



# Bellefonte Hydrology

## COL Application Review

September 12, 2008



# Background

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- NRC QA Inspection found that TVA's existing documentation supporting in-house engineering software computation codes (SOCH) and river system model inputs used to calculate the Bellefonte site Probable Maximum Flood (PMF) was not readily available.



## Background (cont'd)

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- TVA determined that existing documentation did not meet new reactor regulatory expectations.
  - TVA river system inputs (geometry, dam rating curves, and unit hydrographs) were compiled by TVA River System using good engineering practices (but not documented as Nuclear QA records), and
  - Engineering computational software had not been controlled to Nuclear QA software standards.



# TVA Plan

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- Compile river system inputs into Nuclear QA documentation (design calculations).
- Verify and Validate (V&V) TVA's in-house engineering computation codes (SOCH) and maintain to QA software standards.
- Rerun SOCH to confirm PMF value.
- Make copy of input data calculation packages and SOCH codes, along with users manuals available to NRC to support COL application review.



# Scope of Work

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- Producing Nuclear QA calculations to document:
  - 46 Unit Hydrographs,
  - 12 River Basin Geometry packages,
  - 20 Dam Rating Curves,
  - SOCH Model Calibrations,
  - Reservoir Storage Tables,
  - Reservoir Operation Fixed Rules,
  - PMF Inflow Determination, and
  - SOCH PMF computation.



## Scope of Work (cont'd)

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- Other SOCH documents include:
  - Calculation documenting and verifying 19 SOCH runs,
  - 4 User Manuals for SOCH and sub-codes,
  - 4 Software Requirements Specifications,
  - 4 Software Design Documents, and
  - 4 Software V&V Reports.
- Selected Bechtel to support TVA.



# Hurdles

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- Complexity of River Model.
  - Independence of code.
  - Magnitude of input data.
  - River Basin Geometries.
- Moving from non-nuclear QA (River Operations) processes and documentation.
- Interactions between nuclear hydrologists and TVA River System hydrologists.
- Limited key resources available.



# NRC/TVA Interactions

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- White Paper outlining objectives, process and commitments.
- June Workshop detailing SOCH Codes and Model.
- TVA proposed phased review (July letter).
- NRC Schedule Impact Letter (July 2008).
- TVA initiatives to minimize review schedule impacts through aggressive plan and work.





# Deliverable Status

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- Available for NRC review:
  - Blue Ridge Dam Basin Unit Hydrograph Calculation,
  - SOCH User Manual,
  - User manuals for three SOCH sub-codes (DBREACH, CONVEYANCE, and WTDWIDTH), and
  - Spreadsheets for verification of SOCH sub-codes.
- Have not achieved the production levels needed to meet all of the original milestones.



# Lessons-Learned

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- Required extended Scoping Phase.
- Quantity of work is three times greater than originally estimated.
- Complex integrated work processes.
  - Input compilation.
  - Nuclear QA calculation preparation, checking, and verification.
  - Nuclear QA code verification and validation.



# Moving Forward

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- Scoping Phase complete.
- Refining production processes for major calculations (Unit Hydrographs, Geometry Packages, and Dam Rating Curves).
- Improving production rates and work-off curves.



## Moving Forward (cont'd)

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- By mid-October, at least one each of the following major calculations will be complete.
  - Unit Hydrograph,
  - River Basin Geometry package, and
  - Dam Rating Curve.
- Producing Schedule Recovery Plan.



# Schedule Recovery Plan

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- TVA and Bechtel have increased staff and continue to add more staff for an aggressive Schedule Recovery Plan.
- TVA continues to assess our status and production capacity, as well as make process improvements to reflect lessons-learned.
- The Schedule Recovery Plan will reflect these enhancements.
- TVA will submit letter to inform NRC of Schedule Recovery Plan.
- Today's interactions will help TVA understand the NRC's review plans, needs, and schedule.



# Need NRC Feedback

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- Critical to mutual success is an understanding of:
  - NRC's priorities for review of TVA input calculations and V&V documentation for SOCH codes.
  - NRC review process/review needs/resource schedule assumptions.
  - NRC's willingness to support a parallel review (input documentation followed by SOCH rerun).



## Near-Term

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- NRC assess our first deliverables against NRC review needs and expectations.
- TVA Schedule Recovery Plan, available deliverables, and NRC review priorities should support the NRC efforts to develop a revised review schedule.



# FSAR Hydrology Sections

FSAR Section	Proposed Schedule	RAIs Issued
2.4.1 HYDROLOGIC DESCRIPTION	PSER and RAIs Complete - 1/16/2009	
2.4.1.1 Site and Facilities	PSER and RAIs Complete - 1/16/2009	
2.4.1.2 Hydrosphere	PSER and RAIs Complete - 1/16/2009	
2.4.2 FLOODS		
2.4.2.1 Flood History	PSER and RAIs Complete - 1/16/2009	
2.4.2.2 Flood Design Considerations	PSER and RAIs Complete - 1/16/2009	RAI 65
2.4.2.3 Effects of Local Intense Precipitation	PSER and RAIs Complete - 1/16/2009	RAI 82
2.4.3 PROBABLE MAXIMUM FLOOD ON STREAMS AND RIVERS		
2.4.3.1 Probable Maximum Precipitation	PSER and RAIs Complete - 1/16/2009	
2.4.3.2 Precipitation Losses	Review per 12/08 Schedule Determination	RAI 82
2.4.3.3 Runoff and Stream Course Models	Review per 12/08 Schedule Determination	RAI 82
2.4.3.4 Probable Maximum Flood Flow	Review per 12/08 Schedule Determination	
2.4.3.5 Water Level Determinations	Review per 12/08 Schedule Determination	
2.4.3.6 Coincident Wind Wave Activity	PSER and RAIs Complete - 1/16/2009	





# FSAR Hydrology Sections (cont'd)

FSAR Section	Proposed Schedule	RAIs Issued
2.4.4 POTENTIAL DAM FAILURES	Review per 12/08 Schedule Determination	RAI 64, 82
2.4.4.1 Dam Failure Permutations	Review per 12/08 Schedule Determination	
2.4.4.2 Unsteady Flow Analysis of Potential Dam Failures	Review per 12/08 Schedule Determination	
2.4.4.3 Water Level at the Plant Site	Review per 12/08 Schedule Determination	
2.4.5 PROBABLE MAXIMUM SURGE AND SEICHE FLOODING	PSER and RAIs Complete - 1/16/2009	RAI 65
2.4.6 PROBABLE MAXIMUM TSUNAMI HAZARDS	PSER and RAIs Complete - 1/16/2009	
2.4.7 ICE EFFECTS	PSER and RAIs Complete - 1/16/2009	
2.4.8 COOLING WATER CANALS AND RESERVOIRS	PSER and RAIs Complete - 1/16/2009	
2.4.9 CHANNEL DIVERSIONS	PSER and RAIs Complete - 1/16/2009	
2.4.10 FLOODING PROTECTION REQUIREMENTS	Review per 12/08 Schedule Determination	
2.4.11 LOW WATER CONSIDERATIONS	PSER and RAIs Complete - 1/16/2009	RAI 62, 67, 72, 73
2.4.12 GROUNDWATER	PSER and RAIs Complete - 1/16/2009	
2.4.13 ACCIDENTAL RELEASE OF RADIOACTIVE LIQUID EFFLUENTS IN GROUND AND SURFACE WATERS EFFLUENTS IN GROUND AND SURFACE WATERS	PSER and RAIs Complete - 1/16/2009	RAI 63
2.4.14 TECHNICAL SPECIFICATIONS AND EMERGENCY OPERATION REQUIREMENTS	Review per 12/08 Schedule Determination	
2.4.15 COMBINED LICENSE INFORMATION	Review per 12/08 Schedule Determination	