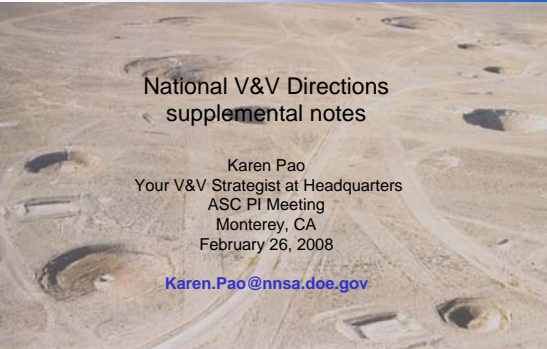


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**National V&V Directions
supplemental notes**

Karen Pao
Your V&V Strategist at Headquarters
ASC PI Meeting
Monterey, CA
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The Defensible Simulation

- Every simulation needs a *provenance*, which may include:
 - A *process* that enables one to “trace back” the state of code,
 - A catalog of tests performed and passed,
 - Documented parameter settings,
 - Understanding of the uncertainties at the time of the run
 - References to open literature, articles, reports, etc.,
 - Manuals (user, physics, and methods),
 - Peer review performed,
 - ...

V&V provenance shows that the simulation has been performed in a credible manner.



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The Quantifiable Simulation

- The *analysis* and *interpretation* of the simulation output need to be presented in a quantified manner:
 - What are the uncertainties? How big?
 - What are the error bars?
 - What are the right metrics for expressing the results?
 - Was it right? How good was it?
 - ...

Good scientists should not leave it as an exercise for the readers to figure out what it all means!



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The Discovery-Enabling Simulation

- The simulation is not the end; it opens the door for more scientific inquiries:
 - What did the result mean?
 - What experiments can be done to validate/disprove model?
 - Which model needs to be looked at further?
 - What improvements are urgently needed?
 - What matters and what doesn't?
 - ...

*The scientific community at large is already using simulations for discovery – it's now just a matter of time before someone demands **credibility!***



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The “Steady State” V&V Program


The long-term V&V program consists of these elements:

- Day-to-day assessment and analysis, plus documentation and quality assurance;
- Research and development of tools to facilitate continuous improvement to our understanding of the complex system under the hood;
- A “test bed” for numerical methods, physics models, and UQ methodologies – comprehensive assessment of new technology for use in production.

*V&V should not be about giving the impression that our codes are right...
V&V should be about “asking the hard questions!”*




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Proposed New V&V Work Breakdown Structure (WBS) and Descriptions

- Verification applications
 - Numerical error estimates/bounds
- Validation, UQ, and Metrics applications
 - Analysis & result representation
 - Test suites development, modeling, analysis, and archiving
 - UQ applications, e.g., sensitivity studies, statistical analysis, etc.
- Support Codes V&V
 - Anything that touches the “mainline product” that needs scrubbing, for example, codes for generating EOS tables and fundamental data, links, etc. – *our V&V is only as good as the weakest link!*
- Experimental Data Quality Assurance
 - Like it or not, experimental data (NTS, AGEX, etc) are our only indication whether the simulation tools are good for the intended purpose! We need to milk them for all they've got, no more, no less.
- SQE/SQA
 - Focus on “feedback” not on “requirements” – “quality” needs to contribute concretely to code improvement
- Foundational Research & Application
 - Adjoint methods, polynomial chaos, PRA, etc. – the blue sky stuff that'll ready us for the future – but not, for example, hydro methods research



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