0     500000 4.0     640000 2.5    IMPURITY
217     4 740000 2.0     820000 1.0     830000 0.4     0      0.0    IMPURITY
218      0
219     4 010000 0.013   050000 0.00033 060000 0.120   070000 0.080    ZIRC-4
220     4 080000 0.950   130000 0.024   140000 0.0     150000 0.0      ZIRC-4
221     4 160000 0.035   220000 0.020   230000 0.020   240000 1.25     ZIRC-4
222     4 250000 0.020   260000 2.25    270000 0.010   280000 0.02     ZIRC-4
223     4 290000 0.020   400000 979.11  410000 0.0     420000 0.0      ZIRC-4
224     4 480000 0.00025 500000 16.0    720000 0.078   740000 0.020    ZIRC-4
225     5 920000 0.0002       0 0.0                                    ZIRC-4
226      0
227     4 010000 0.0     050000 0.0     060000 0.8     070000 1.3      SS-304
228     4 080000 0.0     130000 0.0     140000 10.0    150000 0.45     SS-304
229     4 160000 0.3     220000 0.0     230000 0.0     240000 190.0    SS-304
230     4 250000 20.0    260000 688.44  270000 0.8     280000 89.2     SS-304
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231     4 290000 0.0     400000 0.0     410000 0.0     420000 0.0      SS-304
232     4 480000 0.0     500000 0.0     720000 0.0     740000 0.0      SS-304
233     5 920000 0.0          0 0.0                                    SS-304
234      0
235     4 010000 0.0     050000 0.0     060000 1.5     070000 1.3      SS-302
236     4 080000 0.0     130000 0.0     140000 10.0    150000 0.45     SS-302
237     4 160000 0.3     220000 0.0     230000 0.0     240000 180.0    SS-302
238     4 250000 20.0    260000 697.74  270000 0.8     280000 89.2     SS-302
239     4 290000 0.0     400000 0.0     410000 0.0     420000 0.0      SS-302
240     4 480000 0.0     500000 0.0     720000 0.0     740000 0.0      SS-302
241     5 920000 0.0          0 0.0                                    SS-302
242      0
243     4 010000 0.0     050000 0.0     060000 0.4     070000 1.3     INC-718
244     4 080000 0.0     130000 5.992   140000 1.997   150000 0.0     INC-718
245     4 160000 0.07    220000 7.99    230000 0.0     240000 189.753 INC-718
246     4 250000 1.997   260000 179.766 270000 4.694   280000 519.625 INC-718
247     4 290000 0.999   400000 0.0     410000 55.458  420000 29.961  INC-718
248     4 480000 0.0     500000 0.0     720000 0.0     740000 0.0     INC-718
249     5 920000 0.0          0 0.0                                   INC-718
250      0
251     4 010000 0.0     050000 0.05    060000 0.1     070000 0.066   NICR-50
252     4 080000 0.043   130000 0.1     140000 0.511   150000 103.244 NICR-50
253     4 160000 0.1     220000 0.1     230000 0.0     240000 149.709 NICR-50
254     4 250000 0.1     260000 0.471   270000 0.381   280000 744.438 NICR-50
255     4 290000 0.0     400000 0.1     410000 0.0     420000 0.0     NICR-50
256     4 480000 0.0     500000 0.0     720000 0.0     740000 0.1     NICR-50
257     5 920000 0.0          0 0.0                                   NICR-50
258      0
259
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