INEST

Institute for Nuclear Energy Science and Technology

Safety and Licensing CORE

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CORE MISSION

- To guide strategic investments that will enable INL to effectively support DOE-NE in addressing critical issues in nuclear power Safety and Licensing
- Identify key issues and paths toward issue resolution by improving communication between industry and NRC
- Establish greater linkages with U.S. universities to:
    - Stimulate innovative research at INL
    - Enhance educational and training opportunities for INL staff
    - Provide a resource of highly-qualified future staff

CORE VISION

- As the result of SL-CORE initiatives, INL will have been positioned to have a major role in assuring:
  - The adoption of a more effective (post-Fukushima) regulatory framework
  - Plant life extension to 80 years
  - Power uprates
  - Licensing of Generation 3 plus applications
  - Licensing of SMRs
- The CORE will provide a think-tank in which INL, university, industry and federal personnel can identify solutions to regulatory issues.

CURRENT STATE

- The Fukushima accident completely changed the character of opportunities and challenges for INL in the area of safety and licensing.

CURRENT STATE

- Substantial changes will be made in the U.S. regulatory framework as the result of Fukushima accident
- INL has strengths upon which to make safety and licensing a major thrust area and to assist in the implementation of effective improvements in the regulatory framework
- SL-CORE has identified a number of areas in which INL capabilities can be strengthened to satisfy a national need
- At the end of this presentation, these will be discussed in some depth to obtain comment by the advisory committee

OPPORTUNITIES

(Including funding opportunities)

- Near-Term
  - Establish INL as a center of expertise for the risk-informed assessment of external hazards
  - Assume a lead role in the risk-informed assessment of spent fuel management practices
- Long-Term
  - Assume a lead role for INL in a national Severe Accident Response Support Center and in the performance of research leading to improved capability to mitigate severe accidents

CAPABILITIES

- INL
  - Nuclear power plant risk assessment
  - Advanced simulation within the context of risk-informed safety margins
  - Integral and separate effects experiments with prototype nuclear materials
  - Post-test examination facilities
- University
  - Advanced simulation modeling support
  - Integral and separate effects experiments
  - Specialized facilities, such as for research related to natural phenomena hazards, instrumentation and control systems, and materials development

COMPETITORS

In general, INL's principal competitors are other national laboratories: ANL, SNL, PNNL, BNL, ORNL, LANL, LLNL depending on the specific opportunity.
For each of the Safety and Licensing opportunities identified, collaboration with other DOE laboratories will be essential.

FY 2011 GOALS AND OBJECTIVES

- Expand knowledge of the INEST concept and Safety and Licensing CORE objectives to U.S. universities with safety and licensing interests and capabilities
- Survey the capabilities and facilities of the U.S. universities for thermal-hydraulic research
- Initiate LDRD activities with substantial university support that represent potential growth areas for INL

FY 2011 ACCOMPLISHMENTS

- A report was prepared describing the various thermal-hydraulic facilities at U.S. universities
- An effort was initiated to develop a roadmap for implementation of advanced methods of treating two-phase flow in next generation safety analysis codes (multi-university involvement)
- A “regional meeting” was held at OSU involving Georgia Tech, Purdue, Michigan, Tennessee, MIT, NC State, OhSU, OrSU, Wisconsin and six INL participants
- An LDRD effort was initiated “Science-Based Simulation Model of Human Reliability Analysis,” Dana Kelly, Ron Boring, C. Smidts (OhSU), Ali Mosleh (UMd)

FY 2011 CORE FUNDING

	Allocation	How Used
Program Development	$80,000	– Support for Extended Advisory Committee meeting and interactions – Development of proposals for post-Fukushima S&L R&D – $56,777 subcontract to OSU for road-mapping exercise on thermal-hydraulics research for reactor safety
LDRD	$134,500	$90,000 used for Kelly-Boring-Smidts-Mosleh LDRD "start-up" in HRA
University Contract	$71,200	– Technical lead and support for analytical activities/whitepapers/planning – CORE management activities
University Training	$22,000	Two PhD students from Oregon State University spent summer internship in INL's Risk and Safety groups
Workshops	$30,000	– INL-ACEs Mini-workshop on Uncertainty Quantification at OSU – Regional meeting

UNIVERSITY CONTRIBUTIONS

- Strategic planning – revised strategic plan; provided input to overall INEST plan
- Meeting planning – Regional meeting, advisory committee meeting
- Preparation of white papers on potential INL safety and licensing activities
- LDRD promotion and proposal review

FY 2012 GOALS AND OBJECTIVES (1)

- NRC response to Fukushima has had major impact on SL-CORE objectives
  - Advisory Committee meeting held August 18 and 19
  - Activities recommended to better position INL to support national needs in improving the regulatory framework, risk-informing regulations, and providing emergency response assistance in the future
  - Proposed FY2012 LDRD activity related to severe accident risk management and emergency response provides a vehicle by which early results could strengthen INL's position for a leadership role

FY 2012 GOALS AND OBJECTIVES (2)

- Administer INEST LDRD activities
  - “Science-Based Simulation Model of Human Reliability Analysis,” Dana Kelly, Ron Boring, C. Smidts (OhSU), Ali Mosleh (UMd) – Extended project
  - “Uncertainty Quantification of Safety Codes using a Bayesian Approach with Data from Separate and Integral-Effects Tests,” Dana Kelly, Jacopo Buongiorno (MIT)

FY 2012 GOALS AND OBJECTIVES (3)

- Promote and select new LDRD activities
- Continue the activity with university support to develop a two-phase flow implementation roadmap
- Hold a workshop on the development of a societal safety goal

FY 2013/2014 GOALS AND OBJECTIVES

- Highly dependent on progress toward FY2012/2013 goals

NEEDS

- The regulatory response to Fukushima has opened a number of potential areas in which INL could take a lead laboratory role that requires close cooperation with INPO or EPRI.
- High level contact between INL management and industry management is required as a first step to a collaborative relationship.

RISKS AND RISK MANAGEMENT

- Risk of conflict with other DOE laboratories
  - In pursuing opportunities, potential roles will be identified for other DOE laboratories
- Risk of failure to pursue opportunities with payback
  - Guidance by experienced members of advisory committee

MEASURES OF SUCCESS

- Success of the SL CORE is determined by whether the CORE has an impact on positioning INL to better serve its lead DOE laboratory role in nuclear energy, has improved the quality of research at the laboratory, or has provided high quality employees to the laboratory.
- More timely and objective measures of success for previous year:
  - Publications: 3
  - Staff exchanges: 5
  - Students/postdocs: 4
  - Patent: 0
  - Community interfaces: 3
  - Grants: 0
  - Invited talks: 0
  - Reports: 2

SUMMARY

- The Fukushima accident could potentially have a negative impact on the future of nuclear energy in the U.S.
- Foreseen changes in the U.S. regulatory framework provide both opportunities and challenges for INL.
- The SL-CORE is working to assist laboratory technology leaders in identifying project opportunities and areas in which staff capabilities should be upgraded.

Opportunities/Challenges for INL

90-Day Report

- Recommendation 1. Establishing a logical, systematic, and coherent regulatory framework for adequate protection that appropriately balances DID and risk considerations
- Recommendation 2. Require licensees to reevaluate and upgrade as necessary the design-basis and flooding protection of SSCs
- Recommendation 3. Longer term review. NRC evaluate potential enhancements to the capability to prevent or mitigate seismically induced fires and floods.
- Recommendation 4. Strengthen SBO mitigation capability at all operating and new reactors for DB and BDB external events.

Opportunities/Challenges for INL

- Recommendation 5. Require reliable hardened vents in both Mark I and Mark II
- Recommendation 7. Enhance spent fuel pool makeup capability and instrumentation
- Recommendation 8. Strengthening and integrating onsite emergency response, EOP, SAMG, EDMG
- Recommendation 9. Require that facility emergency plans address prolonged SBO and multiunit events.

Opportunities/Challenges for INL

Industry Response Plan

- Immediate response
  - Industry response centers established (?)
  - Four directives from INPO
  - Industry-wide response organization (?)

EU and Japanese Planned Stress Tests

- Determine role in new regulatory framework

International Plans

- IAEA and CSNI plans mirror 90-day report, particularly related to beyond design basis events

Severe Accident Response Support Center

- Objective: Provide immediate assistance to NPP experiencing or anticipating severe accident conditions
- INL would play a coordinating role with assistance from other DOE laboratories
- NRC's 90-day report recommends:
  - Major changes in the regulatory framework related to beyond design basis events
  - Integrated approach to EOPs and SAMGs
- INL staff would perform research related to:
  - Severe accident behavior
  - A coherent treatment of EOPs, SAMGs, and EDMGs
  - Advanced simulation of beyond design basis accident behavior
  - Development of training tools for Technical Support Center
  - Independent validation of revised SAMGs

Support Center (2) – Why INL?

- To provide effective guidance technical staff must understand both severe accident behavior and nuclear system design
  - NRC SPAR program offers unique understanding of plant design differences
- Beyond design basis events have large uncertainties that will require advanced simulation within the context of risk-informed safety margins
- New validation requirements for beyond design basis simulation will require experimental facilities and a quantitative (Bayesian) approach to validation

Support Center (3) – How do we make it happen?

- Need to convince:
  - DOE-NE about the need
  - Industry about the value in working cooperatively
  - Other DOE labs to accept support roles in areas of their expertise
- Need early INL upper management contacts with INPO, EPRI, (NEI?), and DOE-NE
  - INL staff to prepare white paper (based on minutes of SL CORE advisory committee meeting)

Core Competency in Natural Phenomena Hazards Analysis

- DOE labs no longer have major competency in the analysis of natural phenomena hazards
- Recent events provide further evidence that external events could be the principal sources of NPP risk
- New regulations will need to be developed within a risk-informed framework
- Universities have some unique facilities that would not have to be duplicated at INL
- Because of the high demand for specialists, staff capabilities would probably have to be developed internally with assistance from consultants

Core Competency in Spent Fuel Management

- Upgrading the protection of spent storage pools at NPP sites is an element of a broader need for assuring the safety of a revised national approach for disposal of spent fuel
- Model development is required to realistically assess spent fuel storage pool risks
- A Level 3 PRA is required to assess the magnitude of the problem and to select the best alternatives