Input Deck Conversion
(1.8.5 to 1.8.6 and 1.8.6 to 2.1)

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and
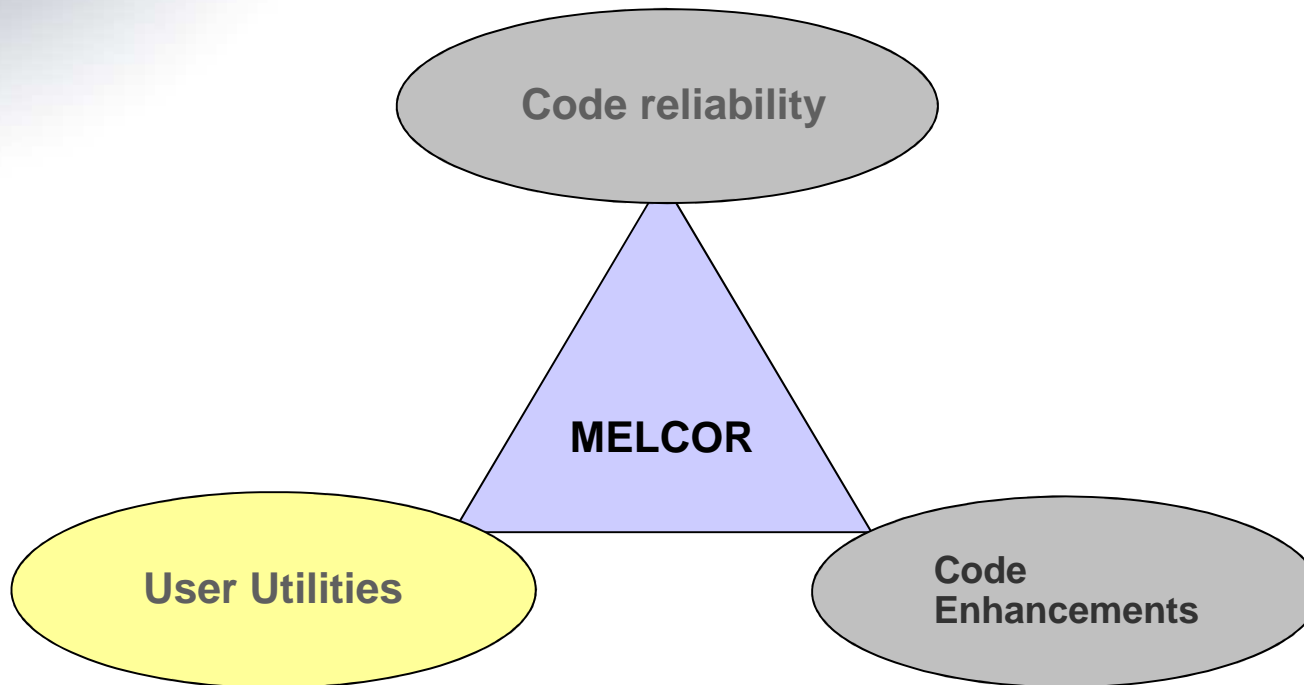## Hossein Esmaili (NRC)

Code Development: User Utilities

- **New models in 1.8.6**
  - Lower head modeling (cylindrical or curved geometries)
  - Added ring beneath downcomer region
  - Control rod Ag release
- **Required input changes**
- **Input Deck Converter**
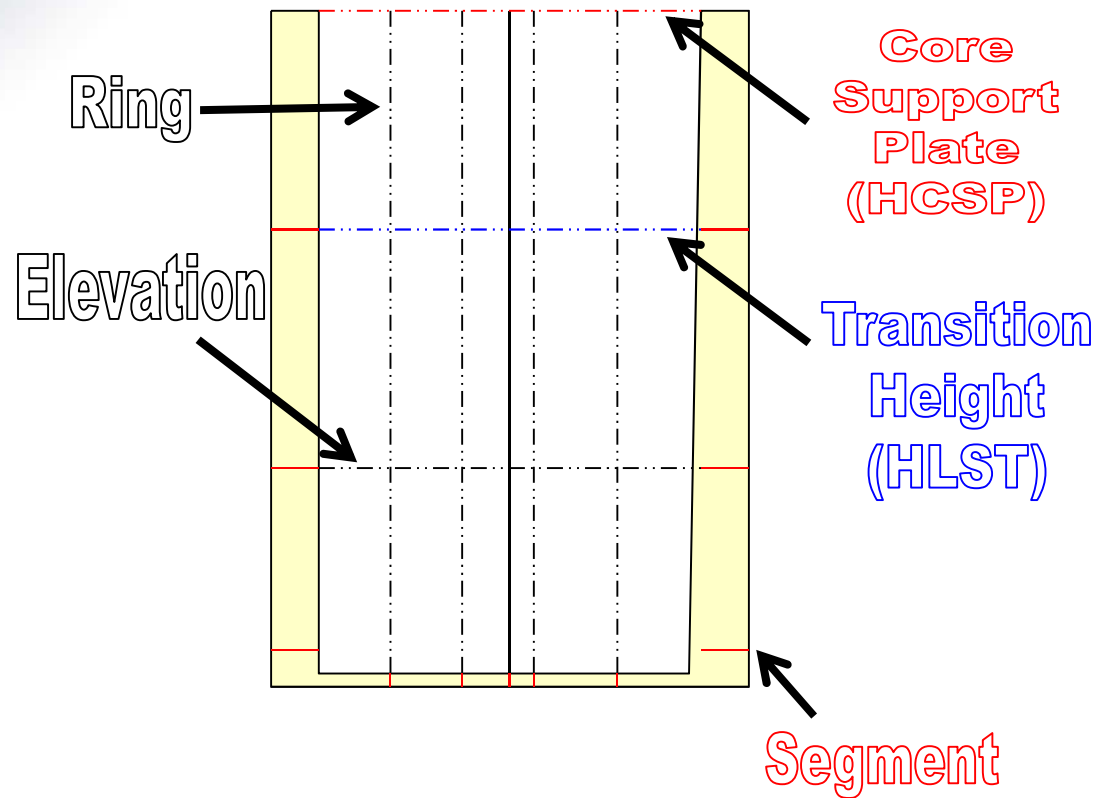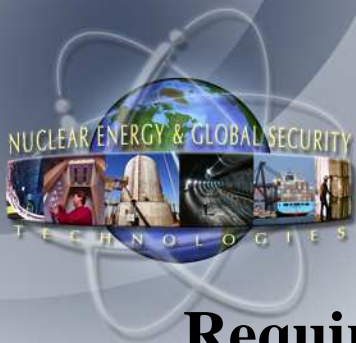
Required Data

- **Elevation of BWR baffle plate or PWR bottom plate (HLST)**

- **Elevation of core support plate (HCSP)**

- **Inner radius of vessel cylinder (RVESS)**

- **Outer radius treated in COR package above HLST (RCOR)**

- **The radius of curvature inside of the lower head (RVLH)**
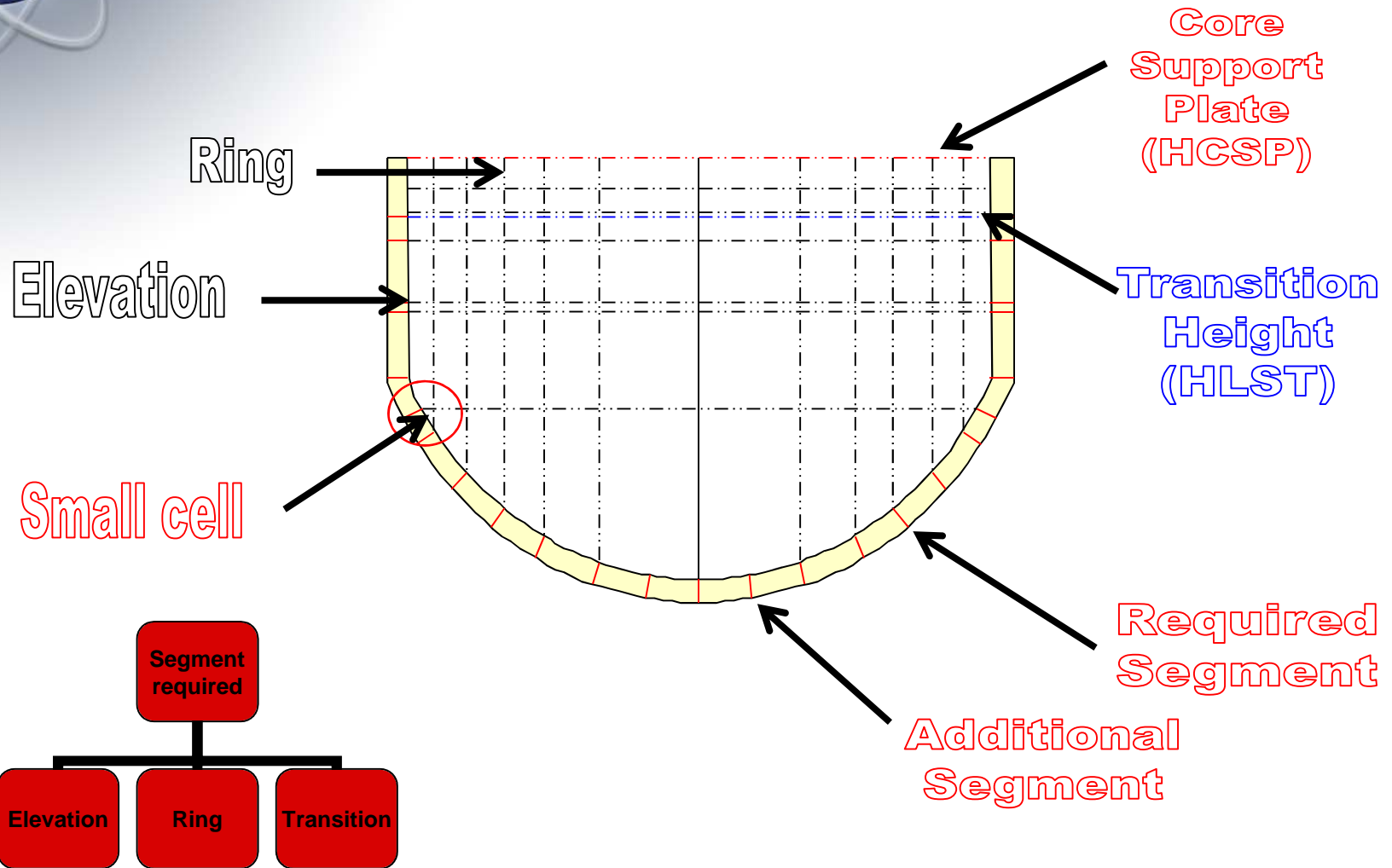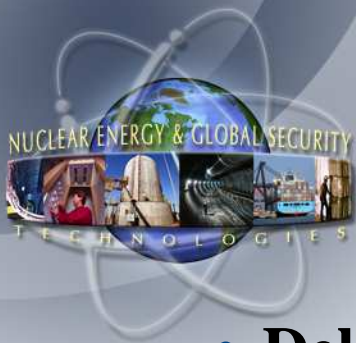
- **Deletion of Records**
  - New *DELETE* option to remove records. This is only required when using a r*i*f file to specify all changes to an existing deck

- **Modification of Records**

- **Addition of new records**
  - New NULL option to specify empty cells in downcomer region and outside hemispherical lower head
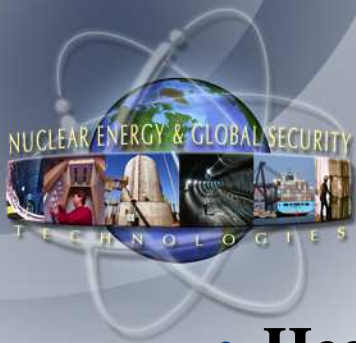
- **Heat structure records associated with lower head (HSccccckk)**

- **Core elevation records associated with lower head (CORZiikk)**

- **Core ring area records (CORRii01)**

- **Core cell records associate with lower head (CORijjkk)**

- **Radionuclide settling (RNDS001)**

- **COR00000: NLHTA (number of segments in curved lower head)**

- **COR00001: Removed DZLH (moved to COR00001A)**

- **COR00009: MDHMPO & MDHMPN (molten pool heat transfer model)**

- **CORZiikk: Core elevations moved as necessary to avoid small cell volumes**

- **CORTST01 (MELCOR input): Added fields 11 – 15 for molten pool model flags**

- **COR00001A:**
  - **Core Radius (RCOR)**
  - **Lower Head Radius (RVLH)**
  - **Vessel Radius (RVESS)**
  - **Lower Head Geometry Type (ILHTYP)**
  - **Lower Head Transition (ILHTRN)**
  - **Vessel Thickness (DZRV)**
  - **Lower Head Thickness (DZLH)**
- **COR00001B:**
  - **Transition Height (HLST)**
  - **Core Support Plate (HCSP)**
- **CORLHDkk for each lower head segment:**
  - **Segment number (IRE)**
  - **Temperature (TLH)**
  - **Segment radius (RADIUS)**
  - **Associated cavity control volume (ICVCAV)**
- **Added core cell records associated with region below downcomer, if modeled.**
- **Core cell records outside hemispherical lower head require NULL indicator**
- **CORRii00 core ring radii records**
- **Ag Release Model: CORCR0**

- **Excel add-in designed to convert MELCOR 1.8.5 input decks to version 1.8.6**

  - **Facilitate use of new lower head modeling in 1.8.6**

  - **Upon completion of Excel worksheet, a text file is created allowing the user to include it in the RIF (Read Input File) sequencing of MELGEN**

  - **The RIF file deletes appropriate records and creates new records in accordance with the user's inputs to the converter**

Region Inaccessible to COR Materials

Portion of Vessel Modeled in COR Package
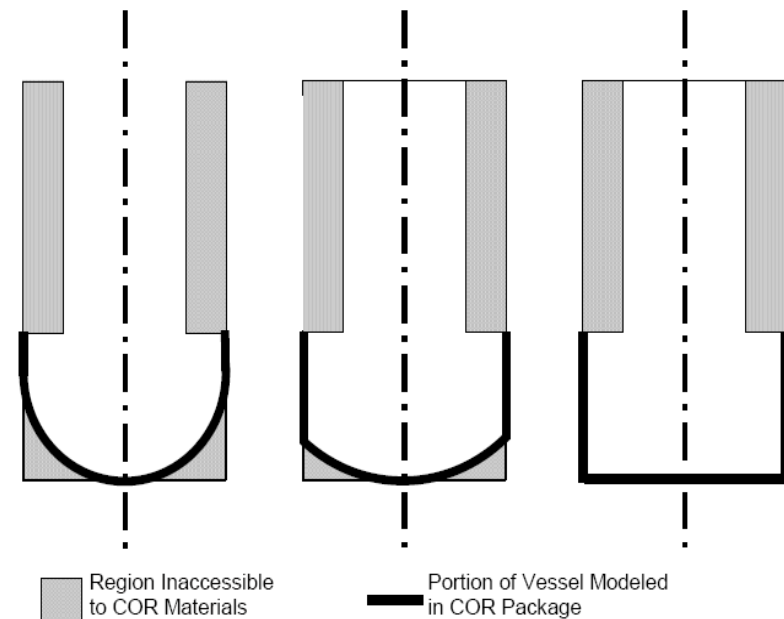
Input Deck Converter for MELCOR 1.8.6

- **Explore worksheet**
    - **Values determined based on the input selected**
    - **Elevations, radii, and segments are displayed with color-coding**
    - **Cells with a red triangle provide a definition of the variable**
    - **Users can only modify pre-determined values, shown in yellow**
    - **Users may add additional elevations or delete elevations (original elevations can not be deleted)**
        - **If an elevation is split by adding an intermediate elevation, user is required to enter a temperature and cavity control volume number (ICVCAV)**
    - **Required segments are calculated from the given ring radii and elevation information**
        - **A segment is required to exist at each ring intersection with the lower head and at each elevation intersection with the lower head**
    - **A segment may be added by entering either the radius or elevation along with the associated temperature and ICVCAV**

Input Deck Converter for MELCOR 1.8.6

- **Create RIF text file**
  - Select Export RIF File on the Update Input Deck drop-down menu
  - Default name of the file displayed ("LHMP.txt" appended)
  - The file extension will always be .txt for compatibility within Excel
  - Following the saving of the file, additional model parameters are displayed
    - Molten pool model flags
    - Control rod Ag release
    - Options
      - Recalculate control volumes: indicate whether the converter should recalculate the volume/altitude table for the control volumes in the lower head
      - Warning message generated in the RIF file when a calculated value differs more than 10% from the value listed in the original input
  - Upon completion of the file creation and model flag selections, users may open and view the RIF file content from the message prompt
  - Excel worksheet can be saved for future references

- **Manual Edit**

  - The RIF file created must be added with a RIF statement at the end of the MELGEN input file

  - User must enter or modify CORTST01 record within MELCOR input in accordance with the message provided at the end of the RIF file

  - Ensure that no existing heat structures radiate to or from the deleted heat structures as indicated on HSRD records

- **Run MELGEN / MELCOR (v.186)**

– **RCOR**

- The value should correspond to the inside radius of the core shroud in a BWR or the core support barrel in a PWR. The suggested value is derived from the sum of the axial ring areas (ASCELA) input

- Often reasonably accurate for a carefully constructed BWR input, but for PWR the suggested value will usually be small since MELCOR 1.8.5 did not treat the peripheral barrel/baffle region of a PWR – the actual physical radius should be used

– **RVESS**

- The value should correspond to the radius of the lower cylindrical portion of the reactor pressure vessel

- Typically included as a cylindrical HS in existing decks and appropriate value of RVESS can be obtained from the inner radius of that structure

– **RVLH**

- The value should correspond to the radius of the interior surface of the lower head

- The value must not be less than RVESS and must not intersect the cylinder above HLST

Steps involved in modeling the peripheral region of a PWR

1. Delete the heat structures that model the core shroud and replace them by component SH in the outermost occupied ring of cells; masses, temperatures, hydraulic diameters, and areas for SH may be obtained from the original edit for the HS they replace.

2. Add formers represented by component FM; formers will need to be included in each core levels above support plate.

3. Redefine the core support vessel as the radial boundary for the COR package using CORZjj02 records and add HSCCCC004 records to specify a dT/dz boundary fluid temperature option for the inner surfaces; this may require subdividing the heat structure so as to have a separate segment for each elevation in the core.

4. Include the bypass region in COR input for appropriate cells; this may require re-adjusting the volume/altitude table(s) for the bypass volume(s) so as to match the elevations in the COR package.

5. If the core flow blockage model was invoked in the original input deck (FLnnnBk), replace option "AXIAL" by "AXIAL-C" for the channel of the ring that includes the bypass and replace option "RADIAL" by "RADIAL-C" for flow between this ring and the ring inside it. It is also desirable to add a flow path or paths between the channel and bypass in that ring to represent failure of the core shroud with a flow blockage option of "CORE-SHROUD"

- **Small cells and/or lower head segments**
  - Occurs when the surface of the lower head passes close to the "corner" of a core cell
  - Computational problems may arise (more likely from a small core cell volume than from a small lower head segment)
- **The cleanest solution is to revise the elevation so that the head passes through the cell corner**
  - Requires far fewer other input changes than reducing the inner ring radius
  - No automated way available within the converter
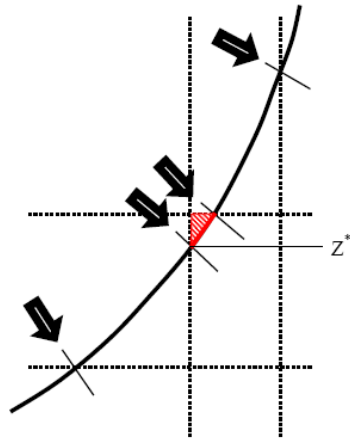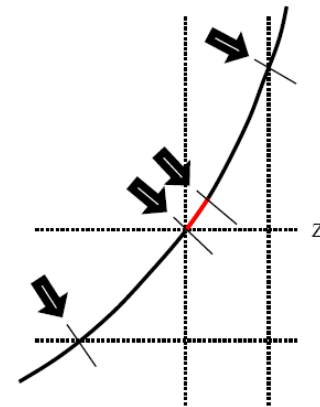
Tiny cell volume   **Tiny cell removed by lowering elevation Z***

- **Elimination of Heat structures that represented the shroud can eliminate deposition surfaces required by the RN package; additional input on RNDSXXX and RNSETXXX may be needed**

- **Removing lower head segments**
  - **Can be eliminated by reducing NLHTA by one and by deleting the CORLHDii record that specifies its outer radius**

- **When an elevation is manually changed, the following modifications are also necessary**
  - **Changes to radial cell boundary areas (ASCELR) for all cells in the two affected rings**
  - **Changes to the effective axial flow area (AFLOWC) for all affected partial cells**
  - **Changes to masses and surface areas of any components (e.g., CRGTs) in the lower plenum**
  - **Changes to volume/altitude tables in the relevant CVH control volumes**

Input Deck Converter for MELCOR 2.1

Command line: 2XConverter fname –arg1 -arg2

Argument	Description
-OnlyUserNumber	Use 186 object number as new object name,i.e. CV128 becomes '128'
-UserNumber	Use 186 object number as new object name,i.e. CV128 becomes 'CV128'
-186Name	Use 186 object name
-NoMerge	Do not merge 2.1 input into 186 input decks
-CommentOld	Converter will include the 186 input records (commented out) in the new input
-DEF	When using DEF application, runs MELCOR from converter restart

- **The `INCLUDE` directive includes the contents of one input file in another**

  – **Simple case**

```
! filename: _simple.inp
MEG_OUTPUTFILE SIMPG.OUT
MEL_OUTPUTFILE SIMP.OUT
MEL_RESTARTFILE SIMP.RST
NCYCLE  0
PLOTFILE SIMP.PTF
 . . .
INCLUDE simple.gen
INCLUDE simple.cor
```

```
! filename: simple.gen
Program MELGEN
 . . .
END Program MELGEN
```

```
! filename: simple.cor
Program MELCOR
 . . .
END Program MELCOR
```

- **`simple.gen` and `simple.cor` can each contain `INCLUDE` directives**

- **Many users split MELGEN input for large problems into several files**
  - **Makes it easier to find specific input; allows reuse of pieces for differing scenarios or similar plants**

```
! filename: simple.gen
Program MELGEN
! Comments, model pedigree
EXEC_INPUT
EXEC_TITLE   'Simple Case'
 . . .
INCLUDE Vessel.gen
INCLUDE Loops.gen
INCLUDE Core.gen
INCLUDE ECCS.gen
INCLUDE Plots.gen
 . . .
END Program MELGEN
```

```
! filename: Vessel.gen
 . . .
```

```
! filename: Loops.gen
 . . .
```

```
! filename: Core.gen
 . . .
```

```
! filename: ECCS.gen
 . . .
```

```
! filename: Plots.gen
 . . .
```

- **MELGEN input for a given package can also be split up in MELCOR 2**
  - **Parts may be in more than one file, and/or in more than one place in a file**
    - **Package specification is required in each case**

```
! filename: Vessel.gen
 . . .
CVH_INPUT
CV_ID 'Lower Plenum'  120
 . . .
FL_INPUT
FL_ID 'Core Inlet' 117
 . . .
```

```
! filename: Loops.gen
 . . .
CVH_INPUT
CV_ID 'Hot Leg A'  230
 . . .
FL_INPUT
FL_ID 'Hot Nozzle A' 231
 . . .
```

  - **All input for any one object (CV_ID, FL_ID, etc.) must be grouped together**

Converter Retains Data Structure of Original Deck

- **Recent modifications to the Converter will preserve input deck file structure**
  - Part of the February 2008 MELCOR 2.1 version
  - Can be disabled on input
- **Last step in Converter procedure reads original input files and substitutes new input objects for old objects**
  - All records for a particular object (i.e. control volume) appear where object is referenced in original deck (CVnnn00 record)
- **User comments are preserved**

  Additional comments added by converter

```
! **************************************
! * Read in data from external files   *
! **************************************
INCLUDE  ..\M2_SQ_ACCUM.GEN
INCLUDE  ..\M2_SQ_ACCUM_N2.GEN
INCLUDE  ..\M2_SQ_BIG_RED.GEN
INCLUDE  ..\M2_SQ_BLOCK.GEN
INCLUDE  ..\M2_SQ_BURN.PRN
INCLUDE  ..\M2_SQ_CAV.GEN
INCLUDE  ..\M2_SQ_CONT.GEN
INCLUDE  ..\M2_SQ_CONT_FAIL.GEN
INCLUDE  ..\M2_SQ_CORE.GEN
…
```

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- **In MELCOR 2.1 (Sept 08):**
- **All Sensitivity Coefficients for a given package must be entered as table**

```
COR_INPUT
 . . .
COR_SC   3  ! N    SCnumber       Value          Index1
            1   1020           60.0           1
            2   1504           0.1E-04        1
            3   1600           1.0            1
 . . .
```

- **There can be at most one such table in MELGEN input and one in MELCOR input**

- **In MELCOR 2.1 (Feb 09):**

- **A third field on the COR_SC card will allow multiple tables**

```
COR_INPUT
 . . .
COR_SC   2  Table1
             1   1020          60.0        1
             2   1504          0.1E-04     1
 . . .
COR_SC    1  Table 2
             1   1600          1.0         1

 . . .
```

- **New field is used to differentiate tables for Allowreplace**

- **Currently implemented for all SC tables, valve tables, and pool scrubbing tables.**

Recent Improvements to Converted Input

September 2008

- HS_ID 'HS31014-UP' 31014   ! 186 name: UP
- …
- !* 103 - Next HS data
  ****
- HS_ID 'HS32001-LOWERPLE' 32001   ! 186 name: LOWERPLENUM
- HS_GD CYLINDRICAL   YES   ! Type of geometry, Steady-state initialization
- HS_EOD 0.1445   1.0   ! HS Elevation and Orientation Data
- HS_SRC NO   ! No power source
- HS_ND   4 ! NXVALU NLXVALUE   TEMPIN   MATNAM
-     1 1 0.22403000E+01 0.56083727E+03 'STAINLESS-STEEL'
-     2 2 0.22874000E+01 0.55612846E+03 'STAINLESS-STEEL'
-     3 3 0.23345000E+01 0.55149002E+03 'STAINLESS-STEEL'
-     4 4 0.23816000E+01 0.54692239E+03
- !   Type   CV name   Mass transfer
- HS_LB CalcCoefHS 'CV320-LOWER-PLEN' YES
- HS_LBP INT   0.50000000E+00   0.50000000E+00
- HS_LBT   0.10000000E+03   0.10000000E+03   0.10000000E+01 0.10000000E+01
- HS_LBS 1.0 0.701 0.5230
- !   Type   CF/TF   CV name   Mass transfer
- HS_RB CoefTempTF 'TF10-PIPE INSULA' 'CV1-CAVITY'   YES
- HS_RBP EXT   0.50000000E+00   0.50000000E+00
- HS_RBT   0.10000000E+03   0.10000000E+03   0.10000000E+01 0.10000000E+01
- HS_RBS 7.8262 1.0 0.5230
- HS_FT OFF
-
- HS_ID 'HS32002-LOWERPLE' 32002   ! 186 name: LOWERPLENUM

Records positioned as in original input

December 2008

```
! *   Lower Vessel Wall - Core level 1
! *
! *   Description from S/R5 Model HS 5062
! *   Inner Radius = 2.2403 m
! *   Outer Radius = 2.3816 m
! *   Inner Dhyd  = 0.701 m
! *   DZ        = 0.523
! *
! *        NODES  CYL   INPUT W4(I)
HS_ID 'HS32001-LOWERPLE' 32001   ! 186 name: LOWERPLENUM
HS_GD CYLINDRICAL     SS              ! Type of geometry, Steady-state initialization
HS_EOD 0.1445        1.0            ! HS Elevation and Orientation Data
HS_SRC NO                          ! No power source
HS_ND   4 ! NXVALU NLXVALUE        TEMPIN     MATNAM
    1  1 2.2403                -   'STAINLESS-STEEL'
    2  2 2.2874                -   'STAINLESS-STEEL'
    3  3 2.3345                -   'STAINLESS-STEEL'
    4  4 2.3816                -
HS_LB CalcCoefHS 'CV320-LOWER-PLEN' YES
HS_LBP INT 5.E-01          5.E-01
HS_LBT 100.0          100.0           1.0           1.0
HS_LBS 1.0 0.701 0.5230
HS_RB CoefTempTF 'TF10-PIPE INSULA' 'CV1-CAVITY'      YES
HS_RBP EXT 5.E-01          5.E-01
HS_RBT 100.0          100.0           1.0           1.0
HS_RBS 7.8262 1.0 0.5230
HS_FT OFF
```

Comments from original input

Steady State temperatures to be calculated

More readable formatting

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Problem	Diagnostic	Solution
NC gas used as HS material	**Error on card HS_ND for Heat Structure 'HSName'** THE MATERIAL NAME HELIUM IS NOT FOUND	**Add user-defined material properties for NCG to 1.8.6 input**
No Steady State initialization for 1.8.6	**ERROR IN SUBROUTINE HSSTDY/HSRUN2** TEMPERATURE CONVERGENCE FAILURE FOR HEAT STRUCTURE 107: TEMPERATURE ERROR = 1.157E-02	**Relax convergence criterion in 1.8.6 deck, i.e.,** sc04051 4051 3.0e-2 2 **Reset convergence criterion in converted deck**
Problem when Vol/Alt table out of sequence, i.e., cv55000 'CL1 ACC N2' 2 1 9 cv550B2 3.4200 0.0000 cv550B1 8.0589 38.2300	**Control volume CV550-CL1 ACC N2:** ALTITUDES ARE NOT MONOTONE INCREASING Z= 0.8059E+01 V= 0.0000E+00 Z= 0.3420E+01 V= 0.0000E+00	**Manually re-order the volume altitude table for now. May have permanent solution in February**

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Summary

Code reliability

- Validation
- QA
- Numerical stability

MELCOR Code Development

User Utilities

- Converter
- PTFREAD
- SNAP
- Uncertainty Engine

Code Enhancements

- New/improved modeling
- Code performance