

MELCOR Uncertainty Analysis with SNAP & DAKOTA



PRESENTED BY

Larry Humphries

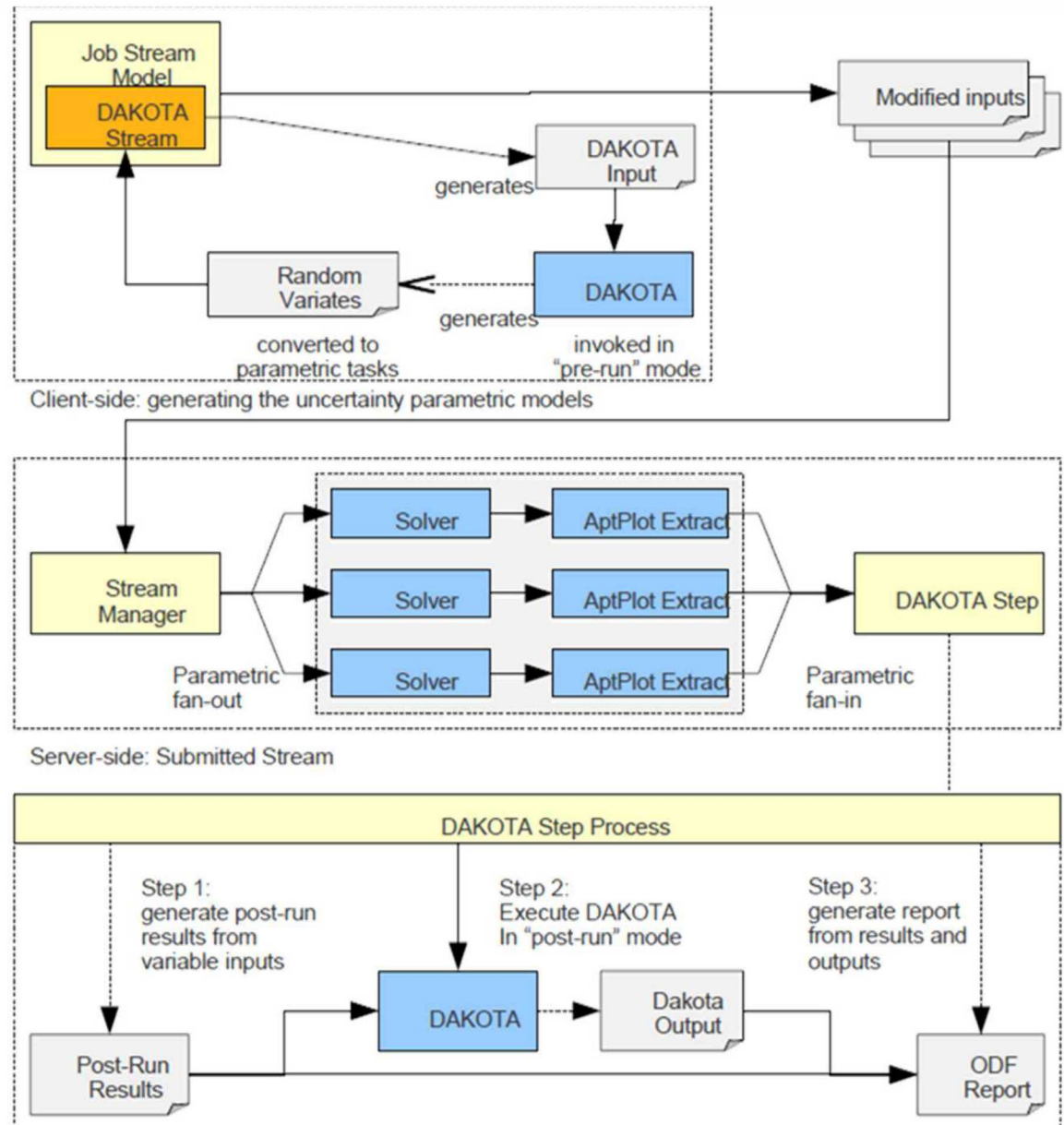
2 SNAP/DAKOTA Uncertainty Analysis

Pros

- SNAP provides access to MELCOR's extensive inventory of sensitivity coefficients and input parameters.
- Rich set of parameter distributions to choose from.
- Graphical interface to DAKOTA input
- Familiar SNAP interface
 - Input, post-processing, UA
 - MELCOR, RELAP, TRACE, COBRA, CONTAIN, FRAPCON, PARCS
- All-in-one solution for UA
 - SNAP schedules multi-parameter runs after setup
 - SNAP prepares statistical report generated upon job completion

Cons

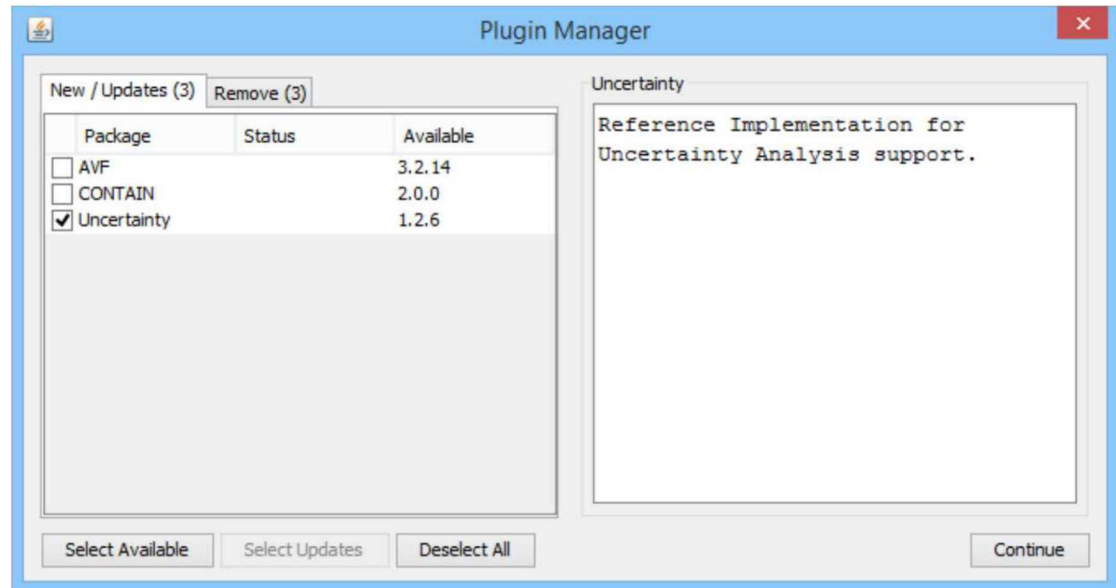
- SNAP has relatively steep learning curve for beginner
- Failed runs (realizations) are not accounted for and no statistical report is generated. They lead to an incomplete job with no diagnostics to user.
- Input decks with new MELCOR models (relative to SNAP version) cannot be used



Performing a Sensitivity Study with SNAP

Step I – Downloading Dakota Plugin

1. Select Dakota plug-in during the SNAP plugins download and installation step
2. Create a Numeric value in your model
3. Assign the Numeric value as an input value
4. Create a Dakota Run Stream
5. Specify a model node as parametric (MELGEN or MELCOR depending on input)
6. Define Dakota parametric properties
7. Coordinate data flow
8. Run Job

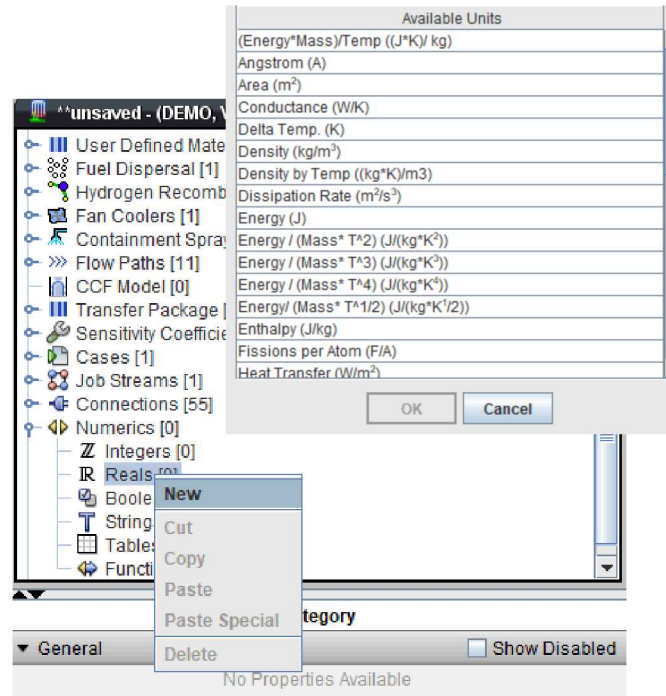


Performing a Sensitivity Study with SNAP

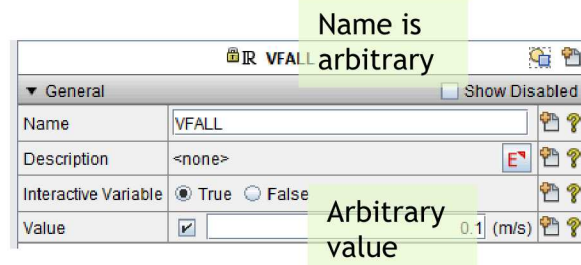
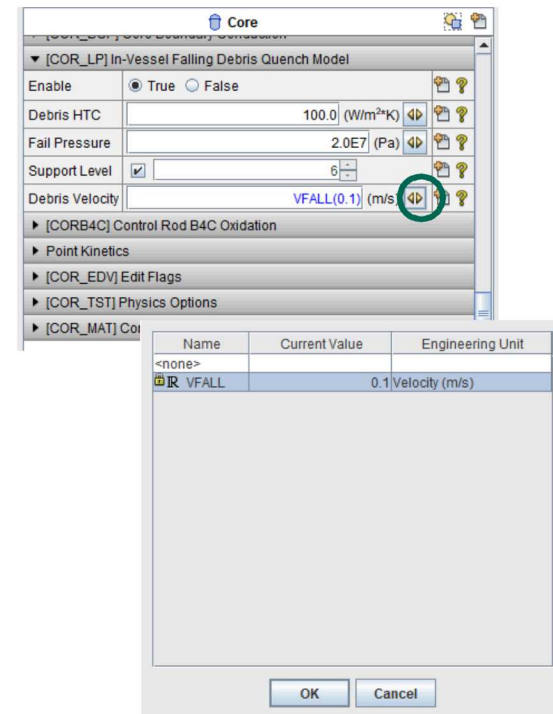
Step 2 – Adding a Numeric (I)

1. Select Dakota plug-in during the SNAP plugins download and installation step
2. Create a Numeric value in your model
3. Assign the Numeric value as an input value
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Create the Numeric



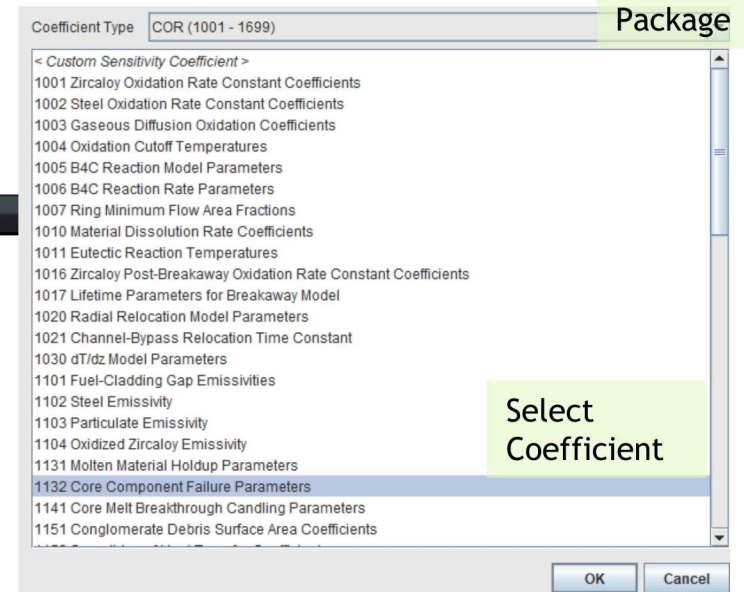
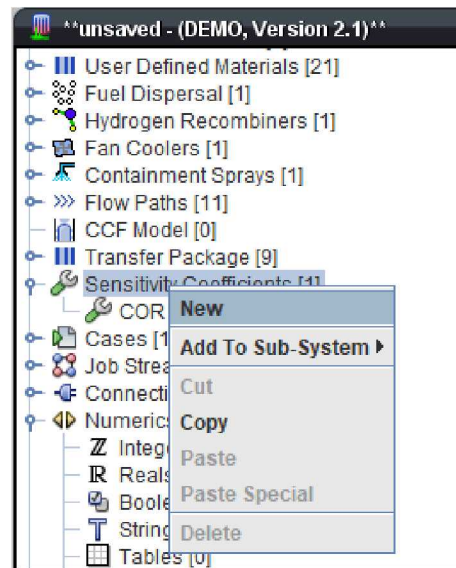
Connect Numeric to Input



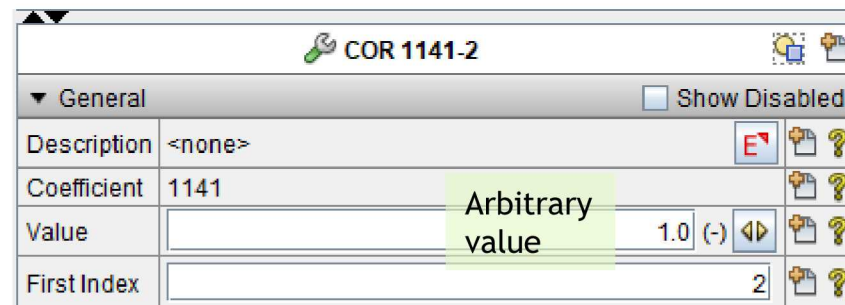
Performing a Sensitivity Study with SNAP

Step 2 – Adding a Sensitivity Coefficient (2)

1. Select Dakota plugin during the SNAP plugins download and installation step
2. Create a Numeric value in your model
3. Assign the Numeric value as an input value
4. Create a Dakota Run Stream
5. Specify a model node as parametric (MELGEN or MELCOR depending on input)
6. Define Dakota parametric properties
7. Coordinate data flow
8. Run Job



Properties
Window



Performing a Sensitivity Study with SNAP

Step 3 – Assign the New Numeric

1. Select Dakota plug-in during the SNAP plugins download and installation step
2. Create a Numeric value in your model
3. Assign the Numeric value as an input value
4. Create a Dakota Run Stream
5. Specify a model node as parametric (MELGEN or MELCOR depending on input)
6. Define Dakota parametric properties
7. Coordinate data flow
8. Run Job

The screenshot shows the SNAP software interface. The main window displays a tree view of the model components. The 'CVH 4407-11' node is selected under the 'Sensitivity Coefficients' category. A dialog box titled 'Select a Shared Real' is open, showing a table with the following data:

Name	Current Value	Engineering Unit
<none>		
IR r1	0.4	No Unit (-)

The 'OK' button is highlighted. Below the tree view, the properties for the 'CVH 4407-11' node are displayed in a table:

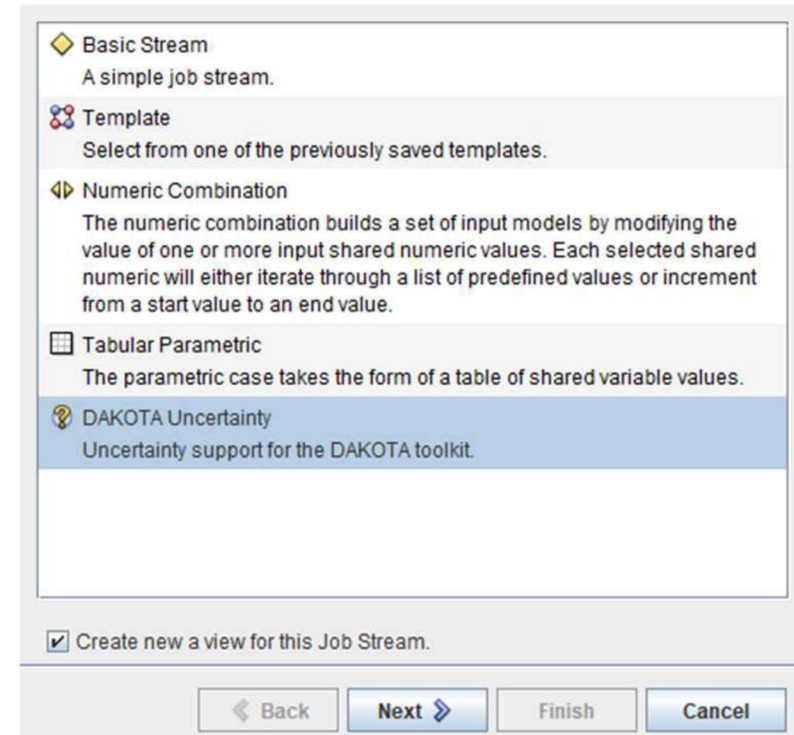
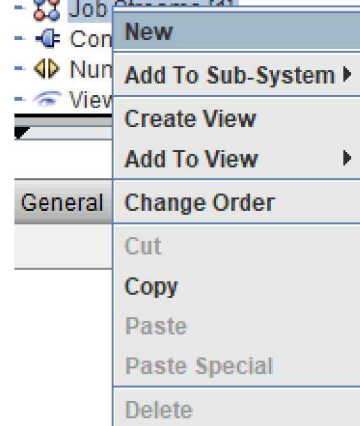
General		Show Disabled
Description	<none>	[E] [?] [?]
Coefficient	4407	[?] [?]
Value	r1(0.4) (-)	[?] [?] [?]
First Index	11	[?] [?]

Performing a Sensitivity Study with SNAP

Step 4 – Dakota Job Stream (I)

1. Select Dakota plug-in during the SNAP plugins download and installation step
2. Create a Numeric value in your model
3. Assign the Numeric value as an input value
4. Create a Dakota Run Stream
5. Specify a model node as parametric (MELGEN or MELCOR depending on input)
6. Define Dakota parametric properties
7. Coordinate data flow
8. Run Job

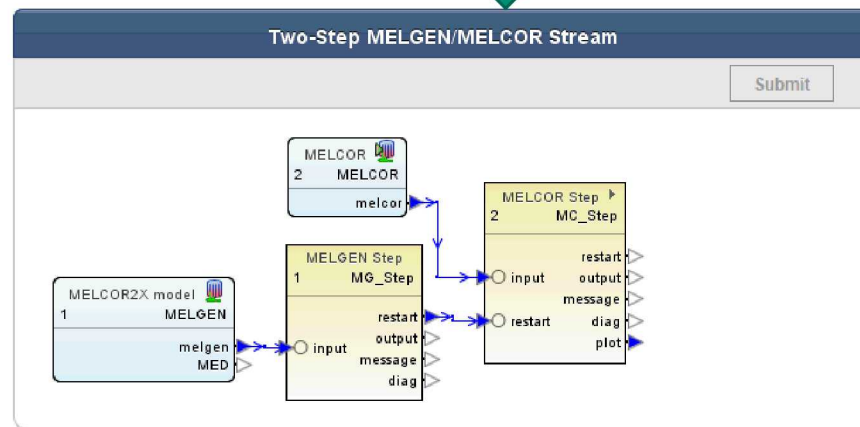
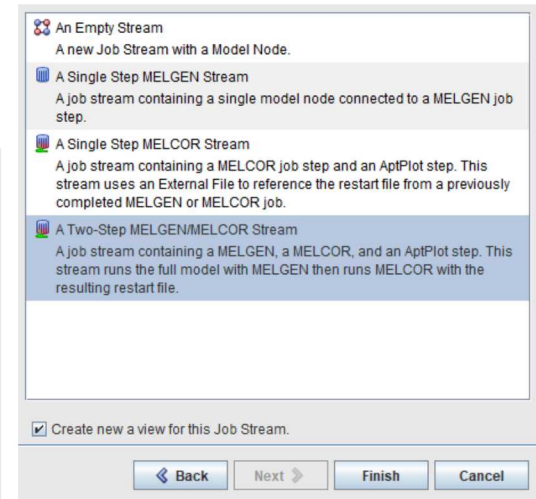
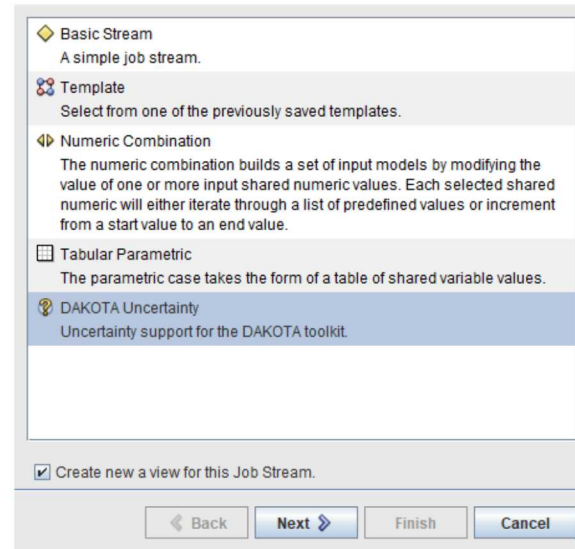
- User Defined Materials [21]
- Fuel Dispersal [1]
- Hydrogen Recombiners [1]
- Fan Coolers [1]
- Containment Sprays [1]
- Flow Paths [11]
- CCF Model [0]
- Transfer Package [9]
- Sensitivity Coefficients [1]
- Cases [1]
- Job Stream [41]
- Con...
- Nun...
- View



Performing a Sensitivity Study with SNAP

Step 4 – Dakota Job Stream (2)

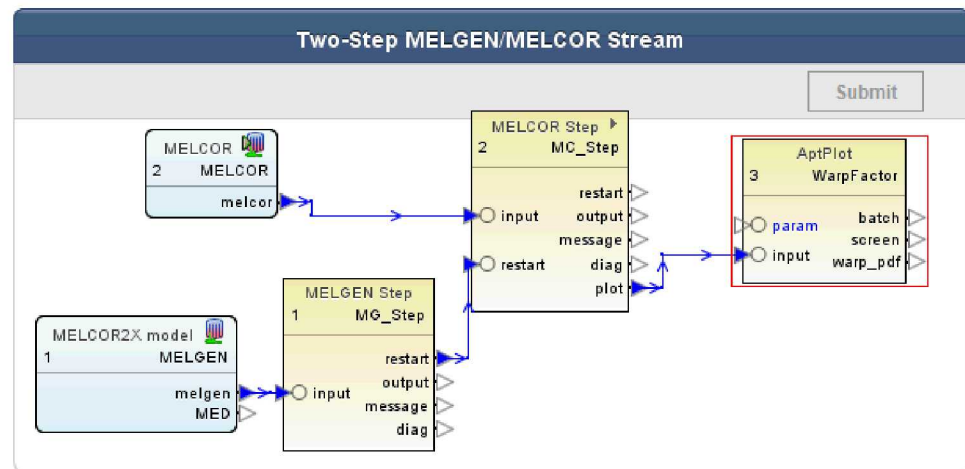
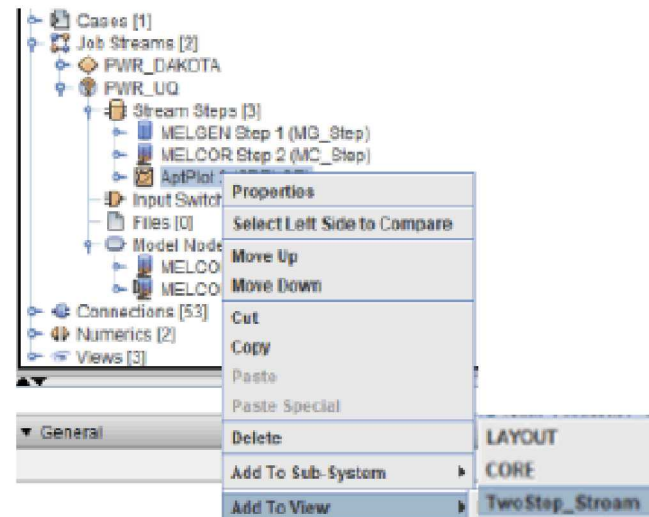
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3. Assign the Numeric value as an input value
4. Create a Dakota Run Stream
5. Specify a model node as parametric (MELGEN or MELCOR depending on input)
6. Define Dakota parametric properties
7. Coordinate data flow
8. Run Job



Performing a Sensitivity Study with SNAP

Step 4 –Dakota Run Stream (3) – Add AptPlot to view

1. Select Dakota plug-in during the SNAP plugins download and installation step
2. Create a Numeric value in your model
3. Assign the Numeric value as an input value
4. Create a Dakota Run Stream
5. Specify a model node as parametric (MELGEN or MELCOR depending on input)
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8. Run Job

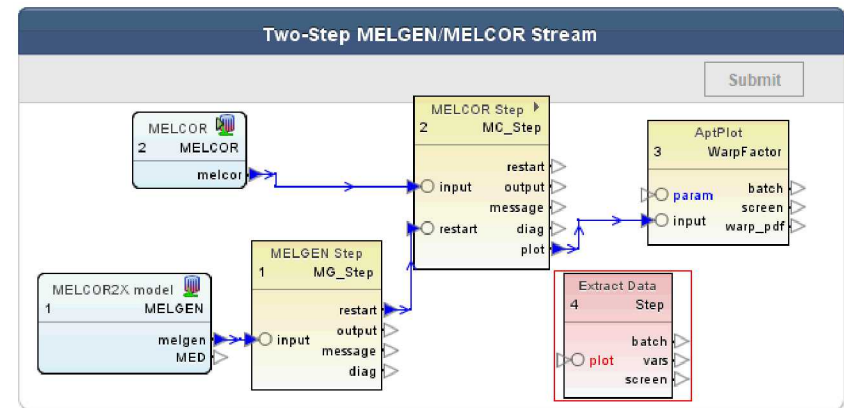
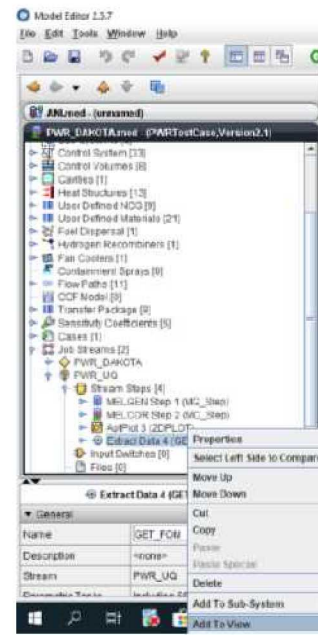
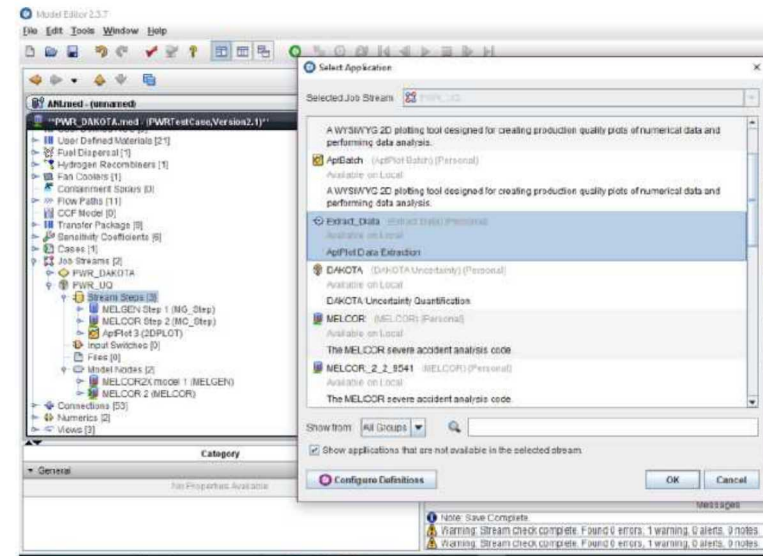


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Step 4 –Dakota Run Stream (4) – Add Extract Data

1. Select Dakota plug-in during the SNAP plugins download and installation step
2. Create a Numeric value in your model
3. Assign the Numeric value as an input value
4. Create a Dakota Run Stream
5. Specify a model node as parametric (MELGEN or MELCOR depending on input)
6. Define Dakota parametric properties
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8. Run Job

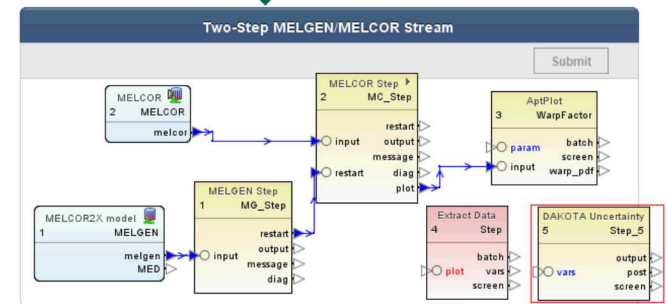
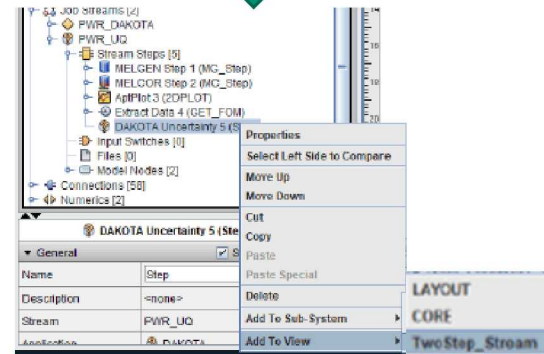
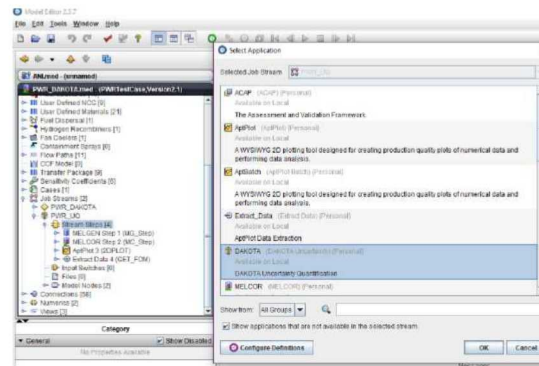
Add Extract Data to Job Stream



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Step 4 –Dakota Run Stream (4) – Add DAKOTA to Job Stream

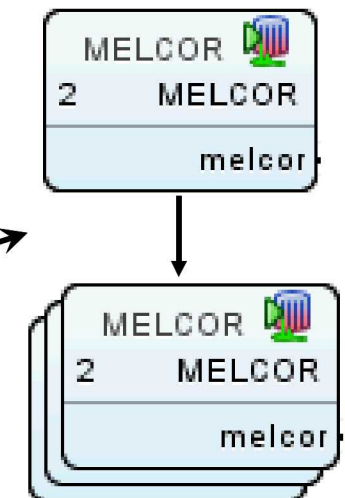
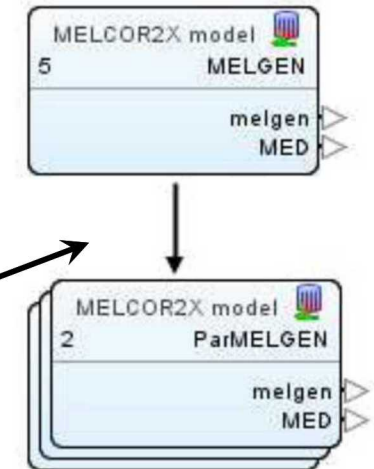
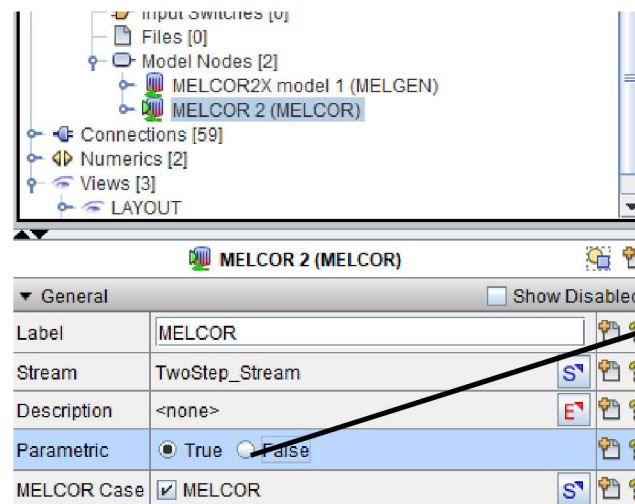
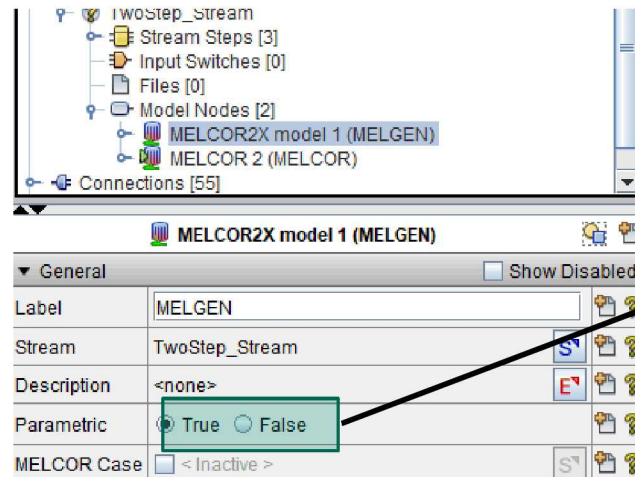
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4. Create a Dakota Run Stream
5. Specify a model node as parametric (MELGEN or MELCOR depending on input)
6. Define Dakota parametric properties
7. Coordinate data flow
8. Run Job



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Step 5 – Parametric Model Node

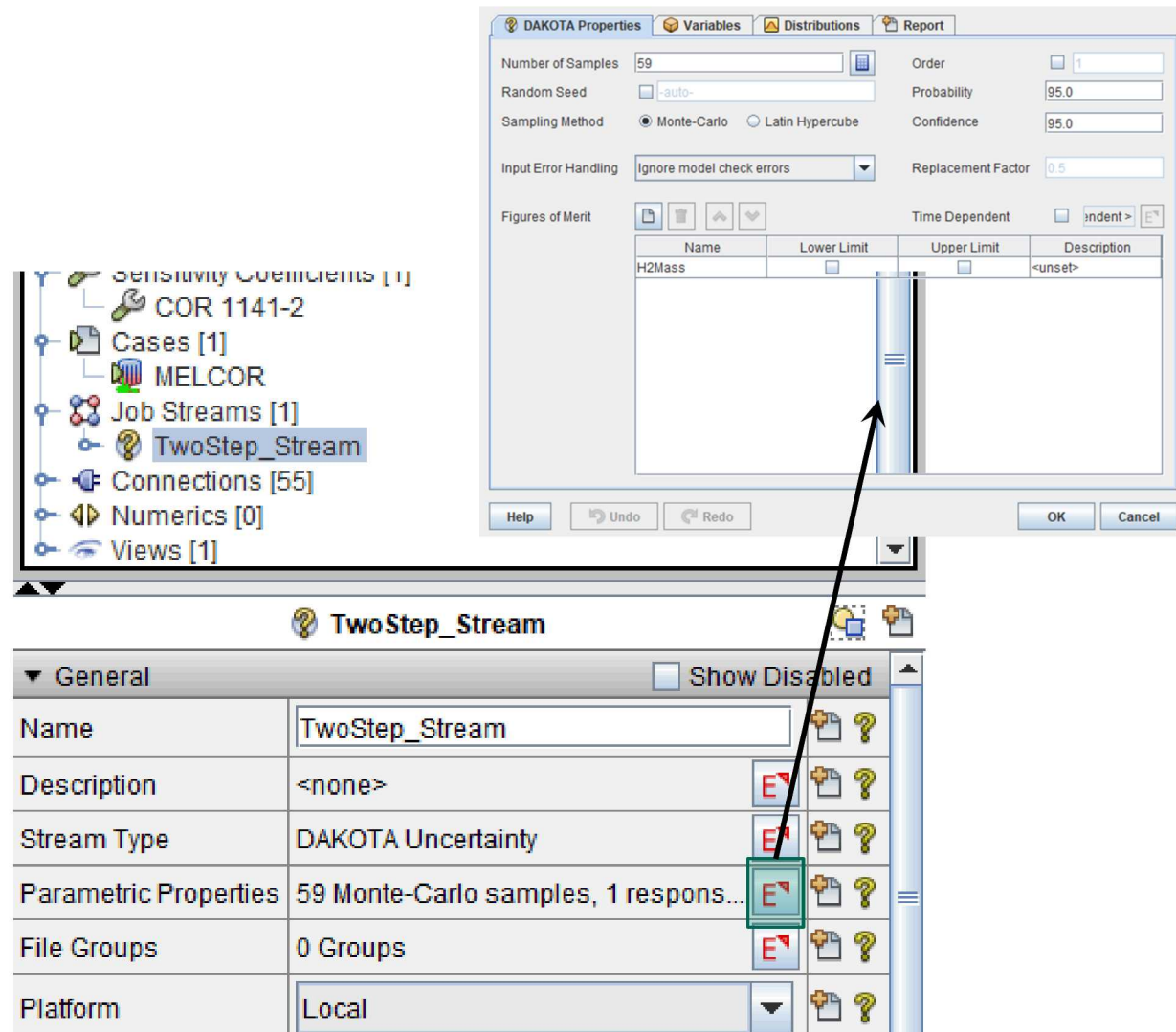
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8. Run Job



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Step 6 – Parametric Properties (I)

1. Select Dakota plug-in during the SNAP plugins download and installation step
2. Create a Numeric value in your model
3. Assign the Numeric value as an input value
4. Create a Dakota Run Stream
5. Specify a model node as parametric (MELGEN or MELCOR depending on input)
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Step 6 – Parametric Properties (2) – Figures of Merit

1. Select Dakota plug-in during the SNAP plugins download and installation step
2. Create a Numeric value in your model
3. Assign the Numeric value as an input value
4. Create a Dakota Run Stream
5. Specify a model node as parametric (MELGEN or MELCOR depending on input)
6. Define Dakota parametric properties
7. Coordinate data flow
8. Run Job

DAKOTA Properties

Number of Samples: 59

Random Seed: ☐ -auto-

Sampling Method: ☒ Monte-Carlo ☐ Latin Hypercube

Input Error Handling: Ignore model check errors

Figures of Merit:

Name	Lower Limit	Upper Limit	Description
H2Mass			<unset>

At this point we have added an FOM, given it a name, limits, and description, but have not connected it to the database

Order: ☐ 1

Probability: 95.0

Confidence: 95.0

Replacement Factor: 0.5

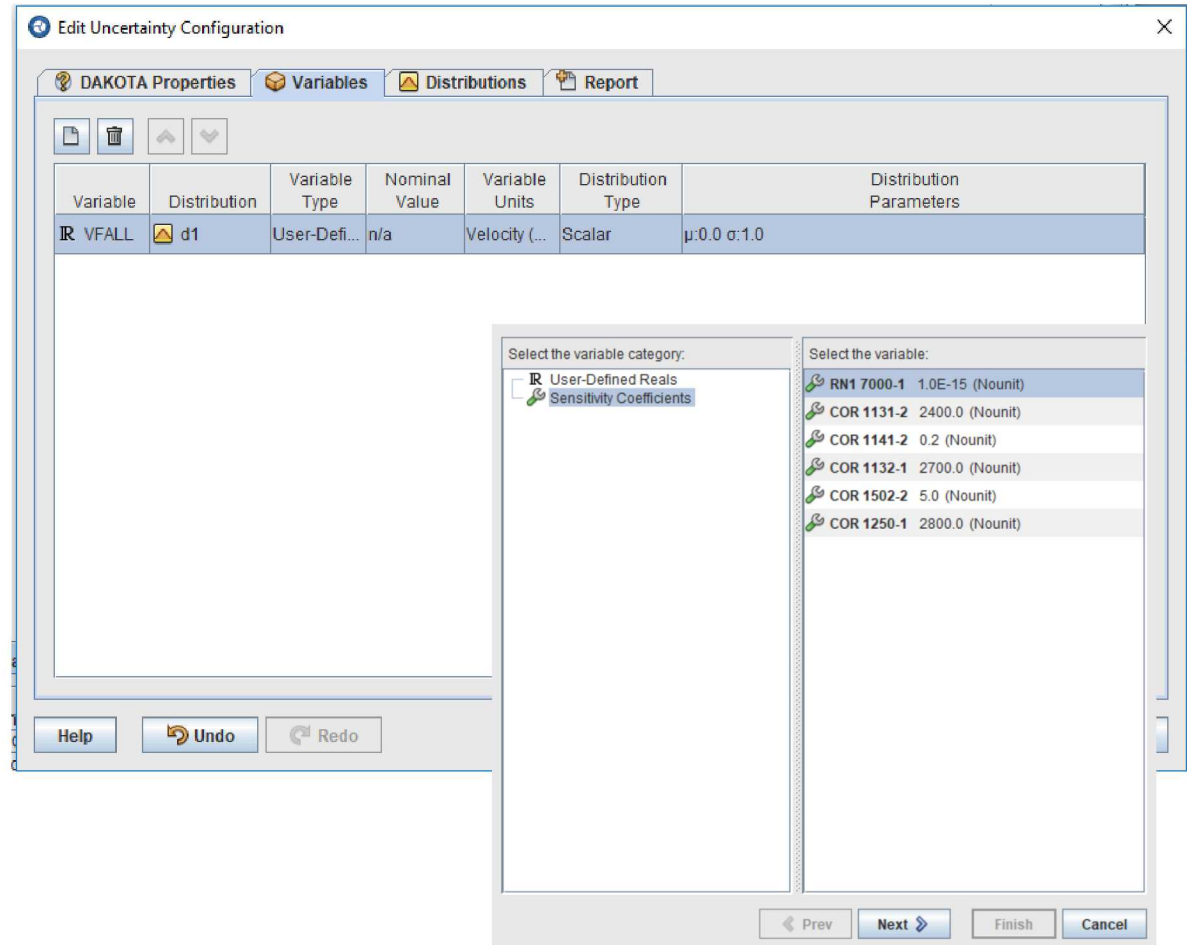
Time Dependent: ☐ indent >

Help Undo Redo OK Cancel

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Step 6 – Parametric Properties (3) – Sensitivity Variables

1. Select Dakota plug-in during the SNAP plugins download and installation step
2. Create a Numeric value in your model
3. Assign the Numeric value as an input value
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Step 6 – Parametric Properties (4) - Distributions

1. Select Dakota plug-in during the SNAP plugins download and installation step
2. Create a Numeric value in your model
3. Assign the Numeric value as an input value
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5. Specify a model node as parametric (MELGEN or MELCOR depending on input)
6. Define Dakota parametric properties
7. Coordinate data flow
8. Run Job

DAKOTA Properties Variables **Distributions** Report

File Edit View Help

d1 (Scalar;No Unit)

Name: d1

Distribution: Normal

Rule: Scalar

Distribution Parameters

μ (Mean) 1.0 (-) ?

σ (STDV) 0.05 (-) ?

Variance 2.5E-3 (-) ?

☒ Min 0.0 (-) ?

☐ Max 3.0 (-) ?

Probability density

Cumulative distribution

Help Undo Redo OK Cancel

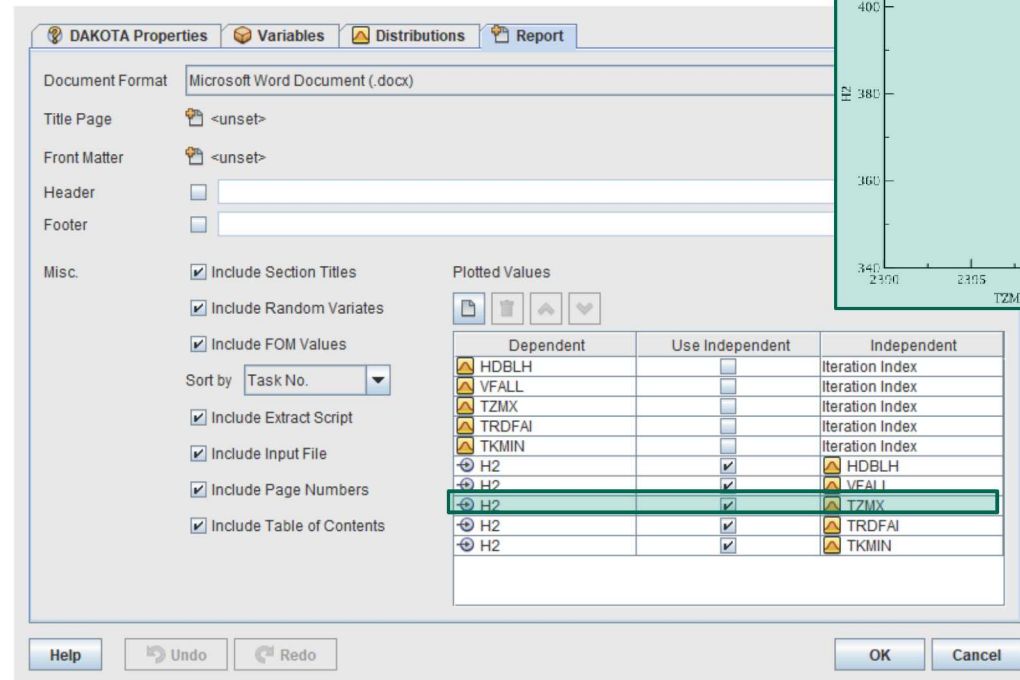
Available Distributions:

Normal	Triangular	Gumbel
Lognormal	Exponential	Frechet
Uniform	Beta	Weibull
Loguniform	Gamma	Histogram

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Step 6 – Parametric Properties (5) – Report Options

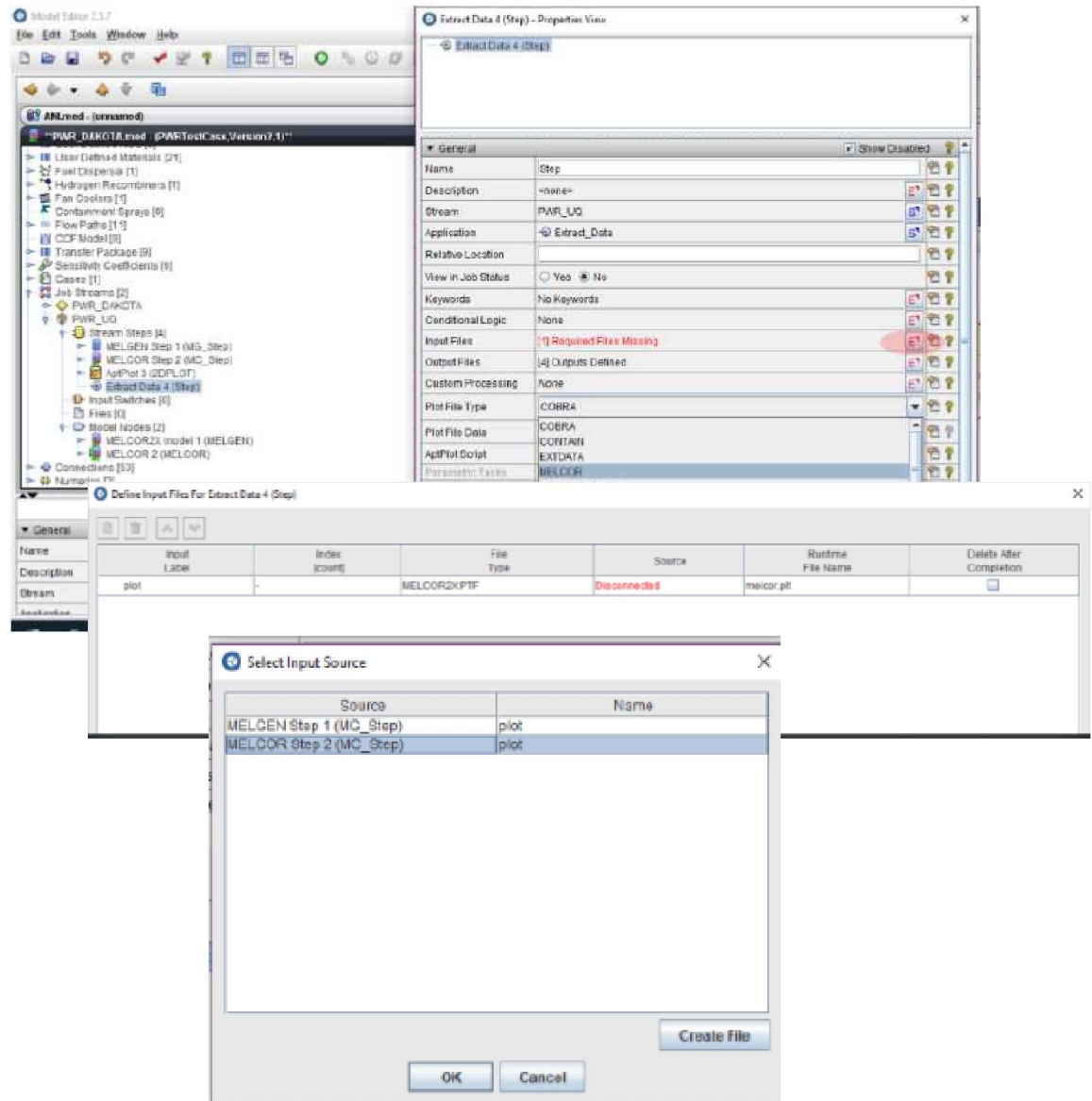
1. Select Dakota plug-in during the SNAP plugins download and installation step
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8. Run Job



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Step 7 – Coordinate Data Flow (Extract Data 2)

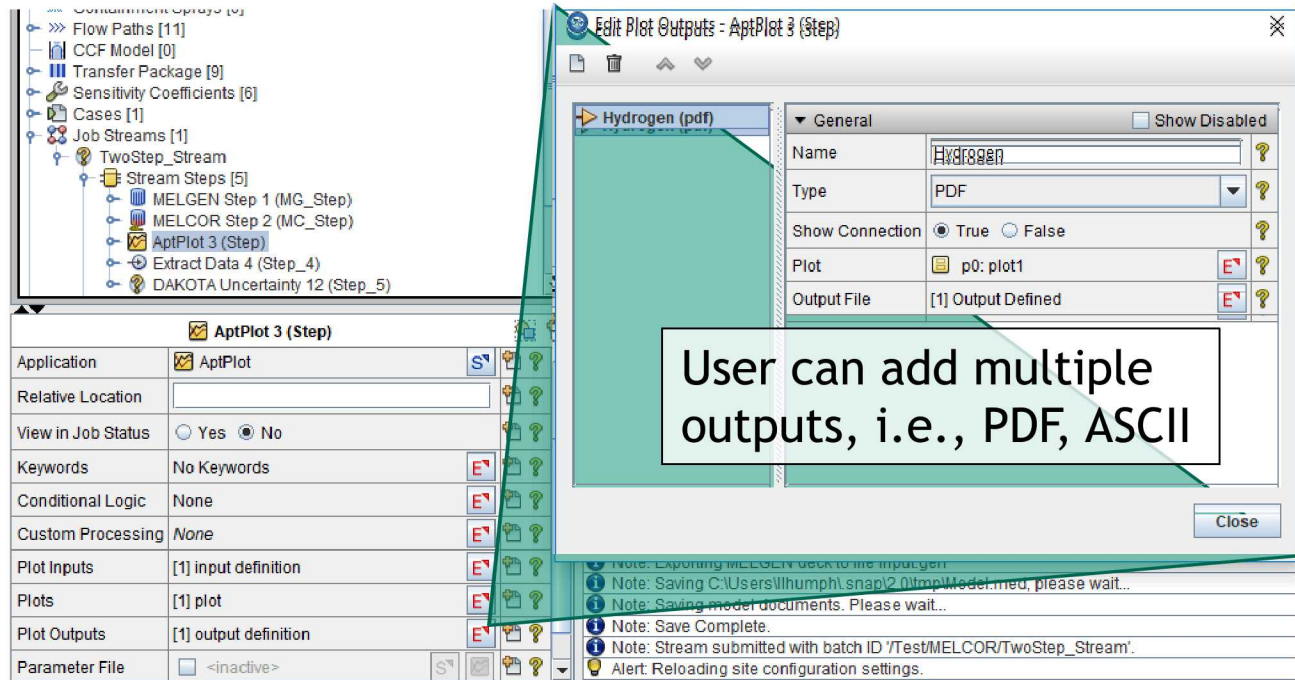
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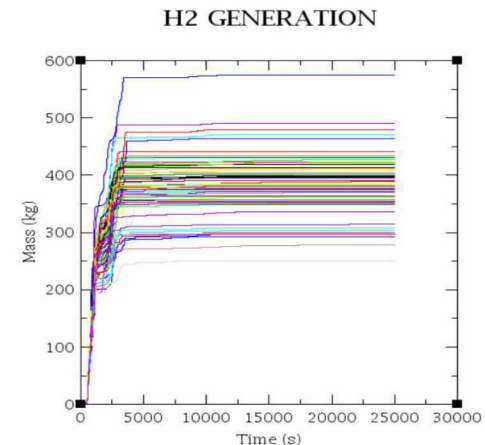
Performing a Sensitivity Study with SNAP

Step 7– Configure AptPlot output

1. Select Dakota plug-in during the SNAP plugins download and installation step
2. Create a Numeric value in your model
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5. Specify a model node as parametric (MELGEN or MELCOR depending on input)
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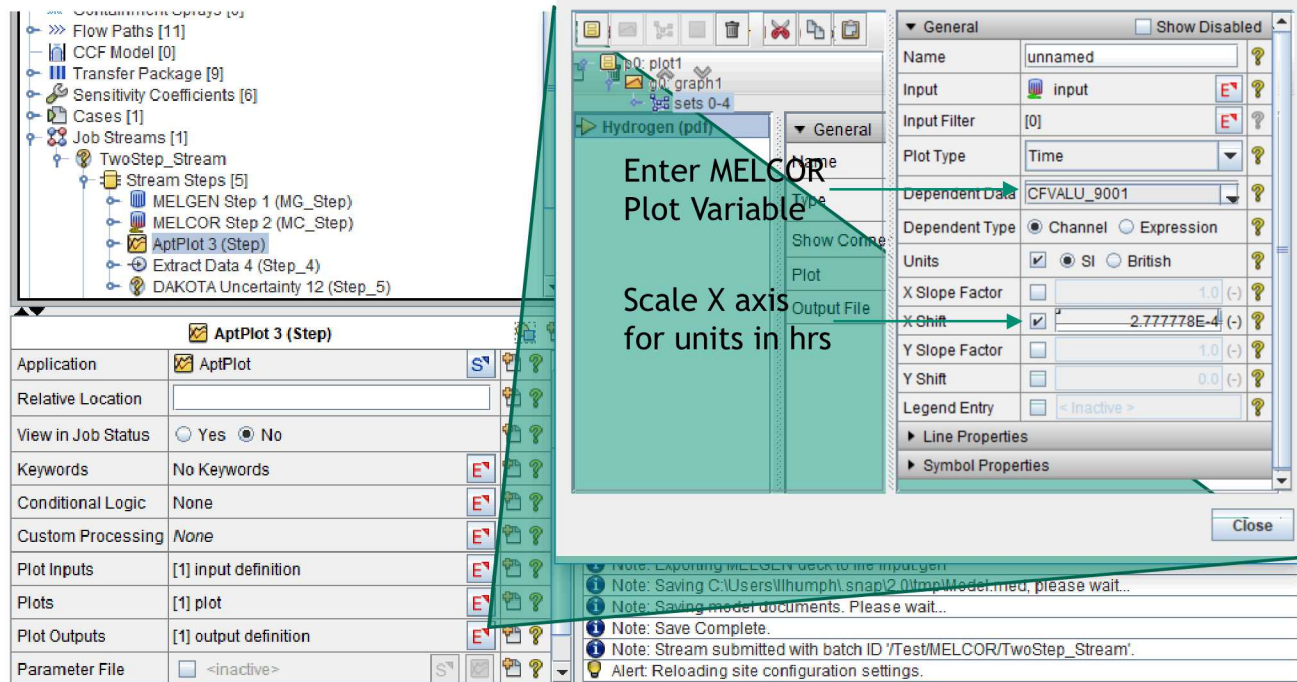
Write horsetail plots to PDF file



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Step 7– Configure AptPlot output

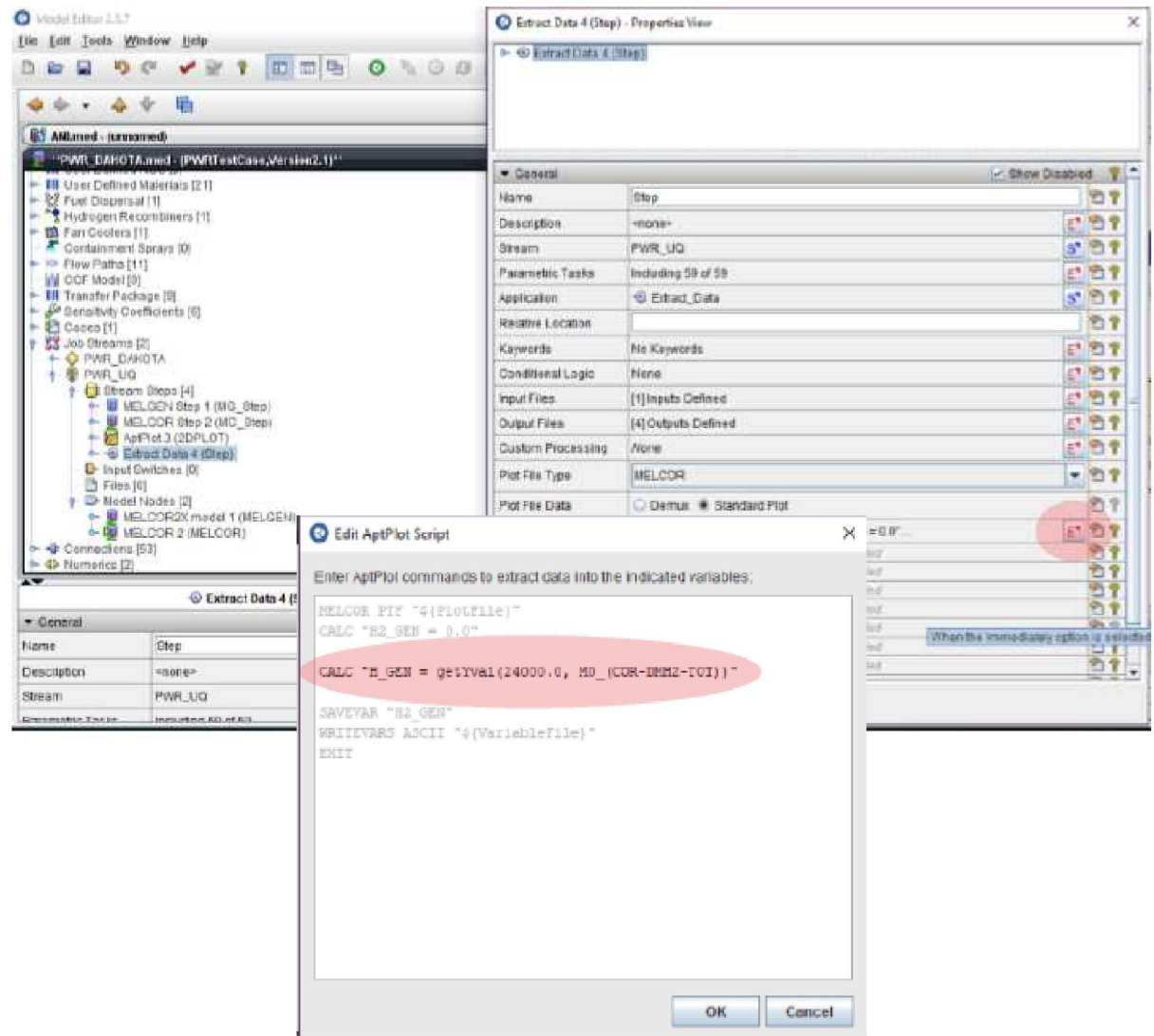
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8. Run Job



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Step 7 – Coordinate Data Flow (Pipe Plot Data)

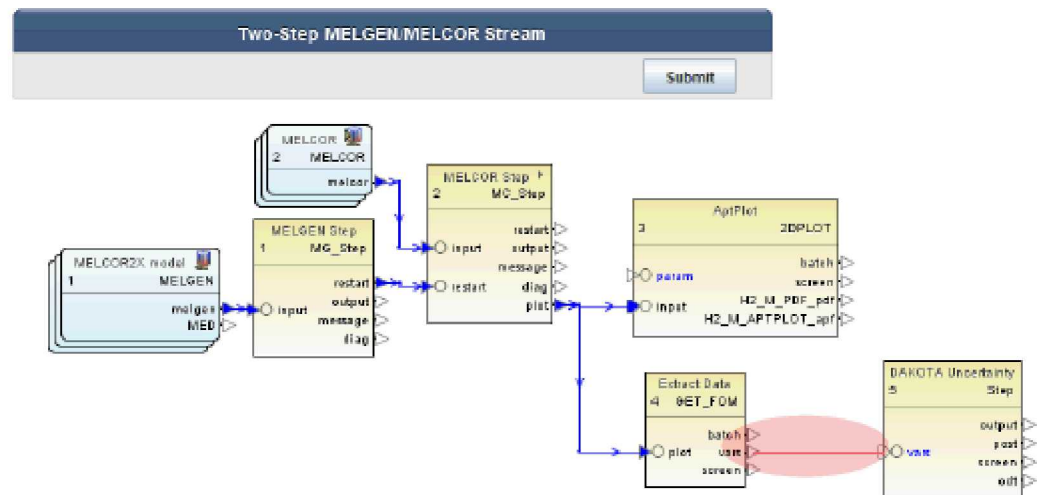
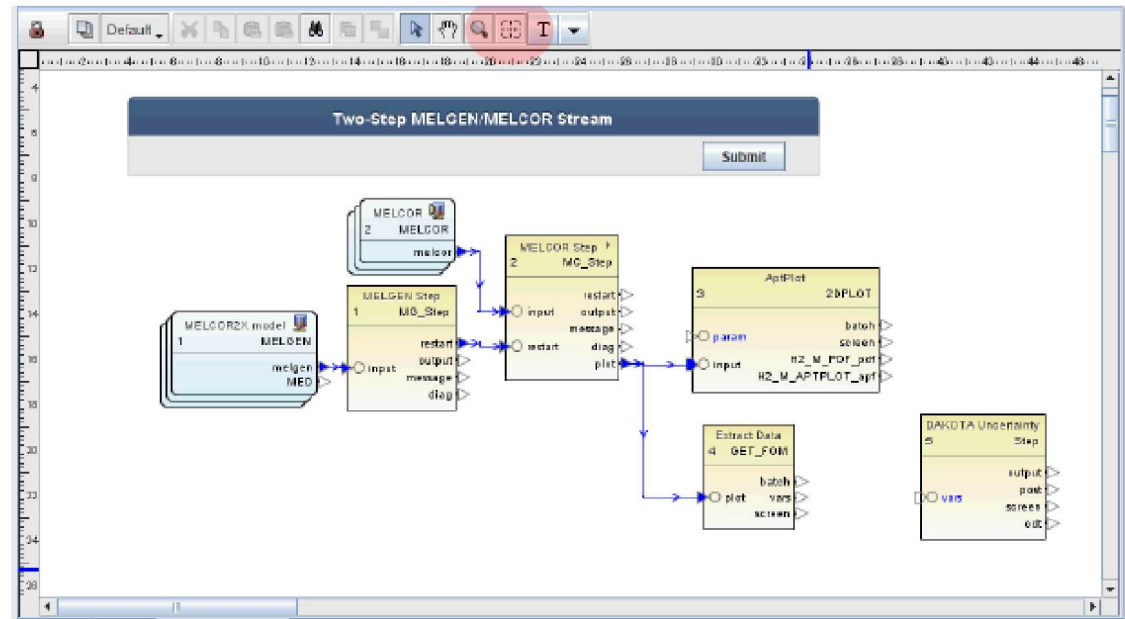
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3. Assign the Numeric value as an input value
4. Create a Dakota Run Stream
5. Specify a model node as parametric (MELGEN or MELCOR depending on input)
6. Define Dakota parametric properties
7. Coordinate data flow
8. Run Job



Performing a Sensitivity Study with SNAP

Step 7 – Coordinate Data Flow (Connect 'Extract Data' output to Dakota input)

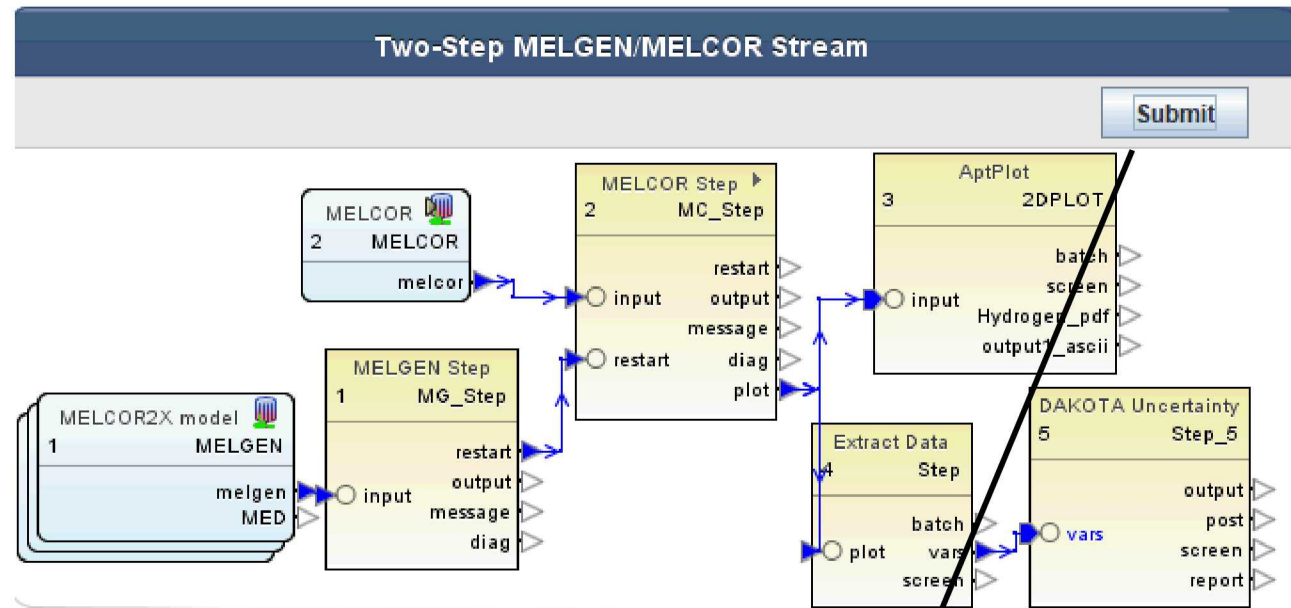
1. Select Dakota plug-in during the SNAP plugins download and installation step
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3. Assign the Numeric value as an input value
4. Create a Dakota Run Stream
5. Specify a model node as parametric (MELGEN or MELCOR depending on input)
6. Define Dakota parametric properties
7. Coordinate data flow
8. Run Job



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Step 7 – Run Dakota Job Stream

1. Select Dakota plug-in during the SNAP plugins download and installation step
2. Create a Numeric value in your model
3. Assign the Numeric value as an input value
4. Create a Dakota Run Stream
5. Specify a model node as parametric (MELGEN or MELCOR depending on input)
6. Define Dakota parametric properties
7. Coordinate data flow
8. Run Job



File View Tools Help

Job List MC_Step_T01

calcserv://Local/Test/MELCOR/TwoStep_Stream/

Job	Priority	Job Type	Status	Submitted	Started	Completed	Calc Time	Loaded	...
MC_Step_T01	5	MELCOR	Complete	12:43:22	12:43:50	12:52:45	No Data	No	
MC_Step_T02	5	MELCOR	Complete	12:43:27	12:43:50	12:52:55	No Data	No	
MC_Step_T03	5	MELCOR	Complete	12:43:27	12:43:50	12:53:29	No Data	No	
MC_Step_T04	5	MELCOR	Complete	12:43:32	12:43:51	12:53:34	No Data	No	
MC_Step_T05	5	MELCOR	Complete	12:43:27	12:43:50	12:52:43	No Data	No	
MC_Step_T06	5	MELCOR	Complete	12:43:32	12:43:51	12:52:55	No Data	No	
MC_Step_T07	5	MELCOR	Complete	12:43:27	12:43:50	12:52:55	No Data	No	
MC_Step_T08	5	MELCOR	Complete	12:43:27	12:43:50	12:53:03	No Data	No	
MC_Step_T09	5	MELCOR	Complete	12:43:27	12:43:51	12:52:52	No Data	No	
MC_Step_T10	5	MELCOR	Complete	12:43:27	12:43:51	12:53:15	No Data	No	
MC_Step_T11	5	MELCOR	Complete	12:43:32	12:43:52	12:52:58	No Data	No	
MC_Step_T12	5	MELCOR	Complete	12:43:27	12:43:51	12:53:03	No Data	No	
MC_Step_T13	5	MELCOR	Complete	12:43:32	12:43:52	12:53:22	No Data	No	
MC_Step_T14	5	MELCOR	Complete	12:43:32	12:43:54	12:52:58	No Data	No	
MC_Step_T15	5	MELCOR	Complete	12:43:28	12:43:51	12:52:53	No Data	No	
MC_Step_T16	5	MELCOR	Complete	12:43:32	12:43:54	12:53:00	No Data	No	
MC_Step_T17	5	MELCOR	Complete	12:43:28	12:43:51	12:53:07	No Data	No	
MC_Step_T18	5	MELCOR	Complete	12:43:33	12:43:55	12:52:42	No Data	No	
MC_Step_T19	5	MELCOR	Complete	12:43:33	12:43:56	12:52:44	No Data	No	

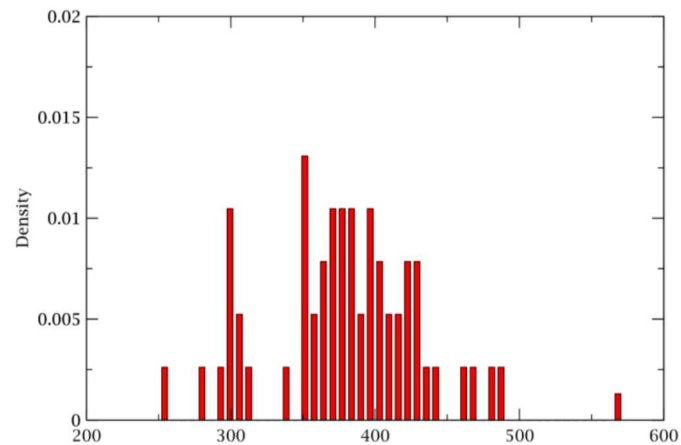
Statistical results based on 59 samples:

Summary	Value	Task #
Min Value	250.87505	54
Max Value	574.76666	51
Mean	381.43805	-
Median	382.44507	40
Standard Deviation	56.8461	-
Coefficient of Variance	0.38578	-

Response Correlations

	Simple	Partial	Simple Rank	Partial Rank
d5	0.0979063	0.102384	0.135067	0.268539
d6	0.110172	0.146704	0.0338983	0.0599765
d7	0.098521	0.123725	0.126768	0.209831
d1	0.737284	0.791904	0.765926	0.855157
d2	-0.495872	-0.627241	-0.379486	-0.653184
d3	0.03035	0.00594472	0.0189947	0.0516358
d4	-0.0188159	0.0125986	-0.0151373	0.0108442

Probability Density Function



H2 GENERATION

