

**Summary of Changes for Converting
RETRAN-02 MOD005.2 Input
to RETRAN-3D MOD004.2**

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This document presents a summary of the changes required to convert RETRAN-02 MOD005.2 input decks to the RETRAN-3D MOD004.2 code. It does not list all of the RETRAN-3D input changes, but only those required to convert a RETRAN-02 input deck to an equivalent "RETRAN-02 Mode" (see the RETRAN-3D SER for a definition) input deck. This document is provided as a guide to converting RETRAN-02 input decks to RETRAN-3D. Refer to the RETRAN-3D input manual for a complete description of RETRAN-3D input requirements.

PROBLEM CONTROL AND DESCRIPTION DATA CARDS 01000Y

A number of the program options have been revised for RETRAN-3D. The following discussion describes how to make the necessary changes to convert RETRAN-02 input to RETRAN-3D.

Word	Description		
W1-I to W18-I		=	Same as corresponding word in RETRAN-02 decks.
W19-I	NODEL	=	Power Calculation Flag. Options -3 through 1 are equivalent between RETRAN-02 and RETRAN-3D. If NODEL=2 or 3, it should be changed to NODEL=1. The NODEL=4 option is not available in RETRAN-3D. If NODEL=5 in a RETRAN-02 deck, it should be changed to NODEL=2 in a RETRAN-3D deck.
			Note: There are differences in the decay heat constants selection methods between RETRAN-02 and RETRAN-3D. Refer to the description for cards 146000 and 30000Y below.
W20-I	MWREAC	=	Same as in RETRAN-02 decks.
W21-I	NCFLOW	=	This word was NLVC for RETRAN-02. It defined the number of volumes in the optional equivalent liquid level calculation, which been removed from RETRAN-3D. W21-I is now used for adding the noncondensable gas continuity equation to the fluid flow balance equations. NCFLOW=0 must be defined and a control system used to model the equivalent liquid level in a stack of volumes.
W22-I	MTDV	=	Same as in RETRAN-02 decks.

W23-I	ISFLAG	=	Slip options 0, 1, and 2 are the same as for RETRAN-02. Additional slip modeling options are available with RETRAN-3D, but they should not be used with "RETRAN-02 Mode" analyses.
W24-I	NCHT	=	Same as in RETRAN-02 decks.
W25-I	JSST	=	Steady-state initialization options <0, 0, and 1 are the same as for RETRAN-02. Additional steady-state initialization options are available with RETRAN-3D. They may be used with "RETRAN-02 Mode" analyses.
W26-I to W30-I		=	Same as corresponding word in RETRAN-02 decks.
W31-I	NACC	=	This word was an unused option for RETRAN-02 and is used to request use of the accumulator model in RETRAN-3D. RETRAN-02 Mode models should use NACC=0.
W32-I	NGAP	=	This word was an unused option for RETRAN-02 and is used to request use of the dynamic gap conductance model in RETRAN-3D. RETRAN-02 Mode models should use NGAP=0.
W33-I	NUMRCS	=	This word was used to define INEXPL, the numerical solution option for RETRAN-02. The two options were the standard RETRAN-02 solution (INEXPL=-1) and the iterative technique (INEXPL=1). The standard solution with non-linear time-step control (NCHK=-1 on card 03XXX0) is not supported in RETRAN-3D. The NUMRCS flag is used to select the matrix solver to be used, either the 3- or 4-equation solver (NUMRCS=2) or the 5-equation solver. RETRAN-02 Mode models should use a value of NUMRCS=2 and select the iterative or fixed time-step selection options on the time-step data cards 03XXX0.
W34-I5 to W38-I		=	Same as corresponding word in RETRAN-02 decks.
W39-I	NEWEQS	=	This word was an unused option for RETRAN-02 and is used to request use of the vapor continuity in the fluid flow balance equation set. RETRAN-02 Mode models should use NEWEQS=0.
W40-I to W41-I		=	Same as in RETRAN-02 decks.

MINOR EDIT VARIABLE DATA CARDS 0200YY

Most RETRAN-02 minor edit variables are available in RETRAN-3D. Several have been removed, e.g. the equivalent liquid level and volume and junction kinetic energy. For bubble rise and nonequilibrium minor edits, RETRAN-3D requires the region number to be the volume number rather than the bubble rise of nonequilibrium set number (1 - NBUB or 1 - number of nonequilibrium volumes).

The decay heat precursor concentration edit flag has been changed to 'CNXX' XX where XX is the group number. In RETRAN-02 the flag was hardwired to 'CN01' 0 to CN21 0.

TIME-STEP DATA CARDS 03XXX0

The format of the data items on the RETRAN-3D time-step card has changed from that of RETRAN-02. The integer edit frequency values have been changed to floating point intervals. There are five different edit types controlled by the time-step data cards: run-time graphics file records, minor edits, restart file records, major edits and timing edits. The user specifies the time interval (in seconds) for each of the edit types. The interval for RTG file records may be smaller or larger than the minor edit frequency but all other specified frequencies must be larger than or equal to the minor edit frequency. Also, all specified frequencies must be integer multiples of the smallest interval. If this is not the case, the code will adjust the interval and print a warning message.

The iterative numerics time-step control parameters (EPSP, EPSIMP, and COURNT) are now input on separate cards (03XXX1).

Word	Description	
W1-R	TRTG	= Time interval between RTG file records (sec). Must be greater than or equal to DELTM (W7) or equal to zero. = 0, no RTG file will be generated
W2-R	TMIN	= Time interval between minor edits (sec). Must be greater than or equal to DELTM (W7). Set equal to NMIN*DELTM on corresponding RETRAN-02 input card.
W3-R	TRST	= Time interval between RESTART file records. Must be greater than or equal to TMIN (W2). (0 defaults to TRST = TMIN). Set equal to NMIN*DELTM on corresponding RETRAN-02 input card.
W4-R	TMAJ	= Time interval between major edits (sec). Must be greater than or equal to TMIN (W2). (0 defaults to TMAJ = 50 x TMIN) Set equal to NMIN*NMAJ*DELTM on corresponding RETRAN-02 input card.

W5-R	TDMP	=	Time interval between TIMING edits (sec). Must be greater than or equal to TMIN (W2). (0 defaults to TDMP = 50 x TMIN) Set equal to NDMP*DELTM on corresponding RETRAN-02 input card.
W6-I	NCHK	=	Option for time-step control selection. The NCHK=-1 option from RETRAN-02 is not supported in RETRAN-3D. = 0, use iterative solution method with time-step control algorithms. Similar to INEXPL=1 and NCHK=0 for RETRAN-02 (RETRAN-3D uses different time-step control algorithms) = 1, use fixed time-step size of DELTM. Equivalent to the corresponding RETRAN-02 option
W7-R	DELTM	=	Same as W5-R in RETRAN-02 decks.
W8-R	TLAST	=	Same as W7-R in RETRAN-02 decks.
W9-I	NSHAPE	=	Same as W11-R in RETRAN-02 decks.

TIME_STEP ALGORITHM CONSTANTS CARD 030001

This card is no longer used in RETRAN-3D and should be removed.

ITERATIVE TIME STEP CONTROL CONSTANTS CARDS 03XXX1

The time-step control constants cards are optional, with XXX1 here corresponding to XXX0 on the time step cards. Similar constants were supplied on the 03XXX0 for RETRAN-02. It is recommended that the default RETRAN-3D constants be used unless the user has justification for changing them. The default Courant time-step algorithm coefficient was changed to 5.0 from 0.3 in RETRAN-02 because the RETRAN-3D implicit numeral solution allows a time step larger than the Courant limit.

Word	Description
W1-R	EPSIMP = Same as corresponding word in RETRAN-02 decks.
W2-R	COURNT = Courant time-step control coefficient. The default is 5.0 and the maximum is 1.0E+6.
W3-R	EPSIU = Same as corresponding word in RETRAN-02 decks.
W4-R	CONDT = Same as corresponding word in RETRAN-02 decks.

TRIP CONTROL DATA CARDS 04XXX0

The trip control data cards are unchanged from RETRAN-02 to RETRAN-3D except that a new description field has been added as follows,

Word	Description
W7-A	IDITL = Trip description, 32 characters maximum. This description is used for edit purposes. The description should be enclosed with Hollerith delimiters (' or ').

VOLUME DATA CARDS 05XXX0

The mixture level is now input on the bubble rise cards 06XXX0 and is required only if the volume uses a bubble rise model.

The parameters for a nonequilibrium volume, VRAIN and VLHTC, are now input on separate nonequilibrium volume cards, 610XXX.

A new variable, wall roughness for use with the wall friction calculation, is input as word 12 on the volume cards.

Word	Description
W1-I to W7-I	= Same as corresponding word in RETRAN-02 decks.
W8-R	= Remove the mixture level ZMIX from the deck. It will be added to the bubble rise cards 06XXX0 for separated volumes.
	FLOWL = Same as W9-R in RETRAN-02 decks.
W9-R	FLOWA = Same as W10-R in RETRAN-02 decks.
W10-R	DIAMV = Same as W11-R in RETRAN-02 decks.
W11-R	ELEV = Same as W12-R in RETRAN-02 decks.
W12-R	EW = This word is used to define the surface roughness for the RETRAN-3D wall friction model. Enter EW=0 for RETRAN-02 Mode model Remove word W13-I, W14-R, and W15-R (INEQ, VRAIN, and VLHTC) from the RETRAN-02 deck. They are now supplied on the two-region nonequilibrium cards 610XXX.

W13-I	MESH	=	Same as W16-I in RETRAN-02 decks.
W14-I to W15-I		=	New RETRAN-3D features. Omit or enter as 0 for RETRAN-02 Mode decks where IVFIT must be supplied.
W16-I	IVFIT	=	New RETRAN-3D feature to allow use of multiple profile fit sets of data. Enter IVFIT=1 if a profile fit data card 06011 is included in the RETRAN-02. Otherwise, enter IVFIT=0.
W17-I		=	New RETRAN-3D features. Omit or enter as 0 for RETRAN-02 Mode decks.

BUBBLE RISE MODEL CARDS 06XXXXY

The mixture level has been moved from the volume cards 05XXXXY to the bubble rise input cards.

Word	Description
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W1-R	ALPH	=	Same as in RETRAN-02 decks. Note: For two-region nonequilibrium volumes (pressurizers or steam separators), RETRAN-02 effectively uses ALPH=0 regardless of the actual value input. To duplicate RETRAN-02 results with RETRAN-3D, set VBUB=0.
W2-R	VBUB	=	Same as in RETRAN-02 decks.
W3-R	ZMIX	=	Mixture level. (The value of W8-R from the volume cards 05XXXXY for RETRAN-02 deck.)
W4-I	IWILSN	=	Option to use the Wilson bubble rise model to define the bubble rise velocity. Enter IWILSN=0 for RETRAN-02 Mode models.
W5-I	IDALPH	=	Same as W3-I in RETRAN-02 decks.
W6-I	IDVBUB	=	Same as W4-I in RETRAN-02 decks.

JUNCTION DATA CARDS 08XXXXY

The data items following W18-I have been revised. The enthalpy transport selection flag has been revised slightly and the junction angle information has also been revised and moved.

Word Description

W1-I to W13-I = Same as corresponding word in RETRAN-02 decks.

W14-I MVMIX = Same as in RETRAN-02 decks.

Note: RETRAN-3D revised the algorithm used to compute the momentum flux pressure drop term for volumes with more than one inlet or exit junction. Consequently, for separated volumes with two exit flow paths, e.g., separators and upper downcomers, set MVMIX=1 to approximate the results obtained using RETRAN-02 with MVMIX=0 in these flow paths. This may lead to artificial numerical oscillations if the flow reverses in one of the junctions flagged with MVMIX=1. Contact the developers if this occurs or check the status of trouble report 263 for recommendations.

W15-I to W18-I = Same as corresponding word in RETRAN-02 decks.

W19-I IHQCOR = Essentially the same as W20-I in RETRAN-02 decks. RETRAN-3D allows values of 1, 2, or 3 to be input, but the options for turning enthalpy transport off at the inlet for exit junctions for reverse flow are determined automatically, depending on whether the resulting donor volume is unheated.

Note: The RETRAN-3D enthalpy transport model uses fewer closure assumptions than the RETRAN-02 model. As a result it should be more accurate (see Volume 1 for details). For most analyses, the results between the two codes are comparable, but some differences have been observed (see Volume 4 comparison of RETRAN-02 and RETRAN-3D results).

W20-I ISP = Same as W21-I in RETRAN-02 decks.

W21-I ANGLJ1 = Angle of the junction relative to the "from" volume.

W22-I ANGLJ2 = Angle of the junction relative to the "to" volume.

Note: RETRAN-02 has an option of supplying a single junction angle, ANGLJ, that is relative to an arbitrary reference angle. Most RETRAN-02 applications use a value of ANGLJ=0. For these situations, both ANGLJ1 and ANGLJ2 should be entered as 0. Some 90 or 180 degree values of ANGLJ may be used in the RETRAN-02 deck, in which case ANGLJ1 or ANGLJ2 should be set to this non-zero value and the other value should be set to zero. See Volume 1 Section II.2.3 for guidance on use of the angle input.

POINT KINETICS CONSTANTS DATA CARD 140000

The point kinetics model basic data are input on this card. Two words are required for RETRAN-3D. Some of the data input on this card (KMUL and UDUF) in RETRAN-02 are now supplied on card RETRAN-3D decay heat input card 146000.

Word	Description		
W1-R	BOVL	=	Same as W2-I in RETRAN-02 decks
W2-C	DPVAR	=	Option to define the units use with the fuel temperature reactivity coefficient ALPHTM. Enter DPVAR=0 for RETRAN-02 Mode models.

SCRAM TABLE DATA CARDS 141XXY

A new variable, KTBL, is required input as the third word. Input KTBL = 0 to run with the RETRAN-02 scram cards.

Word	Description		
W1-I to W2-I		=	Same as corresponding word in RETRAN-02 decks.
W3-I	KTBL	=	Option to define the scram reactivity table in feet versus reactivity rather than the default of time versus reactivity. Enter KTBL=0 for RETRAN-02 Mode models.
W4-I to W5-I		=	Same as W3-I and W4-I in RETRAN-02 decks. The remaining pairs follow.

DECAY HEAT PROBLEM DESCRIPTION CARD 146000

This data card must be supplied to activate the RETRAN-3D decay heat model. If it is not supplied, decay heat will not be included in the power calculation. If the 146000 card is supplied with no other data, the ANS 1979, single U-235, infinite operating time with no actinide contribution is assumed.

If a 146000 card is not supplied in a RETRAN-02 deck, and the point kinetics option is used, the decay heat calculation is determined by NODEL on the problem dimension card 01000Y. The 1973 decay heat model with an infinite operating time is assumed, and the actinide contribution option is determined from NODEL. The 146000 card is essentially required in RETRAN-02 decks to override the ANS 1973 model with the 1979 model and associated data. Note that the 1973 model is the default model on the 146000 card for RETRAN-02, while the 1979 model is the default for

RETRAN-3D. If a 146000 card is in a RETRAN-02 deck, the value of IANS must be changed to use the same model in RETRAN-3D.

In addition, the 1D kinetics option in RETRAN-02 could use the 34100X and 34200X cards to alternately specify decay heat yield fraction and decay constants according to NDGRP on card 300001, and card 343000 to define a multiplication factor and the actinide breeding ratio. These cards are not used in RETRAN-3D and should not be present in RETRAN-3D input decks.

The decay heat options are supplied on data cards 146000, 146010 and 1470XX for all RETRAN-3D kinetics models.

Word	Description		
W1-I	IANS	=	Decay heat calculation type. = 0, 1979 standard. = 1, 1973 proposed standard (RETRAN-02) Note: IANS=0 gives the 1973 model for RETRAN-02, while it gives the 1979 model in RETRAN-3D. Be careful to check that that input is changed to give the same model option.
W2-I	IHIS	=	Same as corresponding word in RETRAN-02 decks.
W3-I	ISOTOP	=	Same as corresponding word in RETRAN-02 decks.
W4-R	KMUL	=	Same as W1-R on card 140000 in RETRAN-02 decks for point kinetics. Same as W1-R on card 343000 in RETRAN-02 decks for 1-D kinetics.
W5-I	IACT	=	Enter IACT=1 if NODEL=3 (W19-I) on card 01000Y, or if NODEL=5 and NDGRP=0 on card 30000Y in the RETRAN-02 deck. Otherwise enter IACT=0.
W6-R	UDUF	=	Same as W4-R on card 140000 in RETRAN-02 decks for point kinetics. Same as W2-R on card 343000 in RETRAN-02 decks for 1-D kinetics.

HEAT CONDUCTOR DATA CARDS 15XXXXY

In RETRAN-3D W17 (IDCON) has been revised to select one of several condensing heat transfer correlations. In RETRAN this parameter was NTUBES. If condensing heat transfer is expected the proper value of IDCOND must be chosen.

Word	Description
W17-I	ICONDN = Condensation correlation selection flag. Condensation models are available only if IHTMAP = 1 on Card 01000Y (default = 0) = -2, Chun and Seban or Siddique correlation for condensation on stacked vertical surfaces; requires heat conductor stack data on 2200XY and value for CNDL (W18). The Siddique correlation is used when noncondensables are present; otherwise the Chun and Seban correlation is used. = -1, Bell et al. correlation or Carpenter and Colburn correlation for condensation inside a horizontal tube = 0, Chun and Seban correlation for condensation on vertical surface of a single conductor = 1, Nusselt correlation for a vertical plate; often used in pressurizer applications = N, Collier correlation for condensation on the outside surface of a bank of horizontal tubes; N is the number of tubes in the bank and must be greater than 1.

SPECIFIED HEAT TRANSFER COEFFICIENT DATA CARDS 15000X

Specified heat transfer coefficients are defined using the specified heat transfer data cards 15000X in RETRAN-02. This limited the number of unique specifications to 9. To increase the number of unique specifications that can be used, the card series was changed to 015XXX for RETRAN-3D. When converting RETRAN-02 decks to RETRAN-3D, change all 15000X card numbers to the corresponding 01500X card number. The format for the data on the 015XXX data cards is the same as the 15000X cards (RETRAN-02).

Heat conductor cards: NTUBES vs. ICONDN

HEAT CONDUCTOR STACK CARDS 2200XY

The Heat Conductor Stack Cards are used in conjunction with either the local conditions heat transfer model, the dynamic gap conductance model, or for film condensation on a vertical surface, and should be supplied only if NSTK > 0 (Card 01000Y). NSTK must be > 0 if NGAP > 0 (Card 01000Y) or if ICONDN = -2 (Card 15XXXXY). X is the stack number and ranges from 1 to NSTK. Y is the sequence number and ranges from 1 to 9. To use this model, a minimum of two conductors must be specified for each stack.

W1-I	ISHD	=	Same as corresponding word in RETRAN-02 except for additional options can be chosen with this parameter.
W2-I	NCON(1)	=	List of conductor numbers in the stack starting at the bottom of the stack.
W3-I	NCON(2)		
W4-I	NCON(3)		
.	.		
.	.		
.	.		

SPACE TIME KINETICS CONSTANT DATA CARD 30000Y

W11-I (NDGRP) has been removed from this card for RETRAN-3D and the decay heat options are now supplied on the 146000 card.

Word	Description		
W1-I to W10-I		=	Same as corresponding word in RETRAN-02 decks.
W11-I			Remove W11-I (NDGRP) from RETRAN-02 input decks.
	ICRXP	=	Same as W12-I in RETRAN-02 decks.
W12-I	ILIM	=	Same as W13-I in RETRAN-02 decks.

NONEQUILIBRIUM VOLUME MODEL DATA CARDS 610XXX

The 610XXX data cards are use to provide the definition for two-region nonequilibrium volumes. For the most part, this input appeared on the volume input cards (05XXX Y) in RETRAN-02 decks.

Word	Description		
W1-I	NEQVOL	=	The nonequilibrium volume number.
W2-I	ISEPFG	=	Flag to specify type of volume. = 0, pressurizer volume. = 1, separator volume (requires separator input cards (60XXX Y)).
W3-R	VRAIN	=	W14-I from volume card for volume NEQVOL in RETRAN-02 deck.
W4-R	VLHTC	=	W15-I from volume card for volume NEQVOL in RETRAN-02 deck.

CONTROL SYSTEMS PROBLEM DIMENSION CARD 701000

The control system steady-state initialization is performed after the thermal-hydraulic steady-state solution has been completed in both RETRAN-3D and RETRAN-02. It is slightly different for RETRAN-3D than for RETRAN-02 for DLY, LAG, LLG, and VLM control blocks (and new RAT and STF blocks). RETRAN-3D initializes them to a steady-state condition by defining the output signal values to be equal to the product of the gain and the input signal value. This allows the resulting output value to be compared with the initial condition to see if they are the same or nearly so (converged). On the other hand, RETRAN-02 initializes these blocks to the specified initial condition rather than the steady-state condition. As a result, these blocks will never appear as not being converged in the steady-state control block output edit for RETRAN-02, when in fact they might be. Because of the differences in the calculation of the initial signal values, the temporal solution of these blocks can be different between RETRAN-02 and RETRAN-3D.

In the event that a RETRAN-02 control block has an initial condition specified that is significantly different from the steady-state value, the RETRAN-3D results may differ from those of RETRAN-02. Consequently, it is important that control system response be carefully reviewed.

The control system is solved using a Gauss-Siedell iterative solution in RETRAN-3D. Solution convergence is determined by comparing the computed output with the output of the previous iteration. Because of the new solution technique, convergence criteria CNTEPS was added to this card.

Word Description

W1-I to W3-R	=	Same as corresponding word in RETRAN-02 decks.
W4-R	CNTEPS	= Control system solution convergence criteria. Enter 0.0 to use default value of 0.0005.
W5-I	ITMAX	= Same as W4-I in RETRAN-02 decks.

Note: The Gauss-Seidel solution may have difficulty converging for some control blocks that have feedback loops. Increasing ITMAX may improve the convergence by allowing more iterations. If this does not resolve convergence problems, pass the feedback through an input block using a 702XXX card rather than feeding it back directly. This will fix the feedback input at the previous time-step value and improve convergence.

W6-I	INIT	=	Steady-state initialization option flag. ≤ 0, Use RETRAN-3D method which gives steady state conditions for LAG, LLG, VLM, DLY, DER, and STF block outputs. Recommended option. (Default = 0.)
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= 1, Use RETRAN-02 method which gives specified initial conditions for blocks identified above. Option provided so RETRAN-02 control system initialization results can be reproduced.

≥ 1 , Use RETRAN-02 method, but make INIT initializing calls to the control system solution. In RETRAN-02, a single pass through the control system solution is made after steady-state initialization. By making several passes through the control system solution before entering the transient, the control block initial values are more accurate.