

# CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

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## TRIP REPORT

**SUBJECT:** TransAtlantic Uncertainty Colloquium Workshop  
Project No. 06002.01.352  
AI No. 06002.01.352.700

**DATE/PLACE:** October 10–11, 2006  
Washington, DC

**AUTHOR:** Olufemi Osidele, Center for Nuclear Waste Regulatory  
Analyses (CNWRA)

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### PERSONS PRESENT:

About 40 invited attendees from the United States, the United Kingdom, and the Netherlands were presented. A list of participants is attached and also published on the workshop website at <http://www.modeling.uga.edu/tauc/>.

### BACKGROUND AND PURPOSE OF TRIP:

The aims of the workshop were to (i) identify key research needs on handling uncertainty at the interfaces among environmental science and engineering, policy, and law and (ii) establish a multidisciplinary network of experts from the United States and the European Union to address these needs. The workshop was sponsored by the National Science Foundation and the U.S. Environmental Protection Agency (EPA). The major themes of the workshop were models and methods of analysis; science and society; technology and risk; policy and administration; adaptive management; and the legal context.

### SUMMARY OF PERTINENT ACTIVITIES:

The workshop featured three topical sessions and an open public forum. The topical sessions addressed models and analysis methods, political science, and legal aspects of environmental regulation (see the attached workshop agenda). In each session, background papers—circulated to participants prior to the workshop—were presented, followed by case studies mainly on water management, air quality, and pharmaceuticals. Participants critiqued the background papers and case studies and discussed areas of improvement needed to effectively integrate the science, engineering, policy, and legal aspects presented. Viewgraphs of the presentations will be published on the workshop website in due course.

Notable presentations were delivered by Andrea Saltelli (European Union Joint Research Center), Bruce Beck (University of Georgia), and Kenneth Reckhow (Duke University) on modeling and uncertainty analysis. Saltelli and Beck presented three criteria for evaluating the quality of a model—fidelity, relevance, and transparency. Fidelity addresses the theoretical bases of the model; in other words, it asks whether the model has been developed with concepts generally

accepted by the relevant subject matter community. Relevance measures how well the model is suited to the task for which it was designed. Transparency indicates how much trust a stakeholder can place in the model and, by extension, the credibility of the model developer(s). The presenters described a model as an archive of current hypotheses about the behavior of a system, an instrument for forecasting and foresight generation in the making and evaluation of an environmental policy or decision, an agent for communicating science to stakeholders, and a vehicle for discovering new knowledge. Saltelli also described current mathematical methods for conducting uncertainty and sensitivity analyses of model outputs, ranging from scatter plots to Monte Carlo and variance-based methods.

Reckhow discussed the role of uncertainty analysis in the EPA Total Maximum Daily Load program with a case study on uncertainty evaluation of fish kills in the Neuse Estuary, North Carolina. The Total Maximum Daily Load program, established by the 1972 Clean Water Act, requires states to identify water bodies not meeting water quality standards, determine the allowable pollutant load to achieve compliance, and oversee implementation of the necessary pollutant load reductions. Three distinctly different models applied in the Neuse Estuary study produced similar levels of precision in predictions of environmental consequences. Reckhow described how one of the models, a Bayesian network model, has become a useful tool for communication between modelers and stakeholders. He also demonstrated adaptive implementation of pollutant load reductions by using the Bayesian network model to provide and update probabilistic statements of uncertainty.

The presentations and ensuing discussions identified two forms of uncertainty—transient and intrinsic. The transient form of uncertainty was characterized by reducibility, objective scientific analysis, and quest for a single, accurate relationship between cause and effect. With this notion of uncertainty, decisionmaking would ultimately rely solely on information provided by experts. On the other hand, the intrinsic form of uncertainty calls for adaptation to imperfect knowledge, deliberation among experts and nonexperts, and participative decisionmaking. Olufemi Osidele discussed the peculiar challenges of uncertainty in long-term estimation of environmental consequences associated with radioactive waste disposal and underscored the need to address temporal variability and scenario uncertainties along with conventional parametric uncertainties.

During the public forum, questions and opinions were invited from stakeholders and staff of federal agencies in attendance. George Gray (EPA Assistant Administrator for Research and Development) reiterated the challenges and trade-offs in making environmental decisions under uncertainty. He advised that research planning be aimed at identifying the important uncertainties to better focus available resources. He spoke of a new initiative to improve the way EPA conducts and applies uncertainty analysis. He also stated that help was needed in improving trust and credibility by making data and models accessible to users and communicating uncertainty to stakeholders. Tom Nicholson [U.S. Nuclear Regulatory Commission (NRC) Office of Research] emphasized the need to clearly identify the different forms of uncertainty that characterize environmental problems. He stressed the need for more research on analytical methods for addressing model structure uncertainty.

## **CONCLUSIONS:**

This workshop offered a unique opportunity to compare United States and European Union perspectives on uncertainty in terms of environmental regulation. With regard to models and uncertainty analysis, because experts in the United States and European Union both draw from the same general body of knowledge, there was consistency between the United States and European

Union on the methodological aspects of uncertainty analysis. Differences in policy and legal aspects were attributed mainly to differences in political and social structures between the United States and European Union. The workshop also provided a forum to share ideas on the treatment of uncertainty with professionals and stakeholders involved with environmental management.

**PROBLEMS ENCOUNTERED:**

None.

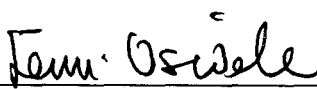
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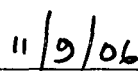
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**RECOMMENDATIONS:**

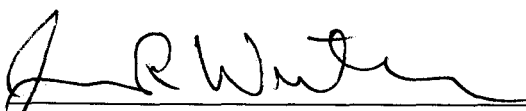
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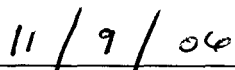
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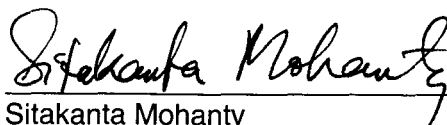
  
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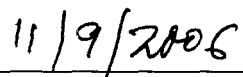
  
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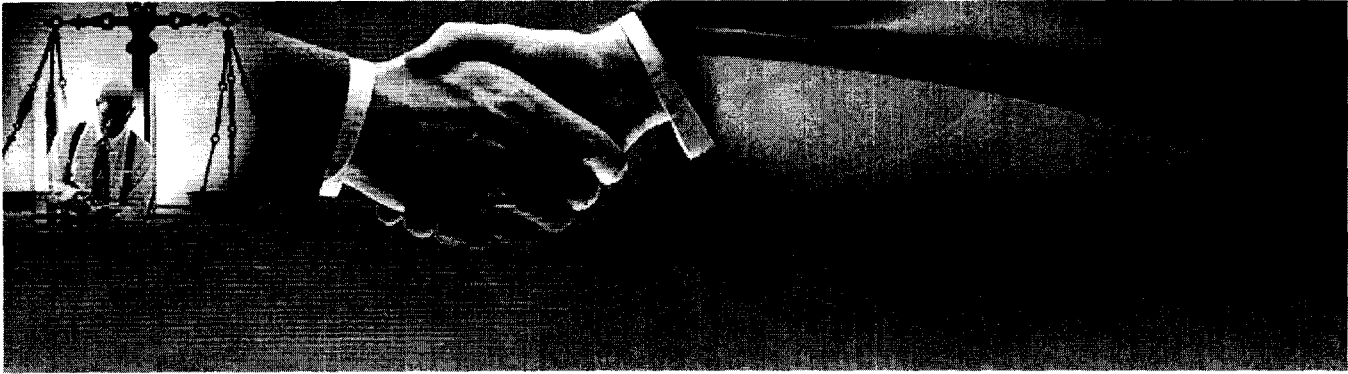
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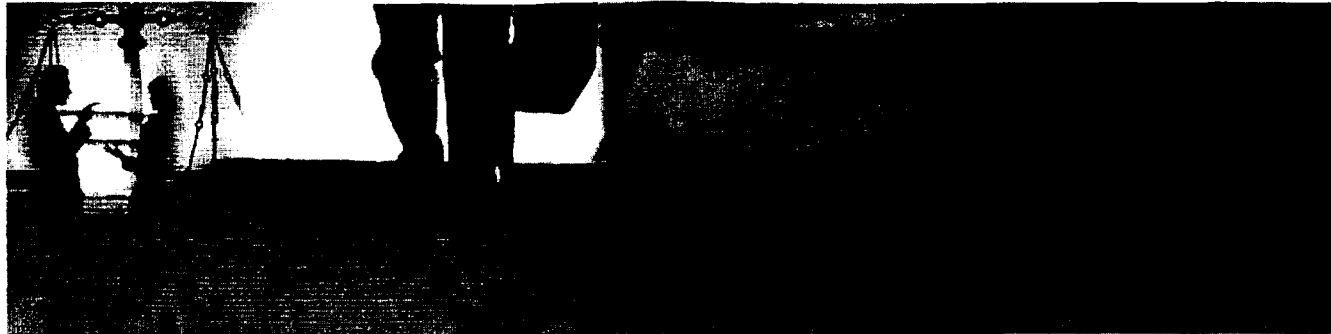
## Organizers and Participants

- Home
- Registration for Workshop
- Hotel Logistics
- List of Organizers and Participants
- Agenda
- General background papers
- Case studies
- Original proposal
- Other papers
- Call for Research in Uncertainty
- Analyses of Models in Integrated Environmental Assessments
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## AGENDA

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Time	Activity	Location
<b>DAY 1: Tuesday 10 October</b>		
7.45-8.15am	REGISTRATION & COFFEE	Culpepper Room
8.15-8.20am	Welcoming Remarks (US EPA and US NSF)	Culpepper Room
8.20-8.30am	<b>INTRODUCTION &amp; Overview</b> ➤ Introduction and Overview: Handling Uncertainty in Models Used to Formulate Environmental Policy (M B Beck); Purpose of TAUC; Purpose/Structure of Workshop; Expected Outcomes.	Culpepper Room
8.30-9.00am	➤ Underlying Theory and Method #1: Models and Uncertainty Analysis and Sensitivity Analysis (UASA) in the Policy Context (A Saltelli)	Culpepper Room
9.00-9.30am	➤ Underlying Theory and Method #1: Models and Uncertainty Analysis and Sensitivity Analysis (UASA) in the Policy Context (M B Beck)	Culpepper Room
9.30-9.50am	➤ Underlying Theory and Method #1: Invited Discussants (S Ney and P Ayton)	Culpepper Room
9.50-10.05am	Break	
10.05-	➤ Underlying Theory and Method #1: General Discussion	Culpepper Room

10.30am		
10.30-11.10am	➤ Case Study #1: Water Policy in the USA and the EU (K H Reckhow)	Culpepper Room
11.10-11.30am	➤ Case Study #1: Invited Discussants (A Petersen and M Borsuk)	Culpepper Room
11.30-12 noon	➤ Case Study #1: General Discussion	Culpepper Room
12 noon-1.00pm	LUNCH	Latrobe Room
1.00-1.40pm	➤ Underlying Theory and Method #2: The Political Science/Economy of Disputation and Negotiation Amongst Affected Parties (K Oye and L Mccray)	Culpepper Room
1.40-2.10pm	➤ Underlying Theory and Method #2: Assessing the Quality of Evidence for Complex and Contested Policy Decisions (J P van der Sluijs and J Ravetz)	Culpepper Room
2.10-2.30pm	➤ Underlying Theory and Method #2: Invited Discussants (R Lofstedt and J Mysiak)	Culpepper Room
2.30-3.00pm	➤ Underlying Theory and Method #2: General Discussion	Culpepper Room
3.00-3.15pm	Break	
3.15-3.55pm	➤ Case Study #2: Policy on Air Quality in the USA and the EU (K Martin and A Petersen)	Culpepper Room
3.55-4.15pm	➤ Case Study #2: Invited Discussants (J Babendreier and C Frey)	Culpepper Room
4.15-4.45pm	➤ Case Study #2: General Discussion	Culpepper Room
4.45-5.30pm	➤ Synthesis #1: Open Discussion Aimed at Providing (Provisional) Integration Amongst the Theory and the Method and Amongst the	Culpepper Room



	Case Studies.	
6.30pm	DINNER	La Chaumiere
<b>DAY 2: Wednesday 11 October</b>		
8.00-8.40am	➤ Underlying Theory and Method #3: The Legal Discourse (P Pascual, W Wagner, and L Fisher)	Culpepper Room
8.40-9.00am	➤ Underlying Theory and Method #3: Invited Discussants (S Gardner and A Finkel)	Culpepper Room
9.00-9.30am	➤ Underlying Theory and Method #3: General Discussion	Culpepper Room
9.30-9.45am	Break	
9.45-10.25am	➤ Case Study #3: Policy on Pharmaceuticals (and Other Technologies) in the USA and the EU (K Oye, L Mccray, G Mukunda, and M Defiguerido)	Culpepper Room
10.25-10.45am	➤ Case Study #3: Invited Discussants (L Shabman)	Culpepper Room
10.45-11.15am	➤ Case Study #3: General Discussion	Culpepper Room
11.15-12 noon	➤ Synthesis #2: Open Discussion Aimed at Providing Integration Amongst the Theory and the Method and Amongst the Case Studies; with special reference to presenting a thought-provoking introduction to Open/Public Session.	Culpepper Room
12 noon-1.00pm	Break	Latrobe Room
1.00-3.00pm	➤ OPEN PUBLIC FORUM/SESSION: Handling Uncertainty in Models Used to Formulate Environmental Policy: What The Stakeholders Want.	Culpepper Room

	➤ Opening Remarks (M B Beck) [5 minutes]	Culpepper Room
	➤ Introductory Remarks (US EPA) [5 minutes]	Culpepper Room
	➤ Summary of US and EU Perspectives from Discussions of: Legal Discourse (W Wagner and L Fisher); Models & Natural Sciences/Engineering (J P van der Sluijs and M Borsuk); Political Science/Economy (K Oye and A Petersen) [30 minutes]	Culpepper Room
	➤ Questions and Answers [30-70 minutes]	Culpepper Room
	➤ EPA RfP on Uncertainty [10 minutes]	Culpepper Room
3.00-3.30pm	BREAK	Culpepper Room
3.30-4.30pm	Closure and Beyond TAUC: WAUCing the TAUC — Next Steps?	Culpepper Room
<b>DAY 3: Thursday, 12 October</b> [For those able and willing]		
8.30-10.30pm	TAUC Project meeting (open to all)	EPA Office (details TBA)

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