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1. Purpose

The purpose of this design analysis is to determine the accuracy of the SAS2H module of SCALE 4.3 in predicting isotopic concentrations of spent fuel assemblies. The objective is to develop a methodology for modeling assemblies similar to those evaluated within this analysis and to establish the consistency of SAS2H predictions. The results of this analysis may then be applied to future depletion calculations using SAS2H in which no measurements are available.

2. Quality Assurance

The Quality Assurance (QA) program applies to this analysis. The work reported in this document is part of the Waste Package Design analysis that will eventually support the License Application Design phase. This activity, when appropriately confirmed, can impact the proper functioning of the Mined Geologic Disposal System (MGDS) waste package; the waste package has been identified as an MGDS Q-List item important to safety and waste isolation (pp. 4, 15, Reference 5.1). The waste package is on the Q-List by direct inclusion by the Department of Energy (DOE), without conducting a QAP-2-3 evaluation. The Waste Package Development Department (WPDD) responsible manager has evaluated this activity in accordance with QAP-2-0, *Conduct of Activities*. The *Perform Criticality, Thermal, Structural, and Shielding Analyses* (Reference 5.2) evaluation has determined the preparation and review of this design analysis is subject to *Quality Assurance Requirements and Description* (Reference 5.3) requirements. As specified in NLP-3-18, this activity is subject to QA controls.

The analysis described in this document supports development of the disposal criticality analysis methodology. No designs were analyzed in this document. This document will not directly support any construction, fabrication, or procurement activity and therefore is not required to be procedurally controlled as TBV (to be verified). The calculation design inputs or information used in this document come from data accepted by the Nuclear Regulatory Commission and by the scientific and engineering community as established fact. The specific references are listed in Section 5 and identified in Section 7. The information is therefore not treated as unqualified data

3. Method

The analytical model employed for this analysis was the SAS2H module of the SCALE sequence. Based upon fuel design, power history, and operating data for specific assemblies in theYankee Rowe pressurized water reactor (PWR), a computational model was developed for use with the SAS2H module of SCALE. The SAS2H module is used to perform a fuel depletion analysis to predict the isotopic concentrations in localized areas of assembly pins (pellet samples) subsequent to irradiation and cooling time. The isotopic concentrations predicted by the SAS2H module are then compared with measured concentrations of the same localized areas (axial locations) of the assembly pins to determine the accuracy of the developed model. The measured isotopic concentrations used for comparisons in the analysis are obtained from a separate report (Reference 5.5).

4. Design Inputs

The sources for the design parameters are References 5.4 through 5.8. Reference 5.4 provides information on molar masses; the assembly design, power history and operating parameters are obtained from References 5.5 through 5.7; the cladding composition from References 5.8 and 5.9; and a list of trace elements in the fuel is derived from Reference 5.10.

4.1 Design Parameters

The molar masses of selected elements are obtained from Reference 5.4 and are provided below within three significant figures. Precision beyond three significant figures is not necessary since calculated isotopic concentrations from SCALE are only to three significant figures. Also, the weight per mole of enriched uranium is approximated by the weight per mole of natural uranium since the weight percent of enrichment is small.

Mole of natural uranium = 238 g,
6.02×10^{23} atoms per mole. (Reference 5.4)

General spent fuel characteristics for each pellet sample are presented in Table 4-1 and include the initial ^{235}U enrichment, final burnup and the cooling time (Section 2.1.1, Reference 5.5). The initial enrichment for all samples is 3.40 wt% ^{235}U and the burnup ranges from 15.95 to 35.97 GWd/MTU. The cooling time for the sample E6-C-f6 at 138.94 cm is 717 days and for the other samples is 281.5 days. Reference 5.5 indicates that the measured isotopic concentrations for ^{241}Pu were back calculated to a zero cooling time.

Assembly design parameters are presented in Table 4-2 (Section 2.1.1, Reference 5.5; p. 2-1, Reference 5.6). The samples come from a special design, Westinghouse 17 x 18 assembly with an empty cell in the center for a flux wire thimble. A diagram of the cross section of the Yankee Rowe assembly is given in Figure 4-1. Since only 22 out of the 76 assemblies were equipped with the thimble, it is assumed that the thimble is not present. The assembly is in effect a square 18 x 18 lattice without 18 of its outer cell positions, which accommodates cruciform blades. In the Yankee Rowe core there are 76 square assemblies and 32 cruciform blades, of which 24 are Ag-In-Cd control blades and 8 are zircaloy shims.

It is assumed that the controls blades are not inserted during Cycles I, II or IV, since accurate information about the control blades composition and movement could not be obtained. However, the zircaloy shims occupied some of the outer ring of control blade positions during each cycle. Although the placement of the assembly during Cycle I is unknown, the placement during Cycles II and IV are in the center of the core, so that the effect of the zircaloy shims would not be significant. Therefore, it is assumed that samples from the assembly examined do not experience the effects of the zircaloy shims. Furthermore, Cycle IV contained 72 assemblies enriched to 4.1 wt.

% ^{235}U; however, due to the limitations of the SAS2H module, it is assumed that all assemblies were enriched to 3.4 wt % ^{235}U (pp. 2-1 through 2-5, Reference 5.6).

The operating parameters in Table 4-3 include the uptime and downtime, cumulative burnups, specific powers, and average cycle boron concentrations (Table 2.1-2 and Appendix A, Reference 5.5). The temperatures of the fuel, cladding and moderator, and the moderator density are presented in Table 4-4 (Table 2.1-2, Reference 5.5). The moderator density is obtained from Appendix A of Reference 5.5 (pp. A-2 and A-3). Unfortunately, Reference 5.5 does not describe the operating data in sufficient detail to determine its accuracy. However, Reference 5.6 (pp. 2-7 through 2-9) provides diagrams of the power history and indicates that the assembly resided in the core during low power testing prior to Cycle I, which are not indicated by Reference 5.5. Although the information in Reference 5.6 is not in sufficient detail to allow accurate modeling, it does indicate that the operating data obtained from Reference 5.5 may have been simplified.

The composition of the cladding, stainless steel 348, is presented in Table 4-5, and has a density of 8.03 g/cm^3 (Table 8, p. 151, Reference 5.8; p. 46, Reference 5.9). However, SCALE 4.3 does not recognize the isotope ^{180}Ta, which is 0.012 wt % of natural tantalum. Since only one other isotope of tantalum exists and the weight percent of ^{181}Ta is small, tantalum is approximated as consisting of only ^{181}Ta. A list of trace elements in the fuel used in updating cross sections during the depletion analysis are presented in Table 4-6 and developed with consideration of elements used in Table 1 of Reference 5.10. A generic set of light element weights for PWRs that is typically used in depletion analyses is included in Table 4-7 (Table 17, Reference 5.7). Variations in light element masses per unit fuel in different PWRs are small when compared to this generic set (p. 2-2, Reference 5.9). This data is provided in units of kg/MTUO_2 or kg/MTU depending on the units required in the analysis.

Measured isotopic concentrations are presented in Table 4-8 and are given in g/MTU (Table 2.1-3, Reference 5.5). The measurements were performed as part of the Yankee Core Evaluation (EYC) Program, a three phase program that performed radiochemical analyses on fuel pellet samples. Samples analyzed in this report are from Phase 3, which examined samples from an assembly that was irradiated in Cycles I, II and IV. Note that the concentration of ^{241}Pu was back calculated to the time of discharge, with a cooling time of zero days (pp. 2-10, Reference 5.5).

Table 4-1. Spent Fuel Characteristic Parameters for Yankee Rowe PWR

Assembly and Rod Number	Axial Location from Bottom of Assembly, cm	Enrichment, wt % ^{235}U	Burnup, GWd/MTU	Cooling Time, days
E6-C-f6	220.22	3.400	15.95	281.5
E6-C-f6	138.94	3.400	30.39	717.0
E6-C-f6	57.66	3.400	31.33	281.5
E6-C-f6	17.02	3.400	20.19	281.5
E6-SE-c2	138.94	3.400	32.03	281.5
E6-SE-c2	57.66	3.400	31.41	281.5
E6-SE-e4	138.94	3.400	35.97	281.5
E6-SE-e4	57.66	3.400	35.26	281.5

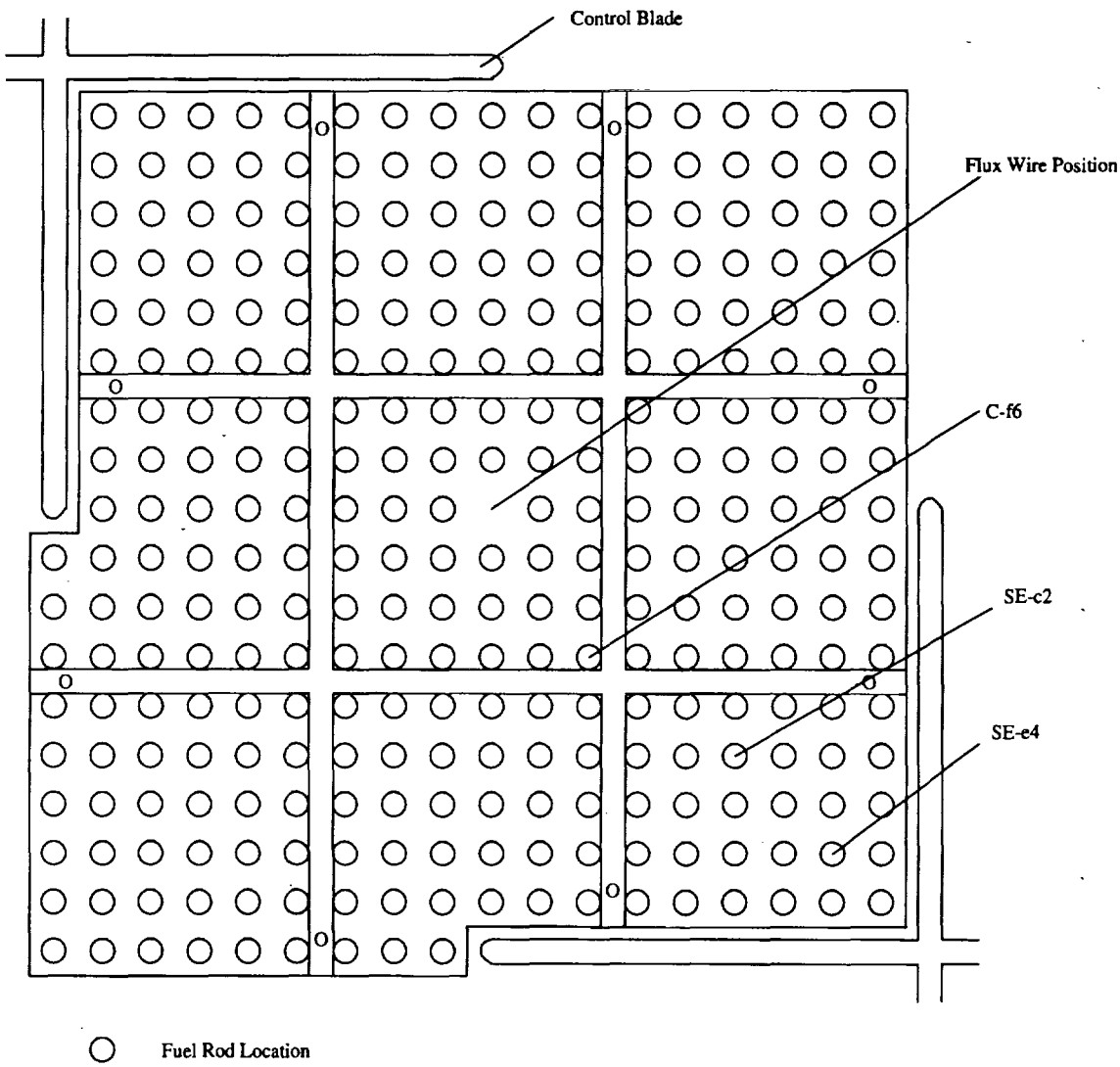
Reference 5.5

Table 4-2. Assembly Design Parameters for Yankee Rowe PWR

Parameter	Data
Core Data:	
Number of Rods per Core	23,142
Uranium Fuel Loading, kg U	20,908
Assembly General Data:	
Designer	Westinghouse
Type	17 x 18
Number of Fuel Rods	305
Number of Instrument Cells	1
Assembly Pitch, cm	19.46
Enrichment:	
wt % ^{234}U	0.020
wt % ^{235}U	3.400
wt % ^{236}U	0.020
wt % ^{238}U	96.56
Fuel Rod Data:	
Type of Fuel Pellet	UO_2
Pellet Density, g/cm^3	10.18
Rod Pitch, cm	1.072
Rod Outside Diameter (OD), cm	0.864
Rod Inside Diameter (ID), cm	0.757
Pellet Diameter, cm	0.747
Active Fuel Length, cm	230.05[a]
Clad Material	SS-348

[a]The active fuel length was given as 90.57 inches in Reference 5.6 and converted to cm by the following relation: 1 in. = 2.54 cm.
References 5.5 and 5.6

Figure 4-1. Cross Section of Yankee Rowe Assembly



Reference 5.5

Table 4-3. Operating Data for Yankee Rowe PWR

	Sample Identifier	Axial Location, cm	Cycle I	Cycle II	Cycle IV
Uptime, days	all	all	451.5	333.1	337.0
Downtime, days	all	all	129.0	370.0	See Table 4-1
Cumulative Burnup, GWd/MTU	E6-C-f6	220.22	5.90	10.23	15.95
	E6-C-f6	138.94	12.53	22.78	30.39
	E6-C-f6	57.66	13.29	23.54	31.33
	E6-C-f6	17.02	8.19	14.54	20.19
	E6-SE-c2	138.94	13.20	24.01	32.03
	E6-SE-c2	57.66	13.33	23.30	31.41
	E6-SE-e4	138.94	14.83	26.97	35.97
	E6-SE-e4	57.66	14.96	26.15	35.26
Specific Power, MW/MTU	E6-C-f6	220.22	13.07	13.00	16.97
	E6-C-f6	138.94	27.74	30.79	22.57
	E6-C-f6	57.66	29.44	29.86	24.01
	E6-C-f6	17.02	18.14	19.07	16.76
	E6-SE-c2	138.94	29.24	32.45	23.79
	E6-SE-c2	57.66	29.51	29.93	24.07
	E6-SE-e4	138.94	32.84	36.44	26.72
	E6-SE-e4	57.66	33.13	33.60	27.02
Boron Concentration, ppm	1 hour	all	0	0	835
	2022 hours	all	0	0	707
	2022 hours	all	0	0	337
	4044 hours	all	0	0	0

Reference 5.5

Table 4-4. Operating Temperatures for Yankee Rowe PWR

	Sample Identifier	Axial Location, cm	Cycle I	Cycle II	Cycle IV	Average H_2O Density, g/cm^3
Moderator Temperature, K	E6-C-f6	220.22	548	549	549	0.77017
	E6-C-f6	138.94	541	541	540	0.78338
	E6-C-f6	57.66	531	531	534	0.79733
	E6-C-f6	17.02	527	527	531	0.80256
	E6-SE-c2	138.94	541	541	540	0.78338
	E6-SE-c2	57.66	531	531	534	0.79733
	E6-SE-e4	138.94	541	541	540	0.78338
	E6-SE-e4	57.66	531	531	534	0.79733
Cladding Temperature, K	E6-C-f6	220.22	558	559	561	
	E6-C-f6	138.94	560	563	557	
	E6-C-f6	57.66	551	552	550	
	E6-C-f6	17.02	540	540	543	
	E6-SE-c2	138.94	560	563	557	
	E6-SE-c2	57.66	540	552	550	
	E6-SE-e4	138.94	560	563	557	
	E6-SE-e4	57.66	540	552	550	
Fuel Temperature, K	E6-C-f6	220.22	755	755	800	
	E6-C-f6	138.94	894	915	848	
	E6-C-f6	57.66	885	889	847	
	E6-C-f6	17.02	788	796	777	
	E6-SE-c2	138.94	894	915	848	
	E6-SE-c2	57.66	885	889	847	
	E6-SE-e4	138.94	894	915	848	
	E6-SE-e4	57.66	885	889	847	

Reference 5.5

Table 4-5. Composition of SS-348

Material	Weight Percent
C	0.08
Mn	2.00
P	0.045
S	0.030
Si	0.75
Cr	18.00
Ni	11.00
Cb	0.70
Ta	0.10
Co	0.20
Fe	67.095

References 5.8 and 5.9

Table 4-6. Nuclides Updated in SAS2H

^{83}Kr	^{85}Kr	^{89}Y	^{90}Sr	^{95}Mo	^{93}Zr
^{94}Zr	^{94}Nb	^{95}Zr	^{99}Tc	^{101}Ru	^{103}Rh
^{105}Rh	^{106}Ru	^{105}Pd	^{108}Pd	^{109}Ag	^{124}Sb
^{131}Xe	^{132}Xe	^{134}Cs	^{135}Xe	^{135}Cs	^{136}Xe
^{136}Ba	^{137}Cs	^{139}La	^{141}Pr	^{143}Pr	^{143}Nd
^{144}Ce	^{145}Nd	^{147}Nd	^{147}Pm	^{147}Sm	^{148}Pm
^{149}Sm	^{150}Sm	^{151}Sm	^{152}Sm	^{153}Eu	^{154}Eu
^{155}Gd	^{155}Eu				

Reference 5.10

Table 4-7. Light Element Mass per Unit of Fuel for a Typical PWR

Element	kg/MTU
O	135.0
Cr	5.9
Mn	0.33
Fe	13.0
Co	0.075
Ni	9.9
Zr	221.0
Nb	0.71
Sn	3.6

Reference 5.7

Table 4-8. Measured Isotopic Concentrations (g/MTU)

Sample	E6-C-f6	E6-C-f6	E6-C-f6	E6-C-f6	E6-SE-c2	E6-SE-c2	E6-SE-e4	E6-SE-e4
Location, cm	220.22	138.94	57.66	17.02	138.94	57.66	138.94	57.66
Burnup, GWd/MTU	15.95	30.39	31.33	20.19	32.03	31.41	35.97	35.26
^{234}U	155	142	119	144	114	115	118	120
^{235}U	19800	12600	11900	17200	11800	11900	9780	9840
^{236}U	2880	4080	4150	3300	4180	4090	4450	4440
^{238}U	949000	937000	935000	936000	935000	936000	933000	934000
^{238}Pu	47.3	176	214	79.1	222	211	247	240
^{239}Pu	5950	7870	8010	6600	7980	7680	6950	6820
^{240}Pu	1120	2120	2260	1440	2370	2270	2570	2480
^{241}Pu	663	1540	1640	915	1670	1580	1680	1620
^{242}Pu	80.3	346	398	145	422	400	552	529

Reference 5.5

4.2 Criteria

The design of the waste package will depend on waste package configuration criticality analyses performed using an acceptable disposal criticality analysis methodology. Criteria that relate to the development and design of repository and engineered barrier components are derived from the applicable requirements and planning documents. The Engineered Barrier Design Requirements Document (EBDRD, Reference 5.13) provides requirements for engineered barrier segment design. The Repository Design Requirements Document (RDRD, Reference 5.14) provides requirements for repository design. The Controlled Design Assumptions Document (Reference 5.15) provides guidance for requirements listed in the EBDRD and RDRD which have unqualified or unconfirmed data associated with the requirement.

This analysis supports the disposal criticality analysis methodology by providing input, in the form of fuel depletion results, to benchmark calculations which address the prediction of both spent fuel isotopic compositions and their associated reactivity. These benchmark calculations will contribute to the determination of bias values in the method of critical multiplication factor calculation that is implemented by the analytic tools to be used in the disposal criticality methodology. The requirements for utilizing the bias in the method of calculation of the critical multiplication factor for disposal configurations containing spent nuclear fuel are located in Section 3.2.2.5 of the RDRD and Section 3.2.2.6 of the EBDRD. This analysis does not satisfy these requirements, but the results from this analysis will be used as input to subsequent analyses which will satisfy these requirements.

4.3 Assumptions

4.3.1 It is assumed that the flux wire thimble was not present in the empty unit cell. The basis for this assumption is that there were only 22 out of 76 assemblies equipped with a thimble and data could not be obtained on the dimensions and composition of the thimble. Therefore, the probability of the assembly containing the thimble is low and the thimble dimensions and compositions would have had to be assumed. This assumption is used throughout Section 7.

4.3.2 It is assumed that effects from the zircaloy shims are negligible. The basis for this assumption is that during Cycles II and IV the assembly was loaded in the center of the core and the zircaloy shims were located in the outer ring of the cruciform positions, so that effects of the zircaloy shims would not be experienced by the assembly during these cycles. However, it is not known where the assembly resided during Cycle I, which could have been next to a zircaloy shim. This assumption is used throughout Section 7.

4.4 Codes and Standards

There are no applicable codes or standards for this design analysis.

5. References

5.1 *Yucca Mountain Site Characterization Project Q-List*, YMP/90-55Q REV 4, Yucca Mountain Site Characterization Project.

5.2 *QAP-2-0 Activity Evaluations: ID #WP-20, Perform Criticality, Thermal, Structural, and Shielding Analyses*, Civilian Radioactive Waste Management System (CRWMS) Management and Operating Contractor (M&O), August 3, 1997.

5.3 *Quality Assurance Requirements and Description*, DOE/RW-0333P REV 7, U.S. Department of Energy (DOE) Office of Civilian Radioactive Waste Management (OCRWM).

5.4 *Nuclides and Isotopes*, General Electric Company, 14ed., 1989.

5.5 *Isotopic and Criticality Validation for PWR-Actinide Only Burnup Credit*, DOE/RW-0497, DOE OCRWM.

5.6 *Supplementary Report on Evaluation of Mass Spectrometric and Radiochemical Analyses of Yankee Core I Spent Fuel, Including Isotopes of Elements Thorium Through Curium*, WCAP-6086, Westinghouse Electric Corporation.

5.7 *Validation of the Scale System for PWR Spent Fuel Isotopic Composition Analyses*, ORNL/TM-12667, Oak Ridge National Laboratory, March 1995.

5.8 *Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels*, ASTM Designation: A240-91a.

5.9 C. F. Lewis, *Materials Engineering: Materials Selector 1991*, Penton Publishers, Cleveland, OH, December 1990.

5.10 *SCALE-4 Analysis of Pressurized Water Reactor Critical Configurations: Volume 2-Sequoyah Unit 2 Cycle 3*, ORNL/TM-12294/V2, March 1995.

5.11 *SCALE 4.3, A Modular Code System for Performing Standardized Computer Analyses for Licensing Evaluation for Workstations and Personal Computers*, NUREG/CR-0200 REV 5, ORNL/NUREG/CSD-2/R5, Volumes 1-3, Oak Ridge National Laboratory.

5.12 *Software Qualification Report for the SCALE Modular Code System*, Document Identifier Number: 30011-2002 REV 01, CRWMS M&O.

5.13 *Engineered Barrier Design Requirements Document,* YMP/CM-0024, REV 00, ICN 01, DOE OCRWM.

5.14 *Repository Design Requirements Document,* YMP/CM-0023, REV 00, ICN 01, DOE OCRWM.

5.15 *Controlled Design Assumptions Document*, DI#: B00000000-01717-4600-00032 REV 04, ICN 01, CRWMS M&O.

6. Use of Computer Software

A. Reference 5.11 describes the SAS2H module of SCALE 4.3 that is used with the 44GROUPNDF5 cross section library to calculate the isotopic concentrations for the specified burnup and cooling time. The computer code's spatially independent point depletion model is appropriate for comparison with pellet sample measurements, and is used within the range of validation, as described in Reference 5.12, in accordance with the QAP-SI series procedures. SCALE is obtained from the Software Configuration Management in accordance with appropriate procedures. SCALE's CSCI number is 30011 V4.3 and is installed on the WPDD HP 9000, 700 Workstation with CRWMS M&O tag number 110433.

B. *Lotus 1-2-3* Release 5 for Windows 95 is an Acquired Software spreadsheet program as defined in QAP-SI-0. User defined formulas and/or algorithms, inputs and results, are documented in the appropriate sections.

7. Design Analysis

The SAS2H module of SCALE 4.3 is used to perform one-dimensional (1-D) neutron transport and point depletion analyses on the Yankee Rowe assemblies using the preferred 44GROUPNDF5 cross-section library. To properly model the neutron flux spectrum and the nuclide composition changes, it is necessary to define the compositions, temperatures, and geometry of the fuel assembly. This is accomplished with the use of data blocks in which similar parameters are grouped together.

7.1 SCALE Input Data Blocks 1, 2, and 3

Data blocks 1 through 3 define the SCALE module to be used, the title of the input file, the cross section library to be used, and the lattice type to be modeled. The module used is SAS2H and the cross sectional library is 44GROUPNDF5, abbreviated as 44GROUP. The 44GROUP cross section library is recommended by Oak Ridge National Laboratory. Since SAS2H is only to be used for isotopic depletion/generation, the 'parm=skipshipdata' option is used so that a shipping cask shielding analysis is not performed. The title is arbitrary and should contain information that is sample specific, while the lattice type is "latticecell" to reflect the array characteristic of the assembly.

7.2 SCALE Input Data Block 4

Data block 4 defines the material compositions present in the assembly. A unique mixture number is assigned to each composition, and follows the form of mixture 1 for fuel, mixture 2 for cladding and mixture 3 for moderator.

The fuel mixture is specified as UO_2 with isotopic weight percentages from Table 4-2. The stack density is calculated from the fuel dimensions and the initial uranium fuel loading, with the following equation:

$$StackDensity = \frac{ULoad}{(NFR)(\frac{\pi}{4})(PDia.)^2(FuelLength)}\left(\frac{1000gU}{1kgU}\right)\left(\frac{270gUO_2}{238gU}\right) \qquad \text{Equation 7-1}$$

Where:

StackDensity = Fuel Stack Density (gUO_2/cm^3)
Uload = Initial Uranium Fuel Loading of the Entire Core ($kgUO_2$)
NFR = Number of Fuel Rods in the Entire Core
PDia. = Fuel Pellet Diameter (cm)
FuelLength = Active Fuel Length (cm)

The resulting stack density is 10.17 gUO_2/cm^3, compared to the pellet density of 10.18 gUO_2/cm^3. Therefore, it is believed that the pellet density reported in Table 4-2 is the stack density, with the

difference being a result of rounding, and is used for mixture 1. Fuel temperatures for the samples during each cycle are presented in Table 4-4 and the temperature during Cycle I is input for the fuel temperature specification in data block 4. The other cycle fuel temperatures are input in data block 9. Isotopes which are selected as needing their cross sections updated during the depletion analysis are included in the fuel mixture. A standard list of trace fuel elements is given in Table 4-6 and defined in the fuel mixture to have a concentration of 10^{-20} atoms/barn·cm.

The cladding material is stainless steel 348 with a material composition given in Table 4-5 and a temperature derived from Table 4-4 by averaging the cladding temperature over the three cycles. The cladding temperatures used for each sample are presented in Table 7-1.

The moderator temperature, density and boron concentration are given in Tables 4-3 and 4-4. The moderator is composed of H_2O and boron. The moderator temperature is determined by averaging the temperature over the three cycles and is presented in Table 7-1. The boron is defined as an arbitrary material with the moderator density and temperature, a volume fraction equal to a cycle average boron concentration of 1 ppm, and a standard boron composition from the Standard Composition Library designated as 5000. A boron concentration of 1 ppm is used to approximate a zero boron concentration so that a boron concentration may be specified for Cycle IV in data block 9, Section 7.5. Included in Table 7-1 is the value of the average boron concentration for Cycle IV, which is calculated by maintaining the cumulative boron concentration over time, as specified in Table 4-3.

Table 7-1. Average Cladding and Moderator Temperatures

Sample	Location	Cladding Temperature, K	Moderator Temperature, K	Cycle IV Boron Concentration, ppm
E6-C-f6	220.22	559	549	261
E6-C-f6	138.94	560	541	261
E6-C-f6	57.66	551	532	261
E6-C-f6	17.02	541	528	261
E6-SE-c2	138.94	560	541	261
E6-SE-c2	57.66	547	532	261
E6-SE-e4	138.94	560	541	261
E6-SE-e4	57.66	547	532	261

7.3 SCALE Input Data Blocks 5 Through 7

The unit fuel rod cell geometry is defined in data block 5. The 'squarepitch' designation for the type of lattice is appropriate since the fuel assembly consists of a square array of fuel rods. Fuel rod, cladding and pitch dimensions are given in Table 4-2 with the mixture number for each composition defined in Section 7.2. The gap mixture is defined as 0.

Data block 6 allows the user to specify such parameters as the spatial mesh, angular quadrature and the convergence criteria. It is determined that the default values are sufficient and such options are not used in this design model.

In data block 7 the user defines general assembly data and determines the level of detail in which the assembly is to be modeled. The number of fuel rods per assembly is given in Table 4-2 and the length is calculated so that an assembly contains 1 MTU, using the following equation:

$$Length = \frac{1}{\frac{\pi}{4}(POD)^2(PDen)(NFR)} * \frac{270gUO_2}{238gU} * \frac{10^6 gU}{1MTU} \qquad \text{Equation 7-2}$$

Where:
Length = Length Required for an Assembly to Contain 1 MTU (cm)
POD = Fuel Pellet Diameter (cm)
PDen = Fuel Pellet Density (gUO_2/cm^3)
NFR = Number of Fuel Rods

Since measured isotopic concentrations are presented in grams of isotope per Metric Ton of Uranium (MTU) and SCALE presents concentrations in grams of isotope per assembly, it is possible to alter the length so that the assembly contains 1 MTU. This is possible since the 1-D transport calculation is axially independent. Consequently, the length of the assembly does not impact the neutron flux spectrum nor the nuclide cross sections. The resulting length for the Yankee Rowe assembly is 833.69 cm.

The assembly was irradiated for three cycles. It is determined that approximately 80 days per cross section library is sufficient to accurately model the change in nuclide cross sections with increasing burnup, without over-burdening the SAS2H code. Therefore, the number of libraries per cycle are specified as five. To obtain the concentrations of all interested nuclides, a print level of 5 is chosen, while an input level of 2 is defined so that a Path B model may be utilized. The number of light elements is nine and is determined from Table 4-7, while the number of zones is three which is determined by the Path B model described in Section 7.4.

7.4 SCALE Input Data Block 8

The Path B model for Yankee Rowe centralizes the empty cell in the center of the assembly, which is surrounded by the homogenized fuel and moderator mixture, and finally, the moderator between assemblies. It is noted that if information concerning the control blade insertion could have been obtained, then the Path B model would incorporate structure to properly model control blade insertion histories. The equations below are used to determine the number of fuel unit cells that surround the empty unit cell, by conserving the fuel to moderator volume ratio. All of the following equations used to calculate the Path B model dimensions are derived. The results of the fuel-unit-cell calculations are presented in Table 7-2, and the resulting Path B model dimensions are presented in Table 7-3.

$$x = \frac{(\frac{F}{M})(CUCMV)}{(FV) - (\frac{F}{M})(MV)} \qquad \text{Equation 7-3}$$

$$\frac{F}{M} = \frac{(NFR)(\frac{\pi}{4})(POD)^2}{(NFR)[RP^2 - (\frac{\pi}{4})(COD)^2] + [RP^2]} \qquad \text{Equation 7-4}$$

$$CUCMV = RP^2 \qquad \text{Equation 7-5}$$

$$FV = (\frac{\pi}{4})(POD)^2 \qquad \text{Equation 7-6}$$

$$MV = RP^2 - (\frac{\pi}{4})(COD)^2 \qquad \text{Equation 7-7}$$

Where:

x = Number of Unit Fuel Cells per Empty Unit Cell
F/M = Fuel to Moderator Volume Ratio
NFR = Number of Fuel Rods
POD = Fuel Pellet Outer Diameter
RP = Rod Pitch
COD = Cladding Outer Diameter
CUCMV = Central Unit Cell Moderator Volume
FV = Fuel Volume of One Fuel Unit Cell
MV = Moderator Volume of One Fuel Unit Cell

Once the number of fuel cells per empty unit cell is determined, the geometry of the Path B model is calculated. Since the empty unit cell is centralized, the dimensions of the radius for the moderator in the empty unit cell is calculated with the following equation:

$$R_1 = \sqrt{(\frac{1}{\pi})RP^2} \qquad \text{Equation 7-8}$$

Where:
R_1 = Radius of Central Moderator Zone

The area of an annular region is calculated by the difference between the outer circular area and the inner circular area. Equation 7-9 is the basis for the Equations 7-10 and 7-11 which determine the radii of the homogenized fuel zone and the outer moderator zone.

$$ARA = \pi(ORAR^2 - IRAR^2) \qquad \text{Equation 7-9}$$

Where:
ARA = Annular Region Area
ORAR = Outer Radius of Annular Region
IRAR = Inner Radius of Annular Region

The area of the homogenized fuel zone surrounding the guide tube unit cell is equal to the number of fuel unit cells surrounding the guide tube multiplied by the area of a fuel unit cell. Consequently, the radius of the homogenized fuel zone is computed with the following equation:

$$R_2 = \sqrt{(\frac{x}{\pi})RP^2 + R_1^2} \qquad \text{Equation 7-10}$$

Where:
R_2 = Radius of Homogenized Fuel and Moderator Zone

The mixture number of the homogenized fuel and moderator mixture must be specified as 500. The code then determines the composition of the region based upon the dimensions and mixtures specified in the fuel unit cell data block 5.

The moderator in the channel between assemblies is determined by calculating the total moderator volume and multiplying by the fraction of unit cells in the larger unit cell of the Path B model. The total moderator volume between assemblies is determined by the assembly pitch and the fuel cell pitch multiplied by the number of unit cells. The radius of the moderator between assemblies is calculated from the following equation:

$$R_3 = \sqrt{\frac{(x+1)}{\pi * NCell}[AP^2 - (NCell)(RP^2)] + R_2^2} \qquad \text{Equation 7-11}$$

Where:

R_3 = Radius of Moderator Surrounding Assembly Zone
NCell = Number of Cells in Assembly
AP = Assembly Pitch

Table 7-2. Calculation of Fuel Unit Cell per Guide Tube Unit Cell

F/M	CUCMV, cm^2	FV, cm^2	MV, cm^2	x
0.7734	1.1492	0.4383	0.5629	305

Table 7-3. Path B Model Dimensions

	R_1	R_2	R_3
Radius, cm	0.6048	10.5799	10.9791
Composition	Moderator	Fuel/Moderator	Moderator

7.5 SCALE Input Data Blocks 9 Through 16

Data block 9 is used to describe the power history of the reactor. The specific power, fuel irradiation period, the length of downtime, the fraction of boron and moderator density, and the temperature during the cycle may all be defined. The specific power is in units of MW/MTU while the irradiation period and length of downtime are both defined in days and are given in Table 4-3. The moderator density is assumed constant for all cycles and the boron fraction is determined by dividing the cycle average boron concentration found in Table 7-1 by the boron concentration specified in data block 4, Section 7.2. The individual cycle temperatures are given in Table 4-4. The boron fraction is specified with the command 'bfrac=' and the temperature with 'temkcyc='.

Light elements and their effective weight, in kg per assembly, are entered in data block 10. Table 4-7 provides a generic set of light elements from a typical PWR and their weights, in kg per MTU. Since the fuel length is altered so that there is 1 MTU per assembly the use of light elements with weights of kg per MTU is appropriate.

Data blocks 11 through 15 describe parameters used in the radial shielding analysis of a shipping cask and are not necessary in performing the depletion analyses. Data block 16 denotes the end of the SCALE input.

7.6 Comparison of Calculated and Measured Concentrations

Comparisons of corresponding calculated and measured concentrations are performed on a percent difference basis. The difference between the measured and the calculated value is divided by the measured value to determine the accuracy of the SAS2H calculation. A positive percent difference represents an over-prediction by the code, while a negative percent difference represents an under-prediction by the code. The measured concentrations are given in Table 4-8, calculated concentrations are presented in Table 7-4 and the percent differences are presented in Table 7-5. Isotopic concentrations of ^{241}Pu are obtained for a zero cooling time since the measured ^{241}Pu concentrations were back calculated to that time.

7.7 Results

SAS2H predicted isotopic concentrations are presented in Table 7-4. The calculated concentrations are obtained through the methodology described in Sections 7.1 through 7.5, and with the input parameters defined in Section 4.1. Calculated concentrations are compared with measured concentrations as described in Section 7.6 to determine the accuracy of the SAS2H code. Results of the comparison, in the form of percent differences, are presented in Table 7-5.

Table 7-4. Calculated Isotopic Concentrations (g/MTU)

Sample	E6-C-f6	E6-C-f6	E6-C-f6	E6-C-f6	E6-SE-c2	E6-SE-c2	E6-SE-e4	E6-SE-e4
Location, cm	220.22	138.94	57.66	17.02	138.94	57.66	138.94	57.66
Burnup, GWd/MTU	15.95	30.39	31.33	20.19	32.03	31.41	35.97	35.26
^{234}U	1.54E2	1.25E2	1.22E2	1.45E2	1.20E2	1.22E2	1.13E2	1.14E2
^{235}U	1.98E4	1.23E4	1.18E4	1.71E4	1.16E4	1.18E4	1.02E4	1.03E4
^{236}U	2.85E3	4.07E3	4.13E3	3.29E3	4.17E3	4.13E3	4.36E3	4.33E3
^{238}U	9.53E5	9.40E5	9.40E5	9.50E5	9.39E5	9.40E5	9.35E5	9.36E5
^{238}Pu	3.84E1	1.79E2	1.85E2	6.66E1	1.97E2	1.86E2	2.51E2	2.38E2
^{239}Pu	5.36E3	6.57E3	6.52E3	5.67E3	6.66E3	6.52E3	6.87E3	6.71E3
^{240}Pu	1.18E3	2.36E3	2.41E3	1.55E3	2.46E3	2.42E3	2.70E3	2.65E3
^{241}Pu	6.24E2	1.53E3	1.56E3	8.81E2	1.62E3	1.56E3	1.82E3	1.76E3
^{242}Pu	8.37E1	4.27E2	4.53E2	1.60E2	4.77E2	4.55E2	6.04E2	5.78E2

Table 7-5. Percent Difference Between Measured and Calculated [(C/M-1)*100]

Sample	E6-C-f6	E6-C-f6	E6-C-f6	E6-C-f6	E6-SE-c2	E6-SE-c2	E6-SE-e4	E6-SE-e4
Location, cm	220.22	138.94	57.66	17.02	138.94	57.66	138.94	57.66
Burnup, GWd/MTU	15.95	30.39	31.33	20.19	32.03	31.41	35.97	35.26
^{234}U	-0.65	-11.97	2.52	0.69	5.26	6.09	-4.24	-5.00
^{235}U	0.00	-2.38	-0.84	-0.58	-1.69	-0.84	4.29	4.67
^{236}U	-1.04	-0.25	-0.48	-0.30	-0.24	0.98	-2.02	-2.48
^{238}U	0.42	0.32	0.53	1.50	0.43	0.43	0.21	0.21
^{238}Pu	-18.82	1.70	-13.55	-15.80	-11.26	-11.85	1.62	-0.83
^{239}Pu	-9.92	-16.52	-18.60	-14.09	-16.54	-15.10	-1.15	-1.61
^{240}Pu	5.36	11.32	6.64	7.64	3.80	6.61	5.06	6.85
^{241}Pu	-5.88	-0.65	-4.88	-3.72	-2.99	-1.27	8.33	8.64
^{242}Pu	4.23	23.41	13.82	10.34	13.03	13.75	9.42	9.26

8. Conclusions

The accuracy in which the SAS2H module is able to predict isotopic concentrations is indicated by the percent differences presented in Table 7-5. Inspection of such results reveals that generally the isotopes of ^{238}Pu and ^{239}Pu are under-predicted, while the isotopes of ^{240}Pu and ^{242}Pu are over-predicted. Due to the lack of detail concerning the operation of Yankee Rowe Cycles I through IV, it is difficult to determine the causes for the under or over-prediction of such isotopes. Percent differences from this analysis are compared with results from Reference 5.5, in which similar calculations were performed with a previous version of SCALE and the 27burnuplib cross section library. The concentrations calculated in Reference 5.5 for the most part agree with the concentrations calculated in this analysis; however, significant differences are seen for the plutonium isotopes. Since there are few differences between the model in Reference 5.5 and the model contained within, it is believed that the discrepancy between calculated concentrations for plutonium isotopes is caused by a change in the cross section library.

The SAS2H code normally predicts isotopic concentrations as a radial assembly average; however, measurements are performed on individual pellet samples. Therefore, local pellet conditions are modeled as closely as possible in this analysis so that a more realistic pellet composition can be determined. However, approximations made to obtain local pellet conditions will influence the calculated isotopic concentrations.

In general, the percent differences reveal that the SAS2H module of SCALE is adequate in predicting isotopic concentrations for Yankee Rowe assemblies, using the modeling methodology presented. The lack of detailed assembly design and operating data requires approximations that are believed to cause the inconsistencies between the calculated and measured concentrations. It is believed that improvements in the model for Yankee Rowe are possible with sample specific operating conditions, and detailed information concerning the cruciform control blades. More detailed operating data would be expected to improve the accuracy of the calculated concentrations in relation to the corresponding measurements. It is recommended that future analyses use more detailed data if possible.

9. Attachments

Attachment I includes eight pages and contains the input files used in the modeling of the Yankee Rowe samples. A description of the parameters contained within the input files is found in Sections 7.1 through 7.5.

Included in Attachment II is an extraction from each of the output files, containing the following information:

- echo of the SAS2H input deck,
- time/date stamp for when the SAS2H depletion calculation was performed,
- the output extraction of information pertinent to the Radiochemical Assay evaluations from the final ORIGEN calculation of the SAS2H depletion calculation.

ye6cf6h1.input

```
=sas2h    parm=skipshipdata
Yankee Rowe sample E6-C-f6-1, 220.22 cm 15.95 gwd/MTU, July 97
'-----------------------------
'
' mixtures of fuel-pin-unit-cell:
'
'
'
44group   latticecell
'
'
'
uo2  1 den=10.18  1  755
  92234 0.020 92235 3.40 92236 0.020 92238 96.56   end
kr-83  1 0 1-20 755  end
kr-85  1 0 1-20 755  end
y-89   1 0 1-20 755  end
sr-90  1 0 1-20 755  end
zr-93  1 0 1-20 755  end
zr-94  1 0 1-20 755  end
zr-95  1 0 1-20 755  end
nb-94  1 0 1-20 755  end
mo-95  1 0 1-20 755  end
tc-99  1 0 1-20 755  end
ru-101 1 0 1-20 755  end
ru-106 1 0 1-20 755  end
rh-103 1 0 1-20 755  end
rh-105 1 0 1-20 755  end
pd-105 1 0 1-20 755  end
pd-108 1 0 1-20 755  end
ag-109 1 0 1-20 755  end
sb-124 1 0 1-20 755  end
xe-131 1 0 1-20 755  end
xe-132 1 0 1-20 755  end
xe-135 1 0 1-20 755  end
xe-136 1 0 1-20 755  end
cs-134 1 0 1-20 755  end
cs-135 1 0 1-20 755  end
cs-137 1 0 1-20 755  end
ba-136 1 0 1-20 755  end
la-139 1 0 1-20 755  end
pr-141 1 0 1-20 755  end
pr-143 1 0 1-20 755  end
ce-144 1 0 1-20 755  end
nd-143 1 0 1-20 755  end
nd-145 1 0 1-20 755  end
nd-147 1 0 1-20 755  end
pm-147 1 0 1-20 755  end
pm-148 1 0 1-20 755  end
sm-147 1 0 1-20 755  end
sm-149 1 0 1-20 755  end
sm-150 1 0 1-20 755  end
sm-151 1 0 1-20 755  end
sm-152 1 0 1-20 755  end
eu-153 1 0 1-20 755  end
eu-154 1 0 1-20 755  end
eu-155 1 0 1-20 755  end
gd-155 1 0 1-20 755  end
'
arbm-ss348  8.03 11 0 0 0 6012 0.08 25055 2.0 15031 0.045
  16000 0.030 14000 0.75 24000 18.0 28000 11.0 41093 0.7
  73181 0.1 27059 0.2 26000 67.095 2 1  559  end
'
h2o  3 den=0.77017  1  549 end
arbm-bormod  0.77017 1 1 0 0 5000 100 3 1.0e-6  549  end
'
' 261 ppm boron (wt) in moderator for Core IV
'-----------------------------
end comp
'
'-----------------------------
'
'   fuel-pin-cell geometry:
'
squarepitch   1.072  0.747 1  3  0.864  2  0.757   0  end
'
'-----------------------------
'
'  assembly and cycle parameters:
'
npin/assm=305 fuelngth=833.69 ncycles=3  nlib/cyc=5
printlevel=5 lightel=9  inplevel=2 numztotal=3   end
3 0.6048 500 10.5799 3 10.9791
power=13.07 burn=451.5  down=129   end
power=13.00 burn=333.1  down=370  end
power=16.97    burn=337       down=281.5      bfrac=261
temkcyc=800  end
   o 135.0  cr 5.9   mn 0.33
   fe 13.0  co 0.075 ni 9.9
   zr 221.0 nb 0.71  sn 3.6
'
end
```

ye6cf6h3.input

```
=sas2h    parm=skipshipdata
Yankee Rowe sample E6-C-f6-3, 138.94 cm 30.39 gwd/MTU, July 97
'-----------------------------
'
'  mixtures of fuel-pin-unit-cell:
'
'
'
44group   latticecell
'
'
'
uo2  1 den=10.18  1  894
  92234 0.020 92235 3.40 92236 0.020 92238 96.56   end
kr-83  1 0 1-20 894  end
kr-85  1 0 1-20 894  end
y-89   1 0 1-20 894  end
sr-90  1 0 1-20 894  end
zr-93  1 0 1-20 894  end
zr-94  1 0 1-20 894  end
zr-95  1 0 1-20 894  end
nb-94  1 0 1-20 894  end
mo-95  1 0 1-20 894  end
tc-99  1 0 1-20 894  end
ru-101 1 0 1-20 894  end
ru-106 1 0 1-20 894  end
rh-103 1 0 1-20 894  end
rh-105 1 0 1-20 894  end
pd-105 1 0 1-20 894  end
pd-108 1 0 1-20 894  end
ag-109 1 0 1-20 894  end
sb-124 1 0 1-20 894  end
xe-131 1 0 1-20 894  end
xe-132 1 0 1-20 894  end
xe-135 1 0 1-20 894  end
xe-136 1 0 1-20 894  end
cs-134 1 0 1-20 894  end
cs-135 1 0 1-20 894  end
cs-137 1 0 1-20 894  end
ba-136 1 0 1-20 894  end
la-139 1 0 1-20 894  end
pr-141 1 0 1-20 894  end
pr-143 1 0 1-20 894  end
ce-144 1 0 1-20 894  end
nd-143 1 0 1-20 894  end
nd-145 1 0 1-20 894  end
nd-147 1 0 1-20 894  end
pm-147 1 0 1-20 894  end
pm-148 1 0 1-20 894  end
sm-147 1 0 1-20 894  end
sm-149 1 0 1-20 894  end
sm-150 1 0 1-20 894  end
sm-151 1 0 1-20 894  end
sm-152 1 0 1-20 894  end
eu-153 1 0 1-20 894  end
eu-154 1 0 1-20 894  end
eu-155 1 0 1-20 894  end
gd-155 1 0 1-20 894  end
'
arbm-ss348  8.03 11 0 0 0 6012 0.08 25055 2.0 15031 0.045
  16000 0.030 14000 0.75 24000 18.0 28000 11.0 41093 0.7
  73181 0.1 27059 0.2 26000 67.095 2 1  560  end
'
h2o  3 den=0.78338  1  541 end
arbm-bormod  0.78338 1 1 0 0 5000 100 3 1.0e-6  541  end
'
'  261 ppm boron (wt) in moderator for Core IV
'-----------------------------
end comp
'
'-----------------------------
'
'    fuel-pin-cell geometry:
'
squarepitch   1.072  0.747 1  3  0.864  2  0.757   0  end
'
'-----------------------------
'
'   assembly and cycle parameters:
'
npin/assm=305 fuelngth=833.69 ncycles=3  nlib/cyc=5
printlevel=5 lightel=9  inplevel=2 numztotal=3   end
3 0.6048 500 10.5799 3 10.9791
power=27.74 burn=451.5  down=129   end
power=30.79 burn=333.1  down=370 temkcyc=915 end
power=22.57 burn=337  down=717  bfrac=261 temkcyc=848
end
   o 135.0  cr 5.9   mn 0.33
   fe 13.0  co 0.075 ni 9.9
   zr 221.0 nb 0.71  sn 3.6
'
end
```

ye6cf6h5.input

```
=sas2h    parm=skipshipdata
Yankee Rowe sample E6-C-f6-5, 57.66 cm 31.33 gwd/MTU, July 97
'-----------------------------
'
' mixtures of fuel-pin-unit-cell:
'
'
'
44group   latticecell
'
'
'
uo2  1 den=10.18  1  885
  92234 0.020 92235 3.40 92236 0.020 92238 96.56   end
kr-83  1 0 1-20 885  end
kr-85  1 0 1-20 885  end
y-89   1 0 1-20 885  end
sr-90  1 0 1-20 885  end
zr-93  1 0 1-20 885  end
zr-94  1 0 1-20 885  end
zr-95  1 0 1-20 885  end
nb-94  1 0 1-20 885  end
mo-95  1 0 1-20 885  end
tc-99  1 0 1-20 885  end
ru-101 1 0 1-20 885  end
ru-106 1 0 1-20 885  end
rh-103 1 0 1-20 885  end
rh-105 1 0 1-20 885  end
pd-105 1 0 1-20 885  end
pd-108 1 0 1-20 885  end
ag-109 1 0 1-20 885  end
sb-124 1 0 1-20 885  end
xe-131 1 0 1-20 885  end
xe-132 1 0 1-20 885  end
xe-135 1 0 1-20 885  end
xe-136 1 0 1-20 885  end
cs-134 1 0 1-20 885  end
cs-135 1 0 1-20 885  end
cs-137 1 0 1-20 885  end
ba-136 1 0 1-20 885  end
la-139 1 0 1-20 885  end
pr-141 1 0 1-20 885  end
pr-143 1 0 1-20 885  end
ce-144 1 0 1-20 885  end
nd-143 1 0 1-20 885  end
nd-145 1 0 1-20 885  end
nd-147 1 0 1-20 885  end
pm-147 1 0 1-20 885  end
pm-148 1 0 1-20 885  end
sm-147 1 0 1-20 885  end
sm-149 1 0 1-20 885  end
sm-150 1 0 1-20 885  end
sm-151 1 0 1-20 885  end
sm-152 1 0 1-20 885  end
eu-153 1 0 1-20 885  end
eu-154 1 0 1-20 885  end
eu-155 1 0 1-20 885  end
gd-155 1 0 1-20 885  end
'
arbm-ss348  8.03 11 0 0 0 6012 0.08 25055 2.0 15031 0.045
  16000 0.030 14000 0.75 24000 18.0 28000 11.0 41093 0.7
  73181 0.1 27059 0.2 26000 67.095 2 1  551  end
'
h2o  3 den=0.79733  1  532  end
arbm-bormod  0.79733 1 1 0 0 5000 100 3 1.0e-6  532   end
'
' 261 ppm boron (wt) in moderator for the Core IV
'-----------------------------
end comp
'
'-----------------------------
'
'    fuel-pin-cell geometry:
'
squarepitch   1.072  0.747 1  3  0.864  2  0.757   0  end
'
'-----------------------------
'
'   assembly and cycle parameters:
'
npin/assm=305 fuelngth=833.69 ncycles=3  nlib/cyc=5
printlevel=5 lightel=9  inplevel=2 numztotal=3   end
3 0.6048 500 10.5799 3 10.9791
power=29.44 burn=451.5  down=129   end
power=29.86 burn=333.1  down=370   temkcyc=889  end
power=24.01    burn=337       down=281.5       bfrac=261
temkcyc=847   end
   o 135.0  cr 5.9   mn 0.33
   fe 13.0  co 0.075 ni 9.9
   zr 221.0 nb 0.71  sn 3.6
'
'-----------------------------
'
end
```

ye6cf6h6.input

```
=sas2h    parm=skipshipdata
Yankee Rowe sample E6-C-f6-6, 17.02 cm 20.19 gwd/MTU, July 97
'-----------------------------
'
' mixtures of fuel-pin-unit-cell:
'
'
'
44group   latticecell
'
'
'
uo2  1 den=10.18  1  788
  92234 0.020 92235 3.40 92236 0.020 92238 96.56   end
kr-83  1 0 1-20 788  end
kr-85  1 0 1-20 788  end
y-89   1 0 1-20 788  end
sr-90  1 0 1-20 788  end
zr-93  1 0 1-20 788  end
zr-94  1 0 1-20 788  end
zr-95  1 0 1-20 788  end
nb-94  1 0 1-20 788  end
mo-95  1 0 1-20 788  end
tc-99  1 0 1-20 788  end
ru-101 1 0 1-20 788  end
ru-106 1 0 1-20 788  end
rh-103 1 0 1-20 788  end
rh-105 1 0 1-20 788  end
pd-105 1 0 1-20 788  end
pd-108 1 0 1-20 788  end
ag-109 1 0 1-20 788  end
sb-124 1 0 1-20 788  end
xe-131 1 0 1-20 788  end
xe-132 1 0 1-20 788  end
xe-135 1 0 1-20 788  end
xe-136 1 0 1-20 788  end
cs-134 1 0 1-20 788  end
cs-135 1 0 1-20 788  end
cs-137 1 0 1-20 788  end
ba-136 1 0 1-20 788  end
la-139 1 0 1-20 788  end
pr-141 1 0 1-20 788  end
pr-143 1 0 1-20 788  end
ce-144 1 0 1-20 788  end
nd-143 1 0 1-20 788  end
nd-145 1 0 1-20 788  end
nd-147 1 0 1-20 788  end
pm-147 1 0 1-20 788  end
pm-148 1 0 1-20 788  end
sm-147 1 0 1-20 788  end
sm-149 1 0 1-20 788  end
sm-150 1 0 1-20 788  end
sm-151 1 0 1-20 788  end
sm-152 1 0 1-20 788  end
eu-153 1 0 1-20 788  end
eu-154 1 0 1-20 788  end
eu-155 1 0 1-20 788  end
gd-155 1 0 1-20 788  end
'
arbm-ss348  8.03 11 0 0 0 6012 0.08 25055 2.0 15031 0.045
  16000 0.030 14000 0.75 24000 18.0 28000 11.0 41093 0.7
  73181 0.1 27059 0.2 26000 67.095 2 1  541  end
'
h2o  3 den=0.80256  1  528  end
arbm-bormod  0.80256 1 1 0 0 5000 100 3 1.0e-6  528   end
'
' 261 ppm boron (wt) in moderator for the Core IV
'-----------------------------
end comp
'
'-----------------------------
'
'    fuel-pin-cell geometry:
'
squarepitch   1.072  0.747 1  3  0.864  2  0.757   0  end
'
'-----------------------------
'
'   assembly and cycle parameters:
'
npin/assm=305 fuelngth=833.69 ncycles=3  nlib/cyc=5
printlevel=5 lightel=9  inplevel=2 numztotal=3   end
3 0.6048 500 10.5799 3 10.9791
power=18.139 burn=451.5  down=129   end
power=19.070 burn=333.1  down=370 temkcyc=796   end
power=16.755   burn=337      down=281.5.     bfrac=261
temkcyc=777   end
   o 135.0  cr 5.9   mn 0.33
   fe 13.0  co 0.075 ni 9.9
   zr 221.0 nb 0.71  sn 3.6
'
end
```

ye6sec2h3.input

```
=sas2h    parm=skipshipdata
Yankee Rowe sample E6-SE-c2-3, 138.94 32.03 gwd/MTU, July 97
'-----------------------------
'
' mixtures of fuel-pin-unit-cell:
'
'
'
44group   latticecell
'
'
'
uo2  1 den=10.18  1  894
  92234 0.020 92235 3.40 92236 0.020 92238 96.56   end
kr-83  1 0 1-20 894  end
kr-85  1 0 1-20 894  end
y-89   1 0 1-20 894  end
sr-90  1 0 1-20 894  end
zr-93  1 0 1-20 894  end
zr-94  1 0 1-20 894  end
zr-95  1 0 1-20 894  end
nb-94  1 0 1-20 894  end
mo-95  1 0 1-20 894  end
tc-99  1 0 1-20 894  end
ru-101 1 0 1-20 894  end
ru-106 1 0 1-20 894  end
rh-103 1 0 1-20 894  end
rh-105 1 0 1-20 894  end
pd-105 1 0 1-20 894  end
pd-108 1 0 1-20 894  end
ag-109 1 0 1-20 894  end
sb-124 1 0 1-20 894  end
xe-131 1 0 1-20 894  end
xe-132 1 0 1-20 894  end
xe-135 1 0 1-20 894  end
xe-136 1 0 1-20 894  end
cs-134 1 0 1-20 894  end
cs-135 1 0 1-20 894  end
cs-137 1 0 1-20 894  end
ba-136 1 0 1-20 894  end
la-139 1 0 1-20 894  end
pr-141 1 0 1-20 894  end
pr-143 1 0 1-20 894  end
ce-144 1 0 1-20 894  end
nd-143 1 0 1-20 894  end
nd-145 1 0 1-20 894  end
nd-147 1 0 1-20 894  end
pm-147 1 0 1-20 894  end
pm-148 1 0 1-20 894  end
sm-147 1 0 1-20 894  end
sm-149 1 0 1-20 894  end
sm-150 1 0 1-20 894  end
sm-151 1 0 1-20 894  end
sm-152 1 0 1-20 894  end
eu-153 1 0 1-20 894  end
eu-154 1 0 1-20 894  end
eu-155 1 0 1-20 894  end
gd-155 1 0 1-20 894  end
'
arbm-ss348  8.03 11 0 0 0 6012 0.08 25055 2.0 15031 0.045
  16000 0.030 14000 0.75 24000 18.0 28000 11.0 41093 0.7
  73181 0.1 27059 0.2 26000 67.095 2 1  560  end
'
h2o  3 den=0.78338  1  541  end
arbm-bormod  0.78338 1 1 0 0 5000 100 3 1.0e-6  541   end
'
' 261 ppm boron (wt) in moderator for the Core IV
'-----------------------------
end comp
'
'-----------------------------
'
'    fuel-pin-cell geometry:
'
squarepitch   1.072  0.747 1  3  0.864  2  0.757   0  end
'
'-----------------------------
'
'   assembly and cycle parameters:
'
npin/assm=305 fuelngth=833.69 ncycles=3  nlib/cyc=5
printlevel=5 lightel=9  inplevel=2 numztotal=3   end
3 0.6048 500 10.5799 3 10.9791
power=29.24 burn=451.5 down=129  end
power=32.45 burn=333.1  down=370 temkcyc=915   end
power=23.79    burn=337       down=281.5       bfrac=261
temkcyc=848   end
   o 135.0  cr 5.9   mn 0.33
   fe 13.0  co 0.075 ni 9.9
   zr 221.0 nb 0.71  sn 3.6
'
end
```

ye6sec2h5.input

```
=sas2h    parm=skipshipdata
Yankee Rowe sample E6-SE-c2-5, 57.66 cm 31.41 gwd/MTU, July 97
'-----------------------------
'
' mixtures of fuel-pin-unit-cell:
'
'
'
44group   latticecell
'
'
'
uo2  1 den=10.18  1  885
  92234 0.020 92235 3.40 92236 0.020 92238 96.56   end
kr-83  1 0 1-20 885  end
kr-85  1 0 1-20 885  end
y-89   1 0 1-20 885  end
sr-90  1 0 1-20 885  end
zr-93  1 0 1-20 885  end
zr-94  1 0 1-20 885  end
zr-95  1 0 1-20 885  end
nb-94  1 0 1-20 885  end
mo-95  1 0 1-20 885  end
tc-99  1 0 1-20 885  end
ru-101 1 0 1-20 885  end
ru-106 1 0 1-20 885  end
rh-103 1 0 1-20 885  end
rh-105 1 0 1-20 885  end
pd-105 1 0 1-20 885  end
pd-108 1 0 1-20 885  end
ag-109 1 0 1-20 885  end
sb-124 1 0 1-20 885  end
xe-131 1 0 1-20 885  end
xe-132 1 0 1-20 885  end
xe-135 1 0 1-20 885  end
xe-136 1 0 1-20 885  end
cs-134 1 0 1-20 885  end
cs-135 1 0 1-20 885  end
cs-137 1 0 1-20 885  end
ba-136 1 0 1-20 885  end
la-139 1 0 1-20 885  end
pr-141 1 0 1-20 885  end
pr-143 1 0 1-20 885  end
ce-144 1 0 1-20 885  end
nd-143 1 0 1-20 885  end
nd-145 1 0 1-20 885  end
nd-147 1 0 1-20 885  end
pm-147 1 0 1-20 885  end
pm-148 1 0 1-20 885  end
sm-147 1 0 1-20 885  end
sm-149 1 0 1-20 885  end
sm-150 1 0 1-20 885  end
sm-151 1 0 1-20 885  end
sm-152 1 0 1-20 885  end
eu-153 1 0 1-20 885  end
eu-154 1 0 1-20 885  end
eu-155 1 0 1-20 885  end
gd-155 1 0 1-20 885  end
'
arbm-ss348  8.03 11 0 0 0 6012 0.08 25055 2.0 15031 0.045
  16000 0.030 14000 0.75 24000 18.0 28000 11.0 41093 0.7
  73181 0.1 27059 0.2 26000 67.095 2 1  547  end
'
h2o  3 den=0.79733  1  532  end
arbm-bormod  0.79733 1 1 0 0 5000 100 3 1.0e-6  532   end
'
' 261 ppm boron (wt) in moderator for the Core IV
'-----------------------------
end comp
'
'-----------------------------
'
'    fuel-pin-cell geometry:
'
squarepitch   1.072  0.747 1  3  0.864  2  0.757   0  end
'
'-----------------------------
'
'   assembly and cycle parameters:
'
npin/assm=305 fuelngth=833.69 ncycles=3  nlib/cyc=5
printlevel=5 lightel=9  inplevel=2 numztotal=3   end
3 0.6048 500 10.5799 3 10.9791
power=29.51 burn=451.5  down=129  end
power=29.93 burn=333.1  down=370  temkcyc=889   end
power=24.07    burn=337       down=281.5       bfrac=261
temkcyc=847   end
   o 135.0  cr 5.9   mn 0.33
   fe 13.0  co 0.075 ni 9.9
   zr 221.0 nb 0.71  sn 3.6
'
end
```

ye6see4h3.input

```
=sas2h    parm=skipshipdata
Yankee Rowe sample E6-SE-e4-3, 138.94 cm 30.39 gwd/MTU, July 97
'-----------------------------
'
' mixtures of fuel-pin-unit-cell:
'
'
'
44group   latticecell
'
'
'
uo2  1 den=10.18  1  894
  92234 0.020 92235 3.40 92236 0.020 92238 96.56   end
kr-83  1 0 1-20 894  end
kr-85  1 0 1-20 894  end
y-89   1 0 1-20 894  end
sr-90  1 0 1-20 894  end
zr-93  1 0 1-20 894  end
zr-94  1 0 1-20 894  end
zr-95  1 0 1-20 894  end
nb-94  1 0 1-20 894  end
mo-95  1 0 1-20 894  end
tc-99  1 0 1-20 894  end
ru-101 1 0 1-20 894  end
ru-106 1 0 1-20 894  end
rh-103 1 0 1-20 894  end
rh-105 1 0 1-20 894  end
pd-105 1 0 1-20 894  end
pd-108 1 0 1-20 894  end
ag-109 1 0 1-20 894  end
sb-124 1 0 1-20 894  end
xe-131 1 0 1-20 894  end
xe-132 1 0 1-20 894  end
xe-135 1 0 1-20 894  end
xe-136 1 0 1-20 894  end
cs-134 1 0 1-20 894  end
cs-135 1 0 1-20 894  end
cs-137 1 0 1-20 894  end
ba-136 1 0 1-20 894  end
la-139 1 0 1-20 894  end
pr-141 1 0 1-20 894  end
pr-143 1 0 1-20 894  end
ce-144 1 0 1-20 894  end
nd-143 1 0 1-20 894  end
nd-145 1 0 1-20 894  end
nd-147 1 0 1-20 894  end
pm-147 1 0 1-20 894  end
pm-148 1 0 1-20 894  end
sm-147 1 0 1-20 894  end
sm-149 1 0 1-20 894  end
sm-150 1 0 1-20 894  end
sm-151 1 0 1-20 894  end
sm-152 1 0 1-20 894  end
eu-153 1 0 1-20 894  end
eu-154 1 0 1-20 894  end
eu-155 1 0 1-20 894  end
gd-155 1 0 1-20 894  end
'
arbm-ss348  8.03 11 0 0 0 6012 0.08 25055 2.0 15031 0.045
  16000 0.030 14000 0.75 24000 18.0 28000 11.0 41093 0.7
  73181 0.1 27059 0.2 26000 67.095 2 1  560  end
'
h2o  3 den=0.78338  1  541 end
arbm-bormod  0.78338 1 1 0 0 5000 100 3 1.0e-6  541  end
'
' 261 ppm boron (wt) in moderator for Core IV
'-----------------------------
end comp
'
'-----------------------------
'
'    fuel-pin-cell geometry:
'
squarepitch   1.072  0.747 1  3  0.864  2  0.757   0  end
'
'-----------------------------
'
'   assembly and cycle parameters:
'
npin/assm=305 fuelngth=833.69 ncycles=3  nlib/cyc=5
printlevel=5 lightel=9  inplevel=2 numztotal=3   end
3 0.6048 500 10.5799 3 10.9791
power=32.84 burn=451.5  down=129   end
power=36.44 burn=333.1  down=370 temkcyc=915 end
power=26.72    burn=337       down=281.5       bfrac=261
temkcyc=848  end
   o 135.0  cr 5.9   mn 0.33
   fe 13.0  co 0.075 ni 9.9
   zr 221.0 nb 0.71  sn 3.6
'
end
```

ye6see4h5.input

```
=sas2h    parm=skipshipdata
Yankee Rowe sample E6-SE-e4-5, 57.66 cm 35.26 gwd/MTU, July 97
'-----------------------------
'
'  mixtures of fuel-pin-unit-cell:
'
' Cross Section Library
'
44group   latticecell
'
' Fuel Composition
'
uo2  1 den=10.18  1  885
  92234 0.020 92235 3.40 92236 0.020 92238 96.56   end
kr-83  1 0 1-20 885  end
kr-85  1 0 1-20 885  end
y-89   1 0 1-20 885  end
sr-90  1 0 1-20 885  end
zr-93  1 0 1-20 885  end
zr-94  1 0 1-20 885  end
zr-95  1 0 1-20 885  end
nb-94  1 0 1-20 885  end
mo-95  1 0 1-20 885  end
tc-99  1 0 1-20 885  end
ru-101 1 0 1-20 885  end
ru-106 1 0 1-20 885  end
rh-103 1 0 1-20 885  end
rh-105 1 0 1-20 885  end
pd-105 1 0 1-20 885  end
pd-108 1 0 1-20 885  end
ag-109 1 0 1-20 885  end
sb-124 1 0 1-20 885  end
xe-131 1 0 1-20 885  end
xe-132 1 0 1-20 885  end
xe-135 1 0 1-20 885  end
xe-136 1 0 1-20 885  end
cs-134 1 0 1-20 885  end
cs-135 1 0 1-20 885  end
cs-137 1 0 1-20 885  end
ba-136 1 0 1-20 885  end
la-139 1 0 1-20 885  end
pr-141 1 0 1-20 885  end
pr-143 1 0 1-20 885  end
ce-144 1 0 1-20 885  end
nd-143 1 0 1-20 885  end
nd-145 1 0 1-20 885  end
nd-147 1 0 1-20 885  end
pm-147 1 0 1-20 885  end
pm-148 1 0 1-20 885  end
sm-147 1 0 1-20 885  end
sm-149 1 0 1-20 885  end
sm-150 1 0 1-20 885  end
sm-151 1 0 1-20 885  end
sm-152 1 0 1-20 885  end
eu-153 1 0 1-20 885  end
eu-154 1 0 1-20 885  end
eu-155 1 0 1-20 885  end
gd-155 1 0 1-20 885  end
'
arbm-ss348  8.03 11 0 0 0 6012 0.08 25055 2.0 15031 0.045
  16000 0.030 14000 0.75 24000 18.0 28000 11.0 41093 0.7
  73181 0.1 27059 0.2 26000 67.095 2 1  547  end
'
h2o  3 den=0.79733  1  532  end
arbm-bormod  0.79733 1 1 0 0 5000 100 3  1.0e-6  532   end
'
' 261 ppm boron (wt) in moderator for the Core IV
'-----------------------------
end comp
'
'-----------------------------
'
'    fuel-pin-cell geometry:
'
squarepitch   1.072  0.747 1  3  0.864  2  0.757   0  end
'
'-----------------------------
'
'   assembly and cycle parameters:
'
npin/assm=305 fuelngth=833.69 ncycles=3  nlib/cyc=5
printlevel=5 lightel=9  inplevel=2 numztotal=3   end
3 0.6048 500 10.5799 3 10.9791
power=33.13 burn=451.5  down=129   end
power=33.60 burn=333.1 down=370  temkcyc=889   end
power=27.02    burn=337       down=281.5       bfrac=261
temkcyc=847   end
   o 135.0  cr 5.9   mn 0.33
   fe 13.0  co 0.075 ni 9.9
   zr 221.0 nb 0.71  sn 3.6
'
end
```

ye6cf6h1.sum

```
0*************************************************************************
 *                                                                       *
 *                    SCALE4.3  Bulletin  Board                          *
 *                    --------  --------  -----                          *
 *                                                                       *
 *                      Welcome to SCALE-4.3.                            *
 *                                                                       *
 *                                                                       *
 *************************************************************************
1          primary module access and input record ( scale driver - 95/03/29 - 09:06:37 )
-   module sas2h    will be called
      Yankee Rowe sample E6-C-f6-1, 220.22 cm 15.95 gwd/MTU, July 97
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
      '   mixtures of fuel-pin-unit-cell:
      '
      '
      '
      44group    latticecell
      '
      '
      '
      uo2  1 den=10.18  1  755
         92234 0.020 92235 3.40 92236 0.020 92238 96.56   end
      kr-83  1 0 1-20 755  end
      kr-85  1 0 1-20 755  end
      y-89   1 0 1-20 755  end
      sr-90  1 0 1-20 755  end
      zr-93  1 0 1-20 755  end
      zr-94  1 0 1-20 755  end
      zr-95  1 0 1-20 755  end
      nb-94  1 0 1-20 755  end
      mo-95  1 0 1-20 755  end
      tc-99  1 0 1-20 755  end
      ru-101 1 0 1-20 755  end
      ru-106 1 0 1-20 755  end
      rh-103 1 0 1-20 755  end
      rh-105 1 0 1-20 755  end
      pd-105 1 0 1-20 755  end
      pd-108 1 0 1-20 755  end
      ag-109 1 0 1-20 755  end
      sb-124 1 0 1-20 755  end
      xe-131 1 0 1-20 755  end
      xe-132 1 0 1-20 755  end
      xe-135 1 0 1-20 755  end
      xe-136 1 0 1-20 755  end
      cs-134 1 0 1-20 755  end
      cs-135 1 0 1-20 755  end
      cs-137 1 0 1-20 755  end
      ba-136 1 0 1-20 755  end
      la-139 1 0 1-20 755  end
      pr-141 1 0 1-20 755  end
      pr-143 1 0 1-20 755  end
      ce-144 1 0 1-20 755  end
      nd-143 1 0 1-20 755  end
      nd-145 1 0 1-20 755  end
      nd-147 1 0 1-20 755  end
      pm-147 1 0 1-20 755  end
      pm-148 1 0 1-20 755  end
      sm-147 1 0 1-20 755  end
      sm-149 1 0 1-20 755  end
      sm-150 1 0 1-20 755  end
      sm-151 1 0 1-20 755  end
      sm-152 1 0 1-20 755  end
      eu-153 1 0 1-20 755  end
      eu-154 1 0 1-20 755  end
      eu-155 1 0 1-20 755  end
      gd-155 1 0 1-20 755  end
      '
      arbm-ss348  8.03 11 0 0 0 6012 0.08 25055 2.0 15031 0.045
         16000 0.030 14000 0.75 24000 18.0 28000 11.0 41093 0.7
         73181 0.1 27059 0.2 26000 67.095 2 1  559  end
      '
      h2o  3 den=0.77017  1  549 end
      arbm-bormod  0.77017 1 1 0 0 5000 100 3 1.0e-6  549  end
      '
      '  261 ppm boron (wt) in moderator for Core IV
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      end comp
      '
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
      '      fuel-pin-cell geometry:
      '
      squarepitch   1.072  0.747 1  3  0.864  2  0.757   0  end
      '
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
      '    assembly and cycle parameters:
      '
      npin/assm=305 fuelngth=833.69 ncycles=3  nlib/cyc=5
      printlevel=5 lightel=9  inplevel=2 numztotal=3   end
      3 0.6048 500 10.5799 3 10.9791
      power=13.07 burn=451.5  down=129   end
      power=13.00 burn=333.1  down=370  end
      power=16.97 burn=337  down=281.5  bfrac=261 temkcyc=800  end
          o 135.0  cr 5.9   mn 0.33
          fe 13.0  co 0.075 ni 9.9
          zr 221.0 nb 0.71  sn 3.6
      '
1   sssssssssss      aaaaaaaaa      sssssssssss     22222222222    hh         hh
   ssssssssssss    aaaaaaaaaaa    ssssssssssss   2222222222222   hh         hh
   ss          ss   aa         aa   ss         ss   22         22   hh         hh
   ss               aa         aa   ss                         22   hh         hh
   ss               aa         aa   ss                         22   hh         hh
   ssssssssssss    aaaaaaaaaaaaa   ssssssssssss             22    hhhhhhhhhhhh
    ssssssssssss   aaaaaaaaaaaaa    ssssssssssss          22       hhhhhhhhhhhh
              ss   aa         aa               ss        22         hh         hh
              ss   aa         aa               ss      22           hh         hh
```

```
   ss          ss   aa          aa   ss          ss    22              hh          hh
   sssssssssssss   aa          aa   sssssssssssss   2222222222222   hh          hh
    sssssssssss    aa          aa    sssssssssss    2222222222222   hh          hh
0

   nn          nn  iiiiiiiiiiii     cccccccccc     hh          hh    oooooooooo     ll
   nnn         nn  iiiiiiiiiiii    cccccccccccc    hh          hh   oooooooooooo    ll
   nnnn        nn      ii         cc          cc   hh          hh   oo          oo  ll
   nn nn       nn      ii         cc               hh          hh   oo          oo  ll
   nn   nn     nn      ii         cc               hh          hh   oo          oo  ll
   nn     nn   nn      ii         cc               hhhhhhhhhhhhh    oo          oo  ll
   nn       nn nn      ii         cc               hhhhhhhhhhhhh    oo          oo  ll
   nn        nn nn     ii         cc               hh          hh   oo          oo  ll
   nn         nnnn     ii         cc               hh          hh   oo          oo  ll
   nn          nnn  iiiiiiiiiiii    cccccccccccc    hh          hh   oooooooooooo    llllllllllll
   nn           nn  iiiiiiiiiiii     cccccccccc     hh          hh    oooooooooo     llllllllllll
0

     0000000      7777777777777                //   33333333333      0000000                  //   99999999999    7777777777777
    000000000     777777777777                //   3333333333333    000000000                //   9999999999999  777777777777
   00       00    77          77              //   33          33   00       00              //   99         99  77         77
  00         00          77                  //                33   00         00            //   99         99           77
  00         00        77                    //                33   00         00            //   99         99          77
  00         00      77                      //              333    00         00            //   9999999999999       77
  00         00      77                      //              333    00         00            //    99999999999        77
  00         00    77                        //                33   00         00            //                99       77
  00         00    77                        //                33   00         00            //                99       77
   00       00     77                        //   33          33   00       00              //                99      77
    000000000       77                        //   3333333333333    000000000                //   9999999999999      77
     0000000        77                        //    33333333333      0000000                //   999999999999       77
0

       11        666666666666                          44     33333333333                        0000000            44
      111       6666666666666                         444    3333333333333                      000000000          444
     1111       66                   :::             4444    33          33        :::         00       00       4444
       11       66                   :::            44 44                33        :::        00         00     44 44
       11       66                   :::           44  44                33        :::        00         00    44  44
       11       666666666666                      44   44              333                   00         00   44   44
       11       6666666666666                    44    44              333                   00         00  44    44
       11       66          66       :::        444444444444             33        :::        00         00  444444444444
       11       66          66       :::       4444444444444             33        :::        00         00 4444444444444
       11       66          66       :::                44     33          33        :::         00       00            44
    11111111    6666666666666                      44    3333333333333                       000000000            44
    11111111     66666666666                       44     33333333333                         0000000             44
1
0                                 sssssssssss    ccccccccccc     aaaaaaaaa     ll            eeeeeeeeeeeee
                                sssssssssssss   cccccccccccccc   aaaaaaaaaaa   ll            eeeeeeeeeeeee
                                ss         ss   cc          cc   aa         aa  ll            ee
                                ss              cc               aa         aa  ll            ee
                                ss              cc               aa         aa  ll            ee
                                sssssssssssss   cc               aaaaaaaaaaaaa ll            eeeeeeeee
                                 sssssssssssss  cc               aaaaaaaaaaaaa ll            eeeeeeeee
                                           ss   cc               aa         aa  ll            ee
                                           ss   cc               aa         aa  ll            ee
                                ss         ss   cc          cc   aa         aa  ll            ee
                                sssssssssssss   cccccccccccccc   aa         aa  llllllllllll   eeeeeeeeeeeee
                                 sssssssssss    ccccccccccc      aa         aa  llllllllllll   eeeeeeeeeeeee


                        ******************************************************************************
                        ******************************************************************************
                        ******************************************************************************
                        *****                                                                      *****
                        *****                 program verification information                    *****
                        *****                                                                      *****
                        *****                 code system:    scale  version:    4.3               *****
                        *****                                                                      *****
                        ******************************************************************************
                        ******************************************************************************
                        *****                                                                      *****
                        *****                                                                      *****
                        *****              program:  sas2                                          *****
                        *****                                                                      *****
                        *****        creation date:  03/07/97                                      *****
                        *****                                                                      *****
                        *****              library:  /opt/neut/Scale4.3/bin                        *****
                        *****                                                                      *****
                        *****                                                                      *****
                        *****    this is not a   scale  configuration controlled code              *****
                        *****                                                                      *****
                        *****              jobname:  nichol                                        *****
                        *****                                                                      *****
                        *****    date of execution:  07/30/97                                      *****
                        *****                                                                      *****
                        *****    time of execution:  16:43:04                                      *****
                        *****                                                                      *****
                        *****                                                                      *****
                        ******************************************************************************
                        ******************************************************************************
                        ******************************************************************************
1
0' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
0'
0                                          nuclide concentrations, grams
                                           basis =single reactor assembly
              initial  1E-18 d
     o 16    1.35E+05  1.35E+05
   total     3.92E+05  3.92E+05
0                                          nuclide concentrations, grams
                                           basis =single reactor assembly
              initial  1E-18 d
     u234    2.00E+02  2.00E+02
     u235    3.40E+04  3.40E+04
     u236    2.00E+02  2.00E+02
     u238    9.65E+05  9.65E+05
   total     1.00E+06  1.00E+06
0                                          basis =
0                  initial        22.6 d        45.2 d        67.7 d        90.3 d        90.3 d
```

0 initial 22.6 d 45.2 d 67.7 d 90.3 d 90.3 d

0 nuclide concentrations, grams
basis =single reactor assembly

	initial	46.9 d	93.8 d	140.8 d	187.7 d	234.6 d	281.5 d
o 16	1.35E+05	1.35E+05	1.35E+05	1.35E+05	1.35E+05	1.35E+05	1.35E+05

0 nuclide concentrations, grams
basis =single reactor assembly

	initial	46.9 d	93.8 d	140.8 d	187.7 d	234.6 d	281.5 d
mo 95	8.14E+00	8.61E+00	8.98E+00	9.23E+00	9.39E+00	9.50E+00	9.56E+00
tc 99	9.59E-06	9.72E-06	9.72E-06	9.72E-06	9.72E-06	9.72E-06	9.72E-06

0 nuclide concentrations, grams
basis =single reactor assembly

	initial	46.9 d	93.8 d	140.8 d	187.7 d	234.6 d	281.5 d
total	3.92E+05	3.92E+05	3.92E+05	3.92E+05	3.92E+05	3.92E+05	3.92E+05

0 nuclide concentrations, grams
basis =single reactor assembly

	initial	46.9 d	93.8 d	140.8 d	187.7 d	234.6 d	281.5 d
u233	1.29E-03	1.30E-03	1.30E-03	1.31E-03	1.32E-03	1.33E-03	1.34E-03
u234	1.54E+02	1.54E+02	1.54E+02	1.54E+02	1.54E+02	1.54E+02	1.54E+02
u235	1.98E+04	1.98E+04	1.98E+04	1.98E+04	1.98E+04	1.98E+04	1.98E+04
u236	2.85E+03	2.85E+03	2.85E+03	2.85E+03	2.85E+03	2.85E+03	2.85E+03
u238	9.53E+05	9.53E+05	9.53E+05	9.53E+05	9.53E+05	9.53E+05	9.53E+05
np237	1.93E+02	1.97E+02	1.97E+02	1.97E+02	1.97E+02	1.97E+02	1.97E+02
pu236	1.32E-04	1.29E-04	1.25E-04	1.21E-04	1.18E-04	1.14E-04	1.11E-04
pu238	3.54E+01	3.64E+01	3.70E+01	3.74E+01	3.78E+01	3.81E+01	3.84E+01
pu238	3.54E+01	3.64E+01	3.70E+01	3.74E+01	3.78E+01	3.81E+01	3.84E+01
pu239	5.32E+03	5.36E+03	5.36E+03	5.36E+03	5.36E+03	5.36E+03	5.36E+03
pu240	1.18E+03	1.18E+03	1.18E+03	1.18E+03	1.18E+03	1.18E+03	1.18E+03
pu241	6.24E+02	6.21E+02	6.17E+02	6.13E+02	6.09E+02	6.05E+02	6.02E+02
pu242	8.37E+01	8.37E+01	8.37E+01	8.37E+01	8.37E+01	8.37E+01	8.37E+01
am241	2.95E+01	3.33E+01	3.72E+01	4.10E+01	4.48E+01	4.85E+01	5.22E+01
am242m	7.08E-01	7.08E-01	7.07E-01	7.07E-01	7.06E-01	7.06E-01	7.06E-01
am243	9.20E+00	9.21E+00	9.21E+00	9.21E+00	9.21E+00	9.21E+00	9.21E+00
total	9.83E+05	9.83E+05	9.83E+05	9.83E+05	9.83E+05	9.83E+05	9.83E+05

0 element concentrations, grams

0 nuclide concentrations, grams
basis =single reactor assembly

	initial	46.9 d	93.8 d	140.8 d	187.7 d	234.6 d	281.5 d
mo 95	3.37E+02	3.54E+02	3.67E+02	3.77E+02	3.83E+02	3.86E+02	3.89E+02

0 nuclide concentrations, grams
basis =single reactor assembly

	initial	46.9 d	93.8 d	140.8 d	187.7 d	234.6 d	281.5 d
tc 99	4.07E+02	4.09E+02	4.09E+02	4.09E+02	4.09E+02	4.09E+02	4.09E+02
ru101	3.73E+02	3.73E+02	3.73E+02	3.73E+02	3.73E+02	3.73E+02	3.73E+02
rh103	2.32E+02	2.44E+02	2.49E+02	2.51E+02	2.52E+02	2.53E+02	2.53E+02
rh103m	2.06E-02	8.99E-03	3.93E-03	1.71E-03	7.49E-04	3.27E-04	1.43E-04
ag109	3.30E+01	3.31E+01	3.31E+01	3.31E+01	3.31E+01	3.31E+01	3.31E+01

0 nuclide concentrations, grams
basis =single reactor assembly

	initial	46.9 d	93.8 d	140.8 d	187.7 d	234.6 d	281.5 d
nd143	4.86E+02	4.96E+02	4.97E+02	4.97E+02	4.97E+02	4.97E+02	4.97E+02

0 nuclide concentrations, grams
basis =single reactor assembly

	initial	46.9 d	93.8 d	140.8 d	187.7 d	234.6 d	281.5 d
nd145	3.57E+02	3.57E+02	3.57E+02	3.57E+02	3.57E+02	3.57E+02	3.57E+02
sm147	6.69E+01	7.04E+01	7.38E+01	7.71E+01	8.02E+01	8.33E+01	8.63E+01
sm149	3.01E+00	3.55E+00	3.55E+00	3.55E+00	3.55E+00	3.55E+00	3.55E+00
sm150	1.28E+02	1.28E+02	1.28E+02	1.28E+02	1.28E+02	1.28E+02	1.28E+02
sm151	1.57E+01	1.58E+01	1.57E+01	1.57E+01	1.57E+01	1.57E+01	1.57E+01
eu151	4.88E-02	6.44E-02	8.00E-02	9.55E-02	1.11E-01	1.27E-01	1.42E-01
sm152	6.24E+01	6.24E+01	6.24E+01	6.24E+01	6.24E+01	6.24E+01	6.24E+01
eu153	4.19E+01	4.22E+01	4.22E+01	4.22E+01	4.22E+01	4.22E+01	4.22E+01
gd155	4.21E-02	7.29E-02	1.03E-01	1.33E-01	1.62E-01	1.91E-01	2.19E-01

0 nuclide concentrations, grams
basis =single reactor assembly

	initial	46.9 d	93.8 d	140.8 d	187.7 d	234.6 d	281.5 d
total	1.64E+04	1.64E+04	1.64E+04	1.64E+04	1.64E+04	1.64E+04	1.64E+04

ye6cf6h3.sum

```
0*************************************************************************
 *                                                                       *
 *                    SCALE4.3  Bulletin  Board                          *
 *                    --------  --------  -----                          *
 *                                                                       *
 *                      Welcome to SCALE-4.3.                            *
 *                                                                       *
 *                                                                       *
 *************************************************************************
1          primary module access and input record ( scale driver - 95/03/29 - 09:06:37 )
-   module sas2h    will be called
      Yankee Rowe sample E6-C-f6-3, 138.94 cm 30.39 gwd/MTU, July 97
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
      '   mixtures of fuel-pin-unit-cell:
      '
      '
      '
      44group    latticecell
      '
      '
      '
      uo2  1 den=10.18  1  894
         92234 0.020 92235 3.40 92236 0.020 92238 96.56   end
      kr-83  1 0 1-20 894  end
      kr-85  1 0 1-20 894  end
      y-89   1 0 1-20 894  end
      sr-90  1 0 1-20 894  end
      zr-93  1 0 1-20 894  end
      zr-94  1 0 1-20 894  end
      zr-95  1 0 1-20 894  end
      nb-94  1 0 1-20 894  end
      mo-95  1 0 1-20 894  end
      tc-99  1 0 1-20 894  end
      ru-101 1 0 1-20 894  end
      ru-106 1 0 1-20 894  end
      rh-103 1 0 1-20 894  end
      rh-105 1 0 1-20 894  end
      pd-105 1 0 1-20 894  end
      pd-108 1 0 1-20 894  end
      ag-109 1 0 1-20 894  end
      sb-124 1 0 1-20 894  end
      xe-131 1 0 1-20 894  end
      xe-132 1 0 1-20 894  end
      xe-135 1 0 1-20 894  end
      xe-136 1 0 1-20 894  end
      cs-134 1 0 1-20 894  end
      cs-135 1 0 1-20 894  end
      cs-137 1 0 1-20 894  end
      ba-136 1 0 1-20 894  end
      la-139 1 0 1-20 894  end
      pr-141 1 0 1-20 894  end
      pr-143 1 0 1-20 894  end
      ce-144 1 0 1-20 894  end
      nd-143 1 0 1-20 894  end
      nd-145 1 0 1-20 894  end
      nd-147 1 0 1-20 894  end
      pm-147 1 0 1-20 894  end
      pm-148 1 0 1-20 894  end
      sm-147 1 0 1-20 894  end
      sm-149 1 0 1-20 894  end
      sm-150 1 0 1-20 894  end
      sm-151 1 0 1-20 894  end
      sm-152 1 0 1-20 894  end
      eu-153 1 0 1-20 894  end
      eu-154 1 0 1-20 894  end
      eu-155 1 0 1-20 894  end
      gd-155 1 0 1-20 894  end
      '
      arbm-ss348  8.03 11 0 0 0 6012 0.08 25055 2.0 15031 0.045
         16000 0.030 14000 0.75 24000 18.0 28000 11.0 41093 0.7
         73181 0.1 27059 0.2 26000 67.095 2 1  560  end
      '
      h2o  3 den=0.78338  1  541 end
      arbm-bormod  0.78338 1 1 0 0 5000 100 3 1.0e-6  541  end
      '
      '  261 ppm boron (wt) in moderator for Core IV
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      end comp
      '
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
      '      fuel-pin-cell geometry:
      '
      squarepitch   1.072  0.747 1  3  0.864  2  0.757   0  end
      '
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
      '    assembly and cycle parameters:
      '
      npin/assm=305 fuelngth=833.69 ncycles=3  nlib/cyc=5
      printlevel=5 lightel=9  inplevel=2 numztotal=3   end
      3 0.6048 500 10.5799 3 10.9791
      power=27.74 burn=451.5  down=129   end
      power=30.79 burn=333.1  down=370 temkcyc=915 end
      power=22.57 burn=337  down=717  bfrac=261 temkcyc=848  end
          o 135.0  cr 5.9   mn 0.33
          fe 13.0  co 0.075 ni 9.9
          zr 221.0 nb 0.71  sn 3.6
      '
1   ssssssssssss      aaaaaaaaa      ssssssssssss     22222222222     hh          hh
   sssssssssssss     aaaaaaaaaaa    sssssssssssss   2222222222222    hh          hh
   ss          ss    aa         aa  ss          ss  22          22   hh          hh
   ss                aa         aa  ss                          22   hh          hh
   ss                aa         aa  ss                          22   hh          hh
   sssssssssss       aaaaaaaaaaaaa  sssssssssss              22     hhhhhhhhhhhhh
    sssssssssss      aaaaaaaaaaaaa   sssssssssss           22       hhhhhhhhhhhhh
              ss     aa         aa              ss        22        hh          hh
              ss     aa         aa              ss      22          hh          hh
```

```
   ss         ss   aa         aa   ss         ss   22              hh         hh
   sssssssssssss   aa         aa   sssssssssssss   2222222222222   hh         hh
    sssssssssss    aa         aa    sssssssssss    2222222222222   hh         hh
0

   nn         nn   iiiiiiiiiiii     cccccccccc     hh         hh    oooooooooo    ll
   nnn        nn   iiiiiiiiiiii    cccccccccccc    hh         hh   oooooooooooo   ll
   nnnn       nn       ii         cc         cc    hh         hh   oo        oo   ll
   nn nn      nn       ii         cc               hh         hh   oo        oo   ll
   nn   nn    nn       ii         cc               hh         hh   oo        oo   ll
   nn    nn   nn       ii         cc               hhhhhhhhhhhhhh   oo        oo   ll
   nn     nn  nn       ii         cc               hhhhhhhhhhhhhh   oo        oo   ll
   nn      nn nn       ii         cc               hh         hh   oo        oo   ll
   nn       nn nn      ii         cc               hh         hh   oo        oo   ll
   nn        nnnn      ii         cc         cc    hh         hh   oo        oo   ll
   nn         nnn   iiiiiiiiiiii    cccccccccccc    hh         hh   oooooooooooo   lllllllllllll
   nn          nn   iiiiiiiiiiii     cccccccccc     hh         hh    oooooooooo    lllllllllllll
0

     0000000      7777777777777              //   33333333333        11                //   99999999999    7777777777777
    000000000     777777777777              //  3333333333333       111                //  9999999999999   777777777777
   00       00    77         77             //   33         33     1111               //   99         99   77         77
  00         00          77               //                33       11              //    99         99          77
  00         00        77                //                 33       11             //     99         99         77
  00         00      77                 //                333       11            //      9999999999999         77
  00         00     77                 //                 333       11           //       999999999999         77
  00         00    77                 //                   33       11          //                  99        77
  00         00   77                 //                    33       11         //                   99        77
   00       00   77               //            33         33       11        //                    99       77
    000000000   77              //            3333333333333    11111111      //                 9999999999999   77
     0000000    77             //              33333333333    11111111     //                  999999999999   77
0

     0000000      88888888888                      11        88888888888                  33333333333    5555555555555
    000000000    8888888888888                    111       8888888888888                3333333333333   5555555555555
   00       00   88         88        :::         1111       88         88        :::    33         33   55
  00         00  88         88        :::           11       88         88        :::                33   55
  00         00  88         88        :::           11       88         88        :::                33   55
  00         00   88888888888                      11        88888888888                        333   555555555555
  00         00   88888888888                      11        88888888888                        333   5555555555555
  00         00  88         88        :::           11       88         88        :::                33             55
  00         00  88         88        :::           11       88         88        :::                33             55
   00       00   88         88        :::           11       88         88        :::    33         33   55         55
    000000000    8888888888888                  11111111    8888888888888                3333333333333   5555555555555
     0000000      88888888888                   11111111     88888888888                 33333333333     55555555555
1
0                                 sssssssssss     cccccccccc      aaaaaaaaa     ll          eeeeeeeeeeeeee
                                 sssssssssssss   cccccccccccc    aaaaaaaaaaa   ll          eeeeeeeeeeeeee
                                 ss         ss   cc         cc   aa         aa   ll          ee
                                 ss              cc              aa         aa   ll          ee
                                 ss              cc              aa         aa   ll          ee
                                 sssssssssssss   cc              aaaaaaaaaaaaa   ll          eeeeeeeee
                                  sssssssssssss  cc              aaaaaaaaaaaaa   ll          eeeeeeeee
                                            ss   cc              aa         aa   ll          ee
                                            ss   cc              aa         aa   ll          ee
                                 ss         ss   cc         cc   aa         aa   ll          ee
                                 sssssssssssss   cccccccccccc    aa         aa   lllllllllllll   eeeeeeeeeeeeee
                                  sssssssssss     cccccccccc     aa         aa   lllllllllllll   eeeeeeeeeeeeee


                        ************************************************************************
                        ************************************************************************
                        ************************************************************************
                        *****                                                              *****
                        *****                 program verification information              *****
                        *****                                                              *****
                        *****                 code system:    scale  version:   4.3        *****
                        *****                                                              *****
                        ************************************************************************
                        ************************************************************************
                        *****                                                              *****
                        *****                                                              *****
                        *****              program:  sas2                                  *****
                        *****        creation date:  03/07/97                              *****
                        *****              library:  /opt/neut/Scale4.3/bin                *****
                        *****                                                              *****
                        *****                                                              *****
                        *****    this is not a   scale  configuration controlled code      *****
                        *****                                                              *****
                        *****              jobname:  nichol                                *****
                        *****                                                              *****
                        *****    date of execution:  07/31/97                              *****
                        *****                                                              *****
                        *****    time of execution:  08:18:35                              *****
                        *****                                                              *****
                        *****                                                              *****
                        ************************************************************************
                        ************************************************************************
                        ************************************************************************
1
0' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
0'
0                                                  nuclide concentrations, grams
                                                   basis =single reactor assembly
              initial  1E-18 d
     o 16   1.35E+05  1.35E+05
   total    3.92E+05  3.92E+05
0                                                  nuclide concentrations, grams
                                                   basis =single reactor assembly
              initial  1E-18 d
     u234   2.00E+02  2.00E+02
     u235   3.40E+04  3.40E+04
     u236   2.00E+02  2.00E+02
     u238   9.65E+05  9.65E+05
   total    1.00E+06  1.00E+06
0                                                  basis =
0                 initial        22.6 d        45.2 d        67.7 d        90.3 d        90.3 d
```

```
0                    initial        22.6 d        45.2 d        67.7 d        90.3 d        90.3 d
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial  119.5 d  239.0 d  358.5 d  478.0 d  597.5 d  717.0 d
      o 16   1.35E+05 1.35E+05 1.35E+05 1.35E+05 1.35E+05 1.35E+05 1.35E+05
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial  119.5 d  239.0 d  358.5 d  478.0 d  597.5 d  717.0 d
     mo 95   1.68E+01 1.83E+01 1.88E+01 1.90E+01 1.90E+01 1.90E+01 1.90E+01
     tc 99   7.49E-05 7.57E-05 7.57E-05 7.57E-05 7.57E-05 7.57E-05 7.57E-05
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial  119.5 d  239.0 d  358.5 d  478.0 d  597.5 d  717.0 d
   total      3.92E+05 3.92E+05 3.92E+05 3.92E+05 3.92E+05 3.92E+05 3.92E+05
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial  119.5 d  239.0 d  358.5 d  478.0 d  597.5 d  717.0 d
      u233   1.83E-03 1.88E-03 1.93E-03 1.98E-03 2.02E-03 2.07E-03 2.12E-03
      u234   1.22E+02 1.23E+02 1.23E+02 1.24E+02 1.24E+02 1.24E+02 1.25E+02
      u235   1.23E+04 1.23E+04 1.23E+04 1.23E+04 1.23E+04 1.23E+04 1.23E+04
      u236   4.07E+03 4.07E+03 4.07E+03 4.07E+03 4.07E+03 4.07E+03 4.07E+03
      u238   9.40E+05 9.40E+05 9.40E+05 9.40E+05 9.40E+05 9.40E+05 9.40E+05
     np237   4.48E+02 4.55E+02 4.55E+02 4.56E+02 4.56E+02 4.56E+02 4.56E+02
     pu236   6.32E-04 5.87E-04 5.43E-04 5.02E-04 4.64E-04 4.29E-04 3.97E-04
     pu238   1.62E+02 1.71E+02 1.75E+02 1.77E+02 1.78E+02 1.79E+02 1.79E+02
     pu238   1.62E+02 1.71E+02 1.75E+02 1.77E+02 1.78E+02 1.79E+02 1.79E+02
     pu239   6.51E+03 6.57E+03 6.57E+03 6.57E+03 6.57E+03 6.57E+03 6.57E+03
     pu240   2.36E+03 2.36E+03 2.36E+03 2.36E+03 2.36E+03 2.36E+03 2.36E+03
     pu241   1.53E+03 1.51E+03 1.48E+03 1.46E+03 1.44E+03 1.41E+03 1.39E+03
     pu242   4.27E+02 4.27E+02 4.27E+02 4.27E+02 4.27E+02 4.27E+02 4.27E+02
     am241   8.71E+01 1.11E+02 1.35E+02 1.58E+02 1.81E+02 2.03E+02 2.25E+02
    am242m   2.44E+00 2.43E+00 2.43E+00 2.43E+00 2.42E+00 2.42E+00 2.42E+00
     am243   9.12E+01 9.13E+01 9.13E+01 9.13E+01 9.13E+01 9.13E+01 9.13E+01
   total     9.68E+05 9.68E+05 9.68E+05 9.68E+05 9.68E+05 9.68E+05 9.68E+05
0                                                element concentrations, grams
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial  119.5 d  239.0 d  358.5 d  478.0 d  597.5 d  717.0 d
     mo 95   6.26E+02 6.70E+02 6.87E+02 6.93E+02 6.94E+02 6.94E+02 6.95E+02
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial  119.5 d  239.0 d  358.5 d  478.0 d  597.5 d  717.0 d
     tc 99   7.28E+02 7.31E+02 7.31E+02 7.31E+02 7.31E+02 7.31E+02 7.31E+02
     ru101   7.03E+02 7.03E+02 7.03E+02 7.03E+02 7.03E+02 7.03E+02 7.03E+02
     rh103   4.28E+02 4.55E+02 4.58E+02 4.59E+02 4.59E+02 4.59E+02 4.59E+02
    rh103m   3.05E-02 3.70E-03 4.49E-04 5.44E-05 6.60E-06 8.00E-07 9.70E-08
     ag109   8.32E+01 8.34E+01 8.34E+01 8.34E+01 8.34E+01 8.34E+01 8.34E+01
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial  119.5 d  239.0 d  358.5 d  478.0 d  597.5 d  717.0 d
     nd143   8.04E+02 8.19E+02 8.19E+02 8.19E+02 8.19E+02 8.19E+02 8.19E+02
     nd145   6.21E+02 6.21E+02 6.21E+02 6.21E+02 6.21E+02 6.21E+02 6.21E+02
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial  119.5 d  239.0 d  358.5 d  478.0 d  597.5 d  717.0 d
     sm147   1.05E+02 1.17E+02 1.27E+02 1.38E+02 1.47E+02 1.55E+02 1.63E+02
     sm149   3.51E+00 4.35E+00 4.35E+00 4.35E+00 4.35E+00 4.35E+00 4.35E+00
     sm150   2.72E+02 2.72E+02 2.72E+02 2.72E+02 2.72E+02 2.72E+02 2.72E+02
     sm151   2.33E+01 2.34E+01 2.33E+01 2.33E+01 2.32E+01 2.32E+01 2.31E+01
     eu151   5.18E-02 1.11E-01 1.70E-01 2.28E-01 2.87E-01 3.45E-01 4.04E-01
     sm152   1.15E+02 1.15E+02 1.15E+02 1.15E+02 1.15E+02 1.15E+02 1.15E+02
     eu153   1.05E+02 1.05E+02 1.05E+02 1.05E+02 1.05E+02 1.05E+02 1.05E+02
     gd155   1.02E-01 3.05E-01 4.98E-01 6.82E-01 8.57E-01 1.02E+00 1.18E+00
   total     3.10E+04 3.10E+04 3.10E+04 3.10E+04 3.10E+04 3.10E+04 3.10E+04
```

ye6cf6h5.sum

```
0*************************************************************************
 *                                                                       *
 *                    SCALE4.3  Bulletin  Board                          *
 *                    --------  --------  -----                          *
 *                                                                       *
 *                      Welcome to SCALE-4.3.                            *
 *                                                                       *
 *                                                                       *
 *************************************************************************
1          primary module access and input record ( scale driver - 95/03/29 - 09:06:37 )
-   module sas2h    will be called
      Yankee Rowe sample E6-C-f6-5, 57.66 cm 31.33 gwd/MTU, July 97
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
      '   mixtures of fuel-pin-unit-cell:
      '
      '
      '
      44group    latticecell
      '
      '
      '
      uo2  1 den=10.18  1  885
         92234 0.020 92235 3.40 92236 0.020 92238 96.56   end
      kr-83  1 0 1-20 885  end
      kr-85  1 0 1-20 885  end
      y-89   1 0 1-20 885  end
      sr-90  1 0 1-20 885  end
      zr-93  1 0 1-20 885  end
      zr-94  1 0 1-20 885  end
      zr-95  1 0 1-20 885  end
      nb-94  1 0 1-20 885  end
      mo-95  1 0 1-20 885  end
      tc-99  1 0 1-20 885  end
      ru-101 1 0 1-20 885  end
      ru-106 1 0 1-20 885  end
      rh-103 1 0 1-20 885  end
      rh-105 1 0 1-20 885  end
      pd-105 1 0 1-20 885  end
      pd-108 1 0 1-20 885  end
      ag-109 1 0 1-20 885  end
      sb-124 1 0 1-20 885  end
      xe-131 1 0 1-20 885  end
      xe-132 1 0 1-20 885  end
      xe-135 1 0 1-20 885  end
      xe-136 1 0 1-20 885  end
      cs-134 1 0 1-20 885  end
      cs-135 1 0 1-20 885  end
      cs-137 1 0 1-20 885  end
      ba-136 1 0 1-20 885  end
      la-139 1 0 1-20 885  end
      pr-141 1 0 1-20 885  end
      pr-143 1 0 1-20 885  end
      ce-144 1 0 1-20 885  end
      nd-143 1 0 1-20 885  end
      nd-145 1 0 1-20 885  end
      nd-147 1 0 1-20 885  end
      pm-147 1 0 1-20 885  end
      pm-148 1 0 1-20 885  end
      sm-147 1 0 1-20 885  end
      sm-149 1 0 1-20 885  end
      sm-150 1 0 1-20 885  end
      sm-151 1 0 1-20 885  end
      sm-152 1 0 1-20 885  end
      eu-153 1 0 1-20 885  end
      eu-154 1 0 1-20 885  end
      eu-155 1 0 1-20 885  end
      gd-155 1 0 1-20 885  end
      '
      arbm-ss348  8.03 11 0 0 0 6012 0.08 25055 2.0 15031 0.045
        .16000 0.030 14000 0.75 24000 18.0 28000 11.0 41093 0.7
        73181 0.1 27059 0.2 26000 67.095 2 1  551  end
      '
      h2o  3 den=0.79733  1  532  end
      arbm-bormod  0.79733 1 1 0 0 5000 100 3 1.0e-6  532   end
      '
      '  261 ppm boron (wt) in moderator for the Core IV
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      end comp
      '
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
      '      fuel-pin-cell geometry:
      '
      squarepitch   1.072  0.747 1  3  0.864  2  0.757   0  end
      '
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
      '    assembly and cycle parameters:
      '
      npin/assm=305 fuelngth=833.69 ncycles=3  nlib/cyc=5
      printlevel=5 lightel=9  inplevel=2 numztotal=3   end
      3 0.6048 500 10.5799 3 10.9791
      power=29.44 burn=451.5  down=129   end
      power=29.86 burn=333.1  down=370   temkcyc=889  end
      power=24.01 burn=337  down=281.5  bfrac=261 temkcyc=847   end
          o 135.0  cr 5.9   mn 0.33
          fe 13.0  co 0.075 ni 9.9
          zr 221.0 nb 0.71  sn 3.6
      '
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
1   ssssssssssss      aaaaaaaaa      ssssssssssss     22222222222    hh          hh
   sssssssssssss    aaaaaaaaaaa    sssssssssssss   2222222222222   hh          hh
   ss          ss   aa         aa   ss          ss   22          22   hh          hh
   ss               aa         aa   ss                           22   hh          hh
   ss               aa         aa   ss                           22   hh          hh
   sssssssssssss    aaaaaaaaaaaaa   sssssssssssss              22    hhhhhhhhhhhhh
    ssssssssssss    aaaaaaaaaaaaa    ssssssssssss            22      hhhhhhhhhhhhh
```

```
            ss   aa         aa            ss       22         hh         hh
            ss   aa         aa            ss     22           hh         hh
   ss       ss   aa         aa   ss       ss   22             hh         hh
   sssssssssssss aa         aa   sssssssssssss 2222222222222 hh         hh
    sssssssssss  aa         aa    sssssssssss  2222222222222 hh         hh
0

   nn         nn iiiiiiiiiiii    cccccccccc    hh         hh   oooooooooooo   ll
   nnn        nn iiiiiiiiiiii   cccccccccccc   hh         hh  oooooooooooooo  ll
   nnnn       nn      ii        cc        cc   hh         hh  oo        oo    ll
   nn nn      nn      ii        cc             hh         hh  oo        oo    ll
   nn   nn    nn      ii        cc             hh         hh  oo        oo    ll
   nn     nn  nn      ii        cc             hhhhhhhhhhhhhh oo        oo    ll
   nn       nn nn     ii        cc             hhhhhhhhhhhhhh oo        oo    ll
   nn        nn nn    ii        cc             hh         hh  oo        oo    ll
   nn         nnnn    ii        cc             hh         hh  oo        oo    ll
   nn          nnn iiiiiiiiiiii  cccccccccccc   hh         hh  oooooooooooooo  llllllllllll
   nn           nn iiiiiiiiiiii   cccccccccc    hh         hh   oooooooooooo   llllllllllll
0

     0000000      7777777777777              //  33333333333      0000000                //  99999999999   7777777777777
    000000000     777777777777              //  3333333333333    000000000              //  9999999999999 777777777777
   00       00    77        77              //  33          33   00       00           //  99        99  77        77
  00         00        77                  //                33  00         00         //  99        99          77
  00         00          77                //                33  00         00        //  99        99           77
  00         00         77                //               333  00         00       //   9999999999999          77
  00         00          77               //               333  00         00      //     999999999999          77
  00         00         77                //                33  00         00     //                99         77
  00         00          77               //                33  00         00    //                 99         77
   00       00          77               //  33          33   00       00      //                  99        77
    000000000          77                //  3333333333333    000000000       //  9999999999999   77
     0000000           77               //    33333333333      0000000        //  999999999999    77
0

        11        7777777777777                 22222222222   7777777777777                          44            44
       111        777777777777                 2222222222222 777777777777                          444           444
      1111        77        77        :::     22         22 77        77        :::              4444          4444
        11              77          :::                22        77          :::             44 44         44 44
        11            77            :::                22      77            :::            44  44        44  44
        11          77                                22    77                           44   44      44   44
        11          77                                22   77                           44   44      44   44
        11          77                      :::     22     77                :::      444444444444  444444444444
        11          77                      :::   22       77                :::      444444444444  444444444444
        11         77                       :::  22       77                :::                44            44
    11111111       77                              2222222222222 77                              44            44
    11111111       77                              2222222222222 77                              44            44
1
0                                  sssssssssss   ccccccccccc    aaaaaaaaa    ll          eeeeeeeeeeeee
                                 sssssssssssss  ccccccccccccc  aaaaaaaaaaa   ll          eeeeeeeeeeeee
                                 ss        ss   cc        cc   aa        aa  ll          ee
                                 ss             cc             aa        aa  ll          ee
                                 ss             cc             aa        aa  ll          ee
                                 sssssssssssss  cc             aaaaaaaaaaaaa ll          eeeeeeeee
                                  sssssssssssss cc             aaaaaaaaaaaaa ll          eeeeeeeee
                                           ss   cc             aa        aa  ll          ee
                                           ss   cc             aa        aa  ll          ee
                                 ss        ss   cc        cc   aa        aa  ll          ee
                                 sssssssssssss  ccccccccccccc aa        aa  llllllllllll eeeeeeeeeeeee
                                  sssssssssss   ccccccccccc   aa        aa  llllllllllll eeeeeeeeeeeee
```

```
*****************************************************************************
*****************************************************************************
*****************************************************************************
*****                                                                   *****
*****                 program verification information                   *****
*****                                                                   *****
*****                 code system:    scale  version:    4.3            *****
*****                                                                   *****
*****************************************************************************
*****************************************************************************
*****                                                                   *****
*****                                                                   *****
*****              program:  sas2                                       *****
*****                                                                   *****
*****        creation date:  03/07/97                                   *****
*****                                                                   *****
*****              library:  /opt/neut/Scale4.3/bin                     *****
*****                                                                   *****
*****                                                                   *****
*****    this is not a   scale  configuration controlled code           *****
*****                                                                   *****
*****              jobname:  nichol                                     *****
*****                                                                   *****
*****    date of execution:  07/30/97                                   *****
*****                                                                   *****
*****    time of execution:  17:27:44                                   *****
*****                                                                   *****
*****                                                                   *****
*****************************************************************************
*****************************************************************************
*****************************************************************************
```

```
1
0' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
0'
0                                   nuclide concentrations, grams
                                    basis =single reactor assembly
            initial  1E-18 d
     o 16   1.35E+05  1.35E+05
   total    3.92E+05  3.92E+05
0                                   nuclide concentrations, grams
                                    basis =single reactor assembly
            initial  1E-18 d
     u234   2.00E+02  2.00E+02
     u235   3.40E+04  3.40E+04
     u236   2.00E+02  2.00E+02
     u238   9.65E+05  9.65E+05
   total    1.00E+06  1.00E+06
```

```
0                                                  basis =
0                    initial          22.6 d          45.2 d          67.7 d          90.3 d          90.3 d
0                    initial          22.6 d          45.2 d          67.7 d          90.3 d          90.3 d
                                                   basis = single reactor assembly
              charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
      o 16  8.41E+03  8.41E+03  8.41E+03  8.41E+03  8.41E+03  8.41E+03
                                                   basis = single reactor assembly
              charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
                                                   basis = single reactor assembly
              charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
     mo 95    .00E+00  6.02E-05  4.11E-04  1.19E-03  2.43E-03  2.43E-03
                                                   basis = single reactor assembly
              charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
     tc 99    .00E+00  3.21E-12  3.31E-11  1.22E-10  3.02E-10  3.02E-10
                                                   basis = single reactor assembly
              charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
                                                   basis = single reactor assembly
              charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
   totals    1.15E+04  1.15E+04  1.15E+04  1.15E+04  1.15E+04  1.15E+04
                                                   basis = single reactor assembly
              charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
      u233    .00E+00  3.04E-07  5.99E-07  8.78E-07  1.14E-06  1.14E-06
      u234   8.55E-01  8.46E-01  8.37E-01  8.28E-01  8.19E-01  8.19E-01
      u235   1.45E+02  1.41E+02  1.38E+02  1.35E+02  1.32E+02  1.32E+02
      u236   8.47E-01  1.48E+00  2.10E+00  2.70E+00  3.28E+00  3.28E+00
      u238   4.06E+03  4.05E+03  4.05E+03  4.05E+03  4.05E+03  4.05E+03
     np237    .00E+00  8.24E-03  2.31E-02  4.07E-02  6.05E-02  6.05E-02
     pu236    .00E+00  2.12E-10  1.30E-09  3.53E-09  7.05E-09  7.05E-09
     pu238    .00E+00  4.58E-05  2.91E-04  8.03E-04  1.62E-03  1.62E-03
     pu238    .00E+00  4.58E-05  2.91E-04  8.03E-04  1.62E-03  1.62E-03
     pu239    .00E+00  1.51E+00  3.18E+00  4.73E+00  6.15E+00  6.16E+00
     pu240    .00E+00  2.02E-02  8.32E-02  1.81E-01  3.06E-01  3.06E-01
     pu241    .00E+00  7.20E-04  6.09E-03  2.00E-02  4.52E-02  4.52E-02
     pu242    .00E+00  3.20E-06  5.59E-05  2.81E-04  8.57E-04  8.57E-04
                                                   basis = single reactor assembly
              charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
     am241    .00E+00  5.13E-07  8.79E-06  4.40E-05  1.34E-04  1.34E-04
     am242m   .00E+00  7.88E-10  2.64E-08  1.91E-07  7.46E-07  7.46E-07
     am243    .00E+00  1.06E-08  3.78E-07  2.89E-06  1.19E-05  1.19E-05
   totals    4.20E+03  4.20E+03  4.20E+03  4.19E+03  4.19E+03  4.19E+03
          *        decay data, including gamma and total energy, are from endf/b-vi        *
0                     1697    total number of nuclides in library
0                                                  nuclide concentrations, grams
                                                   basis =single reactor assembly
              initial   46.9 d   93.8 d  140.8 d   187.7 d   234.6 d   281.5 d
      o 16  1.35E+05  1.35E+05  1.35E+05  1.35E+05  1.35E+05  1.35E+05  1.35E+05
0                                                  nuclide concentrations, grams
                                                   basis =single reactor assembly
              initial   46.9 d   93.8 d  140.8 d   187.7 d   234.6 d   281.5 d
     mo 95  1.71E+01  1.78E+01  1.84E+01  1.88E+01  1.90E+01  1.92E+01  1.93E+01
     tc 99  7.93E-05  8.01E-05  8.01E-05  8.01E-05  8.01E-05  8.01E-05  8.01E-05
0                                                  nuclide concentrations, grams
                                                   basis =single reactor assembly
              initial   46.9 d   93.8 d  140.8 d   187.7 d   234.6 d   281.5 d
   total     3.92E+05  3.92E+05  3.92E+05  3.92E+05  3.92E+05  3.92E+05  3.92E+05
0                                                  nuclide concentrations, grams
                                                   basis =single reactor assembly
              initial   46.9 d   93.8 d  140.8 d   187.7 d   234.6 d   281.5 d
      u233  1.83E-03  1.85E-03  1.87E-03  1.89E-03  1.91E-03  1.93E-03  1.95E-03
      u234  1.21E+02  1.21E+02  1.21E+02  1.21E+02  1.21E+02  1.21E+02  1.22E+02
      u235  1.18E+04  1.18E+04  1.18E+04  1.18E+04  1.18E+04  1.18E+04  1.18E+04
      u236  4.13E+03  4.13E+03  4.13E+03  4.13E+03  4.13E+03  4.13E+03  4.13E+03
      u238  9.40E+05  9.40E+05  9.40E+05  9.40E+05  9.40E+05  9.40E+05  9.40E+05
     np237  4.61E+02  4.68E+02  4.69E+02  4.69E+02  4.69E+02  4.69E+02  4.69E+02
     pu236  6.73E-04  6.55E-04  6.35E-04  6.16E-04  5.97E-04  5.79E-04  5.62E-04
     pu238  1.71E+02  1.76E+02  1.79E+02  1.81E+02  1.83E+02  1.84E+02  1.85E+02
     pu238  1.71E+02  1.76E+02  1.79E+02  1.81E+02  1.83E+02  1.84E+02  1.85E+02
     pu239  6.45E+03  6.52E+03  6.52E+03  6.52E+03  6.52E+03  6.52E+03  6.52E+03
     pu240  2.41E+03  2.41E+03  2.41E+03  2.41E+03  2.41E+03  2.41E+03  2.41E+03
     pu241  1.56E+03  1.55E+03  1.54E+03  1.53E+03  1.52E+03  1.51E+03  1.50E+03
     pu242  4.53E+02  4.53E+02  4.53E+02  4.53E+02  4.53E+02  4.53E+02  4.53E+02
     am241  8.58E+01  9.55E+01  1.05E+02  1.15E+02  1.24E+02  1.33E+02  1.43E+02
     am242m 2.41E+00  2.41E+00  2.41E+00  2.41E+00  2.41E+00  2.40E+00  2.40E+00
     am243  9.84E+01  9.85E+01  9.85E+01  9.85E+01  9.85E+01  9.85E+01  9.85E+01
   total    9.67E+05  9.67E+05  9.67E+05  9.67E+05  9.67E+05  9.67E+05  9.67E+05
0                                                  element concentrations, grams
0                                                  nuclide concentrations, grams
                                                   basis =single reactor assembly
              initial   46.9 d   93.8 d  140.8 d   187.7 d   234.6 d   281.5 d
     mo 95  6.42E+02  6.64E+02  6.81E+02  6.93E+02  7.01E+02  7.06E+02  7.09E+02
0                                                  nuclide concentrations, grams
                                                   basis =single reactor assembly
              initial   46.9 d   93.8 d  140.8 d   187.7 d   234.6 d   281.5 d
     tc 99  7.49E+02  7.51E+02  7.51E+02  7.51E+02  7.51E+02  7.51E+02  7.51E+02
     ru101  7.24E+02  7.24E+02  7.24E+02  7.24E+02  7.24E+02  7.24E+02  7.24E+02
     rh103  4.37E+02  4.56E+02  4.64E+02  4.67E+02  4.69E+02  4.69E+02  4.70E+02
     rh103m 3.26E-02  1.42E-02  6.22E-03  2.72E-03  1.19E-03  5.18E-04  2.26E-04
     ag109  8.62E+01  8.64E+01  8.64E+01  8.64E+01  8.64E+01  8.64E+01  8.64E+01
0                                                  nuclide concentrations, grams
                                                   basis =single reactor assembly
              initial   46.9 d   93.8 d  140.8 d   187.7 d   234.6 d   281.5 d
     nd143  8.20E+02  8.34E+02  8.35E+02  8.35E+02  8.35E+02  8.35E+02  8.35E+02
0                                                  nuclide concentrations, grams
                                                   basis =single reactor assembly
              initial   46.9 d   93.8 d  140.8 d   187.7 d   234.6 d   281.5 d
     nd145  6.37E+02  6.38E+02  6.38E+02  6.38E+02  6.38E+02  6.38E+02  6.38E+02
     sm147  1.06E+02  1.11E+02  1.16E+02  1.20E+02  1.25E+02  1.29E+02  1.33E+02
     sm149  3.47E+00  4.37E+00  4.37E+00  4.37E+00  4.37E+00  4.37E+00  4.37E+00
     sm150  2.81E+02  2.81E+02  2.81E+02  2.81E+02  2.81E+02  2.81E+02  2.81E+02
     sm151  2.33E+01  2.35E+01  2.35E+01  2.34E+01  2.34E+01  2.34E+01  2.34E+01
     eu151  4.76E-02  7.09E-02  9.41E-02  1.17E-01  1.40E-01  1.64E-01  1.87E-01
     sm152  1.18E+02  1.18E+02  1.18E+02  1.18E+02  1.18E+02  1.18E+02  1.18E+02
     eu153  1.09E+02  1.10E+02  1.10E+02  1.10E+02  1.10E+02  1.10E+02  1.10E+02
     gd155  1.00E-01  1.85E-01  2.68E-01  3.50E-01  4.30E-01  5.08E-01  5.85E-01
0                                                  nuclide concentrations, grams
                                                   basis =single reactor assembly
              initial   46.9 d   93.8 d  140.8 d   187.7 d   234.6 d   281.5 d
   total     3.20E+04  3.20E+04  3.20E+04  3.20E+04  3.20E+04  3.20E+04  3.20E+04
```

ye6cf6h6.sum

```
0*************************************************************************
 *                                                                       *
 *                    SCALE4.3  Bulletin  Board                          *
 *                    --------  --------  -----                          *
 *                                                                       *
 *                      Welcome to SCALE-4.3.                            *
 *                                                                       *
 *                                                                       *
 *************************************************************************
1          primary module access and input record ( scale driver - 95/03/29 - 09:06:37 )
-   module sas2h    will be called
      Yankee Rowe sample E6-C-f6-6, 17.02 cm 20.19 gwd/MTU, July 97
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
      '   mixtures of fuel-pin-unit-cell:
      '
      '
      '
      44group    latticecell
      '
      '
      '
      uo2  1 den=10.18  1  788
         92234 0.020 92235 3.40 92236 0.020 92238 96.56   end
      kr-83  1 0 1-20 788  end
      kr-85  1 0 1-20 788  end
      y-89   1 0 1-20 788  end
      sr-90  1 0 1-20 788  end
      zr-93  1 0 1-20 788  end
      zr-94  1 0 1-20 788  end
      zr-95  1 0 1-20 788  end
      nb-94  1 0 1-20 788  end
      mo-95  1 0 1-20 788  end
      tc-99  1 0 1-20 788  end
      ru-101 1 0 1-20 788  end
      ru-106 1 0 1-20 788  end
      rh-103 1 0 1-20 788  end
      rh-105 1 0 1-20 788  end
      pd-105 1 0 1-20 788  end
      pd-108 1 0 1-20 788  end
      ag-109 1 0 1-20 788  end
      sb-124 1 0 1-20 788  end
      xe-131 1 0 1-20 788  end
      xe-132 1 0 1-20 788  end
      xe-135 1 0 1-20 788  end
      xe-136 1 0 1-20 788  end
      cs-134 1 0 1-20 788  end
      cs-135 1 0 1-20 788  end
      cs-137 1 0 1-20 788  end
      ba-136 1 0 1-20 788  end
      la-139 1 0 1-20 788  end
      pr-141 1 0 1-20 788  end
      pr-143 1 0 1-20 788  end
      ce-144 1 0 1-20 788  end
      nd-143 1 0 1-20 788  end
      nd-145 1 0 1-20 788  end
      nd-147 1 0 1-20 788  end
      pm-147 1 0 1-20 788  end
      pm-148 1 0 1-20 788  end
      sm-147 1 0 1-20 788  end
      sm-149 1 0 1-20 788  end
      sm-150 1 0 1-20 788  end
      sm-151 1 0 1-20 788  end
      sm-152 1 0 1-20 788  end
      eu-153 1 0 1-20 788  end
      eu-154 1 0 1-20 788  end
      eu-155 1 0 1-20 788  end
      gd-155 1 0 1-20 788  end
      '
      arbm-ss348  8.03 11 0 0 0 6012 0.08 25055 2.0 15031 0.045
         16000 0.030 14000 0.75 24000 18.0 28000 11.0 41093 0.7
         73181 0.1 27059 0.2 26000 67.095 2 1  541  end
      '
      h2o  3 den=0.80256  1  528  end
      arbm-bormod  0.80256 1 1 0 0 5000 100 3 1.0e-6  528   end
      '
      '  261 ppm boron (wt) in moderator for the Core IV
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      end comp
      '
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
      '      fuel-pin-cell geometry:
      '
      squarepitch   1.072  0.747 1  3  0.864  2  0.757   0  end
      '
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
      '    assembly and cycle parameters:
      '
      npin/assm=305 fuelngth=833.69 ncycles=3  nlib/cyc=5
      printlevel=5 lightel=9  inplevel=2 numztotal=3   end
      3 0.6048 500 10.5799 3 10.9791
      power=18.139 burn=451.5  down=129   end
      power=19.070 burn=333.1  down=370 temkcyc=796   end
      power=16.755 burn=337  down=281.5  bfrac=261 temkcyc=777   end
          o 135.0  cr 5.9   mn 0.33
          fe 13.0  co 0.075 ni 9.9
          zr 221.0 nb 0.71  sn 3.6
      '
1   sssssssssss      aaaaaaaaa      sssssssssss     22222222222    hh         hh
   ssssssssssss    aaaaaaaaaaa    ssssssssssss   2222222222222   hh         hh
   ss          ss   aa         aa   ss          ss   22         22   hh         hh
   ss               aa         aa   ss                          22   hh         hh
   ss               aa         aa   ss                          22   hh         hh
   ssssssssssss    aaaaaaaaaaaaa   ssssssssssss             22     hhhhhhhhhhhhh
    ssssssssssss   aaaaaaaaaaaaa    ssssssssssss          22       hhhhhhhhhhhhh
              ss   aa         aa               ss        22         hh         hh
              ss   aa         aa               ss      22           hh         hh
```

```
   ss         ss   aa         aa   ss         ss    22              hh         hh
   sssssssssssss   aa         aa   sssssssssssss   2222222222222   hh         hh
    sssssssssss    aa         aa    sssssssssss    2222222222222   hh         hh
0

   nn          nn  iiiiiiiiiiii     cccccccccc     hh         hh    oooooooooo    ll
   nnn         nn  iiiiiiiiiiii    cccccccccccc    hh         hh   oooooooooooo   ll
   nnnn        nn       ii         cc         cc   hh         hh   oo        oo   ll
   nn nn       nn       ii         cc              hh         hh   oo        oo   ll
   nn   nn     nn       ii         cc              hh         hh   oo        oo   ll
   nn    nn    nn       ii         cc              hhhhhhhhhhhhh   oo        oo   ll
   nn     nn   nn       ii         cc              hhhhhhhhhhhhh   oo        oo   ll
   nn      nn  nn       ii         cc              hh         hh   oo        oo   ll
   nn       nn nn       ii         cc              hh         hh   oo        oo   ll
   nn        nnnn       ii         cc         cc   hh         hh   oo        oo   ll
   nn         nnn  iiiiiiiiiiii    cccccccccccc    hh         hh   oooooooooooo   llllllllllll
   nn          nn  iiiiiiiiiiii     cccccccccc     hh         hh    oooooooooo    llllllllllll
0

     0000000      7777777777777                //   33333333333      0000000                //   99999999999    7777777777777
    000000000     777777777777                //   3333333333333    000000000              //   9999999999999  777777777777
   00       00    77        77                //   33          33   00       00           //   99         99  77         77
  00         00          77                  //                33   00         00        //   99         99           77
  00         00        77                    //                33   00         00       //    99         99          77
  00         00       77                    //               333   00         00      //     9999999999999         77
  00         00       77                    //               333   00         00     //      999999999999          77
  00         00      77                    //                 33   00         00    //                99         77
  00         00      77                    //                 33   00         00   //                 99         77
   00       00       77                    //   33          33    00       00    //                  99        77
    000000000        77                    //   3333333333333     000000000    //   9999999999999  77
     0000000         77                    //    33333333333       0000000    //   999999999999   77
0

        11        7777777777777                   5555555555555      0000000                   22222222222        11
       111        777777777777                    5555555555555     000000000                2222222222222      111
      1111        77        77          :::       55              00        00        :::    22          22    1111
        11                77          :::       55              00         00       :::                22      11
        11               77           :::       55              00         00       :::                22      11
        11              77                      555555555555     00         00                  22         11
        11              77                      5555555555555    00         00                22           11
        11             77           :::                   55    00         00       :::     22             11
        11             77           :::                   55    00         00       :::   22               11
        11            77            :::       55          55    00        00        :::  22                11
    11111111          77                      5555555555555     000000000                2222222222222   11111111
    11111111          77                       55555555555       0000000                 2222222222222   11111111
1
0                                 sssssssssss     cccccccccc      aaaaaaaaa    ll          eeeeeeeeeeeee
                                 sssssssssssss   cccccccccccc    aaaaaaaaaaa   ll          eeeeeeeeeeeee
                                 ss         ss   cc         cc   aa         aa  ll          ee
                                 ss              cc              aa         aa  ll          ee
                                 ss              cc              aa         aa  ll          ee
                                 sssssssssss     cc              aaaaaaaaaaaaa ll          eeeeeeeee
                                  sssssssssss    cc              aaaaaaaaaaaaa ll          eeeeeeeee
                                           ss    cc              aa         aa  ll          ee
                                           ss    cc              aa         aa  ll          ee
                                 ss        ss    cc         cc   aa         aa  ll          ee
                                 sssssssssssss   cccccccccccc    aa         aa  llllllllllll eeeeeeeeeeeee
                                  sssssssssss     cccccccccc     aa         aa  llllllllllll eeeeeeeeeeeee
```

```
*****************************************************************************
*****************************************************************************
*****************************************************************************
*****                                                                   *****
*****                 program verification information                   *****
*****                                                                   *****
*****                 code system:    scale  version:   4.3              *****
*****                                                                   *****
*****************************************************************************
*****************************************************************************
*****                                                                   *****
*****                                                                   *****
*****              program:  sas2                                       *****
*****                                                                   *****
*****        creation date:  03/07/97                                   *****
*****                                                                   *****
*****              library:  /opt/neut/Scale4.3/bin                     *****
*****                                                                   *****
*****                                                                   *****
*****    this is not a   scale  configuration controlled code           *****
*****                                                                   *****
*****              jobname:  nichol                                     *****
*****                                                                   *****
*****    date of execution:  07/30/97                                   *****
*****                                                                   *****
*****    time of execution:  17:50:21                                   *****
*****                                                                   *****
*****                                                                   *****
*****************************************************************************
*****************************************************************************
*****************************************************************************
```

```
1
0' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
0'
0                                   nuclide concentrations, grams
                                    basis =single reactor assembly
             initial  1E-18 d
     o 16   1.35E+05  1.35E+05
   total    3.92E+05  3.92E+05
0                                   nuclide concentrations, grams
                                    basis =single reactor assembly
             initial  1E-18 d
     u234   2.00E+02  2.00E+02
     u235   3.40E+04  3.40E+04
     u236   2.00E+02  2.00E+02
     u238   9.65E+05  9.65E+05
   total    1.00E+06  1.00E+06
0                                 basis =
0                 initial        22.6 d        45.2 d        67.7 d        90.3 d        90.3 d
```

```
0                    initial        22.6 d        45.2 d        67.7 d        90.3 d        90.3 d
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial   46.9 d   93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
      o 16   1.35E+05  1.35E+05  1.35E+05  1.35E+05  1.35E+05  1.35E+05  1.35E+05
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial   46.9 d   93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
     mo 95   1.05E+01  1.10E+01  1.14E+01  1.16E+01  1.18E+01  1.19E+01  1.19E+01
     tc 99   1.85E-05  1.87E-05  1.87E-05  1.87E-05  1.87E-05  1.87E-05  1.87E-05
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial   46.9 d   93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
   total      3.92E+05  3.92E+05  3.92E+05  3.92E+05  3.92E+05  3.92E+05  3.92E+05
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial   46.9 d   93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
      u233   1.48E-03  1.49E-03  1.50E-03  1.51E-03  1.52E-03  1.54E-03  1.55E-03
      u234   1.45E+02  1.45E+02  1.45E+02  1.45E+02  1.45E+02  1.45E+02  1.45E+02
      u235   1.71E+04  1.71E+04  1.71E+04  1.71E+04  1.71E+04  1.71E+04  1.71E+04
      u236   3.29E+03  3.29E+03  3.29E+03  3.29E+03  3.29E+03  3.29E+03  3.29E+03
      u238   9.50E+05  9.50E+05  9.50E+05  9.50E+05  9.50E+05  9.50E+05  9.50E+05
     np237   2.61E+02  2.65E+02  2.65E+02  2.65E+02  2.65E+02  2.65E+02  2.65E+02
     pu236   2.20E-04  2.14E-04  2.08E-04  2.01E-04  1.95E-04  1.89E-04  1.84E-04
     pu238   6.12E+01  6.29E+01  6.40E+01  6.49E+01  6.56E+01  6.61E+01  6.66E+01
     pu238   6.12E+01  6.29E+01  6.40E+01  6.49E+01  6.56E+01  6.61E+01  6.66E+01
     pu239   5.63E+03  5.67E+03  5.67E+03  5.67E+03  5.67E+03  5.67E+03  5.67E+03
     pu240   1.55E+03  1.55E+03  1.55E+03  1.55E+03  1.55E+03  1.55E+03  1.55E+03
     pu241   8.81E+02  8.75E+02  8.70E+02  8.65E+02  8.59E+02  8.54E+02  8.49E+02
     pu242   1.60E+02  1.60E+02  1.60E+02  1.60E+02  1.60E+02  1.60E+02  1.60E+02
     am241   5.11E+01  5.65E+01  6.19E+01  6.73E+01  7.26E+01  7.79E+01  8.32E+01
    am242m   1.24E+00  1.24E+00  1.24E+00  1.24E+00  1.24E+00  1.24E+00  1.24E+00
     am243   2.23E+01  2.23E+01  2.23E+01  2.23E+01  2.23E+01  2.23E+01  2.23E+01
   total     9.79E+05  9.79E+05  9.79E+05  9.79E+05  9.79E+05  9.79E+05  9.79E+05
0                                                element concentrations, grams
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial   46.9 d   93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
     mo 95   4.33E+02  4.49E+02  4.62E+02  4.71E+02  4.77E+02  4.81E+02  4.83E+02
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial   46.9 d   93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
     tc 99   5.07E+02  5.09E+02  5.09E+02  5.09E+02  5.09E+02  5.09E+02  5.09E+02
     ru101   4.71E+02  4.71E+02  4.71E+02  4.71E+02  4.71E+02  4.71E+02  4.71E+02
     rh103   2.95E+02  3.07E+02  3.12E+02  3.15E+02  3.16E+02  3.16E+02  3.16E+02
    rh103m   2.10E-02  9.18E-03  4.01E-03  1.75E-03  7.65E-04  3.34E-04  1.46E-04
     ag109   4.66E+01  4.66E+01  4.66E+01  4.66E+01  4.66E+01  4.66E+01  4.66E+01
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial   46.9 d   93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
     nd143   5.90E+02  6.00E+02  6.01E+02  6.01E+02  6.01E+02  6.01E+02  6.01E+02
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial   46.9 d   93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
     nd145   4.41E+02  4.41E+02  4.41E+02  4.41E+02  4.41E+02  4.41E+02  4.41E+02
     sm147   8.45E+01  8.84E+01  9.22E+01  9.58E+01  9.94E+01  1.03E+02  1.06E+02
     sm149   2.95E+00  3.51E+00  3.51E+00  3.51E+00  3.51E+00  3.51E+00  3.51E+00
     sm150   1.68E+02  1.68E+02  1.68E+02  1.68E+02  1.68E+02  1.68E+02  1.68E+02
     sm151   1.72E+01  1.73E+01  1.73E+01  1.73E+01  1.73E+01  1.73E+01  1.73E+01
     eu151   5.56E-02  7.27E-02  8.99E-02  1.07E-01  1.24E-01  1.41E-01  1.58E-01
     sm152   7.95E+01  7.95E+01  7.95E+01  7.95E+01  7.95E+01  7.95E+01  7.95E+01
     eu153   5.88E+01  5.91E+01  5.91E+01  5.91E+01  5.91E+01  5.91E+01  5.91E+01
     gd155   5.87E-02  1.02E-01  1.44E-01  1.85E-01  2.26E-01  2.66E-01  3.05E-01
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial   46.9 d   93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
   total      2.07E+04  2.07E+04  2.07E+04  2.07E+04  2.07E+04  2.07E+04  2.07E+04
```

ye6sec2h3.sum

```
0*************************************************************************
 *                                                                       *
 *                    SCALE4.3  Bulletin  Board                          *
 *                    --------  --------  -----                          *
 *                                                                       *
 *                      Welcome to SCALE-4.3.                            *
 *                                                                       *
 *                                                                       *
 *************************************************************************
1          primary module access and input record ( scale driver - 95/03/29 - 09:06:37 )
-   module sas2h    will be called
      Yankee Rowe sample E6-SE-c2-3, 138.94 32.03 gwd/MTU, July 97
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
      '   mixtures of fuel-pin-unit-cell:
      '
      '
      '
      44group    latticecell
      '
      '
      '
      uo2  1 den=10.18  1  894
         92234 0.020 92235 3.40 92236 0.020 92238 96.56   end
      kr-83  1 0 1-20 894  end
      kr-85  1 0 1-20 894  end
      y-89   1 0 1-20 894  end
      sr-90  1 0 1-20 894  end
      zr-93  1 0 1-20 894  end
      zr-94  1 0 1-20 894  end
      zr-95  1 0 1-20 894  end
      nb-94  1 0 1-20 894  end
      mo-95  1 0 1-20 894  end
      tc-99  1 0 1-20 894  end
      ru-101 1 0 1-20 894  end
      ru-106 1 0 1-20 894  end
      rh-103 1 0 1-20 894  end
      rh-105 1 0 1-20 894  end
      pd-105 1 0 1-20 894  end
      pd-108 1 0 1-20 894  end
      ag-109 1 0 1-20 894  end
      sb-124 1 0 1-20 894  end
      xe-131 1 0 1-20 894  end
      xe-132 1 0 1-20 894  end
      xe-135 1 0 1-20 894  end
      xe-136 1 0 1-20 894  end
      cs-134 1 0 1-20 894  end
      cs-135 1 0 1-20 894  end
      cs-137 1 0 1-20 894  end
      ba-136 1 0 1-20 894  end
      la-139 1 0 1-20 894  end
      pr-141 1 0 1-20 894  end
      pr-143 1 0 1-20 894  end
      ce-144 1 0 1-20 894  end
      nd-143 1 0 1-20 894  end
      nd-145 1 0 1-20 894  end
      nd-147 1 0 1-20 894  end
      pm-147 1 0 1-20 894  end
      pm-148 1 0 1-20 894  end
      sm-147 1 0 1-20 894  end
      sm-149 1 0 1-20 894  end
      sm-150 1 0 1-20 894  end
      sm-151 1 0 1-20 894  end
      sm-152 1 0 1-20 894  end
      eu-153 1 0 1-20 894  end
      eu-154 1 0 1-20 894  end
      eu-155 1 0 1-20 894  end
      gd-155 1 0 1-20 894  end
      '
      arbm-ss348  8.03 11 0 0 0 6012 0.08 25055 2.0 15031 0.045
         16000 0.030 14000 0.75 24000 18.0 28000 11.0 41093 0.7
         73181 0.1 27059 0.2 26000 67.095 2 1  560  end
      '
      h2o  3 den=0.78338  1  541  end
      arbm-bormod  0.78338 1 1 0 0 5000 100 3 1.0e-6  541   end
      '
      '  261 ppm boron (wt) in moderator for the Core IV
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      end comp
      '
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
      '      fuel-pin-cell geometry:
      '
      squarepitch   1.072  0.747 1  3  0.864  2  0.757   0  end
      '
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
      '    assembly and cycle parameters:
      '
      npin/assm=305 fuelngth=833.69 ncycles=3  nlib/cyc=5
      printlevel=5 lightel=9  inplevel=2 numztotal=3   end
      3 0.6048 500 10.5799 3 10.9791
      power=29.24 burn=451.5 down=129  end
      power=32.45 burn=333.1  down=370 temkcyc=915   end
      power=23.79 burn=337  down=281.5  bfrac=261 temkcyc=848   end
          o 135.0  cr 5.9   mn 0.33
          fe 13.0  co 0.075 ni 9.9
          zr 221.0 nb 0.71  sn 3.6
      '
1   ssssssssss      aaaaaaaaa      ssssssssss     22222222222    hh         hh
   ssssssssssss    aaaaaaaaaa    ssssssssssss   2222222222222   hh         hh
   ss          ss  aa         aa  ss          ss  22         22  hh         hh
   ss              aa         aa  ss                         22  hh         hh
   ss              aa         aa  ss                         22  hh         hh
   ssssssssssss    aaaaaaaaaaaaa  ssssssssssss             22   hhhhhhhhhhhh
    ssssssssssss   aaaaaaaaaaaaa   ssssssssssss          22     hhhhhhhhhhhh
             ss    aa         aa              ss        22      hh         hh
             ss    aa         aa              ss      22        hh         hh
```

```
   ss         ss   aa         aa   ss         ss   22             hh         hh
   sssssssssssss   aa         aa   sssssssssssss   2222222222222  hh         hh
    sssssssssss    aa         aa    sssssssssss   2222222222222  hh         hh
0

   nn         nn   iiiiiiiiiiii     cccccccccc     hh         hh   oooooooooo     ll
   nnn        nn   iiiiiiiiiiii    cccccccccccc    hh         hh   oooooooooooo   ll
   nnnn       nn       ii         cc         cc    hh         hh   oo        oo   ll
   nn nn      nn       ii         cc               hh         hh   oo        oo   ll
   nn   nn    nn       ii         cc               hh         hh   oo        oo   ll
   nn    nn   nn       ii         cc               hhhhhhhhhhhhh   oo        oo   ll
   nn     nn  nn       ii         cc               hhhhhhhhhhhhh   oo        oo   ll
   nn      nn nn       ii         cc               hh         hh   oo        oo   ll
   nn       nn nn      ii         cc               hh         hh   oo        oo   ll
   nn        nnnn      ii         cc         cc    hh         hh   oo        oo   ll
   nn         nnn  iiiiiiiiiiii    cccccccccccc    hh         hh   oooooooooooo   llllllllllll
   nn          nn  iiiiiiiiiiii     cccccccccc     hh         hh    oooooooooo    llllllllllll
0

     0000000      7777777777777                //   33333333333      0000000                //   99999999999    7777777777777
    000000000     777777777777                //   3333333333333    000000000               //   9999999999999  777777777777
   00       00    77         77               //   33         33   00       00             //   99         99  77         77
  00         00          77                  //                33   00         00           //   99         99            77
  00         00        77                    //                33   00         00           //   99         99           77
  00         00      77                      //              333    00         00           //   9999999999999        77
  00         00      77                      //              333    00         00           //    999999999999        77
  00         00     77                       //                33   00         00           //                99        77
  00         00     77                       //                33   00         00           //                99        77
   00       00      77                       //           33         33   00       00         //                99       77
    000000000        77                       //         3333333333333    000000000         //   9999999999999       77
     0000000         77                       //          33333333333      0000000          //   999999999999        77
0

        11         88888888888                          11        33333333333                        0000000      7777777777777
       111        8888888888888                        111        3333333333333                     000000000     777777777777
      1111        88         88        :::            1111        33         33        :::        00       00   77         77
        11        88         88        :::              11                   33        :::       00         00             77
        11        88         88        :::              11                   33        :::       00         00            77
        11         88888888888                         11                  333                  00         00           77
        11         88888888888                         11                  333                  00         00           77
        11        88         88        :::              11                   33        :::       00         00           77
        11        88         88        :::              11                   33        :::       00         00           77
        11        88         88        :::              11        33         33        :::        00       00          77
    11111111     8888888888888                       11111111     3333333333333                     000000000          77
    11111111      88888888888                        11111111      33333333333                       0000000           77
1
0                                 sssssssssss     ccccccccccc      aaaaaaaaa     ll              eeeeeeeeeeeee
                                 sssssssssssss   ccccccccccccc    aaaaaaaaaaa   ll              eeeeeeeeeeeee
                                 ss         ss   cc         cc   aa         aa   ll              ee
                                 ss              cc              aa         aa   ll              ee
                                 ss              cc              aa         aa   ll              ee
                                 sssssssssssss   cc              aaaaaaaaaaaaa   ll              eeeeeeeee
                                  sssssssssssss  cc              aaaaaaaaaaaaa   ll              eeeeeeeee
                                            ss   cc              aa         aa   ll              ee
                                            ss   cc              aa         aa   ll              ee
                                 ss         ss   cc         cc   aa         aa   ll              ee
                                 sssssssssssss   ccccccccccccc   aa         aa   llllllllllll    eeeeeeeeeeeee
                                  sssssssssss     ccccccccccc    aa         aa   llllllllllll    eeeeeeeeeeeee
```

```
                    ***********************************************************************
                    ***********************************************************************
                    ***********************************************************************
                    *****                                                               *****
                    *****                 program verification information               *****
                    *****                                                               *****
                    *****                 code system:    scale  version:    4.3        *****
                    *****                                                               *****
                    ***********************************************************************
                    ***********************************************************************
                    *****                                                               *****
                    *****                                                               *****
                    *****              program:  sas2                                   *****
                    *****                                                               *****
                    *****        creation date:  03/07/97                               *****
                    *****                                                               *****
                    *****              library:  /opt/neut/Scale4.3/bin                 *****
                    *****                                                               *****
                    *****                                                               *****
                    *****    this is not a   scale  configuration controlled code       *****
                    *****                                                               *****
                    *****              jobname:  nichol                                 *****
                    *****                                                               *****
                    *****    date of execution:  07/30/97                               *****
                    *****                                                               *****
                    *****    time of execution:  18:13:07                               *****
                    *****                                                               *****
                    *****                                                               *****
                    ***********************************************************************
                    ***********************************************************************
                    ***********************************************************************
1
0' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
0'
0                                        nuclide concentrations, grams
                                         basis =single reactor assembly
              initial  1E-18 d
     o 16   1.35E+05  1.35E+05
   total    3.92E+05  3.92E+05
0                                        nuclide concentrations, grams
                                         basis =single reactor assembly
              initial  1E-18 d
     u234   2.00E+02  2.00E+02
     u235   3.40E+04  3.40E+04
     u236   2.00E+02  2.00E+02
     u238   9.65E+05  9.65E+05
   total    1.00E+06  1.00E+06
0                                       basis =
0                 initial        22.6 d        45.2 d        67.7 d        90.3 d        90.3 d
```

```
0                    initial        22.6 d        45.2 d        67.7 d        90.3 d        90.3 d
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial   46.9 d   93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
     o 16   1.35E+05  1.35E+05  1.35E+05  1.35E+05  1.35E+05  1.35E+05  1.35E+05
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial   46.9 d   93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
    mo 95   1.78E+01  1.86E+01  1.91E+01  1.95E+01  1.98E+01  1.99E+01  2.00E+01
    tc 99   8.91E-05  9.00E-05  9.00E-05  9.00E-05  9.00E-05  9.00E-05  9.00E-05
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial   46.9 d   93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
   total    3.92E+05  3.92E+05  3.92E+05  3.92E+05  3.92E+05  3.92E+05  3.92E+05
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial   46.9 d   93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
     u233   1.86E-03  1.88E-03  1.90E-03  1.92E-03  1.94E-03  1.96E-03  1.98E-03
     u234   1.19E+02  1.19E+02  1.19E+02  1.20E+02  1.20E+02  1.20E+02  1.20E+02
     u235   1.16E+04  1.16E+04  1.16E+04  1.16E+04  1.16E+04  1.16E+04  1.16E+04
     u236   4.17E+03  4.17E+03  4.17E+03  4.17E+03  4.17E+03  4.17E+03  4.17E+03
     u238   9.39E+05  9.39E+05  9.39E+05  9.39E+05  9.39E+05  9.39E+05  9.39E+05
    np237   4.78E+02  4.85E+02  4.85E+02  4.85E+02  4.85E+02  4.85E+02  4.85E+02
    pu236   7.22E-04  7.03E-04  6.81E-04  6.61E-04  6.41E-04  6.21E-04  6.03E-04
    pu238   1.82E+02  1.87E+02  1.90E+02  1.92E+02  1.94E+02  1.96E+02  1.97E+02
    pu238   1.82E+02  1.87E+02  1.90E+02  1.92E+02  1.94E+02  1.96E+02  1.97E+02
    pu239   6.60E+03  6.66E+03  6.66E+03  6.66E+03  6.66E+03  6.66E+03  6.66E+03
    pu240   2.46E+03  2.46E+03  2.46E+03  2.46E+03  2.46E+03  2.46E+03  2.46E+03
    pu241   1.62E+03  1.61E+03  1.60E+03  1.59E+03  1.58E+03  1.57E+03  1.56E+03
    pu242   4.77E+02  4.77E+02  4.77E+02  4.77E+02  4.77E+02  4.77E+02  4.77E+02
    am241   9.05E+01  1.00E+02  1.10E+02  1.20E+02  1.30E+02  1.40E+02  1.49E+02
   am242m   2.56E+00  2.56E+00  2.56E+00  2.56E+00  2.55E+00  2.55E+00  2.55E+00
    am243   1.07E+02  1.07E+02  1.07E+02  1.07E+02  1.07E+02  1.07E+02  1.07E+02
   total    9.67E+05  9.67E+05  9.67E+05  9.67E+05  9.67E+05  9.67E+05  9.67E+05
0                                                element concentrations, grams
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial   46.9 d   93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
    mo 95   6.55E+02  6.77E+02  6.94E+02  7.06E+02  7.14E+02  7.19E+02  7.22E+02
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial   46.9 d   93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
    tc 99   7.62E+02  7.65E+02  7.65E+02  7.65E+02  7.65E+02  7.65E+02  7.65E+02
    ru101   7.40E+02  7.40E+02  7.40E+02  7.40E+02  7.40E+02  7.40E+02  7.40E+02
    rh103   4.47E+02  4.65E+02  4.73E+02  4.77E+02  4.78E+02  4.79E+02  4.79E+02
   rh103m   3.25E-02  1.42E-02  6.19E-03  2.70E-03  1.18E-03  5.16E-04  2.25E-04
    ag109   8.91E+01  8.93E+01  8.93E+01  8.93E+01  8.93E+01  8.93E+01  8.93E+01
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial   46.9 d   93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
    nd143   8.34E+02  8.48E+02  8.49E+02  8.49E+02  8.49E+02  8.49E+02  8.49E+02
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial   46.9 d   93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
    nd145   6.48E+02  6.48E+02  6.48E+02  6.48E+02  6.48E+02  6.48E+02  6.48E+02
    sm147   1.06E+02  1.11E+02  1.16E+02  1.21E+02  1.25E+02  1.29E+02  1.34E+02
    sm149   3.56E+00  4.46E+00  4.46E+00  4.46E+00  4.46E+00  4.46E+00  4.46E+00
    sm150   2.89E+02  2.89E+02  2.89E+02  2.89E+02  2.89E+02  2.89E+02  2.89E+02
    sm151   2.41E+01  2.42E+01  2.42E+01  2.42E+01  2.41E+01  2.41E+01  2.41E+01
    eu151   4.99E-02  7.39E-02  9.78E-02  1.22E-01  1.46E-01  1.69E-01  1.93E-01
    sm152   1.20E+02  1.20E+02  1.20E+02  1.20E+02  1.20E+02  1.20E+02  1.20E+02
    eu153   1.12E+02  1.13E+02  1.13E+02  1.13E+02  1.13E+02  1.13E+02  1.13E+02
    gd155   1.08E-01  1.96E-01  2.82E-01  3.67E-01  4.50E-01  5.31E-01  6.11E-01
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
              initial   46.9 d   93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
   total    3.27E+04  3.27E+04  3.27E+04  3.27E+04  3.27E+04  3.27E+04  3.27E+04
```

ye6sec2h5.sum

```
0*************************************************************************
 *                                                                       *
 *                    SCALE4.3  Bulletin  Board                          *
 *                    --------  --------  -----                          *
 *                                                                       *
 *                      Welcome to SCALE-4.3.                            *
 *                                                                       *
 *                                                                       *
 *************************************************************************
1          primary module access and input record ( scale driver - 95/03/29 - 09:06:37 )
-   module sas2h    will be called
      Yankee Rowe sample E6-SE-c2-5, 57.66 cm 31.41 gwd/MTU, July 97
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
      '   mixtures of fuel-pin-unit-cell:
      '
      '
      '
      44group    latticecell
      '
      '
      '
      uo2  1 den=10.18  1  885
         92234 0.020 92235 3.40 92236 0.020 92238 96.56   end
      kr-83  1 0 1-20 885  end
      kr-85  1 0 1-20 885  end
      y-89   1 0 1-20 885  end
      sr-90  1 0 1-20 885  end
      zr-93  1 0 1-20 885  end
      zr-94  1 0 1-20 885  end
      zr-95  1 0 1-20 885  end
      nb-94  1 0 1-20 885  end
      mo-95  1 0 1-20 885  end
      tc-99  1 0 1-20 885  end
      ru-101 1 0 1-20 885  end
      ru-106 1 0 1-20 885  end
      rh-103 1 0 1-20 885  end
      rh-105 1 0 1-20 885  end
      pd-105 1 0 1-20 885  end
      pd-108 1 0 1-20 885  end
      ag-109 1 0 1-20 885  end
      sb-124 1 0 1-20 885  end
      xe-131 1 0 1-20 885  end
      xe-132 1 0 1-20 885  end
      xe-135 1 0 1-20 885  end
      xe-136 1 0 1-20 885  end
      cs-134 1 0 1-20 885  end
      cs-135 1 0 1-20 885  end
      cs-137 1 0 1-20 885  end
      ba-136 1 0 1-20 885  end
      la-139 1 0 1-20 885  end
      pr-141 1 0 1-20 885  end
      pr-143 1 0 1-20 885  end
      ce-144 1 0 1-20 885  end
      nd-143 1 0 1-20 885  end
      nd-145 1 0 1-20 885  end
      nd-147 1 0 1-20 885  end
      pm-147 1 0 1-20 885  end
      pm-148 1 0 1-20 885  end
      sm-147 1 0 1-20 885  end
      sm-149 1 0 1-20 885  end
      sm-150 1 0 1-20 885  end
      sm-151 1 0 1-20 885  end
      sm-152 1 0 1-20 885  end
      eu-153 1 0 1-20 885  end
      eu-154 1 0 1-20 885  end
      eu-155 1 0 1-20 885  end
      gd-155 1 0 1-20 885  end
      '
      arbm-ss348  8.03 11 0 0 0 6012 0.08 25055 2.0 15031 0.045
         16000 0.030 14000 0.75 24000 18.0 28000 11.0 41093 0.7
         73181 0.1 27059 0.2 26000 67.095 2 1  547  end
      '
      h2o  3 den=0.79733  1  532  end
      arbm-bormod  0.79733 1 1 0 0 5000 100 3 1.0e-6  532   end
      '
      '  261 ppm boron (wt) in moderator for the Core IV
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      end comp
      '
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
      '      fuel-pin-cell geometry:
      '
      squarepitch   1.072  0.747 1  3  0.864  2  0.757   0  end
      '
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
      '    assembly and cycle parameters:
      '
      npin/assm=305 fuelngth=833.69 ncycles=3  nlib/cyc=5
      printlevel=5 lightel=9  inplevel=2 numztotal=3   end
      3 0.6048 500 10.5799 3 10.9791
      power=29.51 burn=451.5  down=129  end
      power=29.93 burn=333.1  down=370  temkcyc=889   end
      power=24.07 burn=337  down=281.5  bfrac=261  temkcyc=847   end
          o 135.0  cr 5.9   mn 0.33
          fe 13.0  co 0.075 ni 9.9
          zr 221.0 nb 0.71  sn 3.6
      '
1   ssssssssss      aaaaaaaaa      ssssssssss     22222222222    hh         hh
   ssssssssssss    aaaaaaaaaaa    ssssssssssss   2222222222222   hh         hh
   ss         ss   aa         aa   ss         ss   22         22   hh         hh
   ss              aa         aa   ss                         22   hh         hh
   ss              aa         aa   ss                         22   hh         hh
   ssssssssssss    aaaaaaaaaaaaa   ssssssssssss             22    hhhhhhhhhhhh
    ssssssssssss   aaaaaaaaaaaaa    ssssssssssss          22       hhhhhhhhhhhh
             ss   aa         aa               ss        22         hh         hh
             ss   aa         aa               ss      22           hh         hh
```

```
   ss          ss   aa          aa   ss          ss    22              hh          hh
   sssssssssssss   aa          aa   sssssssssssss   2222222222222   hh          hh
    sssssssssss    aa          aa    sssssssssss    2222222222222   hh          hh
0

   nn          nn  iiiiiiiiiiii     cccccccccc    hh          hh    oooooooooo    ll
   nnn         nn  iiiiiiiiiiii    cccccccccccc   hh          hh   oooooooooooo   ll
   nnnn        nn       ii         cc         cc  hh          hh   oo        oo   ll
   nn nn       nn       ii         cc             hh          hh   oo        oo   ll
   nn   nn     nn       ii         cc             hh          hh   oo        oo   ll
   nn    nn    nn       ii         cc             hhhhhhhhhhhhh    oo        oo   ll
   nn     nn   nn       ii         cc             hhhhhhhhhhhhh    oo        oo   ll
   nn      nn  nn       ii         cc             hh          hh   oo        oo   ll
   nn       nn nn       ii         cc             hh          hh   oo        oo   ll
   nn        nnnn       ii         cc         cc  hh          hh   oo        oo   ll
   nn         nnn  iiiiiiiiiiii    cccccccccccc   hh          hh   oooooooooooo   llllllllllll
   nn          nn  iiiiiiiiiiii     cccccccccc    hh          hh    oooooooooo    llllllllllll
0

     0000000      7777777777777              //   33333333333      0000000                //   99999999999    7777777777777
    000000000     777777777777              //   3333333333333    000000000              //   9999999999999   777777777777
  00        00    77        77             //   33         33   00        00           //   99         99   77         77
 00          00          77              //                33   00          00        //   99         99            77
 00          00        77               //                 33   00          00       //   99         99           77
 00          00       77               //                333   00          00      //   9999999999999          77
 00          00       77              //                 333   00          00     //    999999999999           77
 00          00      77              //                   33   00          00    //                99          77
 00          00      77             //                    33   00          00   //                99          77
  00        00      77            //            33         33   00        00    //                99         77
   000000000        77           //             3333333333333    000000000     //   9999999999999          77
    0000000         77          //               33333333333      0000000      //   999999999999           77
0

       11         88888888888                    33333333333   5555555555555                    33333333333            44
      111        8888888888888                   3333333333333 5555555555555                   3333333333333          444
     1111        88         88        :::        33         33 55                     :::     33         33        4444
       11        88         88        :::                   33 55                     :::                33       44 44
       11        88         88        :::                   33 55                     :::                33      44  44
       11         88888888888                             333 555555555555                           333     44   44
       11         88888888888                             333 5555555555555                          333    44    44
       11        88         88        :::                   33          55            :::                33   444444444444
       11        88         88        :::                   33          55            :::                33  4444444444444
       11        88         88        :::        33         33 55         55           :::     33         33            44
   11111111      8888888888888                   3333333333333 5555555555555                   3333333333333           44
   11111111       88888888888                     33333333333   55555555555                     33333333333            44
1
0                                 sssssssssss     ccccccccccc     aaaaaaaaa     ll              eeeeeeeeeeeee
                                sssssssssssss   cccccccccccccc   aaaaaaaaaaa   ll              eeeeeeeeeeeee
                                ss         ss   cc         cc   aa         aa   ll              ee
                                ss              cc              aa         aa   ll              ee
                                ss              cc              aa         aa   ll              ee
                                sssssssssssss   cc              aaaaaaaaaaaaa   ll              eeeeeeeee
                                 sssssssssssss  cc              aaaaaaaaaaaaa   ll              eeeeeeeee
                                          ss    cc              aa         aa   ll              ee
                                          ss    cc              aa         aa   ll              ee
                                ss         ss   cc         cc   aa         aa   ll              ee
                                sssssssssssss   cccccccccccccc   aa         aa   llllllllllll    eeeeeeeeeeeee
                                 sssssssssss     ccccccccccc     aa         aa   llllllllllll    eeeeeeeeeeeee


                        ******************************************************************
                        ******************************************************************
                        ******************************************************************
                        *****                                                          *****
                        *****                 program verification information          *****
                        *****                                                          *****
                        *****                 code system:    scale  version:   4.3     *****
                        *****                                                          *****
                        ******************************************************************
                        ******************************************************************
                        *****                                                          *****
                        *****                                                          *****
                        *****              program:  sas2                              *****
                        *****                                                          *****
                        *****        creation date:  03/07/97                          *****
                        *****                                                          *****
                        *****              library:  /opt/neut/Scale4.3/bin            *****
                        *****                                                          *****
                        *****                                                          *****
                        *****    this is not a   scale  configuration controlled code  *****
                        *****                                                          *****
                        *****              jobname:  nichol                            *****
                        *****                                                          *****
                        *****    date of execution:  07/30/97                          *****
                        *****                                                          *****
                        *****    time of execution:  18:35:34                          *****
                        *****                                                          *****
                        *****                                                          *****
                        ******************************************************************
                        ******************************************************************
                        ******************************************************************
1
0' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
0'
0                                          nuclide concentrations, grams
                                           basis =single reactor assembly
             initial  1E-18 d
     o 16   1.35E+05  1.35E+05
   total    3.92E+05  3.92E+05
0                                          nuclide concentrations, grams
                                           basis =single reactor assembly
             initial  1E-18 d
     u234   2.00E+02  2.00E+02
     u235   3.40E+04  3.40E+04
     u236   2.00E+02  2.00E+02
     u238   9.65E+05  9.65E+05
   total    1.00E+06  1.00E+06
0                                         basis =
0                 initial        22.6 d        45.2 d        67.7 d        90.3 d        90.3 d
```

```
0                    initial        22.6 d        45.2 d        67.7 d        90.3 d        90.3 d
                                                 basis = single reactor assembly
                 charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
      o 16    8.41E+03  8.41E+03  8.41E+03  8.41E+03  8.41E+03  8.41E+03
                                                 basis = single reactor assembly
                 charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
                                                 basis = single reactor assembly
                 charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
     mo 95     .00E+00  6.04E-05  4.12E-04  1.19E-03  2.43E-03  2.43E-03
                                                 basis = single reactor assembly
                 charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
     tc 99     .00E+00  3.24E-12  3.33E-11  1.23E-10  3.04E-10  3.04E-10
                                                 basis = single reactor assembly
                 charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
                                                 basis = single reactor assembly
                 charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
   totals    1.15E+04  1.15E+04  1.15E+04  1.15E+04  1.15E+04  1.15E+04
                                                 basis = single reactor assembly
                 charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
      u233     .00E+00  3.05E-07  6.00E-07  8.80E-07  1.15E-06  1.15E-06
      u234    8.55E-01  8.46E-01  8.37E-01  8.28E-01  8.19E-01  8.19E-01
      u235    1.45E+02  1.41E+02  1.38E+02  1.35E+02  1.32E+02  1.32E+02
      u236    8.47E-01  1.48E+00  2.10E+00  2.71E+00  3.29E+00  3.29E+00
      u238    4.06E+03  4.05E+03  4.05E+03  4.05E+03  4.05E+03  4.05E+03
     np237     .00E+00  8.27E-03  2.31E-02  4.08E-02  6.07E-02  6.07E-02
     pu236     .00E+00  2.13E-10  1.30E-09  3.55E-09  7.09E-09  7.09E-09
     pu238     .00E+00  4.60E-05  2.92E-04  8.07E-04  1.63E-03  1.63E-03
     pu238     .00E+00  4.60E-05  2.92E-04  8.07E-04  1.63E-03  1.63E-03
     pu239     .00E+00  1.51E+00  3.19E+00  4.74E+00  6.17E+00  6.17E+00
     pu240     .00E+00  2.03E-02  8.35E-02  1.82E-01  3.07E-01  3.07E-01
     pu241     .00E+00  7.25E-04  6.13E-03  2.01E-02  4.55E-02  4.55E-02
     pu242     .00E+00  3.23E-06  5.65E-05  2.83E-04  8.64E-04  8.64E-04
                                                 basis = single reactor assembly
                 charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
     am241     .00E+00  5.17E-07  8.85E-06  4.43E-05  1.35E-04  1.35E-04
     am242m    .00E+00  7.95E-10  2.66E-08  1.93E-07  7.52E-07  7.52E-07
     am243     .00E+00  1.07E-08  3.83E-07  2.92E-06  1.20E-05  1.20E-05
   totals    4.20E+03  4.20E+03  4.20E+03  4.19E+03  4.19E+03  4.19E+03
          *        decay data, including gamma and total energy, are from endf/b-vi        *
0                    1697    total number of nuclides in library
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
                initial    46.9 d    93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
      o 16    1.35E+05  1.35E+05  1.35E+05  1.35E+05  1.35E+05  1.35E+05  1.35E+05
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
                initial    46.9 d    93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
     mo 95    1.71E+01  1.79E+01  1.84E+01  1.88E+01  1.91E+01  1.92E+01  1.93E+01
     tc 99    7.99E-05  8.08E-05  8.08E-05  8.08E-05  8.08E-05  8.08E-05  8.08E-05
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
                initial    46.9 d    93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
   total      3.92E+05  3.92E+05  3.92E+05  3.92E+05  3.92E+05  3.92E+05  3.92E+05
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
                initial    46.9 d    93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
      u233    1.83E-03  1.85E-03  1.87E-03  1.89E-03  1.91E-03  1.93E-03  1.95E-03
      u234    1.20E+02  1.21E+02  1.21E+02  1.21E+02  1.21E+02  1.21E+02  1.22E+02
      u235    1.18E+04  1.18E+04  1.18E+04  1.18E+04  1.18E+04  1.18E+04  1.18E+04
      u236    4.13E+03  4.13E+03  4.13E+03  4.13E+03  4.13E+03  4.13E+03  4.13E+03
      u238    9.40E+05  9.40E+05  9.40E+05  9.40E+05  9.40E+05  9.40E+05  9.40E+05
     np237    4.62E+02  4.70E+02  4.70E+02  4.70E+02  4.70E+02  4.70E+02  4.70E+02
     pu236    6.77E-04  6.59E-04  6.39E-04  6.20E-04  6.01E-04  5.83E-04  5.65E-04
     pu238    1.72E+02  1.77E+02  1.80E+02  1.82E+02  1.84E+02  1.85E+02  1.86E+02
     pu238    1.72E+02  1.77E+02  1.80E+02  1.82E+02  1.84E+02  1.85E+02  1.86E+02
     pu239    6.46E+03  6.52E+03  6.52E+03  6.52E+03  6.52E+03  6.52E+03  6.52E+03
     pu240    2.41E+03  2.41E+03  2.41E+03  2.41E+03  2.41E+03  2.42E+03  2.42E+03
     pu241    1.56E+03  1.55E+03  1.54E+03  1.53E+03  1.53E+03  1.52E+03  1.51E+03
     pu242    4.55E+02  4.55E+02  4.55E+02  4.55E+02  4.55E+02  4.55E+02  4.55E+02
     am241    8.60E+01  9.56E+01  1.05E+02  1.15E+02  1.24E+02  1.34E+02  1.43E+02
     am242m   2.42E+00  2.41E+00  2.41E+00  2.41E+00  2.41E+00  2.41E+00  2.41E+00
     am243    9.91E+01  9.92E+01  9.92E+01  9.92E+01  9.92E+01  9.92E+01  9.92E+01
   total      9.67E+05  9.67E+05  9.67E+05  9.67E+05  9.67E+05  9.67E+05  9.67E+05
0                                                element concentrations, grams
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
                initial    46.9 d    93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
     mo 95    6.43E+02  6.65E+02  6.83E+02  6.95E+02  7.03E+02  7.08E+02  7.11E+02
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
                initial    46.9 d    93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
     tc 99    7.50E+02  7.53E+02  7.53E+02  7.53E+02  7.53E+02  7.53E+02  7.53E+02
     ru101    7.26E+02  7.26E+02  7.26E+02  7.26E+02  7.26E+02  7.26E+02  7.26E+02
     rh103    4.38E+02  4.56E+02  4.65E+02  4.68E+02  4.70E+02  4.70E+02  4.71E+02
     rh103m   3.27E-02  1.43E-02  6.24E-03  2.73E-03  1.19E-03  5.20E-04  2.27E-04
     ag109    8.65E+01  8.66E+01  8.66E+01  8.66E+01  8.66E+01  8.66E+01  8.66E+01
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
                initial    46.9 d    93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
     nd143    8.21E+02  8.35E+02  8.36E+02  8.36E+02  8.36E+02  8.36E+02  8.36E+02
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
                initial    46.9 d    93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
     nd145    6.39E+02  6.39E+02  6.39E+02  6.39E+02  6.39E+02  6.39E+02  6.39E+02
     sm147    1.06E+02  1.11E+02  1.16E+02  1.20E+02  1.25E+02  1.29E+02  1.33E+02
     sm149    3.47E+00  4.38E+00  4.38E+00  4.38E+00  4.38E+00  4.38E+00  4.38E+00
     sm150    2.82E+02  2.82E+02  2.82E+02  2.82E+02  2.82E+02  2.82E+02  2.82E+02
     sm151    2.34E+01  2.35E+01  2.35E+01  2.35E+01  2.35E+01  2.34E+01  2.34E+01
     eu151    4.76E-02  7.08E-02  9.41E-02  1.17E-01  1.41E-01  1.64E-01  1.87E-01
     sm152    1.18E+02  1.18E+02  1.18E+02  1.18E+02  1.18E+02  1.18E+02  1.18E+02
     eu153    1.09E+02  1.10E+02  1.10E+02  1.10E+02  1.10E+02  1.10E+02  1.10E+02
     gd155    1.01E-01  1.86E-01  2.69E-01  3.51E-01  4.31E-01  5.10E-01  5.87E-01
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
                initial    46.9 d    93.8 d   140.8 d   187.7 d   234.6 d   281.5 d
   total      3.21E+04  3.21E+04  3.21E+04  3.21E+04  3.21E+04  3.21E+04  3.21E+04
```

ye6see4h3.sum

```
0*************************************************************************
 *                                                                       *
 *                    SCALE4.3  Bulletin  Board                          *
 *                    --------  --------  -----                          *
 *                                                                       *
 *                      Welcome to SCALE-4.3.                            *
 *                                                                       *
 *                                                                       *
 *************************************************************************
1          primary module access and input record ( scale driver - 95/03/29 - 09:06:37 )
-   module sas2h    will be called
      Yankee Rowe sample E6-SE-e4-3, 138.94 cm 30.39 gwd/MTU, July 97
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
      '   mixtures of fuel-pin-unit-cell:
      '
      '
      '
      44group    latticecell
      '
      '
      '
      uo2  1 den=10.18  1  894
         92234 0.020 92235 3.40 92236 0.020 92238 96.56   end
      kr-83  1 0 1-20 894  end
      kr-85  1 0 1-20 894  end
      y-89   1 0 1-20 894  end
      sr-90  1 0 1-20 894  end
      zr-93  1 0 1-20 894  end
      zr-94  1 0 1-20 894  end
      zr-95  1 0 1-20 894  end
      nb-94  1 0 1-20 894  end
      mo-95  1 0 1-20 894  end
      tc-99  1 0 1-20 894  end
      ru-101 1 0 1-20 894  end
      ru-106 1 0 1-20 894  end
      rh-103 1 0 1-20 894  end
      rh-105 1 0 1-20 894  end
      pd-105 1 0 1-20 894  end
      pd-108 1 0 1-20 894  end
      ag-109 1 0 1-20 894  end
      sb-124 1 0 1-20 894  end
      xe-131 1 0 1-20 894  end
      xe-132 1 0 1-20 894  end
      xe-135 1 0 1-20 894  end
      xe-136 1 0 1-20 894  end
      cs-134 1 0 1-20 894  end
      cs-135 1 0 1-20 894  end
      cs-137 1 0 1-20 894  end
      ba-136 1 0 1-20 894  end
      la-139 1 0 1-20 894  end
      pr-141 1 0 1-20 894  end
      pr-143 1 0 1-20 894  end
      ce-144 1 0 1-20 894  end
      nd-143 1 0 1-20 894  end
      nd-145 1 0 1-20 894  end
      nd-147 1 0 1-20 894  end
      pm-147 1 0 1-20 894  end
      pm-148 1 0 1-20 894  end
      sm-147 1 0 1-20 894  end
      sm-149 1 0 1-20 894  end
      sm-150 1 0 1-20 894  end
      sm-151 1 0 1-20 894  end
      sm-152 1 0 1-20 894  end
      eu-153 1 0 1-20 894  end
      eu-154 1 0 1-20 894  end
      eu-155 1 0 1-20 894  end
      gd-155 1 0 1-20 894  end
      '
      arbm-ss348  8.03 11 0 0 0 6012 0.08 25055 2.0 15031 0.045
         16000 0.030 14000 0.75 24000 18.0 28000 11.0 41093 0.7
         73181 0.1 27059 0.2 26000 67.095 2 1  560  end
      '
      h2o  3 den=0.78338  1  541 end
      arbm-bormod  0.78338 1 1 0 0 5000 100 3 1.0e-6  541  end
      '
      '  261 ppm boron (wt) in moderator for Core IV
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      end comp
      '
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
      '      fuel-pin-cell geometry:
      '
      squarepitch   1.072  0.747 1  3  0.864  2  0.757   0  end
      '
      ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      '
      '    assembly and cycle parameters:
      '
      npin/assm=305 fuelngth=833.69 ncycles=3  nlib/cyc=5
      printlevel=5 lightel=9  inplevel=2 numztotal=3   end
      3 0.6048 500 10.5799 3 10.9791
      power=32.84 burn=451.5  down=129   end
      power=36.44 burn=333.1  down=370 temkcyc=915 end
      power=26.72 burn=337  down=281.5  bfrac=261 temkcyc=848  end
          o 135.0  cr 5.9   mn 0.33
          fe 13.0  co 0.075 ni 9.9
          zr 221.0 nb 0.71  sn 3.6
      '
1   sssssssssss      aaaaaaaaa      sssssssssss     22222222222     hh          hh
   ssssssssssss     aaaaaaaaaaa    ssssssssssss   2222222222222    hh          hh
   ss          ss   aa         aa  ss          ss  22          22  hh          hh
   ss               aa         aa  ss                          22  hh          hh
   ss               aa         aa  ss                          22  hh          hh
   ssssssssssss     aaaaaaaaaaaaa  ssssssssssss             22    hhhhhhhhhhhhh
    ssssssssssss    aaaaaaaaaaaaa   ssssssssssss          22      hhhhhhhhhhhhh
             ss     aa         aa              ss        22        hh          hh
             ss     aa         aa              ss      22          hh          hh
```

```
   ss         ss   aa         aa   ss         ss   22              hh         hh
   sssssssssssss   aa         aa   sssssssssssss   2222222222222   hh         hh
    sssssssssss    aa         aa    sssssssssss    2222222222222   hh         hh
0

   nn         nn   iiiiiiiiiiii    cccccccccccc   hh         hh    oooooooooooo   11
   nnn        nn   iiiiiiiiiiii    cccccccccccc   hh         hh    oooooooooooo   11
   nnnn       nn       ii        cc         cc   hh         hh    oo        oo   11
   nn nn      nn       ii        cc              hh         hh    oo        oo   11
   nn   nn    nn       ii        cc              hh         hh    oo        oo   11
   nn     nn  nn       ii        cc              hhhhhhhhhhhhhh    oo        oo   11
   nn      nn nn       ii        cc              hhhhhhhhhhhhhh    oo        oo   11
   nn       nn nn      ii        cc              hh         hh    oo        oo   11
   nn        nn nn     ii        cc              hh         hh    oo        oo   11
   nn         nnnn     ii        cc         cc   hh         hh    oo        oo   11
   nn          nnn   iiiiiiiiiiii    cccccccccccc   hh         hh    oooooooooooo   1111111111111
   nn           nn   iiiiiiiiiiii     cccccccccccc  hh         hh     oooooooooooo  1111111111111
0

     0000000      7777777777777              //   33333333333      0000000                //   99999999999   7777777777777
    000000000     777777777777              //   3333333333333    000000000              //   9999999999999  777777777777
  00        00    77         77             //   33          33   00        00           //   99         99  77         77
  00        00          77                //                33   00        00          //   99         99          77
  00        00          77               //                 33   00        00         //   99         99         77
  00        00        77               //                333   00        00        //   9999999999999        77
  00        00        77              //                 333   00        00       //    999999999999         77
  00        00      77              //                    33   00        00      //                  99        77
  00        00      77             //                     33   00        00     //                   99       77
  00        00      77            //                 33  33   00        00    //                    99      77
    000000000     77           //                 3333333333333   000000000   //   9999999999999        77
     0000000      77          //                   33333333333     0000000   //   999999999999         77
0

        11        88888888888                    5555555555555   7777777777777                    5555555555555           44
       111        8888888888888                  5555555555555   777777777777                    5555555555555          444
      1111        88         88        :::       55              77         77        :::        55                   4444
        11        88         88        :::       55                      77          :::        55                  44 44
        11        88         88        :::       55                      77          :::        55                 44  44
        11        88888888888                    555555555555           77                     555555555555       44   44
        11        88888888888                    5555555555555          77                     5555555555555    44     44
        11        88         88        :::                  55         77          :::                  55   444444444444
        11        88         88        :::                  55        77           :::                  55   4444444444444
        11        88         88        :::       55         55       77            :::       55         55           44
    11111111      8888888888888                  5555555555555       77                      5555555555555          44
    11111111       88888888888                    55555555555        77                       55555555555          44
1
0                                 sssssssssss    cccccccccccc     aaaaaaaaa     11            eeeeeeeeeeeeee
                                 sssssssssssss   cccccccccccc    aaaaaaaaaaa    11            eeeeeeeeeeeeee
                                 ss         ss   cc         cc   aa         aa   11            ee
                                 ss              cc              aa         aa   11            ee
                                 ss              cc              aa         aa   11            ee
                                 sssssssssssss   cc              aaaaaaaaaaaaaa 11            eeeeeeeee
                                  sssssssssssss  cc              aaaaaaaaaaaaaa 11            eeeeeeeee
                                           ss    cc              aa         aa   11            ee
                                           ss    cc              aa         aa   11            ee
                                 ss         ss   cc         cc   aa         aa   11            ee
                                 sssssssssssss   cccccccccccc    aa         aa   1111111111111 eeeeeeeeeeeeee
                                  sssssssssss     cccccccccccc   aa         aa   1111111111111 eeeeeeeeeeeeee
```

```
*****************************************************************************
*****************************************************************************
*****************************************************************************
*****                                                                   *****
*****                 program verification information                   *****
*****                                                                   *****
*****                 code system:    scale  version:    4.3            *****
*****                                                                   *****
*****************************************************************************
*****************************************************************************
*****                                                                   *****
*****                                                                   *****
*****              program:  sas2                                       *****
*****                                                                   *****
*****        creation date:  03/07/97                                   *****
*****                                                                   *****
*****              library:  /opt/neut/Scale4.3/bin                     *****
*****                                                                   *****
*****                                                                   *****
*****    this is not a   scale  configuration controlled code           *****
*****                                                                   *****
*****              jobname:  nichol                                     *****
*****                                                                   *****
*****    date of execution:  07/30/97                                   *****
*****                                                                   *****
*****    time of execution:  18:57:54                                   *****
*****                                                                   *****
*****                                                                   *****
*****************************************************************************
*****************************************************************************
*****************************************************************************
```

```
1
0' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
0'
0                                 nuclide concentrations, grams
                                  basis =single reactor assembly
            initial  1E-18 d
     o 16   1.35E+05  1.35E+05
   total    3.92E+05  3.92E+05
0                                 nuclide concentrations, grams
                                  basis =single reactor assembly
            initial  1E-18 d
     u234   2.00E+02  2.00E+02
     u235   3.40E+04  3.40E+04
     u236   2.00E+02  2.00E+02
     u238   9.65E+05  9.65E+05
   total    1.00E+06  1.00E+06
0                                 basis =
0                 initial        22.6 d        45.2 d        67.7 d        90.3 d        90.3 d
```

0 initial 22.6 d 45.2 d 67.7 d 90.3 d 90.3 d

0 nuclide concentrations, grams
basis =single reactor assembly

	initial	46.9 d	93.8 d	140.8 d	187.7 d	234.6 d	281.5 d
o 16	1.35E+05	1.35E+05	1.35E+05	1.35E+05	1.35E+05	1.35E+05	1.35E+05

0 nuclide concentrations, grams
basis =single reactor assembly

	initial	46.9 d	93.8 d	140.8 d	187.7 d	234.6 d	281.5 d
mo 95	2.02E+01	2.10E+01	2.17E+01	2.21E+01	2.24E+01	2.26E+01	2.27E+01
tc 99	1.31E-04	1.32E-04	1.32E-04	1.32E-04	1.32E-04	1.32E-04	1.32E-04

0 nuclide concentrations, grams
basis =single reactor assembly

	initial	46.9 d	93.8 d	140.8 d	187.7 d	234.6 d	281.5 d
total	3.92E+05	3.92E+05	3.92E+05	3.92E+05	3.92E+05	3.92E+05	3.92E+05

0 nuclide concentrations, grams
basis =single reactor assembly

	initial	46.9 d	93.8 d	140.8 d	187.7 d	234.6 d	281.5 d
u233	1.92E-03	1.94E-03	1.96E-03	1.99E-03	2.01E-03	2.03E-03	2.05E-03
u234	1.12E+02	1.12E+02	1.12E+02	1.12E+02	1.12E+02	1.13E+02	1.13E+02
u235	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04
u236	4.36E+03	4.36E+03	4.36E+03	4.36E+03	4.36E+03	4.36E+03	4.36E+03
u238	9.35E+05	9.35E+05	9.35E+05	9.35E+05	9.35E+05	9.35E+05	9.35E+05
np237	5.47E+02	5.55E+02	5.55E+02	5.55E+02	5.56E+02	5.56E+02	5.56E+02
pu236	9.65E-04	9.39E-04	9.11E-04	8.83E-04	8.56E-04	8.30E-04	8.05E-04
pu238	2.33E+02	2.39E+02	2.43E+02	2.46E+02	2.48E+02	2.50E+02	2.51E+02
pu238	2.33E+02	2.39E+02	2.43E+02	2.46E+02	2.48E+02	2.50E+02	2.51E+02
pu239	6.79E+03	6.87E+03	6.87E+03	6.87E+03	6.87E+03	6.87E+03	6.87E+03
pu240	2.70E+03	2.70E+03	2.70E+03	2.70E+03	2.70E+03	2.70E+03	2.70E+03
pu241	1.82E+03	1.80E+03	1.79E+03	1.78E+03	1.77E+03	1.76E+03	1.75E+03
pu242	6.04E+02	6.04E+02	6.04E+02	6.04E+02	6.04E+02	6.04E+02	6.04E+02
am241	9.70E+01	1.08E+02	1.19E+02	1.30E+02	1.41E+02	1.52E+02	1.63E+02
am242m	2.80E+00	2.80E+00	2.80E+00	2.80E+00	2.80E+00	2.79E+00	2.79E+00
am243	1.50E+02	1.50E+02	1.50E+02	1.50E+02	1.50E+02	1.50E+02	1.50E+02
total	9.63E+05	9.63E+05	9.63E+05	9.63E+05	9.63E+05	9.63E+05	9.63E+05

0 element concentrations, grams

0 nuclide concentrations, grams
basis =single reactor assembly

	initial	46.9 d	93.8 d	140.8 d	187.7 d	234.6 d	281.5 d
mo 95	7.23E+02	7.47E+02	7.66E+02	7.79E+02	7.88E+02	7.93E+02	7.96E+02

0 nuclide concentrations, grams
basis =single reactor assembly

	initial	46.9 d	93.8 d	140.8 d	187.7 d	234.6 d	281.5 d
tc 99	8.41E+02	8.44E+02	8.44E+02	8.44E+02	8.44E+02	8.44E+02	8.44E+02
ru101	8.27E+02	8.27E+02	8.27E+02	8.27E+02	8.27E+02	8.27E+02	8.27E+02
rh103	4.89E+02	5.10E+02	5.20E+02	5.24E+02	5.25E+02	5.26E+02	5.27E+02
rh103m	3.72E-02	1.62E-02	7.09E-03	3.10E-03	1.35E-03	5.91E-04	2.58E-04
ag109	1.03E+02	1.03E+02	1.03E+02	1.03E+02	1.03E+02	1.03E+02	1.03E+02

0 nuclide concentrations, grams
basis =single reactor assembly

	initial	46.9 d	93.8 d	140.8 d	187.7 d	234.6 d	281.5 d

0 nuclide concentrations, grams
basis =single reactor assembly

	initial	46.9 d	93.8 d	140.8 d	187.7 d	234.6 d	281.5 d
nd143	9.02E+02	9.17E+02	9.19E+02	9.19E+02	9.19E+02	9.19E+02	9.19E+02
nd145	7.11E+02	7.11E+02	7.11E+02	7.11E+02	7.11E+02	7.11E+02	7.11E+02
sm147	1.10E+02	1.15E+02	1.20E+02	1.25E+02	1.30E+02	1.34E+02	1.39E+02
sm149	3.69E+00	4.74E+00	4.74E+00	4.74E+00	4.74E+00	4.74E+00	4.74E+00
sm150	3.31E+02	3.31E+02	3.31E+02	3.31E+02	3.31E+02	3.31E+02	3.31E+02
sm151	2.59E+01	2.61E+01	2.61E+01	2.60E+01	2.60E+01	2.60E+01	2.59E+01
eu151	4.61E-02	7.19E-02	9.77E-02	1.23E-01	1.49E-01	1.75E-01	2.01E-01
sm152	1.33E+02	1.33E+02	1.33E+02	1.33E+02	1.33E+02	1.33E+02	1.33E+02
eu153	1.31E+02	1.32E+02	1.32E+02	1.32E+02	1.32E+02	1.32E+02	1.32E+02
gd155	1.22E-01	2.28E-01	3.32E-01	4.34E-01	5.34E-01	6.33E-01	7.29E-01

0 nuclide concentrations, grams
basis =single reactor assembly

	initial	46.9 d	93.8 d	140.8 d	187.7 d	234.6 d	281.5 d
total	3.66E+04	3.66E+04	3.66E+04	3.66E+04	3.66E+04	3.66E+04	3.66E+04

ye6see4h5.output

```
0*************************************************************************
 *                                                                       *
 *                    SCALE4.3  Bulletin  Board                          *
 *                    --------  --------  -----                          *
 *                                                                       *
 *                      Welcome to SCALE-4.3.                            *
 *                                                                       *
 *                                                                       *
 *************************************************************************
1          primary module access and input record ( scale driver - 95/03/29 - 09:06:37 )
-    module sas2h    will be called
     Yankee Rowe sample E6-SE-e4-5, 57.66 cm 35.26 gwd/MTU, July 97
     ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
     '
     '   mixtures of fuel-pin-unit-cell:
     '
     ' Cross Section Library
     '
     44group    latticecell
     '
     ' Fuel Composition
     '
     uo2  1 den=10.18  1  885
        92234 0.020 92235 3.40 92236 0.020 92238 96.56   end
     kr-83  1 0 1-20 885  end
     kr-85  1 0 1-20 885  end
     y-89   1 0 1-20 885  end
     sr-90  1 0 1-20 885  end
     zr-93  1 0 1-20 885  end
     zr-94  1 0 1-20 885  end
     zr-95  1 0 1-20 885  end
     nb-94  1 0 1-20 885  end
     mo-95  1 0 1-20 885  end
     tc-99  1 0 1-20 885  end
     ru-101 1 0 1-20 885  end
     ru-106 1 0 1-20 885  end
     rh-103 1 0 1-20 885  end
     rh-105 1 0 1-20 885  end
     pd-105 1 0 1-20 885  end
     pd-108 1 0 1-20 885  end
     ag-109 1 0 1-20 885  end
     sb-124 1 0 1-20 885  end
     xe-131 1 0 1-20 885  end
     xe-132 1 0 1-20 885  end
     xe-135 1 0 1-20 885  end
     xe-136 1 0 1-20 885  end
     cs-134 1 0 1-20 885  end
     cs-135 1 0 1-20 885  end
     cs-137 1 0 1-20 885  end
     ba-136 1 0 1-20 885  end
     la-139 1 0 1-20 885  end
     pr-141 1 0 1-20 885  end
     pr-143 1 0 1-20 885  end
     ce-144 1 0 1-20 885  end
     nd-143 1 0 1-20 885  end
     nd-145 1 0 1-20 885  end
     nd-147 1 0 1-20 885  end
     pm-147 1 0 1-20 885  end
     pm-148 1 0 1-20 885  end
     sm-147 1 0 1-20 885  end
     sm-149 1 0 1-20 885  end
     sm-150 1 0 1-20 885  end
     sm-151 1 0 1-20 885  end
     sm-152 1 0 1-20 885  end
     eu-153 1 0 1-20 885  end
     eu-154 1 0 1-20 885  end
     eu-155 1 0 1-20 885  end
     gd-155 1 0 1-20 885  end
     '
     arbm-ss348  8.03 11 0 0 0 6012 0.08 25055 2.0 15031 0.045
        16000 0.030 14000 0.75 24000 18.0 28000 11.0 41093 0.7
        73181 0.1 27059 0.2 26000 67.095 2 1  547  end
     '
     h2o  3 den=0.79733  1  532  end
     arbm-bormod  0.79733 1 1 0 0 5000 100 3  1.0e-6  532   end
     '
     '  261 ppm boron (wt) in moderator for the Core IV
     ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
     end comp
     '
     ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
     '
     '      fuel-pin-cell geometry:
     '
     squarepitch   1.072  0.747 1  3  0.864  2  0.757   0  end
     '
     ' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
     '
     '    assembly and cycle parameters:
     '
     npin/assm=305 fuelngth=833.69 ncycles=3  nlib/cyc=5
     printlevel=5 lightel=9  inplevel=2 numztotal=3   end
     3 0.6048 500 10.5799 3 10.9791
     power=33.13 burn=451.5  down=129   end
     power=33.60 burn=333.1 down=370  temkcyc=889   end
     power=27.02 burn=337  down=281.5  bfrac=261 temkcyc=847   end
         o 135.0  cr 5.9   mn 0.33
         fe 13.0  co 0.075 ni 9.9
         zr 221.0 nb 0.71  sn 3.6
     '
1   ssssssssss      aaaaaaaaa      ssssssssss     22222222222    hh         hh
   sssssssssss    aaaaaaaaaaa    sssssssssss   2222222222222   hh         hh
   ss         ss   aa         aa   ss         ss   22         22   hh         hh
   ss              aa         aa   ss                         22   hh         hh
   ss              aa         aa   ss                         22   hh         hh
   sssssssssss    aaaaaaaaaaaaa   sssssssssss             22     hhhhhhhhhhhh
    sssssssssss   aaaaaaaaaaaaa    sssssssssss          22       hhhhhhhhhhhh
             ss   aa         aa               ss        22         hh         hh
             ss   aa         aa               ss      22           hh         hh
```

```
   ss         ss   aa         aa   ss         ss    22              hh         hh
   sssssssssssss   aa         aa   sssssssssssss   2222222222222   hh         hh
    sssssssssss    aa         aa    sssssssssss    2222222222222   hh         hh
0

   nn          nn  iiiiiiiiiiii     cccccccccc    hh         hh    oooooooooo    ll
   nnn         nn  iiiiiiiiiiii    cccccccccccc   hh         hh   oooooooooooo   ll
   nnnn        nn      ii         cc         cc   hh         hh   oo        oo   ll
   nn nn       nn      ii         cc              hh         hh   oo        oo   ll
   nn   nn     nn      ii         cc              hh         hh   oo        oo   ll
   nn    nn    nn      ii         cc              hhhhhhhhhhhhh   oo        oo   ll
   nn     nn   nn      ii         cc              hhhhhhhhhhhhh   oo        oo   ll
   nn      nn  nn      ii         cc              hh         hh   oo        oo   ll
   nn       nn nn      ii         cc              hh         hh   oo        oo   ll
   nn        nnnn      ii         cc         cc   hh         hh   oo        oo   ll
   nn         nnn  iiiiiiiiiiii    cccccccccccc   hh         hh   oooooooooooo   llllllllllll
   nn          nn  iiiiiiiiiiii     cccccccccc    hh         hh    oooooooooo    llllllllllll
0

     0000000      7777777777777              //   33333333333      0000000                //   99999999999    7777777777777
    000000000     777777777777              //   3333333333333    000000000              //   9999999999999  777777777777
   00       00    77        77              //   33         33   00        00           //   99         99  77        77
  00         00          77               //                33   00        00          //   99         99          77
  00         00         77               //                33   00        00         //   99         99         77
  00         00        77               //               333   00        00        //   9999999999999        77
  00         00       77               //               333   00        00       //    999999999999         77
  00         00      77               //                 33   00        00      //                99         77
  00         00     77               //                 33   00        00     //                 99         77
   00       00     77               //   33         33   00        00    //                  99         77
    000000000      77               //   3333333333333    000000000   //                9999999999999        77
     0000000       77              //     33333333333      0000000  //                999999999999         77
0

        11         99999999999                          44     22222222222                          44     5555555555555
       111        9999999999999                        444    2222222222222                        444     5555555555555
      1111        99         99        :::            4444    22         22        :::            4444     55
        11        99         99        :::           44 44                22        :::           44 44     55
        11        99         99        :::          44  44                22        :::          44  44     55
        11        9999999999999                     44   44              22                    44   44     555555555555
        11         999999999999                    44    44            22                     44    44    5555555555555
        11                   99        :::        444444444444        22                :::  444444444444              55
        11                   99        :::       44444444444444     22                   :::  44444444444444            55
        11                   99        :::                 44    22                      :::            44     55         55
    11111111      9999999999999                          44    2222222222222                        44     5555555555555
    11111111      999999999999                           44    2222222222222                        44      55555555555
1
0                                 sssssssssss     cccccccccccc      aaaaaaaaa     ll              eeeeeeeeeeeeee
                                sssssssssssss   cccccccccccccc    aaaaaaaaaaa    ll              eeeeeeeeeeeeee
                                ss         ss   cc         cc   aa         aa   ll              ee
                                ss              cc              aa         aa   ll              ee
                                ss              cc              aa         aa   ll              ee
                                sssssssssssss   cc              aaaaaaaaaaaaaa ll              eeeeeeeee
                                 sssssssssssss  cc              aaaaaaaaaaaaaa ll              eeeeeeeee
                                           ss   cc              aa         aa   ll              ee
                                           ss   cc              aa         aa   ll              ee
                                ss         ss   cc         cc   aa         aa   ll              ee
                                sssssssssssss   cccccccccccccc   aa         aa   llllllllllll    eeeeeeeeeeeeee
                                 sssssssssss     cccccccccccc    aa         aa   llllllllllll    eeeeeeeeeeeeee


                        ******************************************************************************
                        ******************************************************************************
                        ******************************************************************************
                        *****                                                                    *****
                        *****                 program verification information                    *****
                        *****                                                                    *****
                        *****                 code system:    scale  version:   4.3               *****
                        *****                                                                    *****
                        ******************************************************************************
                        ******************************************************************************
                        *****                                                                    *****
                        *****                                                                    *****
                        *****              program:  sas2                                        *****
                        *****        creation date:  03/07/97                                    *****
                        *****              library:  /opt/neut/Scale4.3/bin                      *****
                        *****                                                                    *****
                        *****                                                                    *****
                        *****    this is not a   scale  configuration controlled code            *****
                        *****                                                                    *****
                        *****              jobname:  nichol                                      *****
                        *****                                                                    *****
                        *****    date of execution:  07/30/97                                    *****
                        *****                                                                    *****
                        *****    time of execution:  19:42:45                                    *****
                        *****                                                                    *****
                        *****                                                                    *****
                        ******************************************************************************
                        ******************************************************************************
                        ******************************************************************************
1
0 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
0
0                                        nuclide concentrations, grams
                                         basis =single reactor assembly
             initial  1E-18 d
     o 16   1.35E+05  1.35E+05
   total    3.92E+05  3.92E+05
0                                        nuclide concentrations, grams
                                         basis =single reactor assembly
             initial  1E-18 d
     u234   2.00E+02  2.00E+02
     u235   3.40E+04  3.40E+04
     u236   2.00E+02  2.00E+02
     u238   9.65E+05  9.65E+05
   total    1.00E+06  1.00E+06
0                                       basis =
0                 initial        22.6 d        45.2 d        67.7 d        90.3 d        90.3 d
```

```
0                    initial        22.6 d        45.2 d        67.7 d        90.3 d        90.3 d
                                                 basis = single reactor assembly
                charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
      o 16    8.41E+03  8.41E+03  8.41E+03  8.41E+03  8.41E+03  8.41E+03
                                                 basis = single reactor assembly
                charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
                                                 basis = single reactor assembly
                charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
     mo 95     .00E+00  6.78E-05  4.62E-04  1.34E-03  2.73E-03  2.73E-03
                                                 basis = single reactor assembly
                charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
     tc 99     .00E+00  4.58E-12  4.73E-11  1.75E-10  4.32E-10  4.32E-10
                                                 basis = single reactor assembly
                charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
                                                 basis = single reactor assembly
                charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
   totals    1.15E+04  1.15E+04  1.15E+04  1.15E+04  1.15E+04  1.15E+04
                                                 basis = single reactor assembly
                charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
      u233     .00E+00  3.42E-07  6.72E-07  9.83E-07  1.28E-06  1.28E-06
      u234    8.55E-01  8.45E-01  8.34E-01  8.25E-01  8.15E-01  8.15E-01
      u235    1.45E+02  1.41E+02  1.37E+02  1.34E+02  1.30E+02  1.30E+02
      u236    8.47E-01  1.56E+00  2.25E+00  2.92E+00  3.57E+00  3.57E+00
      u238    4.06E+03  4.05E+03  4.05E+03  4.05E+03  4.05E+03  4.05E+03
     np237     .00E+00  9.36E-03  2.64E-02  4.69E-02  7.02E-02  7.02E-02
     pu236     .00E+00  2.71E-10  1.67E-09  4.57E-09  9.17E-09  9.17E-09
     pu238     .00E+00  5.82E-05  3.72E-04  1.03E-03  2.09E-03  2.09E-03
     pu238     .00E+00  5.82E-05  3.72E-04  1.03E-03  2.09E-03  2.09E-03
     pu239     .00E+00  1.69E+00  3.55E+00  5.26E+00  6.82E+00  6.82E+00
     pu240     .00E+00  2.53E-02  1.04E-01  2.24E-01  3.75E-01  3.75E-01
     pu241     .00E+00  1.01E-03  8.51E-03  2.77E-02  6.22E-02  6.22E-02
     pu242     .00E+00  5.04E-06  8.79E-05  4.38E-04  1.33E-03  1.33E-03
                                                 basis = single reactor assembly
                charge    22.6 d    45.2 d    67.7 d    90.3 d    90.3 d
     am241     .00E+00  7.20E-07  1.23E-05  6.10E-05  1.84E-04  1.84E-04
     am242m    .00E+00  1.23E-09  4.09E-08  2.93E-07  1.13E-06  1.13E-06
     am243     .00E+00  1.87E-08  6.70E-07  5.09E-06  2.08E-05  2.08E-05
   totals    4.20E+03  4.20E+03  4.20E+03  4.19E+03  4.19E+03  4.19E+03
*          decay data, including gamma and total energy, are from endf/b-vi
0                  1697    total number of nuclides in library
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
                initial   46.9 d   93.8 d  140.8 d   187.7 d   234.6 d   281.5 d
      o 16    1.35E+05  1.35E+05  1.35E+05  1.35E+05  1.35E+05  1.35E+05  1.35E+05
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
                initial   46.9 d   93.8 d  140.8 d   187.7 d   234.6 d   281.5 d
     mo 95    1.94E+01  2.03E+01  2.09E+01  2.14E+01  2.17E+01  2.18E+01  2.20E+01
     tc 99    1.17E-04  1.18E-04  1.18E-04  1.18E-04  1.18E-04  1.18E-04  1.18E-04
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
                initial   46.9 d   93.8 d  140.8 d   187.7 d   234.6 d   281.5 d
   total      3.92E+05  3.92E+05  3.92E+05  3.92E+05  3.92E+05  3.92E+05  3.92E+05
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
                initial   46.9 d   93.8 d  140.8 d   187.7 d   234.6 d   281.5 d
      u233    1.89E-03  1.91E-03  1.93E-03  1.95E-03  1.98E-03  2.00E-03  2.02E-03
      u234    1.13E+02  1.13E+02  1.13E+02  1.14E+02  1.14E+02  1.14E+02  1.14E+02
      u235    1.03E+04  1.03E+04  1.03E+04  1.03E+04  1.03E+04  1.03E+04  1.03E+04
      u236    4.33E+03  4.33E+03  4.33E+03  4.33E+03  4.33E+03  4.33E+03  4.33E+03
      u238    9.36E+05  9.36E+05  9.36E+05  9.36E+05  9.36E+05  9.36E+05  9.36E+05
     np237    5.30E+02  5.38E+02  5.38E+02  5.38E+02  5.39E+02  5.39E+02  5.39E+02
     pu236    9.05E-04  8.81E-04  8.54E-04  8.28E-04  8.03E-04  7.79E-04  7.56E-04
     pu238    2.21E+02  2.26E+02  2.30E+02  2.33E+02  2.35E+02  2.37E+02  2.38E+02
     pu238    2.21E+02  2.26E+02  2.30E+02  2.33E+02  2.35E+02  2.37E+02  2.38E+02
     pu239    6.64E+03  6.71E+03  6.71E+03  6.71E+03  6.71E+03  6.71E+03  6.71E+03
     pu240    2.65E+03  2.65E+03  2.65E+03  2.65E+03  2.65E+03  2.65E+03  2.65E+03
     pu241    1.76E+03  1.74E+03  1.73E+03  1.72E+03  1.71E+03  1.70E+03  1.69E+03
     pu242    5.78E+02  5.78E+02  5.78E+02  5.78E+02  5.78E+02  5.78E+02  5.78E+02
     am241    9.23E+01  1.03E+02  1.14E+02  1.25E+02  1.35E+02  1.46E+02  1.56E+02
     am242m   2.65E+00  2.64E+00  2.64E+00  2.64E+00  2.64E+00  2.64E+00  2.64E+00
     am243    1.39E+02  1.40E+02  1.40E+02  1.40E+02  1.40E+02  1.40E+02  1.40E+02
   total      9.64E+05  9.64E+05  9.64E+05  9.64E+05  9.64E+05  9.64E+05  9.64E+05
0                                                element concentrations, grams
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
                initial   46.9 d   93.8 d  140.8 d   187.7 d   234.6 d   281.5 d
     mo 95    7.09E+02  7.34E+02  7.53E+02  7.67E+02  7.75E+02  7.81E+02  7.84E+02
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
                initial   46.9 d   93.8 d  140.8 d   187.7 d   234.6 d   281.5 d
     tc 99    8.28E+02  8.31E+02  8.31E+02  8.31E+02  8.31E+02  8.31E+02  8.31E+02
     ru101    8.12E+02  8.12E+02  8.12E+02  8.12E+02  8.12E+02  8.12E+02  8.12E+02
     rh103    4.80E+02  5.01E+02  5.10E+02  5.15E+02  5.16E+02  5.17E+02  5.17E+02
     rh103m   3.75E-02  1.63E-02  7.14E-03  3.12E-03  1.36E-03  5.95E-04  2.60E-04
     ag109    1.00E+02  1.01E+02  1.01E+02  1.01E+02  1.01E+02  1.01E+02  1.01E+02
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
                initial   46.9 d   93.8 d  140.8 d   187.7 d   234.6 d   281.5 d
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
                initial   46.9 d   93.8 d  140.8 d   187.7 d   234.6 d   281.5 d
     nd143    8.87E+02  9.03E+02  9.04E+02  9.04E+02  9.04E+02  9.04E+02  9.04E+02
     nd145    7.01E+02  7.01E+02  7.01E+02  7.01E+02  7.01E+02  7.01E+02  7.01E+02
     sm147    1.10E+02  1.15E+02  1.20E+02  1.25E+02  1.29E+02  1.34E+02  1.38E+02
     sm149    3.58E+00  4.64E+00  4.64E+00  4.64E+00  4.64E+00  4.64E+00  4.64E+00
     sm150    3.23E+02  3.23E+02  3.23E+02  3.23E+02  3.23E+02  3.23E+02  3.23E+02
     sm151    2.51E+01  2.53E+01  2.53E+01  2.52E+01  2.52E+01  2.52E+01  2.52E+01
     eu151    4.39E-02  6.90E-02  9.40E-02  1.19E-01  1.44E-01  1.69E-01  1.94E-01
     sm152    1.31E+02  1.31E+02  1.31E+02  1.31E+02  1.31E+02  1.31E+02  1.31E+02
     eu153    1.27E+02  1.28E+02  1.28E+02  1.28E+02  1.28E+02  1.28E+02  1.28E+02
     gd155    1.13E-01  2.16E-01  3.17E-01  4.15E-01  5.12E-01  6.07E-01  7.00E-01
0                                                nuclide concentrations, grams
                                                 basis =single reactor assembly
                initial   46.9 d   93.8 d  140.8 d   187.7 d   234.6 d   281.5 d
   total      3.59E+04  3.59E+04  3.59E+04  3.59E+04  3.59E+04  3.59E+04  3.59E+04
```