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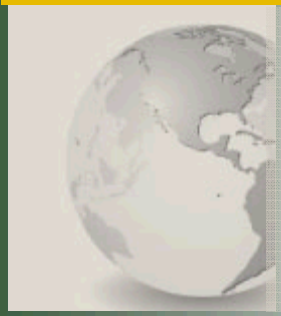

NE-KAMS

Nuclear Energy Knowledge base for Advanced Modeling and Simulation

October 24, 2012

NE-KAMS TEAM

Outline

- 2012 Goals and Objectives
- Data/Knowledge Base Assessment
- Benefits of NE-KAMS
- High-level Demonstration Achievements
- Demonstration Approach and Highlights
- CFD Data Assessment
- NE-KAMS Proof-of-Concept
- Short- and Long-term Outlook

2012 Goals and Objectives

- Conduct a data/knowledge base assessment to differentiate NE-KAMS functionality and attributes
- Develop a proof-of-concept system that demonstrates the added benefits NE-KAMS will bring to programs that rely on modeling and simulation for safety analysis
- Create a cost-effective strategy for developing a focused demonstration for select DOE customers that result in the delivery of a useful product
- Prepare a long-term cost-benefit plan that creates the opportunity for nuclear energy M&S programs to share NE-KAMS benefits and cost

Data/Knowledge Base Assessment

- Assessed 20 data/knowledge bases
  - Most are V&V and M&S databases for CFD and exist outside of the nuclear domain
  - No standards, requirements, best practices guidance for V&V/UQ
  - No explicit process for quality assurance
- Why we're different
  - V&V standards and guidelines (computational models and V&V benchmark data)
  - True knowledge base with quality assessed V&V/UQ benchmark data
  - Web-enabled V&V and UQ tools and utilities
  - Modular, relational and digital database structure
  - Ability to connect to other data sources in a federated fashion

Benefits of NE-KAMS

- Bridge the gap between experimentalists and computational scientists
- Ready access to experiment data and associated knowledge, e.g., design documents, metadata, videos, etc.
- Standardized approach to V&V and UQ for computational models and simulations across the NEAMS program
- Ready access to quality assessed V&V and UQ benchmark data for V&V and UQ assessments and computational methods development
- Ready access to federated systems that contain quality tagged data
- Long-term storage and protection of valuable data

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High-Level Demonstration Achievements

- Highlights key features and functionality required for V&V/UQ
- Designed and developed to support collection, qualification, and integration of CFD and thermal hydraulics experimental data, metadata and related information for computational methods development
- Provides basic infrastructure for long-term development, including
  - Data warehouse to store experimental data, documentation, V&V results, videos, etc.
  - Knowledge base with standards, requirements and best practices for V&V and UQ
  - System software and hardware infrastructure (ORNL)
  - Dedicated website for remote access (ORNL)

Demonstration Approach

- Continue with original team from Bettis, INL, ANL, Sandia, added Weiju Ren, ORNL
- Develop a bridge between NEAMS integrated performance and safety codes and experiments to ensure smooth flow of data requirements
- Springboard from established GEN-IV framework, software, hardware and operation protocols
- Assess, collect, qualify and integrate CFD and T/H experiment data, metadata and related information
- Obtain sample set of CFD validation data from ANL MAX test

Demonstration Highlights

- Created an instance of GEN-IV Handbook, developed by Weiju Ren at ORNL
- Technology Features Utilized
  - Collection, sematic tagging and systematic documentation
  - Initial structuring and classification
  - Quality assessment module with logic structure
  - Archiving, storing, and integration into data warehouse and relational database
  - User access, processing and privileges
  - Records management
  - Data authentication, security and administration
- Drastically reduced cost of demonstration

CFD Data Assessment

- Completed assessments of validation experiment datasets
  - Flow in a cylinder array (Utah State University)
  - High Reynolds number pipeflow (Bettis)
  - Bluff bodies and cross flow (Bettis)
  - VHTR lower plenum flow data, Matching Index of Refraction (MIR) Facility (INL)
  - European Research Community data on flow turbulence and combustion (ERCOFTAC)
  - Code verification benchmarks
- ANL CFD MAX test data including experiment data, associated design documents, metadata, videos of experiment and data measurement techniques, etc.

Proof-of-Concept

- Using the GEN-IV Handbook infrastructure
  - Incorporated and modified data warehouse
  - Designed ANL MAX relational database schema
  - Adopted and redefined network design
  - Designed and implemented knowledge base backup system per ORNL Cyber Security requirements
  - Adopted and configured system security requirements
  - User accounts, privileges and system administration processes and procedures
  - Developed NE-KAMS User Manual, ready for distribution
- Established web domain name (www.nekams.ornl.gov)
- Created new NE-KAMS home page and user interface

Proof-of-Concept Cont'd

- Collected and uploaded ANL MAX CFD validation data, metadata, and related information into data warehouse
- Processed, formatted, and archived data files
- Performed initial quality assessment on data to determine best path forward for future quality assurance tagging

NEAMS Next Steps - Proposal

- Development and implementation of CFD and T/H V&V data and information management system for SHARP suite
  - ANL MAX datasets (separate effect test data)
  - ANL NSTR datasets (integral effects test data)
- Completion of the NEAMS Pathways Demonstration
  - A collaboration with NEAMS experimentalists and computational scientists
  - V&V and UQ process demonstration with the use of NE-KAMS CFD and T/H V&V data and information management system
- NEAMS Pathways Workshop highlighting ANL MAX datasets and NE-KAMS CFD and T/H V&V data management system and its use

One-Year Outlook

- Obtain funding for 2013
- Move from proof-of-concept to implementation
- Collect, document, quality assess, and integrate CFD and T/H validation datasets
- Collect, document, quality assess, and integrate CFD code verification datasets
- Continue development of V&V data standards and requirements
- Initiate development of NE-KAMS V&V Best Practices Guideline