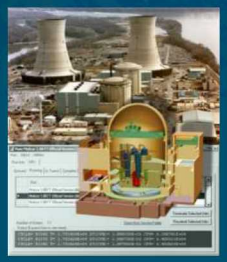
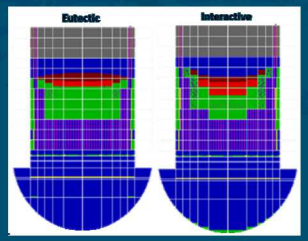
SAND2019-3569PE

COR Package Plot Variables and CF Arguments
EMUG 2019





MELCOR
- New Modeling
- SQA
- Utilities

PRESENTED BY

Larry Humphries, Sandia National Laboratories

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General Characteristics of Plot and CF Variables

Plot Variables are sent to the binary plot file for post-processing

CF arguments can be used by control functions. Generally, analogous CF arguments exist for each plot variable. However, CF arguments can also be added to the plot file.

For each plot variable sent to the binary plot file, an ASCII plot key name is also sent. For versions earlier than MELCOR 2.1, this plot key name was fixed at 24 characters. However, when adding extra plot variables to the plot file, this length may not be sufficient.

MELCOR 2.1 and later versions will extend the length of the plot key names.

- However, this variable length plot key may not be readable by early versions of PTFREAD (earlier than v1.7) as well as other postprocessors. EXEC_PLOTLENGTH will truncate plot key names to be compatible with older versions. Can lead to several plot keys with the same name. (Check the MELGEN Output)

Customizable Plot File

User can remove or add individual plot variables printed to a binary plot file

- Users often request additional plot variables in the plot file
- However, plot files can become extremely large with gigabytes of data
- Customizable plot files puts the burden of choosing important parameters on the user
  - Beware, when you remove a plot variable , that's just when you find you need it.

Currently only implemented for COR package

- COR_PLOTS 2

  1 COR-SS-STRESS OFF

  2 COR-EM ON

Certain energy error, mass error, CPU, NCYCLE variables necessary for diagnostics are not permitted to be removed

COR Plot Variables – Local Cell Energy Balance

Cell Energy Balance

COR-QCNV.k.n	Local convective heat addition from surface n in COR cell n. (units = W/kg, default = OFF, KEYWORD='COR-QCNV')
COR-DHEAT.k.n	Local decay heat addition from component k in COR cell n. (units = W/kg, default = OFF, KEYWORD='COR-DHEAT')
COR-QCND.k.n	Local conductive heat addition from component k in COR cell n. (units = W/kg, default = OFF, KEYWORD='COR-QCND')
COR-QRAD.k.n	Local radiant heat addition from component n in COR cell n. (units = W/kg, default = OFF, KEYWORD='COR-QRAD')
COR-QOXY.k.n	Local oxidation heat addition from component k in COR cell n. (units = W/kg, default = OFF, KEYWORD='COR-QOXY')
COR-ELHPOW.n	Electrical heating power generated in cor cell n (for calculations using electrical heating power option). (units = W, default = OFF, KEYWORD='COR-ELHPOW')

COR Plot Variables for Validation of Lower Plenum

Molten Pool Variables

Masses COR-M-<P>-<MP>	Mass of the convecting oxide molten pool <MP=MP1> or the metallic molten pool <MP=MP2> in the active COR <P=UP> or in the lower plenum<P=LP>. (units = kg, default = ON, KEYWORD=COR-MP-MASS)
Temperatures COR-T-<MP>-<P>	Temperature of the convecting oxide molten pool <MP=MP1> or the metallic molten pool <MP=MP2> in the active COR <POOL=UP> or in the lower plenum<POOL=LP>. (units = K, default = ON, KEYWORD=COR-MP-T)
Volumes COR-V-<MP>-<P>	Volume of the convecting oxide molten pool <MP=MP1> or the metallic molten pool <MP=MP2> in the active COR <POOL=UP> or in the lower plenum<POOL=LP>. (units = m^3, default = ON, KEYWORD=COR-MP-V)
Rayleligh Number COR-RA1-<MP>-<P>	Rayleigh of the convecting oxide molten pool <MP=MP1> or the metallic molten pool <MP=MP2> in the active COR <POOL=UP> or in the lower plenum<POOL=LP>. (units = -, default = ON, KEYWORD=COR-MP-RA)

COR Plot Variables for Validation of Lower Plenum

Energy Balance Molten Pools

COR-RAD-<MP>-<P>	Radiation power from upper surface of pool where <MPX> can be MP1 (oxide) or MP2 (metallic) and <P> can be in the active core <COR> or in the lower plenum <LP> (units = w, default = OFF, KEYWORD=COR-MP-RAD)
COR-CONV-<MPX>-<P>	Convective heat removal rate from pool where <MPX> can be MP1 (oxide) or MP2 (metallic) and <P> can be in the active core <COR> or in the lower plenum <LP> (units = w, default = OFF, KEYWORD=COR-MP-CONV)
COR-QINT-<MPX>-<P>	Convective heat transfer at interface between stratified molten pools where <MPX> can be MP1 (oxide) or MP2 (metallic) and <P> can be in the active core <COR> or in the lower plenum <LP> (units = w, default = OFF, KEYWORD=COR-MP-QINT)
COR-QDCH-<MPX>-<P>	Decay heat power generated in pool where <MPX> can be MP1 (oxide) or MP2 (metallic) and <P> can be in the active core <COR> or in the lower plenum <LP> (units = w, default = OFF, KEYWORD=COR-MP-DCH)

COR Plot Variables for Validation of Lower Plenum

Energy Balance Outer Surface

COR-HTCLH(IS) (CF only)	Heat transfer coefficient from segment IS of lower head to water pool. (units = W/m^2K)
COR-HTCLH-AVE	Average heat transfer coefficient from lower head to water pool. (units = W/m^2K, Default=ON, Keyword=COR-HTCLH-AVE)
COR-QFLXLH(IS)	Exterior heat flux from segment IS of lower head to water pool. (units = W/m^2, Default=ON, Keyword=COR-QFLXLH)
COR-QFLXLH0(IS) Recently added	Interior heat flux to segment IS of lower. (units = W/m^2, Default=ON, Keyword=COR-QFLXLH)
COR-QFLXLH-AVE	Average heat flux from lower head to water pool. (units = W/m^2, Default=ON, Keyword=COR-QFLXLH-AVE)
COR-QTOTLH(IS)	Cumulative heat transferred from segment IS of lower head to water pool. (units = J, Default=ON, Keyword=COR-QTOTLH)
COR-QTOTLH-TOT	COR-QTOTLH-TOT Total cumulative heat transferred from lower head to water pool. (units = J, Default=ON, Keyword=COR-QTOTLH-TOT)

COR Plot Variables for Validation of Lower Plenum

Newly Added

COR-CHF(IS)	Critical Heat Flux from segment IS of outer lower head to water pool. (units = W/m^2K, Default=ON, Keyword=COR-QLH)
COR-QLH-OUT	Cumulative energy transfer from outer surface (units = J, Default=ON, Keyword=COR-QLH)
COR-QLH-IN	Cumulative total energy transfer to inner surface (units = J, Default=ON, Keyword=COR-QLH)
COR-QLH-ENTH	Cumulative enthalpy change of Lower Head (units = J, Default=ON, Keyword=COR-QLH)

COR Plot Variables for Validation of Lower Plenum

Newly Added Dimensionless numbers

COR-**RE**-POOL-cmp.n COR-PR-POOL-cmp.n, etc.	Re, Pr, Gr, Ra # for pool of surface cmp in cell n. (units = none, Default=OFF, Keyword=COR-RE-POOL, COR-PR-POOL, COR-GR-POOL)
COR-RE-FILM-cmp.n	Re, Pr, Gr, Ra # for film of surface cmp in cell n. (units = none, Default=OFF, Keyword=COR-RE-FILM, COR-PR-FILM, COR-GR-FILM)
COR-RE-ATMS-cmp.n	Re, Pr, Gr, Ra # for atm of surface cmp in cell n. (units = none, Default=OFF, Keyword=COR-RE-ATMS, COR-PR-ATMS, COR-GR-ATMS)
COR-NU(N)FRAC-POOLQ-cmp.n	Nusselt no. including (or excluding) area fractions for quenched pool of surface cmp in cell n (units = none, Default=OFF)
COR-NU(N)FRAC-POOLU-cmp.n	Nusselt no. including (or excluding) area fractions for unquenched pool of surface cmp in cell n (units = none, Default=OFF)
COR-NU(N)FRAC-ATM-cmp.n	Nusselt no. including (or excluding) area fractions for atm of surface cmp in cell n (units = none, Default=OFF)

Control Functions

Different Format for Control Function Variable and Plot Variable

Control Function	Plot Variable
COR-CellTemp(IA,IR,COMP)	COR-T< COMP >.n
COR-M(IA,IR,COMP,MAT,[irod])	COR-M.M.m.k.n
COR-TLH(IN,IS)	COR-TLH.ijj

Parameters must be selected from available lists (see UG):

PWR Surfaces

Surface	Description
FU	Fuel
CL	Cladding
SS	Supporting structure
NS	Non-supporting structure
PD	Particulate debris in channel
PB	Particulate debris in bypass
MP1	Molten metallic pool 1
MB1	Molten metallic pool 1 in bypass
MP2	Molten oxidic pool 2
MB2	Molten oxidic pool 2 in bypass
FM	PWR core former
SHI	PWR core shroud adjacent to channel
SHO	PWR core shroud adjacent to bypass

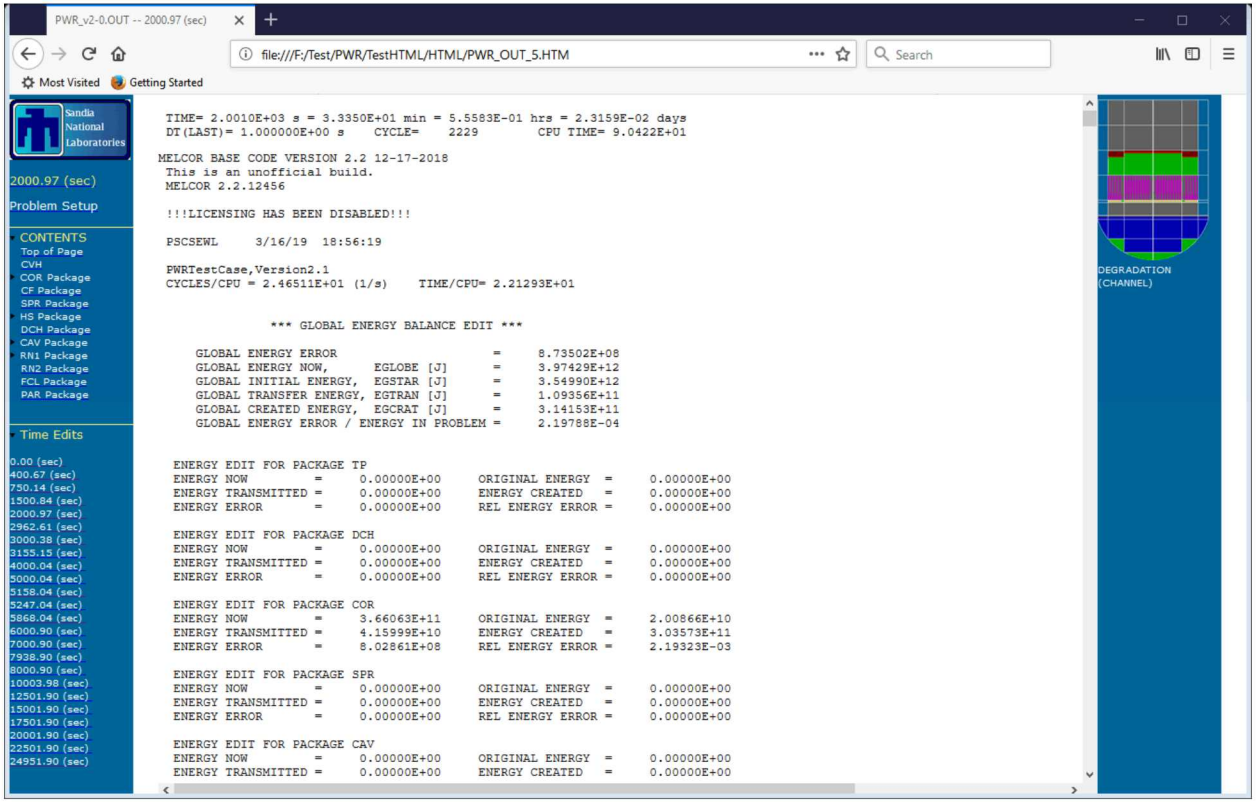
Ranges can be specified for parameters in CF arguments:

COR-M(#RCELL_COMP,MAT,[irod])

MELCOR HTML Output

HTML Output for MELCOR has been available for several years

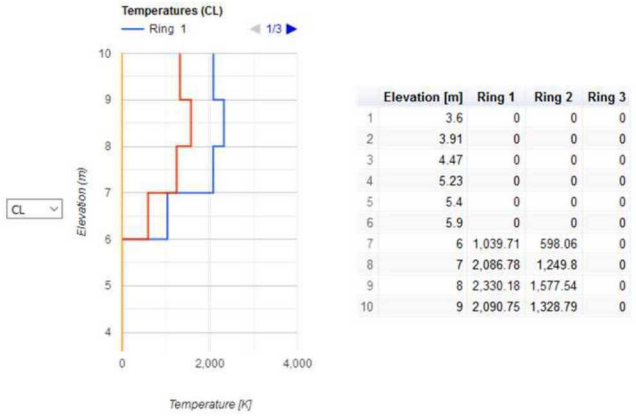
- Text output distributed among multiple files
  - File generated for each output time
  - Hyperlinks between files
  - Convenience in navigation.
- Graphical depiction of core degradation taken from PTFREAD coding several years back.
- Not often used by the general user community



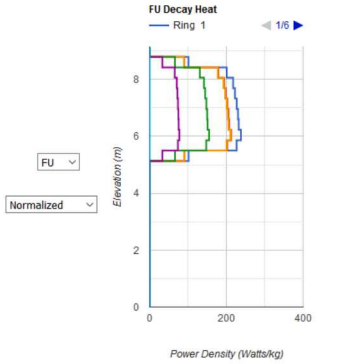
MELCOR HTML Output

Recent updates to HTML output

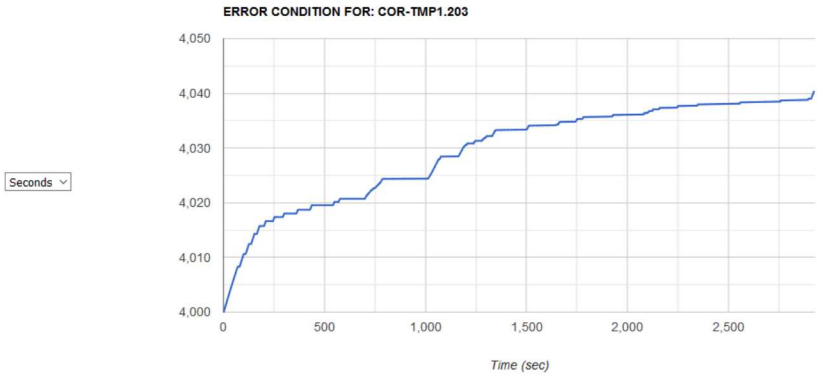
- Uses an 'included' file for time history
  - Speeds up MELCOR generation of HTML files
- Graphical depiction of output data recently added (hopefully next official code release)
  - Several data types for COR package added
    - Temperature profiles
    - Power profiles (decay, oxidation, convection, conduction, radiation)
    - Masses of materials in channel and bypass
    - Component volumes
    - Subgrid frozen volumes
    - Generation of time history plots at end of calculation (TEND or Failed State)
      - Standard plotfiles (CPU, Waterlevels, Core Damage, H2 Generation)
      - User specified plotfiles
      - Error-dependent plots
  - Some data types can be normalized by COR cell mass or volume.
  - Currently using Google Charts
    - Requires that data be exported externally for rendering
      - Investigating other options for internally rendering data (data privacy)



	Elevation [m]	Ring 1	Ring 2	Ring 3
1	3.6	0	0	0
2	3.91	0	0	0
3	4.47	0	0	0
4	5.23	0	0	0
5	5.4	0	0	0
6	5.9	0	0	0
7	6	1,039.71	598.06	0
8	7	2,086.78	1,249.8	0
9	8	2,330.18	1,577.54	0
10	9	2,090.75	1,328.79	0



	Elevation [m]	Ring 1	Ring 2	Ring 3	Ring 4	Ring 5	Ring 6
1	0	0	0	0	0	0	0
2	0.93	0	0	0	0	0	0
3	1.42	0	0	0	0	0	0
4	1.91	0	0	0	0	0	0
5	2.4	0	0	0	0	0	0
6	4.59	0	0	0	0	0	0
7	5.13	101.8	90.92	90.1	66.41	33.41	0
8	5.5	226.8	202.5	200.6	147.7	74.04	0
9	5.86	238.1	212.6	210.7	155.1	77.73	0
10	6.23	232.3	207.4	205.5	151.3	75.82	0
11	6.6	230.5	205.8	203.9	150.2	75.24	0
12	6.96	227.1	202.8	201	148	74.16	0
13	7.33	222.5	198.7	196.9	145	72.65	0
14	7.69	217.7	194.4	192.6	141.8	71.08	0
15	8.06	201.1	179.5	177.9	131	65.68	0
16	8.42	101.5	90.64	89.82	66.21	33.31	0
17	8.79	0	0	0	0	0	0



Questions?