Reducing Errors: Developments at Sellafield to Aid the Criticality Assessor

Fred Winstanley and Paul Hulse
Safety & Risk Management
Sellafield Ltd
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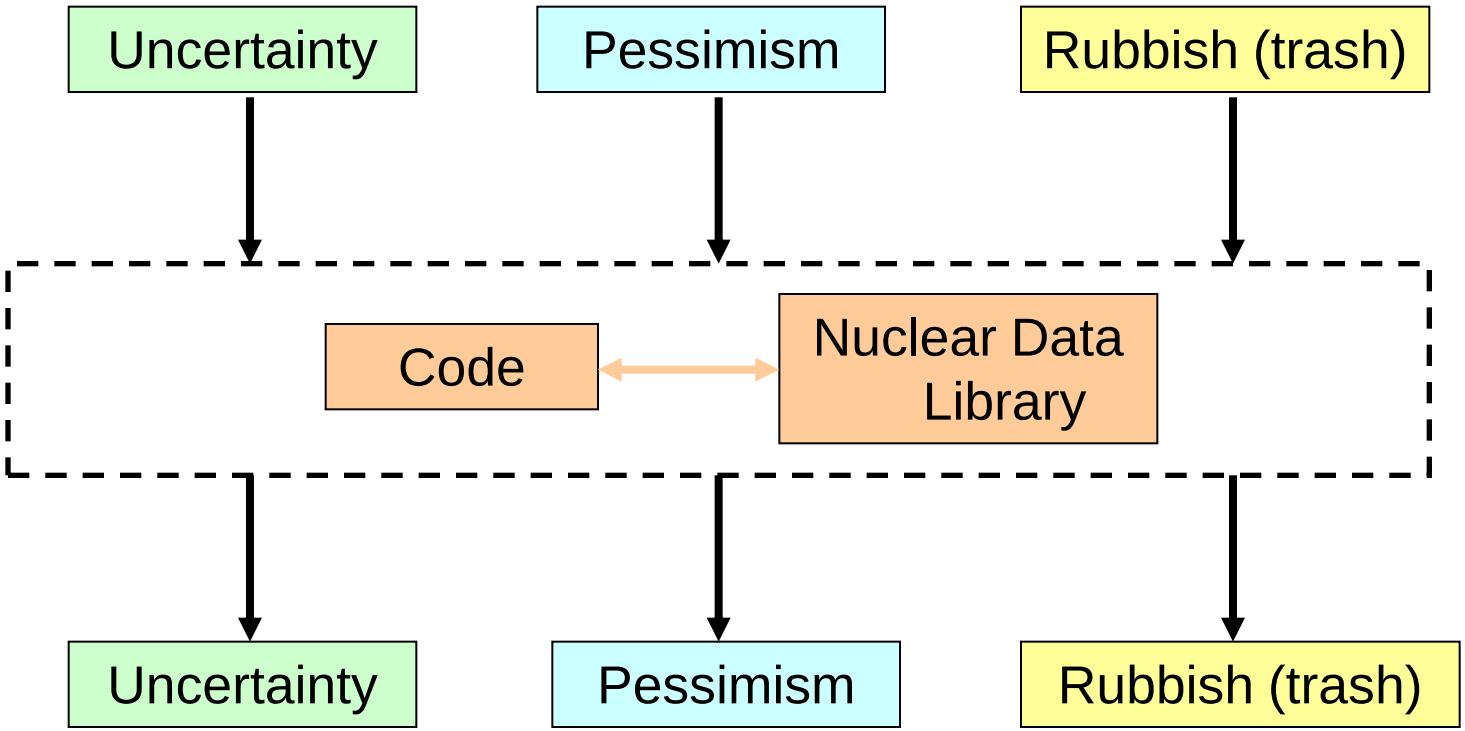
Sellafield Ltd

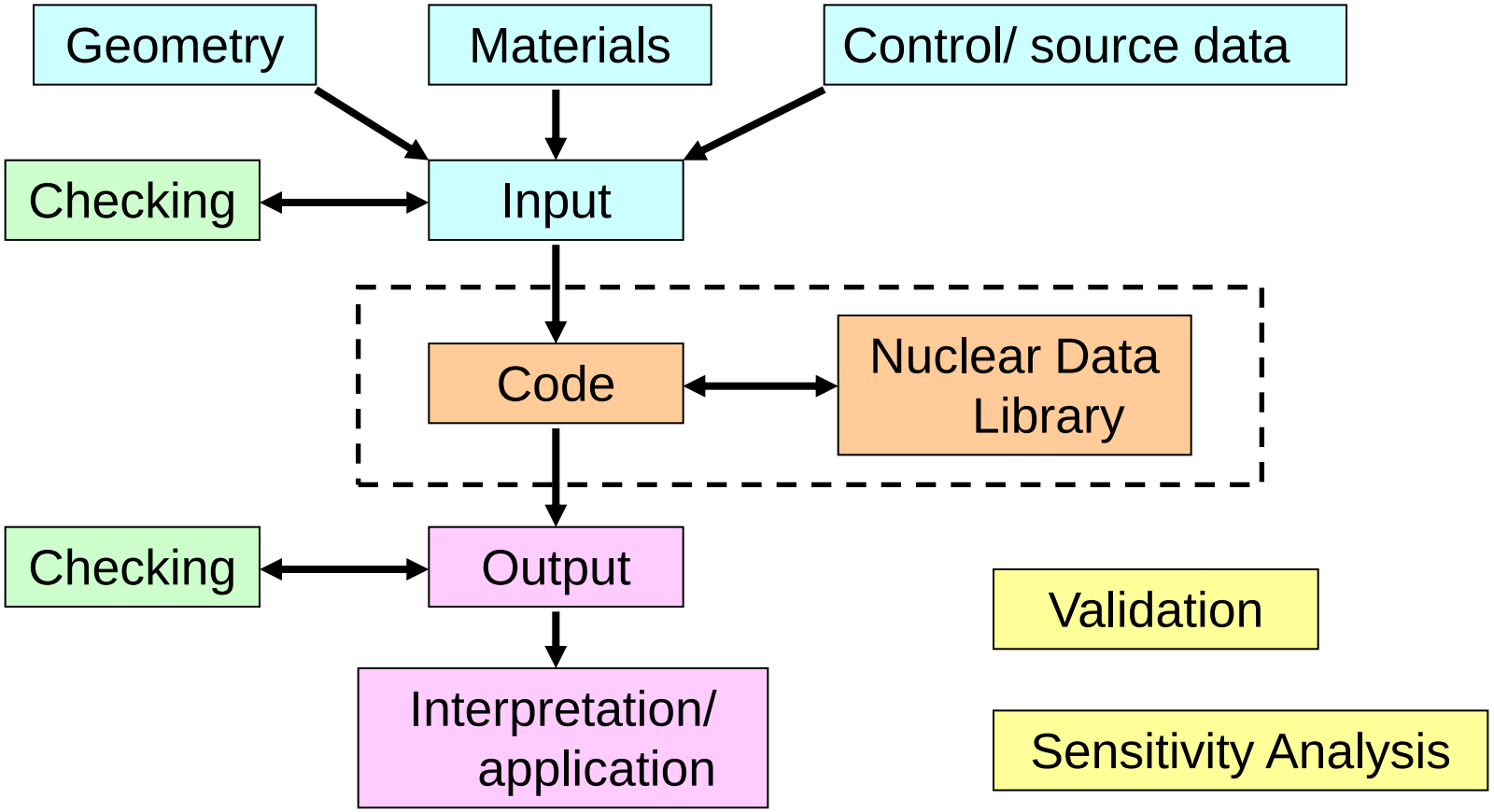
Computing moves on …

VAX 11/780 minicomputer

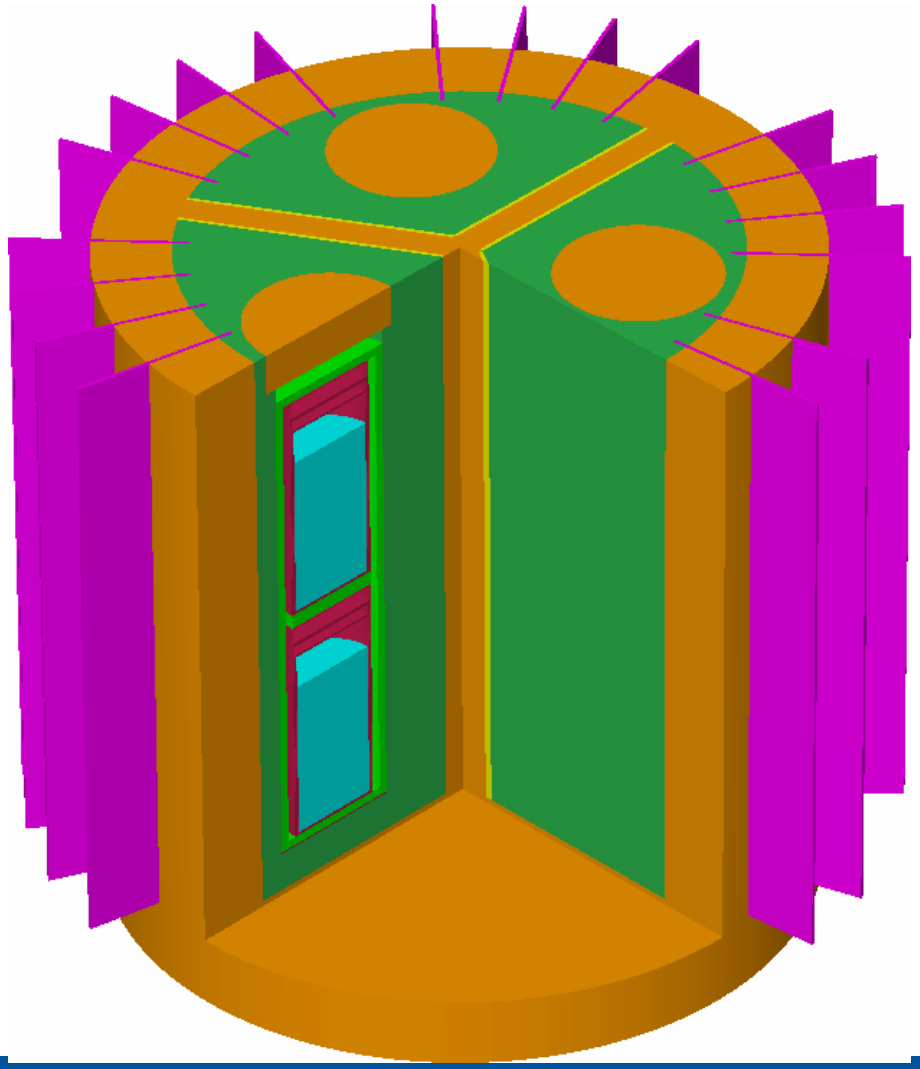
Aims


Uncertainty
Pessimism
Rubbish (trash)
Code
Nuclear Data Library
Uncertainty
Pessimism
Rubbish (trash)

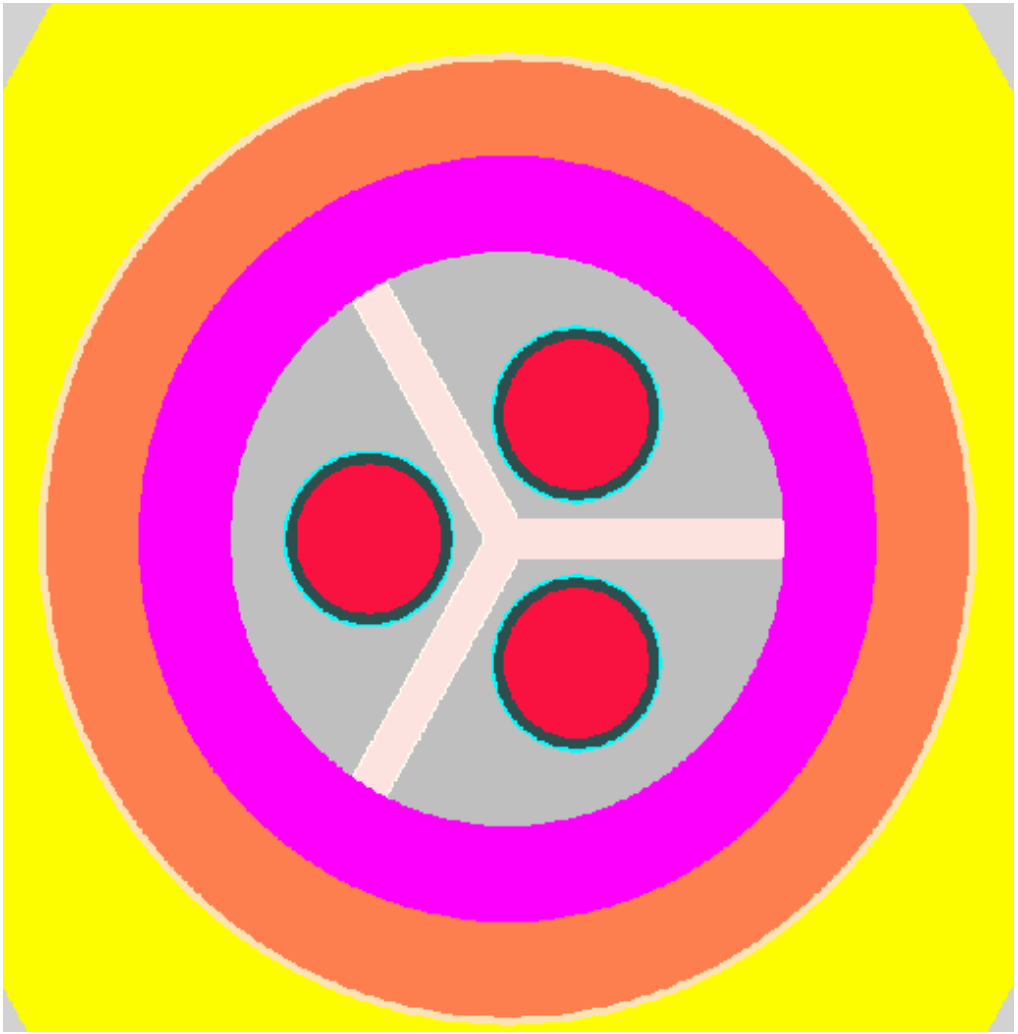
A simple process …



Visualisation (1)

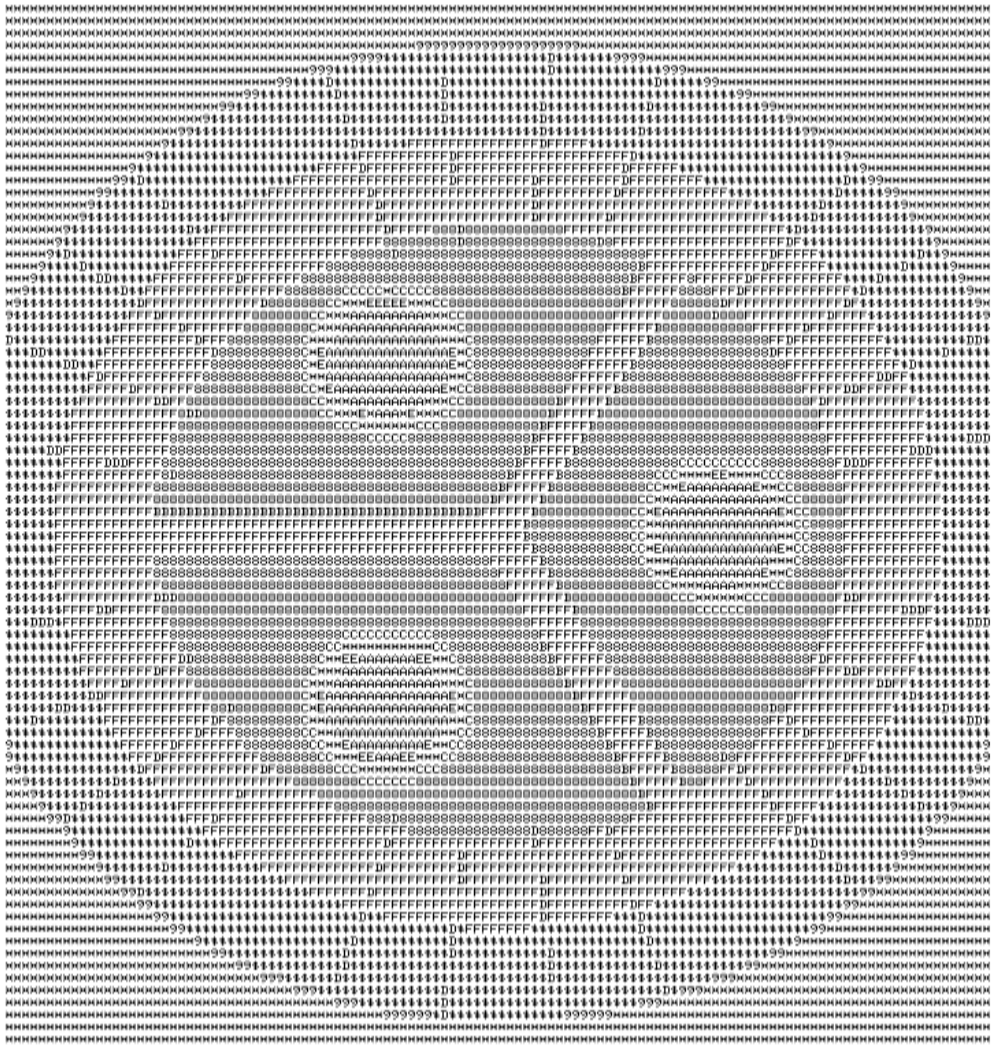


Visualisation (2)



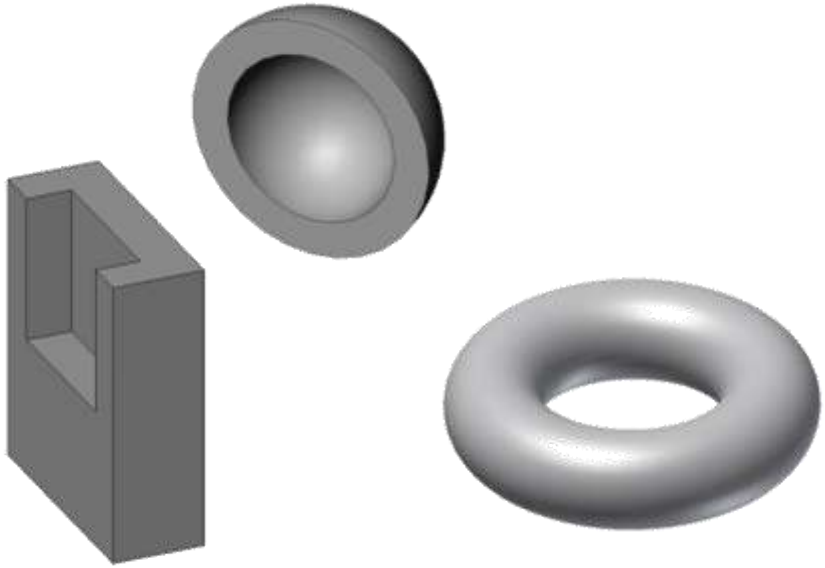
Visualisation (3)

When I started!

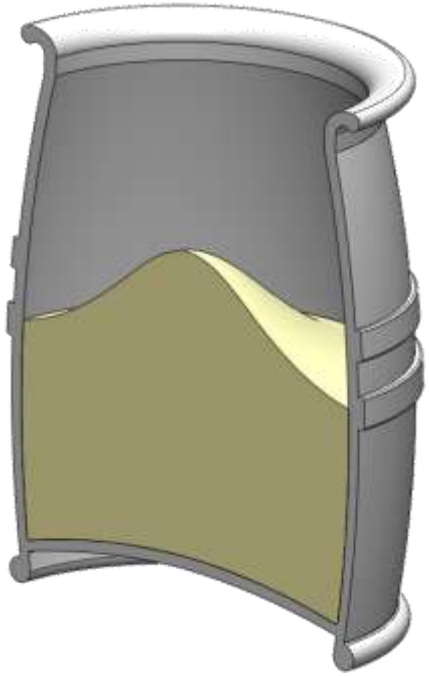


Defining geometry

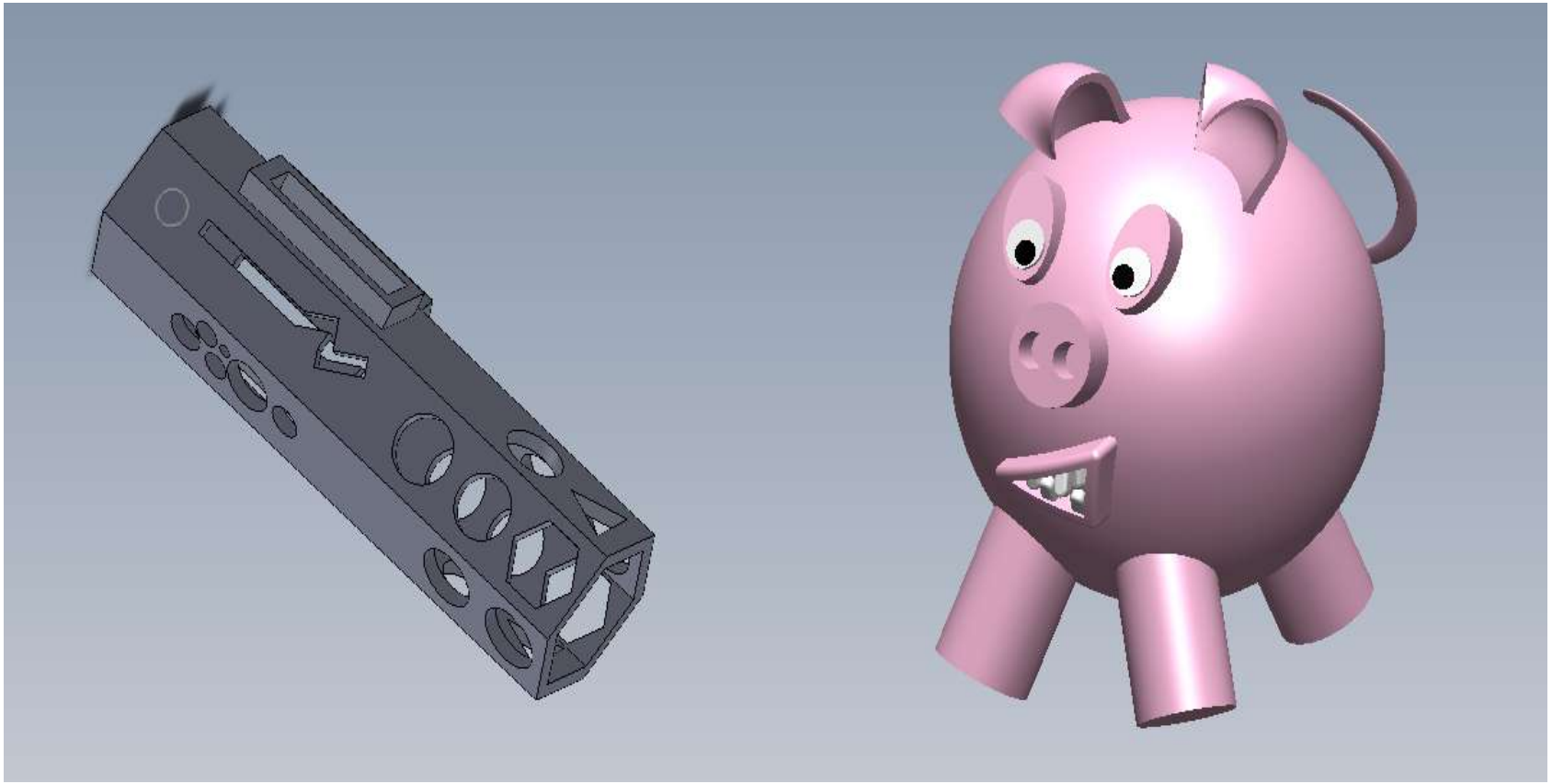
‘Standard’ geometry



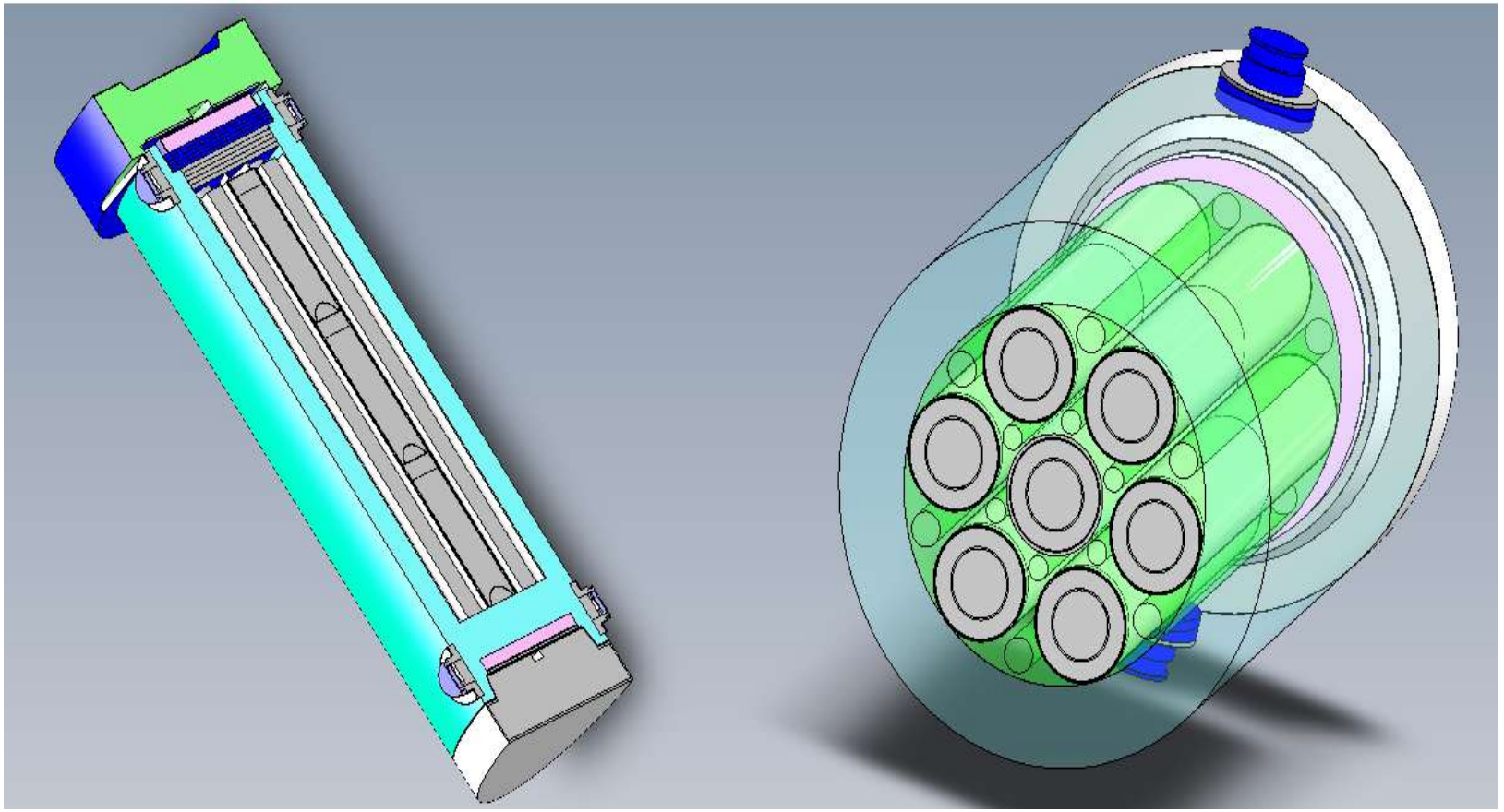
A bit more difficult!



CAD Models - Oinc



CAD Models



Criticality Handbook

Standard Charts

- Chart XYZ
- Chart ABC
- Chart 123

Advanced

Data filters

Reflection: FWR

System: PU239

w/o fissile: All

Moderator: H2O

K-effective: 1.00

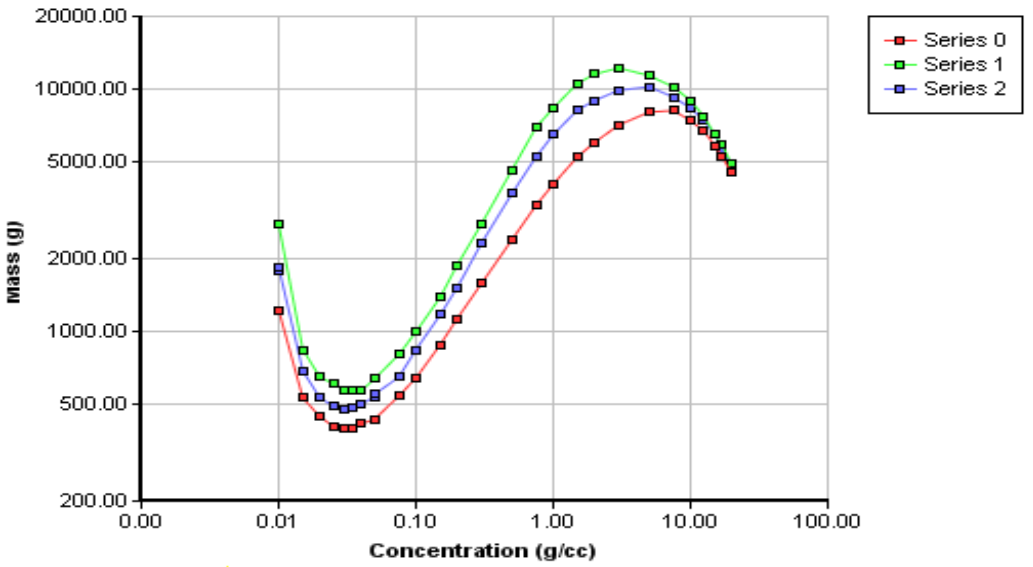
Reset Filter

Matched Files

- FWR-w_PU239_100.0-MOD_H2O_k=1.00.dat
- FWR-w_PU239_90.0-MOD_H2O_k=1.00.dat
- FWR-w_PU239_95.0-MOD_H2O_k=1.00.dat

Hide all Show all

Chart display



Y-column: col2

X log scale Y log scale

Export data to MS Excel

Add chart to Favourites

Input requirements - parameterization

- Before – calculation & transcription errors and typos
  - 'Easy' to check

CONC MN 8.66646E-04 NI 7.2999**EE**-03

CR 1.60244E-02 FE 6.18092E-02

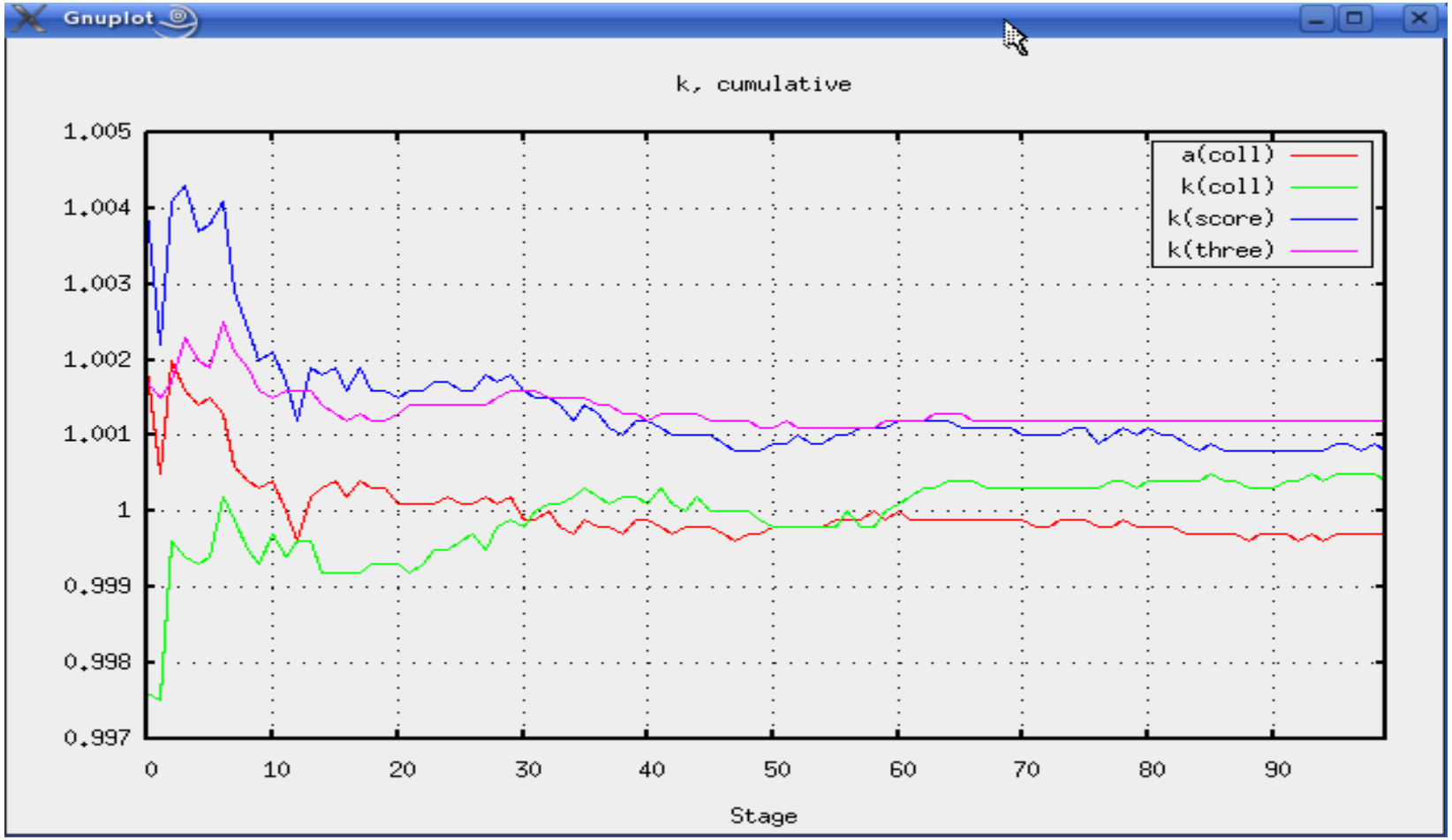
- Now - complex parameterization
  - More difficult to check

@u235 = [(@enr/100.0*@u238_atm)/(@u235_atm+@enr/100.0*@u238_atm-(@enr/100.0*@u235_atm))]

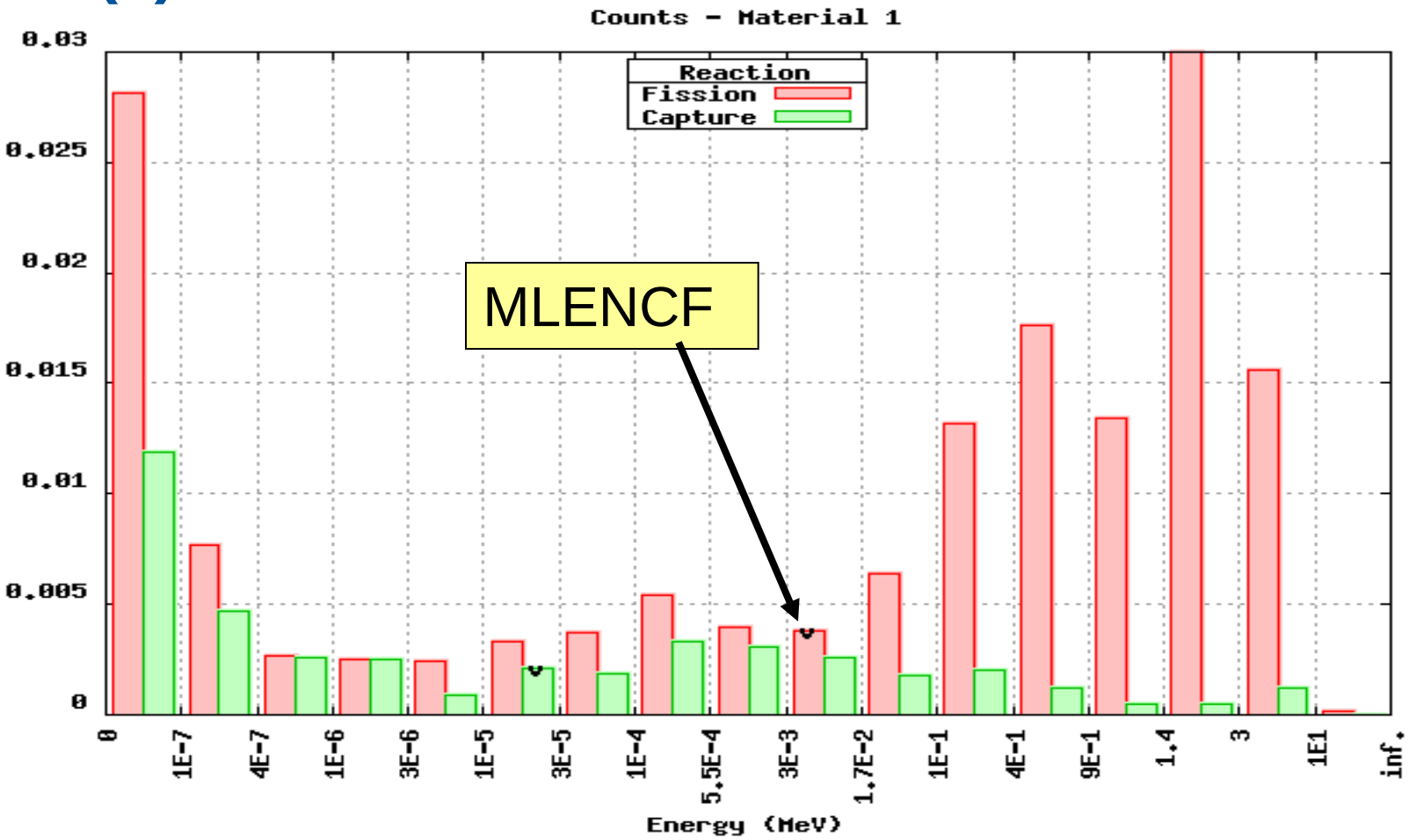
MONKCheck

	A	B	C	D	E	F	G	H
6	# Operating System : Linux 2.6.16.21-0.25-smp Processor type							
7	# Nuclear Data Library : JEF derived from file dice96j2v10.dat							
8	Filename	K-eff	STDV	K-eff+3STDV	CONC	height	Status	
9	finite_11888_02_01.lis	0.4455	0.0015	0.4498	0.02	3	pass	
10	finite_11888_02_02.lis	0.5329	0.0015	0.5373	0.02	4	pass	
11	finite_11888_02_03.lis	0.602	0.0015	0.6064	0.02	5	pass	
12	finite_11888_02_04.lis	0.6706	0.0015	0.675	0.02	6	warning: Estimators	
13	finite_11888_02_05.lis	0.7284	0.0015	0.7329	0.02	7	warning: Estimators	
14	finite_11888_02_06.lis	0.7811	0.0015	0.7855	0.02	8	pass	
15	finite_11888_02_07.lis	0.8279	0.0015	0.8323	0.02	9	warning: Estimators	
16	finite_11888_02_08.lis	0.8714	0.0015	0.8758	0.02	10	pass	
17	finite_11888_02_09.lis	0.9095	0.0015	0.9139	0.02	11	pass	
18	finite_11888_02_10.lis	0.9465	0.0015	0.9509	0.02	12	pass	
19	finite_11888_02_11.lis	0.978	0.0015	0.9824	0.02	13	pass	
20	finite_11888_03_01.lis	0.4915	0.0015	0.496	0.025	3	pass	
21	finite_11888_03_02.lis	0.5816	0.0015	0.586	0.025	4	pass	

Critik


Gnuplot
k, cumulative
1.005
1.004
1.003
1.002
1.001
1
0.999
0.998
0.997
0
10
20
30
40
50
60
70
80
90
Stage
a(coll)
k(coll)
k(score)
k(three)

Critik (2)


Counts - Material 1
Reaction
Fission
Capture
MLENCF
0.03
0.025
0.02
0.015
0.01
0.005
0
0
1E-7
4E-7
1E-6
3E-6
1E-5
3E-5
1E-4
5,5E-4
3E-3
1,7E-2
1E-1
4E-1
9E-1
1,4
3
1E1
inf.
Energy (MeV)

Knowledge Management

NEW! (20/5/10) - CID systems - SRE and SIL2. An anomaly?

NEW! (11/5/10) - Plasticiser content of PVC bags used at Sellafield

NEW! (29/4/10) Sellafield Criticality Library Index

Click here for a full list of criticality-related pages and links

Some quick links are included below

1. Criticality Codes and Nuclear Data
   - Code Manuals
   - Guidance on MONK
   - MONK9A User Guide
   - NUMDEN v3C
   - MOXNUM
2. Criticality Document Library
   - Criticality Videos
3. Conferences and Meetings
4. Criticality Skills and Training Material
5. Methods of criticality control
6. Physics of Criticality
7. Materials properties

Wiki

Nuclear Codes and Data	
Criticality:	MONK | MCNP | SCALE | KENO | Criticality Assistant | NUMDEN (>>NUMDEN3c >>MOXNUM module) | Deterministic criticality code | Monte Carlo methods | MATSPECS
Shielding:	MCBEND | RANKERN | ANISN | CYLIND | Attila | MicroShield | MCNP | DECOM | BETA
Visualisation:	Visage | Vista-Ray | Vista-Wire | Visual Workshop | Sabrina | MCNP Vised | GNUplot
Source determination:	GAMMA | FISPIN
Nuclear data:	Nuclear Data | JANIS | MONK Nuclear Data Libraries (UKNDL - JEF - BINGO - JENDL - ENDF) | ICSBEP | IRPhEP | NEA data bank | SFCOMPO
Misc:	WORM | CodeMore | MONKCHECK | CriTik

General notes on MONK modelling and checking

Article Discussion Edit History Move Watch

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Role in Safety Assessment [edit]

The main role of calculation methods in criticality assessment is to quantify critical and safe values for controlled parameters. In particular the assessment will usually include the definition of the 'Safe Envelope' inside which the operation is demonstrated to be safely sub-critical. If any Fault Sequence were to progress to such a stage where the envelope is breached a criticality might occur. In contrast to many other hazards such as dose from radioactive materials, there is no

Summary

- Developments have been made to reduce:
  - modeling pessimisms
  - time for assessors to produce and process models
  - the potential for user errors during the process