

General Approach to Integration of RELAP5 with Other Codes and Remote Web Based Execution

**Sam Alessi, Ph.D. and Brant Peery
Data and Model Analysis Group (DMAG)
Idaho National Laboratory**

**Presentation to 2013 International RELAP5
Users Group Meeting and Seminar
September 12-13th, 2013**

www.inl.gov

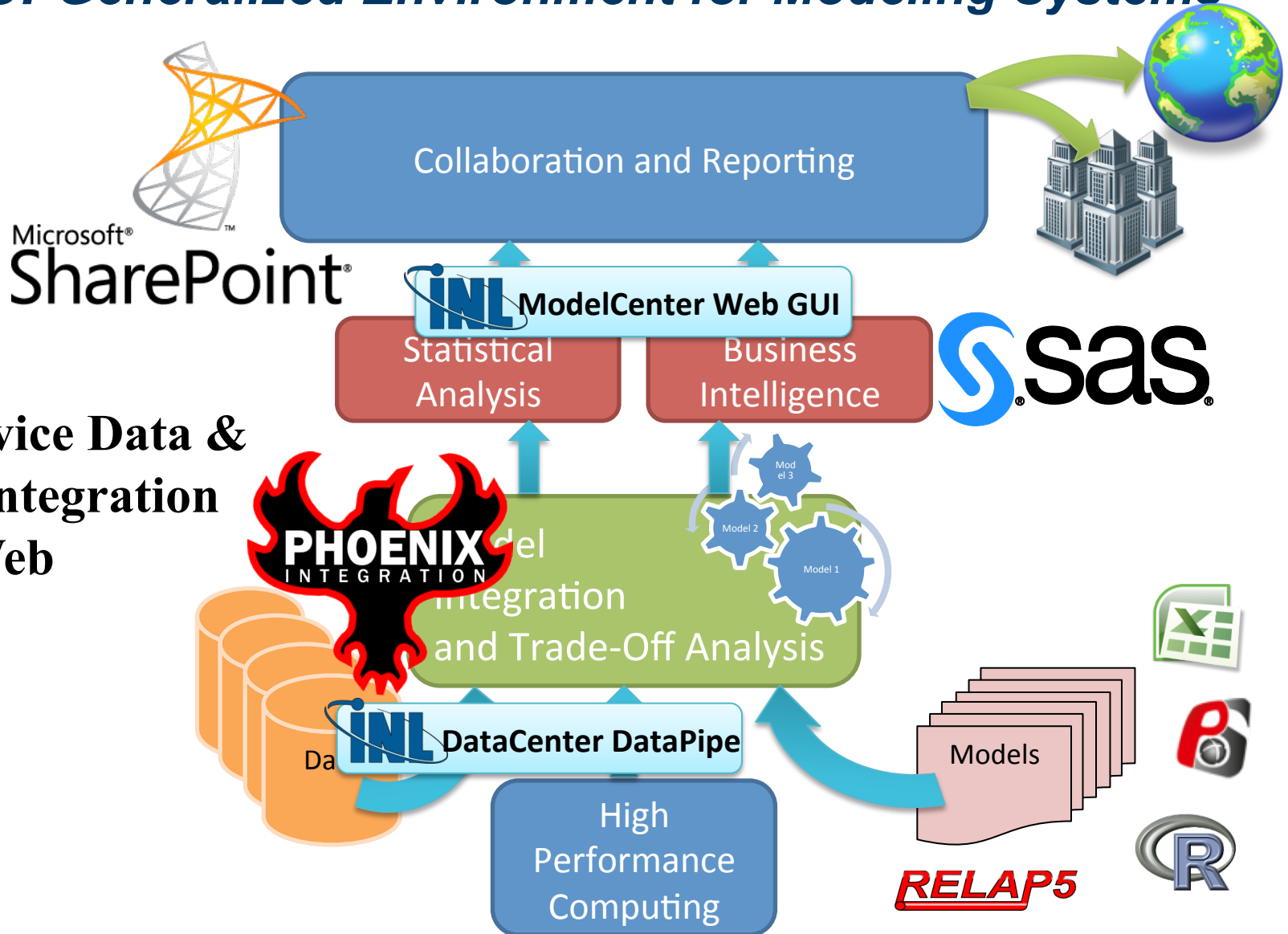


Objectives

- Overview Full Tool Suite Used to work with RELAP5
 - General Environment for Modeling Systems (GEMS)
 - MS Office/SQL Server/SharePoint - Collaboration, Data Mgmt.
 - SAS Institute - Statistical Modeling, Validation
 - Phoenix Integration - Integration, Simulation Experiments
- Discuss Approach Used to Integrate and Automate RELAP5
 - Goal: Provide Web-Based Access To Sensitive Country Researchers
 - Provide an online web based interface for uploading an input file
 - Run the input file and display results to the researcher
- General Integration of RELAP5 with Other Codes
- Using GEMS for RELAP5 Validation against the HTTF Experimental Data
- Summary



GEMS: Generalized Environment for Modeling Systems

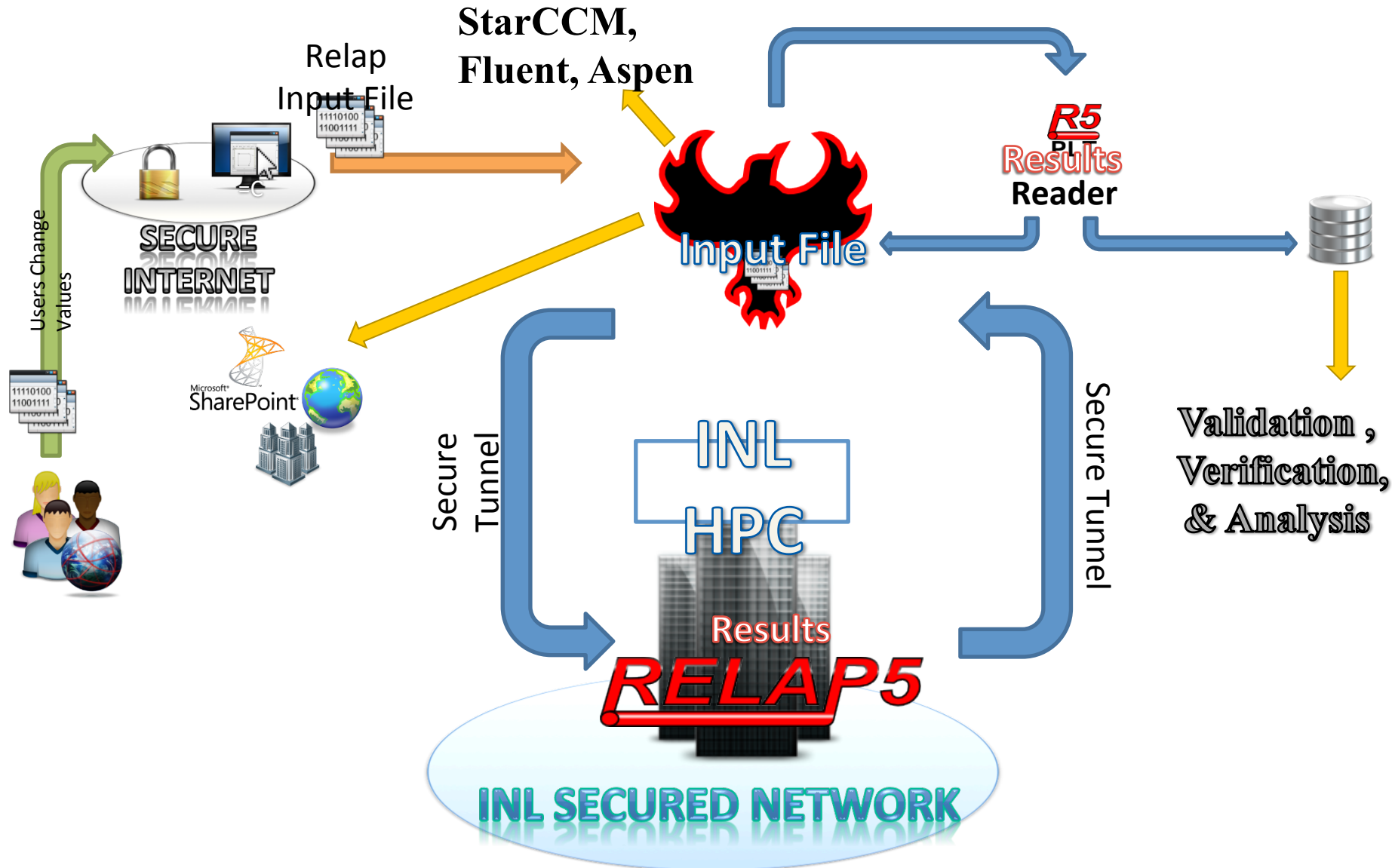


Vision:
Self Service Data &
Model Integration
to the Web

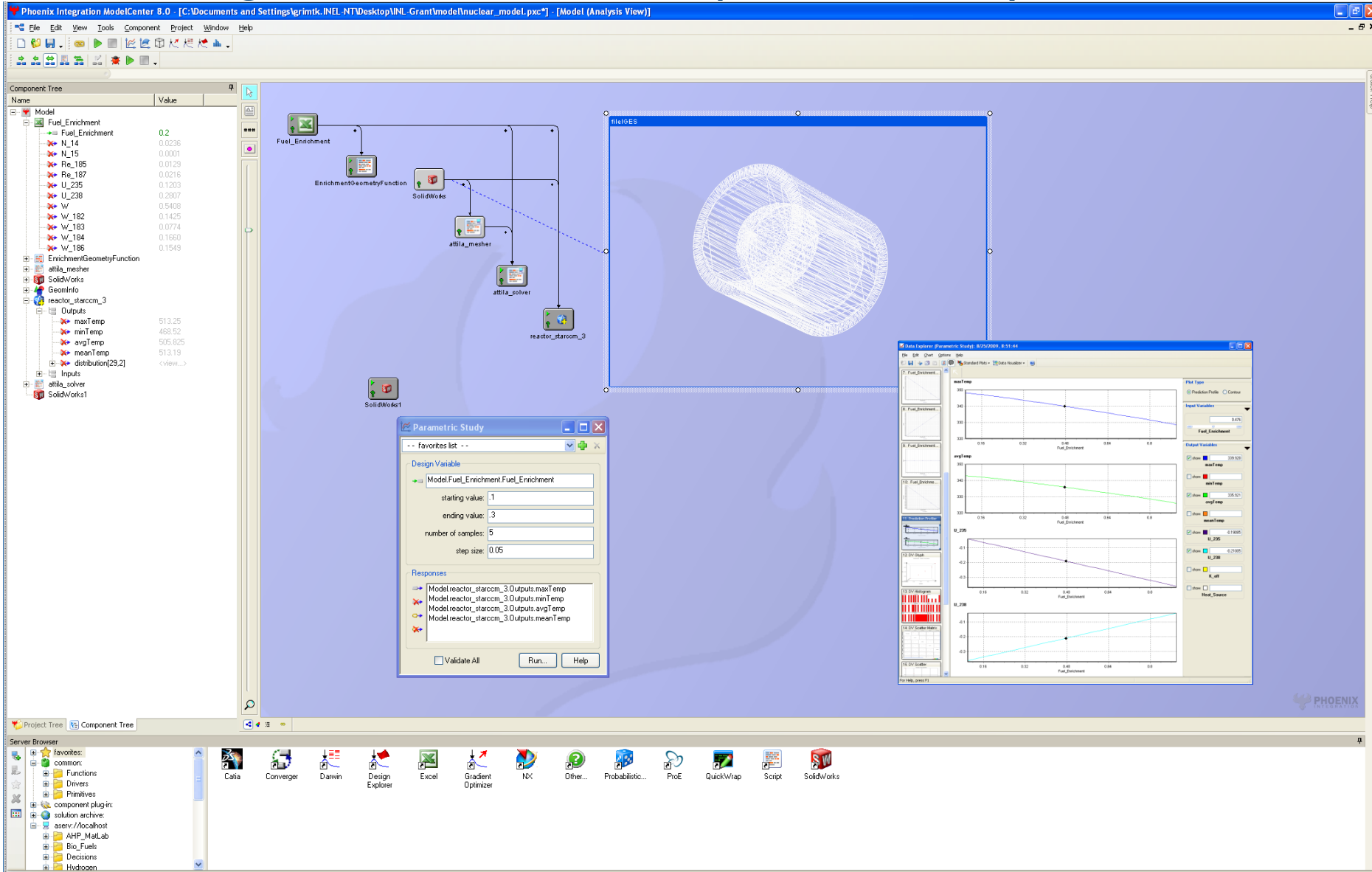
Remote Use and Integration of RELAP5

- User uploads their input file
- ModelCenter:
 - The input file is pushed to the HPC (High performance computing) cluster inside the INL secured network
 - Runs Relap5 3D with the input to create results
 - Stores the results in a database
- Database can have validation verification and further analysis run on the results.
- ModelCenter can continue to push the results into
 - StarCCM
 - Fluent
 - Aspen
 - Almost any current or legacy programs
- Results can become inputs into the same loop for optimization calculations.

Remote Use of RELAP5



Model Integration Environment (ModelCenter)



The screenshot displays the Phoenix Integration ModelCenter 8.0 interface. The main window shows a simulation model with a 3D reactor core visualization. A 'Parametric Study' dialog box is open, showing the following configuration:

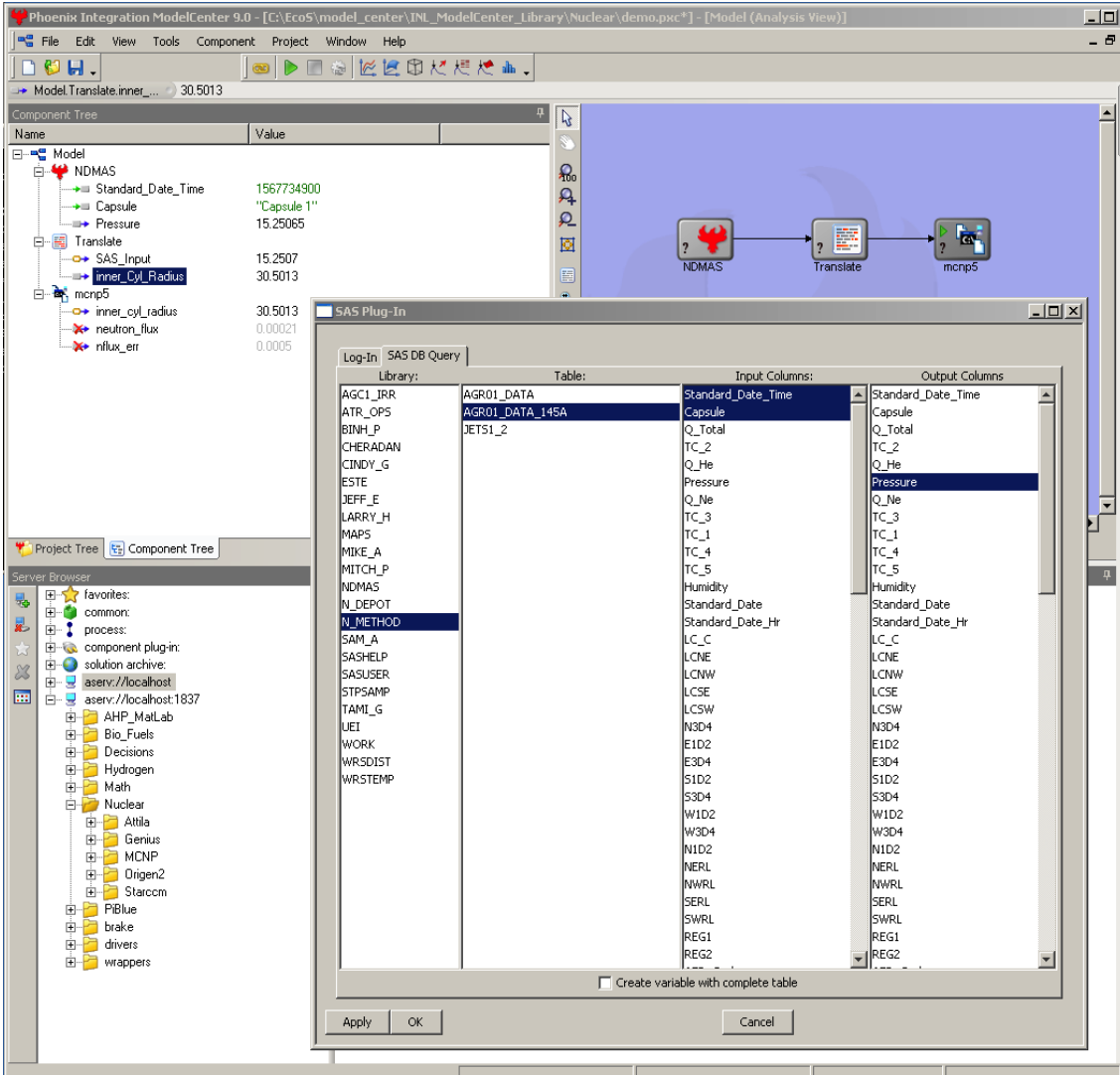
- Design Variable:** Model.Fuel_Enrichment.Fuel_Enrichment
 - starting value: 1
 - ending value: 3
 - number of samples: 5
 - step size: 0.05
- Responses:**
 - Model reactor_starcom_3.Outputs.maxTemp
 - Model reactor_starcom_3.Outputs.minTemp
 - Model reactor_starcom_3.Outputs.avgTemp
 - Model reactor_starcom_3.Outputs.meanTemp

The 'Data Explorer' window on the right displays several plots showing the relationship between the design variable (Fuel_Enrichment) and the responses (maxTemp, minTemp, avgTemp, meanTemp). The plots show that as fuel enrichment increases, the maximum and average temperatures decrease, while the minimum temperature increases.

Fuel_Enrichment	maxTemp	minTemp	avgTemp	meanTemp
1.0	~250	~300	~350	~350
1.2	~245	~305	~345	~345
1.4	~240	~310	~340	~340
1.6	~235	~315	~335	~335
1.8	~230	~320	~330	~330

ModelCenter Model-Data Interface

- Models are included without recoding
- Models can be linked by coupling outputs and inputs
- Data queries are automatically driven by the model run
- Models automatically store data into the data repositories



The screenshot displays the Phoenix Integration ModelCenter 9.0 software interface. The main window shows a 'Component Tree' on the left with a hierarchical view of models and their parameters. A 'Project Tree' and 'Server Browser' are also visible at the bottom left. The central workspace contains a workflow diagram with three nodes: 'NDMAS', 'Translate', and 'mcpn5', connected by arrows. An 'SAS Plug-In' dialog box is open in the foreground, showing a 'Log-In' section with 'SAS DB Query' selected. The dialog contains a table with columns for 'Library', 'Table', 'Input Columns', and 'Output Columns'. The 'Table' column is currently selected, showing a list of tables including 'AGRO1_DATA', 'AGRO1_DATA_145A', and 'JETS1_2'. The 'Input Columns' and 'Output Columns' columns show a list of variables such as 'Standard_Date_Time', 'Capsule', 'Q_Total', 'Q_He', 'Pressure', 'Q_Ne', 'TC_3', 'TC_1', 'TC_4', 'TC_5', 'Humidity', 'Standard_Date', 'Standard_Date_Hr', 'LC_C', 'LCNE', 'LCNW', 'LCSE', 'LCSW', 'N3D4', 'E1D2', 'E3D4', 'S1D2', 'S3D4', 'W1D2', 'W3D4', 'N1D2', 'NERL', 'NWRL', 'SERL', 'SWRL', 'REG1', and 'REG2'. The 'Create variable with complete table' checkbox is unchecked at the bottom of the dialog.

Library	Table	Input Columns	Output Columns
AGC1_IRR	AGRO1_DATA	Standard_Date_Time	Standard_Date_Time
ATR_OPS	AGRO1_DATA_145A	Capsule	Capsule
BINH_P	JETS1_2	Q_Total	Q_Total
CHERADAN		TC_2	TC_2
CINDY_G		Q_He	Q_He
ESTE		Pressure	Pressure
JEFF_E		Q_Ne	Q_Ne
LARRY_H		TC_3	TC_3
MAPS		TC_1	TC_1
MIKE_A		TC_4	TC_4
MITCH_P		TC_5	TC_5
NDMAS		Humidity	Humidity
N_DEPOT		Standard_Date	Standard_Date
N_METHOD		Standard_Date_Hr	Standard_Date_Hr
SAM_A		LC_C	LC_C
SASHELP		LCNE	LCNE
SASUSER		LCNW	LCNW
STPSAMP		LCSE	LCSE
TAMIL_G		LCSW	LCSW
UEI		N3D4	N3D4
WORK		E1D2	E1D2
WRSDIST		E3D4	E3D4
WRSTEMP		S1D2	S1D2
		S3D4	S3D4
		W1D2	W1D2
		W3D4	W3D4
		N1D2	N1D2
		NERL	NERL
		NWRL	NWRL
		SERL	SERL
		SWRL	SWRL
		REG1	REG1
		REG2	REG2

Phoenix Integration ModelCenter 10.2 - [D:\Workspace\Relap\testmodel.pxc] - [Model (Analysis View)]

File Edit View Tools Component Project Window Help

Model Model

Component Tree

Name	Value
Model	
RelapPLTFileReader	
HPC_RELAP5	
_3800000	
v1	up-ihl
v2	sngljun
_3800101	
v1	1
v2	30464.55
v3	0.0
v4	0.0
_1000000	
_1000001	
_1000101	
_1000102	
_1000301	
_1000302	
_1000601	
_1000801	
PLTFile	<view...>
Validate_Script	
StarCCM	

Project Tree Component Tree

Server Browser

favorites:

- common:
- process:
- component plug-in:
- solution archive:
- aserv://localhost
- aserv+ssh://peerdb@quark

Abaqus Adams ANSYS Catia Converger Excel FLAMES Analyze

Matlab MSCNastran NX NXNastran Optimization Tool Other... Probabilistic...

Model Diagram:

```

    graph LR
      HPC_RELAP5 --> RelapPLTFileReader
      RelapPLTFileReader --> Validate_Script
      RelapPLTFileReader --> StarCCM
  
```

Relap PLT File Reader

Step 1: Choose the PLT File

Relap PLT File
D:\Workspace\Relap\run1.plt

RELAP5

Step 2: Choose the Variables to include

Select all variables

- 0
- 113
- 157
- 190
- 209
- 290
- 505
- 185
- 285
- 100010000
- 100020000
- 100201000
- 104010000
- 104020000
- 106010000
- 108010000
- 108020000
- 108030000
- 108040000
- 108050000

Variables to output to ModelCenter Select all variables

- 113.pmpvel
- 113.pmpthead
- 113.pmptra
- 190.acttank
- 190.acvif
- 190.acvdm
- 190.acqtank
- 190.acrhn

Variables to save to the Database Select all variables

- 113.pmpvel
- 113.pmpthead
- 113.pmptra
- 100010000.rho
- 100010000.rhof
- 100010000.rhog
- 100010000.uf
- 100010000.ug
- 100010000.voldf

Save Configuration

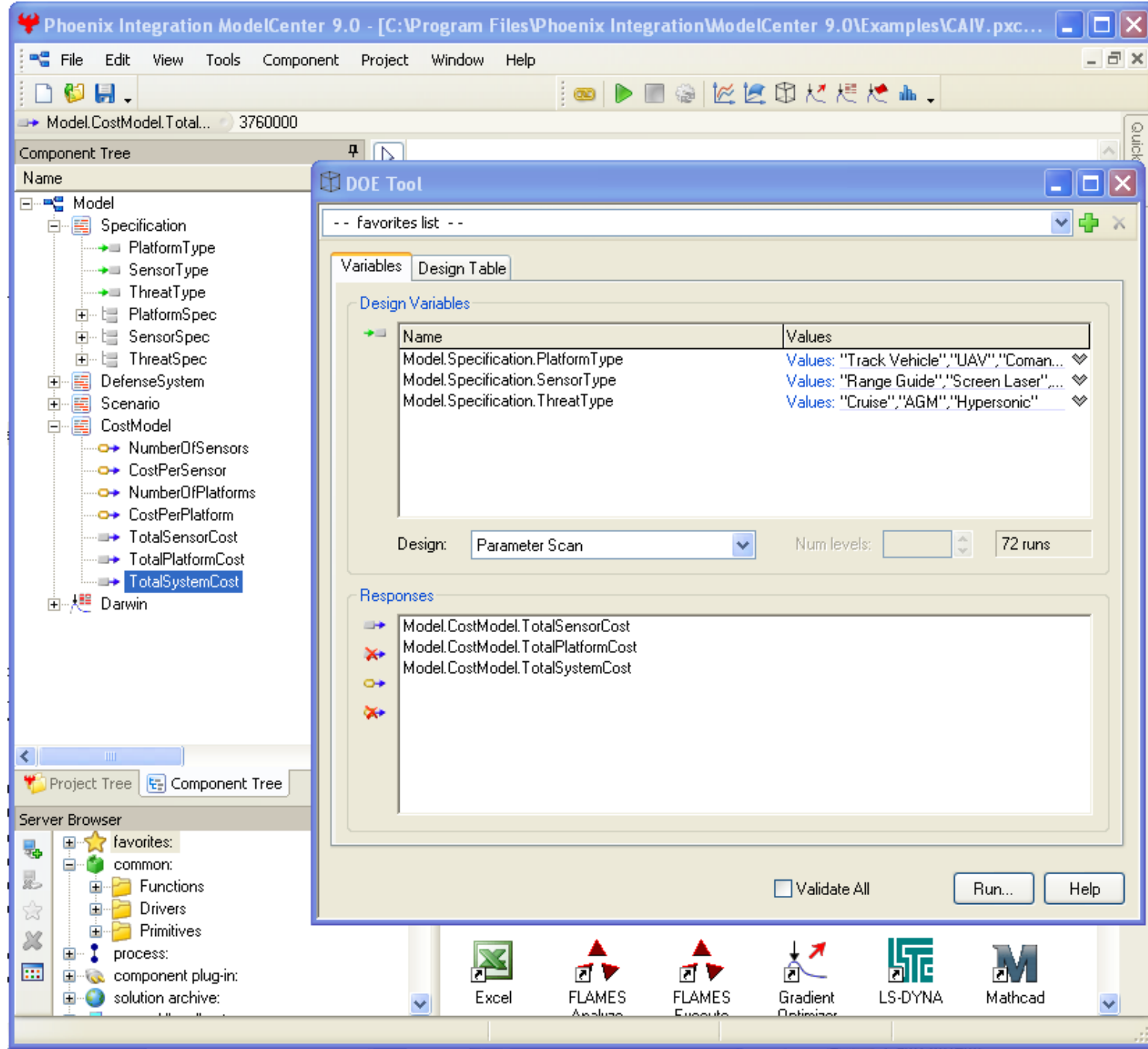
Database Configuration

Server

Username Database Name

Password Table Name

Use Integrated Security



DOE Tool

-- favorites list --

Variables Design Table

Design Variables

Name	Values
Model.Specification.PlatformType	Values: "Track Vehicle","UAV","Coman..."
Model.Specification.SensorType	Values: "Range Guide","Screen Laser",....
Model.Specification.ThreatType	Values: "Cruise","AGM","Hypersonic"

Design: Parameter Scan Num levels: 72 runs

Responses

- Model.CostModel.TotalSensorCost
- Model.CostModel.TotalPlatformCost
- Model.CostModel.TotalSystemCost

Validate All Run... Help

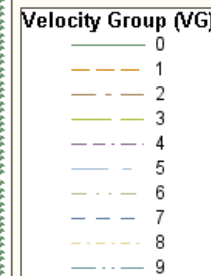
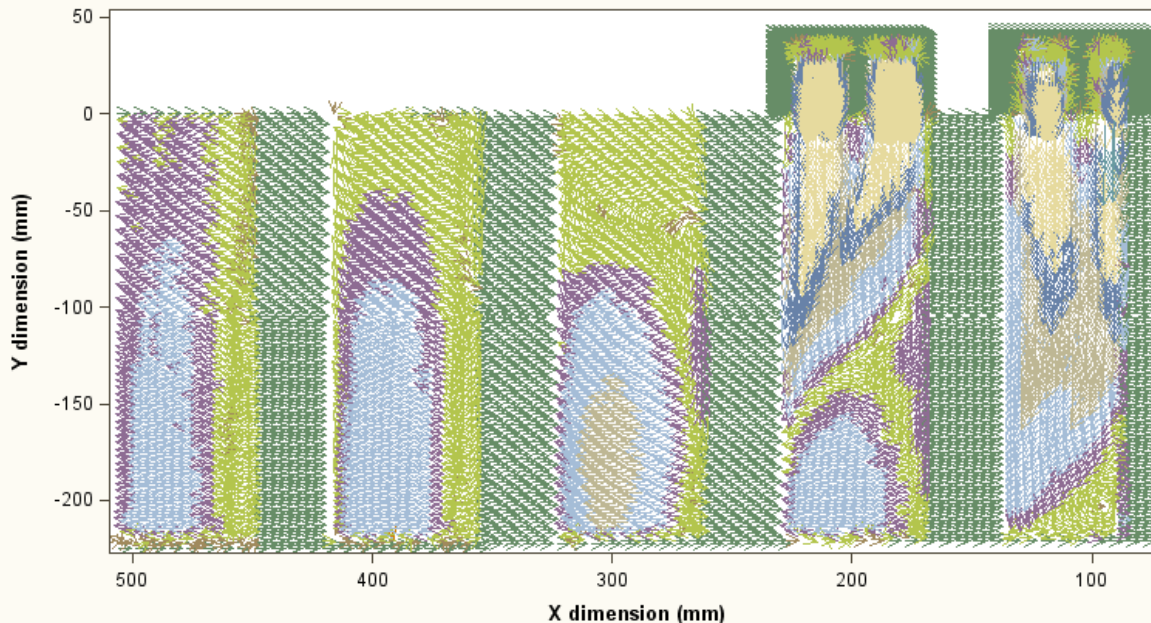


RELAP5 Validation

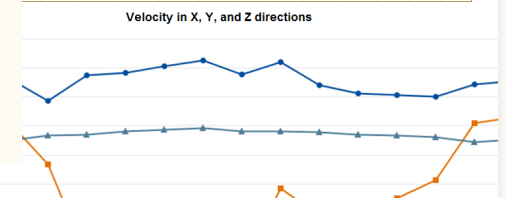
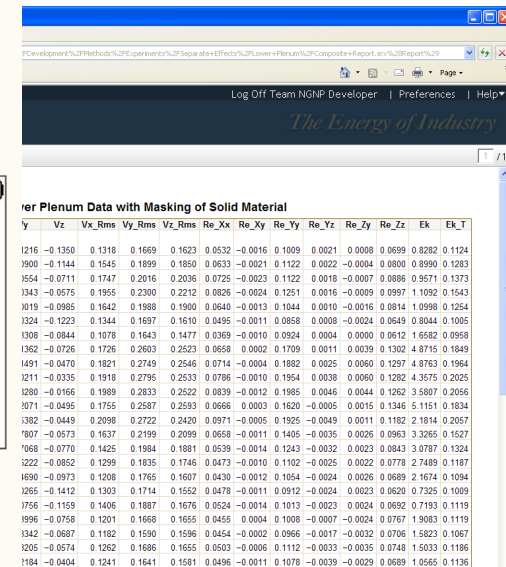
Working with Dick Schultz, we would like to use GEMS tools to conduct Validation studies of RELAP5 against the High Temperature Test Reactor (HTTF) at Oregon State.

- GEMS will be used to store and secure HTTF data
- Automated RELAP5 execution provides a traceable data pedigree
- SAS statistical & Phoenix Int. tools provide unlimited analytic capability

Methods: Lower Plenum (LP), Standard Problem
Flow velocity in the x-y plane by scanplane (fixed z)



VG 0=0; 0.0001<= VG 1 <=0.01< VG 2 <=0.1< VG 3 <=1.0< VG 4 <=2.0< VG 5 <=4.0< VG 6 <=6.0< VG 7 <=8.0< VG 8 <=10.0< VG 9 [m/s]
NGNP Data Management and Analysis System (NDMAS)



Summary

- Overview Full Tool Suite Used to work with RELAP5
- Discuss Approach Used to Integrate and Automate RELAP5
- General Integration of RELAP5 with Other Codes
- Using GEMS for RELAP5 Validation against the HTTF Experimental Data

Sam Alessi, Ph.D.

Rsam.Alessi@inl.gov

Idaho National Laboratory

(208) 526-1136

Brant Peery

Brant.Peery@inl.gov

Idaho National Laboratory

(208) 526-3666