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How to use Errata and Non-Default Nuclear Data Files with MCNP

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2026 MCNP® User Symposium

LA-UR-26-XXXXX

Nuclear Data Files used by MCNP = ACE Files

- ACE stands for A Compact ENDF file
- Helpful ACE format resources:
 - (1) A Compact ENDF (ACE) Format Specification ([LA-UR-19-29016](#)) (Not Complete)
 - (2) How to Read ACE File presentation by K. Tada (JAEA) ([link](#))
- ACE format consists of 2 types and 15 classes of data:
- Type 1: Standard formatted tables containing American Standard Code for Information Interchange (ASCII) text. Machine independent.
- Type 2: Standard unformatted binary tables. Faster to read, BUT machine/platform dependent.
- Data Classes:

Table B.1: MCNP6 Data Classes

	Class description	ZAID suffix
1	$S(\alpha, \beta)$ data tables	t
2	Continuous-energy neutron data libraries	c
3	Discrete-energy neutron data libraries	d
4	Coupled neutron-photon data multigroup library—neutron	m
5	Coupled neutron-photon data multigroup library—photon	g
6	Photoatomic data libraries	p
7	Photonuclear data libraries	u
8	Dosimetry data libraries	y
9	Electron data libraries	e
10	Proton data libraries	h
11	Photoatomic data libraries with atomic relaxation data	p
12	Deuteron data libraries	o
13	Triton data libraries	r
14	Helion data libraries	s
15	Alpha data libraries	a

Use the Nuclear Data Package Manager

- Download and install nuclear data with Nuclear Data Package Manager (mcnp630/MCNP_DATA/nd_manager) – I am using MCNP Version 6.3.0 (mcnp630)
- The Package Manager is also able to append errata nuclear data and create an XSDIR data directory file – LANL Nuclear Data Manager Format Specification v1.0 ([LA-UR-22-28306](#))
- MCNP_DATA folder contents could include the following nuclear data:

100xs	background_v4.dat	el03	gamman.tbl	newxsd
531dos	barpol.dat	endf5mt	gdr.dat	pace2.data
532dos	barpol2001.dat	endf5p	kcksyst.dat	pelxs.dat
CP2011	bert.dat	endf5u	kidman	pht.dat
CP2020	cgmf	endf60	la150h	ripl-3.dat
DBRC_endf71.txt	cgmf-1.1	endf62mt	la150n	rmccs
DBRC_endf80.txt	channel1.tab	endf66	la150u	rmccsa
ENDF71SaB	cinder.dat	endf6dn	level.tbl	sab2002
ENDF80SaB2	cindergl.dat	endf70	l1ldos	shell.tbl
ISC_DATA-2.1	cindergl_v1.dat	endf70prot	mass.tbl	skymap.dat
LAQGSMAtab.dat	database	endf70sab	mcplib	t16_2003
Lib80x	delay_library.dat	endf71x	mcplib02	therxs
actia	delay_library_v2.dat	endf7u	mcplib03	tmccs
actib	delay_library_v3.dat	endl92	mcplib04	uresa
atab.dat	delay_library_v4.dat	endl92fp	mcplib63	vgslid.tab
background	delay_library_v5.dat	eprdata12	mcplib84	xsdire
background.dat	docs	eprdata14	mgxsnp	xsdire_all
background_v1.dat	dre5	flalpha.tab	misc5xs	xsdire_mcn6.1
background_v2.dat	drmccs	freya	mollnix.tbl	xsdire_mcn6.2
background_v3.dat	el	frldm.tab	newxs	xsdire_mcn6.3

ENDF/B-VII.1

ENDF/B-VIII.0

MCNP 6.3.0 XSDIR

- Additional library information can be found on LANL Materials and Physical Data (XCP-5) Nuclear Data Team Website (<https://nucleardata.lanl.gov/>)

XSDIR Data Directory File Information

- What is an XSDIR? Useful information: Appendix B XSDIR Data Directory File in the MCNP® Code Version 6.3.0 Theory & User Manual ([LA-UR-22-30006](#))
- Structure:

DATAPATH (optional)
Atomic Weight Ratios (required)
Data Directory Entries (required)

- Data directory entries could point to various libraries – the ordering of the data directory entries matters – the first encountered file for a specified ZAID is used
- Inside of an XSDIR – Looking at data directory entries for the ENDF/B-VIII.0 nuclear data library (Lib80x):

```
# Library: Lib80x
1001.00c 0.999167 Lib80x/H/1001.800nc 0 1 3 10257 0 0 2.530100E-08
1001.01c 0.999167 Lib80x/H/1001.801nc 0 1 3 10257 0 0 5.170400E-08
1001.02c 0.999167 Lib80x/H/1001.802nc 0 1 3 10257 0 0 7.755600E-08
1001.03c 0.999167 Lib80x/H/1001.803nc 0 1 3 10257 0 0 1.034100E-07
1001.04c 0.999167 Lib80x/H/1001.804nc 0 1 3 10257 0 0 2.154300E-07
1001.05c 0.999167 Lib80x/H/1001.805nc 0 1 3 10257 0 0 8.617400E-12
1001.06c 0.999167 Lib80x/H/1001.806nc 0 1 3 10257 0 0 2.154300E-08
1002.00c 1.996800 Lib80x/H/1002.800nc 0 1 3 43756 0 0 2.530100E-08
1002.01c 1.996800 Lib80x/H/1002.801nc 0 1 3 43922 0 0 5.170400E-08
1002.02c 1.996800 Lib80x/H/1002.802nc 0 1 3 43987 0 0 7.755600E-08
1002.03c 1.996800 Lib80x/H/1002.803nc 0 1 3 44076 0 0 1.034100E-07
```

XSDIR Data Directory Entries

- Example data directory entry for ENDF/B-VIII.0 (Lib80x) ^{239}Pu :

94239.00c	236.998600	Lib80x/Pu/94239.800nc	0	1	3	1039943	0	0	2.530100E-08	ptable
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)

- (1) **Table Name** – Prefix: ZAID (ZAID = $Z * 1000 + A + S * 400$), Suffix: .XX + Data Class (“c” = continuous-energy neutron data library) – Z: atomic number, A: mass number, S: excited state
- (2) **Atomic Weight Ratio** – atomic mass divided by mass of a neutron
- (3) **File Name** – file name includes path to file from DATAPATH
- (4) **Access Route** – string < 70 characters that tells how to access the file if not already accessible, 0 for no access route
- (5) **File Type** – 1 for Type 1 file, 2 for Type 2 file
- (6) **Address** – line number in the ACE file where the table begins (1 for “old-style” Header, 4 for 2.0.0 Header, 3 for 2.0.1 Header)
- (7) **Table Length** – ACE files have 2 major blocks: (1) collection of pointers/counters/character information and (2) sequence of numbers – this is the length of the second block
- (8) **Record Length** – 0 for Type 1 file, compiler-dependent attribute for Type 2 file
- (9) **Number of Entries per Record** – 0 for Type 1 file, usually set to 512 for Type 2 file
- (10) **Temperature (MeV)** – entry only used for neutron data
- (11) **Probability Table Flag** – does the continuous-energy neutron nuclide have unresolved resonance range probability tables? If yes, include “ptable”

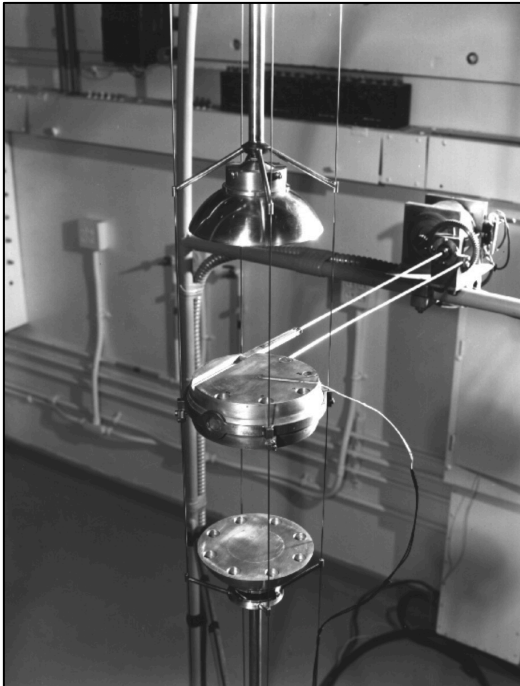
Methods to Specify Nuclear Data

- (1) Replace Input File Material Card Z Aid Suffix
- (2) Manipulate XSDIR Data Directory Entry
- (3) Use the XSn Card in an Input File

Challenge: Modify an ACE file with ACETk and Use the XSn Card

Increasing Level
of Difficulty

- In these examples, we'll be using the simplified Jezebel benchmark (J. Favorite) included in the International Handbook of Evaluated Criticality Safety Benchmark Experiments



New (2021) Simplified Model, Table 57

This input uses 50 settle cycles, 1000 active cycles, and 2,400,000 neutrons per cycle. ENDF/B-VIII.0 cross sections are specified.

```
Pu239 Jezebel 17,065.5 g Pu-alloy (4.5 at% 240Pu, 1.02 wt% Ga)
1 94 0.0402901 -1 imp:n=1
2 0 1 1 imp:n=0

1 so 6.39061

mode n
rand gen=2 seed=2901000001
prtmp j 500
kcode 2400000 1.0 50 1050
totnu
sdef pos=0. 0. 0. rad=d1 erg=d2
sil 0. 6.39061
spl -21 2
sp2 -3 0.966 2.842
m94 94239.00c 3.7047E-02
94240.00c 1.7512E-03
94241.00c 1.1674E-04
31069.00c 8.2663E-04
31071.00c 5.4857E-04
print
```

Method 1: Material Card ZAIID Suffix

Original Input

```
Pu239 Jezebel 17,065.5 g Pu-alloy (4.5 at% 240Pu, 1.02 wt% Ga)
1 94 0.0402901 -1 imp:n=1
2 0 1 imp:n=0

1 so 6.39061

mode n
rand gen=2 seed=2901000001
prtmp j 500
kcode 2400000 1.0 50 1050
totnu
sdef pos=0. 0. 0. rad=d1 erg=d2
si1 0. 6.39061
sp1 -21 2
sp2 -3 0.966 2.842
m94 94239.00c 3.7047E-02
94240.00c 1.7512E-03
94241.00c 1.1674E-04
31069.00c 8.2663E-04
31071.00c 5.4857E-04
print
```

m94	nlib=80c
94239	3.7047E-02
94240	1.7512E-03
94241	1.1674E-04
31069	8.2663E-04
31071	5.4857E-04

Options:

- (1) NLIB (neutron)
- (2) PLIB (photoatomic)
- (3) ELIB (electron)
- (4) PNLIB (photonuclear)
- (5) HLIB (proton)

Default

m94	94239	3.7047E-02
	94240	1.7512E-03
	94241	1.1674E-04
	31069	8.2663E-04
	31071	5.4857E-04

ENDF/B-VII.1

m94	94239. .80c	3.7047E-02
	94240. .80c	1.7512E-03
	94241. .80c	1.1674E-04
	31069. .80c	8.2663E-04
	31071. .80c	5.4857E-04

ENDF/B-VIII.0

m94	94239. .00c	3.7047E-02
	94240. .00c	1.7512E-03
	94241. .00c	1.1674E-04
	31069. .00c	8.2663E-04
	31071. .00c	5.4857E-04

Method 1: Material Card ZAID Suffix

ENDF/B-VII.1

```
Pu239 Jezebel 17,065.5 g Pu-alloy (4.5 at% 240Pu, 1.02 wt% Ga)
1 94 0.0402901 -1 imp:n=1
2 0 1 imp:n=0

1 so 6.39061

mode n
rand gen=2 seed=2901000001
prtmp j 500
kcode 2400000 1.0 50 1050
totnu
sdef pos=0. 0. 0. rad=d1 erg=d2
si1 0. 6.39061
sp1 -21 2
sp2 -3 0.966 2.842
m94 94239.80c 3.7047E-02
94240.80c 1.7512E-03
94241.80c 1.1674E-04
31069.80c 8.2663E-04
31071.80c 5.4857E-04
print
```

↑ Input
↓ Output

Default / ENDF/B-VIII.0

```
Pu239 Jezebel 17,065.5 g Pu-alloy (4.5 at% 240Pu, 1.02 wt% Ga)
1 94 0.0402901 -1 imp:n=1
2 0 1 imp:n=0

1 so 6.39061

mode n
rand gen=2 seed=2901000001
prtmp j 500
kcode 2400000 1.0 50 1050
totnu
sdef pos=0. 0. 0. rad=d1 erg=d2
si1 0. 6.39061
sp1 -21 2
sp2 -3 0.966 2.842
m94 94239.00c 3.7047E-02
94240.00c 1.7512E-03
94241.00c 1.1674E-04
31069.00c 8.2663E-04
31071.00c 5.4857E-04
print
```

↑ Input
↓ Output

```
1cross-section tables
XSDIR used: /Users/kleedtke/export/mcnp630/MCNP_DATA/MCNP_DATA/xsdir_mcnp6.3
print table 100

table length

tables from file endf71x/Ga/31069.710nc
31069.80c 69018 Ga69 ENDF71x (jlconlin) Ref. see jlconlin (ref 09/10/2012 10:00:53) mat3125 12/16/12
Energy range: 1.00000E-11 to 2.00000E+01 MeV.

tables from file endf71x/Ga/31071.710nc
31071.80c 58517 Ga71 ENDF71x (jlconlin) Ref. see jlconlin (ref 09/10/2012 10:00:53) mat3131 12/14/12
Energy range: 1.00000E-11 to 2.00000E+01 MeV.

tables from file endf71x/Pu/94239.710nc
94239.80c 586763 Pu239 ENDF71x (jlconlin) Ref. see jlconlin (ref 09/10/2012 10:00:53) mat9437 12/18/12
Energy range: 1.00000E-11 to 2.00000E+01 MeV.
probability tables used from 2.5000E-03 to 3.0000E-02 mev.

tables from file endf71x/Pu/94240.710nc
94240.80c 633923 Pu240 ENDF71x (jlconlin) Ref. see jlconlin (ref 09/10/2012 10:00:53) mat9440 12/17/12
Energy range: 1.00000E-11 to 3.00000E+01 MeV.
probability tables used from 5.7000E-03 to 4.0000E-02 mev.

tables from file endf71x/Pu/94241.710nc
94241.80c 133343 Pu241 ENDF71x (jlconlin) Ref. see jlconlin (ref 09/10/2012 10:00:53) mat9443 12/17/12
Energy range: 1.00000E-11 to 2.00000E+01 MeV.
probability tables used from 3.0000E-04 to 4.0200E-02 mev.

total 1481564
```

```
1cross-section tables
XSDIR used: /Users/kleedtke/export/mcnp630/MCNP_DATA/MCNP_DATA/xsdir_mcnp6.3
print table 100

table length

tables from file Lib80x/Ga/31069.800nc
31069.00c 77064 Ga69 Lib80x (jlconlin) Reference LA-UR-18-24034 by Conlin, J.L., et a 1. mat3125 05/01/18
Energy range: 1.00000E-11 to 2.00000E+01 MeV.

tables from file Lib80x/Ga/31071.800nc
31071.00c 84218 Ga71 Lib80x (jlconlin) Reference LA-UR-18-24034 by Conlin, J.L., et a 1. mat3131 05/01/18
Energy range: 1.00000E-11 to 2.00000E+01 MeV.

tables from file Lib80x/Pu/94239.800nc
94239.00c 840164 Pu239 Lib80x (jlconlin) Reference LA-UR-18-24034 btotat nu J.L., et al.mat9437 05/02/18
Energy range: 1.00000E-11 to 2.00000E+01 MeV.
probability tables used from 2.5000E-03 to 3.0000E-02 mev.

tables from file Lib80x/Pu/94240.800nc
94240.00c 978253 Pu240 Lib80x (jlconlin) Reference LA-UR-18-24034 btotat nu J.L., et al.mat9440 05/02/18
Energy range: 1.00000E-11 to 3.00000E+01 MeV.
probability tables used from 5.7000E-03 to 4.0000E-02 mev.

tables from file Lib80x/Pu/94241.800nc
94241.00c 138311 Pu241 Lib80x (jlconlin) Reference LA-UR-18-24034 btotat nu J.L., et al.mat9443 05/01/18
Energy range: 1.00000E-11 to 2.00000E+01 MeV.
probability tables used from 3.0000E-04 to 4.0200E-02 mev.

total 2118010
```

Method 2: XSDIR Manipulation

(a) Ordering:

```
#  
# Example 2(a)  
#  
94239.00c 236.998600 Lib80x/Pu/94239.800nc 0 1 3 1039943 0 0 2.530100E-08 +  
ptable  
94239.80c 236.998600 endf71x/Pu/94239.710nc 0 1 4 811599 0 0 2.530100E-08 +  
ptable  
#  
#  
#
```

- If the input file material card specifies 94239, the first instance of 94239 in the data directory entries will be used

(b) Comment:

```
#  
# Example 2(b)  
#  
# 94239.00c 236.998600 Lib80x/Pu/94239.800nc 0 1 3 1039943 0 0 2.530100E-08 +  
# ptable  
94239.80c 236.998600 endf71x/Pu/94239.710nc 0 1 4 811599 0 0 2.530100E-08 +  
ptable  
#  
#  
#
```

- Comment out the first instance of 94239 in the data directory entries to specify the second instance of 94239

Method 2: XSDIR Manipulation

(c) New XSDIR File:

- Create new XSDIR file with only 1 data directory entry for 94239
- Use **xmdir** = in the MCNP6 execution line

Example: `mcnp6 i = input_file.i xmdir = datapath/new_xmdir_file`

Method 3: XSn Card

- Method is helpful for ACE files not contained in a particular nuclear data library
- Details from pages 316-317 in MCNP[®] Code Version 6.3.0 Theory & User Manual ([LA-UR-22-30006](#)):

5.6.9 XS: Cross-Section File

The `XS` card can be used to load cross-section evaluations not listed in the `xsd` file. The `XS` cards can be used in addition to the `xsd` file. Each `XS` card describes one cross-section table. The entries for the `XS` card are identical to those that appear in the default cross-section directory file (i.e., `xsd_mcn6.3`) provided with the MCNP code, version 6.3, except that the “+” is not used for continuation.

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Chapter 5. Input Cards

5.6. Material-focused Data Cards

Data-card Form: `XS n z1 a1 z2 a2 ...`

<i>n</i>	Arbitrary cross-section identification number. Restriction: $1 \leq n \leq 99,999,999$.
<i>zk</i>	Nuclide identifier (ZZZAAA.abx) used on the <code>M</code> material card.
<i>ak</i>	Atomic weight ratio associated with nuclide <i>k</i> .
...	Remaining <code>xsd</code> file entries for the user-provided cross-section table as described in Appendix B.

Use: Add an `xsd`-type entry for nuclides not represented in the `xsd` file.

Method 3: XSn Card

- Example Scenario: You are given a new ^{239}Pu ACE file called pu239_nFission.ace that has an altered fission cross section. Your colleague asks you to see how this change to the fission cross section will impact the criticality of the simplified Jezebel benchmark.
- Step 1: Open the ACE file with a text editor

```
94239.00c 236.998600 2.5301E-08 01/01/25
Pu239 [ Altered file made by MCNP Super User ]
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
1039943 94239 72095 47 45 155 0 6
  0 94 239 0 0 0 0 0
  1 360476 373151 373198 373245 373292 373339 600148
600194 727862 727907 918604 990699 990854 991009 992427
992582 992582 992737 1039919 373526 1039943 900912 907805
907816 907858 907864 0 0 0 0 0
1.0000000000E-11 1.0312500000E-11 1.0625000000E-11 1.0937500000E-11
1.1250000000E-11 1.1562500000E-11 1.1875000000E-11 1.2187500000E-11
1.2500000000E-11 1.2812500000E-11 1.3125000000E-11 1.3437500000E-11
1.3750000000E-11 1.4375000000E-11 1.5000000000E-11 1.5625000000E-11
1.6250000000E-11 1.6875000000E-11 1.7500000000E-11 1.8125000000E-11
1.8750000000E-11 1.9375000000E-11 2.0000000000E-11 2.0937500000E-11
2.1875000000E-11 2.2812500000E-11 2.3750000000E-11 2.4687500000E-11
2.5625000000E-11 2.6562500000E-11 2.7500000000E-11 2.8437500000E-11
2.9375000000E-11 3.0312500000E-11 3.1250000000E-11 3.2187500000E-11
3.3125000000E-11 3.4062500000E-11 3.5000000000E-11 3.5937500000E-11
3.6875000000E-11 3.7812500000E-11 3.8750000000E-11 3.9687500000E-11
4.0625000000E-11 4.2500000000E-11 4.4375000000E-11 4.6250000000E-11
4.8125000000E-11 5.0000000000E-11 5.1562500000E-11 5.3125000000E-11
5.4687500000E-11 5.6250000000E-11 5.7812500000E-11 5.9375000000E-11
6.0937500000E-11 6.2500000000E-11 6.4062500000E-11 6.5625000000E-11
6.7187500000E-11 6.8750000000E-11 7.1875000000E-11 7.5000000000E-11
7.8125000000E-11 8.1250000000E-11 8.4375000000E-11 8.7500000000E-11
9.0625000000E-11 9.3750000000E-11 9.6875000000E-11 1.0000000000E-10
1.0312500000E-10 1.0625000000E-10 1.0937500000E-10 1.1250000000E-10
1.1562500000E-10 1.1875000000E-10 1.2187500000E-10 1.2500000000E-10
1.2812500000E-10 1.3125000000E-10 1.3437500000E-10 1.3750000000E-10
1.4375000000E-10 1.5000000000E-10 1.5625000000E-10 1.6250000000E-10
```

We need 11 pieces of information:

- (1) Table Name
- (2) Atomic Weight Ratio
- (3) File Name
- (4) Access Route
- (5) File Type
- (6) Address
- (7) Table Length
- (8) Record Length
- (9) Number of Entries per Record
- (10) Temperature
- (11) Probability Table Flag

Method 3: XSn Card

- Example Scenario: You are given a new ^{239}Pu ACE file called pu239_nFission.ace that has an altered fission cross section. Your colleague asks you to see how this change to the fission cross section will impact the criticality of the simplified Jezebel benchmark.
- Step 1: Open the ACE file with a text editor

```
94239.00c 236.998600 2.5301E-08 01/01/25
Pu239 [ Altered file made by MCNP Super User ]
  0 0 0 0 0 0 0 0
  0 0 0 0 0 0 0 0
  0 0 0 0 0 0 0 0
  0 0 0 0 0 0 0 0
1039943 94239 72095 47 45 155 0 6
  0 94 239 0 0 0 0 0
  1 360476 373151 373198 373245 373292 373339 600148
600194 727862 727907 918604 990699 990854 991009 992427
992582 992582 992737 1039919 373526 1039943 900912 907805
907816 907858 907864 0 0 0 0 0
1.0000000000E-11 1.0312500000E-11 1.0625000000E-11 1.0937500000E-11
1.1250000000E-11 1.1562500000E-11 1.1875000000E-11 1.2187500000E-11
1.2500000000E-11 1.2812500000E-11 1.3125000000E-11 1.3437500000E-11
1.3750000000E-11 1.4375000000E-11 1.5000000000E-11 1.5625000000E-11
1.6250000000E-11 1.6875000000E-11 1.7500000000E-11 1.8125000000E-11
1.8750000000E-11 1.9375000000E-11 2.0000000000E-11 2.0937500000E-11
2.1875000000E-11 2.2812500000E-11 2.3750000000E-11 2.4687500000E-11
2.5625000000E-11 2.6562500000E-11 2.7500000000E-11 2.8437500000E-11
2.9375000000E-11 3.0312500000E-11 3.1250000000E-11 3.2187500000E-11
3.3125000000E-11 3.4062500000E-11 3.5000000000E-11 3.5937500000E-11
3.6875000000E-11 3.7812500000E-11 3.8750000000E-11 3.9687500000E-11
4.0625000000E-11 4.2500000000E-11 4.4375000000E-11 4.6250000000E-11
4.8125000000E-11 5.0000000000E-11 5.1562500000E-11 5.3125000000E-11
5.4687500000E-11 5.6250000000E-11 5.7812500000E-11 5.9375000000E-11
6.0937500000E-11 6.2500000000E-11 6.4062500000E-11 6.5625000000E-11
6.7187500000E-11 6.8750000000E-11 7.1875000000E-11 7.5000000000E-11
7.8125000000E-11 8.1250000000E-11 8.4375000000E-11 8.7500000000E-11
9.0625000000E-11 9.3750000000E-11 9.6875000000E-11 1.0000000000E-10
1.0312500000E-10 1.0625000000E-10 1.0937500000E-10 1.1250000000E-10
1.1562500000E-10 1.1875000000E-10 1.2187500000E-10 1.2500000000E-10
1.2812500000E-10 1.3125000000E-10 1.3437500000E-10 1.3750000000E-10
1.4375000000E-10 1.5000000000E-10 1.5625000000E-10 1.6250000000E-10
```

We need 11 pieces of information:

- (1) Table Name
- (2) Atomic Weight Ratio
- (3) File Name
- (4) Access Route
- (5) File Type
- (6) Address
- (7) Table Length
- (8) Record Length
- (9) Number of Entries per Record
- (10) Temperature
- (11) Probability Table Flag

Method 3: XSn Card

- Example Scenario: You are given a new ^{239}Pu ACE file called pu239_nFission.ace that has an altered fission cross section. Your colleague asks you to see how this change to the fission cross section will impact the criticality of the simplified Jezebel benchmark.
- Step 1: Open the ACE file with a text editor

```
94239.00c 236.998600 2.5301E-08 01/01/25
Pu239 [ Altered file made by MCNP Super User ]
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
1039943 94239 72095 47 45 155 0 6
  0 94 239 0 0 0 0 0
  1 360476 373151 373198 373245 373292 373339 600148
600194 727862 727907 918604 990699 990854 991009 992427
992582 992582 992737 1039919 373526 1039943 900912 907805
907816 907858 907864 0 0 0 0 0
1.00000000000E-11 1.03125000000E-11 1.06250000000E-11 1.09375000000E-11
1.12500000000E-11 1.15625000000E-11 1.18750000000E-11 1.21875000000E-11
1.25000000000E-11 1.28125000000E-11 1.31250000000E-11 1.34375000000E-11
1.37500000000E-11 1.43750000000E-11 1.50000000000E-11 1.56250000000E-11
1.62500000000E-11 1.68750000000E-11 1.75000000000E-11 1.81250000000E-11
1.87500000000E-11 1.93750000000E-11 2.00000000000E-11 2.09375000000E-11
2.18750000000E-11 2.28125000000E-11 2.37500000000E-11 2.46875000000E-11
2.56250000000E-11 2.65625000000E-11 2.75000000000E-11 2.84375000000E-11
2.93750000000E-11 3.03125000000E-11 3.12500000000E-11 3.21875000000E-11
3.31250000000E-11 3.40625000000E-11 3.50000000000E-11 3.59375000000E-11
3.68750000000E-11 3.78125000000E-11 3.87500000000E-11 3.96875000000E-11
4.06250000000E-11 4.25000000000E-11 4.43750000000E-11 4.62500000000E-11
4.81250000000E-11 5.00000000000E-11 5.15625000000E-11 5.31250000000E-11
5.46875000000E-11 5.62500000000E-11 5.78125000000E-11 5.93750000000E-11
6.09375000000E-11 6.25000000000E-11 6.40625000000E-11 6.56250000000E-11
6.71875000000E-11 6.87500000000E-11 7.18750000000E-11 7.50000000000E-11
7.81250000000E-11 8.12500000000E-11 8.43750000000E-11 8.75000000000E-11
9.06250000000E-11 9.37500000000E-11 9.68750000000E-11 1.00000000000E-10
1.03125000000E-10 1.06250000000E-10 1.09375000000E-10 1.12500000000E-10
1.15625000000E-10 1.18750000000E-10 1.21875000000E-10 1.25000000000E-10
1.28125000000E-10 1.31250000000E-10 1.34375000000E-10 1.37500000000E-10
1.43750000000E-10 1.50000000000E-10 1.56250000000E-10 1.62500000000E-10
```

We need 11 pieces of information:

- (1) Table Name
- (2) Atomic Weight Ratio
- (3) File Name
- (4) Access Route
- (5) File Type
- (6) Address
- (7) Table Length
- (8) Record Length
- (9) Number of Entries per Record
- (10) Temperature
- (11) Probability Table Flag

Method 3: XSn Card

- Example Scenario: You are given a new ^{239}Pu ACE file called **pu239_nFission.ace** that has an altered fission cross section. Your colleague asks you to see how this change to the fission cross section will impact the criticality of the simplified Jezebel benchmark.
- Step 1: Open the ACE file with a text editor

```
94239.00c 236.998600 2.5301E-08 01/01/25
Pu239 [ Altered file made by MCNP Super User ]
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
1039943 94239 72095 47 45 155 0 6
  0 94 239 0 0 0 0 0
  1 360476 373151 373198 373245 373292 373339 600148
600194 727862 727907 918604 990699 990854 991009 992427
992582 992582 992737 1039919 373526 1039943 900912 907805
907816 907858 907864 0 0 0 0 0
1.0000000000E-11 1.0312500000E-11 1.0625000000E-11 1.0937500000E-11
1.1250000000E-11 1.1562500000E-11 1.1875000000E-11 1.2187500000E-11
1.2500000000E-11 1.2812500000E-11 1.3125000000E-11 1.3437500000E-11
1.3750000000E-11 1.4375000000E-11 1.5000000000E-11 1.5625000000E-11
1.6250000000E-11 1.6875000000E-11 1.7500000000E-11 1.8125000000E-11
1.8750000000E-11 1.9375000000E-11 2.0000000000E-11 2.0937500000E-11
2.1875000000E-11 2.2812500000E-11 2.3750000000E-11 2.4687500000E-11
2.5625000000E-11 2.6562500000E-11 2.7500000000E-11 2.8437500000E-11
2.9375000000E-11 3.0312500000E-11 3.1250000000E-11 3.2187500000E-11
3.3125000000E-11 3.4062500000E-11 3.5000000000E-11 3.5937500000E-11
3.6875000000E-11 3.7812500000E-11 3.8750000000E-11 3.9687500000E-11
4.0625000000E-11 4.2500000000E-11 4.4375000000E-11 4.6250000000E-11
4.8125000000E-11 5.0000000000E-11 5.1562500000E-11 5.3125000000E-11
5.4687500000E-11 5.6250000000E-11 5.7812500000E-11 5.9375000000E-11
6.0937500000E-11 6.2500000000E-11 6.4062500000E-11 6.5625000000E-11
6.7187500000E-11 6.8750000000E-11 7.1875000000E-11 7.5000000000E-11
7.8125000000E-11 8.1250000000E-11 8.4375000000E-11 8.7500000000E-11
9.0625000000E-11 9.3750000000E-11 9.6875000000E-11 1.0000000000E-10
1.0312500000E-10 1.0625000000E-10 1.0937500000E-10 1.1250000000E-10
1.1562500000E-10 1.1875000000E-10 1.2187500000E-10 1.2500000000E-10
1.2812500000E-10 1.3125000000E-10 1.3437500000E-10 1.3750000000E-10
1.4375000000E-10 1.5000000000E-10 1.5625000000E-10 1.6250000000E-10
```

We need 11 pieces of information:

- (1) Table Name
- (2) Atomic Weight Ratio
- (3) **File Name**
- (4) Access Route
- (5) File Type
- (6) Address
- (7) Table Length
- (8) Record Length
- (9) Number of Entries per Record
- (10) Temperature
- (11) Probability Table Flag

Method 3: XSn Card

- Example Scenario: You are given a new ^{239}Pu ACE file called pu239_nFission.ace that has an altered fission cross section. Your colleague asks you to see how this change to the fission cross section will impact the criticality of the simplified Jezebel benchmark.
- Step 1: Open the ACE file with a text editor

```
94239.00c 236.998600 2.5301E-08 01/01/25
Pu239 [ Altered file made by MCNP Super User ]
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
1039943 94239 72095 47 45 155 0 6
  0 94 239 0 0 0 0 0
  1 360476 373151 373198 373245 373292 373339 600148
600194 727862 727907 918604 990699 990854 991009 992427
992582 992582 992737 1039919 373526 1039943 900912 907805
907816 907858 907864 0 0 0 0 0
1.0000000000E-11 1.0312500000E-11 1.0625000000E-11 1.0937500000E-11
1.1250000000E-11 1.1562500000E-11 1.1875000000E-11 1.2187500000E-11
1.2500000000E-11 1.2812500000E-11 1.3125000000E-11 1.3437500000E-11
1.3750000000E-11 1.4375000000E-11 1.5000000000E-11 1.5625000000E-11
1.6250000000E-11 1.6875000000E-11 1.7500000000E-11 1.8125000000E-11
1.8750000000E-11 1.9375000000E-11 2.0000000000E-11 2.0937500000E-11
2.1875000000E-11 2.2812500000E-11 2.3750000000E-11 2.4687500000E-11
2.5625000000E-11 2.6562500000E-11 2.7500000000E-11 2.8437500000E-11
2.9375000000E-11 3.0312500000E-11 3.1250000000E-11 3.2187500000E-11
3.3125000000E-11 3.4062500000E-11 3.5000000000E-11 3.5937500000E-11
3.6875000000E-11 3.7812500000E-11 3.8750000000E-11 3.9687500000E-11
4.0625000000E-11 4.2500000000E-11 4.4375000000E-11 4.6250000000E-11
4.8125000000E-11 5.0000000000E-11 5.1562500000E-11 5.3125000000E-11
5.4687500000E-11 5.6250000000E-11 5.7812500000E-11 5.9375000000E-11
6.0937500000E-11 6.2500000000E-11 6.4062500000E-11 6.5625000000E-11
6.7187500000E-11 6.8750000000E-11 7.1875000000E-11 7.5000000000E-11
7.8125000000E-11 8.1250000000E-11 8.4375000000E-11 8.7500000000E-11
9.0625000000E-11 9.3750000000E-11 9.6875000000E-11 1.0000000000E-10
1.0312500000E-10 1.0625000000E-10 1.0937500000E-10 1.1250000000E-10
1.1562500000E-10 1.1875000000E-10 1.2187500000E-10 1.2500000000E-10
1.2812500000E-10 1.3125000000E-10 1.3437500000E-10 1.3750000000E-10
1.4375000000E-10 1.5000000000E-10 1.5625000000E-10 1.6250000000E-10
```

We need 11 pieces of information:

- (1) Table Name
- (2) Atomic Weight Ratio
- (3) File Name
- (4) Access Route – 0, no access route
- (5) File Type – Type 1
- (6) Address
- (7) Table Length
- (8) Record Length
- (9) Number of Entries per Record
- (10) Temperature
- (11) Probability Table Flag

Method 3: XSn Card

- Example Scenario: You are given a new ^{239}Pu ACE file called pu239_nFission.ace that has an altered fission cross section. Your colleague asks you to see how this change to the fission cross section will impact the criticality of the simplified Jezebel benchmark.
- Step 1: Open the ACE file with a text editor



```
94239.00c 236.998600 2.5301E-08 01/01/25
Pu239 [ Altered file made by MCNP Super User ]
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
1039943 94239 72095 47 45 155 0 6
  0 94 239 0 0 0 0 0
  1 360476 373151 373198 373245 373292 373339 600148
600194 727862 727907 918604 990699 990854 991009 992427
992582 992582 992737 1039919 373526 1039943 900912 907805
907816 907858 907864 0 0 0 0 0
1.0000000000E-11 1.0312500000E-11 1.0625000000E-11 1.0937500000E-11
1.1250000000E-11 1.1562500000E-11 1.1875000000E-11 1.2187500000E-11
1.2500000000E-11 1.2812500000E-11 1.3125000000E-11 1.3437500000E-11
1.3750000000E-11 1.4375000000E-11 1.5000000000E-11 1.5625000000E-11
1.6250000000E-11 1.6875000000E-11 1.7500000000E-11 1.8125000000E-11
1.8750000000E-11 1.9375000000E-11 2.0000000000E-11 2.0937500000E-11
2.1875000000E-11 2.2812500000E-11 2.3750000000E-11 2.4687500000E-11
2.5625000000E-11 2.6562500000E-11 2.7500000000E-11 2.8437500000E-11
2.9375000000E-11 3.0312500000E-11 3.1250000000E-11 3.2187500000E-11
3.3125000000E-11 3.4062500000E-11 3.5000000000E-11 3.5937500000E-11
3.6875000000E-11 3.7812500000E-11 3.8750000000E-11 3.9687500000E-11
4.0625000000E-11 4.2500000000E-11 4.4375000000E-11 4.6250000000E-11
4.8125000000E-11 5.0000000000E-11 5.1562500000E-11 5.3125000000E-11
5.4687500000E-11 5.6250000000E-11 5.7812500000E-11 5.9375000000E-11
6.0937500000E-11 6.2500000000E-11 6.4062500000E-11 6.5625000000E-11
6.7187500000E-11 6.8750000000E-11 7.1875000000E-11 7.5000000000E-11
7.8125000000E-11 8.1250000000E-11 8.4375000000E-11 8.7500000000E-11
9.0625000000E-11 9.3750000000E-11 9.6875000000E-11 1.0000000000E-10
1.0312500000E-10 1.0625000000E-10 1.0937500000E-10 1.1250000000E-10
1.1562500000E-10 1.1875000000E-10 1.2187500000E-10 1.2500000000E-10
1.2812500000E-10 1.3125000000E-10 1.3437500000E-10 1.3750000000E-10
1.4375000000E-10 1.5000000000E-10 1.5625000000E-10 1.6250000000E-10
```

We need 11 pieces of information:

- (1) Table Name
- (2) Atomic Weight Ratio
- (3) File Name
- (4) Access Route
- (5) File Type
- (6) Address – 1
- (7) Table Length
- (8) Record Length
- (9) Number of Entries per Record
- (10) Temperature
- (11) Probability Table Flag

Method 3: XSn Card

- Example Scenario: You are given a new ^{239}Pu ACE file called pu239_nFission.ace that has an altered fission cross section. Your colleague asks you to see how this change to the fission cross section will impact the criticality of the simplified Jezebel benchmark.
- Step 1: Open the ACE file with a text editor

```
94239.00c 236.998600 2.5301E-08 01/01/25
Pu239 [ Altered file made by MCNP Super User ]
  0. 0. 0. 0. 0. 0. 0. 0.
  0. 0. 0. 0. 0. 0. 0. 0.
  0. 0. 0. 0. 0. 0. 0. 0.
  0. 0. 0. 0. 0. 0. 0. 0.
1039943 94239 72095 47 45 155 0 6
  0 94 239 0 0 0 0 0
  1 360476 373151 373198 373245 373292 373339 600148
600194 727862 727907 918604 990699 990854 991009 992427
992582 992582 992737 1039919 373526 1039943 900912 907805
907816 907858 907864 0 0 0 0 0
1.0000000000E-11 1.0312500000E-11 1.0625000000E-11 1.0937500000E-11
1.1250000000E-11 1.1562500000E-11 1.1875000000E-11 1.2187500000E-11
1.2500000000E-11 1.2812500000E-11 1.3125000000E-11 1.3437500000E-11
1.3750000000E-11 1.4375000000E-11 1.5000000000E-11 1.5625000000E-11
1.6250000000E-11 1.6875000000E-11 1.7500000000E-11 1.8125000000E-11
1.8750000000E-11 1.9375000000E-11 2.0000000000E-11 2.0937500000E-11
2.1875000000E-11 2.2812500000E-11 2.3750000000E-11 2.4687500000E-11
2.5625000000E-11 2.6562500000E-11 2.7500000000E-11 2.8437500000E-11
2.9375000000E-11 3.0312500000E-11 3.1250000000E-11 3.2187500000E-11
3.3125000000E-11 3.4062500000E-11 3.5000000000E-11 3.5937500000E-11
3.6875000000E-11 3.7812500000E-11 3.8750000000E-11 3.9687500000E-11
4.0625000000E-11 4.2500000000E-11 4.4375000000E-11 4.6250000000E-11
4.8125000000E-11 5.0000000000E-11 5.1562500000E-11 5.3125000000E-11
5.4687500000E-11 5.6250000000E-11 5.7812500000E-11 5.9375000000E-11
6.0937500000E-11 6.2500000000E-11 6.4062500000E-11 6.5625000000E-11
6.7187500000E-11 6.8750000000E-11 7.1875000000E-11 7.5000000000E-11
7.8125000000E-11 8.1250000000E-11 8.4375000000E-11 8.7500000000E-11
9.0625000000E-11 9.3750000000E-11 9.6875000000E-11 1.0000000000E-10
1.0312500000E-10 1.0625000000E-10 1.0937500000E-10 1.1250000000E-10
1.1562500000E-10 1.1875000000E-10 1.2187500000E-10 1.2500000000E-10
1.2812500000E-10 1.3125000000E-10 1.3437500000E-10 1.3750000000E-10
1.4375000000E-10 1.5000000000E-10 1.5625000000E-10 1.6250000000E-10
```

We need 11 pieces of information:

- (1) Table Name
- (2) Atomic Weight Ratio
- (3) File Name
- (4) Access Route
- (5) File Type
- (6) Address
- (7) Table Length
- (8) Record Length
- (9) Number of Entries per Record
- (10) Temperature
- (11) Probability Table Flag

Method 3: XSn Card

- Example Scenario: You are given a new ^{239}Pu ACE file called pu239_nFission.ace that has an altered fission cross section. Your colleague asks you to see how this change to the fission cross section will impact the criticality of the simplified Jezebel benchmark.
- Step 1: Open the ACE file with a text editor

```
94239.00c 236.998600 2.5301E-08 01/01/25
Pu239 [ Altered file made by MCNP Super User ]
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
1039943 94239 72095 47 45 155 0 6
  0 94 239 0 0 0 0 0
  1 360476 373151 373198 373245 373292 373339 600148
600194 727862 727907 918604 990699 990854 991009 992427
992582 992582 992737 1039919 373526 1039943 900912 907805
907816 907858 907864 0 0 0 0 0
1.0000000000E-11 1.0312500000E-11 1.0625000000E-11 1.0937500000E-11
1.1250000000E-11 1.1562500000E-11 1.1875000000E-11 1.2187500000E-11
1.2500000000E-11 1.2812500000E-11 1.3125000000E-11 1.3437500000E-11
1.3750000000E-11 1.4375000000E-11 1.5000000000E-11 1.5625000000E-11
1.6250000000E-11 1.6875000000E-11 1.7500000000E-11 1.8125000000E-11
1.8750000000E-11 1.9375000000E-11 2.0000000000E-11 2.0937500000E-11
2.1875000000E-11 2.2812500000E-11 2.3750000000E-11 2.4687500000E-11
2.5625000000E-11 2.6562500000E-11 2.7500000000E-11 2.8437500000E-11
2.9375000000E-11 3.0312500000E-11 3.1250000000E-11 3.2187500000E-11
3.3125000000E-11 3.4062500000E-11 3.5000000000E-11 3.5937500000E-11
3.6875000000E-11 3.7812500000E-11 3.8750000000E-11 3.9687500000E-11
4.0625000000E-11 4.2500000000E-11 4.4375000000E-11 4.6250000000E-11
4.8125000000E-11 5.0000000000E-11 5.1562500000E-11 5.3125000000E-11
5.4687500000E-11 5.6250000000E-11 5.7812500000E-11 5.9375000000E-11
6.0937500000E-11 6.2500000000E-11 6.4062500000E-11 6.5625000000E-11
6.7187500000E-11 6.8750000000E-11 7.1875000000E-11 7.5000000000E-11
7.8125000000E-11 8.1250000000E-11 8.4375000000E-11 8.7500000000E-11
9.0625000000E-11 9.3750000000E-11 9.6875000000E-11 1.0000000000E-10
1.0312500000E-10 1.0625000000E-10 1.0937500000E-10 1.1250000000E-10
1.1562500000E-10 1.1875000000E-10 1.2187500000E-10 1.2500000000E-10
1.2812500000E-10 1.3125000000E-10 1.3437500000E-10 1.3750000000E-10
1.4375000000E-10 1.5000000000E-10 1.5625000000E-10 1.6250000000E-10
```

We need 11 pieces of information:

- (1) Table Name
- (2) Atomic Weight Ratio
- (3) File Name
- (4) Access Route
- (5) File Type
- (6) Address
- (7) Table Length
- (8) Record Length – 0
- (9) Number of Entries per Record – 0
- (10) Temperature
- (11) Probability Table Flag

Method 3: XSn Card

- Example Scenario: You are given a new ^{239}Pu ACE file called pu239_nFission.ace that has an altered fission cross section. Your colleague asks you to see how this change to the fission cross section will impact the criticality of the simplified Jezebel benchmark.
- Step 1: Open the ACE file with a text editor

```
94239.00c 236.998600 2.5301E-08 01/01/25
Pu239 [ Altered file made by MCNP Super User ]
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
1039943 94239 72095 47 45 155 0 6
  0 94 239 0 0 0 0 0
  1 360476 373151 373198 373245 373292 373339 600148
600194 727862 727907 918604 990699 990854 991009 992427
992582 992582 992737 1039919 373526 1039943 900912 907805
907816 907858 907864 0 0 0 0 0
1.0000000000E-11 1.0312500000E-11 1.0625000000E-11 1.0937500000E-11
1.1250000000E-11 1.1562500000E-11 1.1875000000E-11 1.2187500000E-11
1.2500000000E-11 1.2812500000E-11 1.3125000000E-11 1.3437500000E-11
1.3750000000E-11 1.4375000000E-11 1.5000000000E-11 1.5625000000E-11
1.6250000000E-11 1.6875000000E-11 1.7500000000E-11 1.8125000000E-11
1.8750000000E-11 1.9375000000E-11 2.0000000000E-11 2.0937500000E-11
2.1875000000E-11 2.2812500000E-11 2.3750000000E-11 2.4687500000E-11
2.5625000000E-11 2.6562500000E-11 2.7500000000E-11 2.8437500000E-11
2.9375000000E-11 3.0312500000E-11 3.1250000000E-11 3.2187500000E-11
3.3125000000E-11 3.4062500000E-11 3.5000000000E-11 3.5937500000E-11
3.6875000000E-11 3.7812500000E-11 3.8750000000E-11 3.9687500000E-11
4.0625000000E-11 4.2500000000E-11 4.4375000000E-11 4.6250000000E-11
4.8125000000E-11 5.0000000000E-11 5.1562500000E-11 5.3125000000E-11
5.4687500000E-11 5.6250000000E-11 5.7812500000E-11 5.9375000000E-11
6.0937500000E-11 6.2500000000E-11 6.4062500000E-11 6.5625000000E-11
6.7187500000E-11 6.8750000000E-11 7.1875000000E-11 7.5000000000E-11
7.8125000000E-11 8.1250000000E-11 8.4375000000E-11 8.7500000000E-11
9.0625000000E-11 9.3750000000E-11 9.6875000000E-11 1.0000000000E-10
1.0312500000E-10 1.0625000000E-10 1.0937500000E-10 1.1250000000E-10
1.1562500000E-10 1.1875000000E-10 1.2187500000E-10 1.2500000000E-10
1.2812500000E-10 1.3125000000E-10 1.3437500000E-10 1.3750000000E-10
1.4375000000E-10 1.5000000000E-10 1.5625000000E-10 1.6250000000E-10
```

We need 11 pieces of information:

- (1) Table Name
- (2) Atomic Weight Ratio
- (3) File Name
- (4) Access Route
- (5) File Type
- (6) Address
- (7) Table Length
- (8) Record Length
- (9) Number of Entries per Record
- (10) Temperature
- (11) Probability Table Flag

Method 3: XSn Card

- Example Scenario: You are given a new ^{239}Pu ACE file called pu239_nFission.ace that has an altered fission cross section. Your colleague asks you to see how this change to the fission cross section will impact the criticality of the simplified Jezebel benchmark.
- Step 1: Open the ACE file with a text editor

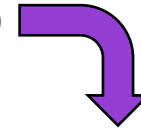
```
94239.00c 236.998600 2.5301E-08 01/01/25
Pu239 [ Altered file made by MCNP Super User ]
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
  0 0. 0 0. 0 0. 0 0.
1039943 94239 72095 47 45 155 0 6
  0 94 239 0 0 0 0 0
  1 360476 373151 373198 373245 373292 373339 600148
600194 727862 727907 918604 990699 990854 991009 992427
992582 992582 992737 1039919 373526 1039943 900912 907805
907816 907858 907864 0 0 0 0 0
1.0000000000E-11 1.0312500000E-11 1.0625000000E-11 1.0937500000E-11
1.1250000000E-11 1.1562500000E-11 1.1875000000E-11 1.2187500000E-11
1.2500000000E-11 1.2812500000E-11 1.3125000000E-11 1.3437500000E-11
1.3750000000E-11 1.4375000000E-11 1.5000000000E-11 1.5625000000E-11
1.6250000000E-11 1.6875000000E-11 1.7500000000E-11 1.8125000000E-11
1.8750000000E-11 1.9375000000E-11 2.0000000000E-11 2.0937500000E-11
2.1875000000E-11 2.2812500000E-11 2.3750000000E-11 2.4687500000E-11
2.5625000000E-11 2.6562500000E-11 2.7500000000E-11 2.8437500000E-11
2.9375000000E-11 3.0312500000E-11 3.1250000000E-11 3.2187500000E-11
3.3125000000E-11 3.4062500000E-11 3.5000000000E-11 3.5937500000E-11
3.6875000000E-11 3.7812500000E-11 3.8750000000E-11 3.9687500000E-11
4.0625000000E-11 4.2500000000E-11 4.4375000000E-11 4.6250000000E-11
4.8125000000E-11 5.0000000000E-11 5.1562500000E-11 5.3125000000E-11
5.4687500000E-11 5.6250000000E-11 5.7812500000E-11 5.9375000000E-11
6.0937500000E-11 6.2500000000E-11 6.4062500000E-11 6.5625000000E-11
6.7187500000E-11 6.8750000000E-11 7.1875000000E-11 7.5000000000E-11
7.8125000000E-11 8.1250000000E-11 8.4375000000E-11 8.7500000000E-11
9.0625000000E-11 9.3750000000E-11 9.6875000000E-11 1.0000000000E-10
1.0312500000E-10 1.0625000000E-10 1.0937500000E-10 1.1250000000E-10
1.1562500000E-10 1.1875000000E-10 1.2187500000E-10 1.2500000000E-10
1.2812500000E-10 1.3125000000E-10 1.3437500000E-10 1.3750000000E-10
1.4375000000E-10 1.5000000000E-10 1.5625000000E-10 1.6250000000E-10
```

We need 11 pieces of information:

- (1) Table Name
- (2) Atomic Weight Ratio
- (3) File Name
- (4) Access Route
- (5) File Type
- (6) Address
- (7) Table Length
- (8) Record Length
- (9) Number of Entries per Record
- (10) Temperature
- (11) Probability Table Flag

Method 3: XSn Card

- Step 2: Put new ACE file in same location as MCNP input file
- Step 3: Define XSn card in MCNP input file
- Step 4: Run MCNP input file / Check MCNP output file Print Table 100
- Step 5: Check MCNP output file for new value of k_{eff}



```
1cross-section tables                                     print table 100
  XSDIR used: /Users/kleedtke/export/mcnp630/MCNP_DATA/MCNP_DATA/xsdir_mcnp6.3

  table      length

          tables from file Lib80x/Ga/31069.800nc

31069.00c    77064  Ga69 Lib80x (jlconlin) Reference LA-UR-18-24034 by Conlin, J.L., et a  1. mat3125    05/01/18
Energy range: 1.00000E-11 to 2.00000E+01 MeV.

          tables from file Lib80x/Ga/31071.800nc

31071.00c    84218  Ga71 Lib80x (jlconlin) Reference LA-UR-18-24034 by Conlin, J.L., et a  1. mat3131    05/01/18
Energy range: 1.00000E-11 to 2.00000E+01 MeV.

          tables from file pu239_nfission.ace

94239.00c    840164  Pu239 [ Altered file made by MCNP Super User ]      total nu      01/01/25
Energy range: 1.00000E-11 to 2.00000E+01 MeV.
probability tables used from 2.5000E-03 to 3.0000E-02 mev.

          tables from file Lib80x/Pu/94240.800nc

94240.00c    978253  Pu240 Lib80x (jlconlin) Reference LA-UR-18-24034 bttotal nu  J.L., et    al.mat9440    05/02/18
Energy range: 1.00000E-11 to 3.00000E+01 MeV.
probability tables used from 5.7000E-03 to 4.0000E-02 mev.

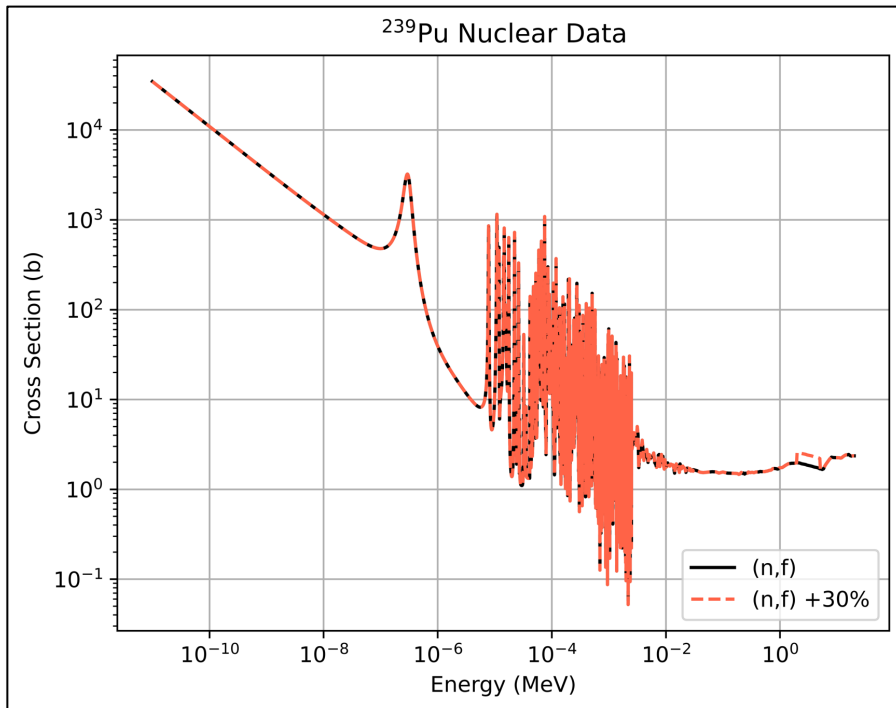
          tables from file Lib80x/Pu/94241.800nc

94241.00c    138311  Pu241 Lib80x (jlconlin) Reference LA-UR-18-24034 bttotal nu  J.L., et    al.mat9443    05/01/18
Energy range: 1.00000E-11 to 2.00000E+01 MeV.
probability tables used from 3.0000E-04 to 4.0200E-02 mev.

total      2118010
```

Challenge: ACEtk + XSn Card

- Use method in
N. Kleedtke, W. Haeck, J. Hutchinson, “Utilization of ACE nuclear data file toolkit ACEtk (<https://github.com/njoy/ACEtk>) to calculate relative sensitivity coefficients of point-kinetics parameters,” *Annals of Nuclear Energy* 193 (2023). DOI: [10.1016/j.anucene.2023.110031](https://doi.org/10.1016/j.anucene.2023.110031)
..to perturb ENDF/B-VIII.0 $^{239}\text{Pu}(n,f) + 30\%$ from 2 MeV – 5 MeV
- Use Method 3 from this presentation to define an XSn card:
XS1 94239.00c 236.9986 pu239_e80_mt18_p30.ace 0 1 1 911710 0 0 2.5301e-8 ptable
- Compare MCNP output with default nuclear data and ^{239}Pu replacement



Test	k_{eff}
Experiment	1.00000(130)
Benchmark, E8.0 Original	1.00056(1)
Benchmark, E8.0 +30%	1.06823(1)
Difference (+30% – Original)	6767 pcm!

Example: Specify Pt/Ta Errata Files for Lib81

- New Platinum (Pt) and Tantalum (Ta) errata files created and posted on Nuclear Data Team's Website for ENDF/B-VIII.1 (Lib81) ([link](#)) after MCNP user identified an issue with outgoing γ distributions containing > 1000 energies for capture (MCNP mode p with Pt/Ta files would hang/crash)
- A detailed description of the problem is included in [LA-UR-26-24142](#) (A. Lewis)
- Define simple test problem:

```
c CELLS
1 1 -1 -1 imp:n,p=1
2 0 +1 imp:n,p=0

c SURFACES
1 so 5

c DATA
mode n p
phys:n
phys:p
nps 1e5
sdef
m1 78190 1
XS1 78190.10c 188.328100 Lib81/Pt/78190.10c 0 1 1 1120384 0 0 2.530E-08 ptable
```

You can use Method 3 from this presentation to define an XS_n card using files downloaded directly from Nuclear Data Team's Website or update existing XSDIR (Method 2) using xsdir provided in Website download



XSDIR from Download:

```
78190.10c 188.328100 Lib81/Pt/78190.10c 0 1 1 1120384 0 0 2.530E-08 ptable
78190.11c 188.328100 Lib81/Pt/78190.11c 0 1 1 1089280 0 0 5.170E-08 ptable
78190.12c 188.328100 Lib81/Pt/78190.12c 0 1 1 1070020 0 0 7.756E-08 ptable
78190.13c 188.328100 Lib81/Pt/78190.13c 0 1 1 1059724 0 0 1.034E-07 ptable
78190.14c 188.328100 Lib81/Pt/78190.14c 0 1 1 1028621 0 0 2.154E-07 ptable
78190.15c 188.328100 Lib81/Pt/78190.15c 0 1 1 1292321 0 0 8.617E-12 ptable
78190.16c 188.328100 Lib81/Pt/78190.16c 0 1 1 1130680 0 0 2.009E-08 ptable
78190.17c 188.328100 Lib81/Pt/78190.17c 0 1 1 1124024 0 0 2.354E-08 ptable
78191.10c 189.321200 Lib81/Pt/78191.10c 0 1 1 1050489 0 0 2.530E-08 ptable
78191.11c 189.321200 Lib81/Pt/78191.11c 0 1 1 1030233 0 0 5.170E-08 ptable
78191.12c 189.321200 Lib81/Pt/78191.12c 0 1 1 1014346 0 0 7.756E-08 ptable
78191.13c 189.321200 Lib81/Pt/78191.13c 0 1 1 1003210 0 0 1.034E-07 ptable
78191.14c 189.321200 Lib81/Pt/78191.14c 0 1 1 967739 0 0 2.154E-07 ptable
78191.15c 189.321200 Lib81/Pt/78191.15c 0 1 1 1080634 0 0 8.617E-12 ptable
78191.16c 189.321200 Lib81/Pt/78191.16c 0 1 1 1054570 0 0 2.009E-08 ptable
78191.17c 189.321200 Lib81/Pt/78191.17c 0 1 1 1051545 0 0 2.354E-08 ptable
78192.10c 190.312000 Lib81/Pt/78192.10c 0 1 1 3420278 0 0 2.530E-08 ptable
78192.11c 190.312000 Lib81/Pt/78192.11c 0 1 1 3247578 0 0 5.170E-08 ptable
78192.12c 190.312000 Lib81/Pt/78192.12c 0 1 1 3138327 0 0 7.756E-08 ptable
78192.13c 190.312000 Lib81/Pt/78192.13c 0 1 1 3066233 0 0 1.034E-07 ptable
78192.14c 190.312000 Lib81/Pt/78192.14c 0 1 1 2866984 0 0 2.154E-07 ptable
78192.15c 190.312000 Lib81/Pt/78192.15c 0 1 1 4663478 0 0 8.617E-12 ptable
78192.16c 190.312000 Lib81/Pt/78192.16c 0 1 1 3479030 0 0 2.009E-08 ptable
78192.17c 190.312000 Lib81/Pt/78192.17c 0 1 1 3436983 0 0 2.354E-08 ptable
78193.10c 191.305300 Lib81/Pt/78193.10c 0 1 1 2289055 0 0 2.530E-08 ptable
78193.11c 191.305300 Lib81/Pt/78193.11c 0 1 1 2109813 0 0 5.170E-08 ptable
78193.12c 191.305300 Lib81/Pt/78193.12c 0 1 1 2020665 0 0 7.756E-08 ptable
78193.13c 191.305300 Lib81/Pt/78193.13c 0 1 1 1935468 0 0 1.034E-07 ptable
78193.14c 191.305300 Lib81/Pt/78193.14c 0 1 1 1742008 0 0 2.154E-07 ptable
78193.15c 191.305300 Lib81/Pt/78193.15c 0 1 1 3115173 0 0 8.617E-12 ptable
78193.16c 191.305300 Lib81/Pt/78193.16c 0 1 1 2344515 0 0 2.009E-08 ptable
78193.17c 191.305300 Lib81/Pt/78193.17c 0 1 1 2304100 0 0 2.354E-08 ptable
78194.10c 192.296400 Lib81/Pt/78194.10c 0 1 1 1359848 0 0 2.530E-08 ptable
78194.11c 192.296400 Lib81/Pt/78194.11c 0 1 1 1328820 0 0 5.170E-08 ptable
```

Example: Specify Pt/Ta Errata Files for Lib81

- Check Table 100* to make sure we are using the correct file:

```
1cross-section tables
```

```
print table 100
```

```
XSDIR used: /Users/kleedtke/export/mcnp630/MCNP_DATA/MCNP_DATA/xsdir_mcnp6.3
```

```
Tables from file lib81/pt/78190.10c:
```

```
Table 78190.10c
```

```
Projectile:  Neutron
Target:      Pt-190
Type:        Continuous
Temperature: 2.53000E-08 MeV
Energy Range: [1.00000E-11, 2.00000E+01] MeV
URR Range:    [1.07604E-03, 2.92842E-01] MeV
Date:         01/12/26
Comment:      Pt190 Lib81 (nuclldata@lanl.gov) Ref. LA-UR-26-24142
Table Length: 779972 entries
```

```
Secondary Production Data:
```

```
In Use:      photons
Expunged:     protons,  deuterons, tritons,  helions,  alphas
```

*Table looks different from before b/c this is MCNP 6.4.0

Summary

- The nuclear data files used by MCNP are called ACE files
- ACE files are defined in the XSDIR data directory file
- The data directory entries have 11 pieces of information that must be specified
- 3 methods presented to specify errata and non-default nuclear data:
 - (1) Replace Input File Material Card ZAID Suffix
 - (2) Manipulate XSDIR Data Directory Entry
 - (3) Use the XS_n Card in an Input File
- The successful implementation of any of these methods would allow users to quantify changes to output (e.g., criticality) for single-file nuclear data replacement and/or combinations of nuclear data changes

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Questions?

Contact the Los Alamos National Laboratory Nuclear
Data Team by email at nucldata@lanl.gov

