Safety Analysis Overview

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

NuScale Power

Outline

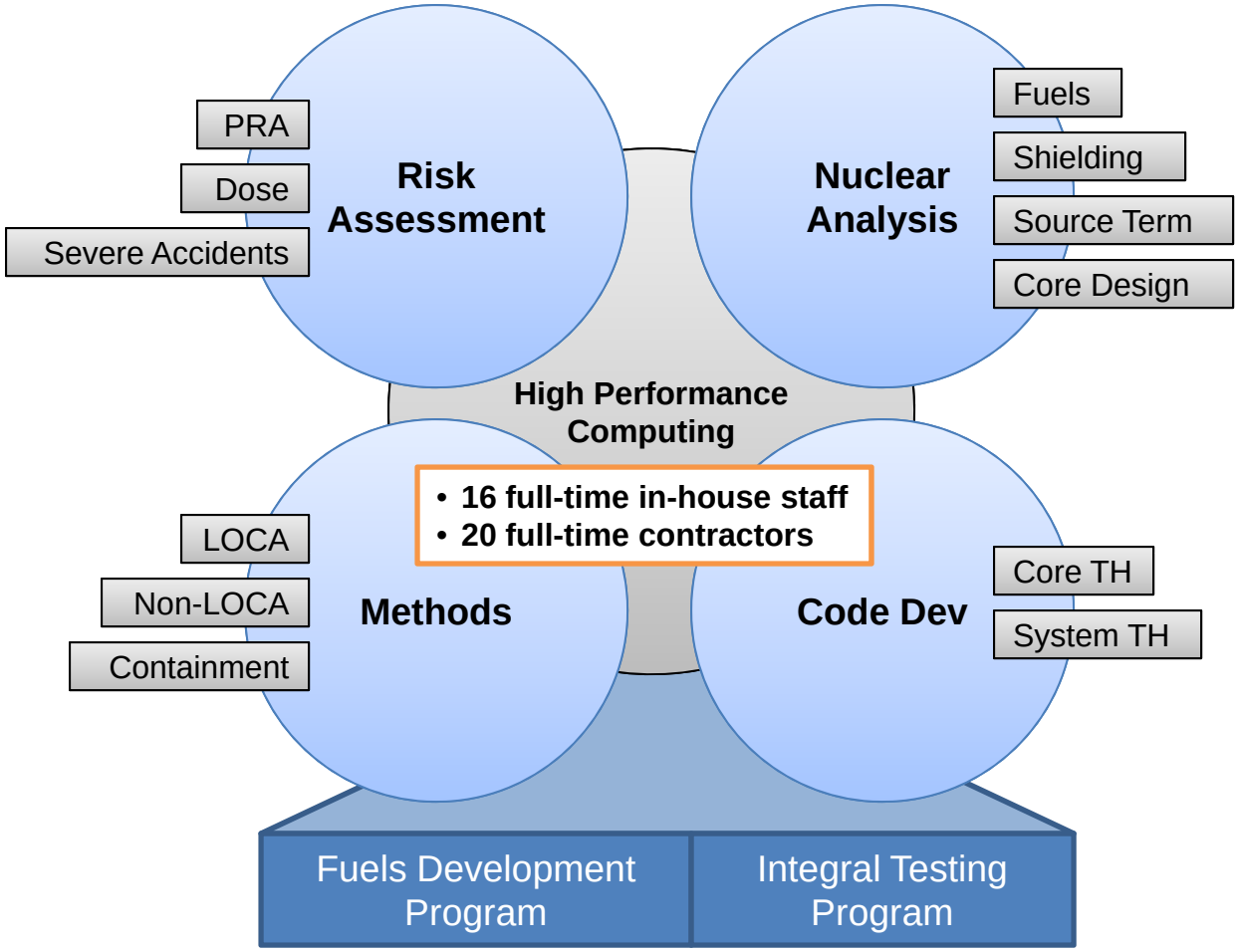
- Background
- Introduction
- Methods
- Code Development
- Codes & Methods Technical Report
- Today's Meeting Outcome Objectives

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

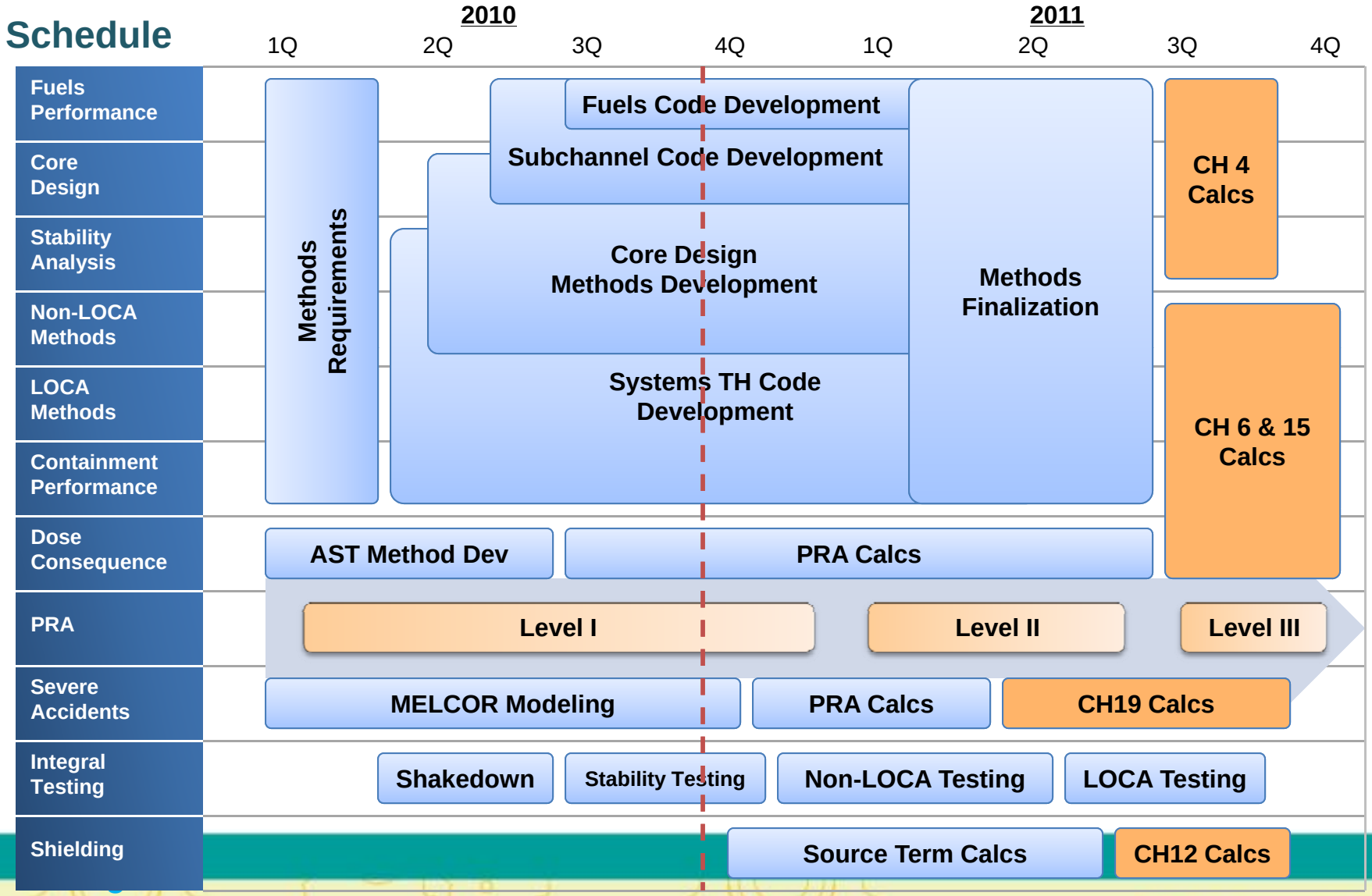
Organization



- 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

Schedule



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 revaluation 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.

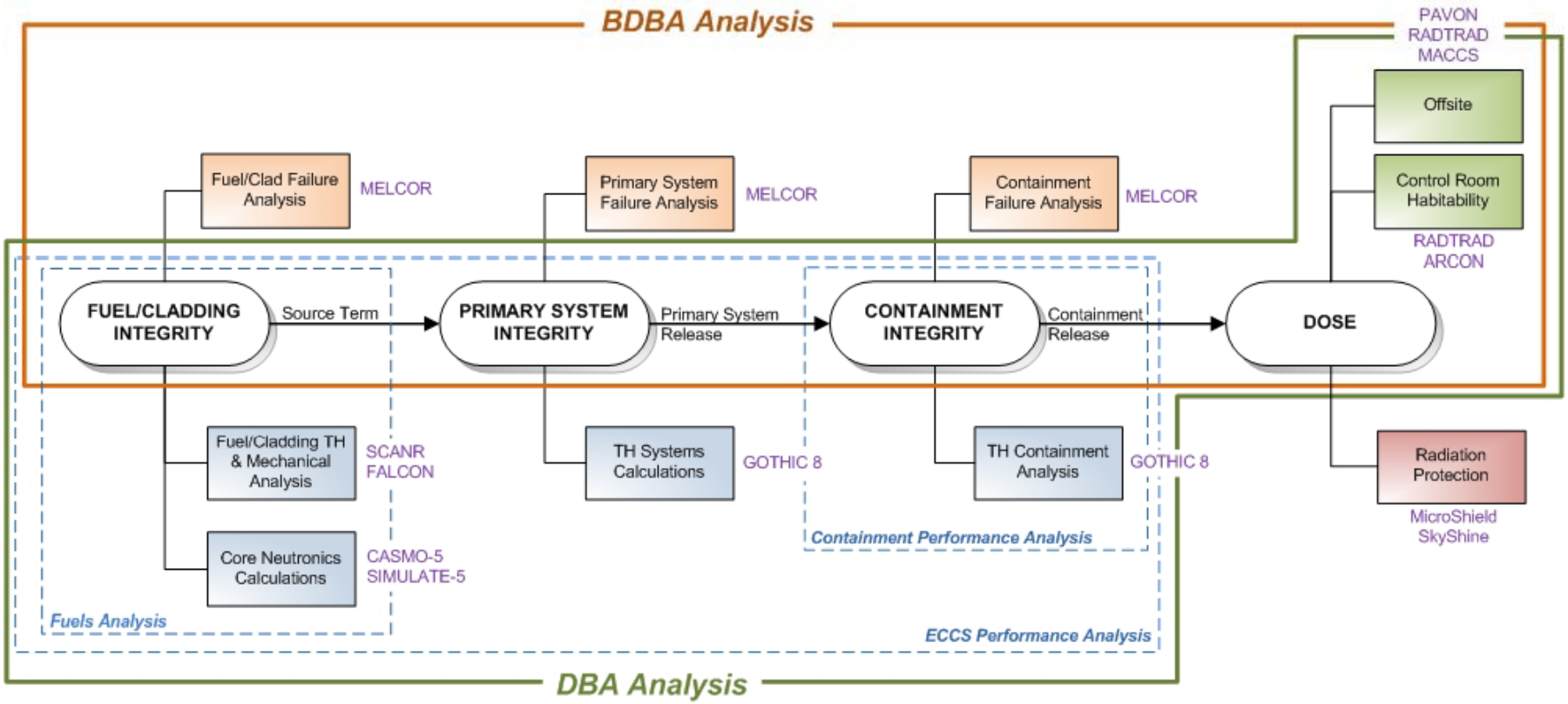
Introduction

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



NuScale Power

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						
SCANR	Core Thermal-Hydraulics	Core Subchannel Analysis	NuScale						
SIMULATE	Core Neutronics	Core Design, RAIs	Studsvik						
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

NuScale Power

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