

Safety Analysis Overview

Dr. Kent Welter, Senior Safety Analysis Manager

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U.S. Nuclear Regulatory Commission
Pre-Application Meeting
Rockville, MD



Outline

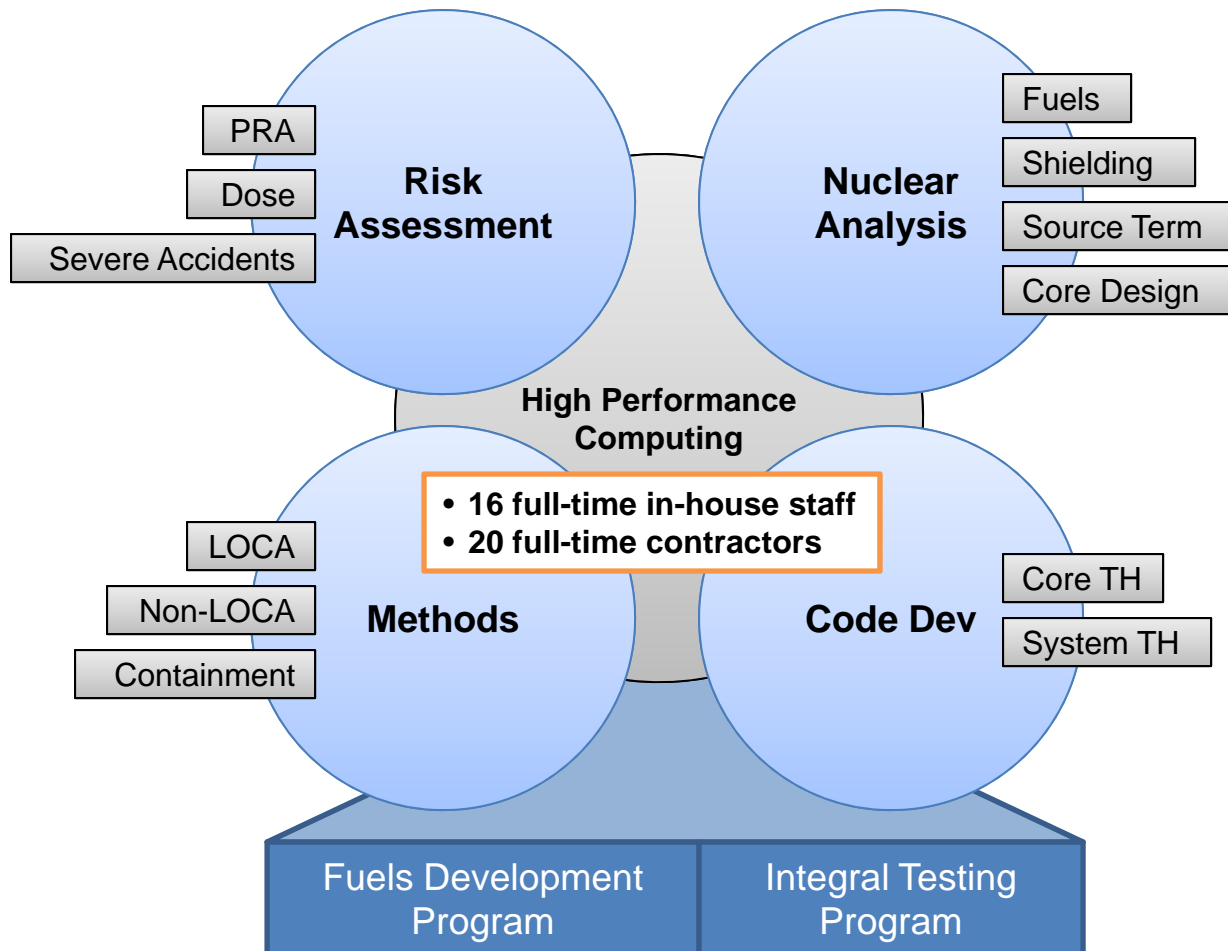
- Background
- Introduction
- Methods
- Code Development
- Codes & Methods Technical Report
- Today's Meeting Outcome Objectives

Background

- Codes and Methods Pre-App Meeting (November 2008)
 - Core Design
 - Fuels Performance
 - LOCA
 - Non-LOCA
 - Containment Performance
 - Code Verification & Validation
- Codes & Methods Technical Report
 - Submitted as part of the November 2008 meeting for informational purposes
 - No action requested
- LOCA PIRT LTR
 - Submitted June 2010 (on time)
 - Awaiting feedback from NRC with respect to highly-ranked phenomena to support test program development

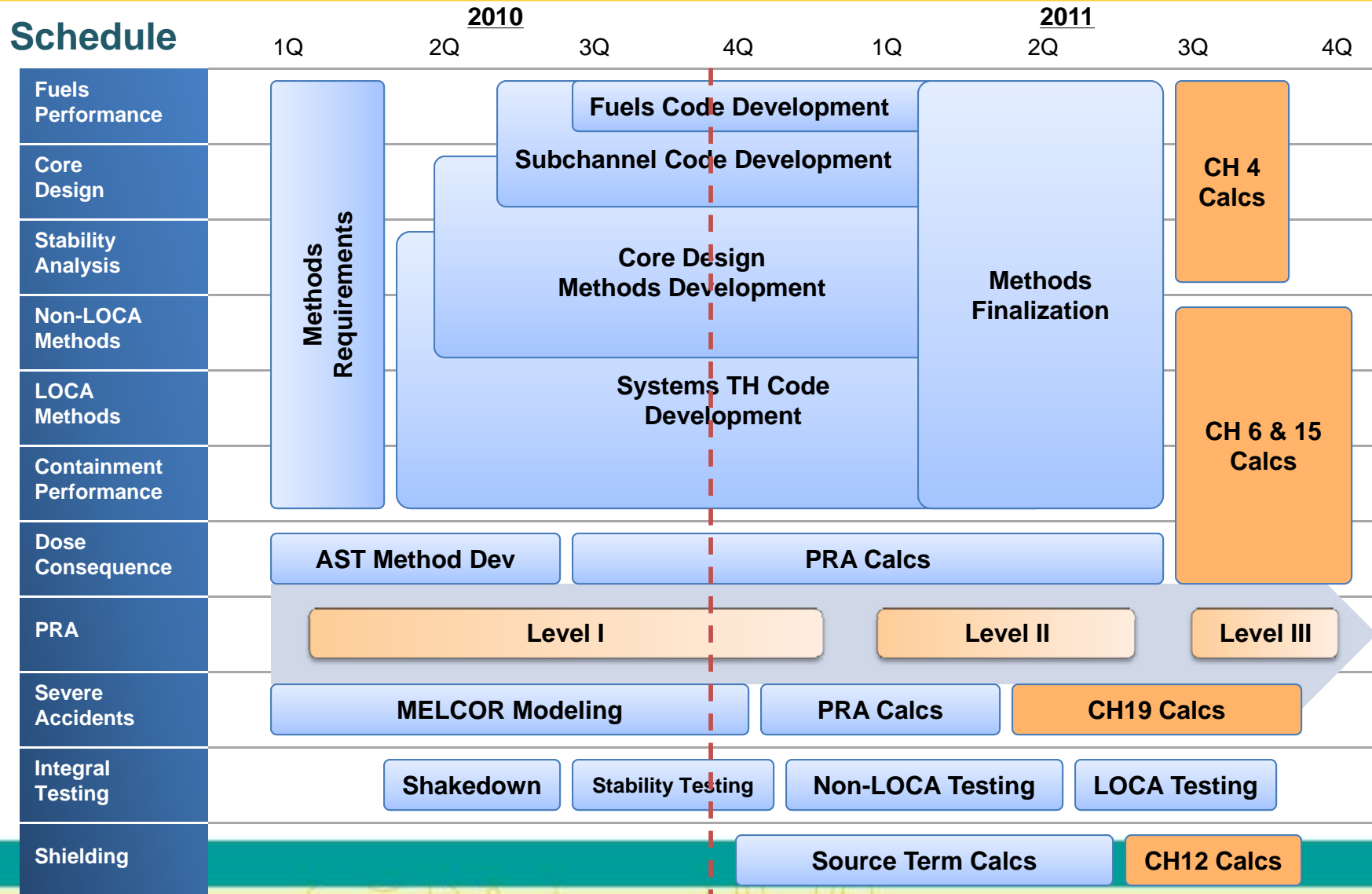
Introduction

Organization



- Modernized High-Performance Computing Environment
- Centralized Data, Models, and Codes
- Efficient and Structured Knowledge Management Program
- Purpose / Function Driven Teams & Projects
- Highly Integrated with Design Teams

Introduction



12/13/10

Introduction

Codes & Methods

- NuScale will employ a suite of well-established computer codes using industry-standard technique.
- Unique features of the NuScale plant need to be considered in selecting and using specific codes and methods (e.g., integrated reactor).
- All codes under reevaluation are conventional codes that have a long history of being used for LWR design and analysis.
- Safety analysis codes will conform to NuScale's Appendix B compliant Software Quality Assurance Program.

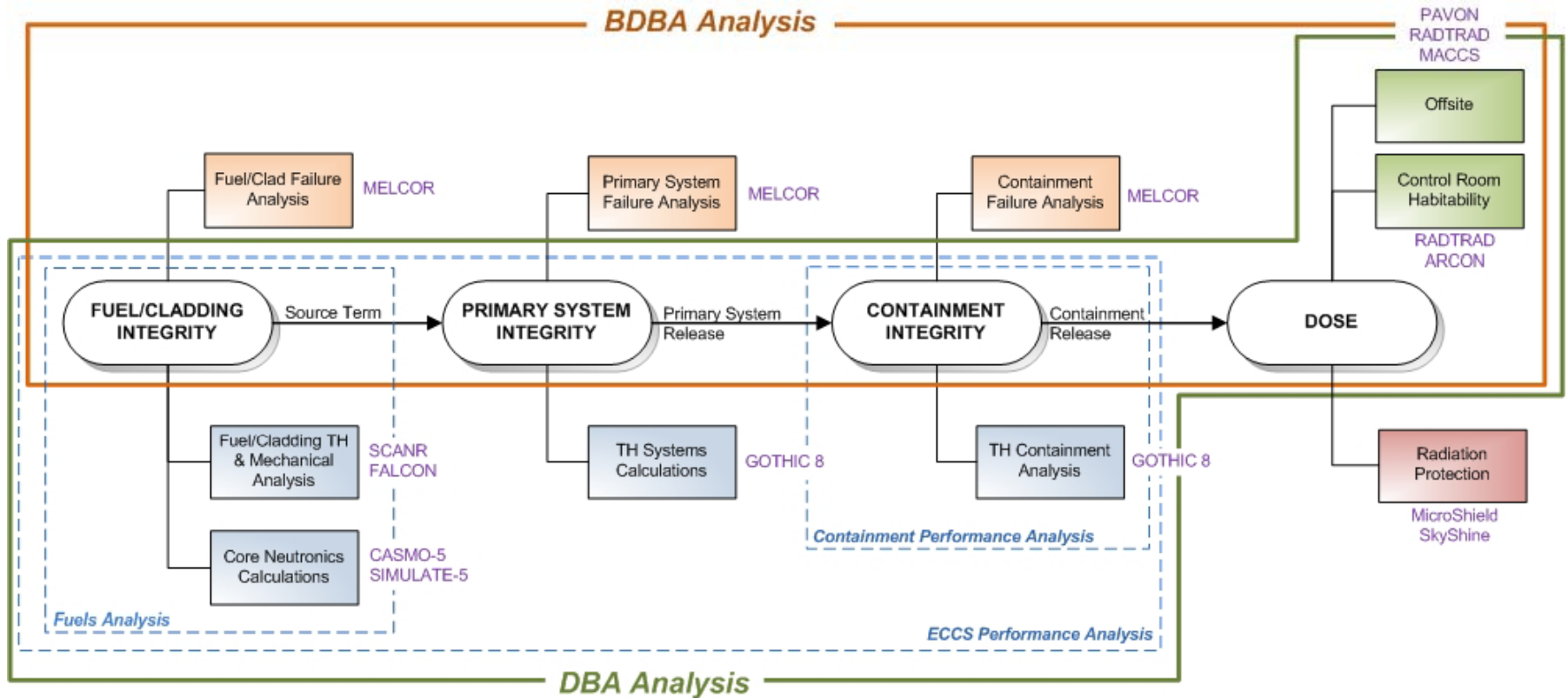
Introduction

Verification & Validation

- Adequacy of codes for conducting steady-state core/fuel design and transient and accident analysis:
 - Reduced-height core
 - Integrated system (e.g., internal steam generators and pressurizer)
 - Natural circulation flow conditions
 - Lower operating pressure
 - Higher cladding surface temperatures under normal operation
- A great deal of available LWR validation data was generated in reduced-scale facilities at reduced flow, pressure, and temperature conditions.
- Validation suite will utilize existing and well-established LWR benchmark data sets, coupled with reliance on the prototype test facility at OSU.

Methods

Defense-in-Depth



Methods

- Majority of Design Basis Accident Analysis Straightforward and based on SRP Chapter 15 Guidance
- Considerations Unique to NuScale Design
 - LOCA: conservative analysis consistent with Appendix K (large safety margins / no cladding heat-up during DBA LOCAs)
 - Reactivity Insertion Events: Evaluating benefits of 3D kinetics methods
 - Control Ejection Accident: Precluded by design
 - Containment Performance directly linked to ECCS Performance

Code Development

Software Life Cycle Management

Code	Description	Application	Vendor	Plan	Requirements	Develop	Verify	Validate	Maintain
GOTHIC	System Thermal-Hydraulics	LOCA, Non-LOCA, Containment Performance	NAI	Vendor Activity	Vendor Activity	Vendor Activity	Vendor Activity	Joint Activity	Joint Activity
SCANR	Core Thermal-Hydraulics	Core Subchannel Analysis	NuScale	NuScale Activity	NuScale Activity	NuScale Activity	NuScale Activity	NuScale Activity	NuScale Activity
SIMULATE	Core Neutronics	Core Design, RAIs	Studsvik	Vendor Activity	Vendor Activity	Vendor Activity	Vendor Activity	Joint Activity	Vendor Activity
TBD	Fuel Thermal-Mechanical	Fuel Performance	TBD	-	-	-	-	-	-

■ Vendor Activity
 ■ NuScale Activity
 ■ Joint Activity



High Performance Computing Cluster

- 30+ CPUs
- Linux & Windows
- Job Queuing
- Production Environment
- Highly Secure
- Automation Tools
- Appendix B Qualified



NuScale Code Development Office
Richland, WA

Evaluation Model Development

- Following RG 1.203, “Transient and Accident Analysis Methods” for development of evaluation models for analyzing Chapter 15 events.
- Have completed EMDAP Elements 1 and 2 for most Chapter 15 events (e.g., plant and scenario descriptions, PIRT, scaling analyses, etc.)
- Finalizing code verification and validation plans
- Starting Phase II OSU Integral Testing (LOCA & non-LOCA scenarios)
- Evaluating importance/sensitivity of highly-ranked phenomena on code results

Codes & Methods TR

Target Submittal: March 2011

- **Scope**

- Licensing Basis Event Selection/Major Equipment Classification
- LOCA & non-LOCA methods overview (i.e., major inputs, assumptions, and outputs)
- Code Development Plans (e.g, GOTHIC, SCANR)
- Experimental Testing Plans (e.g., OSU Integral Facility, CHF)

- **Outcome Objectives**

- Direct feedback on proposed approach for eliminating rod ejection accident from a defense-in-depth perspective
- Direct feedback on proposed code development and experimental testing programs to identify potential validation gaps from a phenomenological perspective

Meeting Outcome Objectives

- Update NRC on existing Code Development and V&V Activities
- Present Plan for use of GOTHIC for NuScale Safety Analysis
- Obtain feedback on proposed GOTHIC activities and discuss engagement strategy for review and approval



1000 NE Circle Blvd, Suite 10310
Corvallis, OR 97330
541-207-3931
nuscalepower.com

