

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

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Intact and Degraded Component Criticality Calculations of N Reactor Spent Nuclear Fuel

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9. Remarks

MCNP input and output files are included in Attachment II. Attachment III is the list of these files with the size and date and time of the last access

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1. PURPOSE

The objective of this calculation is to perform intact and degraded mode criticality evaluations of the Department of Energy's (DOE) N Reactor Spent Nuclear Fuel codisposed in a 2-Defense High-Level Waste (2-DHLW) / 2-Multi-Canister Overpack (MCO) Waste Package (WP) and emplaced in a monitored geologic repository (MGR) (see Attachment I). The scope of this calculation is limited to the determination of the effective neutron multiplication factor (k_{eff}) for both intact and degraded mode internal configurations of the codisposal waste package.

This calculation will support the analysis that will be performed to demonstrate the technical viability for disposing of U-metal (N Reactor) spent nuclear fuel in the potential MGR.

This calculation is associated with the waste package design and is performed in accordance with the *Technical Work Plan For: Department of Energy Spent Nuclear Fuel Work Packages* (Civilian Radioactive Waste Management System Management and Operating Contractor [CRWMS M&O] 2000a). This document is prepared in accordance with the Administrative Procedures AP-3.12Q, *Calculations*, and AP-3.15Q, *Managing Technical Products Inputs*.

The information provided by the sketches attached to this calculation is that of the potential design of the 2-MCO/2-DHLW waste package considered for this calculation (Attachment I).

2. METHOD

The calculational method to perform the criticality calculations consists of using the MCNP Version 4B2 (CRWMS M&O 1998a, CRWMS M&O 1998b) to calculate the effective neutron multiplication factor of the codisposal waste package. The calculations are performed using the continuous-energy cross-section libraries, which are part of the qualified code system MCNP 4B2 (CRWMS M&O 1998a, CRWMS M&O 1998b). All calculations are performed with fresh fuel unless otherwise specified.

With regard to the development of this calculation, the control of the electronic management of data was evaluated in accordance with AP-SV.1Q, *Control of the Electronic Management of Information*. The evaluation (CRWMS M&O 2000a) determined that current work process and procedures are adequate for the control of the electronic management of data for this activity.

3. ASSUMPTIONS

- 3.1 For the degraded mode criticality calculations, it is assumed that the iron in the stainless steel degrades to goethite (FeOOH) rather than hematite (Fe_2O_3). The basis of this assumption is that it is conservative to consider goethite rather than hematite since hydrogen (a moderator) is a component of goethite. All the other constituents of steel are neglected since they are neutron absorbers, and hence their absence provides a conservative (higher) value for the k_{eff} of the system. This assumption is used throughout Section 5.
- 3.2 Ba-138 cross sections are used instead of Ba-137 cross sections in the MCNP input since the cross sections of Ba-137 are not available in either ENDF/B-V or ENDF/B-VI cross-section libraries. The basis of this assumption is that it is conservative since the thermal neutron capture cross section and the resonance integral of Ba-137 (5.1 and 4 barn, respectively [Parrington et al. 1996, p. 34]) are greater than the thermal neutron capture cross section and the resonance integral of Ba-138 (0.43 and 0.3 barn, respectively [Parrington et al. 1996, p. 34]). This assumption is used throughout Section 5.
- 3.3 The metal 'structure' (also called head) on the top of the MCO above the basket is neglected. The bottom plate of the MCO filled with Mark IA is assumed to be 4.4705 cm rather than 5.11 cm. The rationale of this assumption is that components of 304L are neutron absorbers, and hence their absence provides a conservative (higher) value for the k_{eff} of the system. This assumption is used throughout Section 5.

4. USE OF COMPUTER SOFTWARE AND MODELS

4.1 SOFTWARE

4.1.1 MCNP

The MCNP code is used to calculate the k_{eff} of the codisposal waste package. The software specifications are as follow:

- Software name: MCNP
- Software version/revision number: Version 4B2
- Software tracking number (computer software configuration item [CSCI]): 30033 V4B2LV
- Computer type: Hewlett Packard (HP) 9000 Series Workstations
- Computer processing unit number: Software is installed on the CRWMS M&O workstation "bloom" whose CRWMS M&O Tag number is 700887

The input and output files for the various MCNP calculations are documented in Attachment II, (Attachment III gives the list of the files on Attachment II). The calculation files described in Sections 5 and 6 are such that an independent repetition of the software use may be performed.

The MCNP software used is: (a) appropriate for the application of research reactor k_{eff} calculations, (b) used only within the range of validation as documented in CRWMS M&O (1998a and 1998b), (c) obtained from the Software Configuration Management in accordance with appropriate procedures.

4.2 SOFTWARE ROUTINES

4.2.1 Excel

- Title: Excel
- Version/Revision Number: Microsoft® Excel 97 SR-2
- This software is installed on a personal computer running Microsoft Windows 95 with CRMWS M&O Tag number 115769.

The Excel spreadsheet programs are used to calculate the isotopic composition of the materials in the waste package and various volumes (cylinder segment volume) as documented in Section 5 of this calculation document. The user-defined formulas, inputs, and results are documented in sufficient detail in Section 5 to allow an independent repetition of computations. Thus, Excel is only used as a worksheet and not as a software routine. Therefore, the Excel files are exempt from being qualified as a routine by AP-SI.1Q (Section 2.1.1).

4.3 MODELS

None used.

5. CALCULATION

This section describes the calculations performed to calculate the k_{eff} of an intact and a degraded waste package containing high-level waste material and N Reactor spent nuclear fuel. Section 5.1 describes the waste package. Section 5.2 gives the composition of the materials used in this calculation. The basic formulas used in this calculation are listed in Section 5.3. The different intact configurations of a waste package are outlined in Section 5.4. Section 5.5 describes calculations performed to characterize the degraded configurations of a waste package. The MCNP output files attributes are presented in Attachment II. The results of the calculations are presented in Section 6.

Compositions for structural and other nonfuel-related materials are from ASTM (American Society for Testing and Materials) A20/A 20M-97a, *Standard Specification for General Requirements for Steel Plates for Pressure Vessels*; ASTM A 240/ A 240M-99b, *Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels*; ASTM A 276-91a, *Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes*; ASTM A 516/A 516M - 90, *Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service*; ASTM B 575-97, *Standard Specification for Low-Carbon Nickel-Molybdenum-Chromium, Low-Carbon Nickel-Chromium-Molybdenum, Low-Carbon Nickel-Chromium-Molybdenum-Copper and Low-Carbon Nickel-Chromium-Molybdenum-Tungsten Alloy Plate, Sheet, and Strip*; ASTM B 811-97, *Standard Specification for Wrought Zirconium Alloy Seamless Tubes for Nuclear Reactor Fuel Cladding*; and ASTM G 1-90, *Standard Practice for Preparing, Cleaning, and Evaluating Corrosion Test Specimens*; ASM (American Society of Metals) 1961; ASM International 1967. These references are consensus codes or standards, and, therefore, the information taken from them is not subject to verification (according to AP-3.15Q).

The Savannah River Site high-level waste glass degraded composition is from CRWMS M&O 2000c. This information is a technical output. The Savannah River Site high-level waste glass composition and density are from CRWMS M&O (1999a) and Stout and Leider (1991), respectively. The Savannah River Site high-level waste glass canister dimensions are from Taylor (1997). This information is unqualified and is therefore considered to-be-verified.

Avogadro's number is from Parrington et al. (1996). Atomic weights are from Parrington et al. (1996); this information is established fact and is therefore considered accepted due to the nature of the references cited therein.

The description of the N Reactor fuel is from the *N Reactor (U-metal) Fuel Characteristics for Disposal Criticality Analysis* report (DOE 2000). All fuel-related information is from this reference unless otherwise noted.

The tuff composition and the tuff density are taken from Lipman et al. (1966) and Flint (1998), respectively. These information have no impact on the results of this calculation and are therefore considered as "No Confirmation Required" in DIRS.

This calculation is based in part on unqualified information such as that in DOE (2000). However, the unqualified information is only used to determine the bounding values and items that are important to safety for the fuel group. The fuel group is identified by the National Spent Nuclear Fuel Program by establishing the limits based on the representative fuel type (N Reactor) for this group (U-metal). Therefore, the input values used to evaluate the codisposal viability of N Reactor spent nuclear fuel do not constitute information that has to be qualified prior to use of any results from this calculation for input into document supporting procurement, fabrication, or construction. They merely establish the bounds for acceptance. Since the input values are not relied upon directly to address radiological safety and waste isolation issues, nor do the design inputs affect a system characteristic that is critical for satisfactory performance, the information does not need to be controlled as to-be-verified.

The number of digits in the values cited herein may be the result of a calculation or may reflect the input from another source; consequently, the number of digits should not be interpreted as an indication of accuracy.

The metric units used in this document are calculated using the English units as given in DOE (2000). The differences that might exist between the metric units calculated and the metric units cited in DOE (2000) have no effect on the calculation and should not be interpreted as an indication of accuracy.

5.1 WASTE PACKAGE COMPONENTS DESCRIPTION

5.1.1 N Reactor Spent Nuclear Fuel

The N Reactor core was fueled with slightly enriched (0.947 wt%, and 0.947 to 1.25 wt% ^{235}U in Mark IV or Mark IA fuels, respectively [DOE 2000, p. 10]) uranium metal clad in Zircaloy-2. The N Reactor fuel elements consist of the two basic design variants, both of which use two concentric tubes of uranium metal co-extruded with Zircaloy-2 cladding. Lengths and diameters vary slightly by fuel type; these differences are described in DOE (2000, p. 11). In this calculation, only Mark IV E and Mark IA M are analyzed. Indeed, these fuel elements are the longest and thus have the highest content of fissile material. Dimensions are given in Figure 1 and Table 1.

Extended storage of the N reactor fuels in an underwater environment has resulted in a degraded or damaged condition for much of the fuel over time (DOE 2000, p. 21). Estimates of particle masses that may be loaded for disposal are discussed in Appendix C of DOE (2000).

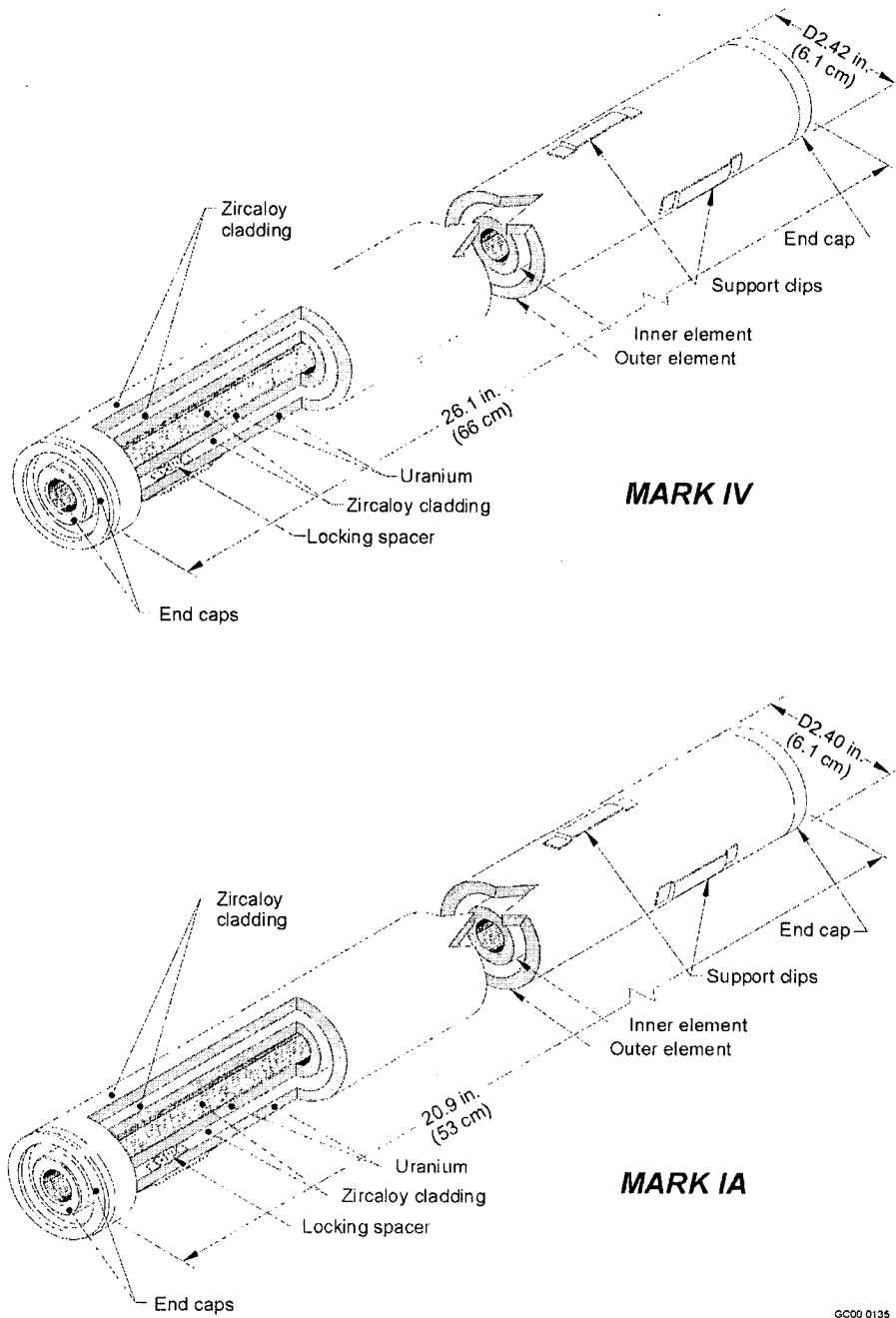


Figure 1. Characteristic N Reactor Fuel Type (DOE 2000, p. 12)

Table 1. Cladding Dimensions

	Mark IV [cm (inches)]	Mark IA [cm (inches)]
Outer layer – outer tube	0.0640 (0.0252)	0.0635 (0.0250)
Inner layer – outer tube	0.0505 (0.0199)	0.0555 (0.0219)
Outer layer – inner tube	0.0765 (0.0301)	0.1015 (0.0400)
Inner layer – inner tube	0.0510 (0.0201)	0.0635 (0.0250)
End cap Thickness	0.4830 (0.1900)	0.4830 (0.1900)

SOURCE: DOE 2000, p. 13.

5.1.2 Multi-Canister Overpack

One canister (MCO) design has been proposed for use in the packaging, transport, and disposal of the N Reactor fuels. The canister design includes a nominal length of 4198.37 mm (165.29 in.) and a maximum outer diameter of 642.9 mm (25.31 in.) Beyond these basic dimensions, fuel-specific internals (also called baskets) have been designed for each canister based on the known maximum lengths of the fuels (Mark IV or IA) contained therein (DOE 2000, p. 23). There are four different types of baskets: one for intact Mark IV fuel elements, one for scrap Mark IV fuel elements, one for intact Mark IA fuel elements, and one for scrap Mark IA fuel elements. Only five baskets loaded with Mark IV fuel elements (intact or scrap) can be stacked up in a MCO, while six baskets loaded with Mark IA fuel elements can be emplaced in the same MCO.

The MCO's are constructed out of 304L stainless steel having an outside diameter 60.92 cm (23.985 in.) and a wall thickness of 1.27 cm (0.5 in.) (Figure 2). The top portion of the MCO has a slightly larger diameter of 64.29 cm (25.31 in.) than the overall tube body in order to accommodate the top mechanical closure device. The overall length of the MCO is 422.707 cm (166.42 in.) with an inner cavity height to the top of the stacked baskets of 356.545 cm (140.372 in.). The bottom plate has a thickness of 5.11 cm (2.01 in.). There is a metal 'structure' that adds another 57.91 cm (22.80 in.) to the top of the MCO above the top basket (DOE 2000, p. 23). This structure is not represented in these calculations (see Assumption 3.6) and the bottom plate is represented with a thickness of 4.4704 cm (see Assumption 3.6) (Taylor, p. 23).

A central process post constructed out of 304L stainless steel is present in the MCO's. This central post is associated with the stacked baskets, and each post is drilled to facilitate water removal from the bottom of the MCO after underwater loading. In the case of the Mark IV fuel baskets, the post outer diameter is 7.20 cm (2.835 in.) with a 1.37-cm (0.54-in.) thick wall. The Mark IA fuel and scrap baskets use a 16.83-cm (6.625-in.) diameter post with a 4.458 cm (1.755 in. [max.]) hole drilled in the center for a 6.18 cm (2.435 in.) wall thickness (DOE 2000, p. 23). Figure 3 shows the arrangement of the fuel elements in the intact baskets. The scrap baskets are divided equally into six compartments separated by six, full-height copper plates (Table 4) that are 0.318 cm (0.125 in.) thick. Heat transfer considerations indicate that a maximum of two scrap baskets may be loaded in an MCO and that they must be placed into the MCO as top and bottom baskets (DOE 2000, pp. 33 and 34). DOE (2000, pp. 26 and 27) contains the detailed descriptions of the intact and scrap baskets for Mark IA and Mark IV fuel elements.

It is important to distinguish between what constitutes intact versus scrap material when discussing MCO basket loading. The following generic guidelines are to be used for differentiating material segregation between baskets (DOE 2000, p. 23).

Scrap cans "... consist of material with a maximum dimension as small as 1/4 inch, but can also consist of pieces as large as entire fuel elements which do not fit in bottom plate sockets of the fuel basket" (DOE 2000, p. 23).

'Intact' fuels, suitable for loading in MCO intact fuel baskets, are defined as material that is "... loaded to form fuel element pairs, at least one end of the outer element fits within the hole machined in the plate of the fuel basket, and the inner element fits within the outer element. Both elements must seat within the fuel basket holes such that the top of either element does not exceed the fuel basket height. Fuel element segments may be stacked (outer segments on intact inner or inner segments in intact outer) to form element pairs in a fuel basket position. The height of stacked segments can not exceed the length of intact element supporting the segment stack." (DOE 2000, p. 26).

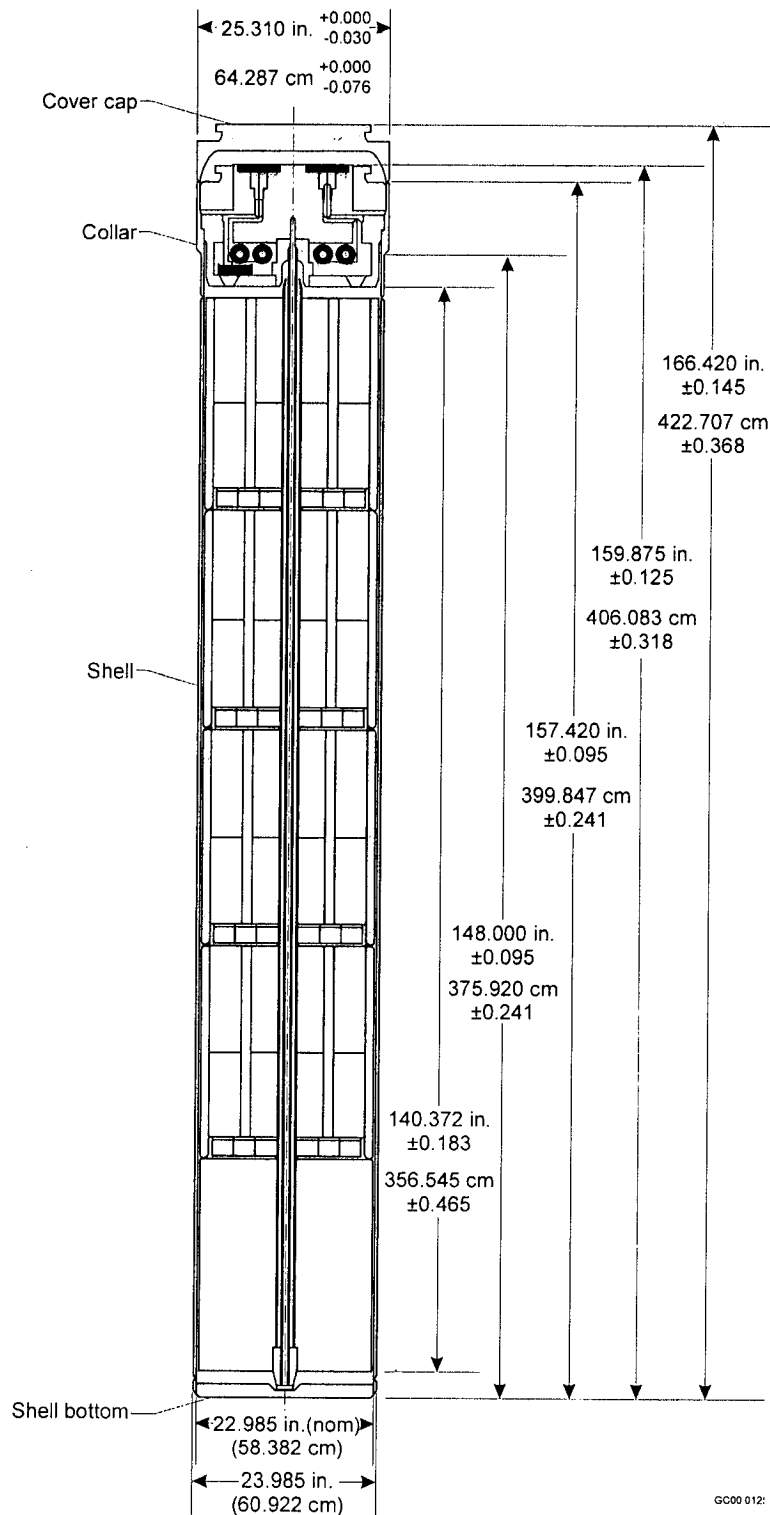
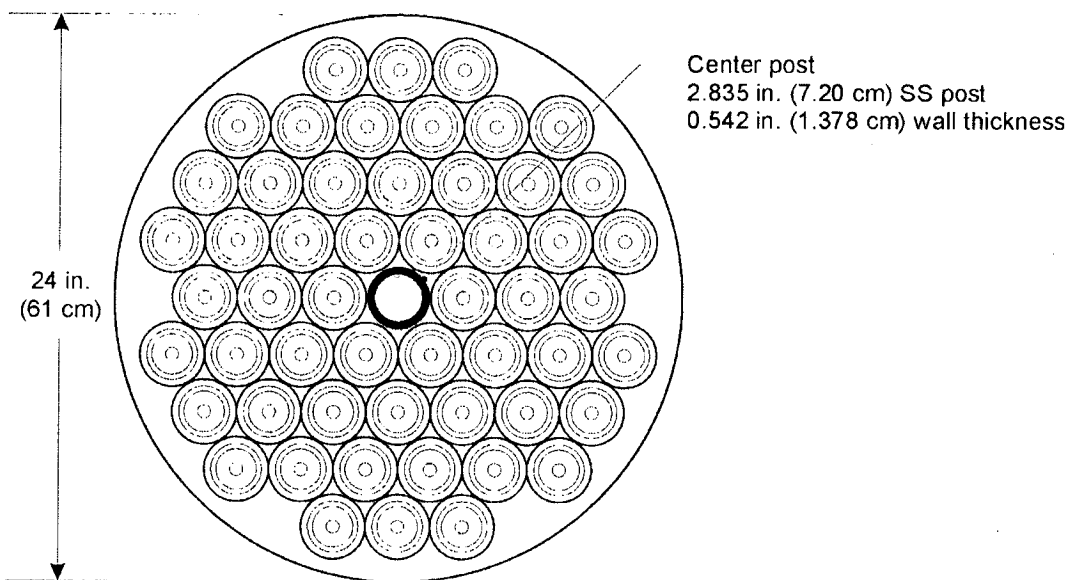


Figure 2. Multi-Canister Overpack (with four intact and one scrap Mark IV baskets) (DOE 2000, p. 24)

Loading Arrangement for Mark IV Fuel in MCO Container



Loading Arrangement for Mark IA Fuel in MCO Container

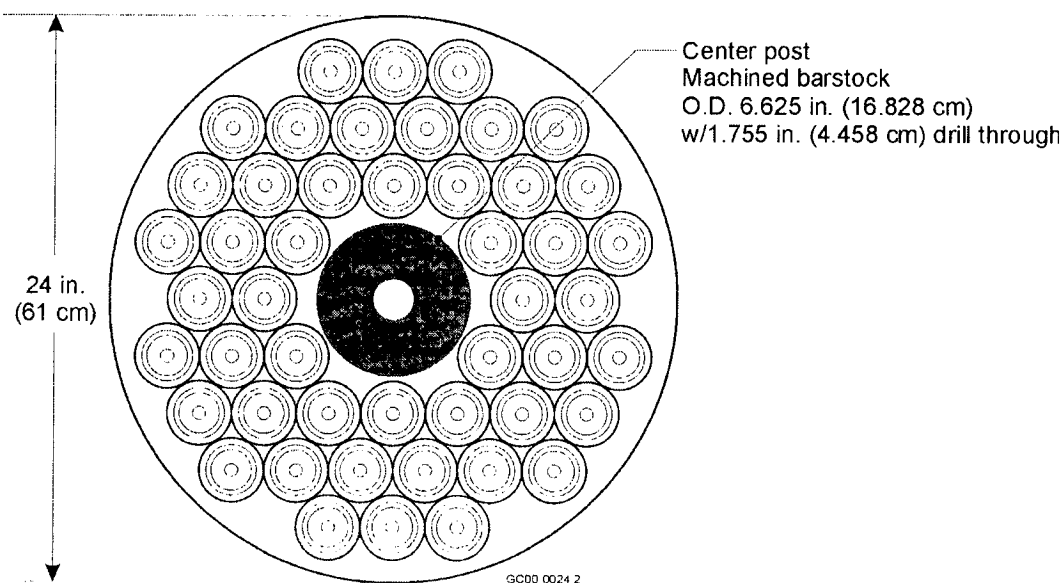


Figure 3. Loading Arrangement for N Reactor Fuel Elements in the MCO (DOE 2000, p. 25)

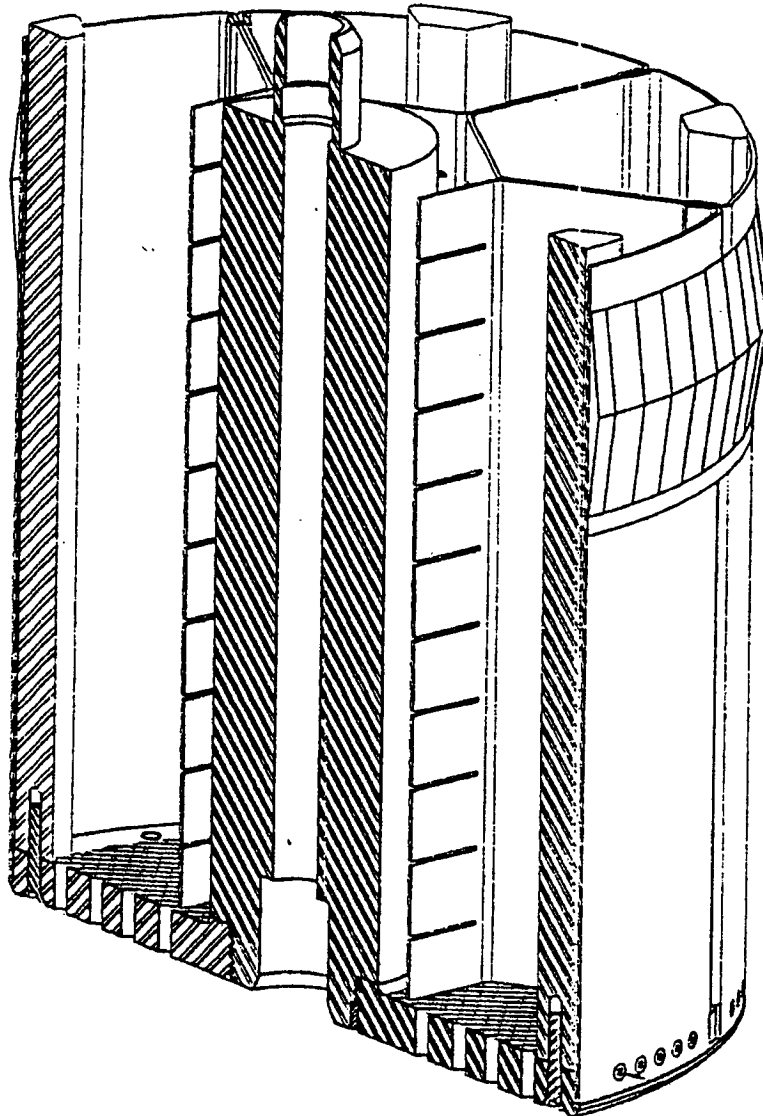


Figure 4. Scrap Basket (DOE 2000, p. 34)

5.1.3 High-Level Waste Glass Pour Canister

There is no long Savannah River Site high-level waste glass canister. Therefore, the Hanford 15-foot high-level waste glass canister is used in the N reactor waste package. Since the specific composition of the Hanford high-level waste glass has not yet been specified, it can only be assumed to be the same as the Savannah River Site glass composition. The Hanford 15-foot high-level waste glass canister is 4,572-mm long stainless steel Type 304L canister with an outer

diameter of 610 mm (24.00 in.) (Taylor 1997). The wall thickness is 10.5 mm. These parameters are the same as the SRS canister, except that it is longer. The maximum loaded canister weight is 4,200 kg and the fill volume is 87%. The heat generation from a single Hanford 15-foot high-level waste glass canister is 2,540 W.

5.1.4 Waste Package Description

The codisposal waste package (Attachment I, p. I-1) contains two Savannah River Site high-level waste glass canisters and two MCOs. The waste package barrier materials are typical of those used for commercial spent nuclear fuel waste containers. The inner barrier shell is composed of 50 mm of Stainless Steel 316 (SA-240 S31600) and serves as a corrosion allowance material. The outer barrier shell is composed of 25 mm of Nickel Alloy (Alloy 22, SB-575 N06022) (ASTM B 575-97) and serves as a corrosion resistant material. The outside diameter of the waste container is 1734 mm and the outer length is 5217 mm. The inner barrier lids are 105 mm thick and the outer barrier lids are 25 mm thick. There is a 30-mm thick closure lid gap between the upper inner and outer barrier lids. There are two 10-mm thick plates made of carbon steel 516 Grade 70 (SA-516 K02700) that divide the waste package in 4 quarters as shown in Figure 5. There are 2 fuel-support cylinders also made of carbon steel 516 Grade 70 at the bottom of the waste package. These support cylinders are needed to meet structural requirements (CRWMS M&O 2000d).

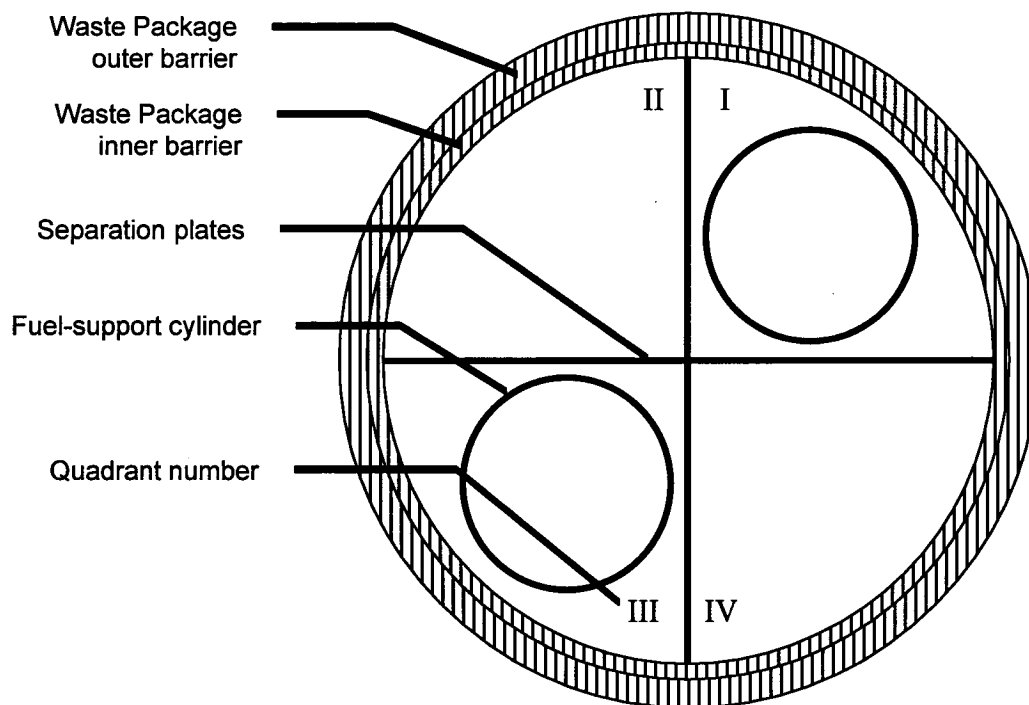


Figure 5. 2-MCO / 2-DHLW Waste Package Configuration

5.2 MATERIALS DESCRIPTION

Tables 2 through 13 give the composition of the materials used in this calculation.

Table 2. Composition and Density of Stainless Steel 304L

Element	Composition (wt %) ^a	Value Used (wt %)
C	0.030 (max)	0.030
Mn	2.000 (max)	2.000
P	0.045 (max)	0.045
S	0.030 (max)	0.030
Si	0.750 (max)	0.750
Cr	18-20	19.000
Ni	8-12	10.000
N	0.100 (max)	0.100
Fe	Balance	68.045
Density ^b = 7.94 g/cm ³		

SOURCES: ^a ASTM A 240/A 240M-99b.

^b ASTM G 1-90, Table X1.1.

Table 3. Composition and Density of Zircaloy-2

Element	Composition (wt %) ^a	Value Used (wt %)
Sn	1.20-1.70	1.45
Fe	0.07-0.20	0.135
Cr	0.05-0.15	0.10
Ni	0.03-0.08	0.055
O	0.09-0.16	0.125
Cr + Fe + Ni	0.18-0.38	
Zr	Balance	98.135
Density ^b = 6.55 g/cm ³		

SOURCES: ^a ASTM B 811-97, Table 2.

^b ASM International 1967, p.1.

Table 4. Composition and Density of Copper

Element	Composition (wt %)	Value Used (wt %)
Cu	99.95 (min)	99.98
P	0.02	0.02
Density = 8.94 g/cm ³		

SOURCE: ASM 1961, p. 1010.

Table 5. Composition and Density of Savannah River Site High-Level Waste Glass

Element / Isotope	Composition ^a (wt %)	Element / Isotope	Composition ^a (wt %)
O	4.4770E+01	Ni	7.3490E-01
U-234	3.2794E-04	Pb	6.0961E-02
U-235	4.3514E-03	Si	2.1888E+01
U-236	1.0415E-03	Th	1.8559E-01
U-238	1.8666E+00	Ti	5.9676E-01
Pu-238	5.1819E-03	Zn	6.4636E-02
Pu-239	1.2412E-02	B-10	5.9176E-01
Pu-240	2.2773E-03	B-11	2.6189E+00
Pu-241	9.6857E-04	Li-6	9.5955E-02
Pu-242	1.9168E-04	Li-7	1.3804E+00
Cs-133	4.0948E-02	F	3.1852E-02
Cs-135	5.1615E-03	Cu	1.5264E-01
Ba-137 ^c	1.1267E-01	Fe	7.3907E+00
Al	2.3318E+00	K	2.9887E+00
S	1.2945E-01	Mg	8.2475E-01
Ca	6.6188E-01	Mn	1.5577E+00
P	1.4059E-02	Na	8.6284E+00
Cr	8.2567E-02	Cl	1.1591E-01
Ag	5.0282E-02		
Density ^b at 25 °C = 2.85 g/cm ³			

SOURCES: ^a CRWMS 1999a, p. 7.^b Stout and Leider 1991, p. 2.2.1.1-4.NOTE: ^c See Assumption 3.2.

Table 6. Composition and Density of Stainless Steel 316L

Element	Composition ^a (wt %)	Value Used
C	0.03 (max)	0.0200
N	0.10 (max)	0.0800
Si	1.00 (max)	1.0000
P	0.045 (max)	0.0450
S	0.03 (max)	0.0300
Cr	16-18	17.0000
Mn	2.00 (max)	2.0000
Ni	10-14	12.0000
Mo	2-3	2.5000
Fe	Balance	65.3249
Density ^b = 7.98 g/cm ³		

SOURCES: ^a ASTM A 276-91a, p. 2.^b ASTM G 1-90, Table X1.1.

Table 7. Composition and Density of Alloy 22

Element	Composition ^a (wt %)	Value Used
C	0.015 (max)	0.015
Mn	0.50 (max)	0.5
Si	0.08 (max)	0.08
Cr	20-22.5	21.25
Mo	12.5-14.5	13.5
Co	2.50 (max)	2.5
W	2.5-3.5	3.0
V	0.35 (max)	0.35
Fe	2.0-6.0	4.0
P	0.02 (max)	0.02
S	0.02 (max)	0.02
Ni	Balance	54.7648
Density ^b = 8.69 g/cm ³		

SOURCES: ^a ASTM B 575-97, Table 1.^b ASTM B 575-97, p. 2.

Table 8. Composition and Density of Carbon Steel 516 Grade 70

Element	Composition ^a (wt %)	Value Used
C	0.27	0.27
Mn	0.79-1.30	1.045
P	0.035 (max)	0.035
S	0.035 (max)	0.035
Si	0.13-0.45	0.29
Fe	Balance	98.325
Density ^b = 7.85 g/cm ³		

SOURCES: ^a ASTM A 516/A 516M - 90, Table 1.^b ASTM A 20/A 20M-97a, p. 9.

Table 9. Burned Fuel Composition for Mark IA at 30 Years

Isotopes	Mass ^a (grams per metric ton of unirradiated uranium)	Value Used ^b (atom/barn-cm)
U-234	7.50E+01	3.64E-06
U-235	8.41E+03	4.07E-04
U-236	9.22E+02	4.44E-05
U-238	9.85E+05	4.71E-02
Np-237	4.25E+01	2.04E-06
Pu-239	1.76E+03	8.37E-05
Pu-240	2.62E+02	1.24E-05
Pu-241	1.66E+01	7.83E-07
Am241	5.26E+01	2.48E-06

SOURCES: ^a DOE 2000, Table 3-7.^b Spreadsheet "degradedMK1A.xls," sheet "burnup credit".

Table 10. Composition and Density of Dry Tuff

Mineral	Composition ^c (wt %)	Element	Composition ^a (wt %)
SiO ₂	76.83	Si	0.359
Al ₂ O ₃	12.74	Al	0.067
FeO	0.84	Fe	0.007
MgO	0.25	Mg	0.002
CaO	0.56	Ca	0.004
Na ₂ O	3.59	Na	0.027
K ₂ O	4.93	K	0.041
TiO ₂	0.1	Ti	0.001
P ₂ O ₅	0.02	P	0.0001
MnO	0.07	Mn	0.001
		H	0.000
		O	0.492
Density ^b =2.245 g/cm ³			

SOURCES: ^a Calculated from Lipman 1966.

^b Calculated from Flint 1998.

^c Calculated from Lipman 1966.

NOTE: Calculated in Attachment II spreadsheet "Tuff Composition.xls."

Table 11. Pre-Breach Clay Composition

Element	Mass of Element after 65 Years of Emplacement (kg)	Mass of Element after 6953 Years of Emplacement (kg)	Mass of Element after 54251 Years of Emplacement (kg)
O	5.332E+02	3.800E+03	3.474E+03
Al	2.045E-01	1.343E+02	1.343E+02
B	0.000E+00	1.541E+02	3.959E-13
Ba	1.320E-02	8.710E+00	8.708E+00
Ca	1.135E-01	3.762E+01	1.462E+01
Cl	1.102E-14	1.231E-17	0.000E+00
Cr	3.312E-11	0.000E+00	3.297E+00
F	1.076E-02	2.784E-01	4.522E-01
Fe	1.206E+03	1.987E+03	3.528E+03
H	4.902E-02	9.840E+01	2.722E+01
C	0.000E+00	3.253E+01	0.000E+00
P	1.857E-01	1.362E+00	2.307E+00
K	6.025E-02	9.912E+01	4.549E+01
Mg	7.047E-02	4.670E+01	3.269E+01
Mn	1.285E+01	1.964E+01	6.575E+01
Mo	1.593E-14	5.328E-16	1.282E+01
Na	5.516E-03	2.328E+02	0.000E+00
Ni	3.385E-01	3.726E+01	2.591E+02
S	3.083E-03	0.000E+00	0.000E+00
Si	5.592E+00	1.263E+03	1.285E+03
U	1.613E-01	3.324E+01	2.165E-01
Total (kg)	1.759E+03	7.985E+03	8.893E+03
Density (g/cm³)	5.232	2.950	3.797

SOURCE: CRWMS M&O 2000c

NOTE: See Attachment II, spreadsheet "pre-post-clay.xls", sheet "pre-breach"

Table 12. Post-Breach Clay Composition

Element	Mass of Element after 103210 Years of Emplacement (kg)	Mass of Element after 350290 Years of Emplacement (kg)	Mass of Element after 634080 Years of Emplacement (kg)
O	7.757E+03	1.013E+04	1.213E+04
Al	1.341E+02	1.341E+02	1.341E+02
Ba	8.700E+00	8.662E+00	8.621E+00
Ca	1.356E+01	1.773E+01	2.313E+01
Cl	2.402E-14	0.000E+00	1.894E-13
Cr	3.294E+00	3.279E+00	3.264E+00
Cu	2.087E+02	1.991E+02	1.910E+02
F	8.393E-13	0.000E+00	6.565E-12
Fe	5.714E+03	1.083E+04	1.509E+04
H	1.897E+02	1.908E+02	1.919E+02
C	3.720E-12	0.000E+00	1.539E-11
P	3.777E+00	7.274E+00	1.021E+01
K	4.101E+01	3.262E+01	2.966E+01
Li	5.403E-17	2.008E-19	2.260E-15
Mg	3.225E+01	3.279E+01	3.360E+01
Mn	1.308E+02	2.856E+02	4.153E+02
Mo	1.189E+01	8.880E-16	9.737E-14
N	2.868E-12	0.000E+00	1.337E-12
Na	4.558E-14	0.000E+00	1.970E-12
Ni	2.352E+02	1.924E+02	1.711E+02
S	7.340E-13	7.420E-18	8.592E-12
Si	1.314E+03	1.395E+03	1.469E+03
U	9.609E+03	9.608E+03	9.607E+03
Total (kg)	2.541E+04	3.308E+04	3.951E+04
Density (g/cm³)	4.472	4.610	4.685

SOURCE: CRWMS M&O 2000c

NOTE: See Attachment II, spreadsheet "pre-post-clay.xls", sheet "post breach"

Table 13. Alternative Post-Breach Clay Composition

Element	Mass of Element after 105440 Years of Emplacement (kg)	Mass of Element after 634090 Years of Emplacement (kg)
O	3.219E+03	8.023E+03
Al	1.188E+01	6.614E+01
B	0.000E+00	1.880E-13
Ba	7.507E-01	4.208E+00
Ca	4.564E+00	2.796E+01
Cl	1.912E-13	0.000E+00
Cr	2.842E-01	0.000E+00
Cu	2.024E+02	1.910E+02
F	3.961E-12	1.129E-01
Fe	6.520E+03	1.492E+04
H	2.848E+00	1.590E+01
C	7.680E-12	3.680E-01
P	3.937E+00	6.797E+00
K	3.303E+00	1.976E+01
Li	5.915E-16	0.000E+00
Mg	3.838E+00	2.165E+01
Mn	1.694E+02	4.185E+02
Mo	1.092E+01	5.440E+01
N	4.812E-12	0.000E+00
Na	9.183E-01	4.766E+00
Ni	2.794E+01	4.076E+02
S	1.111E-11	0.000E+00
Si	1.830E+02	8.304E+02
U	9.461E+00	5.268E+01
Total (kg)	1.038E+04	2.506E+04
Density (g/cm³)	5.063	4.845

SOURCE: CRWMS M&O 2000c

NOTE: See Attachment II, spreadsheet "pre-post-clay.xls", sheet "case8"

5.3 FORMULAS

The basic equation used to calculate the number density values, in the spreadsheets included in Attachment II, and used in the cases described throughout Section 5 is shown below:

$$N = (m/V) \times N_a / M$$

where: N is the number density in atoms/barn·cm

m is the mass in grams

V is the volume in cm³

N_a is the Avogadro's number (6.022 E+23 atoms/mole, Parrington et al. 1996, p. 59)

M is the atomic mass in g/mole.

Volumes of cylinder segments (volume = area of circle segment \times length of the cylinder) are also calculated throughout Attachment II. These calculations are based on the equation for the segment of a circle shown below (Beyer 1987, p. 125):

$$\text{Segment of a Circle} = \left(R^2 \cos^{-1} \left(\frac{R-h}{R} \right) - (R-h) \sqrt{2Rh - h^2} \right)$$

where: R is the cylinder radius,
h is the height of the segment.

The top portion of the MCOs (described in DOE 2000, p. 23) are not represented in the configuration described below (see Assumption 3.3).

5.4 INTACT MODE CRITICALITY CALCULATIONS

In this section, the intact mode of the 2-MCO / 2-DHLW waste package is analyzed. These configurations represent a waste package, which has been breached allowing inflow of water, but the internal components of the waste package are as-loaded (i.e., intact). Section 5.4.1 presents the calculations for a waste package loaded with Mark IV fuel and Section 5.4.2 presents the calculations for a waste package loaded with Mark IA fuel elements. For all the calculations (unless otherwise specified), the waste package has reflected boundaries acting as a mirror (i.e., no neutron leakage). This is a very conservative approach. Variations of the intact configurations are examined to identify the configuration that results in the highest calculated k_{eff} value within the range of possible conditions.

5.4.1 Mark IV

In this section, the k_{eff} of a 2-MCO / 2-DHLW waste package containing Mark IV fuel elements (as described in Section 5.1.1) is investigated. A cross section of a MCO loaded with intact baskets containing 54 intact fuel elements is shown in Figure 6. The effects of parameters such as fuel mass, type of basket in the MCO, moderation, etc., are investigated.

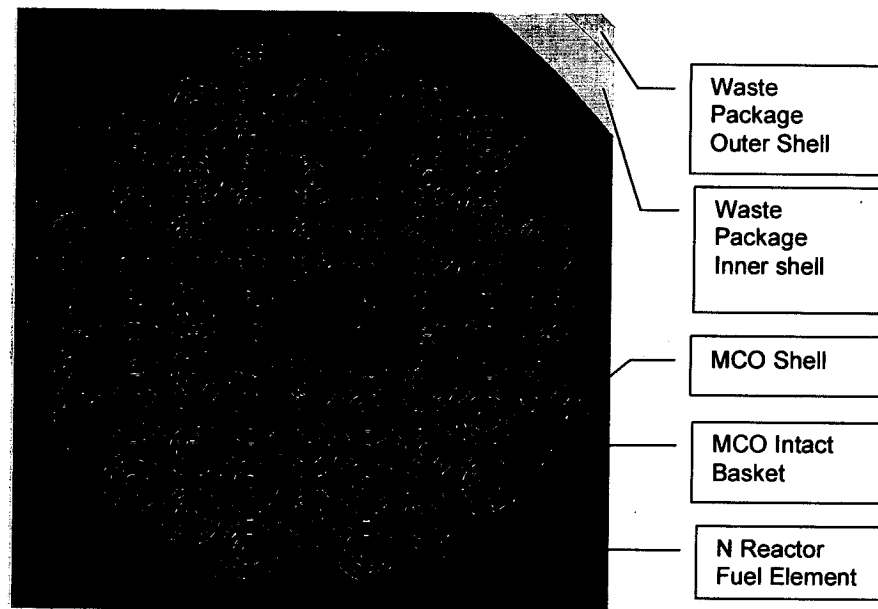


Figure 6. Cross Section of a MCO Loaded with 54 Mark IV Fuel Elements

First a configuration with 5 intact baskets is studied. As shown in Figure 5, because of structural requirements (CRWMS M&O 2000d), the MCOs can only be located in quadrants I & III. Their positions in the waste package are varied (quadrant I & III or quadrants I & IV) in order to find the most penalizing configuration. Once this configuration is identified, variations are examined with the waste package (outside the MCOs) and the MCOs as either flooded or dry to identify the case with the optimal moderation. These results are shown in Table 14.

Using the bounding configuration identified in Table 14, the next set of configurations studies the MCOs loaded with three intact baskets and two scrap baskets located at the top and bottom of the MCO as required (DOE 2000, p. 26). The contents of the scrap baskets can be either partially intact fuel elements (inner only or outer only, for example see Section 6.1.1.2.1) or pieces of intact fuel elements of various sizes (see Section 6.1.1.2.2).

Figure 7 illustrates the configurations where the scrap baskets are loaded with intact inner fuel elements (see Table 15). The number of inner fuel elements is limited so that the weight requirement for the scrap basket (980 kg) is not exceeded. The distance between inner fuel elements (or pitch) is varied. The same type of calculations are conducted with the scrap baskets loaded with intact outer fuel elements (see Table 16). In these calculations, the configuration does not change whether the waste package is in an as-loaded position or with the contents settled due to gravity. These cases are described in Attachment II, spreadsheet "scrapMIV-vertical.xls," sheet "degraded."

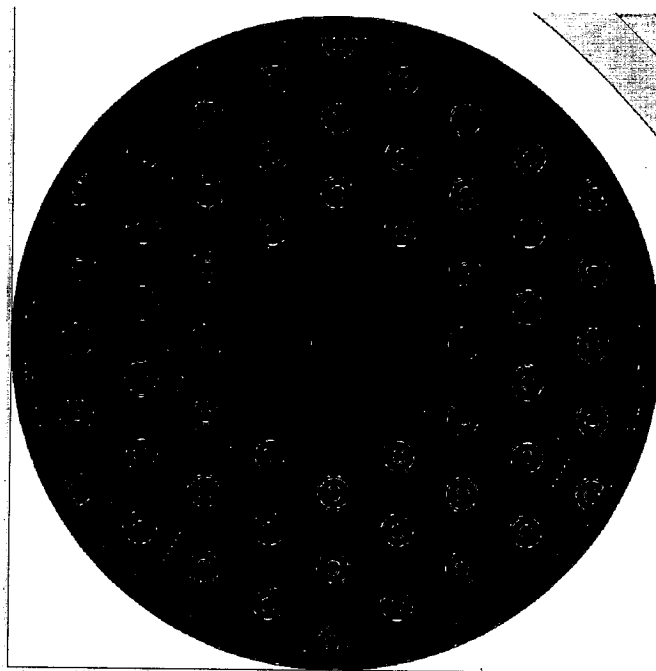
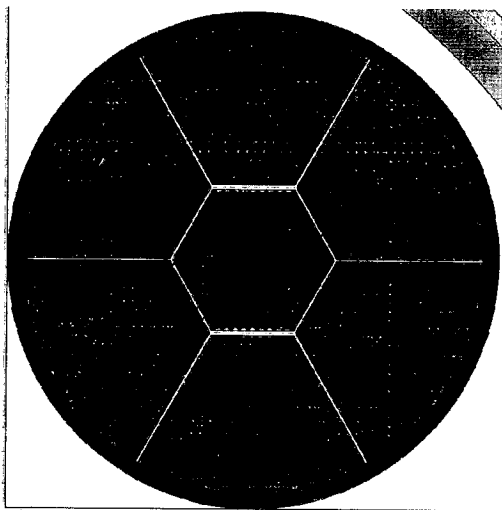


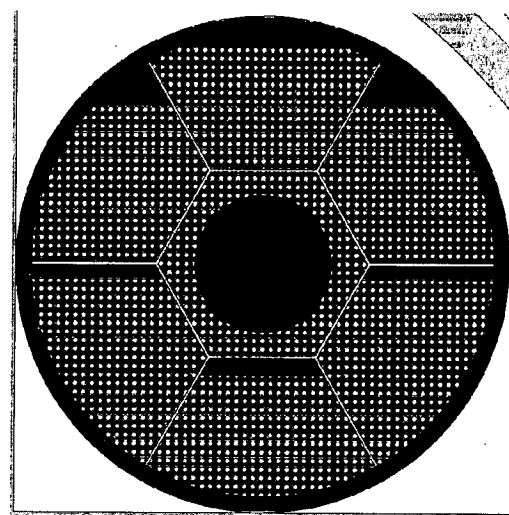
Figure 7. Scrap Basket Filled with Inner Fuel Elements

In the previous configurations the scrap consists of pieces as large as an intact inner or outer fuel elements but scrap can also consist of material with a minimum dimension as small as 1/4 in. (at loading) (DOE 2000, p. 23). In these configurations examined in Section 6.1.1.2.2, unclad fuel spheres represent the scrap fuel. Configurations where credit is taken for the clad are also investigated (Section 6.1.1.3 and in Attachment II, spreadsheet "scrapsMIV-vertical.xls," sheet "980kg"). Such configurations are very unlikely to occur in the MCO: the U-metal particles will degrade very quickly (see degradation rate in CRWMS M&O 2000c, Table 4) and form a sludge at the bottom of the basket. Thus, the "life time" of the configurations where the scrap consist of material with a minimum dimension as small as 1/4 in. is very short. However, such configurations are considered bounding.

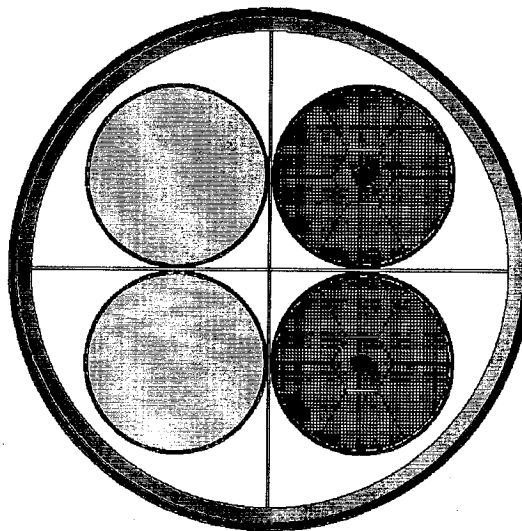
The interiors of the MCOs are flooded with water and water density is varied. The radius and the pitch of the spheres, as well as the total mass of fuel elements in the scrap basket are varied. These cases are described in Attachment II, spreadsheet "scrapsMIV-vertical.xls." This configuration is shown in Figure 8. These results are shown in Tables 17 throughout 23.



a. MCO in an as-Loaded Position



b. MCO with its Contents Settled due to Gravity



c. View of the whole Waste Package

Figure 8. Scrap Basket Loaded with Fuel Represented as Spheres

These configurations are investigated in both as-loaded position and in a position where the contents of the MCO settled due to gravity (Sections 6.1.1.2 and 6.1.1.4, and Figure 8a and Figure 8b, respectively). The five scrap-basket compartments can be either be filled with the same amount of fuel or each compartment can be filled with different masses of fuel (see Table 25).

Once the most reactive configuration for the scrap basket is identified, configurations where a loading with all scrap baskets or a partial loading of the intact baskets has occurred are analyzed (Sections 6.1.1.5 and 6.1.1.6, respectively). The partial loading will result in a missing fuel element in the intact basket or just a missing outer element (see Attachment II, spreadsheet "scrapsMIV-vertical.xls," sheet "K for 980").

5.4.2 Mark IA

The configurations analyzed to determine k_{eff} for the intact mode of a 2-MCO / 2-DHLW waste package containing Mark IA fuel elements are similar to the ones described in Section 5.4.1. However, the basket maximal loadings and design, the fuel enrichment are changed (see Attachment II, spreadsheet "scrapsMk1A.xls"). Figure 9 shows a representation of a MCO loaded with 48 intact fuel elements. Configurations with spent fuel are also investigated (see Table 32 and Attachment II, spreadsheet "degradedMK1A.xls," sheet "burnup credit") to demonstrate lower k_{eff} values. A case with only 85% of the high-level waste canisters filled with Savannah River Site glass is studied (see Table 32) to demonstrate that considering the high-level waste canister 100% filled or 85% filled has no effect on the criticality of the waste package. A case is analyzed to demonstrate that the fuel support cylinders and the fuel support plate (Figure 10 and Attachment I, p. 3) have no effect on the criticality of the intact configuration (see Table 32). When the scrap is represented as bare fuel spheres, the fuel enrichment is 1.25% unless otherwise specified.

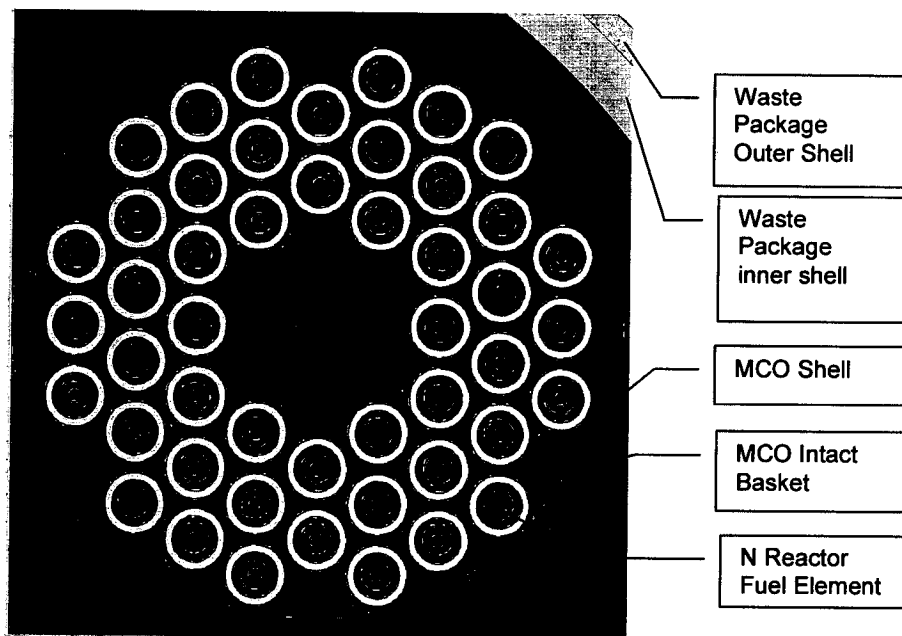


Figure 9. Cross Section of a MCO Loaded with 48 Intact Mark IA Fuel Elements

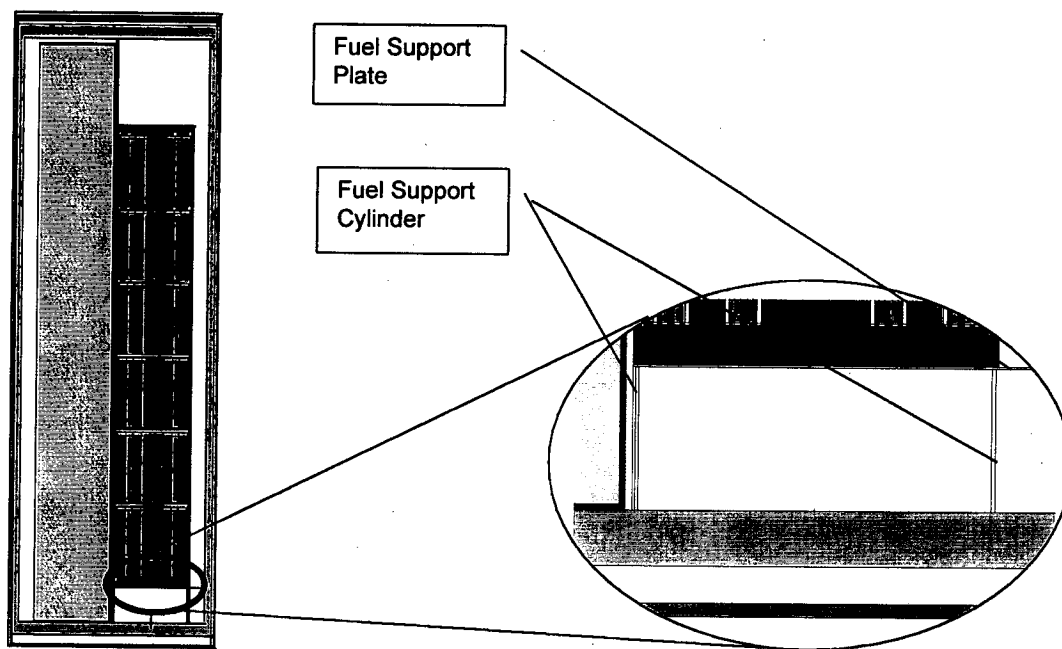


Figure 10. Cases with the Fuel Support Tube In

Since the scrap baskets for Mark IA are more reactive (due to a higher U-235 enrichment of the fuel) than the one containing Mark IV scrap, a configuration with two scrap baskets next to each other at the top of the MCOs is also considered (see Table 47), as well as configurations with the MCOs loaded with six scrap baskets (see Section 6.1.2.5 and Attachment II, spreadsheet "scrapsMkIA.xls").

5.4.3 Mark IV and Mark IA Fuel Elements in the Same Waste Package

In this section, the k_{eff} of a waste package containing one MCO loaded with Mark IA fuel and one MCO loaded with Mark IV fuel is calculated. Each MCO is in the most reactive configuration identified in the above sections. The results are presented in Section 6.1.3.

5.5 DEGRADED MODE

The criticality calculations conducted for the degraded cases are discussed in the following sections. Several configurations are considered. Detailed descriptions of these configurations are given on pages 27 through 37 of CRWMS M&O (1999b). In Section 5.5.1, configurations are analyzed resulting from the degradation scenarios in which the waste form (N Reactor fuel) degrades before the other internal components of the MCOs (CRWMS M&O 1999b, pp. 27-29). In Section 5.5.2, configurations resulting from degradation scenarios in which the waste form degrades after the other internal components of the MCOs are discussed (CRWMS M&O 1999b, pp. 30-31). In Section 5.5.3, configurations resulting from the degradation of the high-level waste glass are investigated (see Attachment II, spreadsheet "pre-post-clay.xls," sheet "post breach"). k_{eff} of the configurations where all the internal components of the waste package degraded are discussed in Section 5.5.4 (see Attachment II, spreadsheet "pre-post-clay.xls"). In configurations resulting from a flow through the waste package, it has been shown (CRWMS M&O 2000c) that the fissile material will likely be flushed out of the waste package. This eliminates the risk of internal criticality. In the calculation described below, the fuel type is Mark IA with two scrap baskets (top and bottom) and four intact baskets unless otherwise specified because, as shown in Section 6.1, the waste package loaded with MCOs containing Mark IA fuel (1.25% enriched) is the most reactive (DOE 2000, p.71).

The MCNP input and output files developed for this section are presented in Attachment II. The spreadsheets used to prepare the MCNP input files are given in Attachment II, file "degradedMkIA.xls," "pre-post-clay.xls," "Tuff Composition.xls," and "hX.xls."

In these calculations, the terms "fraction of water" or "percent of water" refer to a volume fraction or to a percentage of volume, respectively. The MCOs are always considered to be flooded and the waste package is dry because, as shown in Table 32, it is the most reactive configuration.

For the degraded mode analysis, several configurations are presented with the fuel represented as small spheres with a diameter not larger than 0.8637 cm, which is equal to the thickness of the inner fuel elements. Given the high degradation rate of the U-metal, which is higher than any other materials in the MCO (see Table 4 of CRWMS M&O 2000c), if the uranium spheres were placed into the MCO, they would react very quickly. It would never be possible to have fuel

spheres distributed throughout the MCO. Cases where the fuel is represented as spheres are run to provide bounding results. If the critical limit of $k_{\text{eff}}=0.93$ is exceeded, more credible fuel configurations are used.

5.5.1 Waste Form Degrades Before the Internal Components of the MCOs

In this section, cases where the waste form degrades before any other internal components of the waste package are investigated. This corresponds to scenario IP-1A from YMP (1998) and from CRWMS M&O 1999b, p. 27. The fuel in the scrap basket is represented as spheres of uranium 1.25 % U-235 enriched unless otherwise specified.

The first scenario analyzed is a configuration where the intact fuel elements are settled at the bottom of the MCOs as shown in Figure 11. The spacer grid has degraded, allowing the fuel elements to move in the MCOs (Table 58). The fuel elements are surrounded by water and the basket components are neglected.

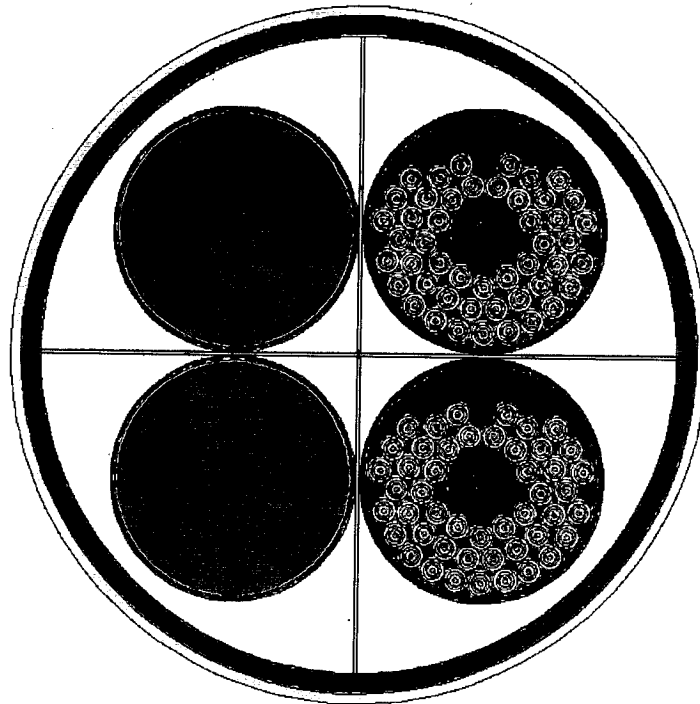
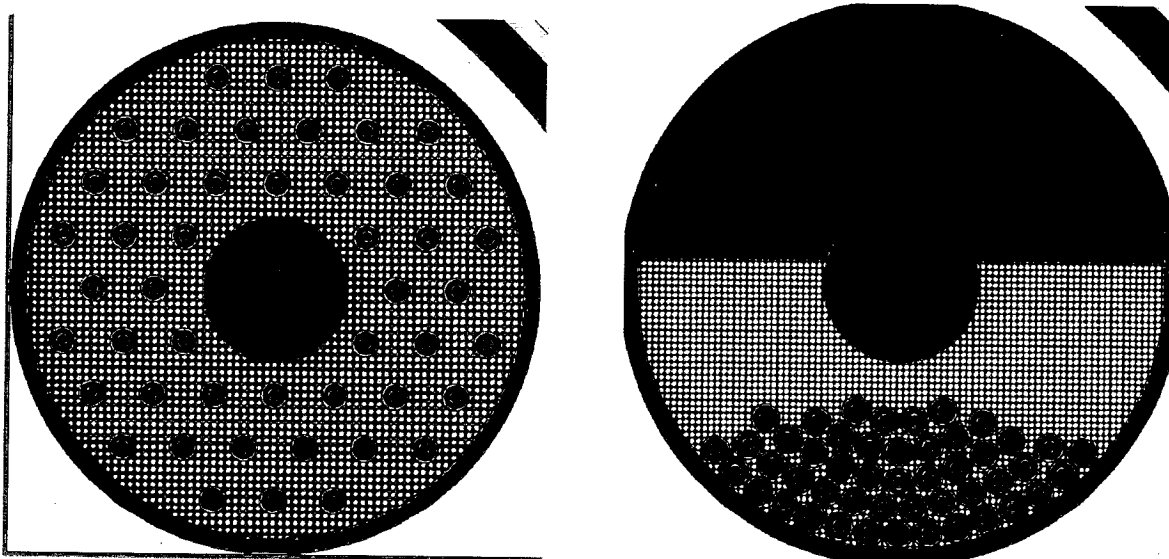


Figure 11. Intact Fuel Elements at the Bottom of the MCO

In the next set of cases, the outer fuel elements have degraded and form spheres that surround the intact inner fuel elements. The radii and pitch (distance between spheres) of the spheres are varied to find the optimum values. The intact fuel elements are either in place (see Figure 12a, Table 59, Section 6.2.1.1, and Attachment II, spreadsheet "degradedMk1A.xls," sheet "48-horizontal") or they form a lump at the bottom of the MCOs (see Figure 12b, Table 60, Section 6.2.1.1, and Attachment II, spreadsheet "degradedMk1A.xls," sheet "48-horizontal-lump").



a. Inner Fuel Elements in Place surrounded by Outer Fuel Spheres

b. Inner Fuel Elements at the Bottom of the MCO surrounded by Outer Fuel Spheres

Figure 12. Fuel Elements Partially Degraded in an Intact MCO Basket

In the following configurations, the outer fuel elements are fully degraded while the inner elements are still intact. The degraded outer fuel elements form a sludge that surrounds the inner fuel elements. The volume percent (vol. %) of water in the uranium sludge varies from 0 to 75. The copper plates in the scrap basket are neglected. This configuration is shown in Figure 13 (see Table 61, Section 6.2.1.1 and Attachment II, spreadsheet "degradedMk1A.xls," sheet "48-hori-lump all outer degraded"). The scrap basket is filled with either uranium spheres or cylinders (as explained in Section 5.4).

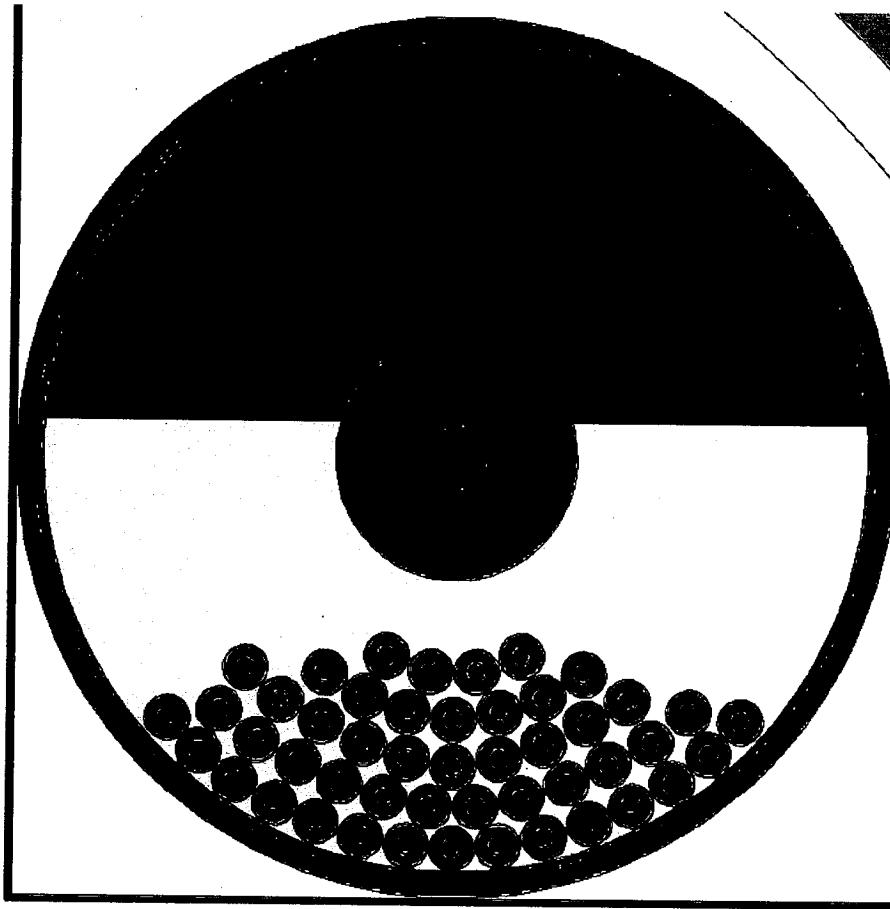


Figure 13. Outer Fuel Elements Degraded (inner elements intact) in an Intact MCO Basket

Another configuration is investigated where the fuel elements (inner and outer) are partially degraded. In this configuration, the MCOs are loaded with six identical baskets. These baskets are filled with spheres of uranium 1.25 % U-235 enriched (see Section 6.1.2.5).

Finally, cases where the fuel elements are fully degraded are investigated. The fuel pins are replaced by sludge made of uranium 1.25 % U-235 enriched. The amount of water mixed with the degraded fuel varies from 0 to 81 vol. %. The scrap basket is also filled with sludge. The copper plates are neglected. This configuration is shown in Figure 14 and results are shown in Table 63 Section 6.2.1.1, and in Attachment II, spreadsheet "degradedMk1A.xls," sheet "48-horizontal-allsludge").

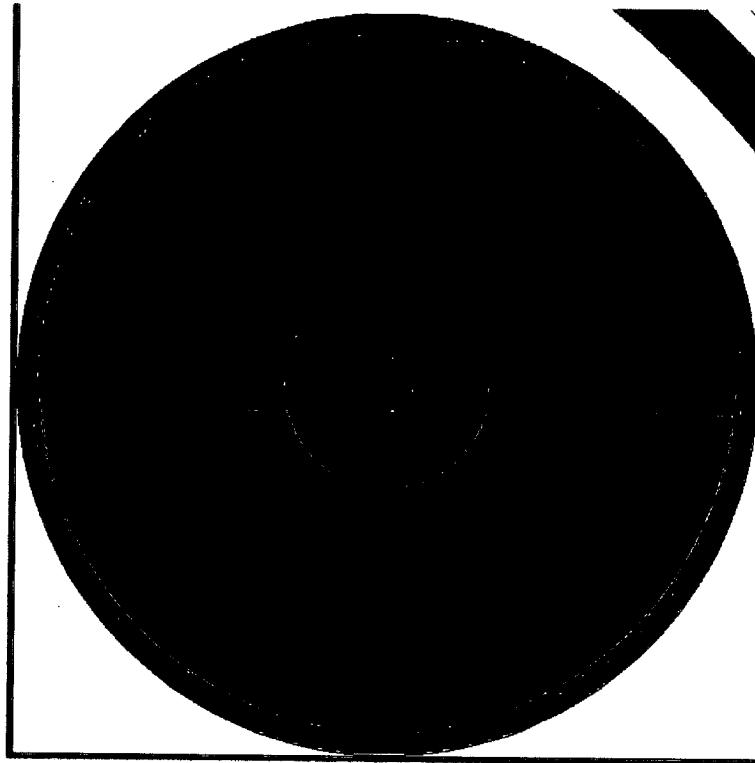


Figure 14. Fully Degraded Fuel Elements in an Intact MCO

5.5.2 Waste Form Degrades After the Internal Components of the MCOs

In this section, configurations where the MCO's internals (bottom plate, center post, and basket) degrades and form goethite (FeOOH) (Assumption 3.1) are investigated. In these configurations, the inner fuel elements are intact and the outer fuel elements are partially degraded (represented as spheres). The atomic composition of the products resulting from the degradation of the basket is given in Attachment II, spreadsheet "degradedMk1A.xls," sheet "degraded basket".

5.5.2.1 MCO Center Posts Degrade

A configuration where the center posts have snapped and fallen to the bottom of the MCOs is investigated (Figure 15). In this configuration, at first the center posts of the scrap baskets do not change as they are protected by the copper plates but then they also fall to the bottom of the MCOs. In these cases, the scrap is either closely packed or spread over the entire volume of the scrap baskets (see Table 64, Section 6.2.1.2.1).

In these configurations, the center posts slowly degrade, increasing in volume as the stainless steel is oxidized and replaced by goethite (see Attachment II, spreadsheet "degradedMk1A.xls," sheet "center post degrades"). In this configuration, the intact baskets are not degraded (Figure 16). The fuel is partially degraded (inners intact, outers degraded) (see Table 65, Section 6.2.1.2.2).

5.5.2.2 MCOs' Internals Degrade

In this section, the center posts and the basket-plates are fully degraded. As a result, goethite accumulates at the bottom of the MCOs. The amount of water in the goethite varies (see Section 6.2.1.2.3). The fuel is always surrounded by degradation products; never by water only. When the basket degradation product has 62 vol. % of water in it, this mixture is distributed over the entire free volume in the MCO.

At first, the fuel elements in the intact baskets are not degraded (Figure 17). The scrap baskets are filled with either spheres of fuel or outer fuel elements. The height of the goethite/water mixture varies as the vol. % of water varies from 50 to 62 vol. % in the goethite (see Section 6.2.1.2.3.1).

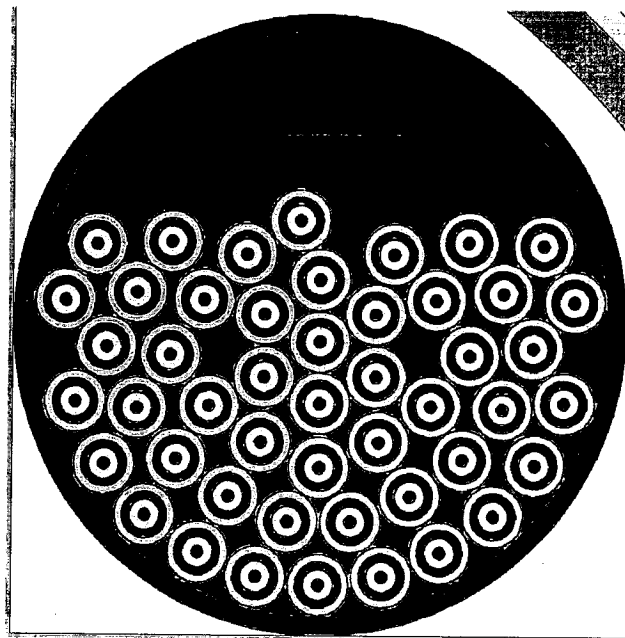


Figure 17. Internals of the MCO Degraded, Fuel Intact

Configurations where the outer fuel elements degrade (but inner elements are intact) are then analyzed. The degraded outer fuel elements are represented as spheres of fuel, 1.25 % enriched, and the pitch of these spheres is varied. The scrap basket is then filled with spheres of fuel. The pitch of these spheres is also varied. The amount of water mixed in the goethite varies from 0 to 68 % (see Section 6.2.1.2.3.2). Figure 18 gives a representation of this configuration.

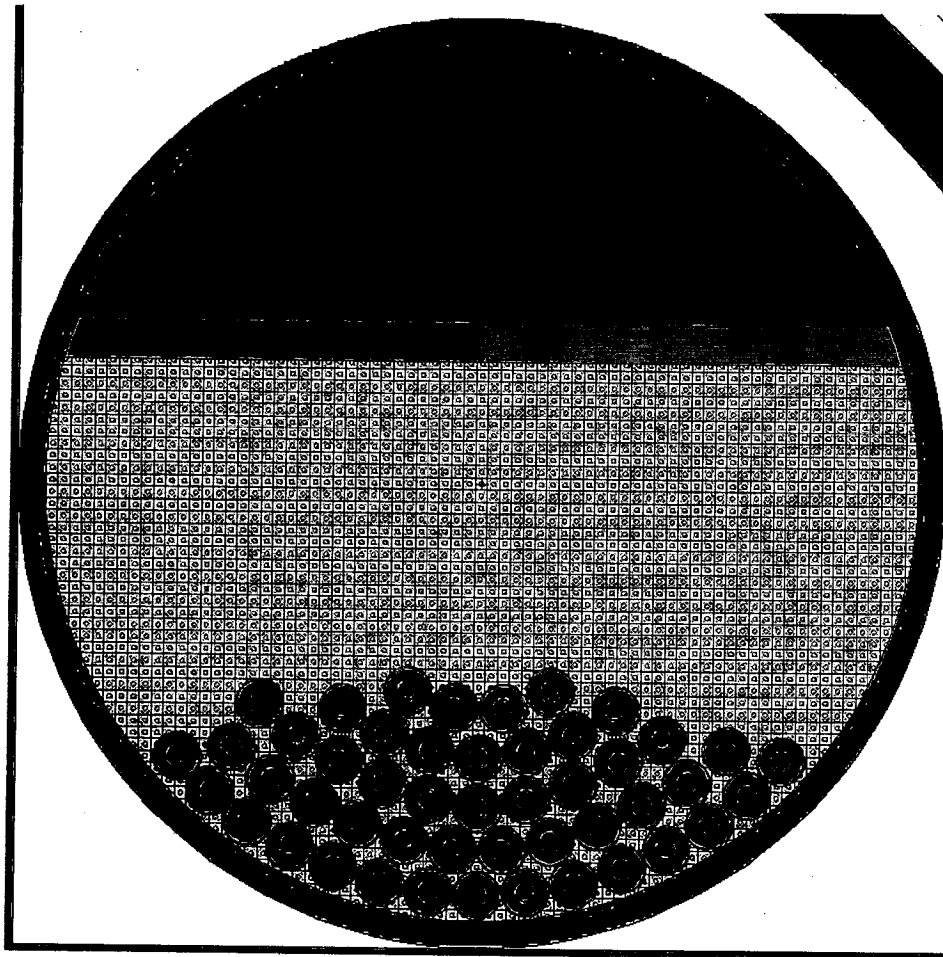


Figure 18. Degraded MCO Basket Filled with Partially Degraded Fuel

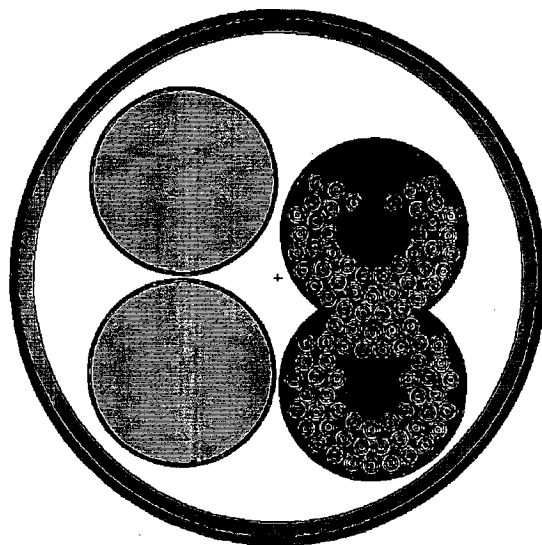
In the next configuration, the outer fuel elements are fully degraded. The goethite is mixed with water and the degradation product of the outer fuel elements (see Section 6.2.1.2.3.3).

Finally, both the MCOs' baskets and the fuel elements (inner and outer) are degraded (see Section 6.2.1.2.3.4). The degradation products are mixed with water (up to 47 vol. %).

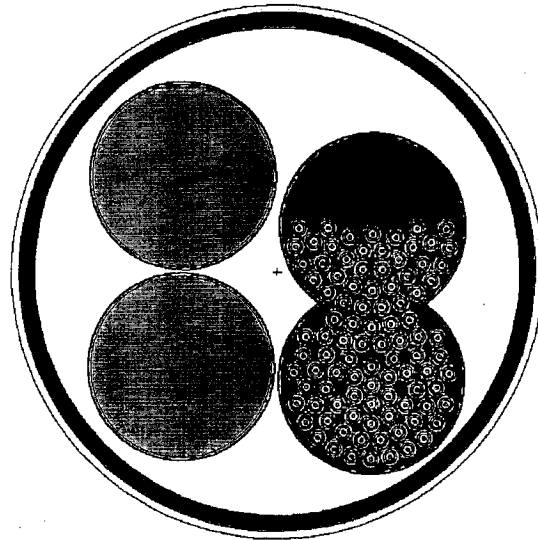
5.5.2.3 MCOs Combined

This section investigates several configurations where the MCOs' baskets are fully degraded and the MCO's shells begin to degrade. For configurations represented by Figure 19a, the center post is kept intact. The degradation products are neglected in these configurations. In the next set of variations, the center post also degrades. The products resulting from these degradations are added to the water in the MCOs. The vol. % of water in the degradation product varies. The MCOs are loaded with intact baskets. These configurations are shown in Figure 19b. Cases where the outer fuel elements are fully degraded are also investigated (Figure 19c). Other cases investigate the total degradation of the fuel elements in the two fused MCOs (Figure 19d). In all

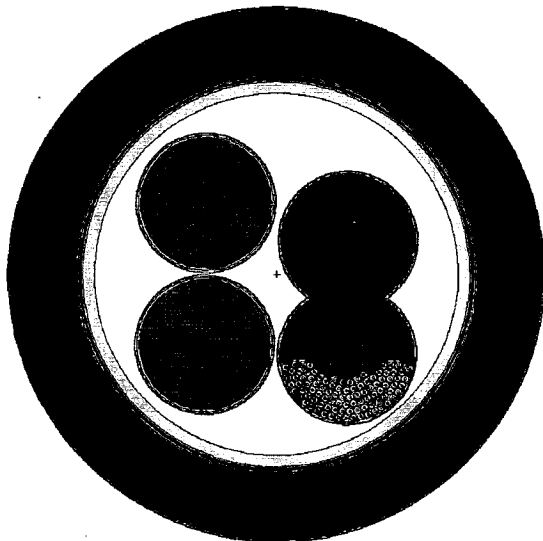
the cases, the baskets are degraded since the MCO shell has partially degraded. These cases are presented in Section 6.2.1.3 and in Attachment II, spreadsheet "degradedMk1A.xls," sheet "mco fused together." Detailed descriptions of each of the cases examined along with the results are given in Table 70.



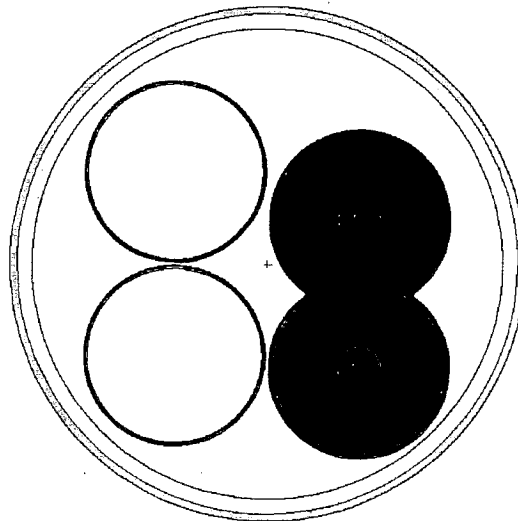
a. Intact Basket



b. Partially Degraded Fuel Elements



c. Partially Degraded Fuel Elements
(tuff reflected case)



d. Fully Degraded Fuel Elements

Figure 19. MCOs Fused

5.5.3 Internal Components of the Waste Package Degraded (outside MCOs)

This section describes configurations resulting from the scenario IP-3 (YMP 1998, p. 3-3). The internal components of the waste package outside the MCOs are completely degraded. The composition of the slurry resulting from this degradation is given in CRWMS M&O 2000c and is referenced as the pre-breach clay (Table 11). The amount of water mixed in this clay varies. There is U-238 present in the slurry from the degraded glass, but it is neglected in these calculations. Different configurations of the MCOs are studied. The composition of the clay with various amounts of water in it is determined in Attachment II, spreadsheet "pre-post-clay.xls," sheet "pre-breach"). The MCOs' configurations studied are the most reactive, identified in the previous sections (5.5.1 and 5.5.2). Figure 20 shows a representation of the waste package in one of these configurations (see Section 6.2.2).

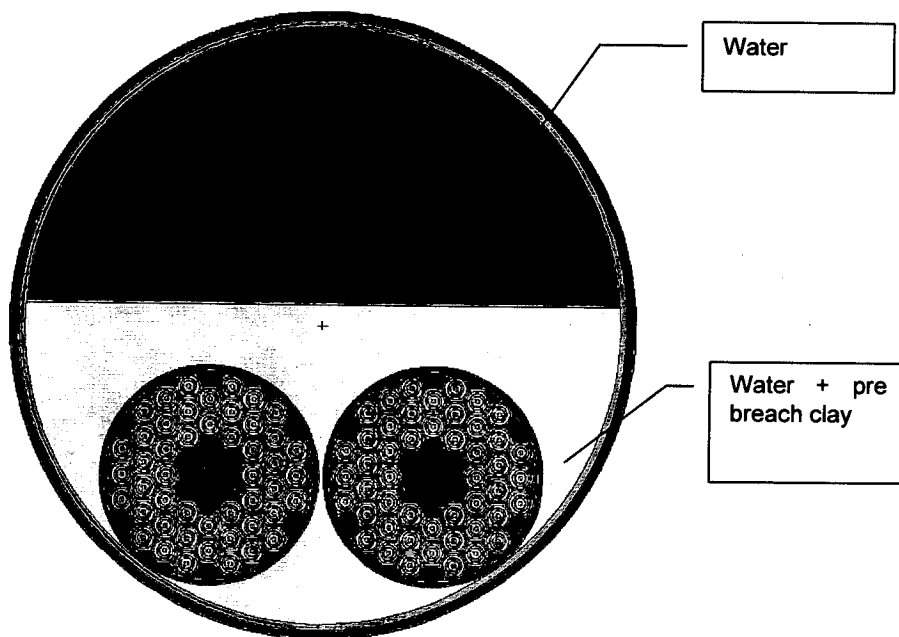


Figure 20. Internal Components of the Waste Package Degraded (outside the MCO)

A case where one MCO shell degrades and the other MCO shell stays intact is investigated. The fuel elements from the degraded MCO surround the intact MCO. The clay composition is as given in Table 11 (i.e., dry), thus the degraded MCO shell is neglected. This is conservative since the MCO shell is made of stainless steel, which is a neutron absorber. MCOs are loaded with intact baskets only. If the degraded MCO were loaded with scrap fuel, the fuel will degrade very fast due its the high corrosion rate compare to the MCO shell. Dry tuff is used as a reflector (see Table 10). The waste package is flooded with water in this configuration. Figure 21 gives a

representation of the waste package in this configuration. k_{eff} for this case (file name "partial") is given in Section 6.2.2.

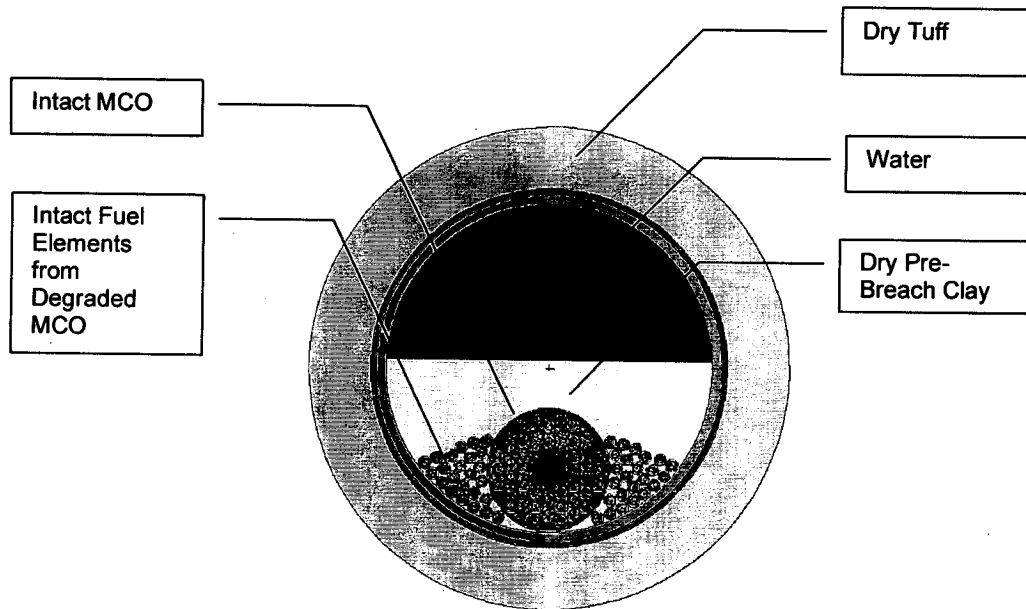


Figure 21. MCOs Partially Degraded

5.5.4 All Components Degrade at the Same Time

These configurations represent the final stage of degradation of the two previous scenarios (where the waste form degrades before/after the internal components of the waste package). CRWMS M&O 2000c gives the composition of the clay resulting from the degradation of the internal components of the waste package. The composition of the clay with various amounts of water in it is determined in Attachment II, spreadsheet "pre-post-clay.xls", sheet "post breach". This clay is referred as post-breach clay and its composition is given in Table 12. Table 13 also gives a post-breach clay composition for an alternative EQ3/6 case as shown in CRWMS M&O (2000c). In this case, the fuel and the other components of the waste package degrade simultaneously as opposed to the case (whose results are presented in Table 12) where the inner components of the waste package other than the MCOs degrade first. To be conservative, all the U in the clay is taken to be 1.25 wt. % U-235 enriched and none of the MCOs' degradation products are represented in the calculations described in this section. The amount of water in the clay is varied to determine the optimum. Figure 22 gives a representation of the waste package in this configuration (see Section 6.2.3).

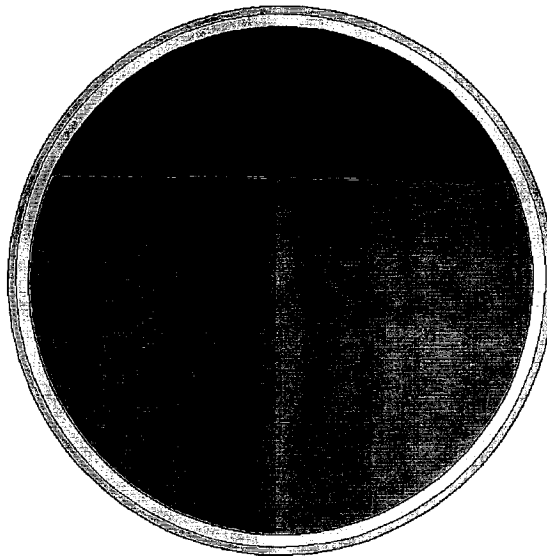


Figure 22. All the Components Degraded at the Same Time

A stage between the “all components degraded at the same time” stage and the “waste form degraded after the other internal component” stage is also analyzed. In this case, the fuel elements are intact, sitting at the bottom of the waste package, surrounded by clay (see Attachment II, spreadsheet “pre-post-clay.xls,” sheet “prepost (all deg, fuel intact”). The clay composition is identical to the one given in CRWMS M&O (2000c). However, the U content is removed since the fuel elements are intact at the bottom of the waste package (Figure 23). Another set of cases uses the clay composition given in Table 24 from CRWMS M&O (2000c) (see Table 13 and Attachment II, spreadsheet “pre-post-clay.xls,” sheet “case8”). For both clay compositions, the spacing between fuel elements is varied as well as the amount of water in the clay. Finally, a set of cases where the fuel elements are represented as spheres is analyzed [see Attachment II, spreadsheet “pre-post-clay.xls,” sheet “prepost (all deg, fuel sphere)”. The size and pitch of the sphere are varied. In these cases, the clay is mixed with water and homogenized over the entire volume of the waste package. Section 6.2.3 gives the results.

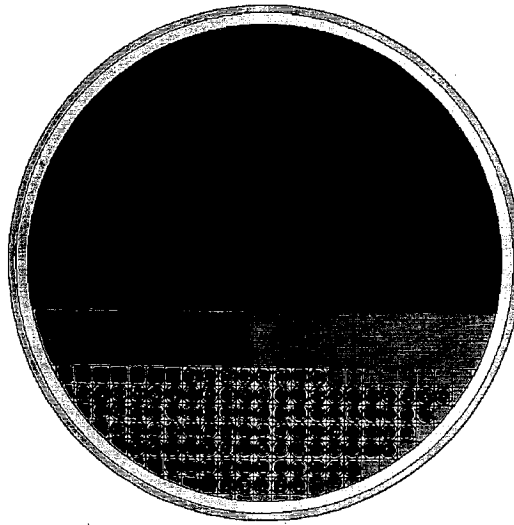


Figure 23. Everything Degraded but the Fuel Elements

6. RESULTS

This calculation documents various intact and degraded mode configurations of the N Reactor fuel codisposal waste package. Sections 6.1 and 6.2 present the k_{eff} for the intact and the degraded configurations, respectively. The k_{eff} results represent the average collision, absorption, and track length estimator from the MCNP calculations. The standard deviation (σ) represents the standard deviation of k_{eff} about the average combined collision, absorption, and track length estimate due to Monte Carlo calculation statistics. The average energy of a neutron causing fission (AENCF) is the energy per source particle lost to fission divided by the weight per source neutron lost to fission from the "problem summary section" of the MCNP output. The MCNP input and output files developed for this calculation are included in ASCII format in Attachment II. The H/X ratio is the ratio of mole of hydrogen to mole of fissile materials (U-235).

This document may be affected by technical product input information that requires confirmation. Any changes to the document that may occur as a result of completing the confirmation activities will be reflected in subsequent revisions. The status of the technical product information quality may be confirmed by review of the DIRS database.

For all the cases, no credit is taken for the fuel burnup, i.e., fuel is assumed to be fresh (non-irradiated) unless otherwise specified.

6.1 INTACT MODE

This section gives the results of the calculations described in Section 5.4. Sections 6.1.1 and 6.1.2 present the results for the intact mode calculations performed with Mark IV fuel elements and Mark IA fuel elements, respectively.

6.1.1 Mark IV

Tables 13 through 30 present the results of the calculations described in Section 5.4.1. Section 6.1.1.1 presents results for MCOs loaded with five intact baskets and Sections 6.1.1.2 through 6.1.1.4 present the results for MCOs filled with three intact baskets and two scrap baskets located at the top on bottom of the MCOs unless otherwise specified.

6.1.1.1 MCOs Loaded with Intact Baskets

Table 14 gives the k_{eff} of 2-MCO / 2-DHLW waste package containing intact Mark IV fuel elements (see Section 5.4.1). The position of the MCOs in the waste package varies. The waste package and the MCOs are either flooded or dry. The density of the water flooding the MCOs varies also. This section identifies the most reactive configuration with regards to the position of the MCOs and the amount of water in the waste package.

Table 14. MCO with Five Baskets of Intact Mark IV Fuel

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	MCO Position	Comment	Water Density (g/cm ³)
4zv0111	0.8196	0.0006	0.8207	0.5237	Quadrants I & III	MCO and waste package flooded	1.00
4zv0211	0.8236	0.0006	0.8248	0.5212	Quadrants I & IV	MCO and waste package flooded	1.00
4zv0221	0.8473	0.0006	0.8484	0.5058	Quadrants I & IV	MCO flooded and waste package dry	1.00
4zv0224	0.8274	0.0006	0.8285	0.5321	Quadrants I & IV	MCO flooded and waste package dry	0.90
4zv0223	0.7912	0.0006	0.7924	0.5860	Quadrants I & IV	MCO flooded and waste package dry	0.75
4zv0222	0.7037	0.0006	0.7048	0.7277	Quadrants I & IV	MCO flooded and waste package dry	0.50
4zv0231	0.3396	0.0003	0.3403	2.1592	Quadrants I & IV	MCO and waste package dry	0.00
4zv0241	0.3857	0.0004	0.3866	1.7288	Quadrants I & IV	MCO dry and waste package flooded	1.00

NOTE: When water is present in the MCO, H/X ratio=152.5 if the density of water is 1 g/cm³. H/X ratio is 0 if the MCO is dry. H/X ratio = 137.2 if the density of the water is 0.9 g/cm³, 114.4 if the density of the water is 0.75 g/cm³ 76.2 if the density of the water is 0.5 g/cm³ (see Attachment II, spreadsheet "hX.xls," sheet 1).

k_{eff} is higher if the waste package is dry and if the MCOs are flooded and located in quadrants I and IV. Unless otherwise specified, in the following cases, the MCOs are flooded and located in quadrants I and IV, although this configuration violates acceptable loading strategies.

6.1.1.2 Optimum Scrap Basket in an as-Loaded Waste Package

In this section, the waste package is in the as-loaded position. It is shown that this configuration has a higher k_{eff} than the configurations where the contents of the MCOs are settled due to gravity (see Section 6.1.1.4). The scrap basket is either filled with partially intact fuel elements (inner and/or outer fuel elements intact) or with scrap fuel (spheres of fuel). The purpose of this section is to identify the most reactive configuration for the scrap basket. In the following tables, the H/X ratio is calculated in the scrap basket only (the H/X ratio in the intact basket is 152.5).

6.1.1.2.1 Partially Intact Elements in Scrap Basket

Table 15 and Table 16 list the k_{eff} of the waste package with MCOs loaded with partially intact fuel elements in the scrap baskets. The partially intact fuel elements are either intact inner fuel elements (Table 15) or intact outer fuel elements (Table 16). The pitch of the intact fuel elements loaded in the scrap basket is varied (see Section 5.4.1). The scrap baskets are located at the top and bottom of the MCOs (DOE 2000, p. 26).

Table 15. Intact Mark IV Inner Fuel Elements in Scrap Basket

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Pitch (cm)
5ev1	0.8417	0.0006	0.8429	0.5098	70.9	3.2512
5ev2	0.8406	0.0006	0.8417	0.5064	163.9	3.885
5ev3b	0.8431	0.0006	0.8442	0.4635	270.8	4.505
5ev4	0.8452	0.0006	0.8463	0.4707	393.5	5.125
5ev5	0.8421	0.0006	0.8433	0.4922	532.1	5.745
5ev6	0.8420	0.0006	0.8432	0.4962	686.4	6.365
5ev7	0.8426	0.0006	0.8438	0.5027	856.6	6.985
5ev8	0.8422	0.0006	0.8434	0.5014	1042.5	7.605
5ev9	0.8414	0.0006	0.8425	0.5050	1244.3	8.225
5ev10	0.8412	0.0005	0.8422	0.5049	1461.8	8.845

NOTE: See Attachment II, spreadsheet "scrapsMIV-vertical.xls," sheet "degraded."

Table 16. Intact Mark IV Outer Fuel Elements in Scrap Basket

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Pitch (cm)
5ev11	0.8414	0.0006	0.8427	0.5013	365.3	6.147
5ev12	0.8417	0.0006	0.8429	0.4970	381.9	6.285
5ev13	0.8428	0.0006	0.8439	0.4965	399.1	6.425
5ev15	0.8442	0.0006	0.8454	0.4866	434.6	6.705
5ev17	0.8448	0.0006	0.8459	0.4758	471.7	6.985
5ev19	0.8445	0.0006	0.8457	0.4650	510.3	7.265

NOTE: See Attachment II, spreadsheet "scrapsMIV-vertical.xls," sheet "degraded."

Loading the MCOs with two baskets with partially intact fuel elements and three baskets with intact fuel elements ($k_{eff} + 2\sigma = 0.8463$, case "5ev4") or with five intact baskets ($k_{eff} + 2\sigma = 0.8484$, case 4zv0221) has very little effect on the k_{eff} of the waste package.

6.1.1.2.2 Scrap Fuel in Scrap Basket

Tables 16 through 24 give the k_{eff} of a waste package containing MCOs loaded with three intact baskets and two scrap baskets (see Section 5.4.1). The scrap baskets are loaded with different masses of fuel. The fuel is represented as spheres and the radii and the pitch of these spheres are varied to find the most reactive configuration.

Table 25 lists the results for a waste package where the scrap level in the scrap basket is unequal. The Mark IV scrap baskets are limited to a maximum loading of 980 kg (DOE 2000, p. 26). The particle's diameter can not be larger than the thickness of the inner fuel elements (0.8885 cm). The MCOs are flooded and the waste package is dry.

Table 17. Three Mark IV Intact Fuel Baskets and Two Mark IV Scrap Baskets of 980 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Particles Radius (cm)	Pitch (cm)
4ev71a1	0.8589	0.0006	0.8601	0.3882	355.1	0.44425	1.0800
4ev71b1	0.8478	0.0005	0.8488	0.4487	288.5	0.44425	1.0300
4ev71c1	0.8434	0.0006	0.8446	0.4903	228.2	0.44425	0.9800
4ev71d1	0.8413	0.0006	0.8424	0.5038	173.7	0.44425	0.9300
4ev71e1	0.8423	0.0006	0.8435	0.5103	133.3	0.44425	0.8885
4ev72a1	0.8580	0.0006	0.8592	0.3899	355.1	0.42425	1.0300
4ev72b1	0.8469	0.0006	0.8480	0.4455	290.9	0.42425	0.9840
4ev72c1	0.8436	0.0006	0.8448	0.4867	232.4	0.42425	0.9380
4ev72d1	0.8429	0.0006	0.8441	0.5014	179.4	0.42425	0.8920
4ev72e1	0.8430	0.0006	0.8442	0.5077	133.3	0.42425	0.8485
4ev73a1	0.8558	0.0005	0.8567	0.3965	355.1	0.40425	0.9820
4ev73b1	0.8455	0.0006	0.8467	0.4461	292.0	0.40425	0.9400
4ev73c1	0.8426	0.0006	0.8438	0.4916	234.5	0.40425	0.8960
4ev73d1	0.8418	0.0006	0.8430	0.5034	182.3	0.40425	0.8540
4ev73e1	0.8408	0.0007	0.8421	0.5081	133.3	0.40425	0.8085
4ev74a1	0.8554	0.0006	0.8565	0.4015	355.1	0.38425	0.9340
4ev74b1	0.8464	0.0006	0.8477	0.4554	288.9	0.38425	0.8900
4ev74c1	0.8434	0.0006	0.8445	0.4914	228.9	0.38425	0.8480
4ev74d1	0.8423	0.0006	0.8435	0.5055	174.6	0.38425	0.8040
4ev74e1	0.8424	0.0006	0.8435	0.5074	133.3	0.38425	0.7685
4ev75a1	0.8551	0.0006	0.8562	0.4034	355.1	0.36425	0.8860
4ev75b1	0.8461	0.0006	0.8472	0.4593	290.1	0.36425	0.8460
4ev75c1	0.8437	0.0006	0.8449	0.4924	231.0	0.36425	0.8060
4ev75d1	0.8423	0.0006	0.8435	0.5033	177.5	0.36425	0.7660
4ev75e1	0.8422	0.0006	0.8435	0.5077	133.3	0.36425	0.7285
4ev76a1	0.8533	0.0006	0.8545	0.4061	355.1	0.34425	0.8360
4ev76b1	0.8454	0.0006	0.8466	0.4595	291.4	0.34425	0.8000
4ev76c1	0.8442	0.0006	0.8453	0.4933	233.4	0.34425	0.7620
4ev76d1	0.8423	0.0006	0.8435	0.5022	180.7	0.34425	0.7260
4ev76e1	0.8418	0.0006	0.8429	0.5078	133.3	0.34425	0.6885
4ev77a1	0.8526	0.0006	0.8538	0.4013	355.1	0.32425	0.7880
4ev77b1	0.8456	0.0006	0.8468	0.4659	291.2	0.32425	0.7520
4ev77c1	0.8442	0.0006	0.8453	0.4953	232.9	0.32425	0.7180
4ev77d1	0.8423	0.0006	0.8435	0.5037	180.1	0.32425	0.6820
4ev77e1	0.8423	0.0006	0.8435	0.5088	133.3	0.32425	0.6485
4ev78a1	0.8516	0.0006	0.8528	0.4198	355.1	0.30425	0.7400
4ev78b1	0.8448	0.0006	0.8459	0.4696	290.9	0.30425	0.7060
4ev78c1	0.8421	0.0005	0.8432	0.4913	232.4	0.30425	0.6740
4ev78d1	0.8426	0.0006	0.8438	0.5044	179.4	0.30425	0.6400
4ev78e1	0.8425	0.0006	0.8437	0.5076	133.3	0.30425	0.6085
4ev79a1	0.8510	0.0006	0.8522	0.4204	355.1	0.28425	0.6900
4ev79b1	0.8428	0.0006	0.8440	0.4679	290.5	0.28425	0.6600
4ev79c1	0.8438	0.0006	0.8449	0.4971	231.8	0.28425	0.6280
4ev79d1	0.8419	0.0006	0.8430	0.5060	178.5	0.28425	0.5980
4ev79e1	0.8420	0.0006	0.8432	0.5076	133.3	0.28425	0.5685
4ev70a1	0.8501	0.0006	0.8513	0.4283	355.1	0.26425	0.6420
4ev70b1	0.8449	0.0006	0.8461	0.4746	292.3	0.26425	0.6140
4ev70c1	0.8431	0.0006	0.8443	0.4931	235.0	0.26425	0.5860
4ev70d1	0.8421	0.0006	0.8433	0.5038	182.9	0.26425	0.5580
4ev70e1	0.8415	0.0005	0.8425	0.5096	133.3	0.26425	0.5285

NOTE: See Attachment II, spreadsheet "scrapsMIV-vertical.xls," sheet "980kg," and "k for 980."

Table 18. Three Mark IV Intact Fuel Baskets and Two Mark IV Scrap Baskets of 955 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Particles Radius (cm)	Pitch (cm)
4ev81a1	0.8585	0.0006	0.8596	0.3873	368.2	0.44425	1.0880
4ev81b1	0.8479	0.0006	0.8490	0.4512	294.1	0.44425	1.0340
4ev81c1	0.8435	0.0006	0.8447	0.4923	227.4	0.44425	0.9780
4ev81d1	0.8429	0.0006	0.8440	0.5045	167.9	0.44425	0.9240
4ev81e1	0.8423	0.0006	0.8435	0.5075	133.2	0.44425	0.8885
4ev82a1	0.8567	0.0006	0.8579	0.3926	368.2	0.42425	1.0400
4ev82b1	0.8463	0.0005	0.8474	0.4503	297.5	0.42425	0.9900
4ev82c1	0.8428	0.0006	0.8440	0.4921	233.5	0.42425	0.9400
4ev82d1	0.8437	0.0006	0.8450	0.5029	176.0	0.42425	0.8900
4ev82e1	0.8416	0.0006	0.8428	0.5092	133.2	0.42425	0.8485

NOTE: See Attachment II, spreadsheet "scrapsMIV-vertical.xls," sheet "955kg," and "k for 955."

Table 19. Three Mark IV Intact Fuel Baskets and Two Mark IV Scrap Baskets of 930 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Particles Radius (cm)	Pitch (cm)
4ev11a1	0.8565	0.0006	0.8577	0.3917	382.0	0.44425	1.0980
4ev11b1	0.8479	0.0006	0.8491	0.4312	313.1	0.44425	1.0480
4ev11c1	0.8431	0.0006	0.8442	0.4867	250.4	0.44425	0.9980
4ev11d1	0.8418	0.0006	0.8429	0.5009	193.7	0.44425	0.9480
4ev11e1	0.8414	0.0006	0.8426	0.5084	133.2	0.44425	0.8885
4ev12a1	0.8586	0.0006	0.8598	0.3791	382.0	0.42425	1.0480
4ev12a2 ^a	0.8400	0.0006	0.8412	0.4052	343.8	0.42425	1.0480
4ev12a3 ^b	0.8197	0.0005	0.8208	0.4373	305.6	0.42425	1.0480
4ev12b1	0.8469	0.0006	0.8480	0.4358	310.0	0.42425	0.9980
4ev12c1	0.8433	0.0006	0.8445	0.4883	244.8	0.42425	0.9480
4ev12d1	0.8425	0.0006	0.8438	0.5019	186.2	0.42425	0.8980
4ev12e1	0.8439	0.0006	0.8451	0.5077	133.2	0.42425	0.8485
4ev13a1	0.8557	0.0005	0.8568	0.3841	382.0	0.40425	1.0000
4ev13b1	0.8463	0.0005	0.8473	0.4484	306.6	0.40425	0.9500
4ev13c1	0.8433	0.0006	0.8444	0.4883	238.7	0.40425	0.9000
4ev13d1	0.8424	0.0006	0.8435	0.5019	178.0	0.40425	0.8500
4ev13e1	0.8407	0.0006	0.8419	0.5087	133.2	0.40425	0.8085
4ev14a1	0.8541	0.0005	0.8551	0.3982	382.0	0.38425	0.9500
4ev14b1	0.8465	0.0006	0.8476	0.4592	302.9	0.38425	0.9000
4ev14c1	0.8433	0.0006	0.8445	0.4905	232.1	0.38425	0.8500
4ev14d1	0.8425	0.0005	0.8436	0.5064	169.2	0.38425	0.8000
4ev14e1	0.8417	0.0006	0.8428	0.5089	133.2	0.38425	0.7685
4ev15a1	0.8544	0.0006	0.8555	0.4012	382.0	0.36425	0.9000
4ev15b1	0.8457	0.0006	0.8468	0.4612	298.8	0.36425	0.8500
4ev15c1	0.8433	0.0006	0.8445	0.4957	224.8	0.36425	0.8000
4ev15d1	0.8427	0.0006	0.8438	0.5087	159.5	0.36425	0.7500
4ev15e1	0.8431	0.0006	0.8443	0.5084	133.2	0.36425	0.7285
4ev16a1	0.8529	0.0006	0.8540	0.4064	382.0	0.34425	0.8520

Table 19. Three Mark IV Intact Fuel Baskets and Two Mark IV Scrap Baskets of 930 kg (Continued)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Particles Radius (cm)	Pitch (cm)
4ev16b1	0.8449	0.0006	0.8461	0.4541	311.0	0.34425	0.8120
4ev16c1	0.8419	0.0006	0.8431	0.4889	246.6	0.34425	0.7720
4ev16d1	0.8431	0.0006	0.8443	0.5033	188.5	0.34425	0.7320
4ev16e1	0.8417	0.0006	0.8429	0.5086	133.2	0.34425	0.6885
4ev17a1	0.8520	0.0006	0.8531	0.3966	382.0	0.32425	0.8020
4ev17b1	0.8454	0.0006	0.8466	0.4581	306.8	0.32425	0.7620
4ev17c1	0.8432	0.0006	0.8444	0.4917	239.1	0.32425	0.7220
4ev17d1	0.8408	0.0006	0.8420	0.5031	178.5	0.32425	0.6820
4ev17e1	0.8419	0.0006	0.8431	0.5080	133.2	0.32425	0.6485
4ev18a1	0.8517	0.0006	0.8528	0.4090	382.0	0.30425	0.7520
4ev18b1	0.8461	0.0006	0.8473	0.4625	311.6	0.30425	0.7180
4ev18c1	0.8432	0.0005	0.8443	0.4920	247.8	0.30425	0.6820
4ev18d1	0.8425	0.0006	0.8438	0.5017	190.2	0.30425	0.6480
4ev18e1	0.8421	0.0005	0.8432	0.5100	133.2	0.30425	0.6085
4ev19a1	0.8510	0.0006	0.8521	0.4161	382.0	0.28425	0.7020
4ev19b1	0.8438	0.0006	0.8450	0.4585	306.9	0.28425	0.6680
4ev19c1	0.8432	0.0006	0.8444	0.4929	239.3	0.28425	0.6320
4ev19d1	0.8431	0.0006	0.8442	0.5044	178.8	0.28425	0.598
4ev19e1	0.8422	0.0006	0.8434	0.5085	133.2	0.28425	0.5685
4ev10a1	0.8504	0.0006	0.8516	0.4211	382.0	0.26425	0.654
4ev10b1	0.8449	0.0006	0.8461	0.4640	312.5	0.26425	0.624
4ev10c1	0.8410	0.0006	0.8422	0.4899	249.4	0.26425	0.594
4ev10d1	0.8433	0.0006	0.8444	0.5029	192.3	0.26425	0.564
4ev10e1	0.8417	0.0006	0.8428	0.5085	133.2	0.26425	0.5285

NOTES: ^a Water density = 0.9 g/cm³.^b Water density = 0.8 g/cm³.

See Attachment II, spreadsheet "scrapsMIV-vertical.xls," sheet "930kg," and "k for 930."

Table 20. Three Mark IV Intact Fuel Baskets and Two Mark IV Scrap Baskets of 860 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Particles Radius (cm)	Pitch (cm)
4ev61a1	0.8553	0.0006	0.8564	0.3804	425.0	0.44425	1.128
4ev61b1	0.8484	0.0006	0.8496	0.4308	338.6	0.44425	1.068
4ev61c1	0.8436	0.0006	0.8448	0.4801	261.3	0.44425	1.008
4ev62a1	0.8543	0.0006	0.8555	0.3901	425.0	0.42425	1.076
4ev62b1	0.8478	0.0006	0.8489	0.4380	334.7	0.42425	1.016
4ev62c1	0.8432	0.0006	0.8444	0.4885	254.5	0.42425	0.956
4ev63a1	0.8537	0.0006	0.8548	0.3844	425.0	0.40425	1.026
4ev63b1	0.8482	0.0006	0.8493	0.4307	345.5	0.40425	0.976
4ev63c1	0.8447	0.0006	0.8459	0.4787	273.7	0.40425	0.926

NOTE: See Attachment II, spreadsheet "scrapsMIV-vertical.xls," sheet "860kg," and "k for 860."

Table 21. Three Mark IV Intact Fuel Baskets and Two Mark IV Scrap Baskets of 800 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Particles Radius (cm)	Pitch (cm)
4ev51a1	0.8530	0.0005	0.8540	0.3860	467.9	0.44425	1.154
4ev51b1	0.8476	0.0006	0.8488	0.4407	362.8	0.44425	1.084
4ev51c1	0.8439	0.0006	0.8450	0.4836	270.5	0.44425	1.014
4ev52a1	0.8509	0.0006	0.8522	0.4022	467.9	0.42425	1.102
4ev52b1	0.8474	0.0006	0.8486	0.4312	365.6	0.42425	1.038
4ev52c1	0.8436	0.0006	0.8448	0.4844	275.3	0.42425	0.972
4ev53a1	0.8527	0.0006	0.8538	0.3824	467.9	0.40425	1.05
4ev53b1	0.8468	0.0006	0.8479	0.4428	368.6	0.40425	0.99
4ev53c1	0.8438	0.0006	0.8449	0.4827	280.6	0.40425	0.93

NOTE: See Attachment II, spreadsheet "scrapsMIV-vertical.xls," sheet "800kg," and "k for 800."

Table 22. Three Mark IV Intact Fuel Baskets and Two Mark IV Scrap Baskets of 730 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Particles Radius (cm)	Pitch (cm)
4ev21a1	0.8492	0.0006	0.8504	0.3938	526.8	0.44425	1.19
4ev21b1	0.8459	0.0006	0.8470	0.4129	445.5	0.44425	1.14
4ev21c1	0.8459	0.0006	0.8471	0.4549	371.0	0.44425	1.09
4ev21d1	0.8446	0.0006	0.8459	0.4808	303.1	0.44425	1.04
4ev21e1	0.8423	0.0006	0.8434	0.5088	133.2	0.44425	0.8885
4ev22a1	0.8490	0.0006	0.8502	0.4101	526.8	0.42425	1.138
4ev22b1	0.8465	0.0006	0.8476	0.4414	402.2	0.42425	1.062
4ev22c1	0.8441	0.0006	0.8452	0.4849	294.0	0.42425	0.988
4ev22d1	0.8426	0.0006	0.8438	0.5033	201.0	0.42425	0.912
4ev22e1	0.8422	0.0006	0.8434	0.5095	133.2	0.42425	0.8485
4ev23a1	0.8472	0.0005	0.8483	0.4026	526.8	0.40425	1.084
4ev23b1	0.8450	0.0006	0.8462	0.4303	404.6	0.40425	1.014
4ev23c1	0.8440	0.0006	0.8452	0.4841	298.1	0.40425	0.944
4ev23d1	0.8427	0.0006	0.8440	0.5013	206.3	0.40425	0.874
4ev23e1	0.8417	0.0006	0.8429	0.5050	133.2	0.40425	0.8085
4ev24a1	0.8481	0.0005	0.8492	0.4051	526.8	0.38425	1.03
4ev24b1	0.8443	0.0005	0.8453	0.4445	398.7	0.38425	0.96
4ev24c1	0.8439	0.0006	0.8450	0.4863	287.9	0.38425	0.89
4ev24d1	0.8433	0.0006	0.8444	0.5016	193.2	0.38425	0.82
4ev24e1	0.8418	0.0006	0.8429	0.5077	133.2	0.38425	0.7685
4ev25a1	0.8464	0.0006	0.8475	0.4106	526.8	0.36425	0.976
4ev25b1	0.8455	0.0006	0.8466	0.4380	410.2	0.36425	0.916
4ev25c1	0.8438	0.0006	0.8450	0.4797	307.8	0.36425	0.856
4ev25d1	0.8417	0.0006	0.8428	0.4995	218.9	0.36425	0.796
4ev25e1	0.8427	0.0006	0.8439	0.5091	133.2	0.36425	0.7285
4ev26a1	0.8462	0.0005	0.8472	0.4059	526.8	0.34425	0.922
4ev26b1	0.8452	0.0006	0.8463	0.4545	403.8	0.34425	0.862
4ev26c1	0.8442	0.0006	0.8454	0.4856	296.8	0.34425	0.802
4ev26d1	0.8426	0.0006	0.8438	0.5025	204.7	0.34425	0.742

Table 22. Three Mark IV Intact Fuel Baskets and Two Mark IV Scrap Baskets of 730 kg (Continued)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Particles Radius (cm)	Pitch (cm)
4ev26e1	0.8418	0.0006	0.8430	0.5079	133.2	0.34425	0.6885
4ev27a1	0.8459	0.0006	0.8470	0.4135	526.8	0.32425	0.87
4ev27b1	0.8451	0.0006	0.8463	0.4475	417.2	0.32425	0.82
4ev27c1	0.8434	0.0006	0.8446	0.4775	320.1	0.32425	0.77
4ev27d1	0.8421	0.0006	0.8434	0.4983	234.9	0.32425	0.72
4ev27e1	0.8424	0.0006	0.8437	0.5093	133.2	0.32425	0.6485
4ev28a1	0.8473	0.0005	0.8484	0.4245	526.8	0.30425	0.816
4ev28b1	0.8453	0.0006	0.8465	0.4571	410.4	0.30425	0.766
4ev28c1	0.8440	0.0006	0.8452	0.4821	308.3	0.30425	0.716
4ev28d1	0.8429	0.0006	0.8441	0.5001	219.4	0.30425	0.666
4ev28e1	0.8427	0.0006	0.8439	0.5078	133.2	0.30425	0.6085
4ev29a1	0.8470	0.0006	0.8482	0.4210	526.8	0.28425	0.762
4ev29b1	0.8434	0.0006	0.8445	0.4582	402.8	0.28425	0.712
4ev29c1	0.8436	0.0006	0.8448	0.4905	295.0	0.28425	0.662
4ev29d1	0.8425	0.0006	0.8436	0.5027	202.3	0.28425	0.612
4ev29e1	0.8418	0.0006	0.8430	0.5089	133.2	0.28425	0.5685
4ev20a1	0.8467	0.0006	0.8478	0.4270	526.8	0.26425	0.708
4ev20b1	0.8443	0.0006	0.8454	0.4582	406.5	0.26425	0.664
4ev20c1	0.8426	0.0006	0.8437	0.4901	301.4	0.26425	0.618
4ev20d1	0.8433	0.0006	0.8445	0.5043	210.6	0.26425	0.574
4ev20e1	0.8431	0.0005	0.8441	0.5076	133.2	0.26425	0.5285

NOTE: See Attachment II, spreadsheet "scrapsMIV-vertical.xls," sheet "730kg," and "k for 730."

Table 23. Three Mark IV Intact Fuel Baskets and Two Mark IV Scrap Baskets of 530 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Particles Radius (cm)	Pitch (cm)
4ev31a1	0.8441	0.0006	0.8452	0.4737	780.9	0.44425	1.324
4ev31b1	0.8420	0.0006	0.8431	0.4640	568.5	0.44425	1.214
4ev31c1	0.8438	0.0006	0.8450	0.4792	391.4	0.44425	1.104
4ev31d1	0.8421	0.0006	0.8432	0.5016	246.2	0.44425	0.994
4ev31e1	0.8430	0.0006	0.8441	0.5070	133.2	0.44425	0.8885
4ev32a1	0.8427	0.0006	0.8438	0.4729	780.9	0.42425	1.266
4ev32b1	0.8429	0.0005	0.8439	0.4680	568.6	0.42425	1.16
4ev32c1	0.8432	0.0006	0.8443	0.4817	391.5	0.42425	1.056
4ev32d1	0.8433	0.0006	0.8444	0.4996	246.4	0.42425	0.95
4ev32e1	0.8428	0.0006	0.8439	0.5073	133.2	0.42425	0.8485
4ev33a1	0.8432	0.0006	0.8443	0.4676	780.9	0.40425	1.206
4ev33b1	0.8418	0.0006	0.8431	0.4706	568.7	0.40425	1.106
4ev33c1	0.8434	0.0006	0.8445	0.4817	391.7	0.40425	1.006
4ev33d1	0.8429	0.0006	0.8440	0.5016	246.6	0.40425	0.906
4ev33e1	0.8413	0.0006	0.8425	0.5080	133.2	0.40425	0.8085
4ev34a1	0.8437	0.0005	0.8447	0.4705	780.9	0.38425	1.146

Table 23. Three Mark IV Intact Fuel Baskets and Two Mark IV Scrap Baskets of 530 kg (Continued)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Particles Radius (cm)	Pitch (cm)
4ev34b1	0.8432	0.0006	0.8444	0.4672	567.4	0.38425	1.05
4ev34c1	0.8420	0.0006	0.8432	0.4787	389.5	0.38425	0.954
4ev34d1	0.8438	0.0006	0.8449	0.5026	243.9	0.38425	0.858
4ev34e1	0.8424	0.0006	0.8436	0.5073	133.2	0.38425	0.7685
4ev35a1	0.8434	0.0006	0.8446	0.4669	780.9	0.36425	1.086
4ev35b1	0.8427	0.0006	0.8438	0.4704	569.0	0.36425	0.996
4ev35c1	0.8426	0.0006	0.8437	0.4819	392.1	0.36425	0.906
4ev35d1	0.8418	0.0006	0.8430	0.4984	247.0	0.36425	0.816
4ev35e1	0.8412	0.0006	0.8424	0.5081	133.2	0.36425	0.7285
4ev36a1	0.8433	0.0006	0.8445	0.4713	780.9	0.34425	1.026
4ev36b1	0.8439	0.0006	0.8451	0.4699	569.1	0.34425	0.942
4ev36c1	0.8422	0.0006	0.8434	0.4792	392.3	0.34425	0.856
4ev36d1	0.8435	0.0005	0.8446	0.5011	247.3	0.34425	0.772
4ev36e1	0.8434	0.0006	0.8446	0.5076	133.2	0.34425	0.6885
4ev37a1	0.8431	0.0006	0.8442	0.4705	780.9	0.32425	0.966
4ev37b1	0.8435	0.0006	0.8448	0.4714	569.2	0.32425	0.886
4ev37c1	0.8430	0.0006	0.8442	0.4846	392.5	0.32425	0.806
4ev37d1	0.8421	0.0006	0.8433	0.5021	247.6	0.32425	0.726
4ev37e1	0.8428	0.0006	0.8440	0.5081	133.2	0.32425	0.6485
4ev38a1	0.8423	0.0006	0.8435	0.4706	780.9	0.30425	0.908
4ev38b1	0.8417	0.0006	0.8429	0.4640	569.4	0.30425	0.832
4ev38c1	0.8421	0.0005	0.8432	0.4861	392.8	0.30425	0.758
4ev38d1	0.8427	0.0006	0.8438	0.4998	247.9	0.30425	0.682
4ev38e1	0.8417	0.0006	0.8429	0.5058	133.2	0.30425	0.6085
4ev39a1	0.8426	0.0006	0.8437	0.4666	780.9	0.28425	0.848
4ev39b1	0.8430	0.0006	0.8442	0.4747	569.6	0.28425	0.778
4ev39c1	0.8432	0.0006	0.8443	0.4849	393.1	0.28425	0.708
4ev39d1	0.8425	0.0006	0.8436	0.5015	248.3	0.28425	0.638
4ev39e1	0.8422	0.0006	0.8434	0.5083	133.2	0.28425	0.5685
4ev30a1	0.8423	0.0006	0.8434	0.4670	780.9	0.26425	0.788
4ev30b1	0.8427	0.0006	0.8439	0.4733	569.8	0.26425	0.724
4ev30c1	0.8437	0.0006	0.8449	0.4867	393.5	0.26425	0.658
4ev30d1	0.8409	0.0006	0.8420	0.5013	248.8	0.26425	0.594
4ev30e1	0.8410	0.0006	0.8421	0.5070	133.2	0.26425	0.5285

NOTE: See Attachment II, spreadsheet "scrapsMIV-vertical.xls," sheet "530kg," and "k for 530."

Table 24. Three Mark IV Intact Fuel Baskets and Two Mark IV Scrap Baskets of 330 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Particles radius (cm)	Pitch (cm)
4ev41a1	0.8416	0.0006	0.8428	0.4942	1342.9	0.44425	1.552
4ev41b1	0.8420	0.0006	0.8433	0.4959	916.5	0.44425	1.386
4ev41c1	0.8428	0.0006	0.8440	0.4902	580.4	0.44425	1.222

Table 24. Three Mark IV Intact Fuel Baskets and Two Mark IV Scrap Baskets of 330 kg (Continued)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Particles radius (cm)	Pitch (cm)
4ev41e1	0.8416	0.0006	0.8428	0.5066	133.2	0.44425	0.8885
4ev42a1	0.8423	0.0006	0.8434	0.4944	1342.9	0.42425	1.482
4ev42b1	0.8437	0.0006	0.8449	0.4943	915.4	0.42425	1.324
4ev42c1	0.8427	0.0006	0.8439	0.4924	578.8	0.42425	1.166
4ev42d1	0.8430	0.0006	0.8442	0.5027	322.0	0.42425	1.008
4ev42e1	0.8422	0.0006	0.8433	0.5066	133.2	0.42425	0.8485
4ev43a1	0.8426	0.0006	0.8438	0.4936	1342.9	0.40425	1.412
4ev43b1	0.8424	0.0006	0.8435	0.4938	916.8	0.40425	1.262
4ev43c1	0.8425	0.0006	0.8437	0.4920	580.9	0.40425	1.112
4ev43d1	0.8428	0.0006	0.8441	0.5017	324.5	0.40425	0.962
4ev43e1	0.8426	0.0006	0.8438	0.5060	133.2	0.40425	0.8085
4ev44a1	0.8434	0.0006	0.8446	0.4940	1342.9	0.38425	1.342
4ev44b1	0.8426	0.0006	0.8439	0.4925	915.7	0.38425	1.198
4ev44c1	0.8435	0.0006	0.8448	0.4927	579.2	0.38425	1.056
4ev44d1	0.8422	0.0006	0.8434	0.5024	322.5	0.38425	0.912
4ev44e1	0.8423	0.0006	0.8435	0.5072	133.2	0.38425	0.7685
4ev45a1	0.8426	0.0006	0.8438	0.4936	1342.9	0.36425	1.272
4ev45b1	0.8420	0.0006	0.8432	0.4923	914.5	0.36425	1.136
4ev45c1	0.8416	0.0006	0.8427	0.4922	577.3	0.36425	1
4ev45d1	0.8433	0.0006	0.8445	0.4999	320.4	0.36425	0.864
4ev45e1	0.8429	0.0006	0.8440	0.5060	133.2	0.36425	0.7285
4ev46a1	0.8420	0.0006	0.8431	0.4920	1342.9	0.34425	1.202
4ev46b1	0.8402	0.0006	0.8414	0.4947	916.1	0.34425	1.074
4ev46c1	0.8427	0.0006	0.8438	0.4943	579.7	0.34425	0.946
4ev46d1	0.8424	0.0006	0.8435	0.5011	323.1	0.34425	0.818
4ev46e1	0.8427	0.0006	0.8439	0.5064	133.2	0.34425	0.6885
4ev47a1	0.8424	0.0006	0.8435	0.4951	1342.9	0.32425	1.132
4ev47b1	0.8426	0.0006	0.8437	0.4953	914.7	0.32425	1.012
4ev47c1	0.8424	0.0006	0.8436	0.4925	577.6	0.32425	0.89
4ev47d1	0.8428	0.0006	0.8441	0.5005	320.7	0.32425	0.770
4ev47e1	0.8429	0.0006	0.8440	0.5061	133.2	0.32425	0.6485
4ev48a1	0.8426	0.0006	0.8438	0.4909	1342.9	0.30425	1.062
4ev48b1	0.8415	0.0006	0.8426	0.4938	916.5	0.30425	0.95
4ev48c1	0.8427	0.0006	0.8438	0.4923	580.4	0.30425	0.836
4ev48d1	0.8422	0.0006	0.8434	0.5017	323.8	0.30425	0.724
4ev48e1	0.8417	0.0006	0.8428	0.5061	133.2	0.30425	0.6085
4ev49a1	0.8416	0.0006	0.8428	0.4910	1342.9	0.28425	0.992
4ev49b1	0.8418	0.0006	0.8430	0.4921	914.9	0.28425	0.886
4ev49c1	0.8420	0.0006	0.8432	0.4904	578.0	0.28425	0.780
4ev49d1	0.8417	0.0006	0.8429	0.5010	321.2	0.28425	0.674
4ev49e1	0.8415	0.0006	0.8427	0.5075	133.2	0.28425	0.5685

NOTE: See Attachment II, spreadsheet "scrapsMIV-vertical.xls," sheet "330kg," and "k for 330."

The following table presents results for scrap baskets loaded with unequal levels of scrap in the different regions of the scrap basket (see Figure 24). The levels are randomly chosen.

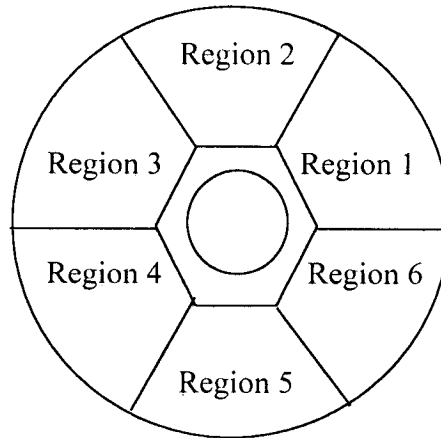


Figure 24. Denomination of the Scrap Basket Regions

Table 25. Three Mark IV Intact Fuel Baskets and Two Mark IV Scrap Baskets (unequal level of scrap in the baskets)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Particles Radius (cm)	Pitch (cm)
4uv71a1 ^a	0.8499	0.0006	0.8511	0.4123	355.1	0.44425	1.080
4uv71a2 ^b	0.8463	0.0006	0.8474	0.4422	355.1	0.44425	1.080
4uv81a1 ^a	0.8509	0.0006	0.8520	0.4041	368.2	0.44425	1.088
4uv91a1 ^c	0.8439	0.0006	0.8451	0.4594	368.2	0.44425	1.088

NOTES: ^a Level of scrap in regions 1, 3, 5: 67.31 cm.
 Level of scrap in regions 2, 4, 6: 57.31 cm.
^b Level of scrap in regions 1, 3, 5: 52.31 cm.
 Level of scrap in regions 2, 4, 6: 57.31 cm.
^c No scrap in region 2, other regions are filled with scrap.

The highest k_{eff} ($k_{eff} + 2\sigma = 0.8601$) for a waste package is found for MCOs loaded with three baskets of intact fuel elements and two scrap baskets loaded with 980 kg of fuel represented as spheres of radius 0.44425 cm and pitch of 1.08 cm.

6.1.1.3 Effect of Zircaloy-2 Cladding

In this section, the effect of the Zircaloy is investigated. The case "4ev71a1" (Table 17) is the base of the cases "zr1" and "zr2" (see Table 26).

Table 26. Three Mark IV Intact Fuel Baskets and Two Mark IV Scrap Baskets of 980 kg; Credit for Zircaloy (particles radius 0.44425 cm and pitch of 1.080 cm)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	Comment
4ev71a1	0.8589	0.0006	0.8601	0.3882	Base case (see Table 16)
zr1	0.8496	0.0006	0.8507	0.4319	Sphere of fuel with a 0.029 cm Zircaloy coat
zr2	0.8421	0.0006	0.8433	0.5097	Zircaloy homogenized in the water surrounding the fuel.

NOTE: See Attachment II, spreadsheet "scrapsMIV-vertical.xls," sheet "980kg."

If the Zircaloy clad is taken into account, k_{eff} will be about 1 % lower than if no credit is given for the clad in the scrap basket.

6.1.1.4 Optimum Scrap Basket for Settled MCO Contents

In this section, the waste package lays horizontally as it will in the drift of the Monitored Geologic Repository. The mass of fuel in the scrap basket varies. The radii of the spheres representing the scrap and the pitch of these spheres are also varied (see Figure 8) to find the most reactive configuration.

Table 27. Three Mark IV Intact Fuel Baskets and Two Mark IV Scrap Baskets of 980 kg (contents of the waste package settled)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Particles Radius (cm)	Pitch (cm)
4eh31a1	0.8583	0.0006	0.8595	0.3797	382.0	0.44425	1.098 ^a
4eh31b1	0.8456	0.0006	0.8467	0.4552	313.1	0.44425	1.048
4eh31c1	0.8419	0.0006	0.8431	0.4942	250.4	0.44425	0.998
4eh31d1	0.8414	0.0006	0.8426	0.4991	193.7	0.44425	0.948
4eh31e1	0.8404	0.0006	0.8415	0.5045	133.2	0.44425	0.889
4eh32a1	0.8580	0.0005	0.8591	0.3851	382.0	0.42425	1.048
4eh32b1	0.8445	0.0006	0.8456	0.4706	310.0	0.42425	0.998

NOTES: ^a This pitch is such that the sphere are distributed over the entire volume of the scrap basket
See Attachment II, spreadsheet "scrapsMIV-vertical.xls," sheet "980kg-hori."

Table 28. Three Mark IV Intact Fuel Baskets and Two Mark IV Scrap Baskets of 930 kg (contents of the waste package settled)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Particles Radius (cm)	Pitch (cm)
4eh11a1	0.8534	0.0005	0.8545	0.3949	382.0	0.44425	1.098
4eh11b1	0.8439	0.0006	0.8450	0.4751	313.1	0.44425	1.048
4eh12a1	0.8516	0.0006	0.8527	0.4099	382.0	0.42425	1.049

NOTE: See Attachment II, spreadsheet "scrapsMIV-vertical.xls," sheet "930kg-hori."

Table 29. Three Mark IV Intact Fuel Baskets and Two Mark IV Scrap Baskets of 860 kg (contents of the waste package settled)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Particles Radius (cm)	Pitch (cm)
4eh21a1	0.8502	0.0006	0.8514	0.4085	425.0	0.44425	1.127
4eh21b1	0.8445	0.0006	0.8456	0.4809	338.6	0.44425	1.067
4eh21c1	0.8424	0.0006	0.8436	0.4957	261.3	0.44425	1.007
4eh22a1	0.8505	0.0006	0.8516	0.4125	425.0	0.42425	1.077
4eh22b1	0.8435	0.0006	0.8447	0.4829	334.7	0.42425	1.017
4eh22c1	0.8412	0.0006	0.8424	0.4991	254.5	0.42425	0.957

NOTE: See Attachment II, spreadsheet "scrapsMIV-vertical.xls," sheet "860kg-hori."

The maximum mass of scrap fuel (980 kg) in the scrap basket gives the highest k_{eff} . However, the k_{eff} of a waste package with settled contents is slightly lower than the k_{eff} of a waste package in an as-loaded position.

6.1.1.5 MCOs with Five Scrap Baskets in Waste Package in an as-Loaded Position

In this section, a configuration where the MCOs are loaded with five scrap baskets is analyzed. This configuration is investigated to determine if there will be a criticality event due to misloading, although this would violate the thermal limits for the MCO.

Table 30. Five Fully Loaded Scrap Baskets of Mark IV Spent Nuclear Fuel in MCOs

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Particles Radius (cm)	Pitch (cm)
alscra1	0.8718	0.0006	0.8729	0.2980	382.0	0.44425	1.098
alscra2	0.8718	0.0006	0.8730	0.2960	382.0	0.42425	1.048

NOTE: The MCOs are in an as-loaded position.

6.1.1.6 Optimum Loading of Mark IV Intact Baskets

In this section, the optimum loading of the MCOs' intact baskets is studied. Fuel elements are taken out of the intact baskets. The fuel elements taken out of the intact baskets are identified as shown in Figure 25. The base case for this calculation is "4ev71a1" from Table 17. These configurations are analyzed because there are no requirement for a minimum number of fuel elements in the intact baskets.

Table 31. Three Mark IV Intact Fuel Baskets and Two Mark IV Scrap Baskets of 980 kg with Partial Loading (particles radius 0.44425 cm and pitch of 1.080 cm)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Comment ^a
case1	0.8576	0.0005	0.8586	0.3758	355.1	Fuel element #1 missing
case2	0.8575	0.0006	0.8587	0.3887	355.1	Fuel element #2 missing
case3	0.8572	0.0006	0.8583	0.3853	355.1	Fuel element #3 missing
case4	0.8576	0.0005	0.8587	0.3817	355.1	Fuel element #4 missing

Table 31. Three Mark IV Intact Fuel Baskets and Two Mark IV Scrap Baskets of 980 kg with Partial Loading (particles radius 0.44425 cm and pitch of 1.080 cm) (Continued)

File Name	k_{eff}	σ	$k_{\text{eff}} + 2\sigma$	AENCF (MeV)	H/X Ratio	Comment ^a
case5	0.8556	0.0006	0.8568	0.3787	355.1	Fuel element #5 missing
case6	0.8573	0.0006	0.8585	0.3812	355.1	Fuel element #6 missing
case7	0.8572	0.0005	0.8583	0.3844	355.1	Fuel element #7 missing
case8	0.8568	0.0006	0.8580	0.3892	355.1	Fuel element #8 missing
case9	0.8561	0.0006	0.8572	0.3916	355.1	Fuel element #9 missing
case10	0.8571	0.0006	0.8582	0.3958	355.1	Outer fuel element #1 missing
case11	0.8584	0.0006	0.8596	0.3937	355.1	Outer fuel element #2 missing
case12	0.8567	0.0006	0.8578	0.3986	355.1	Outer fuel element #3 missing
case13	0.8582	0.0006	0.8594	0.3942	355.1	Outer fuel element #4 missing
case14	0.8585	0.0006	0.8597	0.3892	355.1	Outer fuel element #5 missing
case15	0.8586	0.0005	0.8597	0.3978	355.1	Outer fuel element #6 missing
case16	0.8584	0.0005	0.8595	0.3916	355.1	Outer fuel element #7 missing
case17	0.8586	0.0006	0.8597	0.3965	355.1	Outer fuel element #8 missing
case18	0.8591	0.0006	0.8603	0.3838	355.1	Outer fuel element #9 missing

NOTES: ^a See Figure 25 for numbering of the fuel element.
See Attachment I, spreadsheet "scrapsMIV-vertical.xls," sheet "K for 980."
H/X calculated for a cell with a fuel element in it.

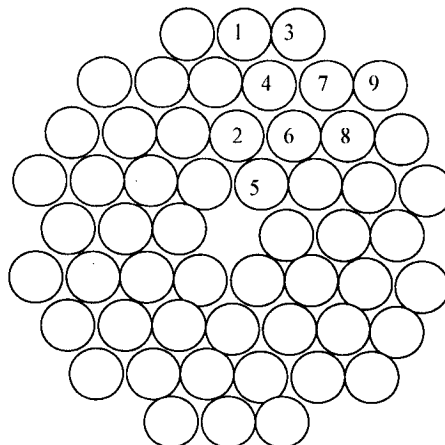


Figure 25. Numbering of the Fuel Elements for Mark IV

Taking one outer or one inner fuel element out of the intact basket has no effect on the reactivity of the waste package.

6.1.2 Mark IA

In this section k_{eff} of the intact waste package loaded with two MCOs containing Mark IA are presented. Tables 31 through 56 present the results of the calculation described in Section 5.4.2. Section 6.1.2.1 presents results for MCO loaded with six intact baskets and Sections 6.1.2.2 through 6.1.2.6 present the results for MCOs filled with four intact baskets and two scrap baskets located at the top and bottom of the MCO unless otherwise noted.

6.1.2.1 MCOs Loaded with Intact Baskets

Table 32 gives the k_{eff} of a waste package containing MCOs loaded with intact Mark IA fuel elements. The water density is 1 g/cm^3 unless otherwise specified. The positions of the MCOs in the waste package varie. Cases with spent fuel are analyzed. The reactivity of the waste package as a function of the amount of high-level waste glass in the glass pour canister is also investigated. The importance of the fuel support cylinders and fuel support plate (Attachment I) is examined.

Table 32. Six Mark IA Intact Fuel Baskets

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio ^b	MCO Position	Comment
1zv0111	0.8149	0.0006	0.8161	0.4374	155.9	Quadrants I & IV	MCO flooded, waste package flooded
1bur111	0.7968	0.0007	0.7982	0.4768	155.9	Quadrants I & IV	MCO flooded, waste package flooded ^a
1zv0121	0.8476	0.0006	0.8490	0.4200	155.9	Quadrants I & IV	MCO flooded, waste package dry
1bur121	0.8280	0.0006	0.8292	0.4606	155.9	Quadrants I & IV	MCO flooded, waste package dry ^a
hlwrun1	0.8479	0.0006	0.8491	0.4209	155.9	Quadrants I & IV	MCO flooded, waste package dry, high-level waste canister filled at 85% with Savannah River Site high-level waste glass and 15% with void
hlwrun2	0.8480	0.0006	0.8492	0.4206	155.9	Quadrants I & IV	MCO flooded, waste package dry, high-level waste canister filled at 85% with Savannah River Site high-level waste glass and 15% with water
1zv0131	0.3095	0.0003	0.3101	2.0289	0	Quadrants I & IV	MCO dry, waste package dry
1bur131	0.3047	0.0003	0.3053	2.0993	0	Quadrants I & IV	MCO dry, waste package dry ^a
1zv0141	0.3642	0.0003	0.3650	1.5735	0	Quadrants I & IV	MCO dry, waste package flooded
1bur141	0.3621	0.0004	0.3629	1.6360	0	Quadrants I & IV	MCO dry, waste package flooded ^a
1zv0221	0.8350	0.0005	0.8360	0.4255	155.9	Quadrants I & III	MCO flooded, waste package dry
raiser	0.8342	0.0007	0.8356	0.4271	155.9	Quadrants I & III	MCO flooded, waste package dry, including the fuel support cylinder and the fuel support plate (see Figure 10)
1zv0321	0.8457	0.0006	0.8469	0.4206	155.9	Quadrants I & IV	MCO flooded, waste package dry, MCOs against waste package inner barrier
1zv0122	0.8305	0.0006	0.8317	0.4416	140.4	Quadrants I & IV	MCO flooded, waste package dry, water density of 0.9 g/cm^3
1zv0123	0.8103	0.0006	0.8115	0.46949	124.8	Quadrants I & IV	MCO flooded, waste package dry, water density of 0.8 g/cm^3
1zv0124	0.7843	0.0006	0.7855	0.5023	109.2	Quadrants I & IV	MCO flooded, waste package dry, water density of 0.7 g/cm^3

NOTES: ^a Spent fuel composition 30 years since reactor discharge (Table 3-7, DOE 2000, spreadsheet "degradedMK1A.xls," sheet "burnup credit").

^b From Spreadsheet "hX.xls," sheet 1.

The k_{eff} is higher for a waste package with flooded MCOs only. Using the spent fuel composition is not conservative as shown by comparing cases "1bur121" and "1zv0121." Configurations including the fuel support cylinder and the fuel support plate are less reactive than configurations that don't include these elements (see Figure 10 and Attachment I, p.3).

6.1.2.2 Optimum Configuration for Two Scrap Baskets in a Loaded Waste Package

In these sections, the H/X ratio is given for the scrap basket only. Case "1zv0121" is the base case for the following calculations. The waste package is dry while the MCOs are flooded. The high-level waste pour canister is filled with high-level waste glass.

This section looks at a vertical waste package with two scrap baskets. Section 6.1.2.2.1 demonstrates the effect of loading the scrap baskets with intact inner or outer elements (Tables 33 and 34, respectively). Section 6.1.2.2.2 examines a vertical waste package loaded with various masses of scrap fuel (represented by spheres). Tables 35 through 43 demonstrate the trend of k_{eff} as the pitch and radii of these spheres are changed for each mass.

6.1.2.2.1 Partially Intact Elements in Scrap Baskets

Table 33 and Table 34 list the k_{eff} of the waste package loaded with partially intact fuel elements in the scrap basket (intact inner fuel elements and intact outer fuel elements, respectively). The pitch of the partially intact fuel elements varies. The scrap baskets are loaded at the top and bottom of the stack of the baskets in the MCO (DOE 2000, p. 33).

Table 33. Intact Mark IA Inner Fuel Elements in Scrap Baskets

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio ^a	Pitch (cm)
1ev01a1	0.8436	0.0006	0.8448	0.4197	1985.3	6.985
1ev01b1	0.8425	0.0006	0.8437	0.4179	1744.7	6.585
1ev01c1	0.8433	0.0006	0.8446	0.4152	1518.2	6.185
1ev01d1	0.8442	0.0006	0.8454	0.4127	1306.0	5.785
1ev01e1	0.8443	0.0006	0.8456	0.4096	1107.9	5.385
1ev01f1	0.8465	0.0006	0.8477	0.4067	924.1	4.985
1ev01g1	0.8475	0.0005	0.8485	0.4055	754.4	4.585
1ev01h1	0.8455	0.0006	0.8468	0.4214	598.9	4.185
1ev01j1	0.8451	0.0006	0.8463	0.4279	457.5	3.785
1ev01k1	0.8438	0.0006	0.8450	0.4285	330.4	3.385
1ev01z1	0.8447	0.0006	0.8460	0.4179	2110.9	7.185
1ev01y1	0.8444	0.0006	0.8457	0.4180	2240.1	7.385
1ev01x1	0.8441	0.0006	0.8453	0.4189	2372.8	7.585
1ev01w1	0.8423	0.0006	0.8436	0.4195	2509.1	7.785
1ev01v1	0.8435	0.0006	0.8448	0.4211	2648.9	7.985

NOTES: ^a H/X ratio calculated in the scrap basket.

Minimum pitch for 575 kg scrap weight limit is 5.14 cm.

See Attachment II, spreadsheet "scrapsMk1A.xls," sheet "Cylinder-scrap."

Table 34. Intact Mark IA Outer Fuel Elements in Scrap Baskets

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio ^a	Pitch (cm)
1ev02a1	0.8702	0.0006	0.8714	0.4028	500.5	6.096
1ev02b1	0.8773	0.0006	0.8785	0.3841	542.6	6.296
1ev02c1	0.8873	0.0006	0.8885	0.3656	586.0	6.496
1ev02d1	0.8901	0.0007	0.8914	0.3502	630.8	6.696
1ev02e1	0.8912	0.0007	0.8926	0.3361	677.0	6.896
1ev02f1	0.8925	0.0006	0.8937	0.3253	724.5	7.096
1ev02g1	0.8874	0.0006	0.8886	0.3205	773.4	7.296
1ev02h1	0.8842	0.0007	0.8855	0.3160	823.6	7.496
1ev02j1	0.8776	0.0006	0.8787	0.3137	875.2	7.696
1ev02k1	0.8670	0.0006	0.8683	0.3222	928.1	7.896
1ev02m1	0.8605	0.0006	0.8618	0.3347	982.4	8.096
1ev02n1	0.8555	0.0006	0.8567	0.3354	1038.1	8.296
1ev02o1	0.8487	0.0006	0.8500	0.3683	1095.1	8.496
1ev02p1	0.8460	0.0006	0.8472	0.3922	1153.5	8.696
1ev02q1	0.8453	0.0006	0.8465	0.3982	1213.2	8.896

NOTES: ^a H/X ratio calculated in the scrap basket.

Minimum pitch for 575 kg scrap weight limit is 7.24 cm.

See Attachment II, spreadsheet "scrapsMk1A.xls," sheet "Cylinder-scrap."

Results show that waste packages with MCOs loaded with partially intact fuel elements in the scrap basket have a higher k_{eff} than waste packages with MCOs loaded with intact fuel elements only.

6.1.2.2.2 Scrap Fuel in Scrap Baskets

Tables 34 through 42 give the k_{eff} of a waste package containing MCO loaded with four intact baskets and two scrap baskets with different masses of fuel. The fuel is represented by spheres. The radius of these spheres and their pitch are varied to find the most reactive configuration. However, the radius of the spheres are bounded by the thickness of the inner fuel element. Although the scrap basket for Mark 1A fuel has a 575-kg maximum loading, baskets with higher loadings are also analyzed.

Table 35. Four Mark IA Intact Fuel Baskets and Two Mark IA Scrap Baskets of 930 kg

File Name	k_{eff}	σ	$k_{\text{eff}} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1ev11a1	0.8695	0.0006	0.8707	0.3852	187.3	0.43185	0.96800
1ev11b1	0.8533	0.0005	0.8543	0.4089	164.8	0.43185	0.94300
1ev11c1	0.8450	0.0006	0.8462	0.4217	143.4	0.43185	0.91800
1ev11d1	0.8438	0.0006	0.8450	0.4254	123.2	0.43185	0.89300
1ev11e1	0.8449	0.0006	0.8461	0.4266	100.9	0.43185	0.86372
1ev11a2 ^a	0.8502	0.0006	0.8514	0.4070	187.3	0.43185	0.96800
1ev12a1	0.8679	0.0006	0.8691	0.3827	187.3	0.41185	0.92400
1ev12b1	0.8517	0.0005	0.8527	0.4092	163.7	0.41185	0.89800
1ev12c1	0.8462	0.0006	0.8474	0.4198	141.4	0.41185	0.87400
1ev12d1	0.8458	0.0006	0.8470	0.4246	120.3	0.41185	0.84800
1ev12e1	0.8435	0.0006	0.8447	0.4259	100.9	0.41185	0.82372
1ev13a1	0.8678	0.0006	0.8690	0.3840	187.3	0.39185	0.87800
1ev13b1	0.8507	0.0006	0.8519	0.4122	162.5	0.39185	0.85400
1ev13c1	0.8465	0.0006	0.8477	0.4209	139.2	0.39185	0.82800
1ev13d1	0.8447	0.0006	0.8459	0.4253	117.2	0.39185	0.80400
1ev13e1	0.8439	0.0006	0.8451	0.4255	100.9	0.39185	0.78372
1ev16a1	0.8628	0.0006	0.8640	0.3845	187.3	0.33185	0.74400
1ev16b1	0.8482	0.0006	0.8494	0.4165	158.2	0.33185	0.71800
1ev16c1	0.8432	0.0005	0.8442	0.4239	131.1	0.33185	0.69400
1ev16d1	0.8435	0.0006	0.8447	0.4278	100.9	0.33185	0.66372
1ev10a1	0.8572	0.0006	0.8584	0.3920	187.3	0.25185	0.56400
1ev10b1	0.8455	0.0006	0.8467	0.4195	149.4	0.25185	0.54000
1ev10c1	0.8432	0.0006	0.8444	0.4249	114.9	0.25185	0.51400
1ev10d1	0.8436	0.0006	0.8448	0.4257	100.9	0.25185	0.50372

NOTES: ^a Water density= 0.9 g/cm³.

See Attachment II, spreadsheet "scrapsMk1A.xls," sheets "930kg," and "930kg-results."

Table 36. Four Mark IA Intact Fuel Baskets and Two Mark IA Scrap Baskets of 730 kg

File Name	k_{eff}	σ	$k_{\text{eff}} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1ev21a1	0.8860	0.0005	0.8870	0.3209	269.0	0.43185	1.0500
1ev21b1	0.8628	0.0006	0.8640	0.3698	217.2	0.43185	1.0000
1ev21c1	0.8469	0.0005	0.8480	0.4124	170.4	0.43185	0.9500
1ev21d1	0.8439	0.0006	0.8451	0.4221	128.2	0.43185	0.9000
1ev21e1	0.8447	0.0006	0.8459	0.4238	100.9	0.43185	0.86372
1ev21a2 ^a	0.8638	0.0007	0.8652	0.3523	269.0	0.43185	1.0500
1ev24a1	0.8818	0.0006	0.8830	0.3251	269.0	0.37185	0.9040
1ev24b1	0.8543	0.0005	0.8553	0.3817	209.4	0.37185	0.8540
1ev24c1	0.8451	0.0006	0.8463	0.4178	156.3	0.37185	0.8040
1ev24d1	0.8437	0.0006	0.8449	0.4249	109.4	0.37185	0.7540
1ev24e1	0.8435	0.0006	0.8447	0.4259	100.9	0.37185	0.74372
1ev27a1	0.8785	0.0006	0.8797	0.3251	269.0	0.31185	0.7580
1ev27b1	0.8503	0.0005	0.8513	0.4023	198.6	0.31185	0.7080

Table 36. Four Mark IA Intact Fuel Baskets and Two Mark IA Scrap Baskets of 730 kg (Continued)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1ev27c1	0.8428	0.0006	0.8440	0.4238	137.6	0.31185	0.6580
1ev27d1	0.8436	0.0006	0.8448	0.4235	100.9	0.31185	0.62372
1ev20a1	0.8736	0.0006	0.8748	0.3301	269.0	0.25185	0.6120
1ev20b1	0.8453	0.0006	0.8465	0.4116	183.3	0.25185	0.5620
1ev20c1	0.8438	0.0006	0.8450	0.4228	111.5	0.25185	0.5120
1ev20d1	0.8445	0.0006	0.8457	0.4242	100.9	0.25185	0.50372

NOTES: ^a Water density= 0.9 g/cm³.

See Attachment II, spreadsheet "scrapsMk1A.xls," sheets "730kg," and "730kg-results."

Table 37. Four Mark IA Intact Fuel Baskets and Two Mark IA Scrap Baskets of 700 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1ev81a1	0.8881	0.0006	0.8893	0.3138	285.3	0.43185	1.0640
1ev81b1	0.8640	0.0006	0.8652	0.3576	232.0	0.43185	1.0140
1ev82a1	0.8859	0.0006	0.8871	0.3158	285.3	0.41185	1.0140
1ev82b1	0.8615	0.0006	0.8627	0.3653	229.6	0.41185	0.9640

NOTE: See Attachment II, spreadsheet "scrapsMk1A.xls," sheets "700kg," and "700kg-results."

Table 38. Four Mark IA Intact Fuel Baskets and Two Mark IA Scrap Baskets of 680 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1ev61a1	0.8884	0.0006	0.8896	0.3073	296.9	0.43185	1.074
1ev61b1	0.8657	0.0006	0.8669	0.3495	242.6	0.43185	1.024
1ev61c1	0.8486	0.0006	0.8498	0.4040	193.3	0.43185	0.974
1ev61a2 ^a	0.8665	0.0006	0.8677	0.3349	296.9	0.43185	1.074
1uv61a1 ^b	0.8803	0.0006	0.8815	0.3135	296.9	0.43185	1.074
1uv61a2 ^{a,b}	0.8600	0.0007	0.8613	0.3386	296.9	0.43185	1.074
1ev62a1	0.8858	0.0006	0.8870	0.3074	296.9	0.41185	1.024
1ev62b1	0.8653	0.0006	0.8665	0.3567	240.1	0.41185	0.974
1ev62c1	0.8466	0.0006	0.8478	0.4073	188.8	0.41185	0.924
1uv62a1 ^b	0.8804	0.0007	0.8817	0.3097	296.9	0.41185	1.024

NOTES: ^a Water density= 0.9 g/cm³.

^b Level of scrap in regions 1, 3, 5: 48.34 cm, level of scrap in regions 2, 4, 6: 53.34 cm.

See Attachment II, spreadsheet "scrapsMk1A.xls," sheets "680kg," and "680kg-results."

Table 39. Four Mark IA Intact Fuel Baskets and Two Mark IA Scrap Baskets of 655 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1ev71a1	0.8869	0.0006	0.8882	0.3041	312.5	0.43185	1.088
1ev71b1	0.8670	0.0006	0.8683	0.3432	256.8	0.43185	1.038
1ev71a2 ^a	0.8668	0.0006	0.8681	0.3276	312.5	0.43185	1.088
1ev72a1	0.8852	0.0006	0.8865	0.3020	312.5	0.41185	1.038
1ev72b1	0.8657	0.0006	0.8669	0.3496	254.2	0.41185	0.988

NOTES: ^a Water density= 0.9 g/cm³.

See Attachment II, spreadsheet "scrapsMk1A.xls," sheets "655kg," and "655kg-results."

Table 40. Four Mark IA Intact Fuel Baskets and Two Mark IA Scrap Baskets of 630 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1ev51a1	0.8868	0.0006	0.8880	0.2986	329.3	0.43185	1.102
1ev51b1	0.8690	0.0006	0.8702	0.3375	272.1	0.43185	1.052
1ev51c1	0.8531	0.0006	0.8543	0.3845	220.0	0.43185	1.002
1ev51d1	0.8435	0.0006	0.8447	0.4236	100.9	0.43185	0.86372
1ev51a2 ^a	0.8661	0.0006	0.8673	0.3225	329.3	0.43185	1.102
1ev54a1	0.8831	0.0006	0.8843	0.2990	329.3	0.37185	0.948
1ev54b1	0.8616	0.0006	0.8628	0.3462	263.3	0.37185	0.898
1ev54c1	0.8473	0.0006	0.8485	0.4025	204.3	0.37185	0.848
1ev54d1	0.8423	0.0006	0.8435	0.4225	100.9	0.37185	0.74372
1ev57a1	0.8805	0.0006	0.8817	0.2978	329.3	0.31185	0.796
1ev57b1	0.8555	0.0006	0.8567	0.3588	251.4	0.31185	0.746
1ev57c1	0.8453	0.0006	0.8465	0.4153	183.3	0.31185	0.696
1ev50a1	0.8751	0.0006	0.8763	0.3069	329.3	0.25185	0.642
1ev50b1	0.8487	0.0006	0.8499	0.3893	234.4	0.25185	0.592
1ev50c1	0.8442	0.0006	0.8454	0.4211	154.1	0.25185	0.542
1ev50d1	0.8439	0.0006	0.8451	0.4234	100.9	0.25185	0.50372

NOTES: ^a Water density= 0.9 g/cm³.

See Attachment II, spreadsheet "scrapsMk1A.xls," sheets "630kg," and "630kg-results."

Table 41. Four Mark IA Intact Fuel Baskets and Two Mark IA Scrap Baskets of 575 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1ev91a1	0.8808	0.0006	0.8821	0.2891	371.4	0.43185	1.136
1ev91b1	0.8699	0.0007	0.8712	0.3155	310.5	0.43185	1.086
1ev91c1	0.8560	0.0006	0.8572	0.3676	254.9	0.43185	1.036
1ev91d1	0.8421	0.0006	0.8433	0.4243	100.9	0.43185	0.864
1ev93a1	0.8797	0.0006	0.8809	0.2910	371.4	0.39185	1.030
1ev93b1	0.8675	0.0006	0.8687	0.3213	304.6	0.39185	0.980
1ev93c1	0.8519	0.0006	0.8532	0.3776	244.2	0.39185	0.930
1ev93d1	0.8432	0.0006	0.8444	0.4233	100.9	0.39185	0.784
1ev95a1	0.8804	0.0007	0.8817	0.2848	371.4	0.35185	0.926
1ev95b1	0.8622	0.0006	0.8634	0.3287	297.4	0.35185	0.876
1ev95c1	0.8505	0.0006	0.8516	0.3979	231.4	0.35185	0.826
1ev95d1	0.8438	0.0006	0.8451	0.4224	100.9	0.35185	0.704
1ev97a1	0.8761	0.0006	0.8773	0.2911	371.4	0.31185	0.820
1ev97b1	0.8580	0.0006	0.8592	0.3428	288.5	0.31185	0.770
1ev97c1	0.8452	0.0006	0.8464	0.4072	215.7	0.31185	0.720
1ev97d1	0.8432	0.0006	0.8445	0.4236	100.9	0.31185	0.624
1ev99a1	0.8717	0.0006	0.8729	0.2928	371.4	0.27185	0.716
1ev99b1	0.8533	0.0007	0.8546	0.3636	277.2	0.27185	0.666
1ev99c1	0.8440	0.0006	0.8452	0.4168	196.1	0.27185	0.616
1ev99d1	0.8445	0.0006	0.8457	0.4224	100.9	0.27185	0.544

NOTE: See Attachment II, spreadsheet "scrapsMk1A.xls," sheets "575kg," and "575kg-results."

Table 42. Four Mark IA Intact Fuel Baskets and Two Mark IA Scrap Baskets of 530 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1ev31a1	0.8776	0.0006	0.8788	0.2818	412.4	0.43185	1.1680
1ev31b1	0.8686	0.0006	0.8698	0.3069	348.0	0.43185	1.1180
1ev31c1	0.8568	0.0006	0.8580	0.3578	289.1	0.43185	1.0680
1ev31g1	0.8435	0.0005	0.8445	0.4245	100.9	0.43185	0.86372
1ev31a2 ^a	0.8592	0.0006	0.8604	0.3073	412.4	0.43185	1.1680
1ev34a1	0.8766	0.0006	0.8778	0.2795	412.4	0.37185	1.0060
1ev34b1	0.8642	0.0006	0.8654	0.3115	338.1	0.37185	0.9560
1ev34c1	0.8525	0.0006	0.8537	0.3691	271.2	0.37185	0.9060
1ev34g1	0.8438	0.0006	0.8450	0.4223	100.9	0.37185	0.74372
1ev37a1	0.8724	0.0006	0.8736	0.2884	412.4	0.31185	0.8440
1ev37b1	0.8603	0.0005	0.8613	0.3263	324.7	0.31185	0.7940
1ev37c1	0.8470	0.0006	0.8482	0.3945	247.4	0.31185	0.7440
1ev30a1	0.8697	0.0005	0.8707	0.2885	412.4	0.25185	0.6800
1ev30b1	0.8522	0.0006	0.8534	0.3553	305.4	0.25185	0.6300
1ev30c1	0.8457	0.0006	0.8469	0.4102	214.0	0.25185	0.5800
1ev30d1	0.8447	0.0006	0.8459	0.4229	137.1	0.25185	0.5300

NOTES: ^a Water density = 0.9 g/cm³.
See Attachment II, spreadsheet "scrapsMk1A.xls," sheets "530kg," and "530kg-results."

Table 43. Four Mark IA Intact Fuel Baskets and Two Mark IA Scrap Baskets of 330 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1ev41a1	0.8443	0.0006	0.8455	0.3879	729.6	0.43185	1.3680
1ev41b1	0.8446	0.0006	0.8458	0.3880	558.3	0.43185	1.2680
1ev41c1	0.8458	0.0006	0.8470	0.3948	412.0	0.43185	1.1680
1ev41f1	0.8434	0.0006	0.8446	0.4223	100.9	0.43185	0.86372
1ev44a1	0.8455	0.0006	0.8467	0.3885	729.6	0.37185	1.1780
1ev44b1	0.8464	0.0006	0.8476	0.3908	533.1	0.37185	1.0780
1ev44c1	0.8459	0.0006	0.8471	0.3988	369.8	0.37185	0.9780
1ev44f1	0.8440	0.0006	0.8452	0.4222	100.9	0.37185	0.74372
1ev47a1	0.8443	0.0005	0.8453	0.3832	729.6	0.31185	0.9880
1ev47b1	0.8456	0.0006	0.8468	0.3876	499.2	0.31185	0.8880
1ev47e1	0.8445	0.0005	0.8457	0.4208	100.9	0.31185	0.62372
1ev40a1	0.8445	0.0006	0.8455	0.3812	729.6	0.25185	0.7980
1ev40b1	0.8465	0.0006	0.8477	0.3953	451.3	0.25185	0.6980
1ev40c1	0.8447	0.0006	0.8459	0.4156	242.5	0.25185	0.5980
1ev40d1	0.8437	0.0006	0.8449	0.4233	100.9	0.25185	0.5080
1ev40b2 ^a	0.8271	0.0006	0.8283	0.4091	451.3	0.25185	0.698

NOTES: ^a Water density = 0.9 g/cm³.

See Attachment II, spreadsheet "scrapsMKIA.xls," sheets "330kg," and "330kg-results."

Although the Mark IA scrap baskets are limited to a maximum loading to 575 kg (case "1ev91a1" $k_{eff} + 2\sigma = 0.8821$), configurations with up to 930 kg are studied. The highest k_{eff} was found for MCOs loaded with two scrap baskets with 680 kg (case "1ev61a1" $k_{eff} + 2\sigma = 0.8896$). k_{eff} decreases as the mass of fuel in the scrap basket is increased or decreased relative to 680 kg. ($k_{eff} + 2\sigma = 0.8788$ for 530 kg in the scrap basket). The k_{eff} of a waste package in this configuration is almost independent of the mass of fuel in the scrap basket. For a given mass of fuel in the scrap basket, k_{eff} decreases with decreasing sphere radius (pitch held constant) and decreases with decreasing pitch (radius held constant).

6.1.2.3 Effect of Zircaloy-2 Cladding

In Section 6.1.1.2.2, the Zircaloy clad is neglected. In this section, the effect of the Zircaloy is demonstrated. Results are given in Table 44.

Table 44. Four Mark IA Intact Fuel Baskets and Two Mark IA Scrap Baskets (effect of Zr)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Comment
1ev61k1 ^a	0.8695	0.0006	0.8708	0.3337	296.9	0.0328 cm Zircaloy-2 shell around fuel spheres
1ev61m1 ^a	0.8428	0.0006	0.8440	0.4259	296.9	Zircaloy-2 mixed homogeneously with water among fuel spheres
1ev91k1 ^b	0.8662	0.0006	0.8675	0.3173	371.4	0.0328 cm Zircaloy-2 shell around fuel spheres
1ev91m1 ^b	0.8430	0.0006	0.8442	0.4224	371.4	Zircaloy-2 mixed homogeneously with water among fuel spheres

NOTES: ^a Cases are based on the case 1ev61a1,680kg in the scrap basket.

^b Cases are based on the case 1ev91a1,575kg in the scrap basket.

See Attachment II, spreadsheet "scrapsMK1A.xls," sheets "680 Kg-Zr" and "575 kg-Zr"

As for Mark IV fuel element, k_{eff} of a waste package loaded with two scrap baskets filled with Zircaloy and fuel sphere is lower than the k_{eff} of the waste package loaded with two scrap baskets filled with fuel spheres only.

6.1.2.4 Optimum Scrap Baskets in a Waste Package with Settled Contents

In this section, the waste package contents are settled. The mass of fuel in the scrap basket and the pitch of the scrap fuel vary. Although the scrap baskets for Mark 1A are limited to a maximum loading of 575 kg, baskets with up to 730 kg are analyzed. A representation of a configuration similar to these is shown in Figure 8b. Results are given in Tables 45 through 49.

Table 45. Four Mark IA Intact Fuel Baskets and Two Mark IA Scrap Baskets of 730 kg (contents of the waste package settled)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1eh21a1	0.8802	0.0006	0.8815	0.3271	269.0	0.43185	1.05
1eh21b1	0.8496	0.0006	0.8508	0.3906	217.2	0.43185	1.00
1eh21c1	0.8441	0.0006	0.8453	0.4160	170.4	0.43185	0.95
1eh22a1	0.8794	0.0007	0.8807	0.3255	269.0	0.41185	1.00
1eh22b1	0.8478	0.0006	0.8490	0.3947	214.9	0.41185	0.95

NOTE: See Attachment II, spreadsheet "scrapsMk1A.xls," sheets "730kg-horizontal."

Table 46. Four Mark IA Intact Fuel Baskets and Two Mark IA Scrap Baskets of 700 kg (contents of the waste package settled)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1eh81a1	0.8800	0.0006	0.8812	0.3175	285.3	0.43185	1.064
1eh81b1	0.8489	0.0006	0.8501	0.3848	232.0	0.43185	1.014
1eh81c1	0.8455	0.0005	0.8465	0.4141	183.7	0.43185	0.964
1eh82a1	0.8795	0.0006	0.8807	0.3222	285.3	0.41185	1.015
1eh82b1	0.8484	0.0005	0.8494	0.3911	229.6	0.41185	0.965
1eh82c1	0.8462	0.0007	0.8475	0.4145	179.3	0.41185	0.915

NOTE: See Attachment II, spreadsheet "scrapsMk1A.xls," sheets "700kg-horizontal."

Table 47. Four Mark IA Intact Fuel Baskets and Two Mark IA Scrap Baskets of 680 kg (contents of the waste package settled)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1eh61a1	0.8820	0.0006	0.8832	0.3132	296.9	0.43185	1.074
1eh61b1	0.8505	0.0005	0.8515	0.3834	242.6	0.43185	1.024
1eh61c1	0.8430	0.0005	0.8440	0.4118	193.3	0.43185	0.974
1eh62a1	0.8797	0.0006	0.8809	0.3131	296.9	0.41185	1.025
1eh62b1	0.8484	0.0006	0.8496	0.3879	240.1	0.41185	0.975
1eh62c1	0.8440	0.0006	0.8452	0.4141	188.8	0.41185	0.925

NOTE: See Attachment II, spreadsheet "scrapsMk1A.xls," sheets "680kg-horizontal."

Table 48. Four Mark IA Intact Fuel Baskets and Two Mark IA Scrap Baskets of 655 kg (contents of the waste package settled)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1eh71a1	0.8809	0.0006	0.8821	0.3087	312.5	0.43185	1.088
1eh71b1	0.8498	0.0006	0.8510	0.3767	256.8	0.43185	1.038
1eh71c1	0.8457	0.0007	0.8470	0.4120	206.1	0.43185	0.988
1eh72a1	0.8770	0.0006	0.8782	0.3117	312.5	0.41185	1.038
1eh72b1	0.8483	0.0006	0.8495	0.3854	254.2	0.41185	0.988
1eh72c1	0.8441	0.0006	0.8454	0.4126	201.5	0.41185	0.938

NOTE: See Attachment II, spreadsheet "scrapsMk1A.xls," sheets "655kg-horizontal."

Table 49. Four Mark IA Intact Fuel Baskets and Two Mark IA Scrap Baskets of 575 kg (contents of the waste package settled)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1eh91a1	0.8719	0.0006	0.8731	0.3000	371.4	0.43185	1.136
1eh91b1	0.8470	0.0006	0.8482	0.3765	310.5	0.43185	1.086
1eh91c1	0.8450	0.0006	0.8463	0.4090	254.9	0.43185	1.036
1eh92a1	0.8751	0.0006	0.8763	0.2997	371.4	0.41185	1.084
1eh92b1	0.8480	0.0006	0.8492	0.3832	307.7	0.41185	1.034
1eh92c1	0.8452	0.0007	0.8465	0.4118	249.8	0.41185	0.984

NOTE: See Attachment II, spreadsheet "scrapsMk1A.xls," sheets "575kg-horizontal."

The mass of fuel in the scrap basket has no effect on k_{eff} . k_{eff} is lower if the waste package is emplaced horizontally than if the waste package is in an as-loaded position.

6.1.2.5 MCOs with Six Scrap Baskets in Position where the Contents of Waste Package Have Settled Due to Gravity

As discussed in Section 5.1.1, much of the N reactor spent nuclear fuel has experienced some level of degradation while in wet storage. In addition, damage could have resulted to the degraded spent nuclear fuel during storage and transportation activities before disposal. Both the scrap and the intact MCO baskets can be loaded with pieces of elements. Given the large number of variations that could result, calculations are performed to find the spherical particle size and distribution resulting in the highest value of k_{eff} given the fuel composition. These calculations also bound the results for all combinations of fuel lengths and possible loading. This series of calculations identifies the most reactive configuration given the physical limits (dimensions) of the MCO. k_{eff} s of the waste package in these configurations are given in Tables 51 through 57.

Table 50. Six Mark IA Scrap Baskets of 865 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1cv31a2	0.9312	0.0006	0.9324	0.3161	252.8	0.43185	1.015
1cv31t2 ^a	0.9188	0.0006	0.9200	0.3189	252.8	0.43185	1.015
1cv31b2	0.8812	0.0007	0.8825	0.3679	200.3	0.43185	0.965
1cv32a2	0.9303	0.0006	0.9314	0.3121	252.8	0.41185	0.968
1cv32t2 ^a	0.9175	0.0006	0.9187	0.3177	252.8	0.41185	0.968
1cv32b2	0.8635	0.0006	0.8647	0.3902	182.9	0.41185	0.903
1cv33a2	0.9299	0.0006	0.9310	0.3151	252.8	0.39185	0.921
1cv33t2 ^a	0.9161	0.0006	0.9172	0.3200	252.8	0.39185	0.921
1cv34a2	0.9274	0.0006	0.9285	0.3134	252.8	0.37185	0.874
1cv34b2	0.8693	0.0006	0.8706	0.3807	192.3	0.37185	0.824

NOTES: ^a Tuff reflected (see Table 9).

See Attachment II, spreadsheet "scrapsMk1A.xls," sheet 865kg-all-scrap."

865kg of fuel is the exact mass of 48 Mark 1A elements.

No copper plate in the basket (i.e., this Table gives also the case for a partially degraded intact basket).

Table 51. Six Mark IA Scrap Baskets of 830 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1cw31a2	0.9363	0.0006	0.9375	0.3021	268.6	0.43185	1.029
1cw31t2 ^a	0.9225	0.0006	0.9237	0.3069	268.6	0.43185	1.029
1cw31b2	0.8884	0.0006	0.8897	0.3534	214.6	0.43185	0.979
1cw32a2	0.9344	0.0006	0.9356	0.3009	268.6	0.41185	0.981
1cw32t2 ^a	0.9217	0.0006	0.9229	0.3046	268.6	0.41185	0.981
1cw32b2	0.8700	0.0006	0.8713	0.3902	182.9	0.41185	0.903

NOTES: ^a Tuff used as a reflector (Table 10).

See Attachment II, spreadsheet "scrapsMk1A.xls," sheet 830kg-all-scrap."

Table 52. Six Mark IA Scrap Baskets of 810 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1cw51a2	0.9371	0.0006	0.9383	0.2951	278.2	0.43185	1.037
1cw51t2 ^a	0.9242	0.0006	0.9254	0.2985	278.2	0.43185	1.037
1cw51b2	0.8925	0.0006	0.8938	0.3417	223.3	0.43185	0.987
1cw52a2	0.9357	0.0006	0.9369	0.2936	278.2	0.41185	0.989
1cw52t2 ^a	0.9218	0.0006	0.9229	0.2988	278.2	0.41185	0.989
1cw52b2	0.8700	0.0006	0.8713	0.3902	182.9	0.41185	0.903

NOTES: ^a Tuff used as a reflector (Table 10).

See Attachment II, spreadsheet "scrapsMk1A.xls," sheet 810kg-all-scrap."

Table 53. Six Mark IA Scrap Baskets of 792 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1cw21a2	0.9385	0.0006	0.9397	0.2897	287.3	0.43185	1.045
1cw21t2 ^a	0.9262	0.0006	0.9273	0.2952	287.3	0.43185	1.045
1cw21b2	0.8945	0.0006	0.8957	0.3384	231.5	0.43185	0.995
1cw22a2	0.9352	0.0006	0.9364	0.2900	287.3	0.41185	0.997
1cw22t2 ^a	0.9234	0.0006	0.9245	0.2943	287.3	0.41185	0.997
1cw22b2	0.8914	0.0006	0.8926	0.3380	228.9	0.41185	0.947

NOTES: ^a Tuff used as a reflector (Table 10).
See Attachment II, spreadsheet "scrapsMk1A.xls," sheet "792kg-all-scrap."

Table 54. Six Mark IA Scrap Baskets of 730 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1cw41a2	0.9411	0.0006	0.9422	0.2698	321.9	0.43185	1.074
1cw41t2 ^a	0.9287	0.0006	0.9298	0.2725	321.9	0.43185	1.074
1cw41b2	0.9005	0.0006	0.9017	0.3091	262.9	0.43185	1.024
1cw42a2	0.9393	0.0006	0.9405	0.2689	321.9	0.41185	1.024
1cw42t2 ^a	0.9256	0.0006	0.9268	0.2724	321.9	0.41185	1.024
1cw42b2	0.9001	0.0006	0.9013	0.3113	260.2	0.41185	0.974

NOTES: ^a Tuff used as a reflector (Table 10).
See Attachment II, spreadsheet "scrapsMk1A.xls," sheets "730kg-all-scrap."

Table 55. Six Mark IA Scrap Baskets of 650 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1cw71a2	0.9386	0.0006	0.9397	0.2435	376.4	0.43185	1.116
1cw71t2 ^a	0.9266	0.0006	0.9278	0.2468	376.4	0.43185	1.116
1cw71b2	0.9074	0.0006	0.9086	0.2770	312.5	0.43185	1.066
1cw72a2	0.9394	0.0005	0.9404	0.2425	376.4	0.41185	1.064
1cw72t2 ^a	0.9267	0.0006	0.9279	0.2482	376.4	0.41185	1.064
1cw72b2	0.9055	0.0006	0.9067	0.2770	309.6	0.41185	1.014

NOTES: ^a Tuff used as a reflector (Table 10).
See Attachment II, spreadsheet "scrapsMk1A.xls," sheets "650kg-all-scrap-results."

Table 56. Six Mark IA Scrap Baskets of 575 kg

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Scrap Basket	Particle Radius (cm)	Pitch (cm)
1cv11a1 ^a	0.8990	0.0006	0.9001	0.2296	371.2	0.43185	1.136
1cv11b1 ^a	0.8511	0.0006	0.8524	0.2558	310.3	0.43185	1.086
1cv12a1 ^a	0.9001	0.0006	0.9012	0.2308	372.0	0.41185	1.084
1cv12b1 ^a	0.8481	0.0006	0.8492	0.2549	308.2	0.41185	1.034
1cw61a2 ^b	0.9315	0.0005	0.9326	0.2219	441.2	0.43185	1.163
1cw61t2 ^{b,c}	0.9211	0.0006	0.9223	0.2252	441.2	0.43185	1.163
1cw61b2 ^b	0.9083	0.0006	0.9094	0.2490	371.8	0.43185	1.113
1cw62a2 ^b	0.9331	0.0006	0.9343	0.2220	441.2	0.41185	1.109
1cw62t2 ^{b,c}	0.9191	0.0006	0.9203	0.2252	441.2	0.41185	1.109
1cw62b2 ^b	0.9064	0.0006	0.9075	0.2503	368.6	0.41185	1.059
1cw63a2 ^b	0.9302	0.0006	0.9314	0.2209	441.2	0.39185	1.109
1cw63t2 ^{b,c}	0.9188	0.0006	0.9199	0.2254	441.2	0.39185	1.109

NOTES: ^a Cases run with the copper basket in the scrap basket, the fuel spheres are 1.25 % enriched, and the waste package is in a horizontal position.

^b Cases run for an intact basket with fuel spheres 1.15 % enriched.

^c Tuff used as a reflector (Table 9).

See Attachment II, spreadsheet "scrapsMk1A.xls," sheet "575kg-horizontal."

In this particular configuration, the mass of fuel in the scrap basket has no effect on the k_{eff} of the waste package. Waste packages loaded with six scrap baskets are more reactive than waste packages loaded with two scrap baskets and four intact baskets.

6.1.2.6 Optimum Loading of Mark IA Intact Baskets

In this section, the optimum loading of the MCO intact basket is studied. Intact fuel elements are taken out of the intact basket. There is 575 kg in the scrap basket. The base case for this configuration is "1ev91a1," shown in Table 41 ($k_{eff}+2\sigma=0.8821$).

Table 57. Optimum Loading of Mark IA Intact Fuel Baskets

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	Comment ^a
1ev61n	0.8808	0.0006	0.8820	0.2828	Fuel element #1 Missing
1ev61o	0.8813	0.0006	0.8825	0.2812	Fuel element #2 Missing
1ev61p	0.8818	0.0006	0.8830	0.2830	Fuel element #3 Missing
1ev61q	0.8793	0.0006	0.8805	0.2873	Fuel element #4 Missing
1ev61r	0.8811	0.0006	0.8824	0.2846	Fuel element #5 Missing
1ev61s	0.8796	0.0006	0.8808	0.2866	Fuel element #6 Missing
1ev61t	0.8810	0.0007	0.8823	0.2864	Fuel element #7 Missing
1ev61u	0.8823	0.0007	0.8836	0.2826	Fuel element #8 Missing
1ev6101	0.8799	0.0006	0.8811	0.2802	Fuel element #9 Missing
1ev6111	0.8805	0.0006	0.8818	0.2849	Fuel element #10 Missing
1ev6121	0.8816	0.0006	0.8828	0.2833	Fuel element #11 Missing
1ev6131	0.8821	0.0006	0.8834	0.2804	Fuel element #12 Missing
1ev6141	0.8807	0.0006	0.8819	0.2851	Fuel element #13 Missing

Table 57. Optimum Loading of Mark IA Intact Fuel Baskets (Continued)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	Comment ^a
1ev6151	0.8801	0.0006	0.8813	0.2868	Fuel element #14 Missing
2ev61a	0.8807	0.0006	0.8819	0.2787	Fuel elements #1 & 9 Missing
2ev61b	0.8802	0.0006	0.8814	0.2779	Fuel elements #2 & 9 Missing
2ev61c	0.8806	0.0007	0.8819	0.2773	Fuel elements #3 & 9 Missing
2ev61d	0.8803	0.0006	0.8816	0.2759	Fuel elements #4 & 9 Missing
2ev61e	0.8801	0.0006	0.8813	0.2778	Fuel elements #5 & 9 Missing
2ev61f	0.8794	0.0006	0.8806	0.2811	Fuel elements #6 & 9 Missing
2ev61g	0.8812	0.0006	0.8825	0.2781	Fuel elements #7 & 9 Missing
2ev61h	0.8797	0.0007	0.8810	0.2742	Fuel elements #8 & 9 Missing
2ev61j	0.8799	0.0006	0.8811	0.2778	Fuel elements #10 & 9 Missing
2ev61k	0.8794	0.0006	0.8806	0.2776	Fuel elements #11 & 9 Missing
2ev61m	0.8773	0.0006	0.8785	0.2788	Fuel elements #12 & 9 Missing
2ev61n	0.8801	0.0006	0.8814	0.2770	Fuel elements #13 & 9 missing
2ev61o	0.8778	0.0007	0.8791	0.2777	Fuel elements #14 & 9 missing
2ev61p	0.8799	0.0006	0.8812	0.2718	Fuel elements #1, 8 & 9 missing
2ev61q	0.8782	0.0007	0.8795	0.2741	Fuel elements #2, 8 & 9 missing
2ev61r	0.8784	0.0006	0.8797	0.2756	Fuel elements #3, 8 & 9 missing
2ev61s	0.8798	0.0006	0.8810	0.2732	Fuel elements #4, 8 & 9 missing
2ev61t	0.8779	0.0007	0.8792	0.2727	Fuel elements #5, 8 & 9 missing
2ev61u	0.8785	0.0006	0.8798	0.2744	Fuel elements #6, 8 & 9 missing
2ev61v	0.8775	0.0006	0.8787	0.2745	Fuel elements #7, 8 & 9 missing
2ev61w	0.8796	0.0006	0.8808	0.2738	Fuel elements #10, 8 & 9 missing
2ev61x	0.8795	0.0006	0.8808	0.2740	Fuel elements #11, 8 & 9 missing
2ev61y	0.8783	0.0006	0.8795	0.2747	Fuel elements #12, 8 & 9 missing
2ev61z	0.8795	0.0006	0.8808	0.2732	Fuel elements #13, 8 & 9 missing
2ev610	0.8779	0.0006	0.8791	0.2722	Fuel elements #14, 8 & 9 missing
3ev61a	0.8805	0.0007	0.8818	0.2693	Fuel elements #1, 14, 8 & 9 missing
3ev61b	0.8790	0.0006	0.8803	0.2713	Fuel elements #2, 14, 8 & 9 missing
3ev61c	0.8797	0.0006	0.8809	0.2685	Fuel elements #3, 14, 8 & 9 missing
3ev61d	0.8779	0.0007	0.8792	0.2713	Fuel elements #4, 14, 8 & 9 missing
3ev61e	0.8793	0.0006	0.8806	0.2682	Fuel elements #5, 14, 8 & 9 missing
3ev61f	0.8784	0.0007	0.8797	0.2703	Fuel elements #6, 14, 8 & 9 missing
3ev61g	0.8798	0.0006	0.8810	0.2697	Fuel elements #7, 14, 8 & 9 missing
3ev61h	0.8794	0.0006	0.8806	0.2711	Fuel elements #10, 14, 8 & 9 missing
3ev61j	0.8791	0.0006	0.8804	0.2691	Fuel elements #11, 14, 8 & 9 missing
3ev61k	0.8797	0.0006	0.8810	0.2714	Fuel elements #12, 14, 8 & 9 missing
3ev61m	0.8770	0.0007	0.8783	0.2710	Fuel elements #13, 14, 8 & 9 missing
1ev61x	0.8784	0.0007	0.8797	0.2696	Random (total 5)
1ev61y	0.8766	0.0006	0.8778	0.2641	Random (total 8)
1ev61z	0.8748	0.0006	0.8761	0.2489	Random (total 18)
1ev61v	0.8767	0.0006	0.8779	0.2455	Random (total 12)
1ev61w	0.8777	0.0006	0.8789	0.2523	Random (total 18)

NOTE: ^aSee Figure 26.

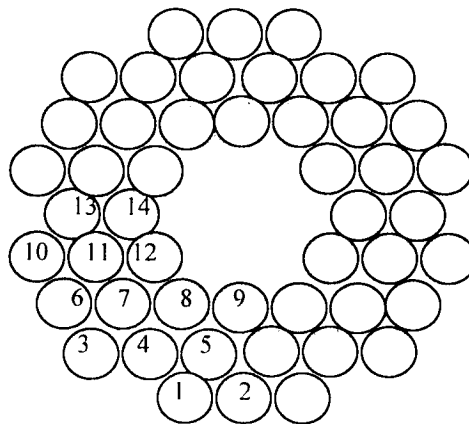


Figure 26. Numbering of the Fuel Elements for Mark IA

Results show that taking fuel elements out of the intact basket of the MCOs has a statistically insignificant effect on the k_{eff} (0.15 % increases in k_{eff} , which falls within the standard deviation) of a waste package.

6.1.3 Waste Package Loaded with both Fuel Elements

The k_{eff} of a waste package containing one MCO loaded with Mark IV fuel elements and one MCO loaded with Mark IA is 0.8692. σ is 0.0006. $k_{eff} + 2\sigma$ is equal to 0.8704 (see case "4_1A"), the average energy neutron causing fission is 0.34963 MeV. The MCO loaded with Mark IA fuel elements is in the same configuration as that of case "1ev91a1" (Table 41, $k_{eff}+2\sigma=0.8821$). The other MCO in the waste package is in the same configuration as that of case "4ev7a1" (Table 17, $k_{eff}+2\sigma=0.8601$).

6.2 DEGRADED MODE

As shown in the previous sections, MCOs containing Mark IA fuel elements are the most reactive. Therefore, the degraded mode criticality will only focus on waste packages containing two MCOs loaded with Mark IA fuel elements (unless otherwise specified). This section gives the results of the calculations presented in Section 5.5. Section 6.2.1 presents the results of the calculation where the inner components of the MCO (waste form and baskets) degrade before the high-level waste canister and the waste package basket (see Sections 5.5.1 and 5.5.2). Section 6.2.2 gives the results for the calculation where the internal components of the waste package (but external to the MCOs) degrade first (see Section 5.5.3). In the configurations studied in this section, the high-level waste and the waste package basket degrade before the inner components of the MCOs. Section 6.2.3 presents the results for a waste package with its components fully degraded (see Section 5.5.4). In the configurations studied, the MCOs are located in quadrants I and IV unless otherwise specified. The waste package is fully reflected unless otherwise specified, although this is a very conservative approach.

6.2.1 Inner Components of the MCO Degrade First

These configurations are the result of the scenario IP-1 from YMP (1998). The high-level waste glass canister and the waste package basket are intact. Water penetrates both MCOs and degrades the fuel elements and the MCO baskets and center post. k_{eff} for the cases where the fuel elements degrade first are given in Section 6.2.1.1. Section 6.2.1.2 lists the results for the cases where water degrades the baskets first. Section 6.2.1.3 shows the results of the calculations described in Section 5.5.2.3 where the MCO shells partially degrade. As a result of this degradation, the MCOs are fused together and their contents are mixed as shown in Figure 19.

6.2.1.1 Fuel Elements Degraded Before the MCO Basket

In this section, cases where the MCO basket is intact are investigated (see Section 5.5.1). The fuel elements are displaced and degraded. The following tables present the results.

Table 58 gives k_{eff} of configurations where the intact fuel elements are displaced towards the bottom of the MCO (Figure 11). Random configurations of the fuel elements of both fuel types (Mark IA and Mark IV) are investigated. The base cases are "4zv0221" (Table 14) and "1zv0121" (Table 32) for MCOs loaded with Mark IV and Mark IA fuel elements, respectively.

Table 58. Fuel Elements Collapsed on the Bottom of the Basket

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Comments
1Pcola	0.7965	0.0006	0.7975	0.4854	702.5	Fuel elements displaced (Mark IA)
1Pcolat ^a	0.7845	0.0006	0.7857	0.4930	702.5	Similar to previous case, but waste package reflected with dry tuff rock
1Pcolaw ^b	0.7801	0.0007	0.7124	0.4937	702.5	Similar to case 1Pcola, but waste package reflected with water
Pcola	0.7923	0.0006	0.7935	0.5795	646.9	Fuel elements displaced (Mark IV)

NOTES: See Attachment II spreadsheet "hX.xls."

^a Water reflected.

^b Tuff reflected (see Table 9).

Results show a decrease of 6.1% and 6.5% in k_{eff} for a waste package loaded with Mark IA fuel in a collapsed configuration and Mark IV fuel in a collapsed configuration, respectively.

Table 59 presents the k_{eff} of a waste package with degraded outer fuel elements in the intact basket. The degraded outer elements are represented as spheres of various radii and pitches (see Section 5.5.1). The inner fuel elements are in their original positions (Figure 12a).

Table 59. Outer of the Mark IA Fuel Elements Degraded as Sphere, Inners Still in Place
(575 kg in the scrap basket R=0.43185, Pitch=1.136 cm)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Particles Radius of the Degraded Outer Fuel Element	Pitch of the Degraded Outer Fuel Element
try11a	0.9137	0.0006	0.9149	0.3262	219.0	0.34055	0.866
try11aw ^a	0.8977	0.0006	0.8989	0.3333	219.0	0.34055	0.866
try11at ^b	0.9034	0.0006	0.9046	0.3321	219.0	0.34055	0.866
try11b	0.9079	0.0006	0.9090	0.3284	219.2	0.34055	0.857
try12a	0.9118	0.0005	0.9128	0.3249	219.2	0.29055	0.740
try12b	0.9053	0.0006	0.9065	0.3306	212.1	0.29055	0.732

NOTES: See Attachment II, spreadsheet "degradedMk1A.xls," sheet "48-horizontal."

^a Water reflected.

^b Tuff reflected (see Table 9).

The following table presents the k_{eff} of a waste package with degraded outer fuel elements as presented in the previous table but with the inner fuel elements lumped at the bottom of the intact basket (Figure 12b, see Section 5.5.1).

Table 60. Outer of the Mark IA Fuel Elements Degraded as Spheres, Inners Lumped at the Bottom of the MCO (575 kg in the scrap basket R=0.43185, pitch=1.136 cm)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Particles Radius of the Degraded Outer Fuel Element	Pitch of the Degraded Outer Fuel Element	Level of Scrap in the Intact Basket (from the bottom of the basket)
try21a	0.7485	0.0006	0.7496	0.2136	100.9	0.34055	0.681	31.221
try21b	0.8439	0.0006	0.8451	0.3673	215.2	0.34055	0.786	42.91
try21c	0.9322	0.0006	0.9334	0.2777	325.1	0.34055	0.866	Full
rot21c ^a	0.9307	0.0007	0.9320	0.2788	325.1	0.34055	0.866	Full
try21d ^b	0.9137	0.0006	0.9150	0.2869	325.1	0.34055	0.866	Full
try21e ^c	0.9191	0.0006	0.9203	0.2859	325.1	0.34055	0.866	Full
try22a	0.6896	0.0006	0.6908	0.6005	100.9	0.29055	0.581	31.221
try22b	0.8398	0.0006	0.8410	0.3793	215.2	0.29055	0.670	42.91
try22c	0.9260	0.0006	0.9273	0.2805	325.1	0.29055	0.740	Full
rot22c ^a	0.9259	0.0006	0.9271	0.2778	325.1	0.29055	0.740	Full

NOTES: ^a MCO positioned in quadrants III and IV as opposed to quadrants I and IV for the other cases (Figure 5)

^b Water reflected.

^c Tuff reflected (see Table 9).

See Attachment II, spreadsheet "degradedMk1A.xls," sheet "48-horizontal-lump."

Results show that k_{eff} varies significantly as a function of the pitch of the spheres. k_{eff} of the system increases as the pitch increases. This would require gravity to be defined during the degradation process: the fuel spheres are suspended in the MCOs.

In the next configuration, the outer fuel elements are fully degraded at the bottom of the intact basket. The inner fuel elements are lumped at the bottom of the intact basket (Figure 13, see

Section 5.5.1). The amount of water in the sludge varies. The scrap baskets are filled with either spheres or outer fuel elements. The results are given in Table 61.

Table 61. Outer of the Mark IA Fuel Elements Degraded as Sludge, Inners Lumped at the Bottom of the MCO (575 kg in the scrap basket R=0.43185, pitch=1.136 cm)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	% Water in the sludge	Type, Size of Fuel in the Scrap basket
6ev11	0.8622	0.0006	0.8634	0.2458	0	0	Sphere, R=0.43185, pitch=1.136
6ev12	0.8629	0.0006	0.8641	0.2478	19.6	15	Sphere, R=0.43185, pitch=1.136
6ev13	0.8632	0.0006	0.8644	0.2479	47.5	30	Sphere, R=0.43185, pitch=1.136
6ev14	0.8645	0.0006	0.8657	0.2507	90.8	45	Sphere, R=0.43185, pitch=1.136
6ev15	0.8637	0.0006	0.8650	0.2577	166.4	60	Sphere, R=0.43185, pitch=1.136
6ev16	0.8812	0.0007	0.8825	0.2692	325.1	74.56	Sphere, R=0.43185, pitch=1.136
6ev21	0.8903	0.0006	0.8916	0.3084	0	0	Outer fuel element, pitch=7.096
6ev22	0.8903	0.0006	0.8915	0.3090	19.6	15	Outer fuel element, pitch=7.096
6ev23	0.8905	0.0006	0.8916	0.3080	47.5	30	Outer fuel element, pitch=7.096
6ev24	0.8889	0.0006	0.8902	0.3099	90.8	45	Outer fuel element, pitch=7.096
6ev25	0.8930	0.0006	0.8943	0.3114	166.4	60	Outer fuel element, pitch=7.096
6ev26	0.8938	0.0006	0.8950	0.2818	325.1	74.56	Outer fuel element, pitch=7.096
6ev26t ^b	0.8848	0.0006	0.8861	0.2893	325.1	74.56	Similar to previous case, but waste package reflected with dry tuff
6ev26w ^a	0.8783	0.0006	0.8795	0.2896	325.1	74.56	Similar to previous case, but waste package reflected with water

NOTES: See Attachment II, spreadsheet "degradedMk1A.xls," sheet "48-horil-lump all outer degraded."

^a Water reflected.

^b Tuff reflected (see Table 9).

Complete degradation of the outer fuel elements results in a lower k_{eff} (up to 3 % lower when compared to case "1ev61a1" [Table 38]) for most of the cases. k_{eff} is slightly higher (0.13 %) than k_{eff} of the base case ("1ev02f1," Table 34) if the scrap basket is loaded with partially intact fuel elements.

The results for cases with all the fuel elements degraded as spheres (in both intact and scrap baskets) are reported in Section 6.1.2.5. A case was run where the scrap baskets are filled with scrap (575 kg of fuel homogenized over the whole volume) and the intact baskets are filled with spheres (representing 865 kg of degraded intact fuel elements enriched at 1.15 % [see spreadsheet "scrapsMk1A.xls," sheet "575kg-865kg-all-scrap-results"]). The results are given in Table 62.

Table 62. Degraded Fuel Represented as Spheres in the Intact and Degraded Baskets

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	Pitch/Sphere Radius in the Scrap Baskets	Pitch/Sphere Radius in the Intact Baskets
degrade	0.9281	0.0006	0.9293	0.3054	252.8	1.136/0.43185	1.015/0.43185
degrad2	0.8657	0.0006	0.8670	0.2728	123.8	1.136/0.43185	0.881/0.43185
degrad3 ^a	0.9120	0.0007	0.9133	0.3125	252.8	1.136/0.43185	1.015/0.43185
degrad4 ^b	0.9162	0.0006	0.9174	0.3107	252.8	1.136/0.43185	1.015/0.43185

NOTES: ^aWater as a reflector.^bTuff as a reflector (see composition Table 9).

Table 63 presents the results for the configurations where the fuel is fully degraded (see Figure 14, see Section 5.5.1). The volume percent of water in the sludge varies from 0 to 80.62. The MCOs are filled with a mixture of water and degraded product. The sludge is conservatively represented as 1.25% enriched compared to the actual average enrichment of 1.15%. Cases where some of fuel leaked out of the waste package are also investigated.

Table 63. Mark IA Fuel Elements Degraded as Sludge

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in the Sludge	% Water in the sludge	Level of the Sludge in the MCO (from the bottom of the MCO)
6ev31	0.4781	0.0005	0.4792	1.4585	0.0	0	19.23
6ev32	0.5198	0.0005	0.5208	1.2046	19.6	15	21.88
6ev33	0.6198	0.0005	0.6209	0.8753	47.5	30	26.37
6ev34	0.7284	0.0006	0.7296	0.6056	90.8	45	34.17
6ev35	0.9076	0.0006	0.9088	0.2254	232.5	67.7	Full
6ev35t ^b	0.8760	0.0006	0.8772	0.3219	232.5	67.7	Full
6ev35w ^a	0.8688	0.0007	0.8701	0.3239	232.5	67.7	Full
6ev36	0.8933	0.0007	0.8947	0.2843	258.3	70.9	Full with 90% of initial volume of the fuel
6ev37	0.8981	0.0007	0.8995	0.2531	290.6	74.2	Full with 80% of initial volume of the fuel
6ev38	0.8961	0.0006	0.8973	0.2223	322.1	77.4	Full with 70% of initial volume of the fuel
6ev39	0.8892	0.0006	0.8904	0.1931	387.4	80.6	Full with 60% of initial volume of the fuel

NOTES: See Attachment II, spreadsheet "degradedMk1A.xls," sheet "48-horizontal-allsludge."

^aWater as a reflector.^bTuff as a reflector (see composition Table 9).

Results show that the k_{eff} of the waste package increases with increasing volume of water in the sludge.

6.2.1.2 MCO Basket Degrades Before the Fuel Element

This section presents the results of the calculation described in Section 5.5.2. First, only the center post is degraded (Sections 6.2.1.2.1 and 6.2.1.2.2). The degradation of the basket shell and the basket plate are then considered (Section 6.2.1.2.3).

6.2.1.2.1 Center Post Falls at the Bottom of the MCO Basket

The k_{eff} of the configurations presented in Section 5.5.2.1 are shown in Table 64. Figure 15 shows the MCO in this configuration. The center post has fallen at the bottom of the MCO, displacing the fuel elements. The H/X is as that of Table 58.

Table 64. Center Post Falls to the Bottom of the MCO Basket
(Radius of the spheres is 0.43185cm)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	Comments
Basket Intact					
6ev52	0.8793	0.0007	0.8806	0.3137	Center post of the scrap basket still in place, center post of the intact basket at the bottom of the intact basket, intact fuel elements around (680kg of fuel in the scrap basket, pitch=1.074 cm).
6ev541	0.9739	0.0007	0.9752	0.2519	Center post of the scrap and intact basket at the bottom of the MCO baskets. (575kg of material in the scrap basket). Half-pitch of the scrap fuel= 0.56681 cm (i.e., fuel is distributed throughout the scrap basket)
6ev542	0.8314	0.0006	0.8326	0.4894	Center post of the scrap and intact basket at the bottom of the MCO baskets. (575kg of material in the scrap basket). Half-pitch of the scrap fuel= 0.43185 cm (i.e., fuel is settled at the bottom of the scrap basket in a rectangular array)
6ev543	0.9919	0.0006	0.9931	0.2394	same as 6ev541 with two scrap basket next to each other
6ev54w ^a	0.9805	0.0006	0.9817	0.2419	same as 6ev543 with water as a reflector
6ev54t ^b	0.9855	0.0006	0.9867	0.2399	same as 6ev543 with tuff as a reflector
6ev544	0.8317	0.0006	0.8329	0.4889	same as 6ev542 with two scrap basket next to each other
Basket Degraded					
7ev52	0.8716	0.0007	0.8729	0.3190	Center post of the scrap basket still in place, center post of the intact basket at the bottom of the Intact basket, intact fuel elements around (680kg of fuel in the scrap basket, pitch=1.074 cm).
7ev541	0.9666	0.0007	0.9679	0.2513	Center post of the scrap and intact basket at the bottom of the MCO baskets. (575kg of material in the scrap basket). Half-pitch of the scrap fuel= 0.56681 cm (i.e., fuel is distributed throughout the scrap basket)
7ev542	0.8263	0.0006	0.8275	0.4916	Center post of the scrap and intact basket at the bottom of the MCO baskets. (575kg of material in the scrap basket). Half-pitch of the scrap fuel= 0.43185 cm (i.e., fuel is settled at the bottom of the scrap basket in a rectangular array)
7ev543	0.9843	0.0006	0.9855	0.2411	same as 7ev541 with two scrap basket next to each other
7ev54w ^a	0.9724	0.0006	0.9737	0.2443	same as 7ev543 with water as a reflector
7ev54t ^b	0.9758	0.0006	0.9770	0.2421	same as 7ev543 with tuff as a reflector
7ev544	0.8253	0.0006	0.8265	0.4911	same as 7ev542 with two scrap basket next to each other

NOTES: See Attachment II, spreadsheet "degradedMk1A.xls," sheet "center post degrades."

^aWater as a reflector.

^bTuff as a reflector (see composition Table 9).

This configuration is very unlikely, as there are no physical mechanisms for the center post to snap. Furthermore, in the event of a break of the center post, the scrap fuel will not be homogenized over the entire volume available in the basket but rather be settled at the bottom of the basket. In this case (7ev542), k_{eff} of the waste package is well below the interim criticality limit.

6.2.1.2.2 Center Post Degrades and Expands

k_{eff} of the configuration presented in Section 5.5.2.1. Figure 16 shows the MCO in this configuration. In this case, the center post degrades and expands, rearranging the fuel elements in the baskets.

Table 65. Center Post Degrades and Expands

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	Comments
Basket Intact					
6ev51	0.8615	0.0006	0.8626	0.3496	The center post of the intact basket is degraded (FeOOH) and has expanded (R=11.51cm), 575 kg of fuel in the scrap basket.
6ev51 ^b	0.8685	0.0006	0.8697	0.3460	Similar to previous case, but the waste package is reflected with dry tuff
6ev51w ^a	0.8621	0.0006	0.8633	0.3492	Similar to previous case, but the waste package is reflected with water

NOTES: See Attachment II, spreadsheet "degradedMk1A.xls," sheet "center post degrades."

H/X is 282.6 in the intact basket.

^aWater as a reflector.

^bTuff as a reflector (see composition Table 9).

6.2.1.2.3 Center Post and Basket Fully Degraded

In this section, configurations where the center post and the baskets have fully degraded are investigated (see Section 5.5.2.2). The degradation products (FeOOH) are settled at the bottom of the MCO and mixed with various volume percents of water.

6.2.1.2.3.1 Fuel Elements Intact (in the intact baskets)

The results for the configuration shown in Figure 17 are given in Table 66. The fuel elements are intact and center post and the baskets shells are fully degraded. The products resulting from this degradation (goethite see Assumption 3.1) are at the bottom of the MCO in clay surrounding the fuel elements. Various volume percent of water are added to this clay.

Table 66. Fuel Elements Intact (in the intact baskets)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio ^c	% Water in the FeOOH	Comments
7ev411a	0.7971	0.0006	0.7982	0.3917	168.8	49.70	scrap pitch=1.136 ^a
7ev421a	0.8055	0.0006	0.8067	0.3975	196.6	55.00	scrap pitch=1.136 ^a
7ev431a	0.8303	0.0006	0.8315	0.3546	246.7	62.18	scrap pitch=1.136 ^a
7ev412a	0.7792	0.0006	0.7805	0.5421	168.8	49.70	scrap pitch=0.8367 ^a
7ev422a	0.7849	0.0006	0.7861	0.5324	196.6	55.00	scrap pitch=0.8367 ^a
7ev422 ^e	0.7754	0.0006	0.7766	0.5429	196.6	55.00	Similar to previous case, but waste package reflected with dry tuff
7ev422w ^d	0.7740	0.0006	0.7752	0.5453	196.6	55.00	Similar to previous case, but waste package reflected with water
7ev432a	0.7949	0.0006	0.7962	0.5236	246.7	62.18	scrap pitch=0.8367 ^a
7ev41b	0.8124	0.0006	0.8136	0.3867	757.8	49.70	scrap pitch=7.096 ^b
7ev42b	0.8003	0.0006	0.8015	0.4207	757.8	55.00	scrap pitch=7.096 ^b

Table 66. Fuel Elements Intact (in the intact baskets) (Continued)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio ^c	% Water in the FeOOH	Comments
7ev43b	0.8111	0.0006	0.8124	0.4173	757.8	62.18	scrap pitch=7.096 ^d

NOTES: ^a Scrap as spheres of radius=0.43185, total mass in the scrap basket is 575 kg.

^b Scrap as outer fuel element.

^c Averaged in the scrap basket.

^d Water as a reflector.

^e Tuff as a reflector (see composition Table 9).

See Attachment II, spreadsheets "degradedMk1A.xls," sheet "degraded basket" and "hX.xls," sheet 1.

In these cases, an increase of roughly 3% is noticed when the volume percent of water is increase in the clay resulting from the degradation of the center post.

6.2.1.2.3.2 Fuel elements Partially Degraded (inner intact)

The k_{eff} s of the configuration shown in Figure 18 (Section 5.5.2.2) are given in Table 67. The volume percent of water in the goethite resulting from the degradation of the center post varies. k_{eff} is also evaluated as a function of the pitch of the scrap in the intact and the degraded basket.

Table 67. Outer Fuel Elements Partially Degraded

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio ^a	% Water in the FeOOH in Scrap Basket/in Intact Basket	Pitch of Scrap (top and bottom basket) R=0.43185 cm (575 kg)	Pitch of Scrap (outer fuel element) R=0.34055 cm
6ev4111	0.9133	0.0005	0.9144	0.2630	140.9	0/0	1.136	0.786
6v4111 ^c	0.9103	0.0006	0.9115	0.2623	140.9	0/0	1.136	0.786
6v4111w ^b	0.9092	0.0007	0.9106	0.2620	140.9	0/0	1.136	0.786
6ev4112	0.6086	0.0005	0.6097	0.6677	140.9	0/0	0.864	0.786
6ev4121	0.9112	0.0006	0.9124	0.2617	91.7	0/0	1.136	0.681
6ev4122	0.5507	0.0005	0.5517	0.8631	91.7	0/0	0.864	0.681
6ev4211	0.8836	0.0006	0.8848	0.2691	177.9	20/20	1.136	0.786
6ev4212	0.6673	0.0005	0.6684	0.1054	177.9	20/20	0.864	0.786
6ev4221	0.8870	0.0006	0.8882	0.2665	115.7	20/20	1.136	0.681
6ev4222	0.5760	0.0006	0.5772	0.8598	115.7	20/20	0.864	0.681
6ev4311	0.8530	0.0006	0.8542	0.2990	213.8	39.47/64.5 (fully homogenized)	1.136	0.786
6ev4312	0.7891	0.0006	0.7903	0.5917	213.8	39.47/64.5 (fully homogenized)	0.864	0.786
6ev4321	0.8511	0.0005	0.8521	0.2978	139.1	39.47/64.5 (fully homogenized)	1.136	0.681
6ev4322	0.7828	0.0006	0.7840	0.6203	139.1	39.47/64.5 (fully homogenized)	0.864	0.681

NOTES: ^aIn the intact basket from the degraded outer fuel elements.

^bWater as a reflector.

^cTuff as a reflector (see composition Table 9).

See Attachment II, spreadsheet "degradedMk1A.xls," sheet "degraded basket."

k_{eff} is higher if the pitch of the fuel spheres in both the scrap and the intact baskets is maximized and there is no water in the MCO.

6.2.1.2.3.3 Outer Fuel elements Degraded (inner intact)

This section presents the k_{eff} of configurations where the center post is degraded as well as the outer fuel elements in the intact basket. The percentage of volume of water mixed in the degradation product varies. The results are given in Table 68.

Table 68. Outer Fuel Elements Degraded

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio in Sludge	% Water in the Degraded Products in Scrap Basket/in Intact Basket	Pitch of Scrap (top and bottom basket) R=0.43185 (575 kg)
6ev41d	0.9144	0.0006	0.9156	0.2618	70.8	0/0	1.136
6ev41dt ^b	0.9101	0.0006	0.9113	0.2606	70.8	0/0	1.136
6ev41dw ^a	0.9078	0.0006	0.9091	0.2607	70.8	0/0	1.136
6ev42d	0.8909	0.0006	0.8921	0.2655	184.7	20/20	1.136
6ev43d	0.8512	0.0006	0.8523	0.2715	374.6	40/40	1.136
6ev44d	0.8503	0.0006	0.8515	0.2527	479.6	64.5/47.29	1.136

NOTES: See Attachment II, spreadsheet "degradedMk1A.xls," sheet "degraded basket."

^bWater as a reflector.

^cTuff as a reflector (see composition Table 9).

Results shows that waste packages are more reactive if the outer fuel elements are fully degraded and settled at the bottom of the MCO baskets with no water. Adding water to the degradation product decreases k_{eff} by as much as 6%.

6.2.1.2.3.4 Fuel Elements Degraded

k_{eff} s of a waste package with two MCOs filled with degraded fuel elements (both inner and outer) and center post are given in Table 69. Various volumes of water are added to this mixture.

Table 69. Fuel Elements Degraded

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio	% Water in the FeOOH and Degraded Fuel Sludge
6ev41e	0.2873	0.0004	0.2881	0.6965	47.3	0
6ev42e	0.5163	0.0006	0.5174	0.2510	377.7	20
6ev43e	0.6558	0.0005	0.6569	0.1279	928.2	40
6ev44e	0.6772	0.0005	0.6781	0.1054	1226.5	47 (full)

NOTE: See Attachment II, spreadsheet "degradedMk1A.xls," sheet "degraded basket."

Results show that k_{eff} increases dramatically as water is added to the degraded mixture.

6.2.1.3 MCO Combinations

This Section presents the results of the calculations described in Figure 19 Section 5.5.2.3. Table 70 lists the k_{eff} of a waste package with two MCOs combined together after partial degradation of the MCO shells. In each of the cases investigated, the fuel is either intact (cladded) or fully degraded (sludge); there are no case with the fuel partially degraded (i.e., represented as spheres). Indeed, the degradation rate of the 314L stainless steel (material of the MCO shell) is lower (by at least two order of magnitude) than the degradation rate of U-metal (see CRWMS M&O 2000c, Table 4). Thus, if the MCO shell degrades, any uncladded U-metal has already degraded. The outer radius of the center post is reduced ($R=7$ cm rather than 8.41375 cm) to account for the degradation of the 314L stainless steel. The iron oxide resulting from this degradation is neglected.

Table 70. MCO Fused

File Name	k_{eff}	σ	$k_{\text{eff}} + 2\sigma$	AENCF (MeV)	H/X Ratio	Comments
fus1b	0.8552	0.0006	0.8565	0.4580	318.4	Fuel is intact at the bottom of the MCO, degradation product of the MCO internal structure neglected (MCO loaded with intact baskets only). See Figure 19a.
fus1a	0.8236	0.0006	0.8248	0.5310	150.0	Fuel is intact at the bottom of the MCO, degradation product of the MCO internal structure mixed with 45.35% of water settled at the bottom of the fused MCO (MCO loaded with intact baskets only). See Figure 19b.
fus2a	0.8361	0.0006	0.8372	0.5222	190.9	Fuel is intact at the bottom of the MCO, degradation product of the MCO internal structure mixed with 54.00% of water settled at the bottom of the fused MCO (MCO loaded with intact baskets only). See Figure 19b.
fus3a	0.8467	0.0006	0.8478	0.5110	251.0	Fuel is intact at the bottom of the MCO, degradation product of the MCO internal structure mixed with 62.69% of water settled at the bottom of the fused MCO (MCO loaded with intact baskets only). See Figure 19b.
fus1e ^a	0.5903	0.0005	0.5913	1.1561	0 ^b	Inner fuel elements are surrounded by the sludge resulting from the degradation of the outer fuel elements. There is 0 vol. % of water in the sludge. The degradation products of the basket are neglected. See Figure 19c.
fus2e ^a	0.6310	0.0006	0.6321	0.9768	25.27 ^b	Inner fuel elements are surrounded by the sludge resulting from the degradation of the outer fuel elements. There is 22.5 vol. % of water in the sludge. The degradation products of the basket are neglected. See Figure 19c.
fus3e ^a	0.7588	0.0006	0.7600	0.5864	106.7 ^b	Inner fuel elements are surrounded by the sludge resulting from the degradation of the outer fuel elements. There is 95 vol. % of water in the sludge. The degradation products of the basket are neglected. See Figure 19c.
fus1f	0.5079	0.0005	0.5088	1.3589	12.9	Fuel elements fully degraded mixed with 18.35 vol. % water, degradation product neglected. See Figure 19d.
fus2f	0.7630	0.0006	0.7642	0.6678	78.8	Fuel elements fully degraded mixed with 41.61 vol. % water, degradation product neglected. See Figure 19d.
fus3f	0.9482	0.0006	0.9495	0.2873	268.1	Fuel elements fully degraded mixed with 70.81 vol. % water, degradation product neglected. See Figure 19d.
fus4f	0.9087	0.0006	0.9099	0.3047	250.1	Fuel elements fully degraded and degradation product from the MCOs shell mixed with 62.39 vol. % water. See Figure 19d.

NOTES: ^aTuff as a reflector (see composition Table 9).

^bH/X in the degraded basket.

See Attachment II, spreadsheet "degradedMk1A.xls," sheet "mco fused together."

The k_{eff} of the waste package is below the interim criticality for the less unlikely configurations. It is very unlikely that all the degradation products will be flushed out of the waste package and that all the fuel stay in the MCO if both MCOs fuse.

6.2.2 Outer Components of the MCO Degrade First

This section gives the results of the calculations described in Section 5.5.3. Table 71 gives the k_{eff} of waste packages containing for MCOs intact surrounded by a pre-breach clay with various vol. % of water inside. Figure 20 shows the waste package in this configuration. The base cases used are 1zv0121 (Table 32, $k_{\text{eff}}+2\sigma=0.8490$), 1ev02f1 (Table 34, $k_{\text{eff}}+2\sigma=0.8937$), and 1eh91a1 (Table 49, $k_{\text{eff}}+2s=0.8731$).

Table 71. Intact MCO Surrounded by Pre-Breach Clay

File Name	k_{eff}	σ	$k_{\text{eff}} + 2\sigma$	AENCF (MeV)	H/X Ratio ^c	Comments
bzv01a1	0.8183	0.0007	0.8196	0.4368	189.1	Six intact basket with dry pre-breach clay at 6953 years
bzv01b1	0.8088	0.0007	0.8102	0.4410	189.1	Six intact basket with 20 vol. % of water in the pre-breach clay at 6953 years
bzv01c1	0.8100	0.0007	0.8113	0.4394	189.1	Six intact basket with 40 vol. % of water in the pre-breach clay at 6953 years
bzv01d1	0.8120	0.0007	0.8134	0.4380	189.1	Six intact basket with 61 vol. % of water in the pre-breach clay at 6953 years
bzv01a2	0.8345	0.0006	0.8357	0.4257	189.1	Six intact basket with dry pre-breach clay at 54250 years
bzv01a3	0.8365	0.0006	0.8376	0.4259	189.1	Similar to bzv01a2 but the thickness of the MCO is 0.635 cm (rather than 1.27 cm). The products resulting from the degradation of the MCO shell are neglected
bzv01t3	0.8351	0.0006	0.8364	0.4255	189.1	Similar to bzv01a3 but tuff relected
bzv01b2	0.8099	0.0006	0.8112	0.4394	189.1	Six intact basket with 20 vol. % of water in the pre-breach clay at 54250 years
bzv01c2	0.8103	0.0006	0.8116	0.4395	189.1	Six intact basket with 40 vol. % of water in the pre-breach clay at 54250 years
bzv01d2	0.8102	0.0007	0.8115	0.4397	189.1	Six intact basket with 67 vol. % of water in the pre-breach clay at 54250 years
bev02a1	0.8709	0.0007	0.8722	0.3224	724.5	The MCO is the same as in case 1ev02f1 (Table 34) and is surrounded by dry pre-breach clay at 6953 years
bev02b1	0.8615	0.0006	0.8627	0.3226	724.5	The MCO is the same as in case 1ev02f1 (Table 34) and is surrounded by pre-breach clay with 20 vol. % of water at 6953 years
bev02c1	0.8612	0.0007	0.8625	0.3251	724.5	The MCO is the same as in case 1ev02f1 (Table 34) and is surrounded by pre-breach clay with 40 vol. % of water at 6953 years
bev02d1	0.8649	0.0006	0.8661	0.3209	724.5	The MCO is the same as in case 1ev02f1 (Table 34) and is surrounded by pre-breach clay with 61 vol. % of water at 6953 years
bev02a2	0.8883	0.0006	0.8895	0.3168	724.5	The MCO is the same as in case 1ev02f1 (Table 34) and is surrounded by dry pre-breach clay at 54251 years
bev02a2 ^b	0.8882	0.0006	0.8894	0.3163	724.5	Similar to previous case, but waste package reflected with dry tuff
bev02a2w ^a	0.8885	0.0007	0.8899	0.3153	724.5	Similar to previous case, but waste package reflected with water
bev02a3	0.8893	0.0006	0.8906	0.3174	724.5	Similar to bev02a2 but the thickness of the MCO is 0.635 cm (rather than 1.27 cm). The products resulting from the degradation of the MCO shell are neglected
bev02b2	0.8589	0.0007	0.8603	0.3243	724.5	MCO is the same as in 1ev02f1 (Table 33) and is surrounded by pre-breach clay with 20 vol. % of water at 54251 years

Table 71. Intact MCO Surrounded by Pre-Breach Clay (Continued)

File Name	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio ^c	Comments
bev02c2	0.8619	0.0006	0.8631	0.3229	724.5	The MCO is the same as in case 1ev02f1 (Table 33) and is surrounded by pre-breach clay with 40 vol. % of water at 54251 years
bev02d2	0.8626	0.0007	0.8639	0.3246	724.5	The MCO is the same as in case 1ev02f1 (Table 33) and is surrounded by pre-breach clay with 67 vol. % of water at 54251 years
beh61a1	0.8440	0.0006	0.8453	0.2964	371.4	The MCO is the same as in case 1eh91a1 (Table 48) and is surrounded by dry pre-breach clay at 6953 years
beh61a2	0.8674	0.0006	0.8686	0.2762	371.4	The MCO is the same as in case 1eh91a1 (Table 48) and is surrounded by dry pre-breach clay at 54251 years

NOTES: See Attachment II, spreadsheet "pre-post-clay.xls," sheet "pre-breach."

^aWater as a reflector.

^bTuff as a reflector (see composition Table 9).

^cH/X ratio is given for the scrap basket and is identical to the one of the base-cases.

Results show that k_{eff} of the waste package is lower if the MCOs are surrounded with pre-breach clay.

A case where one of the MCO shell degrades while the other remains intact is depicted in Section 5.5.3 and Figure 21 (case named "partial"). The intact MCO is the same configuration than case "1zv0121" (Table 32, $k_{eff}+2\sigma=0.8490$). k_{eff} of a waste package in this configuration is 0.8478, σ is 0.0007, $k_{eff}+2\sigma$ is 0.8490. The average energy of a neutron causing fission is 0.4447. The degradation of only one MCO shell has no effect on the k_{eff} of the waste package.

6.2.3 Waste Package Components Degrade at the Same Time

This section presents the results of the calculations described in Section 5.5.4. Table 72 presents the results for the calculation where the fuel elements are the only intact components in the waste package (see Figure 23). Results for the calculation where the fuel elements partially degrade (fuel elements represented as sphere) are given in Table 73. Table 74 gives the k_{eff} of a waste package with all its internal components degraded (see Figure 22).

In the following table, results for waste package with degraded internal components (but intact fuel elements) are listed. Three clay compositions are investigated (depending on the time after emplacement). Water is added to the dry clay to find the most reactive composition. The pitch of the fuel elements is also varied.

Table 72. Everything Degraded, the Fuel Elements Intact

File Name	Pitch (cm)	Years after Emplacement	vol. % of Water	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio
p1y1v0	6.1	103210	0	0.7909	0.0006	0.7920	0.5594	279.8
p1y1v20	6.1	103210	20	0.8068	0.0006	0.8080	0.5432	340.5
p1y1v40	6.1	103210	40	0.8268	0.0006	0.8281	0.5265	401.1
p1y1v53	6.1	103210	53	0.8463	0.0006	0.8475	0.5141	413.4
p1y2v0	6.1	350290	0	0.7650	0.0006	0.7661	0.5925	195.4
p1y2v25	6.1	350290	25	0.7861	0.0006	0.7873	0.5695	292.3
p1y2v40	6.1	350290	40	0.8077	0.0007	0.8090	0.5490	335.1
p1y3v0	6.1	634080	0	0.7557	0.0006	0.7569	0.6100	156.7
p1y3v34	6.1	634080	34	0.8014	0.0006	0.8025	0.5674	290.1
p6y1v53	6.6	103210	53	0.8702	0.0006	0.8714	0.4564	498.5
p2y1v53	7.1	103210	53	0.8770	0.0006	0.8781	0.4170	590.3
p2y1v53 ^b	7.1	103210	53	0.8739	0.0006	0.8751	0.4163	590.3
p2y1v53w ^a	7.1	103210	53	0.8733	0.0006	0.8744	0.4181	590.3
p2y2v40	7.1	350290	40	0.8235	0.0006	0.8247	0.4519	478.5
p2y3v34	7.1	634080	34	0.8053	0.0006	0.8064	0.4775	414.2
p7y1v53	8.1	103210	53	0.8450	0.0006	0.8462	0.3753	794.1
p3y1v53	9.1	103210	53	0.7731	0.0006	0.7743	0.3692	1024.7
p3y2v40	9.1	350290	40	0.7142	0.0005	0.7152	0.4093	830.6
p3y3v34	9.1	634080	34	0.6914	0.0006	0.6925	0.4337	719.0
p4y1v53	12.1	103210	53	0.5398	0.0006	0.5409	0.4374	1877.3
p4y2v40	12.1	350290	40	0.4981	0.0005	0.4992	0.4860	1521.7
p4y3v34	12.1	634080	34	0.4825	0.0005	0.4835	0.5113	1317.3
p5y1v53	13.1	103210	53	0.4806	0.0005	0.4817	0.4749	2215.1
p5y2v40	13.1	350290	40	0.4441	0.0005	0.4452	0.5294	1795.6
p5y3v34	13.1	634080	34	0.4324	0.0005	0.4335	0.5483	1554.4
p8y1v0	7.1	105440	0	0.6323	0.0005	0.6334	0.6636	10.3
p8y1v25	7.1	105440	25	0.7115	0.0006	0.7126	0.5561	215.9
p8y1v50	7.1	105440	50	0.7809	0.0006	0.7821	0.48472	421.5
p8y1v75	7.1	105440	75.84	0.86495	0.00058	0.8661	0.4206	634.0
p8y2v0	7.1	634090	0	0.64964	0.00051	0.6507	0.6446	22.9
p8y2v25	7.1	634090	25	0.7189	0.0005	0.7200	0.5511	225.3
p8y2v49	7.1	634090	49.14	0.79261	0.00061	0.7938	0.4799	420.9

NOTES: The clay composition is taken from case 10 – second stage – without the U for all the cases in this table but p8y1v0, p8y1v25, p8y1v50, p8y1v75, p8y2v0, p8y2v25, p8y2v49. For these 7 cases, the clay is taken from case 8 of CRWMS M&O (2000c) (see Attachment II, spreadsheet "pre-post-clay.xls," sheet "case8"). See Attachment II, spreadsheet "pre-post-clay.xls," sheet "pre-post (all deg.fuel intact)."

^a Water as a reflector.

^b Tuff as a reflector (see composition Table 9).

The highest k_{eff} is obtained for a waste package emplaced after 103210 years and for clay homogenized over the entire volume of the waste package. The optimal pitch of the fuel elements is 7.1 cm.

In Table 73, the fuel elements start degrading and are represented as spheres. They are surrounded by various clay compositions (depending and the time after emplacement). The clay is homogenized over the entire volume available in the waste package.

Table 73. Everything Degraded, the Fuel Elements Represented as Spheres.

File Name	Years after Emplacement	Pitch (cm)	Radius (cm)	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio
y1p1r1	103210	0.864	0.432	0.7783	0.0006	0.7794	0.5804	80.0
y2p1r1	350290	0.864	0.432	0.7190	0.0006	0.7201	0.6546	65.1
y3p1r1	634080	0.864	0.432	0.6782	0.0006	0.6793	0.7065	56.3
y1p2r1	103210	1.364	0.432	0.8597	0.0005	0.8606	0.1885	572.9
y1p2r1t ^b	103210	1.364	0.432	0.8552	0.0004	0.8561	0.1894	572.9
y1p2r1w ^a	103210	1.364	0.432	0.8523	0.0005	0.8532	0.1894	572.9
y2p2r1	350290	1.364	0.432	0.7617	0.0005	0.7627	0.2238	466.4
y3p2r1	634080	1.364	0.432	0.7056	0.0005	0.7065	0.2497	403.1
y1p1r2	103210	0.464	0.232	0.7603	0.0006	0.7615	0.5944	80.0
y2p1r2	350290	0.464	0.232	0.7038	0.0006	0.7049	0.6609	65.1
y3p1r2	634080	0.464	0.232	0.6648	0.0006	0.6660	0.7166	56.3
y1p2r2	103210	0.864	0.232	0.7331	0.0004	0.7338	0.1386	996.4
y2p2r2	350290	0.864	0.232	0.6334	0.0004	0.6341	0.1692	811.3
y3p2r2	634080	0.864	0.232	0.5813	0.0004	0.5821	0.1943	701.0

NOTES:

See Attachment II, spreadsheet "pre-post-clay.xls," sheet "prepost (all deg, fuel sphere)."

For waste package emplaced for 103210 years, the water represents 60 % of the clay homogenized over the entire volume.

For waste package emplaced for 350290 years, the water represents 47 % of the clay homogenized over the entire volume.

For waste package emplaced for 634080 years, the water represents 40 % of the clay homogenized over the entire volume.

^a water as a reflector.

^b tuff as a reflector (see composition Table 9).

Results show that waste packages with partially degraded fuel elements surrounded by clay are less reactive than waste package with intact fuel elements.

As shown in Table 74, waste packages with their contents fully degraded (Figure 22) present no risk of criticality. In this configuration, water is added to the composition of the clay resulting from the degradation of the inner components of the waste package.

Table 74. Everything Degraded in the Waste Package (including the fuel element)

File Name	vol. % of Water	Years after Emplacement	k_{eff}	σ	$k_{eff} + 2\sigma$	AENCF (MeV)	H/X Ratio
dey1v0	0	103210	0.5922	0.0004	0.5930	0.2324	368.3
dey1v20	20	103210	0.6176	0.0004	0.6184	0.1641	676.9
dey1v39	39.41	103210	0.6062	0.0003	0.6068	0.1189	1171.2
dey2v0	0	350290	0.4520	0.0003	0.4527	0.2556	370.5
dey2v29	28.65	350290	0.4808	0.0003	0.4814	0.1495	996.2
dey3v0	0	634080	0.3755	0.0003	0.3760	0.2712	372.7
dey3v24	23.77	634080	0.4059	0.0002	0.4064	0.1741	944.1

NOTE: See Attachment II, spreadsheet "pre-post-clay.xls," sheet "post breach."

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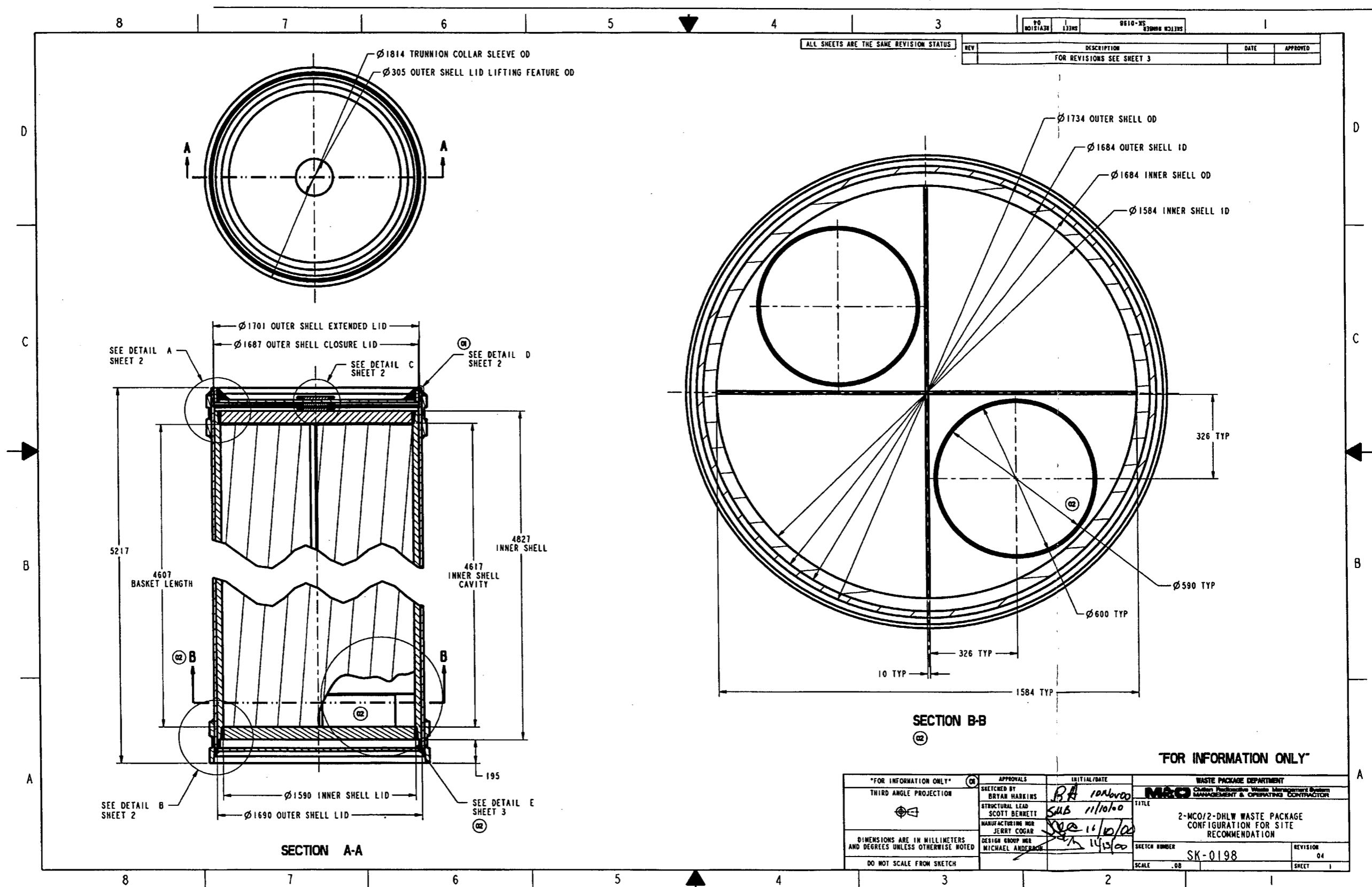
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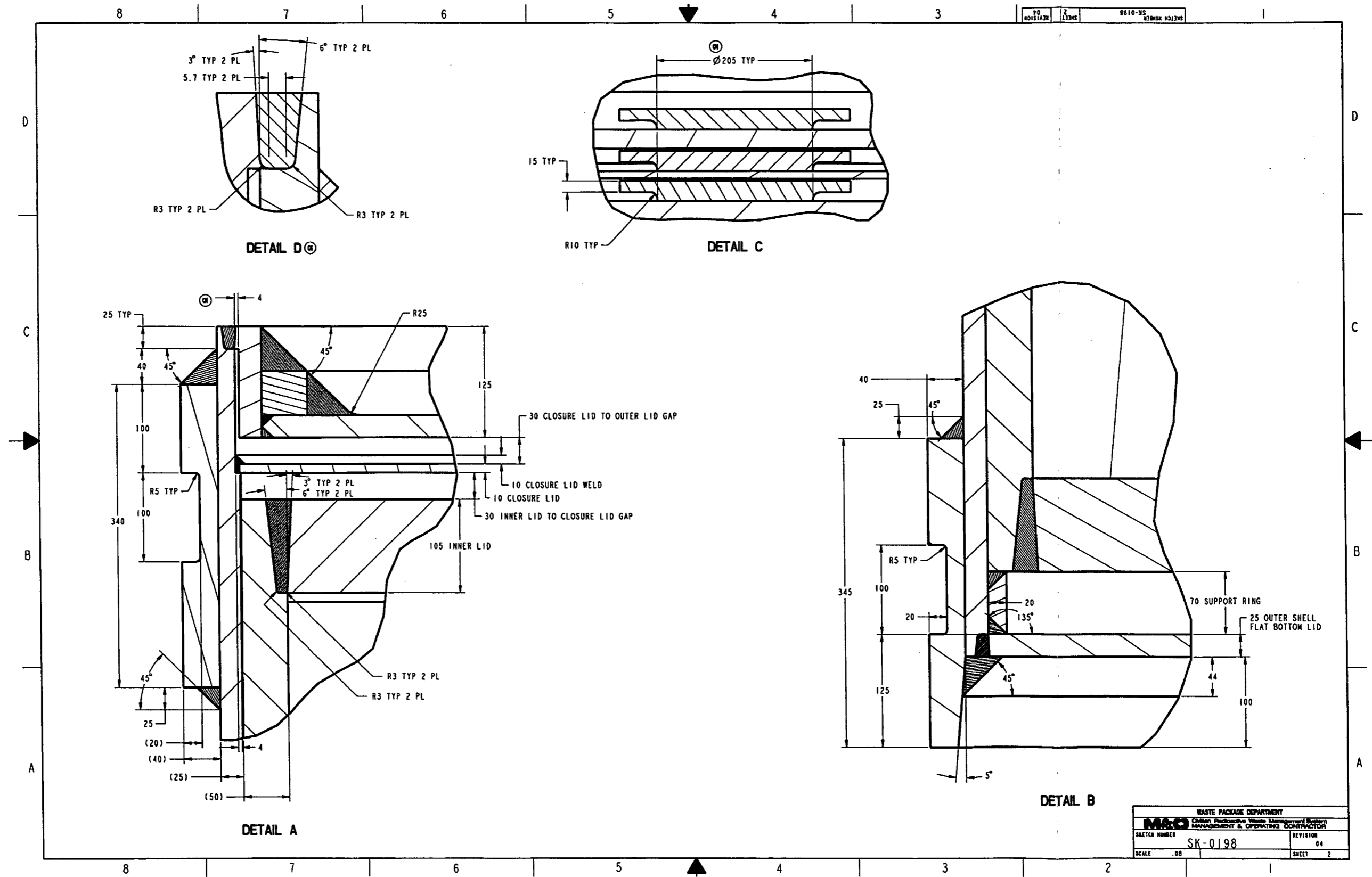
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8. ATTACHMENTS

- Attachment I: Sketches SK-0198 REV 04, *2-MCO/2-DHLW Waste Package Configuration for Site Recommendation*, 3 pages and SK-0199 REV 01, *2-MCO / 2-DHLW Waste Package Weld Configuration*, 1 page.
- Attachment II: One Compact disc (CD) containing the MCNP input and output files and the Excel spreadsheets.
- Attachment III: List of the electronic files located in the Attachment II, 48 pages.

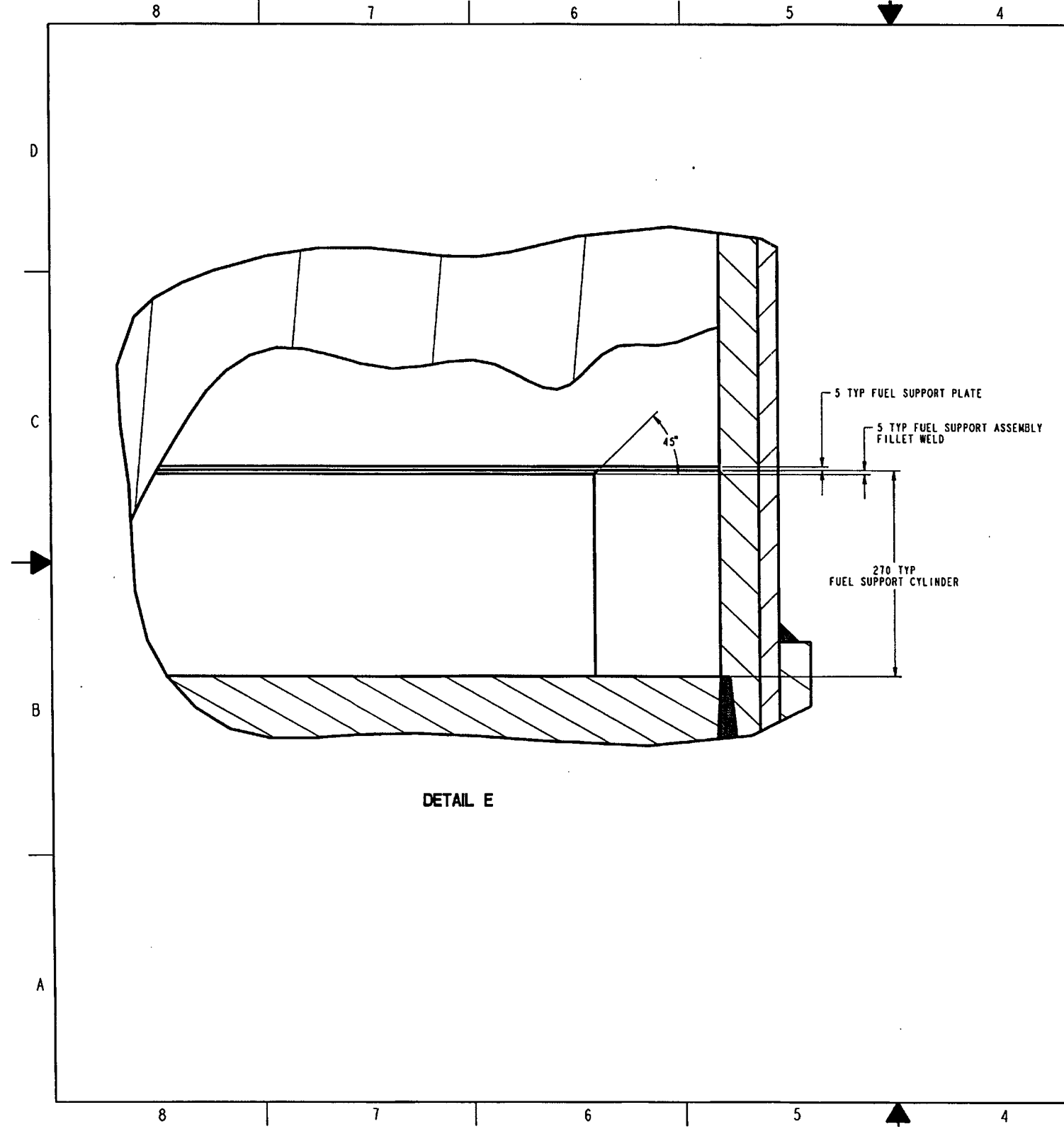


"FOR INFORMATION ONLY"		APPROVALS	INITIAL/DATE	WASTE PACKAGE DEPARTMENT
THIRD ANGLE PROJECTION	SKETCHED BY BRYAN HARRIS		BA 10/10/00	M&O Custom Packaging Waste Management System MANAGEMENT & OPERATING CONTRACTOR
	STRUCTURAL LEAD SCOTT BERNETT		SUB 11/10/00	TITLE 2-MCO/2-DHLW WASTE PACKAGE CONFIGURATION FOR SITE RECOMMENDATION
	MANUFACTURING MGR JERRY COGAR		See 11/10/00	SKETCH NUMBER SK-0198
	DESIGN GROUP MGR MICHAEL ANDERSON		11/10/00	REVISION 04
DIMENSIONS ARE IN MILLIMETERS AND DEGREES UNLESS OTHERWISE NOTED				SCALE .08
DO NOT SCALE FROM SKETCH				SHEET 1



SKETCH NUMBER SK-0198

WASTE PACKAGE DEPARTMENT	
M&O CHRYSLER FINANCIAL SERVICES MANAGEMENT & OPERATING CONTRACTOR	
SKETCH NUMBER	REVISION
SK-0198	04
SCALE .00	SHEET 2

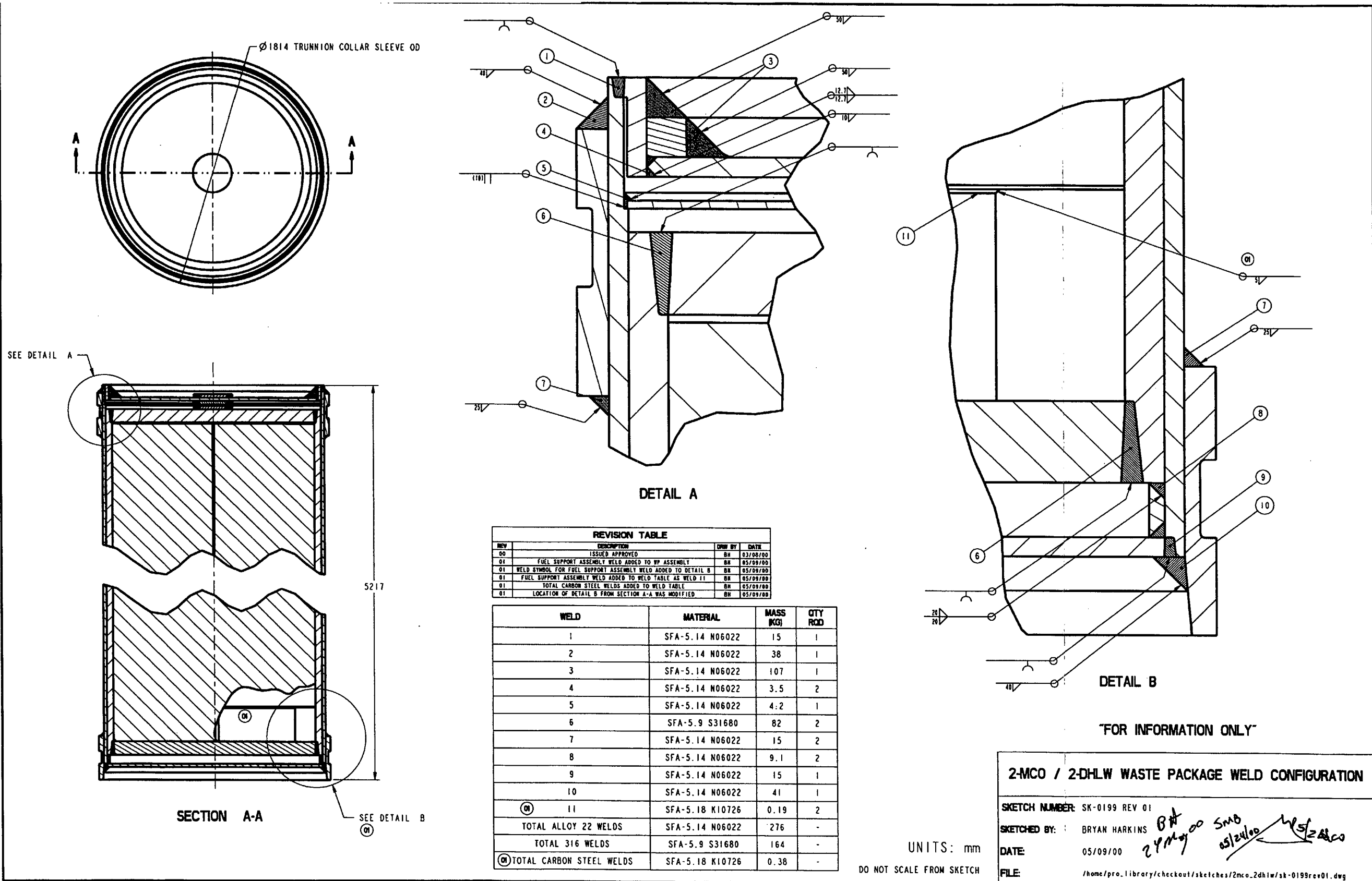


REV	DESCRIPTION	DRW BY	DATE
00	ISSUED APPROVED	DM	01/25/00
01	MASS 9743 "WAS" 9730, MASS 1641 "WAS" 1647, MASS 5897 "WAS" 4670, MASS 561 "WAS" 558, MASS 550 "WAS" 547, MASS 276 "WAS" 274, MASS 23801 "WAS" 21846, MASS 49300 "WAS" 48066, THICKNESS 25 "WAS" 20, SKETCHED BY "WAS" ORIGINATOR, "CREATED" DETAIL D, "ADDED" Ø TO DETAIL C, "DELETED" WELD DIMENSIONS FROM DETAIL A	BH	03/09/00
02	MASS 23159 "WAS" 23081, MASS 49378 "WAS" 49300, "ADDED" FUEL SUPPORT ASSEMBLY, "MODIFIED" COMPONENTS LIST, "CREATED" DETAIL E, "MOVED" COMPONENTS LIST TO SHEET 3, "MOVED" REVISION TABLE TO SHEET 3, "MODIFIED" REVISION TABLE FORMAT, "ADDED" DIMENSIONS TO SECTION B-B.	BH	05/18/00
03	DOE/RW-0351 "WAS" DOE/RW-0315P, "ADDED" NEW FORMAT, "MODIFIED" REVISION TABLE	EJC	06/09/00
04	8746.4 NCO MASS WAS 8909.6, REFERENCE CHANGED, 49052 LOADED WP MASS WAS 49378	BH	11/10/00

COMPONENT NAME	MATERIAL	THICKNESS	MASS (KG)	QTY	REQ
A-PLATE	SA-516 K02700	10	571	2	
(02) FUEL SUPPORT PLATE	SA-516 K02700	5	19	2	
(02) FUEL SUPPORT CYLINDER	SA-516 K02700	5	20	2	
INNER SHELL	SA-240 S31600	50	(01) 9743	1	
INNER SHELL LID	SA-240 S31600	105	(01) 1641	2	
INNER LID LIFTING FEATURE	SA-240 S31600	27	12	1	
OUTER SHELL	SB-575 N06022	(01) 25	(01) 5897	1	
EXTENDED OUTER SHELL LID	SB-575 N06022	25	146	1	
EXTENDED OUTER SHELL LID BASE	SB-575 N06022	25	450	1	
EXTENDED OUTER LID REINFORCING RING	SB-575 N06022	50	108	1	
OUTER LID LIFTING FEATURE	SB-575 N06022	27	13	2	
OUTER SHELL FLAT CLOSURE LID	SB-575 N06022	10	194	1	
OUTER SHELL FLAT BOTTOM LID	SB-575 N06022	25	484	1	
UPPER TRUNNION COLLAR SLEEVE	SB-575 N06022	40	(01) 561	1	
LOWER TRUNNION COLLAR SLEEVE	SB-575 N06022	40	(01) 550	1	
INNER SHELL SUPPORT RING	SB-575 N06022	20	45	1	
TOTAL ALLOY 22 WELDS	SFA-5.14 N06022	-	(01) 276	***	
TOTAL 316 WELDS	SFA-5.9 S31680	-	164	***	
(02) TOTAL CARBON STEEL WELDS	SFA-5.18 K10726	-	0.37	***	
WASTE PACKAGE ASSEMBLY	-	-	(01) (02) 23159	1	
HLW GLASS ASSEMBLY	-	-	4200*	2	
NCO	-	-	(04) 8746.4**	2	
WP ASSEMBLY WITH SNF	-	-	(01) (02) 49052 (04)	1	

* WASTE ACCEPTANCE SYSTEM REQUIREMENTS DOCUMENT, E0000000-00811-1708-00001 REV 03, DOE/RW-0351, ACC: N00.19990226.0001, PAGE 18, SECTION 4.2.3.1.A.4.
 (02) U.S. DEPARTMENT OF ENERGY 2000, N REACTOR (U-METAL) FUEL CHARACTERISTICS FOR DISPOSAL CRITICALITY ANALYSIS, DOE/SNF/REP-056 REV 0, U.S. DEPARTMENT OF ENERGY, TIC: 247956
 (04) ** SEE SK-0199 FOR WELD CONFIGURATION AND MASSES.

WASTE PACKAGE DEPARTMENT
 M&O
 SK-0198
 SCALE .08
 REVISION 04
 SHEET 3



REVISION TABLE			
REV	DESCRIPTION	DRN BY	DATE
00	ISSUED APPROVED	BH	03/09/00
01	FUEL SUPPORT ASSEMBLY WELD ADDED TO WP ASSEMBLY	BH	05/09/00
01	WELD SYMBOL FOR FUEL SUPPORT ASSEMBLY WELD ADDED TO DETAIL B	BH	05/09/00
01	FUEL SUPPORT ASSEMBLY WELD ADDED TO WELD TABLE AS WELD 11	BH	05/09/00
01	TOTAL CARBON STEEL WELDS ADDED TO WELD TABLE	BH	05/09/00
01	LOCATION OF DETAIL B FROM SECTION A-A WAS MODIFIED	BH	05/09/00

WELD	MATERIAL	MASS (KG)	QTY ROD
1	SFA-5.14 N06022	15	1
2	SFA-5.14 N06022	38	1
3	SFA-5.14 N06022	107	1
4	SFA-5.14 N06022	3.5	2
5	SFA-5.14 N06022	4.2	1
6	SFA-5.9 S31680	82	2
7	SFA-5.14 N06022	15	2
8	SFA-5.14 N06022	9.1	2
9	SFA-5.14 N06022	15	1
10	SFA-5.14 N06022	41	1
⑪	SFA-5.18 K10726	0.19	2
TOTAL ALLOY 22 WELDS		276	-
TOTAL 316 WELDS		164	-
⑪ TOTAL CARBON STEEL WELDS		0.38	-

"FOR INFORMATION ONLY"

2-MCO / 2-DHLW WASTE PACKAGE WELD CONFIGURATION

SKETCH NUMBER: SK-0199 REV 01
 SKETCHED BY: BRYAN HARKINS *BH*
 DATE: 05/09/00 *2 PM 9/00* *SMB*
 FILE: /home/pro_library/checkout/sketches/2mco_2dhlw/sk-0199rev01.dwg *05/24/00* *W/SZ/ACO*

UNITS: mm
 DO NOT SCALE FROM SKETCH

File Name	File Size or Directory Denomination	Date of Last Access	Time
Directory of D:\			
CD	<DIR>	01/30/2001	1:59p
Directory of D:\CD			
CD	<DIR>	01/30/2001	1:59p
degradedMkIA.xls	231,424	01/25/2001	3:41p
hX.xls	24,576	12/06/2000	6:12p
pre-post-clay.xls	136,704	12/19/2000	11:39a
scrapsMIV-vertical.xls	603,136	12/06/2000	6:42p
scrapsMkIA.xls	989,696	01/24/2001	4:03p
Tuff composition.xls	28,672	12/07/2000	7:26a
Directory of D:\CD\CD			
degraded	<DIR>	01/30/2001	1:59p
intact	<DIR>	01/30/2001	2:15p
Directory of D:\CD\CD\degraded			
6ev1_2_3	<DIR>	01/30/2001	1:59p
6ev4_5	<DIR>	01/30/2001	2:01p
degtable	<DIR>	01/30/2001	2:07p
fus	<DIR>	01/30/2001	2:07p
partial	21,982	12/08/2000	8:28a
partialcolap	<DIR>	01/30/2001	2:08p
partialo	399,560	12/08/2000	8:29a
postbreach	<DIR>	01/30/2001	2:09p
postintact	<DIR>	01/30/2001	2:09p
postsphere	<DIR>	01/30/2001	2:11p
prebreach	<DIR>	01/30/2001	2:13p
trytables	<DIR>	01/30/2001	2:14p
Directory of D:\CD\CD\degraded\6ev1_2_3			
6ev11	21,924	12/08/2000	8:29a
6ev11o	402,737	12/08/2000	8:29a
6ev12	21,934	12/08/2000	8:29a
6ev12o	403,605	12/08/2000	8:29a
6ev13	21,934	12/08/2000	8:29a
6ev13o	403,727	12/08/2000	8:29a
6ev14	21,940	12/08/2000	8:29a
6ev14o	402,935	12/08/2000	8:29a
6ev15	21,939	12/08/2000	8:29a
6ev15o	403,821	12/08/2000	8:29a
6ev16	21,823	12/08/2000	8:29a
6ev16o	403,516	12/08/2000	8:29a
6ev21	20,529	12/08/2000	8:29a
6ev21o	399,498	12/08/2000	8:29a
6ev22	20,521	12/08/2000	8:29a
6ev22o	399,403	12/08/2000	8:29a

File Name	File Size or Directory Denomination	Date of Last Access	Time
6ev23	20,521	12/08/2000	8:29a
6ev23o	399,208	12/08/2000	8:29a
6ev24	20,520	12/08/2000	8:29a
6ev24o	399,307	12/08/2000	8:29a
6ev25	20,520	12/08/2000	8:29a
6ev25o	399,304	12/08/2000	8:29a
6ev26	20,420	12/08/2000	8:29a
6ev26o	398,934	12/08/2000	8:29a
6ev26t	20,910	12/08/2000	8:29a
6ev26t.o	400,452	12/08/2000	8:29a
6ev26w	20,435	12/08/2000	8:29a
6ev26w.o	399,122	12/08/2000	8:29a
6ev31	10,845	12/08/2000	8:29a
6ev31o	354,453	12/08/2000	8:29a
6ev32	10,816	12/08/2000	8:29a
6ev32o	353,276	12/08/2000	8:29a
6ev33	10,815	12/08/2000	8:29a
6ev33o	352,628	12/08/2000	8:29a
6ev34	10,816	12/08/2000	8:29a
6ev34o	353,498	12/08/2000	8:29a
6ev35	10,708	12/08/2000	8:29a
6ev35o	350,658	12/08/2000	8:29a
6ev35t	11,025	12/08/2000	8:29a
6ev35to	354,557	12/08/2000	8:29a
6ev35w	10,701	12/08/2000	8:29a
6ev35wo	353,322	12/08/2000	8:29a
6ev36	10,708	12/08/2000	8:29a
6ev36o	352,996	12/08/2000	8:29a
6ev37	10,708	12/08/2000	8:29a
6ev37o	352,980	12/08/2000	8:29a
6ev38	10,708	12/08/2000	8:29a
6ev38o	353,314	12/08/2000	8:29a
6ev39	10,708	12/08/2000	8:29a
6ev39o	352,332	12/08/2000	8:29a
Directory of D:\CD\CD\degraded\6ev4_5			
6e4111t	20,706	12/08/2000	8:29a
6e4111to	402,644	12/08/2000	8:29a
6e4111w	20,249	12/08/2000	8:29a
6e4111wo	401,310	12/08/2000	8:29a
6ev4111	20,208	12/08/2000	8:29a
6ev4111o	401,179	12/08/2000	8:29a
6ev4112	20,223	12/08/2000	8:29a
6ev4112o	407,787	12/08/2000	8:29a

File Name	File Size or Directory Denomination	Date of Last Access	Time
6ev4121	20,220	12/08/2000	8:29a
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6ev4122	20,234	12/08/2000	8:29a
6ev4122o	405,783	12/08/2000	8:29a
6ev41d	19,886	12/08/2000	8:29a
6ev41do	399,408	12/08/2000	8:29a
6ev41dt	20,338	12/08/2000	8:29a
6ev41dto	401,065	12/08/2000	8:29a
6ev41dw	20,329	12/08/2000	8:29a
6ev41dwo	401,118	12/08/2000	8:29a
6ev41e	8,035	12/08/2000	8:29a
6ev41eo	345,515	12/08/2000	8:29a
6ev4211	20,218	12/08/2000	8:29a
6ev4211o	400,314	12/08/2000	8:29a
6ev4212	20,233	12/08/2000	8:29a
6ev4212o	408,214	12/08/2000	8:29a
6ev4221	20,230	12/08/2000	8:29a
6ev4221o	400,956	12/08/2000	8:29a
6ev4222	20,248	12/08/2000	8:29a
6ev4222o	406,906	12/08/2000	8:29a
6ev42d	19,901	12/08/2000	8:29a
6ev42do	399,583	12/08/2000	8:29a
6ev42e	8,034	12/08/2000	8:29a
6ev42eo	344,879	12/08/2000	8:29a
6ev4311	20,219	12/08/2000	8:29a
6ev4311o	402,242	12/08/2000	8:29a
6ev4312	20,232	12/08/2000	8:29a
6ev4312o	401,912	12/08/2000	8:29a
6ev4321	20,235	12/08/2000	8:29a
6ev4321o	401,924	12/08/2000	8:29a
6ev4322	20,246	12/08/2000	8:29a
6ev4322o	401,252	12/08/2000	8:29a
6ev43d	19,899	12/08/2000	8:29a
6ev43do	399,065	12/08/2000	8:30a
6ev43e	8,034	12/08/2000	8:30a
6ev43eo	344,561	12/08/2000	8:30a
6ev44d	19,844	12/08/2000	8:30a
6ev44do	400,099	12/08/2000	8:30a
6ev44e	8,031	12/08/2000	8:30a
6ev44eo	344,465	12/08/2000	8:30a
6ev51	22,855	12/08/2000	8:30a
6ev51b	20,551	12/08/2000	8:30a
6ev51bo	399,784	12/08/2000	8:30a

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6ev51o	409,838	12/08/2000	8:30a
6ev51t	22,850	12/08/2000	8:30a
6ev51to	409,249	12/08/2000	8:30a
6ev51w	22,850	12/08/2000	8:30a
6ev51wo	409,398	12/08/2000	8:30a
6ev52	22,989	12/08/2000	8:30a
6ev52o	405,410	12/08/2000	8:30a
6ev541	21,493	12/08/2000	8:30a
6ev541o	402,626	12/08/2000	8:30a
6ev542	21,493	12/08/2000	8:30a
6ev542o	403,580	12/08/2000	8:30a
6ev543	21,493	12/08/2000	8:30a
6ev543o	402,113	12/08/2000	8:30a
6ev544	21,493	12/08/2000	8:30a
6ev544o	403,786	12/08/2000	8:30a
6ev54t	21,815	12/08/2000	8:30a
6ev54to	403,094	12/08/2000	8:30a
6ev54w	21,486	12/08/2000	8:30a
6ev54wo	402,952	12/08/2000	8:30a
7ev411a	21,438	12/08/2000	8:30a
7ev411ao	402,768	12/08/2000	8:30a
7ev412a	21,447	12/08/2000	8:30a
7ev412ao	402,549	12/08/2000	8:30a
7ev41b	22,949	12/08/2000	8:30a
7ev41bo	410,901	12/08/2000	8:30a
7ev421ao	403,319	12/08/2000	8:30a
7ev422a	21,420	12/08/2000	8:30a
7ev422ao	403,956	12/08/2000	8:30a
7ev422t	21,917	12/08/2000	8:30a
7ev422to	403,474	12/08/2000	8:30a
7ev422w	21,456	12/08/2000	8:30a
7ev422wo	403,193	12/08/2000	8:30a
7ev42b	22,949	12/08/2000	8:30a
7ev42bo	411,222	12/08/2000	8:30a
7ev431a	21,331	12/08/2000	8:30a
7ev431ao	401,992	12/08/2000	8:30a
7ev432a	21,353	12/08/2000	8:30a
7ev432ao	402,517	12/08/2000	8:30a
7ev43b	22,946	12/08/2000	8:30a
7ev43bo	412,187	12/08/2000	8:30a
7ev52	23,140	12/08/2000	8:30a
7ev52o	405,624	12/08/2000	8:30a
7ev541	21,579	12/08/2000	8:30a

File Name	File Size or Directory Denomination	Date of Last Access	Time
7ev541o	401,731	12/08/2000	8:30a
7ev542	21,533	12/08/2000	8:30a
7ev542o	403,675	12/08/2000	8:30a
7ev543	21,589	12/08/2000	8:30a
7ev543o	403,111	12/08/2000	8:30a
7ev544	21,597	12/08/2000	8:30a
7ev544o	404,066	12/08/2000	8:30a
7ev54t	21,875	12/08/2000	8:30a
7ev54to	404,377	12/08/2000	8:30a
7ev54w	21,598	12/08/2000	8:30a
7ev54wo	403,325	12/08/2000	8:30a
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Directory of D:\CD\CD\degraded\6ev4_5\rev00a			
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6ev4111o	398,755	12/08/2000	8:30a
6ev4111t.i	20,707	12/08/2000	8:30a
6ev4111t.o	403,595	12/08/2000	8:30a
6ev4111w.i	20,250	12/08/2000	8:30a
6ev4111w.o	402,459	12/08/2000	8:30a
6ev4112	20,224	12/08/2000	8:30a
6ev4112o	402,673	12/08/2000	8:30a
6ev411a	21,436	12/08/2000	8:30a
6ev411ao	402,864	12/08/2000	8:30a
6ev4121	20,221	12/08/2000	8:30a
6ev4121o	399,493	12/08/2000	8:30a
6ev4122	20,235	12/08/2000	8:30a
6ev4122o	400,945	12/08/2000	8:30a
6ev412a	21,447	12/08/2000	8:30a
6ev412ao	403,737	12/08/2000	8:30a
6ev41b	22,948	12/08/2000	8:30a
6ev41bo	409,212	12/08/2000	8:30a
6ev41d	19,887	12/08/2000	8:30a
6ev41do	399,626	12/08/2000	8:30a
6ev41dt.i	20,386	12/08/2000	8:30a
6ev41dt.o	402,019	12/08/2000	8:30a
6ev41dw.i	19,928	12/08/2000	8:30a
6ev41dw.o	397,916	12/08/2000	8:30a
6ev41e	8,036	12/08/2000	8:30a
6ev41eo	344,243	12/08/2000	8:30a
6ev4211	20,218	12/08/2000	8:30a
6ev4211o	399,903	12/08/2000	8:31a
6ev4212	20,233	12/08/2000	8:31a
6ev4212o	403,196	12/08/2000	8:31a

File Name	File Size or Directory Denomination	Date of Last Access	Time
6ev421a	21,411	12/08/2000	8:31a
6ev421ao	403,507	12/08/2000	8:31a
6ev4221	20,230	12/08/2000	8:31a
6ev4221o	399,588	12/08/2000	8:31a
6ev4222	20,248	12/08/2000	8:31a
6ev4222o	403,189	12/08/2000	8:31a
6ev422a	21,420	12/08/2000	8:31a
6ev422ao	404,055	12/08/2000	8:31a
6ev422at.i	21,917	12/08/2000	8:31a
6ev422at.o	405,616	12/08/2000	8:31a
6ev422aw.i	21,456	12/08/2000	8:31a
6ev422aw.o	406,390	12/08/2000	8:31a
6ev42b	22,949	12/08/2000	8:31a
6ev42bo	410,682	12/08/2000	8:31a
6ev42d	19,901	12/08/2000	8:31a
6ev42do	399,503	12/08/2000	8:31a
6ev42e	8,034	12/08/2000	8:31a
6ev42eo	342,641	12/08/2000	8:31a
6ev4311	20,219	12/08/2000	8:31a
6ev4311o	400,652	12/08/2000	8:31a
6ev4312	20,232	12/08/2000	8:31a
6ev4312o	399,686	12/08/2000	8:31a
6ev431a	21,331	12/08/2000	8:31a
6ev431ao	403,180	12/08/2000	8:31a
6ev4321	20,235	12/08/2000	8:31a
6ev4321o	400,652	12/08/2000	8:31a
6ev4322	20,246	12/08/2000	8:31a
6ev4322o	399,662	12/08/2000	8:31a
6ev432a	21,353	12/08/2000	8:31a
6ev432ao	401,381	12/08/2000	8:31a
6ev43b	22,946	12/08/2000	8:31a
6ev43bo	411,014	12/08/2000	8:31a
6ev43d	19,899	12/08/2000	8:31a
6ev43do	400,133	12/08/2000	8:31a
6ev43e	8,034	12/08/2000	8:31a
6ev43eo	342,419	12/08/2000	8:31a
6ev44d	19,844	12/08/2000	8:31a
6ev44do	400,099	12/08/2000	8:31a
6ev44e	8,031	12/08/2000	8:31a
6ev44eo	343,607	12/08/2000	8:31a
6ev51o	403,324	12/08/2000	8:31a
6ev51t.i	22,854	12/08/2000	8:31a
6ev51t.o	416,084	12/08/2000	8:31a

File Name	File Size or Directory Denomination	Date of Last Access	Time
6ev51w.i	22,397	12/08/2000	8:31a
6ev51w.o	410,464	12/08/2000	8:31a
6ev53	20,676	12/08/2000	8:31a
Directory of D:\CD\CD\degraded\degtable			
degrad2	17,988	12/08/2000	8:31a
degrad2o	375,584	12/08/2000	8:31a
degrad3	17,888	12/08/2000	8:31a
degrad3o	375,691	12/08/2000	8:31a
degrad4	18,213	12/08/2000	8:31a
degrad4o	376,830	12/08/2000	8:31a
degrade	17,896	12/08/2000	8:31a
degradeo	375,357	12/08/2000	8:31a
rev0a	<DIR>	01/30/2001	2:07p
Directory of D:\CD\CD\degraded\degtable\rev0a			
degrad2o	376,436	12/08/2000	8:31a
degrad3	17,889	12/08/2000	8:31a
degrad3o	376,341	12/08/2000	8:31a
degrad4	18,212	12/08/2000	8:31a
degrad4o	377,576	12/08/2000	8:31a
degrade	17,896	12/08/2000	8:31a
degradeo	375,047	12/08/2000	8:31a
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fus1a	21,419	12/08/2000	8:31a
fus1ao	415,063	12/08/2000	8:31a
fus1b	21,407	12/08/2000	8:31a
fus1bo	420,197	12/08/2000	8:31a
fus1e	19,720	01/30/2001	1:48p
fus1eo	418,532	01/30/2001	1:48p
fus1f	11,178	12/08/2000	8:31a
fus1fo	353,352	12/08/2000	8:31a
fus2a	21,072	12/08/2000	8:31a
fus2ao	415,381	12/08/2000	8:31a
fus2e	19,712	01/30/2001	1:48p
fus2eo	416,906	01/30/2001	1:48p
fus2f	11,228	12/08/2000	8:31a
fus2fo	352,827	12/08/2000	8:31a
fus3a	21,070	12/08/2000	8:31a
fus3ao	416,569	12/08/2000	8:31a
fus3e	19,709	01/30/2001	1:48p
fus3eo	417,372	01/30/2001	1:48p
fus3f	11,230	12/08/2000	8:31a
fus3fo	351,735	12/08/2000	8:31a
fus4f	11,255	12/08/2000	8:31a

File Name	File Size or Directory Denomination	Date of Last Access	Time
fus4fo	352,346	12/08/2000	8:31a
rev00a	<DIR>	01/30/2001	2:08p
Directory of D:\CD\CD\degraded\fus\rev00a			
fus1c	20,137	12/08/2000	8:32a
fus1co	415,222	12/08/2000	8:32a
fus1d	19,824	12/08/2000	8:32a
fus1do	417,573	12/08/2000	8:32a
fus1e	20,470	12/08/2000	8:32a
fus1eo	418,297	12/08/2000	8:32a
fus2c	20,245	12/08/2000	8:32a
fus2co	417,248	12/08/2000	8:32a
fus2d	19,894	12/08/2000	8:32a
fus2do	423,989	12/08/2000	8:32a
fus2e	23,612	12/08/2000	8:32a
fus2eo	430,102	12/08/2000	8:32a
fus3c	20,566	12/08/2000	8:32a
fus3co	417,457	12/08/2000	8:32a
fus3d	22,511	12/08/2000	8:32a
fus3do	426,234	12/08/2000	8:32a
fus4c	21,080	12/08/2000	8:32a
fus4co	420,305	12/08/2000	8:32a
fus4d	22,595	12/08/2000	8:32a
fus4do	432,919	12/08/2000	8:32a
fus5d	23,029	12/08/2000	8:32a
fus5do	428,868	12/08/2000	8:32a
Directory of D:\CD\CD\degraded\partialcolap			
1Pcola	23,132	12/08/2000	8:32a
1Pcolao	407,670	12/08/2000	8:32a
1Pcolat	23,629	12/08/2000	8:32a
1Pcolato	409,418	12/08/2000	8:32a
1Pcolaw	23,170	12/08/2000	8:32a
1Pcolawo	408,182	12/08/2000	8:32a
Pcola	23,203	12/08/2000	8:32a
Pcolao	409,613	12/08/2000	8:32a
Directory of D:\CD\CD\degraded\postbreach			
dey1v0	4,210	12/08/2000	8:32a
dey1v0o	330,329	12/08/2000	8:32a
dey1v20	4,205	12/08/2000	8:32a
dey1v20o	329,495	12/08/2000	8:32a
dey1v39	4,204	12/08/2000	8:32a
dey1v39o	331,283	12/08/2000	8:32a
dey2v0	3,988	12/08/2000	8:32a
dey2v0o	329,268	12/08/2000	8:32a

File Name	File Size or Directory Denomination	Date of Last Access	Time
dey2v29	4,036	12/08/2000	8:32a
dey2v29o	329,586	12/08/2000	8:32a
dey3v0	2,976	12/08/2000	8:32a
dey3v0o	326,274	12/08/2000	8:32a
dey3v24	2,752	12/08/2000	8:32a
dey3v24o	326,276	12/08/2000	8:32a
Directory of D:\CD\CD\degraded\postintact			
p1y1v0	13,214	12/08/2000	8:32a
p1y1v0o	360,610	12/08/2000	8:32a
p1y1v20	13,210	12/08/2000	8:32a
p1y1v20o	359,644	12/08/2000	8:32a
p1y1v40	13,217	12/08/2000	8:32a
p1y1v40o	360,928	12/08/2000	8:32a
p1y1v53	13,216	12/08/2000	8:32a
p1y1v53o	360,928	12/08/2000	8:32a
p1y2v25	12,947	12/08/2000	8:32a
p1y2v25o	358,790	12/08/2000	8:32a
p1y2v40	12,987	12/08/2000	8:32a
p1y2v40o	358,584	12/08/2000	8:32a
p1y3v0	12,654	12/08/2000	8:32a
p1y3v0o	358,221	12/08/2000	8:32a
p1y3v34	12,650	12/08/2000	8:32a
p1y3v34o	358,214	12/08/2000	8:32a
p2y1v53	10,931	12/08/2000	8:32a
p2y1v53o	352,296	12/08/2000	8:32a
p2y1v53t.i	11,629	12/08/2000	8:32a
p2y1v53t.o	353,366	12/08/2000	8:32a
p2y1v53w.i	11,176	12/08/2000	8:32a
p2y1v53w.o	353,281	12/08/2000	8:32a
p2y2v40	10,706	12/08/2000	8:32a
p2y2v40o	351,140	12/08/2000	8:32a
p2y3v34	10,450	12/08/2000	8:32a
p2y3v34o	348,929	12/08/2000	8:32a
p3y1v53	11,138	12/08/2000	8:32a
p3y1v53o	353,026	12/08/2000	8:32a
p3y2v40	10,911	12/08/2000	8:32a
p3y2v40o	351,717	12/08/2000	8:32a
p3y3v34	10,653	12/08/2000	8:32a
p3y3v34o	350,720	12/08/2000	8:32a
p4y1v53	11,157	12/08/2000	8:32a
p4y1v53o	353,869	12/08/2000	8:32a
p4y2v40	10,915	12/08/2000	8:32a
p4y2v40o	350,816	12/08/2000	8:32a

File Name	File Size or Directory Denomination	Date of Last Access	Time
p4y3v34	10,680	12/08/2000	8:32a
p4y3v34o	349,689	12/08/2000	8:32a
p5y1v53	11,316	12/08/2000	8:32a
p5y1v53o	352,760	12/08/2000	8:32a
p5y2v40	11,067	12/08/2000	8:32a
p5y2v40o	349,913	12/08/2000	8:32a
p5y3v34	10,833	12/08/2000	8:32a
p5y3v34o	351,228	12/08/2000	8:32a
p6y1v53	10,926	12/08/2000	8:32a
p6y1v53o	352,200	12/08/2000	8:33a
p7y1v53	10,931	12/08/2000	8:33a
p7y1v53o	350,274	12/08/2000	8:33a
p8y1v0	12,679	12/08/2000	8:33a
p8y1v0o	359,199	12/08/2000	8:33a
p8y1v25	12,662	12/08/2000	8:33a
p8y1v25o	358,992	12/08/2000	8:33a
p8y1v50	12,693	12/08/2000	8:33a
p8y1v50o	360,296	12/08/2000	8:33a
p8y1v75	12,653	12/08/2000	8:33a
p8y1v75o	360,632	12/08/2000	8:33a
p8y2v0	11,825	12/08/2000	8:33a
p8y2v0o	355,698	12/08/2000	8:33a
p8y2v25	11,738	12/08/2000	8:33a
p8y2v25o	354,404	12/08/2000	8:33a
p8y2v49	11,815	12/08/2000	8:33a
p8y2v49o	356,538	12/08/2000	8:33a
rev00a	<DIR>	01/30/2001	2:11p
Directory of D:\CD\CD\degraded\postintact\rev00a			
p8y1v25	12,662	12/08/2000	8:33a
p8y1v25o	360,164	12/08/2000	8:33a
p8y1v50	12,693	12/08/2000	8:33a
p8y1v50o	360,090	12/08/2000	8:33a
p8y2v25	11,738	12/08/2000	8:33a
p8y2v25o	355,392	12/08/2000	8:33a
Directory of D:\CD\CD\degraded\postsphere			
rev00a	<DIR>	01/30/2001	2:11p
y1p1r1	5,937	12/10/2000	3:12p
y1p1r1o	335,672	12/10/2000	3:12p
y1p1r2	5,943	12/10/2000	3:12p
y1p1r2o	338,966	12/10/2000	3:12p
y1p2r1	5,937	12/10/2000	3:12p
y1p2r1o	338,012	12/10/2000	3:12p
y1p2r1t	6,631	12/10/2000	3:12p

File Name	File Size or Directory Denomination	Date of Last Access	Time
y1p2r1to	339,394	12/10/2000	3:12p
y1p2r1w	6,182	12/10/2000	3:12p
y1p2r1wo	339,299	12/10/2000	3:12p
y1p2r2	5,936	12/10/2000	3:12p
y1p2r2o	338,950	12/10/2000	3:12p
y2p1r1	5,663	12/10/2000	3:12p
y2p1r1o	336,532	12/10/2000	3:12p
y2p1r2	5,663	12/10/2000	3:12p
y2p1r2o	336,976	12/10/2000	3:12p
y2p2r1	5,662	12/10/2000	3:12p
y2p2r1o	335,661	12/10/2000	3:12p
y2p2r2	5,662	12/10/2000	3:12p
y2p2r2o	336,336	12/10/2000	3:13p
y3p1r1	5,324	12/10/2000	3:13p
y3p1r1o	336,040	12/10/2000	3:13p
y3p1r2	5,322	12/10/2000	3:13p
y3p1r2o	336,994	12/10/2000	3:13p
y3p2r1	5,322	12/10/2000	3:13p
y3p2r1o	334,252	12/10/2000	3:13p
y3p2r2	5,321	12/10/2000	3:13p
y3p2r2o	334,888	12/10/2000	3:13p
Directory of D:\CD\CD\degraded\postsphere\rev00a			
y1p1r1o	338,436	12/08/2000	8:33a
y1p1r2	5,943	12/08/2000	8:33a
y1p1r2o	339,072	12/08/2000	8:33a
y1p2r1	5,937	12/08/2000	8:33a
y1p2r1o	338,022	12/08/2000	8:33a
y1p2r1t.i	6,631	12/08/2000	8:33a
y1p2r1t.o	340,226	12/08/2000	8:33a
y1p2r1w.i	6,182	12/08/2000	8:33a
y1p2r1w.o	339,093	12/08/2000	8:33a
y1p2r2	5,936	12/08/2000	8:33a
y1p2r2o	339,072	12/08/2000	8:33a
y2p1r1	5,663	12/08/2000	8:33a
y2p1r1o	337,280	12/08/2000	8:33a
y2p1r2	5,663	12/08/2000	8:33a
y2p1r2o	337,046	12/08/2000	8:33a
y2p2r1	5,662	12/08/2000	8:33a
y2p2r1o	336,644	12/08/2000	8:33a
y2p2r2	5,662	12/08/2000	8:33a
y2p2r2o	337,280	12/08/2000	8:33a
y3p1r1	5,324	12/08/2000	8:33a
y3p1r1o	336,146	12/08/2000	8:33a

File Name	File Size or Directory Denomination	Date of Last Access	Time
y3p1r2	5,322	12/08/2000	8:33a
y3p1r2o	334,958	12/08/2000	8:33a
y3p2r1	5,322	12/08/2000	8:33a
y3p2r1o	334,358	12/08/2000	8:33a
y3p2r2	5,321	12/08/2000	8:33a
y3p2r2o	336,146	12/08/2000	8:33a
Directory of D:\CD\CD\degraded\prebreach			
beh61a1	20,580	12/08/2000	8:33a
beh61a1o	380,397	12/08/2000	8:33a
beh61a2	20,900	12/08/2000	8:33a
beh61a2o	380,187	12/08/2000	8:33a
bev02a1	23,717	12/08/2000	8:33a
bev02a1o	386,101	12/08/2000	8:33a
bev02a2	24,037	12/08/2000	8:33a
bev02a2o	386,761	12/08/2000	8:33a
bev02a2t.i	24,537	12/08/2000	8:33a
bev02a2t.o	388,442	12/08/2000	8:33a
bev02a2w.i	24,078	12/08/2000	8:33a
bev02a2w.o	386,117	12/08/2000	8:33a
bev02a3	24,037	12/08/2000	8:33a
bev02a3o	386,857	12/08/2000	8:33a
bev02b1	24,169	12/08/2000	8:33a
bev02b1o	386,616	12/08/2000	8:33a
bev02b2	23,994	12/08/2000	8:33a
bev02b2o	387,492	12/08/2000	8:33a
bev02c1	24,169	12/08/2000	8:33a
bev02c1o	386,927	12/08/2000	8:33a
bev02c2	23,926	12/08/2000	8:33a
bev02c2o	387,588	12/08/2000	8:33a
bev02d1	24,090	12/08/2000	8:33a
bev02d1o	388,020	12/08/2000	8:33a
bev02d2	23,991	12/08/2000	8:33a
bev02d2o	387,386	12/08/2000	8:33a
bzv01a1	20,484	12/08/2000	8:33a
bzv01a1o	375,708	12/08/2000	8:33a
bzv01a2	21,092	12/08/2000	8:33a
bzv01a2o	375,847	12/08/2000	8:33a
bzv01a3	21,093	12/08/2000	8:33a
bzv01a3o	374,695	12/08/2000	8:33a
bzv01b1	20,861	12/08/2000	8:33a
bzv01b1o	376,121	12/08/2000	8:34a
bzv01b2	20,685	12/08/2000	8:34a
bzv01b2o	376,096	12/08/2000	8:34a

File Name	File Size or Directory Denomination	Date of Last Access	Time
bzv01c1	20,861	12/08/2000	8:34a
bzv01c1o	376,121	12/08/2000	8:34a
bzv01c2	20,550	12/08/2000	8:34a
bzv01c2o	376,103	12/08/2000	8:34a
bzv01d1	20,857	12/08/2000	8:34a
bzv01d1o	376,340	12/08/2000	8:34a
bzv01d2	20,750	12/08/2000	8:34a
bzv01d2o	374,819	12/08/2000	8:34a
bzv01t3	21,415	12/08/2000	8:34a
bzv01t3o	377,729	12/08/2000	8:34a
Directory of D:\CD\CD\degraded\trytables			
rev00a	<DIR>	01/30/2001	2:14p
rot21c	21,916	12/08/2000	8:34a
rot21co	408,948	12/08/2000	8:34a
rot22c	21,914	12/08/2000	8:34a
rot22co	409,514	12/08/2000	8:34a
try11a	22,265	12/08/2000	8:34a
try11ao	408,630	12/08/2000	8:34a
try11at	22,587	12/08/2000	8:34a
try11ato	410,294	12/08/2000	8:34a
try11aw	22,258	12/08/2000	8:34a
try11awo	408,957	12/08/2000	8:34a
try11b	22,669	12/08/2000	8:34a
try11bo	409,438	12/08/2000	8:34a
try12a	22,265	12/08/2000	8:34a
try12ao	408,078	12/08/2000	8:34a
try12b	22,360	12/08/2000	8:34a
try12bo	409,695	12/08/2000	8:34a
try21a	22,346	12/08/2000	8:34a
try21ao	406,767	12/08/2000	8:34a
try21b	22,334	12/08/2000	8:34a
try21bo	410,258	12/08/2000	8:34a
try21c	21,912	12/08/2000	8:34a
try21co	407,442	12/08/2000	8:34a
try21d	21,905	12/08/2000	8:34a
try21do	409,282	12/08/2000	8:34a
try21e	22,233	12/08/2000	8:34a
try21eo	410,612	12/08/2000	8:34a
try22a	22,346	12/08/2000	8:34a
try22ao	412,421	12/08/2000	8:34a
try22b	22,333	12/08/2000	8:34a
try22bo	411,149	12/08/2000	8:34a
try22c	21,912	12/08/2000	8:34a

File Name	File Size or Directory Denomination	Date of Last Access	Time
try22co	408,214	12/08/2000	8:34a
Directory of D:\CD\CD\degraded\trytables\rev00a			
try11b	22,360	12/08/2000	8:34a
try11bo	409,059	12/08/2000	8:34a
Directory of D:\CD\CD\intact			
4_1A	33,919	12/08/2000	8:34a
4_1Ao	422,554	12/08/2000	8:34a
MK1A	<DIR>	01/30/2001	2:15p
MKIV	<DIR>	01/30/2001	2:38p
Directory of D:\CD\CD\intact\MK1A			
1bur111	21,018	12/08/2000	8:34a
1bur111o	379,385	12/08/2000	8:34a
1bur121	21,012	12/08/2000	8:34a
1bur121o	380,573	12/08/2000	8:34a
1bur131	21,021	12/08/2000	8:34a
1bur131o	384,460	12/08/2000	8:34a
1bur141	21,021	12/08/2000	8:34a
1bur141o	381,965	12/08/2000	8:34a
1zv0111	20,659	12/08/2000	8:34a
1zv0111.o	379,079	12/08/2000	8:34a
1zv0121	20,659	12/08/2000	8:34a
1zv0121.o	377,891	12/08/2000	8:34a
1zv0122	20,659	12/08/2000	8:34a
1zv0122.o	377,891	12/08/2000	8:34a
1zv0123	20,659	12/08/2000	8:34a
1zv0123.o	379,079	12/08/2000	8:34a
1zv0124	20,659	12/08/2000	8:34a
1zv0124.o	379,079	12/08/2000	8:34a
1zv0131	20,659	12/08/2000	8:34a
1zv0131.o	383,490	12/08/2000	8:34a
1zv0141	20,659	12/08/2000	8:34a
1zv0141.o	380,789	12/08/2000	8:34a
1zv0221	20,660	12/08/2000	8:34a
1zv0221.o	377,891	12/08/2000	8:34a
1zv0321	20,659	12/08/2000	8:34a
1zv0321.o	379,079	12/08/2000	8:34a
hlwrun1	20,747	12/08/2000	8:34a
hlwrun1o	377,971	12/08/2000	8:34a
hlwrun2	20,747	12/08/2000	8:35a
hlwrun2o	377,971	12/08/2000	8:35a
raiser	21,101	12/08/2000	8:35a
raisero	381,111	12/08/2000	8:35a
scrap	<DIR>	01/30/2001	2:16p

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scrap-all-basket	<DIR>	01/30/2001	2:30p
scrap-horizontal	<DIR>	01/30/2001	2:36p
zr effect	<DIR>	01/30/2001	2:38p
Directory of D:\CD\CD\intact\MK1A\scrap			
330kg	<DIR>	01/30/2001	2:16p
4uv71a1	19,514	12/08/2000	8:35a
4uv71a1o	379,979	12/08/2000	8:35a
4uv71a2	19,514	12/08/2000	8:35a
4uv71a2o	379,859	12/08/2000	8:35a
4uv81a1	19,514	12/08/2000	8:35a
4uv81a1o	380,177	12/08/2000	8:35a
4uv91a1	19,515	12/08/2000	8:35a
4uv91a1o	380,849	12/08/2000	8:35a
530kg	<DIR>	01/30/2001	2:17p
575kg	<DIR>	01/30/2001	2:19p
630kg	<DIR>	01/30/2001	2:23p
655kg	<DIR>	01/30/2001	2:24p
680kg	<DIR>	01/30/2001	2:24p
700kg	<DIR>	01/30/2001	2:25p
730kg	<DIR>	01/30/2001	2:25p
930kg	<DIR>	01/30/2001	2:27p
cylinders	<DIR>	01/30/2001	2:28p
Directory of D:\CD\CD\intact\MK1A\scrap\330kg			
1ev40a1	20,494	12/08/2000	8:35a
1ev40a1.o	382,979	12/08/2000	8:35a
1ev40b1	20,494	12/08/2000	8:35a
1ev40b1.o	381,827	12/08/2000	8:35a
1ev40b2	20,494	12/08/2000	8:35a
1ev40b2.o	382,979	12/08/2000	8:35a
1ev40c1	20,494	12/08/2000	8:35a
1ev40c1.o	381,997	12/08/2000	8:35a
1ev40d1	20,506	12/08/2000	8:35a
1ev40d1.o	382,979	12/08/2000	8:35a
1ev41a1	20,494	12/08/2000	8:35a
1ev41a1.o	382,979	12/08/2000	8:35a
1ev41b1	20,494	12/08/2000	8:35a
1ev41b1.o	381,791	12/08/2000	8:35a
1ev41c1	20,494	12/08/2000	8:35a
1ev41c1.o	382,979	12/08/2000	8:35a
1ev41f1	20,506	12/08/2000	8:35a
1ev41f1.o	382,979	12/08/2000	8:35a
1ev44a1	20,494	12/08/2000	8:35a
1ev44a1.o	381,791	12/08/2000	8:35a

File Name	File Size or Directory Denomination	Date of Last Access	Time
1ev44b1	20,494	12/08/2000	8:35a
1ev44b1.o	382,979	12/08/2000	8:35a
1ev44c1	20,494	12/08/2000	8:35a
1ev44c1.o	380,639	12/08/2000	8:35a
1ev44f1	20,506	12/08/2000	8:35a
1ev44f1.o	381,791	12/08/2000	8:35a
1ev47a1	20,494	12/08/2000	8:35a
1ev47a1.o	382,019	12/08/2000	8:35a
1ev47b1	20,494	12/08/2000	8:35a
1ev47b1.o	382,979	12/08/2000	8:35a
1ev47e1	20,506	12/08/2000	8:35a
1ev47e1.o	382,979	12/08/2000	8:35a
Directory of D:\CD\CD\intact\MK1A\scrap\530kg			
1ev30a1	20,494	12/08/2000	8:35a
1ev30a1.o	383,102	12/08/2000	8:35a
1ev30b1	20,494	12/08/2000	8:35a
1ev30b1.o	383,297	12/08/2000	8:35a
1ev30c1	20,494	12/08/2000	8:35a
1ev30c1.o	382,979	12/08/2000	8:35a
1ev30d1	20,494	12/08/2000	8:35a
1ev30d1.o	382,979	12/08/2000	8:35a
1ev31a1	20,494	12/08/2000	8:35a
1ev31a1.o	383,198	12/08/2000	8:35a
1ev31a2	20,494	12/08/2000	8:35a
1ev31a2.o	383,201	12/08/2000	8:35a
1ev31b1	20,494	12/08/2000	8:35a
1ev31b1.o	383,201	12/08/2000	8:35a
1ev31c1	20,494	12/08/2000	8:35a
1ev31c1.o	382,979	12/08/2000	8:35a
1ev31g1	20,506	12/08/2000	8:35a
1ev31g1.o	382,979	12/08/2000	8:35a
1ev34a1	20,494	12/08/2000	8:35a
1ev34a1.o	383,297	12/08/2000	8:35a
1ev34b1	20,494	12/08/2000	8:35a
1ev34b1.o	383,297	12/08/2000	8:35a
1ev34c1	20,494	12/08/2000	8:35a
1ev34c1.o	382,337	12/08/2000	8:35a
1ev34g1	20,506	12/08/2000	8:36a
1ev34g1.o	380,831	12/08/2000	8:36a
1ev37a1	20,494	12/08/2000	8:36a
1ev37a1.o	382,109	12/08/2000	8:36a
1ev37b1	20,494	12/08/2000	8:36a
1ev37b1.o	383,297	12/08/2000	8:36a

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1ev37c1	20,494	12/08/2000	8:36a
1ev37c1.o	381,827	12/08/2000	8:36a
Directory of D:\CD\CD\intact\MK1A\scrap\575kg			
1ev50a1	20,494	12/08/2000	8:36a
1ev6101	20,494	12/08/2000	8:36a
1ev6101o	381,900	12/08/2000	8:36a
1ev6111	20,494	12/08/2000	8:36a
1ev6111o	381,890	12/08/2000	8:36a
1ev6121	20,494	12/08/2000	8:36a
1ev6121o	380,903	12/08/2000	8:36a
1ev6131	20,494	12/08/2000	8:36a
1ev6131o	381,893	12/08/2000	8:36a
1ev6141	20,494	12/08/2000	8:36a
1ev6141o	382,106	12/08/2000	8:36a
1ev6151	20,494	12/08/2000	8:36a
1ev6151o	381,900	12/08/2000	8:36a
1ev61n	20,494	12/08/2000	8:36a
1ev61no	380,903	12/08/2000	8:36a
1ev61o	20,494	12/08/2000	8:36a
1ev61oo	381,900	12/08/2000	8:36a
1ev61p	20,494	12/08/2000	8:36a
1ev61po	381,900	12/08/2000	8:36a
1ev61q	20,494	12/08/2000	8:36a
1ev61qo	381,989	12/08/2000	8:36a
1ev61r	20,497	12/08/2000	8:36a
1ev61ro	381,995	12/08/2000	8:36a
1ev61s	20,497	12/08/2000	8:36a
1ev61so	381,124	12/08/2000	8:36a
1ev61t	20,497	12/08/2000	8:36a
1ev61to	382,084	12/08/2000	8:36a
1ev61u	20,497	12/08/2000	8:36a
1ev61uo	381,005	12/08/2000	8:36a
1ev61v	20,497	12/08/2000	8:36a
1ev61vo	381,896	12/08/2000	8:36a
1ev61w	20,494	12/08/2000	8:36a
1ev61wo	381,989	12/08/2000	8:36a
1ev61x	20,494	12/08/2000	8:36a
1ev61xo	381,989	12/08/2000	8:36a
1ev61y	20,559	12/08/2000	8:36a
1ev61yo	380,998	12/08/2000	8:36a
1ev61z	20,497	12/08/2000	8:36a
1ev61zo	380,998	12/08/2000	8:36a
1ev91a1	20,493	12/08/2000	8:36a

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1ev91a1o	382,854	12/08/2000	8:36a
1ev91b1	20,496	12/08/2000	8:36a
1ev91b1o	382,755	12/08/2000	8:36a
1ev91c1	20,496	12/08/2000	8:36a
1ev91c1o	382,950	12/08/2000	8:36a
1ev91d1	20,494	12/08/2000	8:36a
1ev91d1o	382,632	12/08/2000	8:36a
1ev93a1	20,493	12/08/2000	8:36a
1ev93a1o	382,847	12/08/2000	8:36a
1ev93b1	20,498	12/08/2000	8:36a
1ev93b1o	382,854	12/08/2000	8:36a
1ev93c1	20,498	12/08/2000	8:36a
1ev93c1o	382,950	12/08/2000	8:36a
1ev93d1	20,504	12/08/2000	8:36a
1ev93d1o	381,444	12/08/2000	8:37a
1ev95a1	20,493	12/08/2000	8:37a
1ev95a1o	382,854	12/08/2000	8:37a
1ev95b1	20,493	12/08/2000	8:37a
1ev95b1o	381,974	12/08/2000	8:37a
1ev95c1	20,493	12/08/2000	8:37a
1ev95c1o	381,480	12/08/2000	8:37a
1ev95d1	20,498	12/08/2000	8:37a
1ev95d1o	381,672	12/08/2000	8:37a
1ev97a1	20,487	12/08/2000	8:37a
1ev97a1o	382,847	12/08/2000	8:37a
1ev97b1	20,498	12/08/2000	8:37a
1ev97b1o	381,798	12/08/2000	8:37a
1ev97c1	20,495	12/08/2000	8:37a
1ev97c1o	382,632	12/08/2000	8:37a
1ev97d1	20,494	12/08/2000	8:37a
1ev97d1o	380,682	12/08/2000	8:37a
1ev99a1	20,498	12/08/2000	8:37a
1ev99a1o	382,847	12/08/2000	8:37a
1ev99b1	20,496	12/08/2000	8:37a
1ev99b1o	382,950	12/08/2000	8:37a
1ev99c1	20,498	12/08/2000	8:37a
1ev99c1o	382,632	12/08/2000	8:37a
1ev99d1	20,495	12/08/2000	8:37a
1ev99d1o	381,444	12/08/2000	8:37a
2ev610	20,497	12/08/2000	8:37a
2ev610o	381,995	12/08/2000	8:37a
2ev61a	20,497	12/08/2000	8:37a
2ev61ao	381,995	12/08/2000	8:37a

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2ev61b	20,497	12/08/2000	8:37a
2ev61bo	381,889	12/08/2000	8:37a
2ev61c	20,497	12/08/2000	8:37a
2ev61co	380,800	12/08/2000	8:37a
2ev61d	20,497	12/08/2000	8:37a
2ev61do	381,988	12/08/2000	8:37a
2ev61e	20,497	12/08/2000	8:37a
2ev61eo	381,995	12/08/2000	8:37a
2ev61f	20,497	12/08/2000	8:37a
2ev61fo	381,988	12/08/2000	8:37a
2ev61g	20,497	12/08/2000	8:37a
2ev61go	382,084	12/08/2000	8:37a
2ev61h	20,494	12/08/2000	8:37a
2ev61ho	381,890	12/08/2000	8:37a
2ev61j	20,494	12/08/2000	8:37a
2ev61jo	381,893	12/08/2000	8:37a
2ev61k	20,497	12/08/2000	8:37a
2ev61ko	381,988	12/08/2000	8:38a
2ev61m	20,497	12/08/2000	8:38a
2ev61mo	381,995	12/08/2000	8:38a
2ev61n	20,497	12/08/2000	8:38a
2ev61no	381,988	12/08/2000	8:38a
2ev61o	20,497	12/08/2000	8:38a
2ev61oo	381,988	12/08/2000	8:38a
2ev61p	20,497	12/08/2000	8:38a
2ev61po	381,988	12/08/2000	8:38a
2ev61q	20,497	12/08/2000	8:38a
2ev61qo	382,084	12/08/2000	8:38a
2ev61r	20,497	12/08/2000	8:38a
2ev61ro	381,006	12/08/2000	8:38a
2ev61s	20,494	12/08/2000	8:38a
2ev61so	381,006	12/08/2000	8:38a
2ev61t	20,497	12/08/2000	8:38a
2ev61to	381,094	12/08/2000	8:38a
2ev61u	20,497	12/08/2000	8:38a
2ev61uo	382,290	12/08/2000	8:38a
2ev61v	20,497	12/08/2000	8:38a
2ev61vo	380,903	12/08/2000	8:38a
2ev61w	20,497	12/08/2000	8:38a
2ev61wo	381,988	12/08/2000	8:38a
2ev61x	20,494	12/08/2000	8:38a
2ev61xo	380,903	12/08/2000	8:38a
2ev61y	20,497	12/08/2000	8:38a

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2ev61yo	382,194	12/08/2000	8:38a
2ev61z	20,497	12/08/2000	8:38a
2ev61zo	382,084	12/08/2000	8:38a
3ev61a	20,497	12/08/2000	8:38a
3ev61ao	381,988	12/08/2000	8:38a
3ev61b	20,497	12/08/2000	8:38a
3ev61bo	382,084	12/08/2000	8:38a
3ev61c	20,497	12/08/2000	8:38a
3ev61co	382,011	12/08/2000	8:38a
3ev61d	20,497	12/08/2000	8:38a
3ev61do	382,084	12/08/2000	8:38a
3ev61e	20,497	12/08/2000	8:38a
3ev61eo	382,084	12/08/2000	8:38a
3ev61f	20,497	12/08/2000	8:38a
3ev61fo	382,107	12/08/2000	8:38a
3ev61g	20,497	12/08/2000	8:38a
3ev61go	381,995	12/08/2000	8:38a
3ev61h	20,497	12/08/2000	8:38a
3ev61ho	381,995	12/08/2000	8:38a
3ev61j	20,497	12/08/2000	8:38a
3ev61jo	382,084	12/08/2000	8:38a
3ev61k	20,497	12/08/2000	8:38a
3ev61ko	382,084	12/08/2000	8:38a
3ev61m	20,497	12/08/2000	8:38a
3ev61mo	381,094	12/08/2000	8:38a
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1ev50a1	20,494	12/08/2000	8:38a
1ev50a1.o	383,201	12/08/2000	8:39a
1ev50b1	20,494	12/08/2000	8:39a
1ev50b1.o	383,297	12/08/2000	8:39a
1ev50c1	20,494	12/08/2000	8:39a
1ev50c1.o	382,979	12/08/2000	8:39a
1ev50d1	20,506	12/08/2000	8:39a
1ev50d1.o	381,791	12/08/2000	8:39a
1ev51a1	20,494	12/08/2000	8:39a
1ev51a1.o	382,300	12/08/2000	8:39a
1ev51a2	20,494	12/08/2000	8:39a
1ev51a2.o	383,297	12/08/2000	8:39a
1ev51b1	20,494	12/08/2000	8:39a
1ev51b1.o	383,201	12/08/2000	8:39a
1ev51c1	20,494	12/08/2000	8:39a
1ev51c1.o	382,979	12/08/2000	8:39a
1ev51d1	20,506	12/08/2000	8:39a

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1ev51d1.o	382,979	12/08/2000	8:39a
1ev54a1	20,494	12/08/2000	8:39a
1ev54a1.o	383,194	12/08/2000	8:39a
1ev54b1	20,494	12/08/2000	8:39a
1ev54b1.o	383,201	12/08/2000	8:39a
1ev54c1	20,494	12/08/2000	8:39a
1ev54c1.o	382,979	12/08/2000	8:39a
1ev54d1	20,506	12/08/2000	8:39a
1ev54d1.o	382,979	12/08/2000	8:39a
1ev57a1	20,494	12/08/2000	8:39a
1ev57a1.o	382,211	12/08/2000	8:39a
1ev57b1	20,494	12/08/2000	8:39a
1ev57b1.o	383,297	12/08/2000	8:39a
1ev57c1	20,494	12/08/2000	8:39a
1ev57c1.o	382,979	12/08/2000	8:39a
Directory of D:\CD\CD\intact\MK1A\scrap\655kg			
1ev71a1	20,494	12/08/2000	8:39a
1ev71a1.o	382,950	12/08/2000	8:39a
1ev71a2	20,494	12/08/2000	8:39a
1ev71a2.o	381,762	12/08/2000	8:39a
1ev71b1	20,494	12/08/2000	8:39a
1ev71b1.o	381,762	12/08/2000	8:39a
1ev72a1	20,494	12/08/2000	8:39a
1ev72a1.o	382,847	12/08/2000	8:39a
1ev72b1	20,494	12/08/2000	8:39a
1ev72b1.o	380,610	12/08/2000	8:39a
Directory of D:\CD\CD\intact\MK1A\scrap\680kg			
1ev61a1	20,494	12/08/2000	8:39a
1ev61a1.o	383,503	12/08/2000	8:39a
1ev61a2	20,494	12/08/2000	8:39a
1ev61a2.o	382,006	12/08/2000	8:39a
1ev61b1	20,494	12/08/2000	8:39a
1ev61b1.o	382,102	12/08/2000	8:39a
1ev61c1	20,494	12/08/2000	8:39a
1ev61c1.o	381,827	12/08/2000	8:39a
1ev61k1	20,590	12/08/2000	8:39a
1ev61k1.o	383,623	12/08/2000	8:39a
1ev61m1	20,491	12/08/2000	8:39a
1ev61m1.o	382,088	12/08/2000	8:39a
1ev62a1	20,494	12/08/2000	8:39a
1ev62a1.o	383,201	12/08/2000	8:39a
1ev62b1	20,494	12/08/2000	8:39a
1ev62b1.o	382,307	12/08/2000	8:39a

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1ev62c1	20,494	12/08/2000	8:39a
1ev62c1.o	381,791	12/08/2000	8:39a
1uv61a1	20,571	12/08/2000	8:39a
1uv61a1.o	383,289	12/08/2000	8:39a
1uv61a2	20,571	12/08/2000	8:39a
1uv61a2.o	382,949	12/08/2000	8:39a
1uv62a1	20,571	12/08/2000	8:39a
1uv62a1.o	382,942	12/08/2000	8:39a
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1ev81a1	20,494	12/08/2000	8:39a
1ev81a1.o	382,006	12/08/2000	8:39a
1ev81b1	20,494	12/08/2000	8:39a
1ev81b1.o	383,290	12/08/2000	8:39a
1ev82a1	20,494	12/08/2000	8:39a
1ev82a1.o	382,006	12/08/2000	8:40a
1ev82b1	20,494	12/08/2000	8:40a
1ev82b1.o	383,297	12/08/2000	8:40a
Directory of D:\CD\CD\intact\MK1A\scrap\730kg			
1ev20a1	20,494	12/08/2000	8:40a
1ev20a1.o	383,519	12/08/2000	8:40a
1ev20b1	20,494	12/08/2000	8:40a
1ev20b1.o	383,503	12/08/2000	8:40a
1ev20c1	20,494	12/08/2000	8:40a
1ev20c1.o	382,979	12/08/2000	8:40a
1ev20d1	20,506	12/08/2000	8:40a
1ev20d1.o	382,979	12/08/2000	8:40a
1ev21a1	20,494	12/08/2000	8:40a
1ev21a1.o	383,201	12/08/2000	8:40a
1ev21a2	20,494	12/08/2000	8:40a
1ev21a2.o	383,102	12/08/2000	8:40a
1ev21b1	20,494	12/08/2000	8:40a
1ev21b1.o	382,129	12/08/2000	8:40a
1ev21c1	20,494	12/08/2000	8:40a
1ev21c1.o	380,639	12/08/2000	8:40a
1ev21d1	20,494	12/08/2000	8:40a
1ev21d1.o	382,979	12/08/2000	8:40a
1ev21e1	20,506	12/08/2000	8:40a
1ev21e1.o	382,979	12/08/2000	8:40a
1ev24a1	20,494	12/08/2000	8:40a
1ev24a1.o	383,201	12/08/2000	8:40a
1ev24b1	20,494	12/08/2000	8:40a
1ev24b1.o	382,109	12/08/2000	8:40a
1ev24c1	20,494	12/08/2000	8:40a

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1ev24c1.o	381,827	12/08/2000	8:40a
1ev24d1	20,494	12/08/2000	8:40a
1ev24d1.o	381,827	12/08/2000	8:40a
1ev24e1	20,506	12/08/2000	8:40a
1ev24e1.o	382,979	12/08/2000	8:40a
1ev27a1	20,494	12/08/2000	8:40a
1ev27a1.o	383,290	12/08/2000	8:40a
1ev27b1	20,494	12/08/2000	8:40a
1ev27b1.o	381,920	12/08/2000	8:40a
1ev27c1	20,494	12/08/2000	8:40a
1ev27c1.o	381,989	12/08/2000	8:40a
1ev27d1	20,506	12/08/2000	8:40a
1ev27d1.o	382,979	12/08/2000	8:40a
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1ev10a1	20,494	12/08/2000	8:40a
1ev10a1.o	382,013	12/08/2000	8:40a
1ev10b1	20,494	12/08/2000	8:40a
1ev10b1.o	383,297	12/08/2000	8:40a
1ev10c1	20,494	12/08/2000	8:40a
1ev10c1.o	382,979	12/08/2000	8:40a
1ev10d1	20,506	12/08/2000	8:40a
1ev10d1.o	382,979	12/08/2000	8:40a
1ev11a1	20,494	12/08/2000	8:40a
1ev11a1.o	383,201	12/08/2000	8:40a
1ev11a2	20,494	12/08/2000	8:40a
1ev11a2.o	382,291	12/08/2000	8:40a
1ev11b1	20,494	12/08/2000	8:40a
1ev11b1.o	381,791	12/08/2000	8:40a
1ev11c1	20,494	12/08/2000	8:40a
1ev11c1.o	382,979	12/08/2000	8:40a
1ev11d1	20,494	12/08/2000	8:40a
1ev11d1.o	381,973	12/08/2000	8:40a
1ev11e1	20,506	12/08/2000	8:41a
1ev11e1.o	382,979	12/08/2000	8:41a
1ev12a1	20,494	12/08/2000	8:41a
1ev12a1.o	382,543	12/08/2000	8:41a
1ev12b1	20,494	12/08/2000	8:41a
1ev12b1.o	382,109	12/08/2000	8:41a
1ev12c1	20,494	12/08/2000	8:41a
1ev12c1.o	380,837	12/08/2000	8:41a
1ev12d1	20,494	12/08/2000	8:41a
1ev12d1.o	382,979	12/08/2000	8:41a
1ev12e1	20,506	12/08/2000	8:41a

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1ev12e1.o	382,019	12/08/2000	8:41a
1ev13a1	20,494	12/08/2000	8:41a
1ev13a1.o	383,297	12/08/2000	8:41a
1ev13b1	20,494	12/08/2000	8:41a
1ev13b1.o	382,883	12/08/2000	8:41a
1ev13c1	20,494	12/08/2000	8:41a
1ev13c1.o	381,791	12/08/2000	8:41a
1ev13d1	20,494	12/08/2000	8:41a
1ev13d1.o	382,979	12/08/2000	8:41a
1ev13e1	20,506	12/08/2000	8:41a
1ev13e1.o	382,019	12/08/2000	8:41a
1ev16a1	20,494	12/08/2000	8:41a
1ev16a1.o	383,274	12/08/2000	8:41a
1ev16b1	20,494	12/08/2000	8:41a
1ev16b1.o	381,775	12/08/2000	8:41a
1ev16c1	20,494	12/08/2000	8:41a
1ev16c1.o	381,029	12/08/2000	8:41a
1ev16d1	20,506	12/08/2000	8:41a
1ev16d1.o	381,827	12/08/2000	8:41a
Directory of D:\CD\CD\intact\MK1A\scrap\cylinders			
1ev01a1	25,031	12/08/2000	8:41a
1ev01a1.o	390,211	12/08/2000	8:41a
1ev01b1	25,031	12/08/2000	8:41a
1ev01b1.o	391,165	12/08/2000	8:41a
1ev01c1	25,031	12/08/2000	8:41a
1ev01c1.o	390,175	12/08/2000	8:41a
1ev01d1	25,031	12/08/2000	8:41a
1ev01d1.o	390,175	12/08/2000	8:41a
1ev01e1	25,031	12/08/2000	8:41a
1ev01e1.o	391,165	12/08/2000	8:41a
1ev01f1	23,880	12/08/2000	8:41a
1ev01f1.o	388,881	12/08/2000	8:41a
1ev01g1	23,880	12/08/2000	8:41a
1ev01g1.o	389,835	12/08/2000	8:41a
1ev01h1	23,876	12/08/2000	8:41a
1ev01h1.o	390,041	12/08/2000	8:41a
1ev01j1	23,876	12/08/2000	8:41a
1ev01j1.o	388,647	12/08/2000	8:41a
1ev01k1	23,876	12/08/2000	8:41a
1ev01k1.o	389,835	12/08/2000	8:41a
1ev01v1	25,045	12/08/2000	8:41a
1ev01v1.o	389,341	12/08/2000	8:41a
1ev01w1	25,045	12/08/2000	8:41a

File Name	File Size or Directory Denomination	Date of Last Access	Time
1ev01w1.o	390,211	12/08/2000	8:41a
1ev01x1	25,031	12/08/2000	8:41a
1ev01x1.o	391,165	12/08/2000	8:42a
1ev01y1	25,031	12/08/2000	8:42a
1ev01y1.o	391,165	12/08/2000	8:42a
1ev01z1	25,031	12/08/2000	8:42a
1ev01z1.o	390,211	12/08/2000	8:42a
1ev02a1	23,880	12/08/2000	8:42a
1ev02a1.o	389,103	12/08/2000	8:42a
1ev02b1	23,880	12/08/2000	8:42a
1ev02b1.o	389,103	12/08/2000	8:42a
1ev02c1	23,880	12/08/2000	8:42a
1ev02c1.o	387,915	12/08/2000	8:42a
1ev02d1	23,880	12/08/2000	8:42a
1ev02d1.o	389,093	12/08/2000	8:42a
1ev02e1	23,880	12/08/2000	8:42a
1ev02e1.o	389,215	12/08/2000	8:42a
1ev02f1	23,880	12/08/2000	8:42a
1ev02f1.o	389,103	12/08/2000	8:42a
1ev02g1	23,880	12/08/2000	8:42a
1ev02g1.o	389,199	12/08/2000	8:42a
1ev02h1	23,880	12/08/2000	8:42a
1ev02h1.o	389,192	12/08/2000	8:42a
1ev02j1	23,880	12/08/2000	8:42a
1ev02j1.o	389,835	12/08/2000	8:42a
1ev02k1	23,880	12/08/2000	8:42a
1ev02k1.o	387,878	12/08/2000	8:42a
1ev02m1	23,880	12/08/2000	8:42a
1ev02m1.o	389,739	12/08/2000	8:42a
1ev02n1	23,880	12/08/2000	8:42a
1ev02n1.o	389,835	12/08/2000	8:42a
1ev02o1	23,880	12/08/2000	8:42a
1ev02o1.o	388,749	12/08/2000	8:42a
1ev02p1	23,880	12/08/2000	8:42a
1ev02p1.o	388,647	12/08/2000	8:42a
1ev02q1	23,880	12/08/2000	8:42a
1ev02q1.o	388,845	12/08/2000	8:42a
Directory of D:\CD\CD\intact\MK1A\scrap-all-basket			
575kg	<DIR>	01/30/2001	2:30p
650kg	<DIR>	01/30/2001	2:31p
655kg	<DIR>	01/30/2001	2:31p
680kg	<DIR>	01/30/2001	2:31p
690kg	<DIR>	01/30/2001	2:32p

File Name	File Size or Directory Denomination	Date of Last Access	Time
700kg	<DIR>	01/30/2001	2:32p
730kg	<DIR>	01/30/2001	2:32p
792kg	<DIR>	01/30/2001	2:33p
810kg	<DIR>	01/30/2001	2:34p
830kg	<DIR>	01/30/2001	2:34p
865kg	<DIR>	01/30/2001	2:34p
Directory of D:\CD\CD\intact\MK1A\scrap-all-basket\575kg			
1cv11a1	20,766	12/08/2000	8:42a
1cv11a1o	384,100	12/08/2000	8:42a
1cv11b1	20,763	12/08/2000	8:42a
1cv11b1o	384,100	12/08/2000	8:42a
1cv12a1	20,764	12/08/2000	8:42a
1cv12a1o	384,004	12/08/2000	8:42a
1cv12b1	20,763	12/08/2000	8:42a
1cv12b1o	383,140	12/08/2000	8:42a
1cw61a2	14,837	12/08/2000	8:42a
1cw61a2o	366,661	12/08/2000	8:42a
1cw61b2	14,840	12/08/2000	8:42a
1cw61b2o	365,377	12/08/2000	8:42a
1cw61t2	15,159	12/08/2000	8:42a
1cw61t2o	367,129	12/08/2000	8:42a
1cw62a2	14,835	12/08/2000	8:42a
1cw62a2o	365,509	12/08/2000	8:42a
1cw62b2	14,839	12/08/2000	8:42a
1cw62b2o	366,661	12/08/2000	8:42a
1cw62t2	15,164	12/08/2000	8:42a
1cw62t2o	367,357	12/08/2000	8:42a
1cw63a2	14,835	12/08/2000	8:42a
1cw63a2o	366,661	12/08/2000	8:42a
1cw63t2	15,167	12/08/2000	8:42a
1cw63t2o	368,389	12/08/2000	8:42a
Directory of D:\CD\CD\intact\MK1A\scrap-all-basket\650kg			
1cw71a2	14,836	12/08/2000	8:42a
1cw71a2o	366,661	12/08/2000	8:42a
1cw71b2	14,840	12/08/2000	8:42a
1cw71b2o	366,645	12/08/2000	8:43a
1cw71t2	15,165	12/08/2000	8:43a
1cw71t2o	367,357	12/08/2000	8:43a
1cw72a2	14,833	12/08/2000	8:43a
1cw72a2o	365,377	12/08/2000	8:43a
1cw72b2	14,837	12/08/2000	8:43a
1cw72b2o	365,671	12/08/2000	8:43a
1cw72t2	15,155	12/08/2000	8:43a

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1cw72t2o	368,317	12/08/2000	8:43a
Directory of D:\CD\CD\intact\MK1A\scrap-all-basket\655kg			
1cv71a1	20,496	12/08/2000	8:43a
1cv71a1.o	383,522	12/08/2000	8:43a
1cv71a2	20,496	12/08/2000	8:43a
1cv71a2.o	383,618	12/08/2000	8:43a
1cv71b1	20,496	12/08/2000	8:43a
1cv71b1.o	383,522	12/08/2000	8:43a
1cv72a1	20,496	12/08/2000	8:43a
1cv72a1.o	383,618	12/08/2000	8:43a
1cv72b1	20,496	12/08/2000	8:43a
1cv72b1.o	383,618	12/08/2000	8:43a
Directory of D:\CD\CD\intact\MK1A\scrap-all-basket\680kg			
1cv61a1	20,496	12/08/2000	8:43a
1cv61a1.o	381,817	12/08/2000	8:43a
1cv61a2	20,496	12/08/2000	8:43a
1cv61a2.o	382,466	12/08/2000	8:43a
1cv61b1	20,496	12/08/2000	8:43a
1cv61b1.o	383,869	12/08/2000	8:43a
1cv62a1	20,496	12/08/2000	8:43a
1cv62a1.o	382,813	12/08/2000	8:43a
1cv62b1	20,496	12/08/2000	8:43a
1cv62b1.o	383,965	12/08/2000	8:43a
Directory of D:\CD\CD\intact\MK1A\scrap-all-basket\690kg			
1cv91a1	20,496	12/08/2000	8:43a
1cv91a1.o	383,618	12/08/2000	8:43a
1cv91a2	20,496	12/08/2000	8:43a
1cv91a2.o	381,817	12/08/2000	8:43a
1cv91b1	20,496	12/08/2000	8:43a
1cv91b1.o	383,618	12/08/2000	8:43a
1cv92a1	20,496	12/08/2000	8:43a
1cv92a1.o	383,618	12/08/2000	8:43a
1cv92b1	20,496	12/08/2000	8:43a
1cv92b1.o	383,005	12/08/2000	8:43a
Directory of D:\CD\CD\intact\MK1A\scrap-all-basket\700kg			
1cv81a1	20,496	12/08/2000	8:43a
1cv81a1.o	382,777	12/08/2000	8:43a
1cv81a2	20,496	12/08/2000	8:43a
1cv81a2.o	382,430	12/08/2000	8:43a
1cv81b1	20,496	12/08/2000	8:43a
1cv81b1.o	382,777	12/08/2000	8:43a
1cv82a1	20,496	12/08/2000	8:43a
1cv82a1.o	383,965	12/08/2000	8:43a

File Name	File Size or Directory Denomination	Date of Last Access	Time
1cv82b1	20,496	12/08/2000	8:43a
1cv82b1.o	382,879	12/08/2000	8:43a
Directory of D:\CD\CD\intact\MK1A\scrap-all-basket\730kg			
1cw41a2	14,839	12/08/2000	8:43a
1cw41a2o	366,661	12/08/2000	8:43a
1cw41b2	14,842	12/08/2000	8:43a
1cw41b2o	366,661	12/08/2000	8:43a
1cw41t2	15,164	12/08/2000	8:43a
1cw41t2o	367,452	12/08/2000	8:43a
1cw42a2	14,838	12/08/2000	8:43a
1cw42a2o	365,575	12/08/2000	8:43a
1cw42b2	14,844	12/08/2000	8:43a
1cw42b2o	365,509	12/08/2000	8:43a
1cw42t2	15,163	12/08/2000	8:43a
1cw42t2o	368,313	12/08/2000	8:43a
rev00a	<DIR>	01/30/2001	2:33p
Directory of D:\CD\CD\intact\MK1A\scrap-all-basket\730kg\rev00a			
1cv21a1	20,496	12/08/2000	8:43a
1cv21a1.o	382,777	12/08/2000	8:43a
1cv21a2	20,496	12/08/2000	8:43a
1cv21a2.o	382,430	12/08/2000	8:43a
1cv21b1	20,496	12/08/2000	8:43a
1cv21b1.o	382,813	12/08/2000	8:43a
1cv22a1	20,496	12/08/2000	8:43a
1cv22a1.o	382,327	12/08/2000	8:43a
1cv22b1	20,496	12/08/2000	8:43a
1cv22b1.o	382,466	12/08/2000	8:43a
1cv23a1	20,496	12/08/2000	8:43a
1cv23a1.o	382,636	12/08/2000	8:43a
1cv23b1	20,496	12/08/2000	8:43a
1cv23b1.o	383,618	12/08/2000	8:43a
Directory of D:\CD\CD\intact\MK1A\scrap-all-basket\792kg			
1cw21a2	14,839	12/08/2000	8:43a
1cw21a2o	365,509	12/08/2000	8:43a
1cw21b2	14,841	12/08/2000	8:43a
1cw21b2o	365,473	12/08/2000	8:43a
1cw21t2	15,161	12/08/2000	8:43a
1cw21t2o	368,221	12/08/2000	8:43a
1cw22a2	14,840	12/08/2000	8:43a
1cw22a2o	365,781	12/08/2000	8:43a
1cw22b2	14,842	12/08/2000	8:43a
1cw22b2o	365,377	12/08/2000	8:43a
1cw22t2	15,162	12/08/2000	8:43a

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1cw22t2o	368,317	12/08/2000	8:44a
Directory of D:\CD\CD\intact\MK1A\scrap-all-basket\810kg			
1cw51a2	14,837	12/08/2000	8:44a
1cw51a2o	365,473	12/08/2000	8:44a
1cw51b2	14,841	12/08/2000	8:44a
1cw51b2o	366,565	12/08/2000	8:44a
1cw51t2	15,165	12/08/2000	8:44a
1cw51t2o	367,355	12/08/2000	8:44a
1cw52a2	14,836	12/08/2000	8:44a
1cw52a2o	366,687	12/08/2000	8:44a
1cw52b2	14,840	12/08/2000	8:44a
1cw52b2o	366,661	12/08/2000	8:44a
1cw52t2	15,171	12/08/2000	8:44a
1cw52t2o	368,629	12/08/2000	8:44a
Directory of D:\CD\CD\intact\MK1A\scrap-all-basket\830kg			
1cw31a2	14,842	12/08/2000	8:44a
1cw31a2o	365,509	12/08/2000	8:44a
1cw31b2	14,846	12/08/2000	8:44a
1cw31b2o	366,661	12/08/2000	8:44a
1cw31t2	15,164	12/08/2000	8:44a
1cw31t2o	368,317	12/08/2000	8:44a
1cw32a2	14,850	12/08/2000	8:44a
1cw32a2o	366,661	12/08/2000	8:44a
1cw32b2	14,854	12/08/2000	8:44a
1cw32b2o	366,661	12/08/2000	8:44a
1cw32t2	15,175	12/08/2000	8:44a
1cw32t2o	368,412	12/08/2000	8:44a
Directory of D:\CD\CD\intact\MK1A\scrap-all-basket\865kg			
rev00a	<DIR>	01/30/2001	2:34p
rev0b	<DIR>	01/30/2001	2:35p
Directory of D:\CD\CD\intact\MK1A\scrap-all-basket\865kg\rev00a			
1cv31a1	14,832	12/08/2000	8:44a
1cv31a1o	365,473	12/08/2000	8:44a
1cv31b1	14,848	12/08/2000	8:44a
1cv31b1o	366,661	12/08/2000	8:44a
1cv32a1	14,843	12/08/2000	8:44a
1cv32a1o	365,473	12/08/2000	8:44a
1cv32a2	14,843	12/08/2000	8:44a
1cv32a2o	365,473	12/08/2000	8:44a
1cv32b1	14,847	12/08/2000	8:44a
1cv32b1o	366,979	12/08/2000	8:44a
1cv33a1	14,842	12/08/2000	8:44a
1cv33a1o	366,661	12/08/2000	8:44a

File Name	File Size or Directory Denomination	Date of Last Access	Time
1cv33a2	14,842	12/08/2000	8:44a
1cv33a2o	365,509	12/08/2000	8:44a
1cv33b1	14,845	12/08/2000	8:44a
1cv33b1o	366,979	12/08/2000	8:44a
1cv34a1	14,836	12/08/2000	8:44a
1cv34a1o	366,661	12/08/2000	8:44a
1cv34a2	14,836	12/08/2000	8:44a
1cv34a2o	366,661	12/08/2000	8:44a
1cv34b1	14,843	12/08/2000	8:44a
1cv34b1o	366,883	12/08/2000	8:44a
1cv3ta1	15,161	12/08/2000	8:44a
1cv3ta1o	368,214	12/08/2000	8:44a
1cv3ta2	15,154	12/08/2000	8:44a
1cv3ta2o	478,338	12/08/2000	8:44a
1cv3wa1	14,825	12/08/2000	8:44a
1cv3wa1o	366,987	12/08/2000	8:44a
1cv3wa2	14,825	12/08/2000	8:44a
1cv3wa2o	365,703	12/08/2000	8:44a
Directory of D:\CD\CD\intact\MK1A\scrap-all-basket\865kg\rev0b			
1cv31a2	14,844	12/08/2000	8:44a
1cv31a2o	366,565	12/08/2000	8:44a
1cv31b2	14,848	12/08/2000	8:44a
1cv31b2o	365,671	12/08/2000	8:44a
1cv31t2	15,175	12/08/2000	8:44a
1cv31t2o	368,317	12/08/2000	8:44a
1cv32a2	14,843	12/08/2000	8:44a
1cv32a2o	366,661	12/08/2000	8:44a
1cv32b2	14,847	12/08/2000	8:44a
1cv32b2o	365,473	12/08/2000	8:44a
1cv32t2	15,165	12/08/2000	8:44a
1cv32t2o	367,327	12/08/2000	8:44a
1cv33a2	14,839	12/08/2000	8:44a
1cv33a2o	366,645	12/08/2000	8:44a
1cv33t2	15,164	12/08/2000	8:44a
1cv33t2o	367,224	12/08/2000	8:44a
1cv34a2	14,842	12/08/2000	8:44a
1cv34a2o	364,519	12/08/2000	8:44a
1cv34b2	14,842	12/08/2000	8:44a
1cv34b2o	366,979	12/08/2000	8:44a
Directory of D:\CD\CD\intact\MK1A\scrap-horizontal			
575kg	<DIR>	01/30/2001	2:36p
655kg	<DIR>	01/30/2001	2:36p
680kg	<DIR>	01/30/2001	2:36p

File Name	File Size or Directory Denomination	Date of Last Access	Time
700kg	<DIR>	01/30/2001	2:37p
730kg	<DIR>	01/30/2001	2:37p
Directory of D:\CD\CD\intact\MK1A\scrap-horizontal\575kg			
1eh91a1	20,762	12/08/2000	8:44a
1eh91a1o	382,244	12/08/2000	8:44a
1eh91b1	20,759	12/08/2000	8:44a
1eh91b1o	383,114	12/08/2000	8:44a
1eh91c1	20,755	12/08/2000	8:44a
1eh91c1o	382,154	12/08/2000	8:44a
1eh92a1	20,760	12/08/2000	8:44a
1eh92a1o	383,425	12/08/2000	8:44a
1eh92b1	20,759	12/08/2000	8:44a
1eh92b1o	383,114	12/08/2000	8:44a
1eh92c1	20,750	12/08/2000	8:44a
1eh92c1o	383,114	12/08/2000	8:44a
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1eh71a1	20,752	12/08/2000	8:44a
1eh71a1.o	383,329	12/08/2000	8:44a
1eh71b1	20,752	12/08/2000	8:44a
1eh71b1.o	383,114	12/08/2000	8:44a
1eh71c1	20,752	12/08/2000	8:44a
1eh71c1.o	383,114	12/08/2000	8:44a
1eh72a1	20,752	12/08/2000	8:44a
1eh72a1.o	383,425	12/08/2000	8:44a
1eh72b1	20,752	12/08/2000	8:44a
1eh72b1.o	383,114	12/08/2000	8:45a
1eh72c1	20,752	12/08/2000	8:45a
1eh72c1.o	383,114	12/08/2000	8:45a
Directory of D:\CD\CD\intact\MK1A\scrap-horizontal\680kg			
1eh61a1	20,752	12/08/2000	8:45a
1eh61a1.o	383,577	12/08/2000	8:45a
1eh61b1	20,752	12/08/2000	8:45a
1eh61b1.o	382,273	12/08/2000	8:45a
1eh61c1	20,752	12/08/2000	8:45a
1eh61c1.o	382,471	12/08/2000	8:45a
1eh62a1	20,752	12/08/2000	8:45a
1eh62a1.o	382,686	12/08/2000	8:45a
1eh62b1	20,752	12/08/2000	8:45a
1eh62b1.o	382,471	12/08/2000	8:45a
1eh62c1	20,752	12/08/2000	8:45a
1eh62c1.o	382,273	12/08/2000	8:45a
Directory of D:\CD\CD\intact\MK1A\scrap-horizontal\700kg			
1eh81a1	20,752	12/08/2000	8:45a

File Name	File Size or Directory Denomination	Date of Last Access	Time
1eh81a1.o	383,683	12/08/2000	8:45a
1eh81b1	20,752	12/08/2000	8:45a
1eh81b1.o	383,461	12/08/2000	8:45a
1eh81c1	20,752	12/08/2000	8:45a
1eh81c1.o	383,461	12/08/2000	8:45a
1eh82a1	20,752	12/08/2000	8:45a
1eh82a1.o	382,488	12/08/2000	8:45a
1eh82b1	20,752	12/08/2000	8:45a
1eh82b1.o	383,461	12/08/2000	8:45a
1eh82c1	20,752	12/08/2000	8:45a
1eh82c1.o	381,910	12/08/2000	8:45a
Directory of D:\CD\CD\intact\MK1A\scrap-horizontal\730kg			
1eh21a1	20,752	12/08/2000	8:45a
1eh21a1.o	382,346	12/08/2000	8:45a
1eh21b1	20,752	12/08/2000	8:45a
1eh21b1.o	381,926	12/08/2000	8:45a
1eh21c1	20,752	12/08/2000	8:45a
1eh21c1.o	383,114	12/08/2000	8:45a
1eh22a1	20,752	12/08/2000	8:45a
1eh22a1.o	383,336	12/08/2000	8:45a
1eh22b1	20,752	12/08/2000	8:45a
1eh22b1.o	383,114	12/08/2000	8:45a
Directory of D:\CD\CD\intact\MK1A\zr effect			
1ev91k1	20,590	12/08/2000	8:45a
1ev91k1o	382,389	12/08/2000	8:45a
1ev91m1	20,491	12/08/2000	8:45a
1ev91m1o	381,549	12/08/2000	8:45a
Directory of D:\CD\CD\intact\MKIV			
4zv0111	20,554	12/08/2000	8:45a
4zv0111o	382,070	12/08/2000	8:45a
4zv0211	20,658	12/08/2000	8:45a
4zv0211o	382,070	12/08/2000	8:45a
4zv0221	20,657	12/08/2000	8:45a
4zv0221o	380,564	12/08/2000	8:45a
4zv0222	20,657	12/08/2000	8:45a
4zv0222o	382,070	12/08/2000	8:45a
4zv0223	20,657	12/08/2000	8:45a
4zv0223o	382,070	12/08/2000	8:45a
4zv0224	20,657	12/08/2000	8:45a
4zv0224o	382,070	12/08/2000	8:45a
4zv0231	20,657	12/08/2000	8:45a
4zv0231o	383,660	12/08/2000	8:45a
4zv0241	20,657	12/08/2000	8:45a

File Name	File Size or Directory Denomination	Date of Last Access	Time
4zv0241o	383,024	12/08/2000	8:45a
cylinder	<DIR>	01/30/2001	2:38p
intactwscrap	<DIR>	01/30/2001	2:39p
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5ev1	19,897	12/08/2000	8:45a
5ev10	20,066	12/08/2000	8:45a
5ev10o	379,739	12/08/2000	8:45a
5ev11	19,708	12/08/2000	8:45a
5ev11o	381,081	12/08/2000	8:45a
5ev12	19,704	12/08/2000	8:45a
5ev12o	381,074	12/08/2000	8:45a
5ev13	19,704	12/08/2000	8:45a
5ev13o	381,081	12/08/2000	8:45a
5ev15	19,692	12/08/2000	8:45a
5ev15o	379,893	12/08/2000	8:45a
5ev17	19,692	12/08/2000	8:45a
5ev17o	379,929	12/08/2000	8:45a
5ev19	19,692	12/08/2000	8:45a
5ev19o	380,121	12/08/2000	8:45a
5ev1o	381,461	12/08/2000	8:45a
5ev2	19,893	12/08/2000	8:45a
5ev2o	381,461	12/08/2000	8:45a
5ev3b	19,893	12/08/2000	8:45a
5ev3bo	380,463	12/08/2000	8:45a
5ev4	19,117	12/08/2000	8:45a
5ev4o	378,278	12/08/2000	8:45a
5ev5	19,117	12/08/2000	8:45a
5ev5o	378,476	12/08/2000	8:45a
5ev6	19,117	12/08/2000	8:45a
5ev6o	379,466	12/08/2000	8:45a
5ev7	20,066	12/08/2000	8:45a
5ev7o	380,891	12/08/2000	8:45a
5ev8	20,066	12/08/2000	8:45a
5ev8o	379,703	12/08/2000	8:45a
5ev9	20,066	12/08/2000	8:46a
5ev9o	380,891	12/08/2000	8:46a
rev00a	<DIR>	01/30/2001	2:39p
Directory of D:\CD\CD\intact\MKIV\cylinder\rev00a			
5ev3	19,117	12/08/2000	8:46a
5ev3o	379,466	12/08/2000	8:46a
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330kg	<DIR>	01/30/2001	2:39p
530kg	<DIR>	01/30/2001	2:42p

File Name	File Size or Directory Denomination	Date of Last Access	Time
730kg	<DIR>	01/30/2001	2:45p
800kg	<DIR>	01/30/2001	2:48p
860kg	<DIR>	01/30/2001	2:49p
930kg	<DIR>	01/30/2001	2:49p
955kg	<DIR>	01/30/2001	2:52p
980kg	<DIR>	01/30/2001	2:53p
alscrap	<DIR>	01/30/2001	2:56p
horizontal	<DIR>	01/30/2001	2:56p
optimalloading	<DIR>	01/30/2001	2:57p
zreflect	<DIR>	01/30/2001	2:58p
Directory of D:\CD\CD\intact\MKIV\intactwscrap\330kg			
4ev41a1o	380,754	12/08/2000	8:46a
4ev41b1	19,494	12/08/2000	8:46a
4ev41b1o	380,754	12/08/2000	8:46a
4ev41c1	19,494	12/08/2000	8:46a
4ev41c1o	380,754	12/08/2000	8:46a
4ev41d1	19,494	12/08/2000	8:46a
4ev41d1o	379,602	12/08/2000	8:46a
4ev41e1	19,506	12/08/2000	8:46a
4ev41e1o	380,754	12/08/2000	8:46a
4ev42a1	19,494	12/08/2000	8:46a
4ev42a1o	379,566	12/08/2000	8:46a
4ev42b1	19,494	12/08/2000	8:46a
4ev42b1o	380,658	12/08/2000	8:46a
4ev42c1	19,494	12/08/2000	8:46a
4ev42c1o	379,602	12/08/2000	8:46a
4ev42d1	19,494	12/08/2000	8:46a
4ev42d1o	380,754	12/08/2000	8:46a
4ev42e1	19,506	12/08/2000	8:46a
4ev42e1o	379,602	12/08/2000	8:46a
4ev43a1	19,494	12/08/2000	8:46a
4ev43a1o	380,754	12/08/2000	8:46a
4ev43b1	19,494	12/08/2000	8:46a
4ev43b1o	380,754	12/08/2000	8:46a
4ev43c1	19,494	12/08/2000	8:46a
4ev43c1o	379,566	12/08/2000	8:46a
4ev43d1	19,494	12/08/2000	8:46a
4ev43d1o	379,566	12/08/2000	8:46a
4ev43e1	19,506	12/08/2000	8:46a
4ev43e1o	379,794	12/08/2000	8:46a
4ev44a1	19,494	12/08/2000	8:46a
4ev44a1o	380,754	12/08/2000	8:46a
4ev44b1	19,494	12/08/2000	8:46a

File Name	File Size or Directory Denomination	Date of Last Access	Time
4ev44b1o	380,747	12/08/2000	8:46a
4ev44c1	19,494	12/08/2000	8:46a
4ev44c1o	379,566	12/08/2000	8:46a
4ev44d1	19,494	12/08/2000	8:46a
4ev44d1o	379,566	12/08/2000	8:46a
4ev44e1	19,506	12/08/2000	8:46a
4ev44e1o	380,754	12/08/2000	8:46a
4ev45a1	19,494	12/08/2000	8:46a
4ev45a1o	380,953	12/08/2000	8:46a
4ev45b1	19,494	12/08/2000	8:46a
4ev45b1o	380,754	12/08/2000	8:46a
4ev45c1	19,494	12/08/2000	8:46a
4ev45c1o	380,754	12/08/2000	8:46a
4ev45d1	19,494	12/08/2000	8:46a
4ev45d1o	380,754	12/08/2000	8:46a
4ev45e1	19,506	12/08/2000	8:46a
4ev45e1o	379,566	12/08/2000	8:46a
4ev46a1	19,494	12/08/2000	8:46a
4ev46a1o	380,754	12/08/2000	8:46a
4ev46b1	19,494	12/08/2000	8:46a
4ev46b1o	380,876	12/08/2000	8:46a
4ev46c1	19,494	12/08/2000	8:46a
4ev46c1o	380,754	12/08/2000	8:46a
4ev46d1	19,494	12/08/2000	8:46a
4ev46d1o	380,754	12/08/2000	8:46a
4ev46e1	19,506	12/08/2000	8:46a
4ev46e1o	380,960	12/08/2000	8:46a
4ev47a1	19,494	12/08/2000	8:46a
4ev47a1o	379,794	12/08/2000	8:46a
4ev47b1	19,494	12/08/2000	8:46a
4ev47b1o	380,754	12/08/2000	8:46a
4ev47c1	19,494	12/08/2000	8:46a
4ev47c1o	379,794	12/08/2000	8:46a
4ev47d1	19,494	12/08/2000	8:46a
4ev47d1o	380,738	12/08/2000	8:46a
4ev47e1	19,506	12/08/2000	8:46a
4ev47e1o	379,566	12/08/2000	8:46a
4ev48a1	19,494	12/08/2000	8:46a
4ev48a1o	380,754	12/08/2000	8:46a
4ev48b1	19,494	12/08/2000	8:46a
4ev48b1o	380,754	12/08/2000	8:46a
4ev48c1	19,494	12/08/2000	8:46a
4ev48c1o	379,566	12/08/2000	8:46a

File Name	File Size or Directory Denomination	Date of Last Access	Time
4ev48d1	19,494	12/08/2000	8:46a
4ev48d1o	379,566	12/08/2000	8:46a
4ev48e1	19,506	12/08/2000	8:46a
4ev48e1o	378,398	12/08/2000	8:46a
4ev49a1	19,494	12/08/2000	8:46a
4ev49a1o	379,602	12/08/2000	8:46a
4ev49b1	19,494	12/08/2000	8:46a
4ev49b1o	379,566	12/08/2000	8:46a
4ev49c1	19,494	12/08/2000	8:46a
4ev49c1o	379,566	12/08/2000	8:46a
4ev49d1	19,494	12/08/2000	8:46a
4ev49d1o	379,566	12/08/2000	8:46a
4ev49e1	19,506	12/08/2000	8:46a
4ev49e1o	380,754	12/08/2000	8:46a
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4ev30a1	19,495	12/08/2000	8:46a
4ev30a1o	380,118	12/08/2000	8:46a
4ev30b1	19,495	12/08/2000	8:46a
4ev30b1o	380,111	12/08/2000	8:46a
4ev30c1	19,495	12/08/2000	8:46a
4ev30c1o	380,118	12/08/2000	8:46a
4ev30d1	19,495	12/08/2000	8:46a
4ev30d1o	378,612	12/08/2000	8:47a
4ev30e1	19,507	12/08/2000	8:47a
4ev30e1o	379,800	12/08/2000	8:47a
4ev31a1	19,495	12/08/2000	8:47a
4ev31a1o	378,612	12/08/2000	8:47a
4ev31b1	19,495	12/08/2000	8:47a
4ev31b1o	378,930	12/08/2000	8:47a
4ev31c1	19,495	12/08/2000	8:47a
4ev31c1o	380,118	12/08/2000	8:47a
4ev31d1	19,495	12/08/2000	8:47a
4ev31d1o	379,800	12/08/2000	8:47a
4ev31e1	19,507	12/08/2000	8:47a
4ev31e1o	379,800	12/08/2000	8:47a
4ev32a1	19,495	12/08/2000	8:47a
4ev32a1o	380,111	12/08/2000	8:47a
4ev32b1	19,495	12/08/2000	8:47a
4ev32b1o	380,118	12/08/2000	8:47a
4ev32c1	19,495	12/08/2000	8:47a
4ev32c1o	378,930	12/08/2000	8:47a
4ev32d1	19,495	12/08/2000	8:47a
4ev32d1o	379,800	12/08/2000	8:47a

File Name	File Size or Directory Denomination	Date of Last Access	Time
4ev32e1	19,507	12/08/2000	8:47a
4ev32e1o	379,800	12/08/2000	8:47a
4ev33a1	19,495	12/08/2000	8:47a
4ev33a1o	380,118	12/08/2000	8:47a
4ev33b1	19,495	12/08/2000	8:47a
4ev33b1o	380,102	12/08/2000	8:47a
4ev33c1	19,495	12/08/2000	8:47a
4ev33c1o	380,118	12/08/2000	8:47a
4ev33d1	19,495	12/08/2000	8:47a
4ev33d1o	378,612	12/08/2000	8:47a
4ev33e1	19,507	12/08/2000	8:47a
4ev33e1o	379,800	12/08/2000	8:47a
4ev34a1	19,495	12/08/2000	8:47a
4ev34a1o	378,923	12/08/2000	8:47a
4ev34b1	19,495	12/08/2000	8:47a
4ev34b1o	380,102	12/08/2000	8:47a
4ev34c1	19,495	12/08/2000	8:47a
4ev34c1o	378,930	12/08/2000	8:47a
4ev34d1	19,495	12/08/2000	8:47a
4ev34d1o	379,800	12/08/2000	8:47a
4ev34e1	19,507	12/08/2000	8:47a
4ev34e1o	379,800	12/08/2000	8:47a
4ev35a1	19,495	12/08/2000	8:47a
4ev35a1o	380,118	12/08/2000	8:47a
4ev35b1	19,495	12/08/2000	8:47a
4ev35b1o	380,111	12/08/2000	8:47a
4ev35c1	19,495	12/08/2000	8:47a
4ev35c1o	377,771	12/08/2000	8:47a
4ev35d1	19,495	12/08/2000	8:47a
4ev35d1o	379,800	12/08/2000	8:47a
4ev35e1	19,507	12/08/2000	8:47a
4ev35e1o	379,800	12/08/2000	8:47a
4ev36a1	19,495	12/08/2000	8:47a
4ev36a1o	380,118	12/08/2000	8:47a
4ev36b1	19,495	12/08/2000	8:47a
4ev36b1o	380,118	12/08/2000	8:47a
4ev36c1	19,495	12/08/2000	8:47a
4ev36c1o	380,118	12/08/2000	8:47a
4ev36d1	19,495	12/08/2000	8:47a
4ev36d1o	378,612	12/08/2000	8:47a
4ev36e1	19,507	12/08/2000	8:47a
4ev36e1o	379,800	12/08/2000	8:47a
4ev37a1	19,495	12/08/2000	8:47a

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4ev37a1o	380,118	12/08/2000	8:47a
4ev37b1	19,495	12/08/2000	8:47a
4ev37b1o	379,128	12/08/2000	8:47a
4ev37c1	19,495	12/08/2000	8:47a
4ev37c1o	380,118	12/08/2000	8:47a
4ev37d1	19,495	12/08/2000	8:47a
4ev37d1o	378,840	12/08/2000	8:47a
4ev37e1	19,507	12/08/2000	8:47a
4ev37e1o	379,800	12/08/2000	8:47a
4ev38a1	19,495	12/08/2000	8:47a
4ev38a1o	380,118	12/08/2000	8:47a
4ev38b1	19,495	12/08/2000	8:47a
4ev38b1o	378,966	12/08/2000	8:47a
4ev38c1	19,495	12/08/2000	8:47a
4ev38c1o	380,118	12/08/2000	8:47a
4ev38d1	19,495	12/08/2000	8:47a
4ev38d1o	378,612	12/08/2000	8:47a
4ev38e1	19,507	12/08/2000	8:47a
4ev38e1o	379,800	12/08/2000	8:47a
4ev39a1	19,495	12/08/2000	8:47a
4ev39a1o	380,118	12/08/2000	8:47a
4ev39b1	19,495	12/08/2000	8:47a
4ev39b1o	378,930	12/08/2000	8:47a
4ev39c1	19,495	12/08/2000	8:47a
4ev39c1o	379,136	12/08/2000	8:47a
4ev39d1	19,495	12/08/2000	8:47a
4ev39d1o	379,800	12/08/2000	8:47a
4ev39e1	19,507	12/08/2000	8:47a
4ev39e1o	380,006	12/08/2000	8:47a
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4ev20a1	19,494	12/08/2000	8:47a
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4ev20b1	19,494	12/08/2000	8:47a
4ev20b1o	380,118	12/08/2000	8:47a
4ev20c1	19,494	12/08/2000	8:47a
4ev20c1o	380,118	12/08/2000	8:47a
4ev20d1	19,494	12/08/2000	8:47a
4ev20d1o	380,118	12/08/2000	8:47a
4ev20e1	19,506	12/08/2000	8:47a
4ev20e1o	379,800	12/08/2000	8:48a
4ev21a1	19,494	12/08/2000	8:48a
4ev21a1o	380,118	12/08/2000	8:48a
4ev21b1	19,494	12/08/2000	8:48a

File Name	File Size or Directory Denomination	Date of Last Access	Time
4ev21b1o	378,966	12/08/2000	8:48a
4ev21c1	19,494	12/08/2000	8:48a
4ev21c1o	380,118	12/08/2000	8:48a
4ev21d1	19,494	12/08/2000	8:48a
4ev21d1o	378,966	12/08/2000	8:48a
4ev21e1	19,506	12/08/2000	8:48a
4ev21e1o	379,800	12/08/2000	8:48a
4ev22a1	19,494	12/08/2000	8:48a
4ev22a1o	380,118	12/08/2000	8:48a
4ev22b1	19,494	12/08/2000	8:48a
4ev22b1o	380,118	12/08/2000	8:48a
4ev22c1	19,494	12/08/2000	8:48a
4ev22c1o	380,324	12/08/2000	8:48a
4ev22d1	19,494	12/08/2000	8:48a
4ev22d1o	379,800	12/08/2000	8:48a
4ev22e1	19,506	12/08/2000	8:48a
4ev22e1o	379,800	12/08/2000	8:48a
4ev23a1	19,494	12/08/2000	8:48a
4ev23a1o	380,118	12/08/2000	8:48a
4ev23b1	19,494	12/08/2000	8:48a
4ev23b1o	380,118	12/08/2000	8:48a
4ev23c1	19,494	12/08/2000	8:48a
4ev23c1o	377,900	12/08/2000	8:48a
4ev23d1	19,494	12/08/2000	8:48a
4ev23d1o	379,800	12/08/2000	8:48a
4ev23e1	19,506	12/08/2000	8:48a
4ev23e1o	378,605	12/08/2000	8:48a
4ev24a1	19,494	12/08/2000	8:48a
4ev24a1o	380,324	12/08/2000	8:48a
4ev24b1	19,494	12/08/2000	8:48a
4ev24b1o	380,118	12/08/2000	8:48a
4ev24c1	19,494	12/08/2000	8:48a
4ev24c1o	380,118	12/08/2000	8:48a
4ev24d1	19,494	12/08/2000	8:48a
4ev24d1o	379,800	12/08/2000	8:48a
4ev24e1	19,506	12/08/2000	8:48a
4ev24e1o	379,800	12/08/2000	8:48a
4ev25a1	19,494	12/08/2000	8:48a
4ev25a1o	380,118	12/08/2000	8:48a
4ev25b1	19,494	12/08/2000	8:48a
4ev25b1o	378,930	12/08/2000	8:48a
4ev25c1	19,494	12/08/2000	8:48a
4ev25c1o	379,158	12/08/2000	8:48a

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4ev25d1	19,494	12/08/2000	8:48a
4ev25d1o	379,158	12/08/2000	8:48a
4ev25e1	19,506	12/08/2000	8:48a
4ev25e1o	378,966	12/08/2000	8:48a
4ev26a1	19,494	12/08/2000	8:48a
4ev26a1o	380,118	12/08/2000	8:48a
4ev26b1	19,494	12/08/2000	8:48a
4ev26b1o	378,930	12/08/2000	8:48a
4ev26c1	19,494	12/08/2000	8:48a
4ev26c1o	380,118	12/08/2000	8:48a
4ev26d1	19,494	12/08/2000	8:48a
4ev26d1o	378,930	12/08/2000	8:48a
4ev26e1	19,506	12/08/2000	8:48a
4ev26e1o	380,118	12/08/2000	8:48a
4ev27a1	19,494	12/08/2000	8:48a
4ev27a1o	380,118	12/08/2000	8:48a
4ev27b1	19,494	12/08/2000	8:48a
4ev27b1o	379,158	12/08/2000	8:48a
4ev27c1	19,494	12/08/2000	8:48a
4ev27c1o	380,111	12/08/2000	8:48a
4ev27d1	19,494	12/08/2000	8:48a
4ev27d1o	378,930	12/08/2000	8:48a
4ev27e1	19,506	12/08/2000	8:48a
4ev27e1o	378,612	12/08/2000	8:48a
4ev28a1	19,494	12/08/2000	8:48a
4ev28a1o	379,158	12/08/2000	8:48a
4ev28b1	19,494	12/08/2000	8:48a
4ev28b1o	380,118	12/08/2000	8:48a
4ev28c1	19,494	12/08/2000	8:48a
4ev28c1o	379,158	12/08/2000	8:48a
4ev28d1	19,494	12/08/2000	8:48a
4ev28d1o	380,111	12/08/2000	8:48a
4ev28e1	19,506	12/08/2000	8:48a
4ev28e1o	380,006	12/08/2000	8:48a
4ev29a1	19,494	12/08/2000	8:48a
4ev29a1o	377,778	12/08/2000	8:48a
4ev29b1	19,494	12/08/2000	8:48a
4ev29b1o	378,930	12/08/2000	8:48a
4ev29c1	19,494	12/08/2000	8:48a
4ev29c1o	380,118	12/08/2000	8:48a
4ev29d1	19,494	12/08/2000	8:48a
4ev29d1o	378,930	12/08/2000	8:48a
4ev29e1	19,506	12/08/2000	8:48a

File Name	File Size or Directory Denomination	Date of Last Access	Time
4ev29e1o	380,118	12/08/2000	8:48a
Directory of D:\CD\CD\intact\MKIV\intactwscrap\800kg			
4ev51a1	19,495	12/08/2000	8:48a
4ev51a1o	380,118	12/08/2000	8:48a
4ev51b1	19,495	12/08/2000	8:48a
4ev51b1o	380,118	12/08/2000	8:48a
4ev51c1	19,495	12/08/2000	8:48a
4ev51c1o	380,118	12/08/2000	8:48a
4ev52a1	19,495	12/08/2000	8:48a
4ev52a1o	380,118	12/08/2000	8:48a
4ev52b1	19,495	12/08/2000	8:49a
4ev52b1o	380,118	12/08/2000	8:49a
4ev52c1	19,495	12/08/2000	8:49a
4ev52c1o	377,778	12/08/2000	8:49a
4ev53a1	19,495	12/08/2000	8:49a
4ev53a1o	379,158	12/08/2000	8:49a
4ev53b1	19,495	12/08/2000	8:49a
4ev53b1o	380,118	12/08/2000	8:49a
4ev53c1	19,495	12/08/2000	8:49a
4ev53c1o	377,778	12/08/2000	8:49a
Directory of D:\CD\CD\intact\MKIV\intactwscrap\860kg			
4ev61a1	19,495	12/08/2000	8:49a
4ev61a1o	378,914	12/08/2000	8:49a
4ev61b1	19,495	12/08/2000	8:49a
4ev61b1o	380,118	12/08/2000	8:49a
4ev61c1	19,495	12/08/2000	8:49a
4ev61c1o	380,118	12/08/2000	8:49a
4ev62a1	19,495	12/08/2000	8:49a
4ev62a1o	380,118	12/08/2000	8:49a
4ev62b1	19,495	12/08/2000	8:49a
4ev62b1o	380,324	12/08/2000	8:49a
4ev62c1	19,495	12/08/2000	8:49a
4ev62c1o	380,118	12/08/2000	8:49a
4ev63a1	19,495	12/08/2000	8:49a
4ev63a1o	378,966	12/08/2000	8:49a
4ev63b1	19,495	12/08/2000	8:49a
4ev63b1o	380,118	12/08/2000	8:49a
4ev63c1	19,495	12/08/2000	8:49a
4ev63c1o	379,128	12/08/2000	8:49a
Directory of D:\CD\CD\intact\MKIV\intactwscrap\930kg			
4ev10a1	34,862	12/08/2000	8:49a
4ev10a1o	380,118	12/08/2000	8:49a
4ev10b1o	378,930	12/08/2000	8:49a

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4ev10c1o	379,128	12/08/2000	8:49a
4ev10d1o	378,930	12/08/2000	8:49a
4ev10e1o	378,930	12/08/2000	8:49a
4ev11a1	19,494	12/08/2000	8:49a
4ev11a1o	378,930	12/08/2000	8:49a
4ev11b1	19,494	12/08/2000	8:49a
4ev11b1o	379,250	12/08/2000	8:49a
4ev11c1	19,494	12/08/2000	8:49a
4ev11c1o	380,118	12/08/2000	8:49a
4ev11d1	19,494	12/08/2000	8:49a
4ev11d1o	380,118	12/08/2000	8:49a
4ev11e1	19,506	12/08/2000	8:49a
4ev11e1o	378,818	12/08/2000	8:49a
4ev12a1	19,494	12/08/2000	8:49a
4ev12a1o	380,022	12/08/2000	8:49a
4ev12a2	19,494	12/08/2000	8:49a
4ev12a2o	379,115	12/08/2000	8:49a
4ev12a3	19,494	12/08/2000	8:49a
4ev12a3o	379,884	12/08/2000	8:49a
4ev12b1	19,494	12/08/2000	8:49a
4ev12b1o	379,318	12/08/2000	8:49a
4ev12c1	19,494	12/08/2000	8:49a
4ev12c1o	380,102	12/08/2000	8:49a
4ev12d1	19,494	12/08/2000	8:49a
4ev12d1o	379,800	12/08/2000	8:49a
4ev12e1	19,506	12/08/2000	8:49a
4ev12e1o	379,800	12/08/2000	8:49a
4ev13a1	19,494	12/08/2000	8:49a
4ev13a1o	380,118	12/08/2000	8:49a
4ev13b1	19,494	12/08/2000	8:49a
4ev13b1o	378,966	12/08/2000	8:49a
4ev13c1	19,494	12/08/2000	8:49a
4ev13c1o	379,158	12/08/2000	8:49a
4ev13d1	19,494	12/08/2000	8:49a
4ev13d1o	380,118	12/08/2000	8:49a
4ev13e1	19,506	12/08/2000	8:49a
4ev13e1o	379,800	12/08/2000	8:49a
4ev14a1	19,494	12/08/2000	8:49a
4ev14a1o	380,118	12/08/2000	8:49a
4ev14b1	19,494	12/08/2000	8:49a
4ev14b1o	379,128	12/08/2000	8:49a
4ev14c1	19,494	12/08/2000	8:49a
4ev14c1o	380,118	12/08/2000	8:49a

File Name	File Size or Directory Denomination	Date of Last Access	Time
4ev14d1	19,494	12/08/2000	8:49a
4ev14d1o	380,118	12/08/2000	8:49a
4ev14e1	19,506	12/08/2000	8:49a
4ev14e1o	379,800	12/08/2000	8:49a
4ev15a1	19,494	12/08/2000	8:49a
4ev15a1o	380,118	12/08/2000	8:49a
4ev15b1	19,494	12/08/2000	8:49a
4ev15b1o	378,966	12/08/2000	8:49a
4ev15c1	19,494	12/08/2000	8:49a
4ev15c1o	380,324	12/08/2000	8:49a
4ev15d1	19,494	12/08/2000	8:49a
4ev15d1o	380,118	12/08/2000	8:49a
4ev15e1	19,506	12/08/2000	8:49a
4ev15e1o	378,810	12/08/2000	8:49a
4ev16a1	19,494	12/08/2000	8:49a
4ev16a1o	381,072	12/08/2000	8:49a
4ev16b1	19,494	12/08/2000	8:49a
4ev16b1o	378,732	12/08/2000	8:50a
4ev16c1	19,494	12/08/2000	8:50a
4ev16c1o	380,754	12/08/2000	8:50a
4ev16d1	19,494	12/08/2000	8:50a
4ev16d1o	379,602	12/08/2000	8:50a
4ev16e1	19,506	12/08/2000	8:50a
4ev16e1o	379,566	12/08/2000	8:50a
4ev17a1	19,494	12/08/2000	8:50a
4ev17a1o	379,884	12/08/2000	8:50a
4ev17b1	19,494	12/08/2000	8:50a
4ev17b1o	380,112	12/08/2000	8:50a
4ev17c1	19,494	12/08/2000	8:50a
4ev17c1o	379,764	12/08/2000	8:50a
4ev17d1	19,494	12/08/2000	8:50a
4ev17d1o	380,754	12/08/2000	8:50a
4ev17e1	19,506	12/08/2000	8:50a
4ev17e1o	380,754	12/08/2000	8:50a
4ev18a1	19,494	12/08/2000	8:50a
4ev18a1o	379,884	12/08/2000	8:50a
4ev18b1	19,494	12/08/2000	8:50a
4ev18b1o	381,072	12/08/2000	8:50a
4ev18c1	19,494	12/08/2000	8:50a
4ev18c1o	380,960	12/08/2000	8:50a
4ev18d1	19,494	12/08/2000	8:50a
4ev18d1o	380,754	12/08/2000	8:50a
4ev18e1	19,506	12/08/2000	8:50a

File Name	File Size or Directory Denomination	Date of Last Access	Time
4ev18e1o	379,772	12/08/2000	8:50a
4ev19a1o	379,128	12/08/2000	8:50a
4ev19b1o	378,930	12/08/2000	8:50a
4ev19c1o	377,778	12/08/2000	8:50a
4ev19d1o	378,930	12/08/2000	8:50a
4ev19e1o	380,118	12/08/2000	8:50a
Directory of D:\CD\CD\intact\MKIV\intactwscrap\955kg			
4ev81a1	19,494	12/08/2000	8:50a
4ev81a1o	380,118	12/08/2000	8:50a
4ev81b1	19,494	12/08/2000	8:50a
4ev81b1o	380,118	12/08/2000	8:50a
4ev81c1	19,494	12/08/2000	8:50a
4ev81c1o	380,118	12/08/2000	8:50a
4ev81d1	19,494	12/08/2000	8:50a
4ev81d1o	380,118	12/08/2000	8:50a
4ev81e1	19,506	12/08/2000	8:50a
4ev81e1o	377,658	12/08/2000	8:50a
4ev82a1	19,494	12/08/2000	8:50a
4ev82a1o	380,118	12/08/2000	8:50a
4ev82b1	19,494	12/08/2000	8:50a
4ev82b1o	379,158	12/08/2000	8:50a
4ev82c1	19,494	12/08/2000	8:50a
4ev82c1o	380,118	12/08/2000	8:50a
4ev82d1	19,494	12/08/2000	8:50a
4ev82d1o	380,118	12/08/2000	8:50a
4ev82e1	19,506	12/08/2000	8:50a
4ev82e1o	379,800	12/08/2000	8:50a
Directory of D:\CD\CD\intact\MKIV\intactwscrap\980kg			
4ev70a1	19,494	12/08/2000	8:50a
4ev70a1o	381,072	12/08/2000	8:50a
4ev70b1	19,494	12/08/2000	8:50a
4ev70b1o	379,884	12/08/2000	8:50a
4ev70c1	19,494	12/08/2000	8:50a
4ev70c1o	381,056	12/08/2000	8:50a
4ev70d1	19,494	12/08/2000	8:50a
4ev70d1o	380,754	12/08/2000	8:50a
4ev70e1	19,506	12/08/2000	8:50a
4ev70e1o	380,754	12/08/2000	8:50a
4ev71a1	19,494	12/08/2000	8:50a
4ev71a1o	379,920	12/08/2000	8:50a
4ev71b1	19,494	12/08/2000	8:50a
4ev71b1o	381,072	12/08/2000	8:50a
4ev71c1	19,494	12/08/2000	8:50a

File Name	File Size or Directory Denomination	Date of Last Access	Time
4ev71c1o	380,754	12/08/2000	8:50a
4ev71d1	19,494	12/08/2000	8:50a
4ev71d1o	379,566	12/08/2000	8:50a
4ev71e1	19,506	12/08/2000	8:50a
4ev71e1o	380,754	12/08/2000	8:50a
4ev72a1	19,494	12/08/2000	8:50a
4ev72a1o	381,065	12/08/2000	8:50a
4ev72b1	19,494	12/08/2000	8:50a
4ev72b1o	379,884	12/08/2000	8:50a
4ev72c1	19,494	12/08/2000	8:50a
4ev72c1o	379,764	12/08/2000	8:50a
4ev72d1	19,494	12/08/2000	8:50a
4ev72d1o	380,754	12/08/2000	8:50a
4ev72e1	19,506	12/08/2000	8:50a
4ev72e1o	380,754	12/08/2000	8:51a
4ev73a1	19,494	12/08/2000	8:51a
4ev73a1o	381,072	12/08/2000	8:51a
4ev73b1	19,494	12/08/2000	8:51a
4ev73b1o	381,072	12/08/2000	8:51a
4ev73c1	19,494	12/08/2000	8:51a
4ev73c1o	380,754	12/08/2000	8:51a
4ev73d1	19,494	12/08/2000	8:51a
4ev73d1o	380,754	12/08/2000	8:51a
4ev73e1	19,506	12/08/2000	8:51a
4ev73e1o	380,754	12/08/2000	8:51a
4ev74a1	19,494	12/08/2000	8:51a
4ev74a1o	379,884	12/08/2000	8:51a
4ev74b1	19,494	12/08/2000	8:51a
4ev74b1o	381,072	12/08/2000	8:51a
4ev74c1	19,494	12/08/2000	8:51a
4ev74c1o	379,566	12/08/2000	8:51a
4ev74d1	19,494	12/08/2000	8:51a
4ev74d1o	379,764	12/08/2000	8:51a
4ev74e1	19,506	12/08/2000	8:51a
4ev74e1o	380,754	12/08/2000	8:51a
4ev75a1	19,494	12/08/2000	8:51a
4ev75a1o	381,182	12/08/2000	8:51a
4ev75b1	19,494	12/08/2000	8:51a
4ev75b1o	381,072	12/08/2000	8:51a
4ev75c1	19,494	12/08/2000	8:51a
4ev75c1o	380,754	12/08/2000	8:51a
4ev75d1	19,494	12/08/2000	8:51a
4ev75d1o	380,754	12/08/2000	8:51a

File Name	File Size or Directory Denomination	Date of Last Access	Time
4ev75e1	19,506	12/08/2000	8:51a
4ev75e1o	378,812	12/08/2000	8:51a
4ev76a1	19,494	12/08/2000	8:51a
4ev76a1o	380,976	12/08/2000	8:51a
4ev76b1	19,494	12/08/2000	8:51a
4ev76b1o	380,082	12/08/2000	8:51a
4ev76c1	19,494	12/08/2000	8:51a
4ev76c1o	380,754	12/08/2000	8:51a
4ev76d1	19,494	12/08/2000	8:51a
4ev76d1o	380,754	12/08/2000	8:51a
4ev76e1	19,506	12/08/2000	8:51a
4ev76e1o	379,764	12/08/2000	8:51a
4ev77a1	19,494	12/08/2000	8:51a
4ev77a1o	379,884	12/08/2000	8:51a
4ev77b1	19,494	12/08/2000	8:51a
4ev77b1o	381,072	12/08/2000	8:51a
4ev77c1	19,494	12/08/2000	8:51a
4ev77c1o	378,407	12/08/2000	8:51a
4ev77d1	19,494	12/08/2000	8:51a
4ev77d1o	379,765	12/08/2000	8:51a
4ev77e1	19,506	12/08/2000	8:51a
4ev77e1o	380,754	12/08/2000	8:51a
4ev78a1	19,494	12/08/2000	8:51a
4ev78a1o	379,788	12/08/2000	8:51a
4ev78b1	19,494	12/08/2000	8:51a
4ev78b1o	379,884	12/08/2000	8:51a
4ev78c1	19,494	12/08/2000	8:51a
4ev78c1o	380,754	12/08/2000	8:51a
4ev78d1	19,494	12/08/2000	8:51a
4ev78d1o	379,566	12/08/2000	8:51a
4ev78e1	19,506	12/08/2000	8:51a
4ev78e1o	379,794	12/08/2000	8:51a
4ev79a1	19,494	12/08/2000	8:51a
4ev79a1o	380,082	12/08/2000	8:51a
4ev79b1	19,494	12/08/2000	8:51a
4ev79b1o	381,072	12/08/2000	8:51a
4ev79c1	19,494	12/08/2000	8:51a
4ev79c1o	380,754	12/08/2000	8:51a
4ev79d1	19,494	12/08/2000	8:51a
4ev79d1o	380,754	12/08/2000	8:51a
4ev79e1	19,506	12/08/2000	8:51a
4ev79e1o	380,754	12/08/2000	8:51a
Directory of D:\CD\CD\intact\MKIV\intactwscrap\alscrap			

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alscra1	19,568	12/08/2000	8:51a
alscra1o	380,866	12/08/2000	8:51a
alscra2	19,568	12/08/2000	8:51a
alscra2o	381,028	12/08/2000	8:51a
Directory of D:\CD\CD\intact\MKIV\intactwscrap\horizontal			
860k	<DIR>	01/30/2001	2:56p
930k	<DIR>	01/30/2001	2:57p
980kg	<DIR>	01/30/2001	2:57p
Directory of D:\CD\CD\intact\MKIV\intactwscrap\horizontal\860k			
4eh21a1	19,731	12/08/2000	8:51a
4eh21a1o	379,448	12/08/2000	8:51a
4eh21b1	19,731	12/08/2000	8:51a
4eh21b1o	379,640	12/08/2000	8:51a
4eh21c1	19,731	12/08/2000	8:51a
4eh21c1o	380,600	12/08/2000	8:51a
4eh22a1	19,731	12/08/2000	8:51a
4eh22a1o	380,504	12/08/2000	8:51a
4eh22b1	19,731	12/08/2000	8:51a
4eh22b1o	380,722	12/08/2000	8:51a
4eh22c1	19,731	12/08/2000	8:51a
4eh22c1o	380,282	12/08/2000	8:51a
Directory of D:\CD\CD\intact\MKIV\intactwscrap\horizontal\930k			
4eh11a1	19,732	12/08/2000	8:51a
4eh11a1o	380,594	12/08/2000	8:51a
4eh11b1	19,731	12/08/2000	8:51a
4eh11b1o	381,872	12/08/2000	8:51a
4eh11c1	19,731	12/08/2000	8:51a
4eh12a1	19,732	12/08/2000	8:51a
4eh12a1o	381,554	12/08/2000	8:52a
Directory of D:\CD\CD\intact\MKIV\intactwscrap\horizontal\980kg			
4eh31a1	19,729	12/08/2000	8:52a
4eh31a1o	381,554	12/08/2000	8:52a
4eh31b1	19,732	12/08/2000	8:52a
4eh31b1o	381,236	12/08/2000	8:52a
4eh31c1	19,732	12/08/2000	8:52a
4eh31c1o	381,236	12/08/2000	8:52a
4eh31d1	19,732	12/08/2000	8:52a
4eh31d1o	380,048	12/08/2000	8:52a
4eh31e1	19,730	12/08/2000	8:52a
4eh31e1o	381,236	12/08/2000	8:52a
4eh32a1	19,726	12/08/2000	8:52a
4eh32a1o	380,402	12/08/2000	8:52a
4eh32b1	19,731	12/08/2000	8:52a

File Name	File Size or Directory Denomination	Date of Last Access	Time
4eh32b1o	381,236	12/08/2000	8:52a
Directory of D:\CD\CD\intact\MKIV\intactwscrap\optimalloading			
case1	19,494	12/08/2000	8:52a
case10	20,483	12/08/2000	8:52a
case10o	382,835	12/08/2000	8:52a
case11	20,447	12/08/2000	8:52a
case11o	385,175	12/08/2000	8:52a
case12	20,447	12/08/2000	8:52a
case12o	384,215	12/08/2000	8:52a
case13	20,447	12/08/2000	8:52a
case13o	385,374	12/08/2000	8:52a
case14	20,447	12/08/2000	8:52a
case14o	385,175	12/08/2000	8:52a
case15	20,447	12/08/2000	8:52a
case15o	385,175	12/08/2000	8:52a
case16	20,447	12/08/2000	8:52a
case16o	385,175	12/08/2000	8:52a
case17	20,447	12/08/2000	8:52a
case17o	385,175	12/08/2000	8:52a
case18	20,447	12/08/2000	8:52a
case18o	384,089	12/08/2000	8:52a
case1o	380,082	12/08/2000	8:52a
case2	19,458	12/08/2000	8:52a
case2o	378,732	12/08/2000	8:52a
case3	19,458	12/08/2000	8:52a
case3o	381,072	12/08/2000	8:52a
case4	19,458	12/08/2000	8:52a
case4o	380,976	12/08/2000	8:52a
case5	19,458	12/08/2000	8:52a
case5o	379,913	12/08/2000	8:52a
case6	19,458	12/08/2000	8:52a
case6o	379,877	12/08/2000	8:52a
case7	19,458	12/08/2000	8:52a
case7o	381,072	12/08/2000	8:52a
case8	19,458	12/08/2000	8:52a
case8o	379,884	12/08/2000	8:52a
case9	19,458	12/08/2000	8:52a
case9o	379,788	12/08/2000	8:52a
Directory of D:\CD\CD\intact\MKIV\intactwscrap\zreflect			
zr1	19,568	12/08/2000	8:52a
zr1o	381,501	12/08/2000	8:52a
zr2	19,638	12/08/2000	8:52a
zr2o	380,477	12/08/2000	8:52a