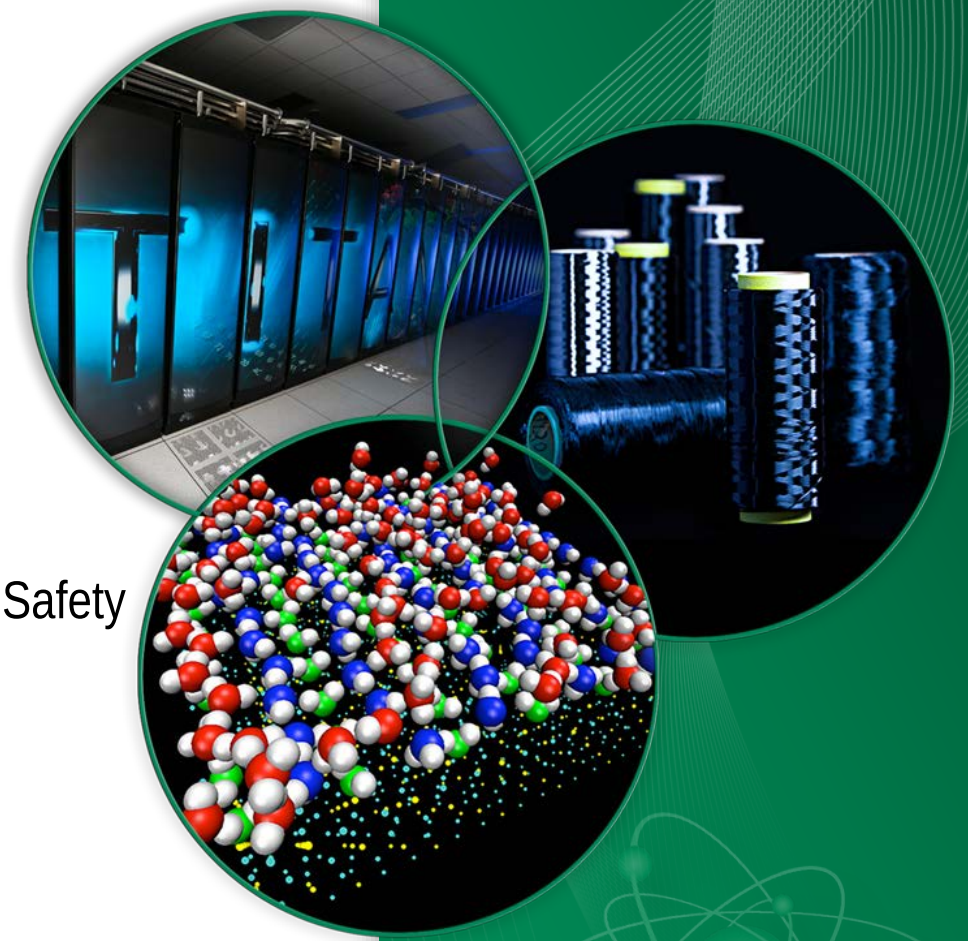
US Nuclear Criticality Safety Program (NCSP) Analytical Methods Working Group



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March 19, 2015

Agenda

- Brief review of AM WG Meeting on November 5, 2014 at BNL
- CSSG proposal for QA'd benchmark input files
- Discussion of site QA requirements for NCS software
- Future tasks for WG
- Time/place of next AM WG meeting

US DOE NCSP AM Working Group

- **Objective:** Improve overall quality of NCSP AM capabilities (cross-section processing and radiation transport) and strengthen core AM capabilities for accomplishing NCSP Mission and Vision
- Technical focus areas:
  - Develop and implement common SQA practices
  - Identify and implement code modernization strategies to position NCS tools for future computer architectures;
  - Investigate and solve challenging Monte Carlo transport problems that are difficult for state-of-the art NCS transport codes;
  - Strengthen the linkage with the Integral Experiments Program Element by developing and implementing needed AM capabilities for designing/analyzing NCS integral experiments;
  - Identify and implement needed sensitivity/uncertainty (S/U) capability improvements for NCS;
  - Perform processing and radiation transport code comparison studies (e.g., radiation transport for systems that are sensitive to the unresolved resonance region) to help identify issues and implement capability improvements;
  - Etc.

Recap from Nov 5, 2014 Meeting

- Presentations from different sites on status of current NCSP AM capabilities including SQA and plans for development, maintenance and modernization
  - LANL: MCNP6, NJOY-2012.8, plans for NJOY21
  - LLNL:
    - MC: TART, COG, and MERCURY
    - Processing: PREPRO, FUDGE, BIGFIT, KIWI, and NCSU
    - Sn: ARDRA
  - ORNL: SCALE and AMPX
  - IRSN: MORET5, MACSENS/BERING, GAIA
- Spent time discussing possible tasks for AM investigation and comparison studies

Comments on the focus areas

* Common (or shared) SQA practices;
* Code modernization (new codes - FUDGE, ARDRA, MERCURY);
* Challenging problems (OECD NEA EG);
* AM linkage with IE needs (as-built geometry, S/U, deep penetration, multiplicity);
* Sensitivity/uncertainty (S/U) capabilities (KIWI);
* Intercomparison studies (Cullen);
* Etc (ADVANCE, J30).

All codes are continuously improved. FUDGE, MERCURY and ARDRA are recent codes designed to take advantage of modern computing platforms.

Possible NCSP-AM Monte Carlo Collaboration Topics (from Forrest Brown)

- MC parallel computing algorithms
  - MPI, threading, mixed
  - asynchronous schemes
- MC code optimization, modernization
- MC source convergence - automated testing, acceleration
- MC on future computers - Intel Xeon Phi in particular, since we are getting loads of those with the Trinity system. (1 processor = 60 cores x 4 hyperthreads/core = 240 threads)
- Coverage
  - also called "detection of undersampling“
  - interesting challenge: how can you tell if there are too-few particles in a region to get good tallies, when you need particles to give you that information?
  - the OECD expert group EGAMCT has been looking into this, at IRSN, CEA, ORNL.
  - ORNL (Perfetti) has tried a couple of metrics for diagnosing undersampling, based on ideas from Markov chain analysis methods. Similar in concept to convergence checking based on Shannon entropy.
  - Eric Dumnteil (CEA) is also looking at the theory of particle clustering, using ideas from statistical physics
  - Brian & I dabbled in this a few years ago, to try to assess the quality of mesh tallies.

Possible NCSP-AM Processing Topics (from Morgan White)

- Build upon WPEC SG38 effort to develop/test new, modern ENDF data format
- Define “isotope of tedium” for comparison between processing codes
  - Morgan expressed willingness to define comparison test
  - Goal is to exercise processing capabilities all the way from ENDF→processing→ transport
    - 1D CE cross-sections [resonance parameter formats (e.g., LRF=7), Doppler broadening]
    - Kinematics [including S(a,b)]
    - Probability tables,
    - Etc.

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