

# Recent Updates to SNAP MELCOR Plugin





PRESENTED BY

Larry Humphries



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#### <sup>2</sup> Introduction

SNL interface with APT greatly improved.

APT has full SNL test suite.

APT is completing updates through MELCOR 2.2, Rev 11932 (i.e., MELCOR Plugin 2.4.6 doe not include current efforts)

SNL will release updated documentation for Rev 14959, which will be subsequently addressed by APT

# 3 Expanded Support for New Global Variables

PrintDefaultSC

RN1 Visua

Current 0

#### GLOBAL Variables

• Environment variables preceding MELGEN/MELCOR program input

#### Expanded Keyword Utility

- DEFAULTDIRECTORY path
  - Redirects all output to a directory
- MEL\_HTML\*FILE filename
  - When present, an HTML file will be generated with each text edit
- PrintDefaultSC filename
  - Prints all sensitivity coefficient to a file
- PrintCurrentSC filename
  - Prints current values of all sensitivity coefficients
- RN1VISUALFILE
  - Creates a file to be used by the RNVisual utility for visualizing distribution of aerosols in a CV
- NOTEPAD++
  - When present adds NotePad++ folding directives to the output
- NewNcycle integer
  - Will change the cycle number on restart to value specified
- KEYWORDF\*ILE
  - Prints all plotfile keywords to file
- RESTARTF\*ILE filename
  - Provide name for restartfile and cycle or time for starting
- EXEC\_CFEXFILE filename
  - CF READ/WRITE Exchange file
- PAUSEFILE filename
  - · Calculation pauses when file is present

```
********************
          LIST OF DEFAULT SCs
          , also de la ferra de la fe
    (WARNING: This list only contains default values,
     not necessarily the values currently being used)
     *****DECAY HEAT (DCH) PACKAGE*****
    *SC3200: ANS DECAY HEAT MULTIPLIER
     SC3200(1)
                       1.0
   *SC3201: ENERGY PER FISSION
                     FISSION ENERGY - U235
      SC3201(1)
                                                 199.0
      SC3201(2)
                     FISSION ENERGY - PU239 210.2
      SC3201(3)
                     FISSION ENERGY - U238 199.3
    *SC3202: DECAY HEAT TIMES
                       0.0
      SC3202(1)
      SC3202(2)
                       1.0
                       1.5
      SC3202(3)
      sc3202(4)
                       2.0
      SC3202(5)
                       4.0
      SC3202(6)
                       6.0
      SC3202(7)
                       8.0
      SC3202 (8)
                       10.0
        E:IMELCOR 2.111 Run Areal A&VforWorkshop\A01(CV100).txt
 0.12
                                                           XE
CS
BA
12
TE
RU
MO
CE
LA
UO
 0.11
  0.1
 0.09
 0.08
002
CD
AG
B02
H20
CON
CSI
 0.04
 0.03
 0.02
 0.01
         Location
```

## **SNAP** Interface

			1		
8	Model Options	2	P		
Initial Time	Unknown (s)	* ?	-		
Plot Length		🔁 🢡			
Control Time Limit	<pre>S<sup>¬</sup></pre>	2 ?			
Plot Arguments	XIY [4]CAV-MASS('CAVITY',F S	🔁 🥐			
Thermal Steady State 🔾 True 🖲 False					
Condition Sets	[0] Initial Condition Sets	2 ?			
Activate ESF Input O True  False					
Default Directory	Default Directory S				
Enable Notepad++ Charcters	Enable Notepad++ Charcters   On  Off				
Reset Cycle Number					
▼ File Names					
Diagnostic File	DEMOGN_v2-0.DIA	2 2			
MC Diagnostic File	DEMON_v2-0.DIA	🔁 🥐			
Extended Diagnostic File	Inactive >	🔁 🢡			
Output File	DEMOGN_v2-0.OUT	2 ?			
MC Output File	DEMON_v2-0.OUT	🔁 🥐			
MG/MC Restart File	Inactive >	🔁 🢡			
MG Restart File DEMON_v2-0.RST					
MC Restart File DEMON_v2-0.RST					
CF Execution File	Inactive >	🔁 🥐			
Plot File	DEMON v2-0 PTF	ም 🤊	•		

4 Named Comment Blocks



MELCOR comment blocks were added as part of the code conversion project. In MELCOR 2.1, a block of input can be commented out by enclosing that block of input within a set of triple parenthesis.

Comment Blocks can be 'activated' through the following input:

CommentBlock Record

CommentBlock case1 case2 case3

• Command line arguments melgen i=inputfile c=case1+case2+case3

CommentBlock SBO

PROGRAM MELGEN

(((SBO !Additional comments placed here ...These input records are not ignored

...Else if not SBO, these input records are not ignored )))

(((LBLOCA !This is a large break LOCA scenario ...These input records are ignored

# Running MELGEN/MELCOR from Console:

Accordorea inp	ut Deck	Execute	Files			
Melcor/Melgen						
				Interrupt		
MELGEN BAS This is a				.2 12-17-2018		
MELGEN 2			I DUI			
!!!LICEN:	SING H	AS BEEI	N DIS	ABLED!!!		
				ABLED!!! cks in input deck:		
List of 1 WITHLHC						
List of 1 WITHLHC NOLHC	Named	Commen	t Blo	cks in input deck:		
List of 1 WITHLHC NOLHC	Named comme	Commen nt blo	t Blo cks t	cks in input deck: o activate (separated by +)		

## Importing MELGEN/MELCOR into SNAP

Named Comment Block	Selected
WITHLHC	<b>×</b>
NOLHC	
Select All	Clear
OK	Cancel

)))

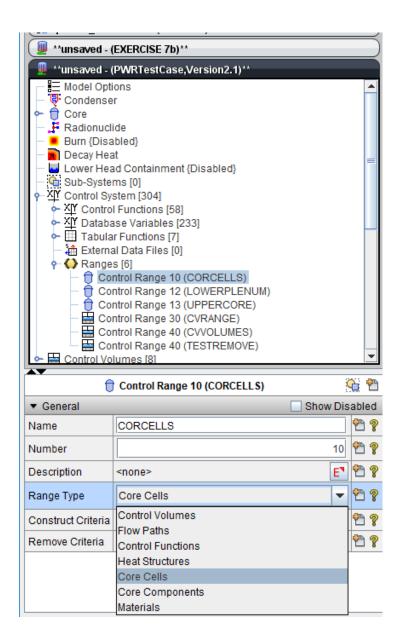
# 5 Range Object

#### Released in r9541 (January 2017)

The range is an object that is defined once in the database and then can be referenced by other control function arguments. The range specifies an ordered list of objects such a control volumes, COR cells, materials, or components

#### Define a Range:

	name	type	ndim	Number
CF_RANGE	CVRANGE	CVOLUMES	2	30
CONSTRUCT	Г 2			
1 CVTYPE=	'PRIMARY'			
2 DC				
REMOVE 1				
1 LowerPl	enum			



## 6 Vector Control Functions

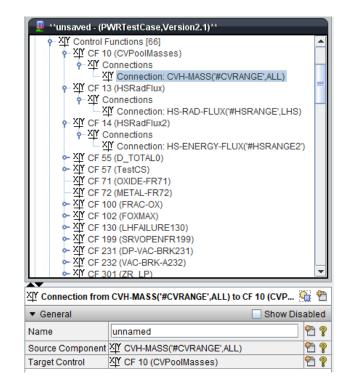
#### Released in r9541 (January 2017)

A range can be referenced by control functions and control function arguments. The hashtag (#) that precedes range specified for the volume in the CF argument indicates a range of control volumes rather than a single volume.

#### Referencing a Range:

CF\_ID 'CVMass2' 1010 ADD CF\_SAI 1.0 0.00 CFVALR (INITIAL VALUE) CF\_ARG 1 1 CVH-MASS(#CVRANGE,POOL) 1.0 0.0

Control Arguments For: CF 10 (CVPoolMasses) ×							
B R T							
Argument Type	Input source	Index	Scale Factor				
Control	CVH-MASS('#CVRANGE',ALL)	2	1.0	0.0			
Control	CVH-MASS('#CVRANGE',ALL)	2	1.0	0			



# 7 Radiation Enclosures

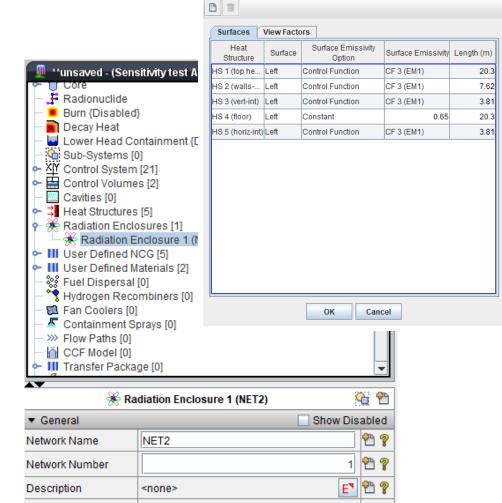
#### Released in r9541 (January 2017)



#### Radiation enclosure model

- Multiple enclosure networks, each with multiple heat structures defined by the user.
  - Memory dynamically allocated
- User defines <u>all</u> surfaces exchanging radiant heat
  - Matrix of view factors connecting surfaces
  - View factors are constants and cannot change
  - Does not account for surfaces submerged below pool.
- Participating gas
  - Transmissivity accounts for reduction in radiation between surfaces
  - Only 1 CV associated with all surfaces
    - Does not account for rising pool in CV (yet)
  - User supplies beam length (similar to COR package)

HS_F	Rad 4 N	ET3 !	EM	BeamL	VF			
1	HS1C	RIGHT	EM1	0.5	0.0	0.2	0.4	£
				'M	yLong	Name	edCF'	
2	HS2C	LEFT	EM2	0.5	0.2	0.0 (	0.3 0	).5
3	HS3C	LEFT	-	0.5	0.4	0.3	0.2	0.1
4	HS4C	RIGHT	-	0.5	0.4	0.5	0.1	0.0



Use Line Continuation 🖲 True 🔾 False

Yes O No

[5] Valid Values

Ignore Pool

Surfaces

2 2

2 ?

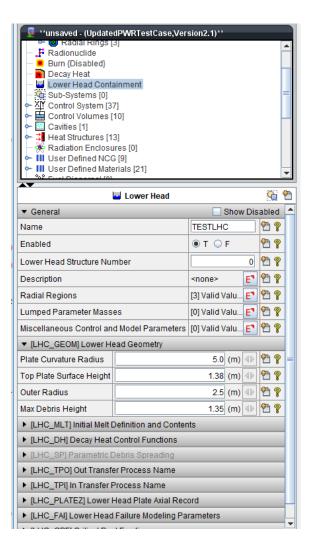
E 🕈 ?

#### 8 Lower Head Components

#### Released in r9541 (January 2017)

A new 'LHC' (Lower Head and Containment) package has been added to MELCOR to model a "second lower head" or a "core-catcher" structure around/about the COR lower head. This new model calculates the thermal response of a new LHC structure and debris supported by this structure. The user specifies the LHC plate geometry, material, nodalization, etc. as well as CVH connections and COR/RN interfaces via TP.

LHCNAM LHCNUM 1 ! LHC structure object name and (optional) sequence number LHC ID 'TESTLHC' RADLH HGTLH RADOUT MAXHGT LHC GEOM 2.9401 1.38 1.632 ! Plate geometry 1.5 NREGZ TEMPI LHC PLATEZ 3 311.0 ! 1 node, total thickness 0.003 m, SS 1 0.00318 'SS' 1 2 0.01717 'CS' ! 5 nodes equally thick, total thickness 0.017 m,CS 5 3 2 ! 2 nodes equally thick, total thickness 0.003 m, SS 0.00318 'SS' NREGR LHC PLATER ! Plate radial/transverse nodalization NNR DRR **IBCB** CVT IBCT 'CAVITY' 3 ! 6 nodes equally thick, 0.28835 3 'TESTLHC' 6 total thickness 0.28 m 0.24750 3 'TESTLHC' 2 3 'CAVITY' 3 ! 3 nodes equally thick, total thickness 0.24 m **IPDHCF** LHC DH 'UseDCH' ! Decay heat option NTPOT RNTPOT LHC TPI 'TP102' 'TP602' ! Out transfer processes (out from COR, out from RNCOR) NTPIN RNTPIN LHC TPI 'TP105' 'TP605' ! In transfer processes (in to CAV, in to RNCAV)



# 9 CAVITY Changes

# Released in r9541 (January 2017)

# ASCII

#### CAV\_SP (Parametric Debris Spreading)

CAV\_U (Misc. Control and Model Parameters

- WATINGR
- ERUPT
- MEVAL

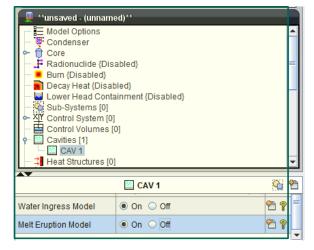
Support for new CF arguments

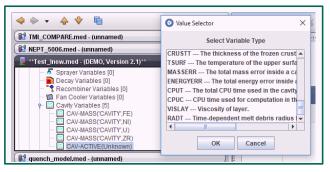
- CAV-VISLAY
- CAV-RADT

#### CAV Sensitivity Coefficients

- 2302: Melt Viscosity Enhancement
- 2303: Internal Debris Spreading Model Coefficient
- 2309: Heat Transfer, Layer Bulk to Interface/Added support for the HTRINT on top crust flag.
- 2312: Iteration Method Selector for CCSURF
- 2315: Melt Eruption and Water Ingress Parameters

#### **SNAP**







# BONUS Model: Bateman Equations for Activity Calculations

General Radioactive Decay Chain

$$N_1 \rightarrow N_2 \rightarrow N_3 \rightarrow \cdots N_j \rightarrow \cdots N_i$$

Sources and losses

Solution

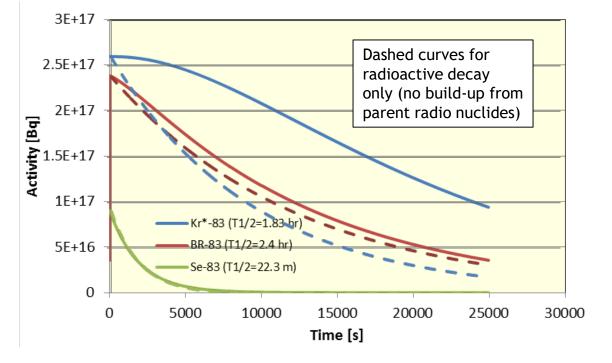
 $\frac{dN_i}{dt} = \sum_{j=1}^{i-1} \lambda_j N_j - \lambda_i N_i$  $N_i(t) = \lambda_1 \lambda_2 \cdots \lambda_{i-1} N_1(0) \sum_{j=1}^{i} \frac{e^{-\lambda_i t}}{\prod_{k \neq j} (\lambda_k - \lambda_j)}$ 

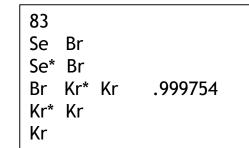
Isobaric  $\beta$  and  $\gamma$  decays of fission products are considered

Thermal neutron capture also taken into account

Daughter products defined in file Fpchains.in

- Placement of chains is arbitrary
- Coupled chains should follow each other







# <sup>11</sup> Support for New BONUS Input

• DCH ACT - Activity Calculation Option								
• DCH_ACT - Activity Calculation Options								
DCH_ACT ON OLD								
• DCH_SUR - Output Activity Data								
DCH_SUR 1 !n type name ikey	-							
1 CVH 'CV110-CORE' ALL								
• DCH_RCT - Reactor Type/Added support								
for the FILE and BLOCK words.								
InitInventory.in can contain multiple inventories. This user input								
specifies which inventory (Reactor type) to use:								
! Reactp file block								
. Reactp file block								
DCH_RCT PWR FissProd.in 'REACTOR_PW	7 <b>R'</b>							
	7R'							
DCH_RCT PWR FissProd.in 'REACTOR_PW	7R'							
DCH_RCT PWR FissProd.in 'REACTOR_PWR $R = A C T O R P WR$	/R'							
DCH_RCT PWR FissProd.in 'REACTOR_PWR $R = A C T O R P WR$	7R'							
DCH_RCT       PWR       FissProd.in       'REACTOR_PW         R       E       A       C       T       O       R       P       WR         !       2       3       4       5       6       7       8       9       0       1       2       3       4       5       6         S       e       -       8       0       4       0       6       E       0       1         S       e       -       8       1       1       3       1       E       0       5	/R'							
DCH_RCT       PWR       FissProd.in       'REACTOR_PW         R       E       A       C       T       O       R       P       WR         !       2       3       4       5       6       7       8       9       0       1       2       3       4       5       6         S       e       -       8       0       4       0       6       E       0       1         S       e       -       8       1       1       3       1       E       0       5         B       r       -       8       1       6       8       1       E       0       1	7R'							
DCH_RCT       PWR       FissProd.in       'REACTOR_PW         R       E       A       C       T       O       R       P       WR         !       2       3       4       5       6       7       8       9       0       1       2       3       4       5       6         S       e       -       8       0       4       0       6       E       0       1         S       e       -       8       1       1       3       1       E       0       5         B       r       -       8       1       6       8       1       E       0       1         S       e       -       8       2       1       0       4       E       0       0	7R'							
DCH_RCT       PWR       FissProd.in       'REACTOR_PW         R       E       A       C       T       O       R       P       WR         !       2       3       4       5       6       7       8       9       0       1       2       3       4       5       6         S       e       -       8       0       4       0       6       E       -       0       1         S       e       -       8       1       1       3       1       E       -       0       5         B       r       -       8       1       6       8       1       E       -       0       1	/R'							

67E

1 . 6 4 E + 0 0 8 . 2 3 E - 0 6

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8 4

Burn {Disabled} Decay Heat Lower Head Containment {Disabled} Sub-Systems [0] Yf Control System [33] Control Volumes [8] Cavities [1] Decay Heat						
Enabled						
	True      False	° ?				
Description	<none> E</none>	2 ?				
Default Scheme	<pre>&lt; Inactive &gt;</pre>	2 ?				
Reactor Type	PWR] Pressurized W	2 ?				
Initial Inventory File	Ref. 🖕 vFormat\FissProd.in S	۳ ?				
Initial Inventory Data Block	<pre>Inactive &gt;</pre>	🔁 🥐				
Shutdown Flag	🕑 [0] Constant 💌	2 ?				
Shutdown Time	0.0 (s) 🜗	۳ ?				
Operating Power	✓ 3.142E9 (W)	🔁 🥐				
Whole Core Decay	<pre>&lt; Inactive &gt;</pre>	🔁 🥐				
Decay Elements	[0] Defined Elements	🔁 🥐				
RN Classes	[17] RN Classes	🔁 🥐				
Normalization Flag	Inactive >	🔁 🥐				
Activity Calculation	[1] On 💌	🔁 🥐				
Activity Calculation Input Format	[0] Old	🔁 🥐				