

MELCOR Uncertainty Analysis with SNAP & DAKOTA



PRESENTED BY

Larry Humphries

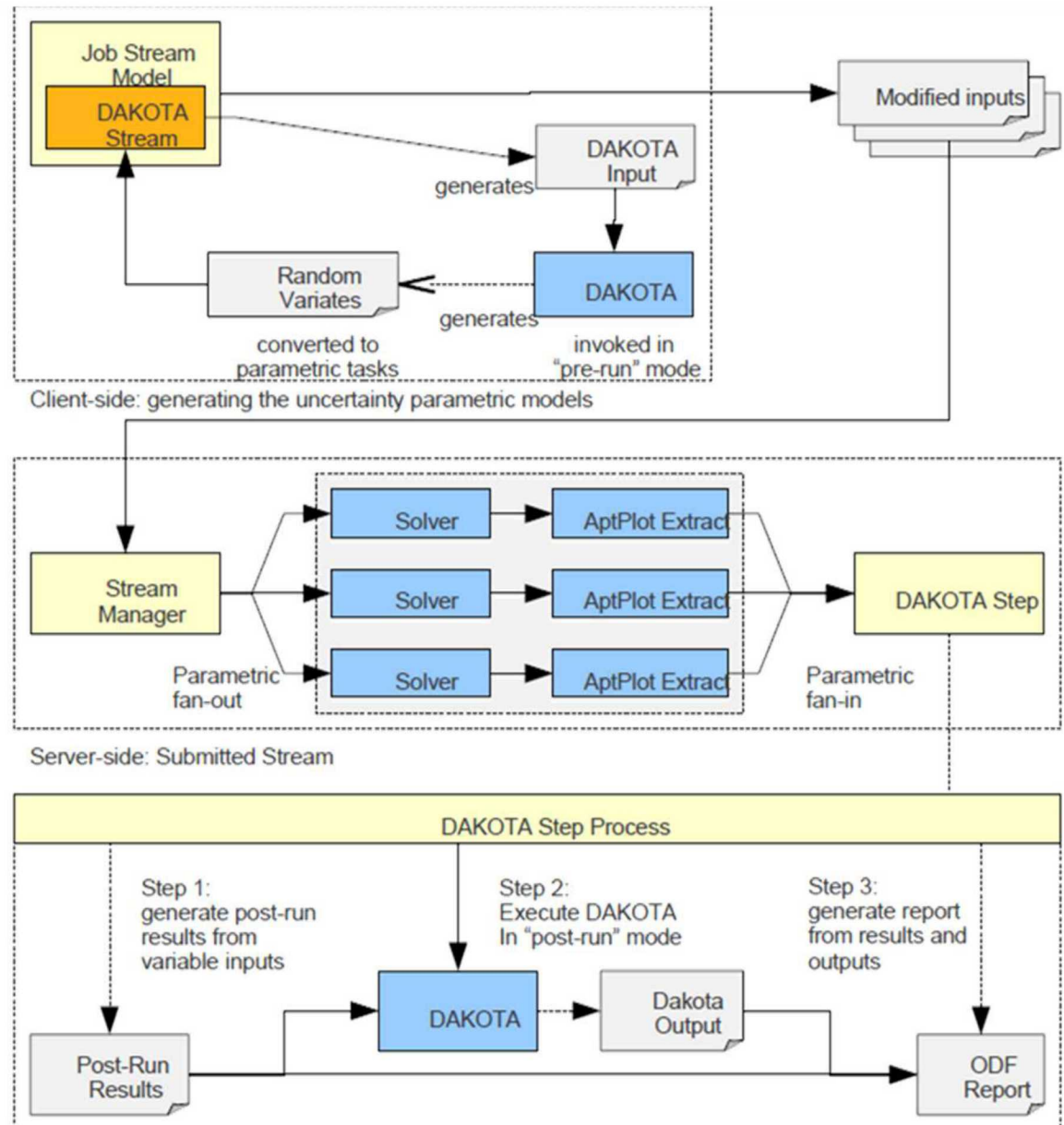
2 SNAP/DAKOTA Uncertainty Analysis

Pros

- SNAP provides access to MELCOR's rich 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

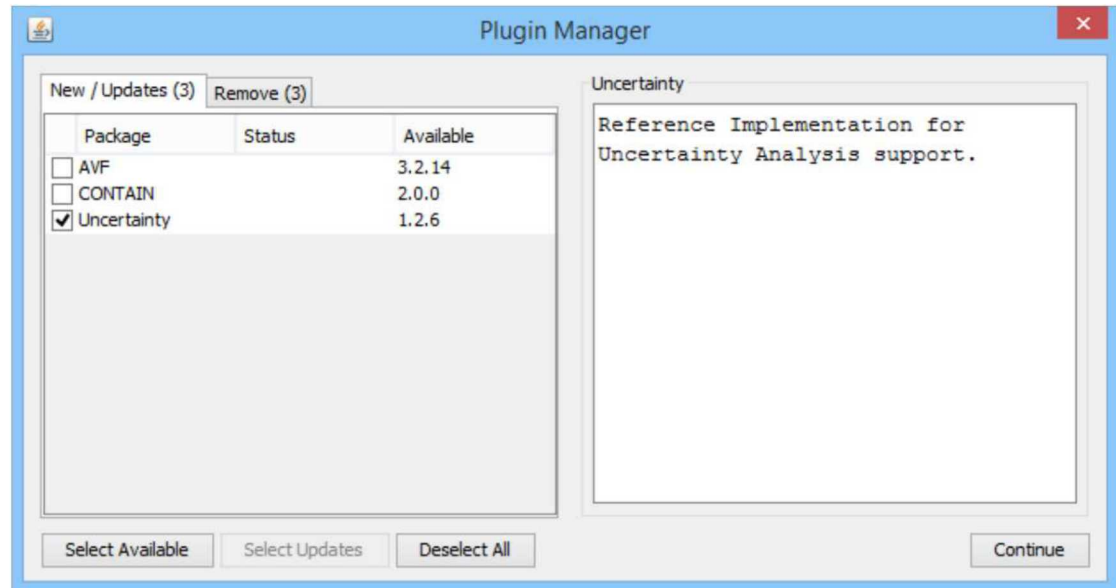
- SNAP has relatively steep learning curve for beginner
- Failed runs (realizations) are not accounted for and no statistical report is generated. They lead to an incomplete job with no diagnostics to user.
- Input decks with new MELCOR models (relative to SNAP version) cannot be used



Performing a Sensitivity Study with SNAP

Step I – Downloading Dakota Plugin

1. Select Dakota 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

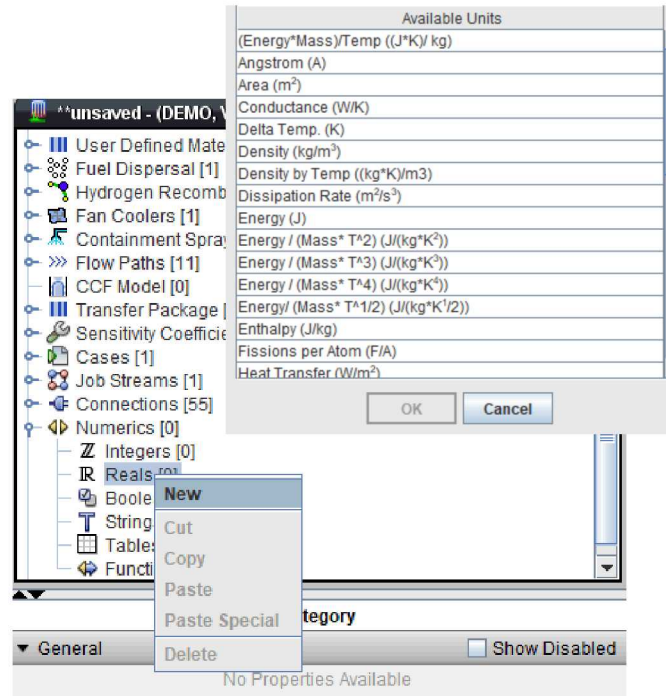


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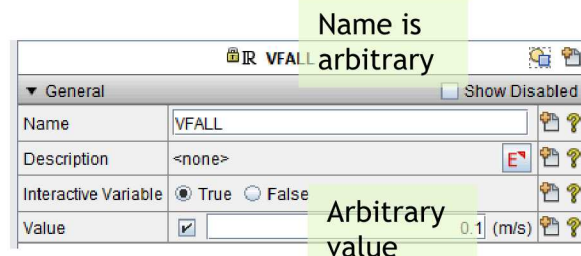
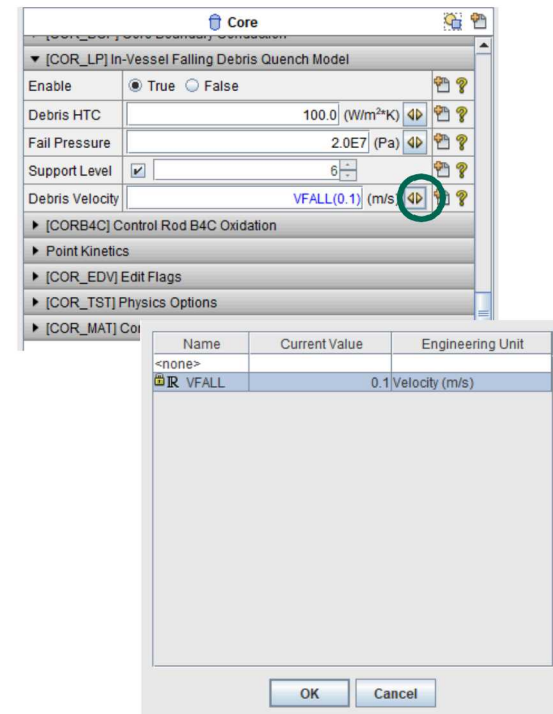
Step 2 – Adding a Numeric (I)

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



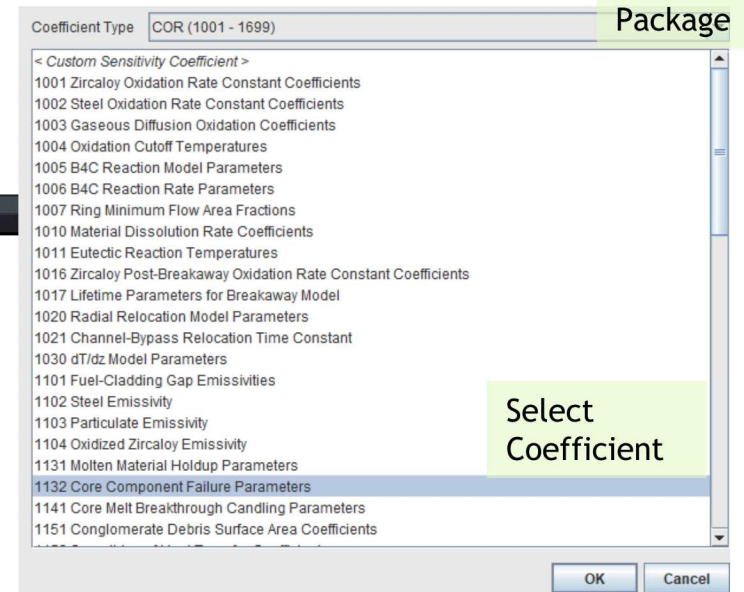
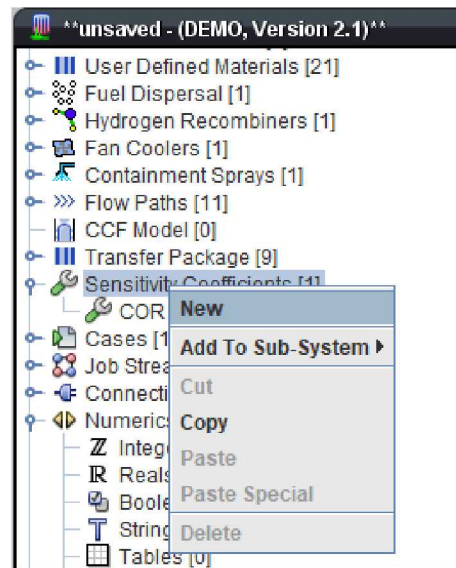
Connect Numeric to Input



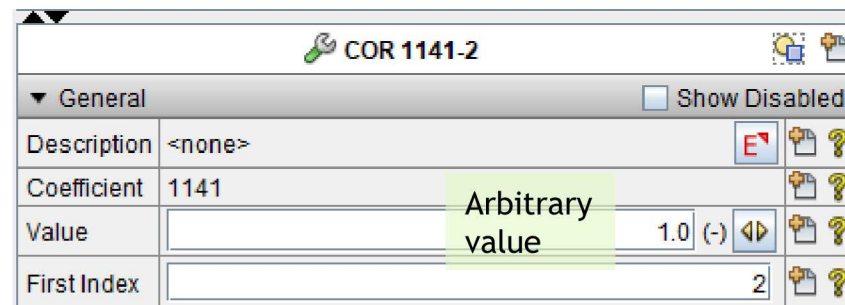
Performing a Sensitivity Study with SNAP

Step 2 – Adding a Sensitivity Coefficient (2)

1. Select Dakota 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
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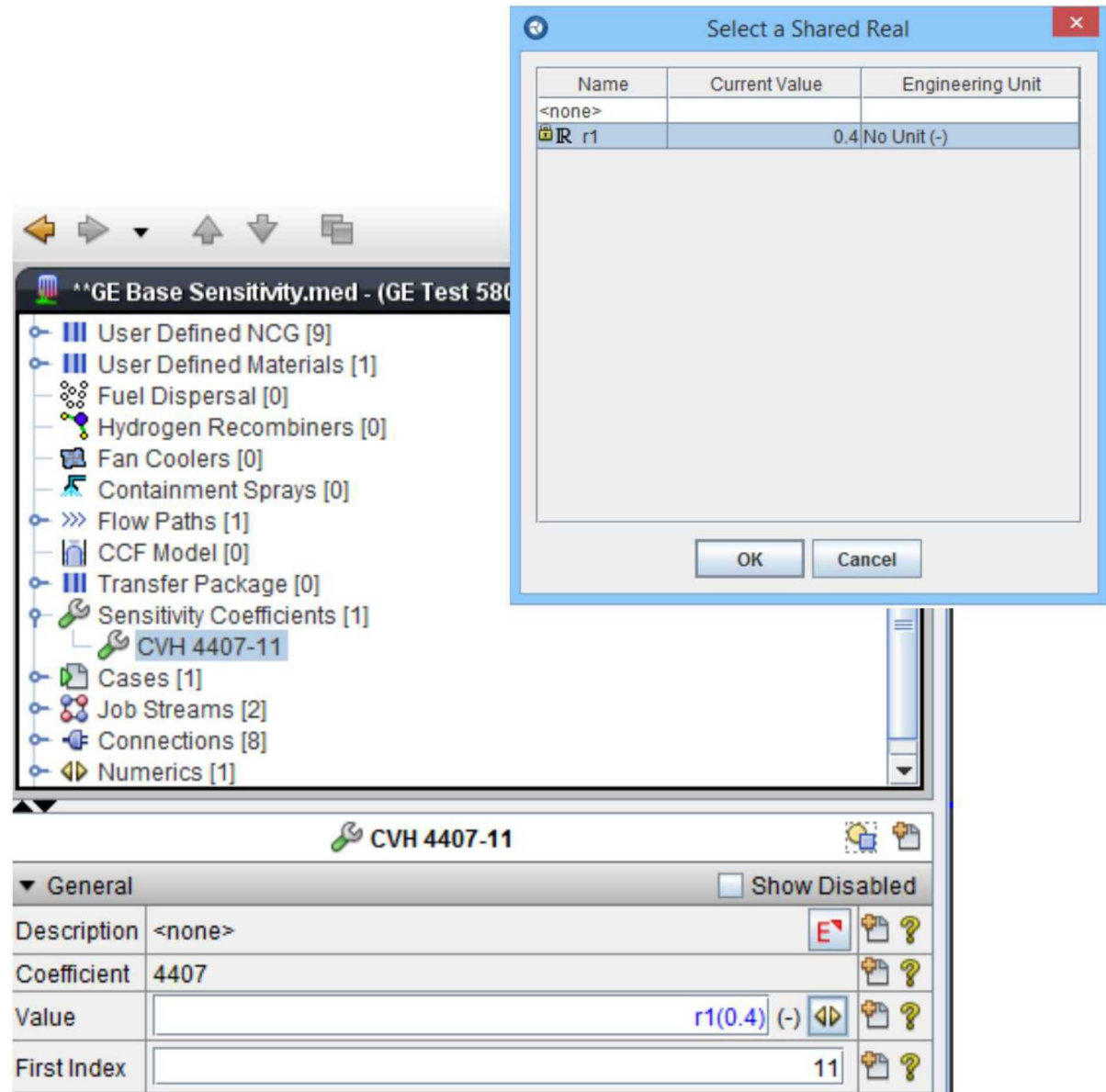
Properties
Window



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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)
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8. Run Job

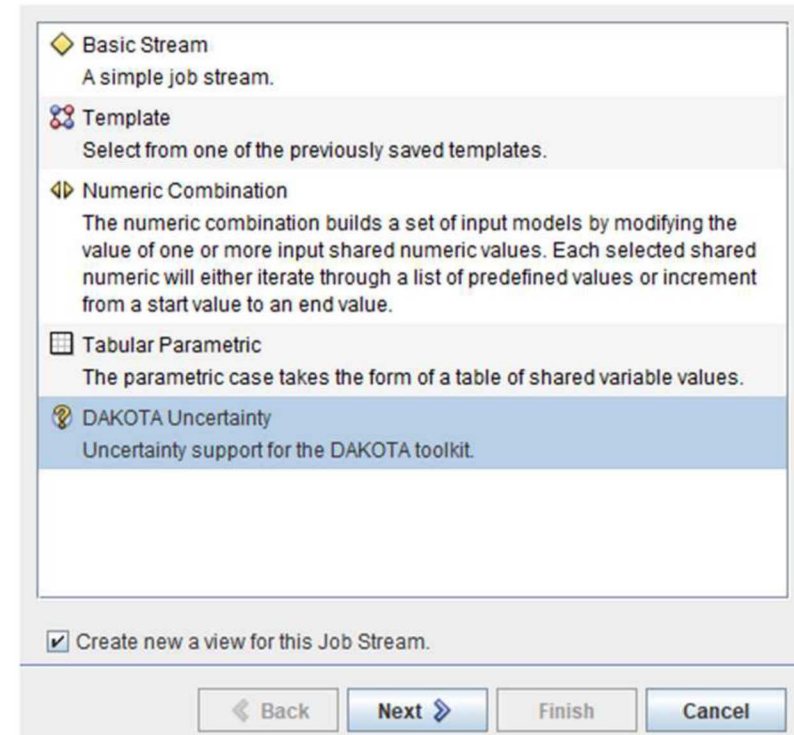
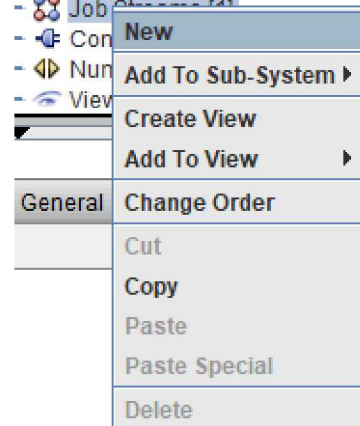


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Step 4 – Dakota Job Stream (I)

1. Select Dakota plug-in during the SNAP plugins download and installation step
2. Create a Numeric value in your model
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4. Create a Dakota Run Stream
5. Specify a model node as parametric (MELGEN or MELCOR depending on input)
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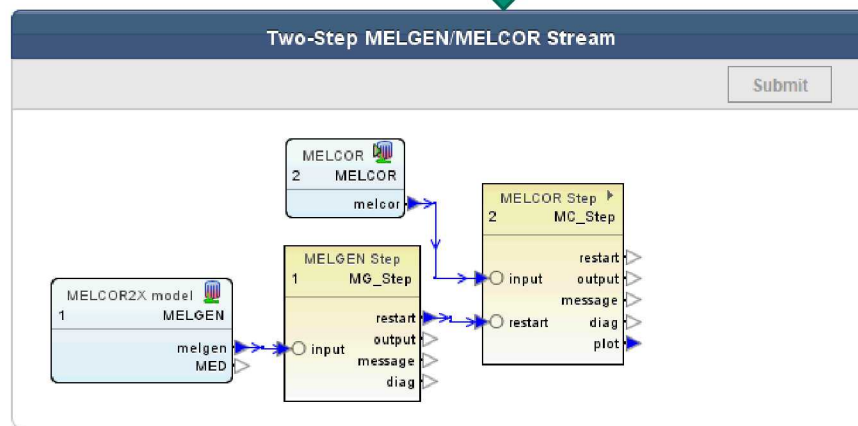
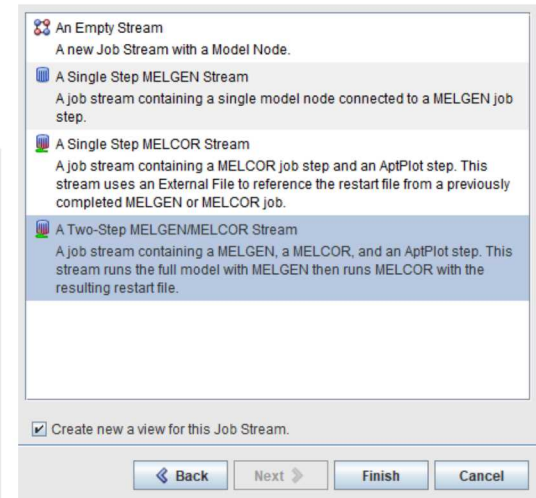
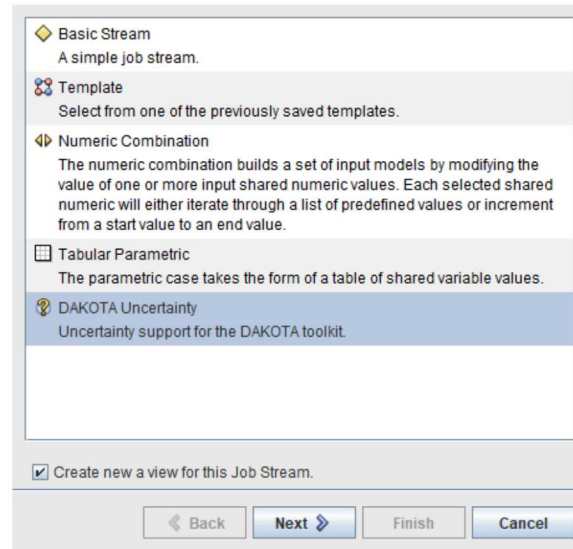
- User Defined Materials [21]
- Fuel Dispersal [1]
- Hydrogen Recombiners [1]
- Fan Coolers [1]
- Containment Sprays [1]
- Flow Paths [11]
- CCF Model [0]
- Transfer Package [9]
- Sensitivity Coefficients [1]
- Cases [1]
- Job Stream [41]
- Con...
- Nun...
- View



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Step 4 – Dakota Job Stream (2)

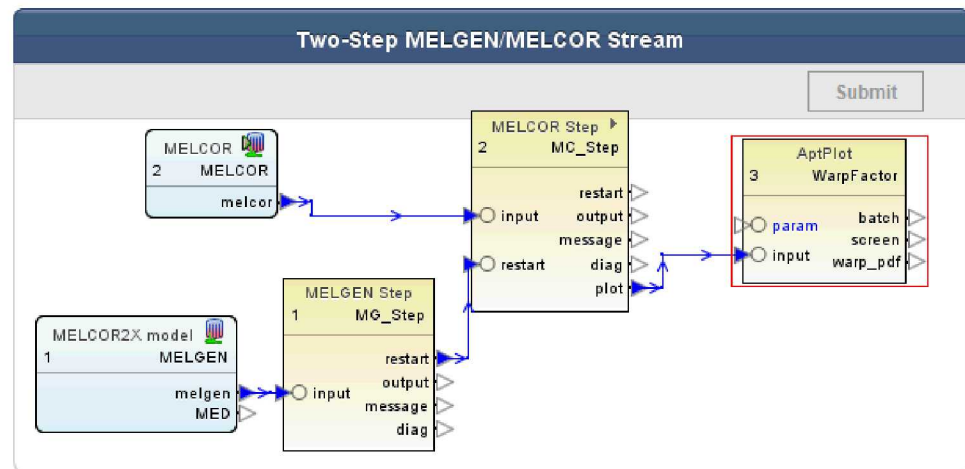
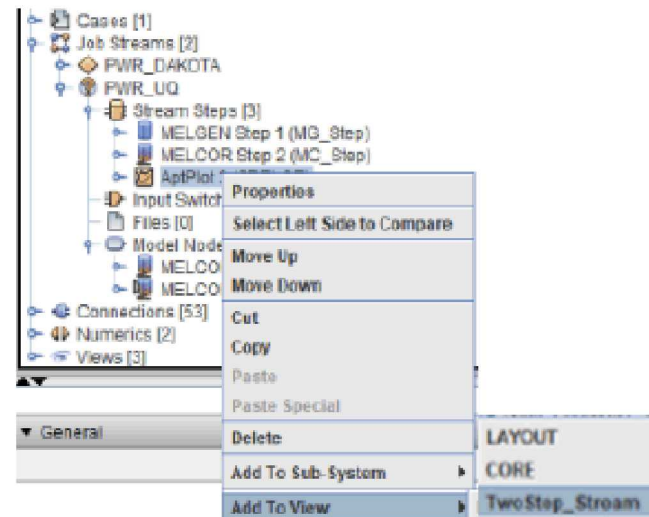
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Step 4 –Dakota Run Stream (3) – Add AptPlot to view

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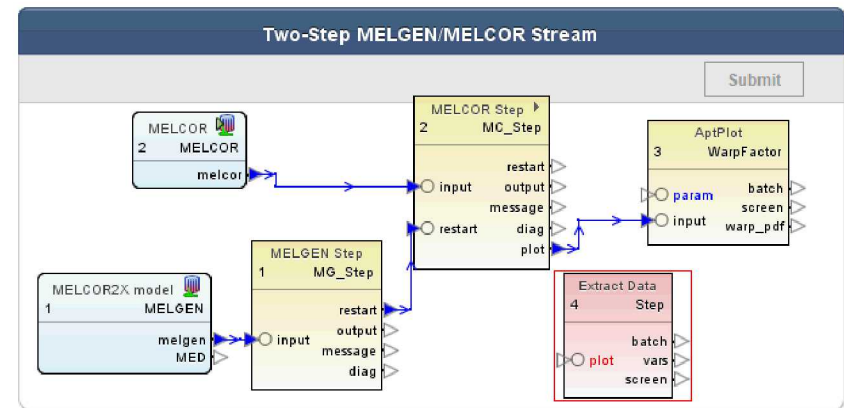
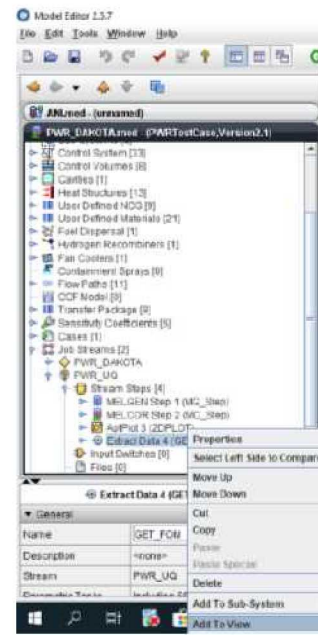
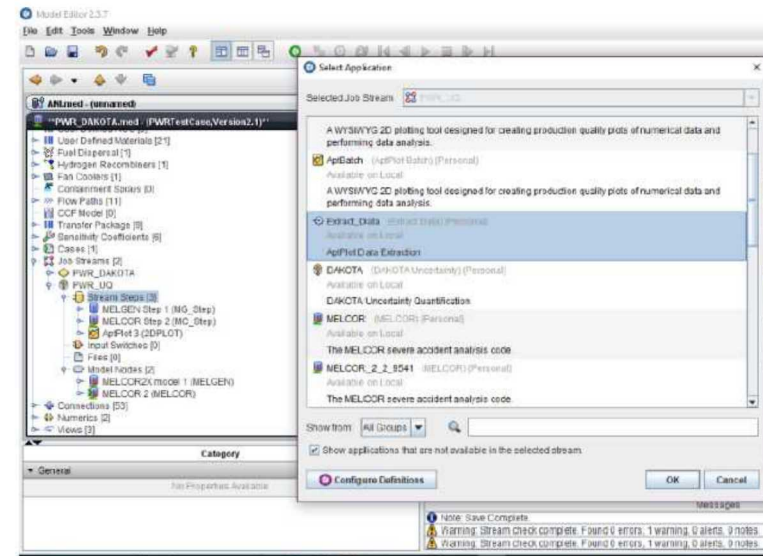


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Step 4 –Dakota Run Stream (4) – Add Extract Data

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)
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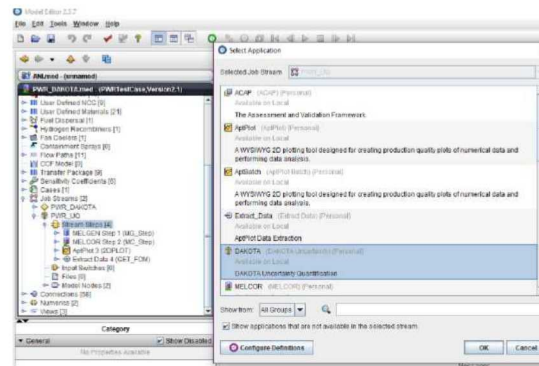
Add Extract Data to Job Stream



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

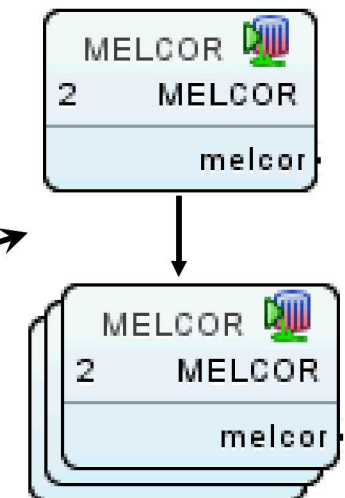
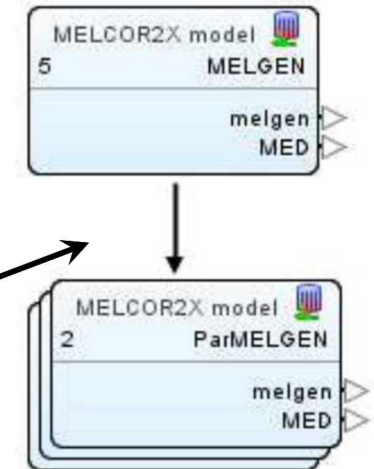
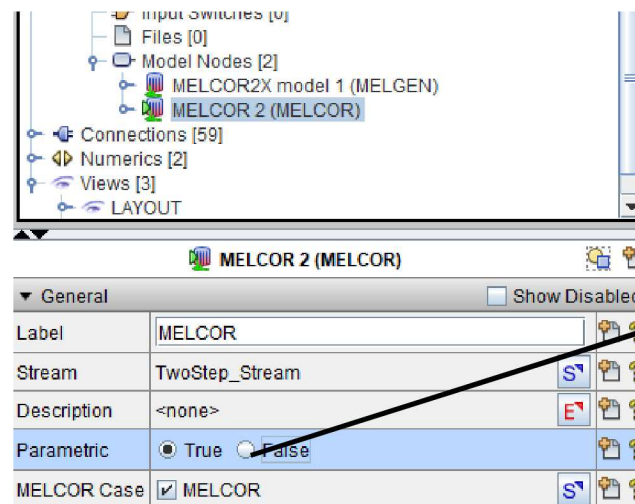
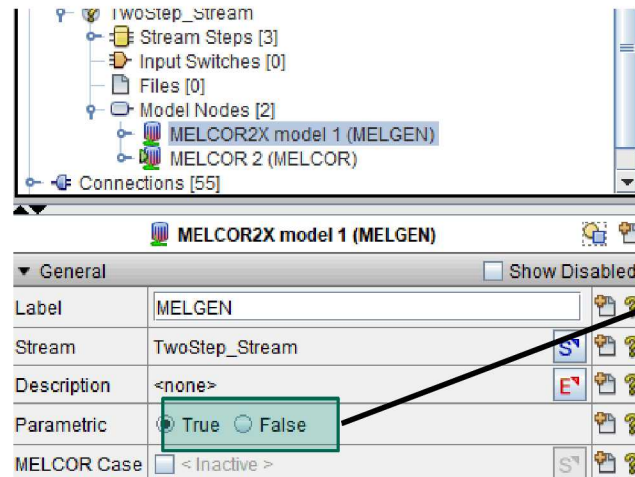
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Step 5 – Parametric Model Node

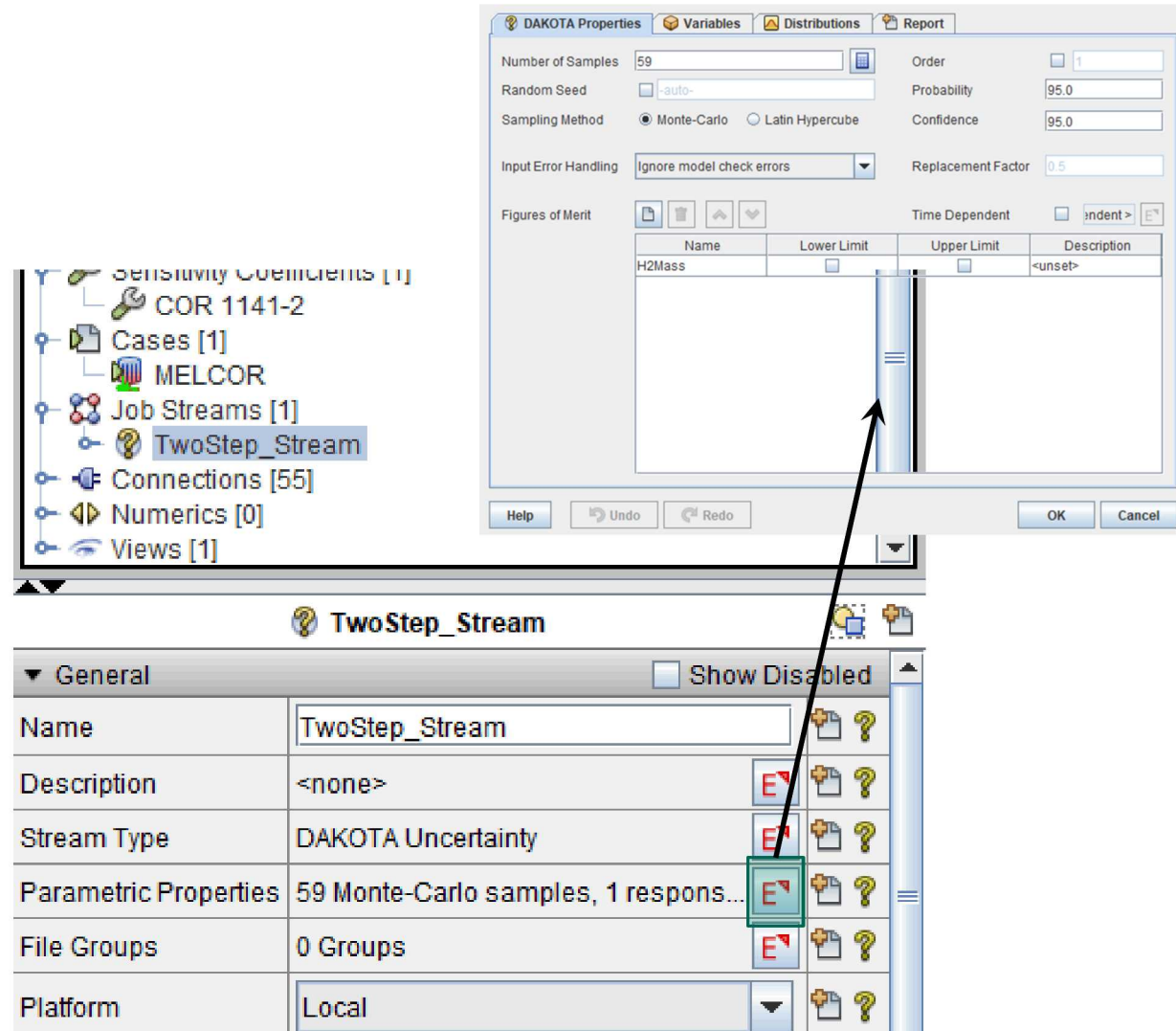
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Step 6 – Parametric Properties (I)

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

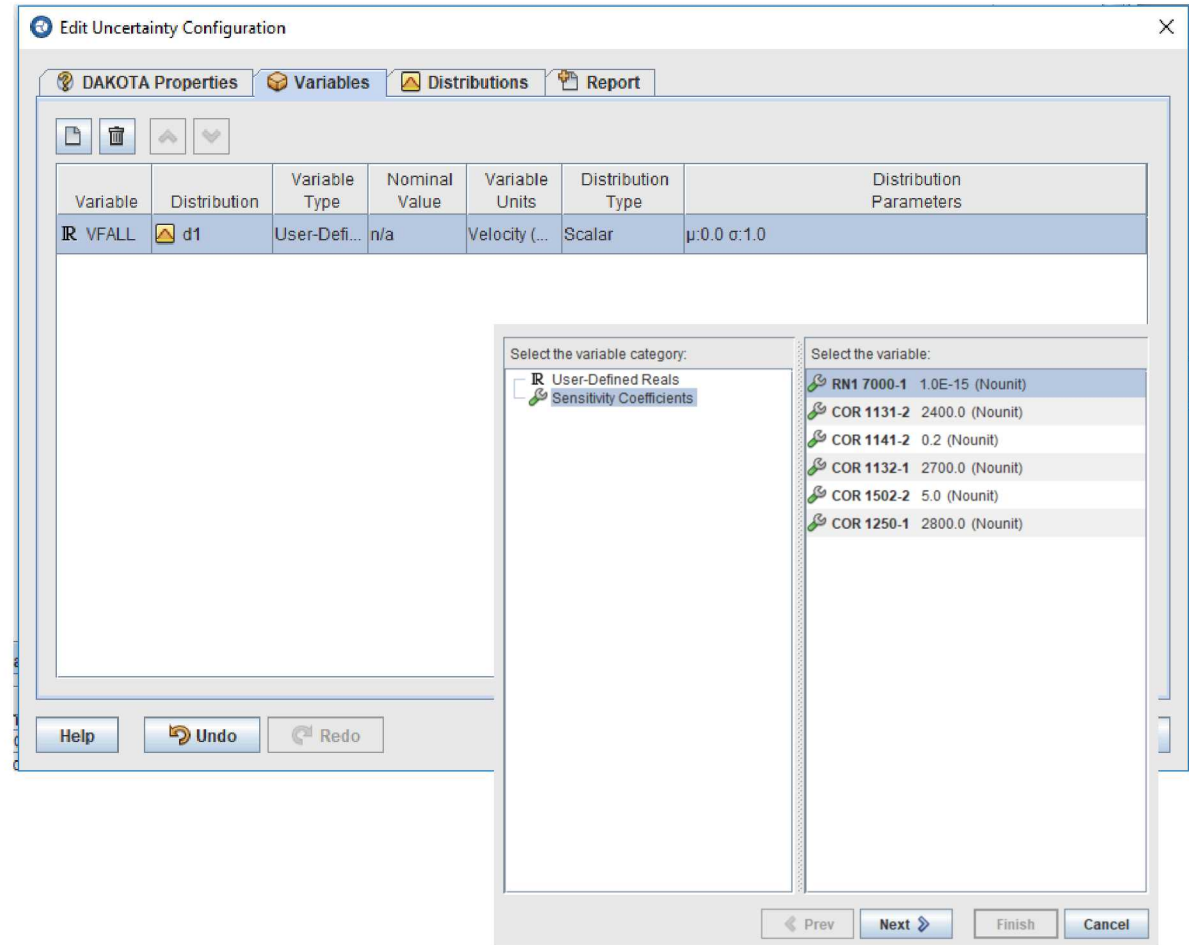
Time Dependent: ☐ indent >

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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5. Specify a model node as parametric (MELGEN or MELCOR depending on input)
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Step 6 – Parametric Properties (4) - Distributions

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

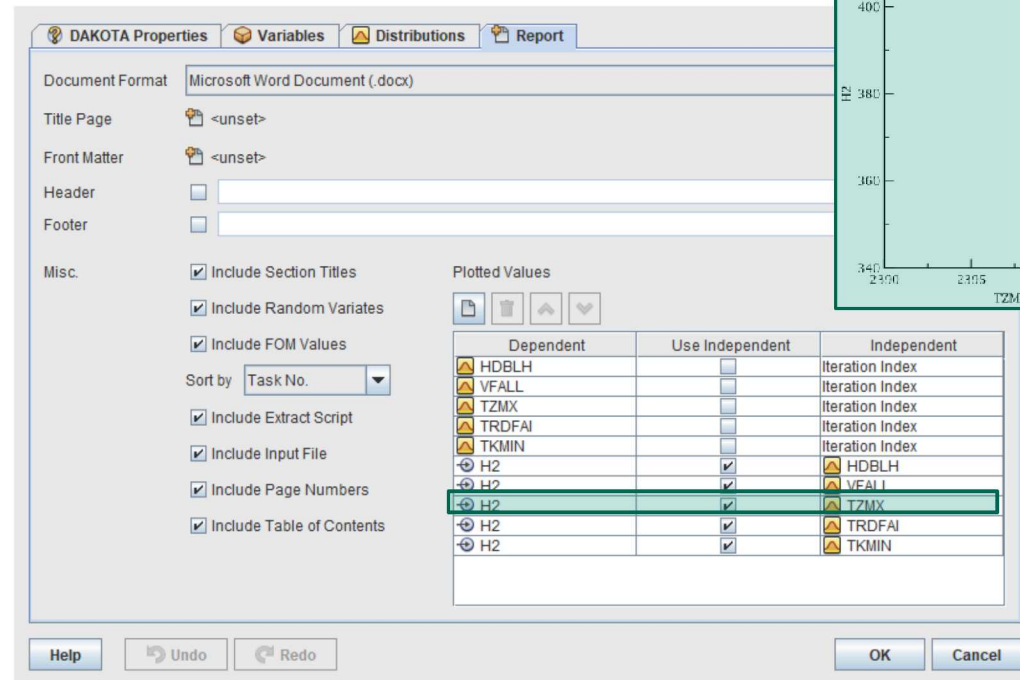
Available Distributions:

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

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Step 6 – Parametric Properties (5) – Report Options

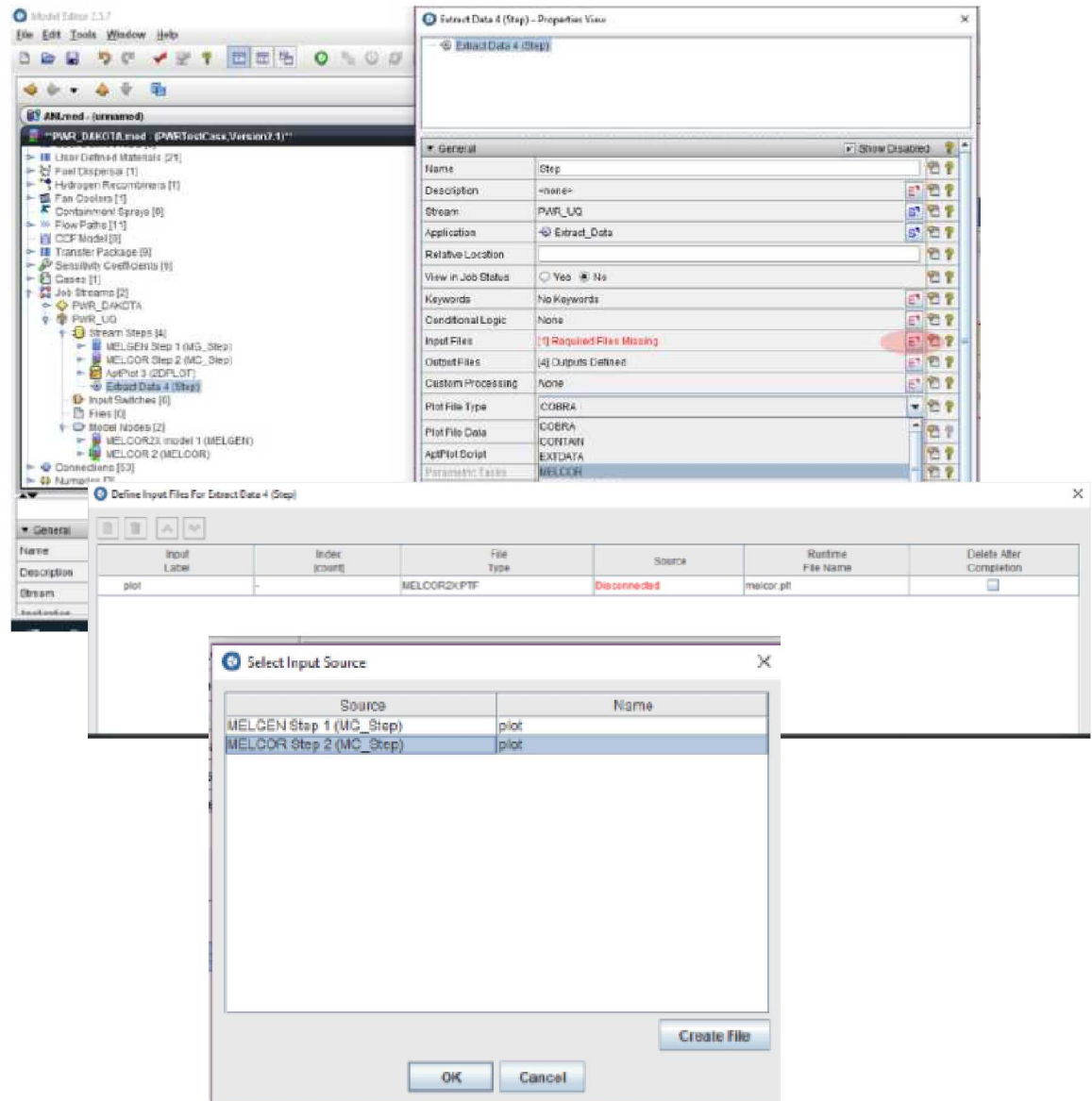
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Step 7 – Coordinate Data Flow (Extract Data 2)

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
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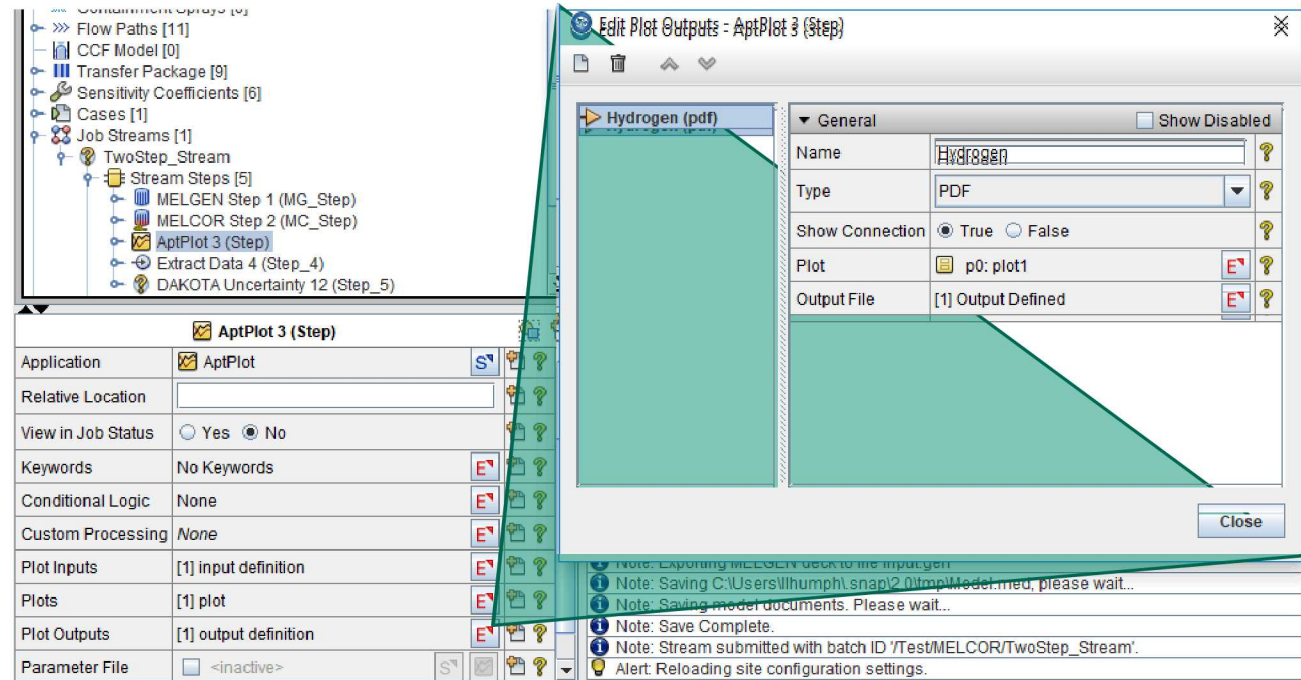


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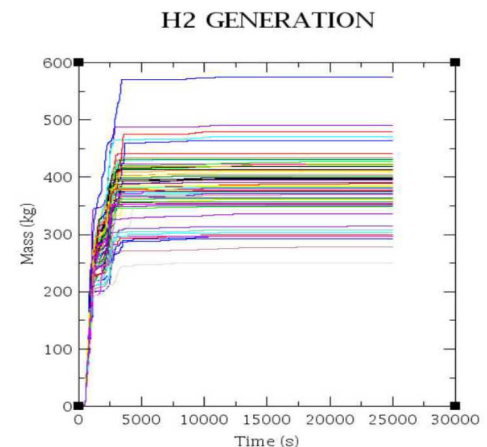
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Step 7– Configure AptPlot output

1. Select Dakota plug-in during the SNAP plugins download and installation step
2. Create a Numeric value in your model
3. Assign the Numeric value as an input value
4. Create a Dakota Run Stream
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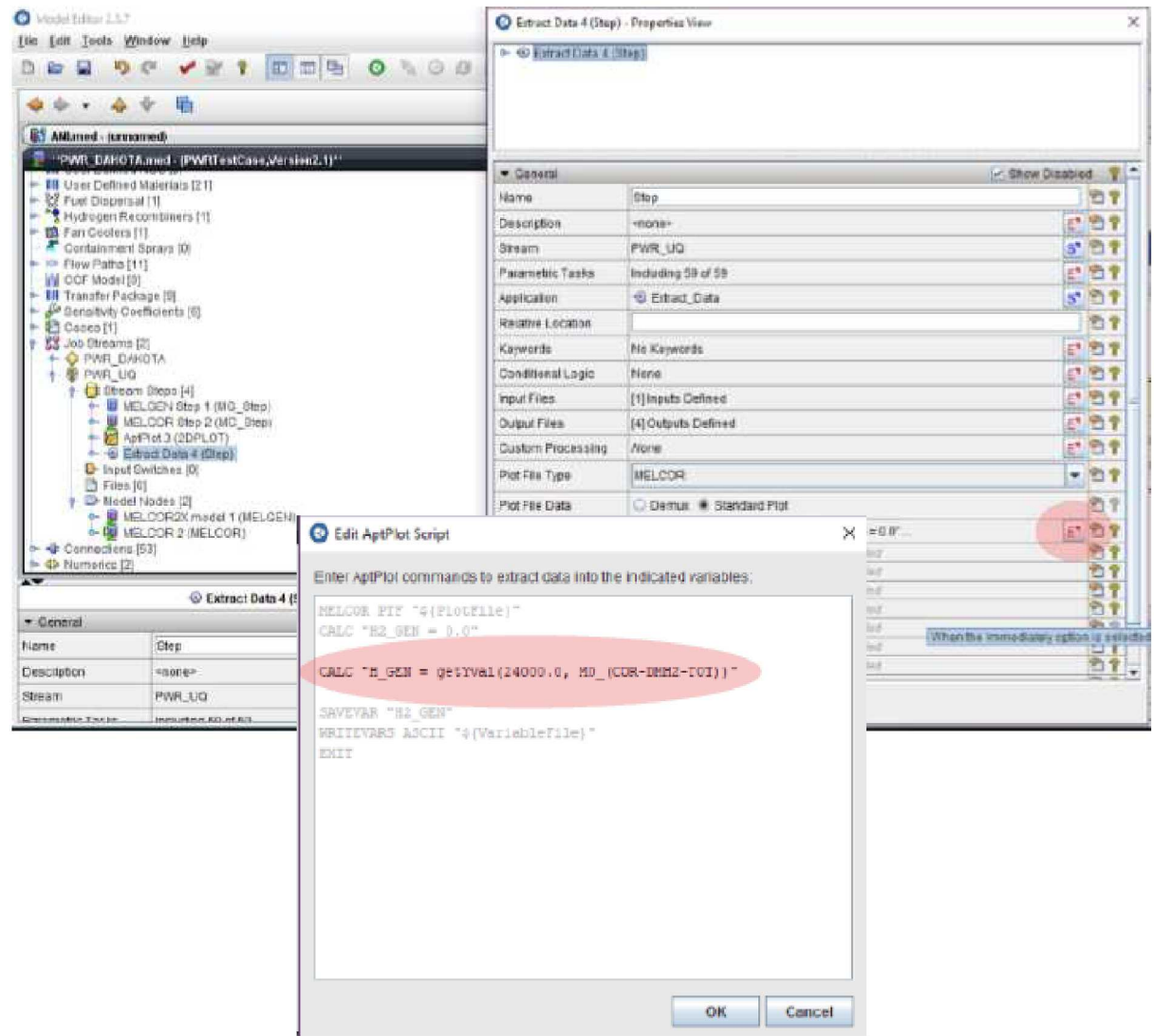
Write horsetail plots to PDF file



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Step 7 – Coordinate Data Flow (Pipe Plot Data)

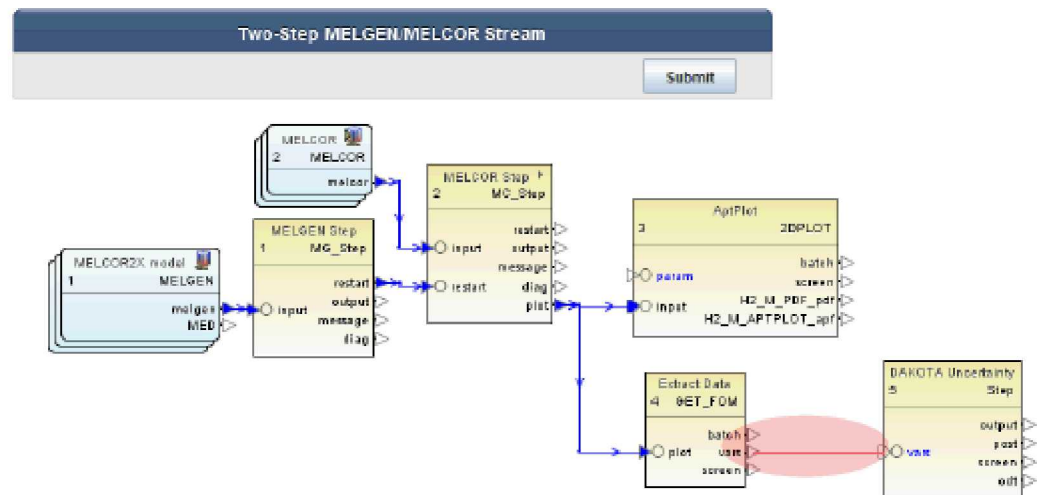
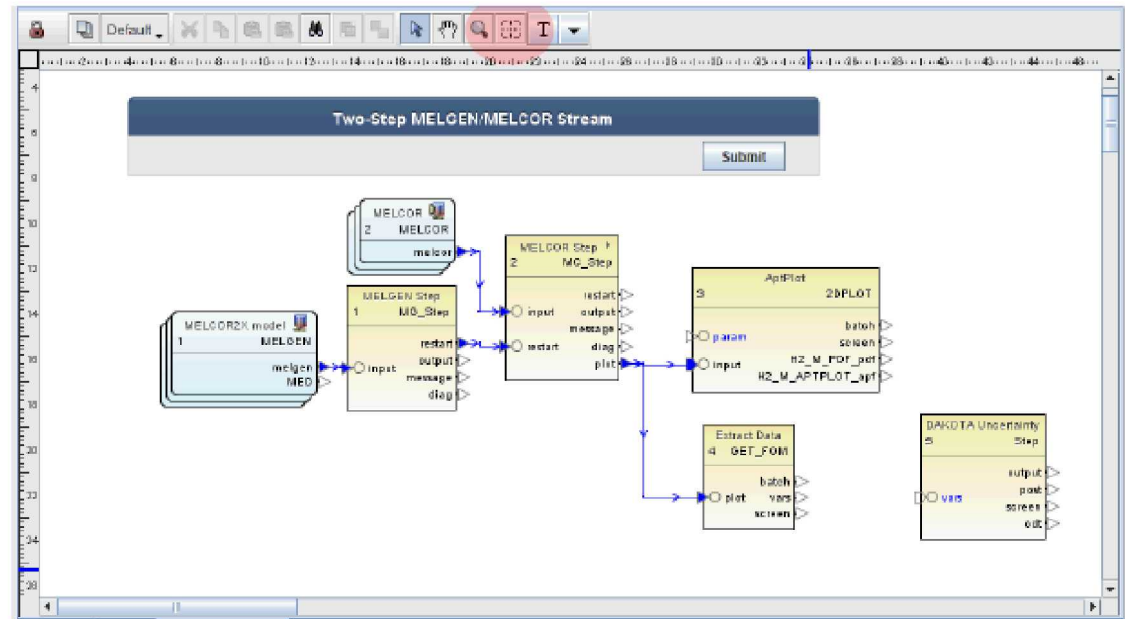
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3. Assign the Numeric value as an input value
4. Create a Dakota Run Stream
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8. Run Job



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

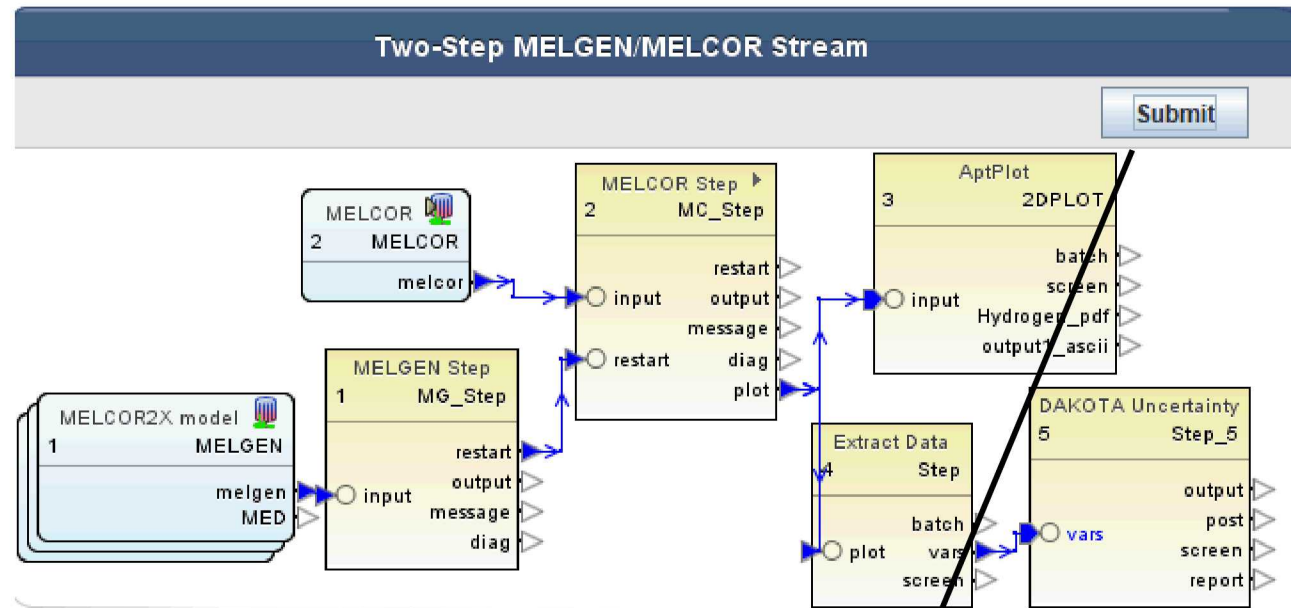
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4. Create a Dakota Run Stream
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Step 7 – Run Dakota Job Stream

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



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	

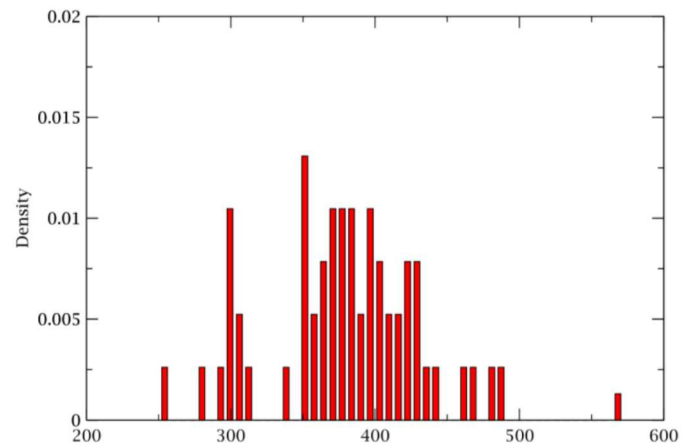
Statistical results based on 59 samples:

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

