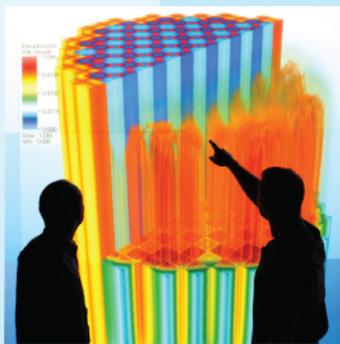


Power uprates
and plant life extension

CASL-U-2010-0025-000-c



Engineering design
and analysis



Level 1 Milestone: CASL.Y1.01

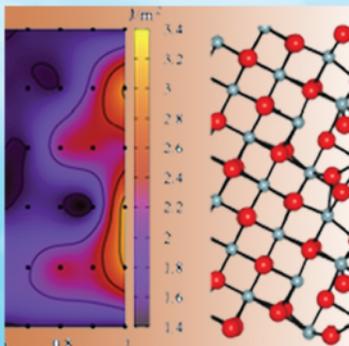
Port and Integrate Base-line WEC Codes into VERA/LIME

Science-enabling
high performance
computing



Rod Schmidt
Sandia National Laboratory
with Chris Baker/John Turner, ORNL;
Ross Bartlett, Noel Belcourt, Roger
Pawlowski, SNL;
David Paterline, Pete Hilton and Brian
Coulter: WEC

Fundamental science



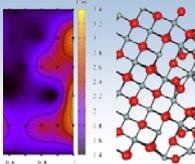
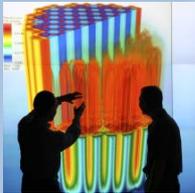
January 12, 2011

Plant operational data



U.S. DEPARTMENT OF
ENERGY

Nuclear Energy



Level 1 Milestone: CASL.Y1.01 Port and Integrate Base-line WEC Codes into VERA/LIME

VRI Physics Simulation Suite Project

*Presented by: Rod Schmidt, SNL
with:*

Chris Baker and John Turner: ORNL

Ross Bartlett, Noel Belcourt, Roger Pawlowski: SNL

David Paterline, Pete Hilton and Brian Coulter: WEC



Jan. 12, 2011



U.S. DEPARTMENT OF
ENERGY

Nuclear
Energy

Milestone Execution Responsibility & Personnel

- Who is the single point-of-contact? Rod Schmidt, SNL
- List the Focus Areas (VRI), FA Projects (PSS), and CASL partners and staff responsible for executing this milestone and the role each played
 - David Paterline, WEC: Prepare codes for transfer, place on Tumbleweed
 - Pete Hilton, WEC: VIPRE code support
 - Brian Coulter, WEC: ANC code support
 - Yixing Sung, WEC: WEC coordination
 - Chris Baker, ORNL: Set-up CASL repo, transfer codes to CASL, build codes and test on CASL systems, help create ME and drivers, run LIME-based code tests
 - Ross Bartlett, SNL: gForge, Kanban, help with repo, . . .
 - Noel Belcourt, SNL: help build and test codes, help create MEs and drivers
 - Roger Pawloski, SNL: help create MEs and drivers
 - Rod Schmidt, SNL: CASL coord., Prj. Mng., help create MEs and drivers

Milestone Description

- PoR description:
“Port to CASL computers and apply a baseline WEC diffusion and subchannel (ANC, VIPRE-W) capability with loose coupling to an operational PWR core scenario with CRUD-relevant conditions.”
- As reflected in KANBAN epic 1667:
Work with Westinghouse to transfer and port VIPRE, ANC, and ANCKVIPRE to CASL and demonstrate the ability to wrap and run each of these codes under LIME

Milestone Description - Comments

- By itself, achieving this milestone does not represent a new capability, **however**, this milestone was and is fundamental to achieving longer term CASL goals
- Significant elements to achieving this milestone included
 - Establishing productive working relationships with WEC, including staff
 - Addressing all of the issues associated with the transfer, porting, and running of important proprietary WEC legacy codes
 - Demonstrating the ability to “wrap” these codes using the VERA/LIME framework (initially in the simplest way possible)
- This work represents a foundation for creating new and improved multi-physics coupling capability using WEC and EPRI codes.
 - ANC-VIPRE-BOA coupling
 - Residual-based solution algorithm

Milestone Completion Criteria

- Completion of the following for the Westinghouse VIPRE, ANC, and ANCKVIPRE codes
 - Transfer to CASL (incl. all associated WEC libraries), port and successfully run standalone on frost
 - Commit to CASL repository
 - Revise as needed so that it could be built as a library, linked to LIME, and executed in stand-alone mode running under LIME
 - Create a simple model evaluator and LIME-based driver.
 - Successfully run and test against a benchmark solution.
- An acceptable Completion Memo/Report

Milestone Deliverables

- Tangible deliverables include:
 - WEC codes in CASL repository
 - a working build system for the WEC codes on frost
 - revised WEC codes (library mode), MEs and drivers
 - Completion Memo/Report

Milestone Stakeholders and Requirements

- Who are the customers and users of the products and deliverables associated with this milestone? Which projects and/or FAs?
 - The deliverables for this milestone are primarily for internal VRI FA use, because this is a stepping stone to enhanced capability.
- What are the requirements driving this milestone?
 - “Assess the importance of CRUD deposition on axial offset and fuel temperatures by linking in a two-way manner the ANC, VIPRE-W and BOA codes under LIME, accounting for boron holdup and cladding surface heat transfer coefficient change due to CRUD deposition for the 3x3 pin geometry problem.” Table 3, CASL PoR-2
- Which of the customers and/or users can these requirements be linked to?
 - VRI, AMA

Milestone Linkages

- List the relevant and most important L2, L3, and L4 Milestones that linked to (must be completed before or in parallel with) this milestone, and any subsequent L1 and L2 Milestones dependent upon this milestone.
 - milestones and activities that CASL.Y1.01 depended on are shown in the following two slides
 - subsequent dependent milestones include:
 - L2: CASL.VRI.Y1.02 - VERA Release 1.0
 - L2: CASL.VRI.Y1.03 - initial demonstration of tightly-coupled flow-neutronics within VERA
 - L1: CASL.Y1.03 - vulnerable assy/pin, relevant quantities
 - and of course more beyond PoR-2

PoR-1 Plan: VERA

	2010					
	Q4FY10			Q1FY11		
	July	Aug	Sept	Oct	Nov	Dec
L1 CRUD						Y1.01: ANC / VIPRE-W Y1.02: DeCART / Star-CCM+
L2 VRI						VRI.Y1.01: VERA Release 0.5 (LIME/RAVE)
L3 VRI VERA						VRI.VERA.Y1.01: Workflow reqs
L4 VRI Startup	CASL email lists	ORNL UCAMS developer accounts sharepoint access, VRI workshop		dedicated CASL gForge deployed		
L4 Dev Env		Initial VRI software processes defined	Initial draft SQAP circulated for comment; Initial config/build system in place		Initial test infrastructure in place	
L4 User Workflow				AMA-VRI wkshp		Initial VERA Requirements Document

PoR-1 Plan: VERA PSS

	2010					
	Q4FY10			Q1FY11		
	July	Aug	Sept	Oct	Nov	Dec
L1 CRUD						Y1.01: ANC / VIPRE-W Y1.02: DeCART / Star-CCM+
L2 VRI						VRI.Y1.01: VERA Release 0.5 (LIME/RAVE)
L3 VRI VERA-PSS	VRI.VERA-PSS.Y1.01: LIME release					
L4 LIME			Initial LIME implementation		LIME uses VRI config / build / test system	initial integration of DAKOTA
L4 Integration			gForge projects configured and populated with initial PSS components		initial RAVE components integrated into VERA via LIME	DeCART, Star-CCM integrated into VERA via LIME
L4 Coupling						Initial demonstration of coupling (RAVE components)

Non-CASL Linkages

- List any non-CASL-funded activities and products that were used and leveraged for this milestone. Consider in particular programs such as NNSA/ASC, SC/SciDAC, and NE/NEAMS or NE/LWRS.
 - Legacy WEC code development efforts
 - LDRD funded work at SNL
 - Trilinos project (multiple funding sources)

Milestone Risks

- List the top 3-5 risks potentially in the way of completing this milestone, . . . (see PoR)
 - Staffing
 - Institutional roadblocks and delays in startup activities
 - Roadblocks and delay due to intellectual property and export control issues
 - Insurmountable inadequacies in gForge as the CASL software project repository
 - Unforeseen software challenges related to creating a common configure/build/test environment
 - Unforeseen software challenges integrating existing capabilities (*PoR-1 Milestone tracker*)
- ...if any of the risks became problems, and, if so, how the problems were mitigated
 - All were concerns, some were challenges, none became serious problems

Milestone Execution Plan

- What was the baseline plan for executing the milestone? List the top 10 (or less) activities, dates, and associated deliverables (if applicable) that were needed to complete this milestone.
 - Project Management was accomplished using an agile KANBAN/SCRUM based approach and tracked in Gforge. Milestones, Epics, and Stories were created, tracked, and documented online
 - Bi-weekly stand-up meetings
 - Monthly Review/Retrospective/Planning meetings
- Note: Work on this Milestone was concurrent with several other ongoing VRI-PSS activities (e.g. DeCART & StarCCM+, RELAP-5, Denovo, Dakota-LIME interface, LIME documentation ...)

Milestone Execution Plan

- Gforge Kanban site-1 (*Set-up by Ross Bartlett*)

The screenshot shows the GForge web interface for the 'CASL VRI Kanban' project. The top navigation bar includes 'FORGE', 'Home', 'My Stuff', 'Search', 'Projects', and 'Snippets'. The breadcrumb trail is 'Home » Projects » CASL VRI Kanban » Home'. A left sidebar contains a 'Summary' section and a list of navigation links: Admin, Reporting, Search, Tracker, Docs, Lists, Wiki, and Git. The main content area features the project title 'CASL VRI Kanban Project' and two paragraphs of text. The first paragraph describes the project's use of a Lean/Agile process based on Kanban with Scrum elements. The second paragraph explains that the project is a process management project not tied to a specific code repository, but that it can be associated with other repositories via Tracker items. Below the text is an 'Outline' section with a list of links to various project management and development lists, subproject areas, issue types, roles, workflow activities, meetings, developer information, project activity, and page editing.

CASL VRI Kanban

Home » Projects » CASL VRI Kanban » Home

- Summary
- >> Admin
- >> Reporting
- >> Search
- >> Tracker
- >> Docs
- >> Lists
- >> Wiki
- >> Git

CASL VRI Kanban Project

This GForge project uses a Lean/Agile process based on Kanban with elements for Scrum to drive CASL VRI development. The Lean Kanban approach compared with the better know Agile Scrum process is described in the short online book [Scrum and Kanban](#). Another good overview of Kanban and comparison to Scrum is given in [What is Best, Scrum or Kanban?](#). See [Overview VRI Kanban Process?](#).

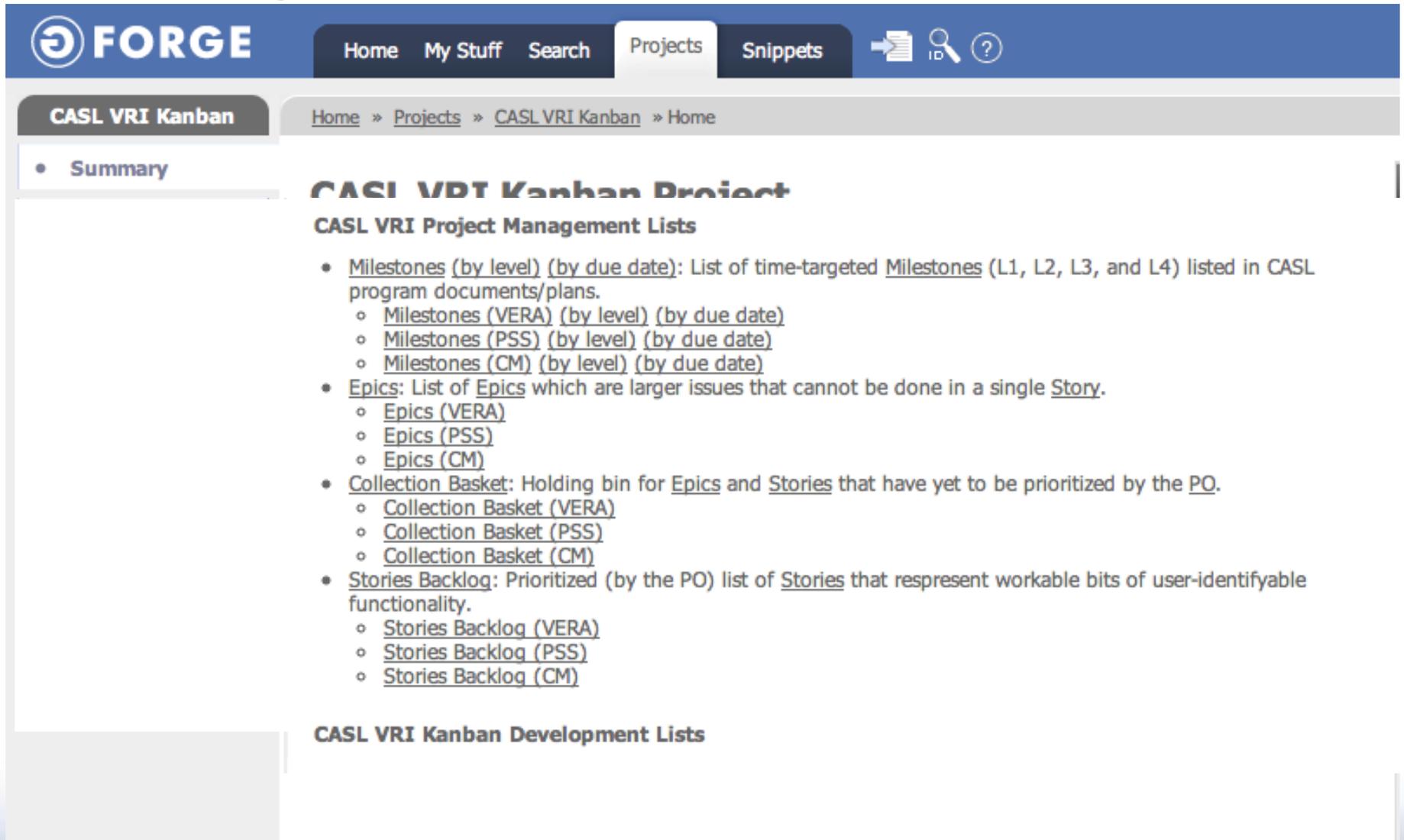
This GForge project is a process management project and is not tied to any specific code repository. Code repository specific projects (e.g. Denovo, SCALE, etc.) will refer to the Stories and Tasks in this GForge "CASL VRI Kanban" project but will not be considered to be GForge subprojects of this GForge project. A Tracker in a related GForge code-specific repository can create an "association" to a Tracker (e.g. Story or Task) in this "CASL VRI Kanban" project to show full tracability from CASL requirements to specific code changes (see [CASL VRI Common Workflow Activities](#)).

Outline

- [CASL VRI Project Management Lists](#)
- [CASL VRI Kanban Development Lists](#)
- [CASL VRI Completed Work Lists](#)
- [CASL VRI Subproject Areas](#)
- [CASL VRI Issue Types](#)
- [CASL VRI Project Roles](#)
- [CASL VRI Common Workflow Activities](#)
- [CASL VRI Regular Meetings](#)
- [CASL VRI Developer Information](#)
- [CASL VRI Project Activity](#)
- [Page Editing](#)

Milestone Execution Plan

- Gforge Kanban site-2 (*Set-up by Ross Bartlett*)



The screenshot shows the GForge web interface. At the top is a blue navigation bar with the GForge logo and menu items: Home, My Stuff, Search, Projects, and Snippets. Below this is a breadcrumb trail: Home » Projects » CASL VRI Kanban » Home. A sidebar on the left contains a 'Summary' link. The main content area is titled 'CASL VRI Kanban Project' and 'CASL VRI Project Management Lists'. It contains a bulleted list of project management lists, each with sub-items for different environments (VERA, PSS, CM).

CASL VRI Kanban Project

CASL VRI Project Management Lists

- Milestones (by level) (by due date): List of time-targeted Milestones (L1, L2, L3, and L4) listed in CASL program documents/plans.
 - Milestones (VERA) (by level) (by due date)
 - Milestones (PSS) (by level) (by due date)
 - Milestones (CM) (by level) (by due date)
- Epics: List of Epics which are larger issues that cannot be done in a single Story.
 - Epics (VERA)
 - Epics (PSS)
 - Epics (CM)
- Collection Basket: Holding bin for Epics and Stories that have yet to be prioritized by the PO.
 - Collection Basket (VERA)
 - Collection Basket (PSS)
 - Collection Basket (CM)
- Stories Backlog: Prioritized (by the PO) list of Stories that represent workable bits of user-identifiable functionality.
 - Stories Backlog (VERA)
 - Stories Backlog (PSS)
 - Stories Backlog (CM)

CASL VRI Kanban Development Lists

Milestone Execution Plan

- Gforge Kanban site-3 (*Set-up by Ross Bartlett*)



Home

My Stuff

Search

Projects

Snippets



CASL VRI Kanban

Home » Projects » CASL VRI Kanban » Home

CASL VRI Kanban Development Lists

These are lists of work in progress (WIP) who's size should be limited based on principles from Kanban. ToDo: Define the Kanban limits for each of these lists.

- Ready for Development: Stories selected by the PO and in a state ready to be developed.
 - Ready for Development (VERA)
 - Ready for Development (PSS)
 - Ready for Development (CM)
- In Development (with tasks): Stories and Tasks currently under development by the Development Team.
 - In Development (VERA) (with tasks)
 - In Development (PSS) (with tasks)
 - In Development (CM) (with tasks)
- Ready for Review: Stories that are finished development that are waiting for review.
 - Ready for Review (VERA)
 - Ready for Review (PSS)
 - Ready for Review (CM)
- Ready for Deployment: Stories that are finished development and review but have not been deployed yet.
 - Ready for Deployment (VERA)
 - Ready for Deployment (PSS)
 - Ready for Deployment (CM)

CASL VRI Completed Work Lists



Milestone Execution Plan

- Primary Epic and Stories

Epic 1667: Work with Westinghouse to produce and demonstrate a coupled ANC-VIPRE multi-physics simulation capability running under LIME

(1) Transfer to CASL and successfully build the following three codes on FROST

- a. VIPRE (GF 1763: **completed**)
- b. ANC (GF 1602: **completed**)
- c. ANCKVIPRE (GF 1762: **completed**)

(2) Revise each code as needed so that it can be built as a library, linked to LIME, and executed in stand-alone mode running under LIME

- a. VIPRE (no assigned story: **completed**)
- b. ANC (GF 1732: **completed**)
- c. ANCKVIPRE (GF 1957: **completed**)

(3) Create a simple model evaluator for each code that enables LIME to drive each code in stand-alone mode and be tested against a benchmark solution.

- a. VIPRE (no assigned story: **completed**)
- b. ANC (GF 1604: **completed**)
- c. ANCKVIPRE (GF 1958: **completed**)

(4) Revise VIPRE and ANC as needed to allow for data transfer operations needed for multi-physics coupling under LIME (i.e. not using PVM). (GF 1935, 1936: **in progress**)

(5) Create the multi-physics model evaluators for each code that enables LIME to execute coupled ANC-VIPRE calculations and test against a benchmark solution. (GF 1935, 1936: **in progress**)

Milestone Technical Approach

- CASL Repository

Open-source code developed/used for creating CASL MP Applications

A GForge project/Git repository for each physics code or code-suite enables IP/ECT access controls customized for different partner needs

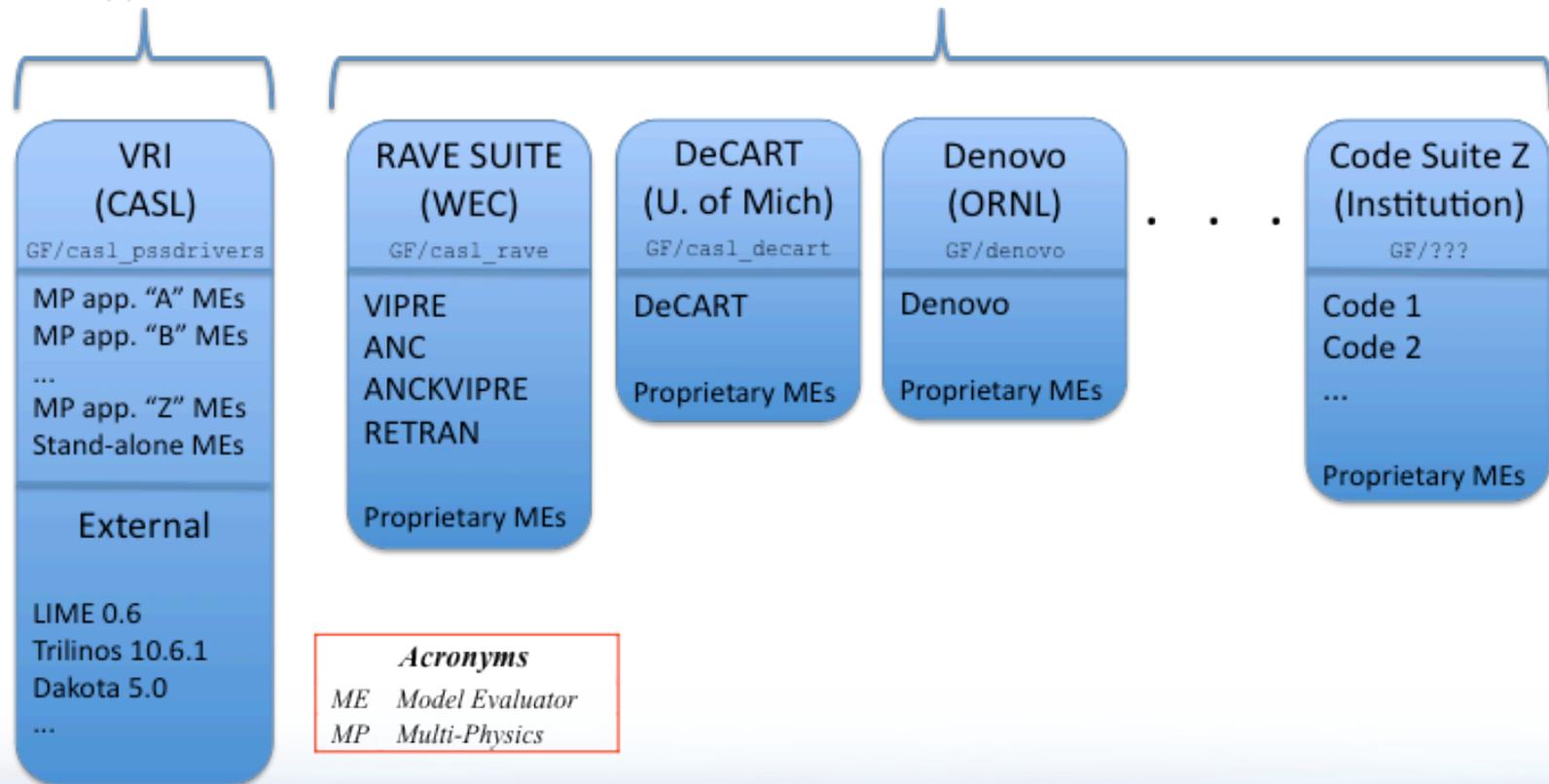
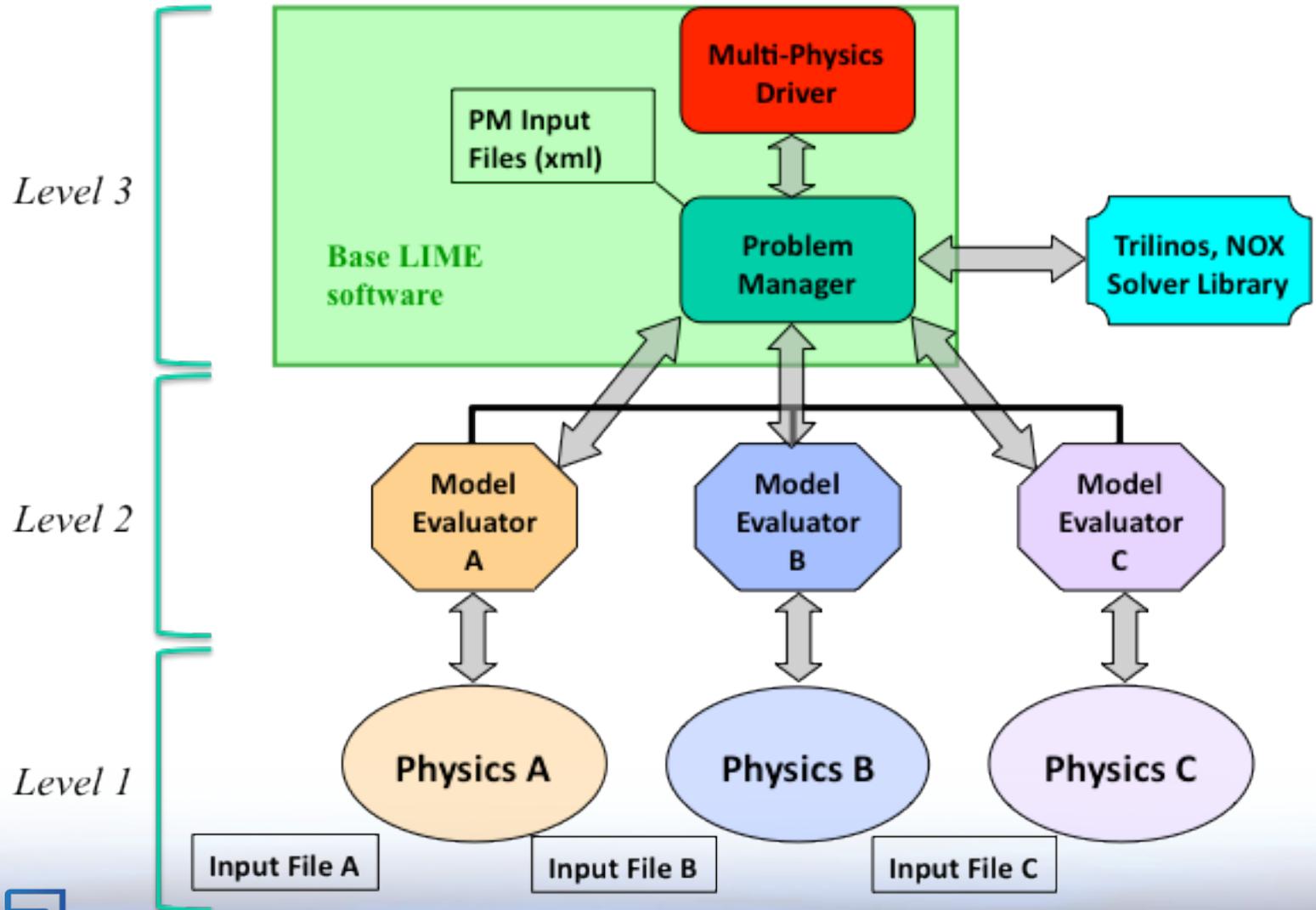


Diagram showing organization of the VRI Software Repository

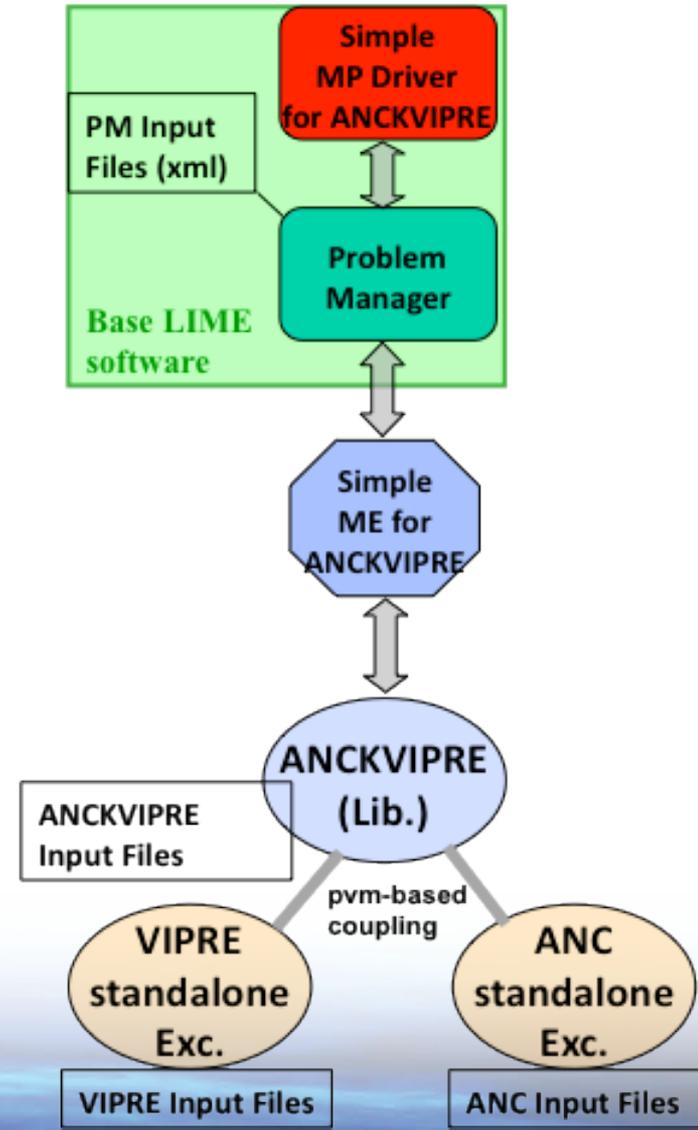
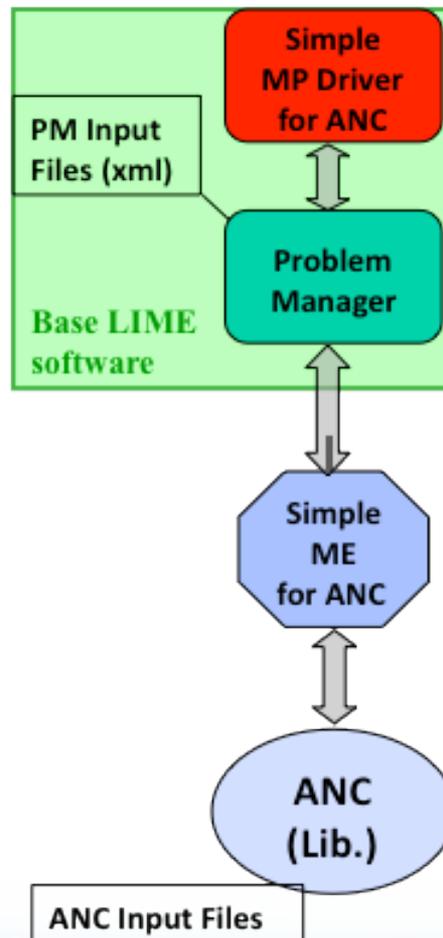
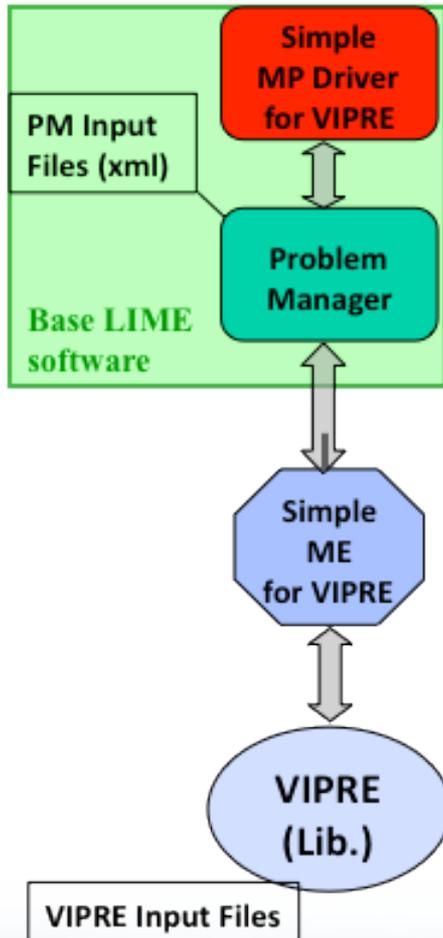
Milestone Technical Approach

- LIME: Lightweight Integ. Multi-physics Env. for coupling codes



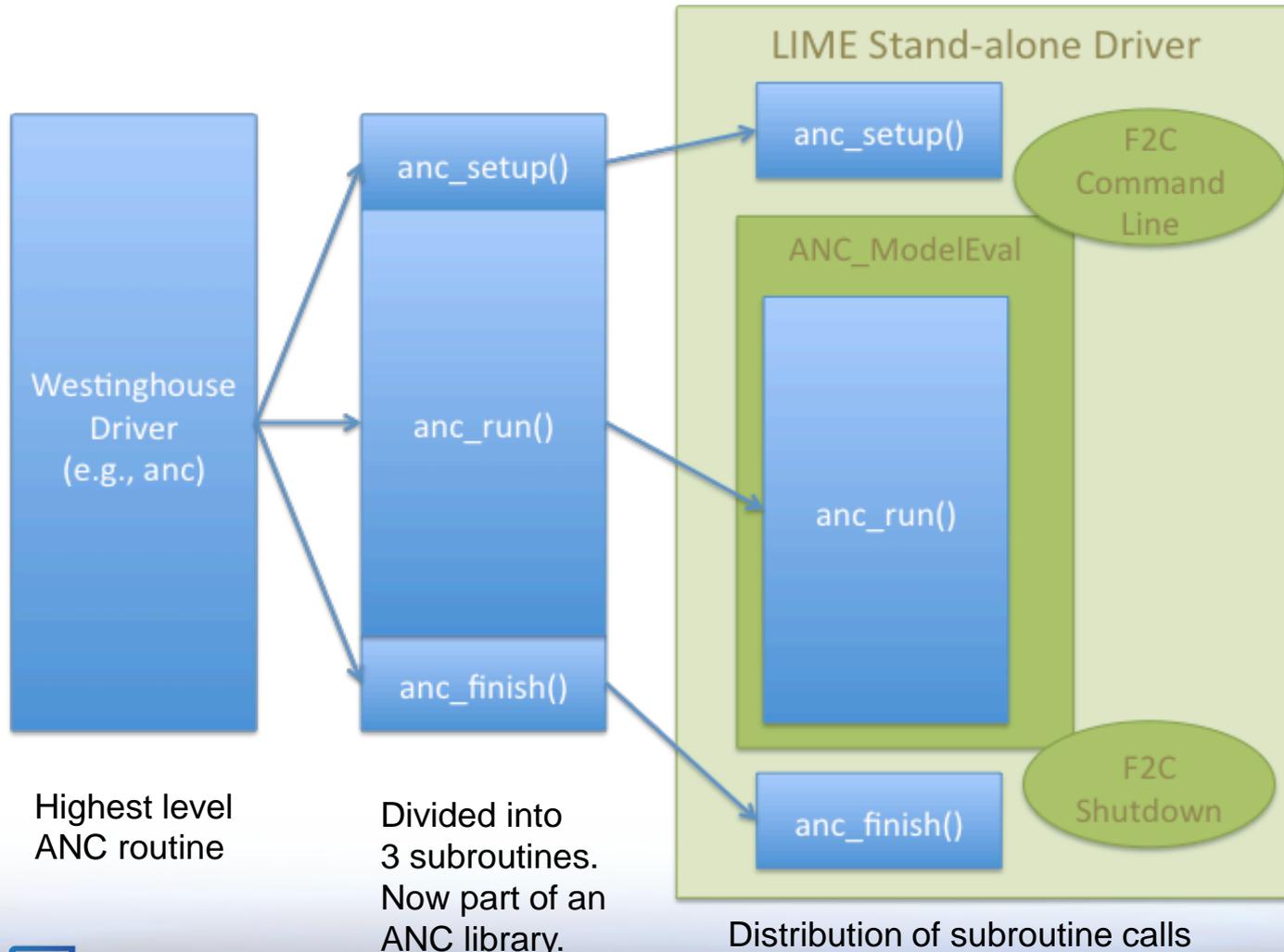
Milestone Technical Approach

- Simple "wrap" of VIPRE, ANC, and ANCKVIPRE



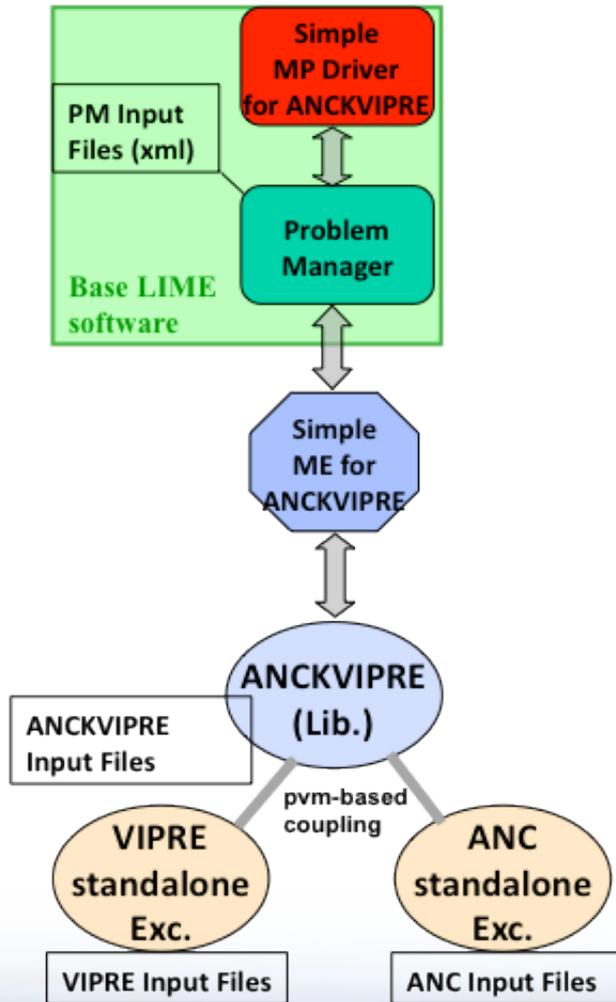
Milestone Technical Approach

- Illustration of mods to physics code (simple wrap of ANC)

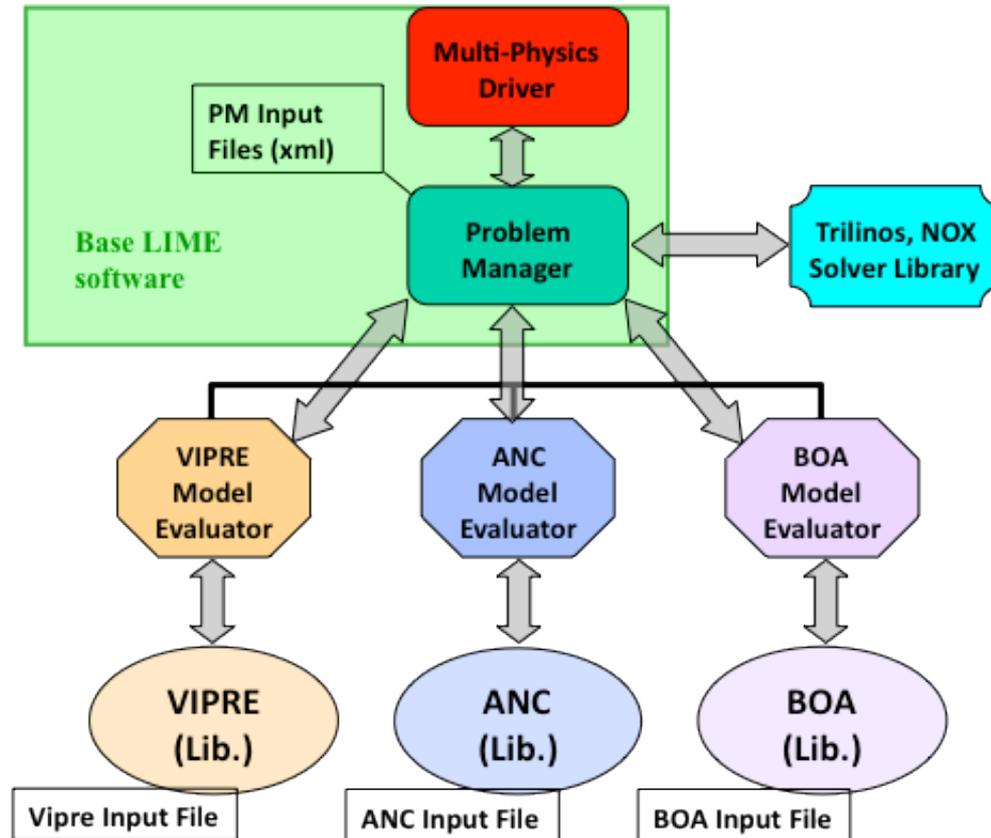


Milestone Technical Approach

- Current WEC Capability vs. Desired WEC Capability



VS.



Important additional challenges:

- * Transfer operations
- * Dealing with global data
- * Residual-based convergence criteria

Milestone Results

- Elucidate the principal milestone results and deliverables (5-10 slides as appropriate)
 - No flashy results to present. Simply that the “wrapped” ANCKVIPRE run produces the correct output

Milestone Discovery and Innovation

- List any “non-planned” results emanating from this milestone activity that could be considered “new” and potentially innovative
 - There were no un-planned results of note
 - Work to complete the follow-on Milestone will demonstrate key methods for addressing all aspects of full-coupling of legacy codes (global data issues, transfer operations, etc.)

Milestone Lessons Learned

- What problems (technical or non-technical) arose during this activity that remain unsolved and/or CASL can learn from?
 - No unsolved problems for this Milestone
 - Non-technical code transfer issues (e.g. obtaining permissions, addressing IP and/or legal) can take more time than expected.
 - transferring back to WEC not really worked out yet
 - Trilinos on WEC computers
 - Potential changes to WEC code base
- What can CASL “do better” henceforth (lessons learned)?
 - Work to continue to strengthen WEC–CASL collaboration (as potential end-users, they play a crucial role when we are working on their codes)

Milestone Path Forward

- What should the “next milestone” be if it served as a progression of this activity?
 - L3 VRI.PSS.Y1.02 Interim PSS release (ANC9, VIPRE-W, BOA / improved components coupled) 28 Feb, 2011
 - L2 VRI.Y1.02 VERA Release 1.0 (RAVE and Numerical Nuclear Reactor components coupled) 29 Mar, 2011
 - L1 CASL.Y1.03 CRUD – Quarter core with VIPRE/ANC/BOA 30 June, 2011
- What might other linked milestones be that serve as input (requirements)?
 - L2 VUQ.Y1.01 Integrate DAKOTA into LIME 31 Jan, 2011
 - L3 VRI.VERA.Y1.03 DAKOTA integrated 30 June, 2011

Milestone Summary

- The following has been completed for the Westinghouse VIPRE, ANC, and ANCKVIPRE codes
 - Transfer to CASL (incl. all associated WEC libraries), port and successfully run standalone on frost
 - Commit to CASL repository
 - Revise as needed so that it could be built as a library, linked to LIME, and executed in stand-alone mode running under LIME
 - Create a simple model evaluator and LIME-based driver.
 - Successfully run and test against a benchmark solution.
- An draft Completion Memo/Report has been prepared and is under review