

Riverine Flooding and Structured Hazard Assessment Committee Process for Flooding (SHAC-F)

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SHAC-F Project: Purpose and Approach

◆ Purpose

- Adapt the well-established Senior Seismic Hazard Assessment Committee (SSHAC) approach to Probabilistic Flood Hazard Assessment (PFHA)
- Refer to as the “Structured Hazard Assessment Committee Process for Flooding” (SHAC-F)
- Develop SHAC-F framework and guidance

◆ SSHAC process

- Provides assurance that all data, models, and methods have been evaluated and that full range of knowledge and uncertainties is captured in the hazard analysis

◆ Approach for development of the SHAC-F framework

- Based on virtual implementation of the SSHAC process to PFHA for selected flood mechanisms
- Development of a Template Project Plan for selected flood mechanisms

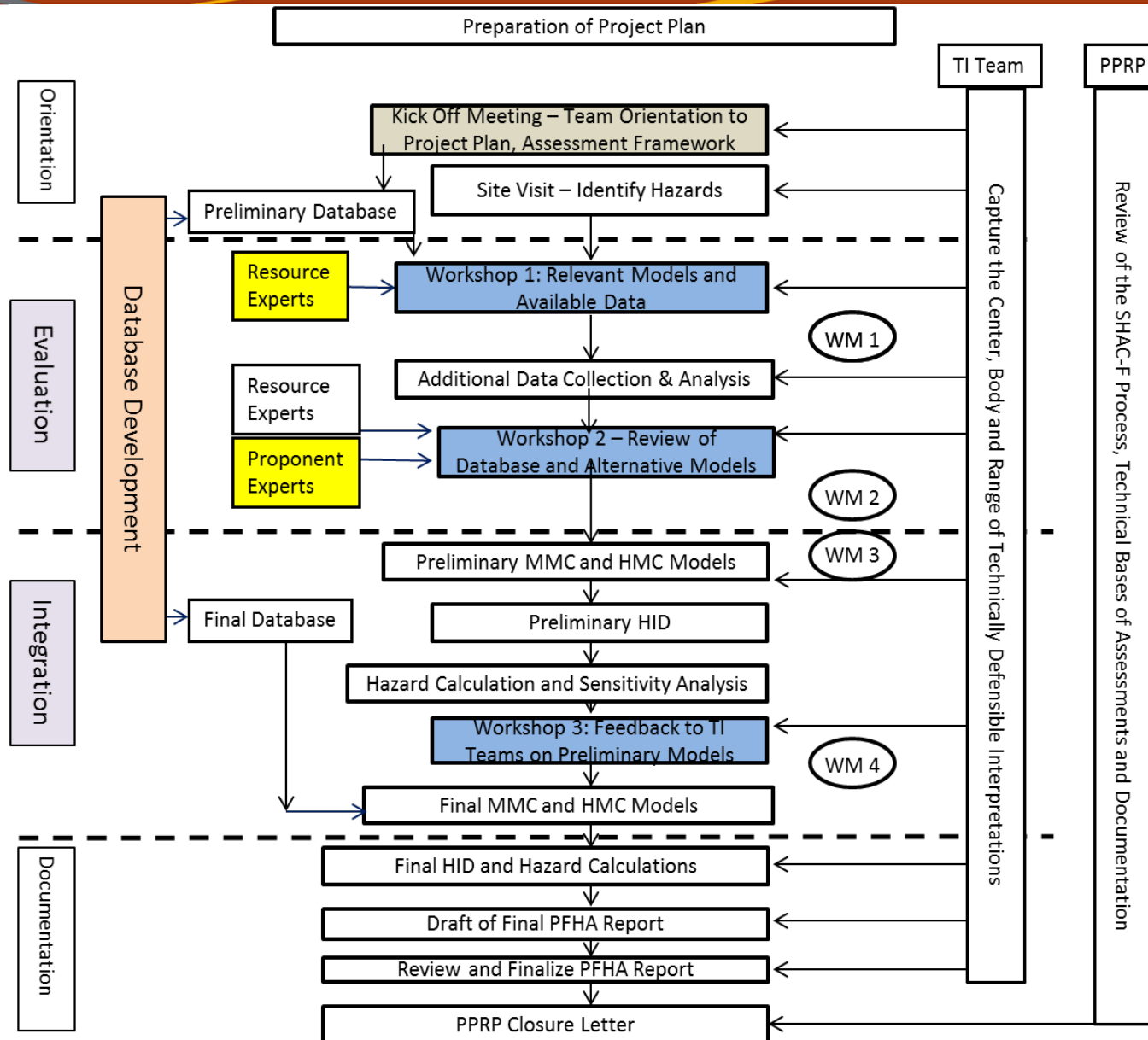


SHAC-F Project: Purpose and Approach

- ◆ Selected flood mechanisms
 - Local intense precipitation (LIP) flooding
 - Riverine flooding (RF) without snowmelt
 - Riverine flooding from combined rainfall and snowmelt
- ◆ Project adapts and tailors elements of SSHAC process
 - Implementing typical steps of SSHAC to PFHA in virtual studies
 - Documenting lessons learned
 - Refining Template Project Plan
- ◆ Activities and Products
 - SHAC-F Work Plan: defines the activities associated with the virtual studies for the SHAC-F project
 - PFHA Template Project Plan: defines all elements of an actual SHAC-F study for a selected flood mechanism
 - Goal is to produce PFHA Template Project Plans
 - Guidance for SHAC-F PFHA studies

} RF Virtual Study

SHAC-F LIP PFHA Project Structure - Workflow



Lessons Learned from the LIP SHAC-F Virtual Study and Path Forward for Riverine PFHA

◆ Logistics issues

- Structured workflow for a Level 3 project; large number of participants
- Highly site-specific nature of flooding processes
- Both of these issues raise costs of a SHAC-F study

◆ September 2017 Project Meeting at Richland

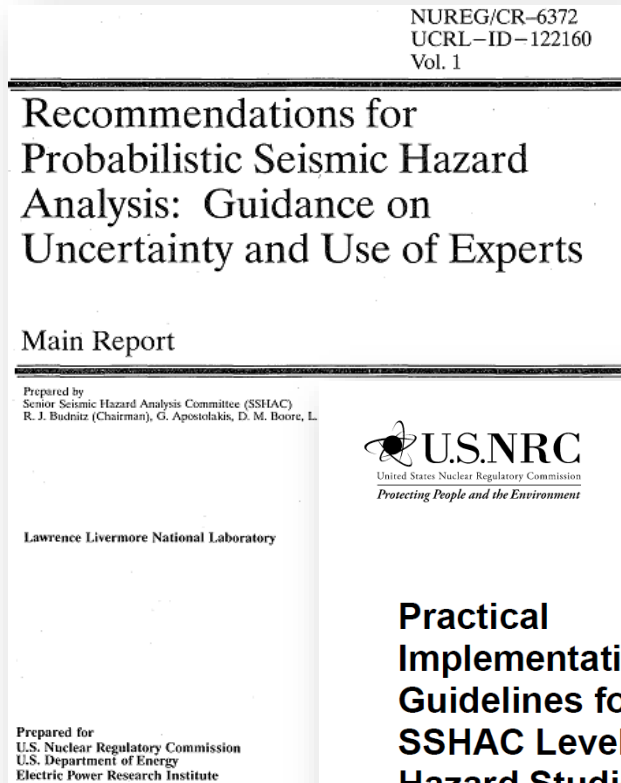
- SHAC-F Levels are now defined in terms of the purpose of the assessment
 - SHAC-F Levels 1 and 2: support NRC's Significance Determination Process (SDPs)
 - SHAC-F Level 1 to support screening
 - SHAC-F Level 2 to support a more refined screening assessment
 - SHAC-F Level 2 to support update of an existing SHAC-F Level 3 assessment
 - SHAC-F Level 3 to support design reviews and PRAs for new and existing power reactors

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SSHAC Guidelines and Guidance

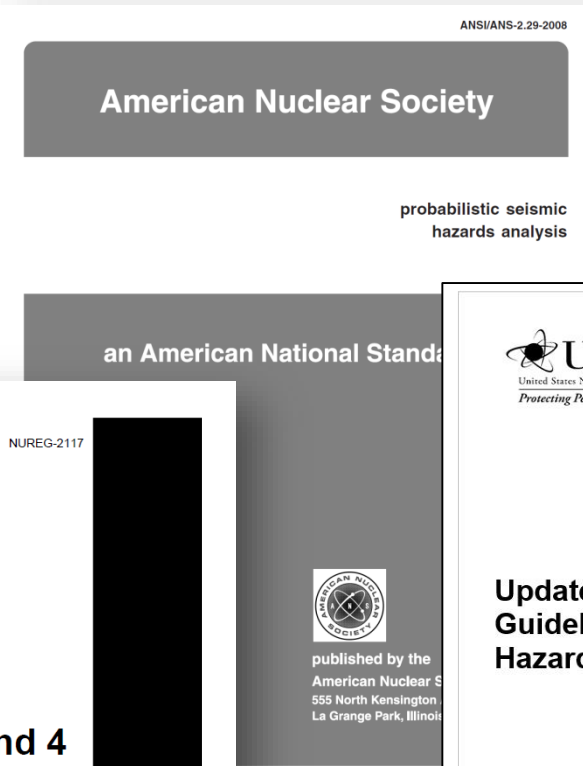


**NUREG-2117 SSHAC
Implementation
Guidelines**



Practical Implementation Guidelines for SSHAC Level 3 and 4 Hazard Studies

Office Nuclear Regulatory Research



**NUREG-2213
Updated Implementation
Guidelines**



Updated Implementation Guidelines for SSHAC Hazard Studies

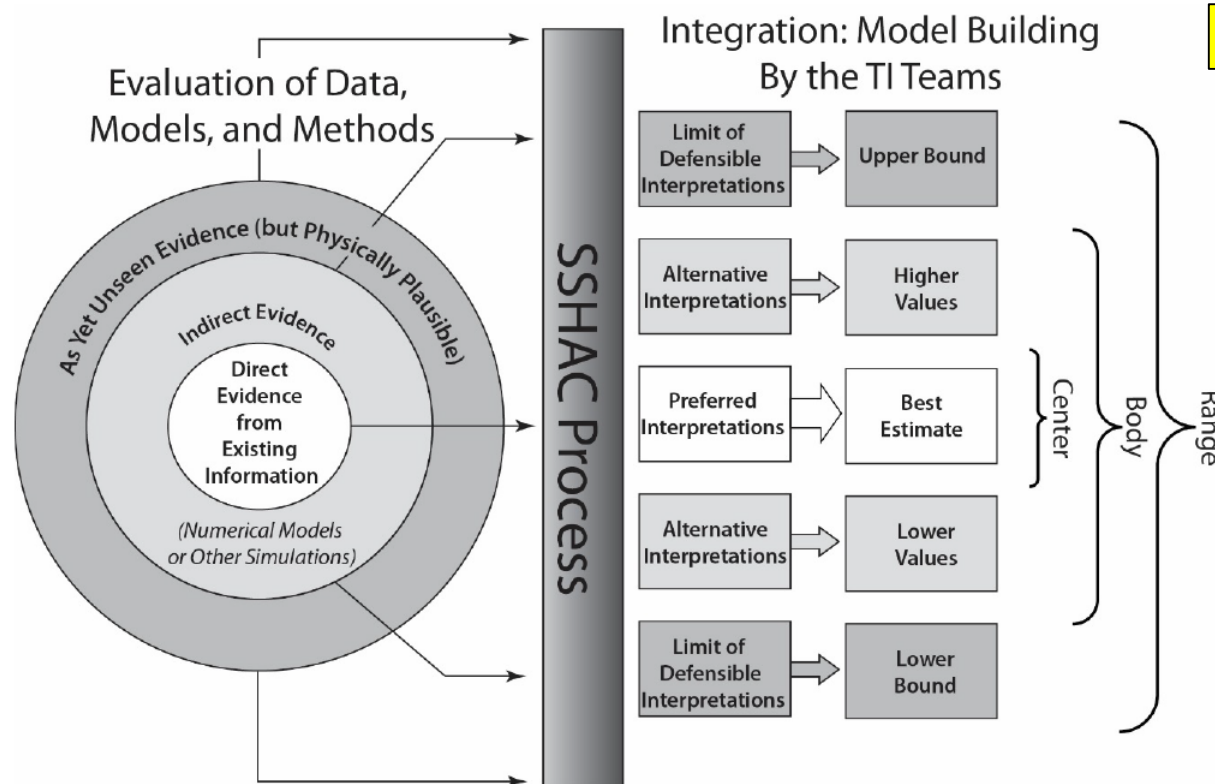
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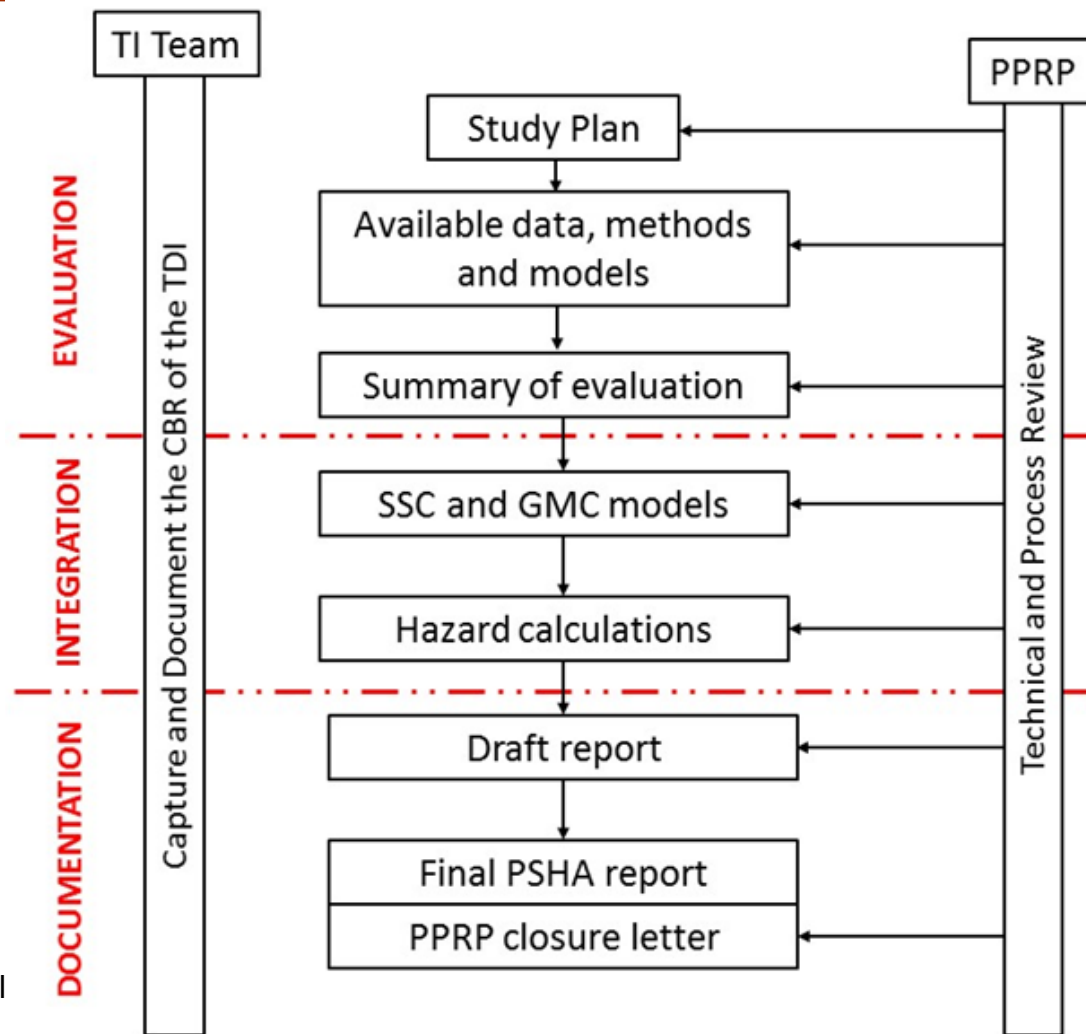
Goal of a SSHAC Process

- ◆ The fundamental goal of a SSHAC process is to properly carry out and completely document the activities of evaluation and integration, defined as:
 - Evaluation: The **consideration of the complete set of data, models, and methods** proposed by the larger technical community that are relevant to the hazard analysis.
 - Integration: **Representing the center, body, and range of technically defensible interpretations** in light of the evaluation process (i.e., informed by the assessment of existing data, models, and methods)."



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SSHAC Level 1 Project Workflow



PPRP: Participatory Peer Review Panel

TI Team: Technical Integration Team

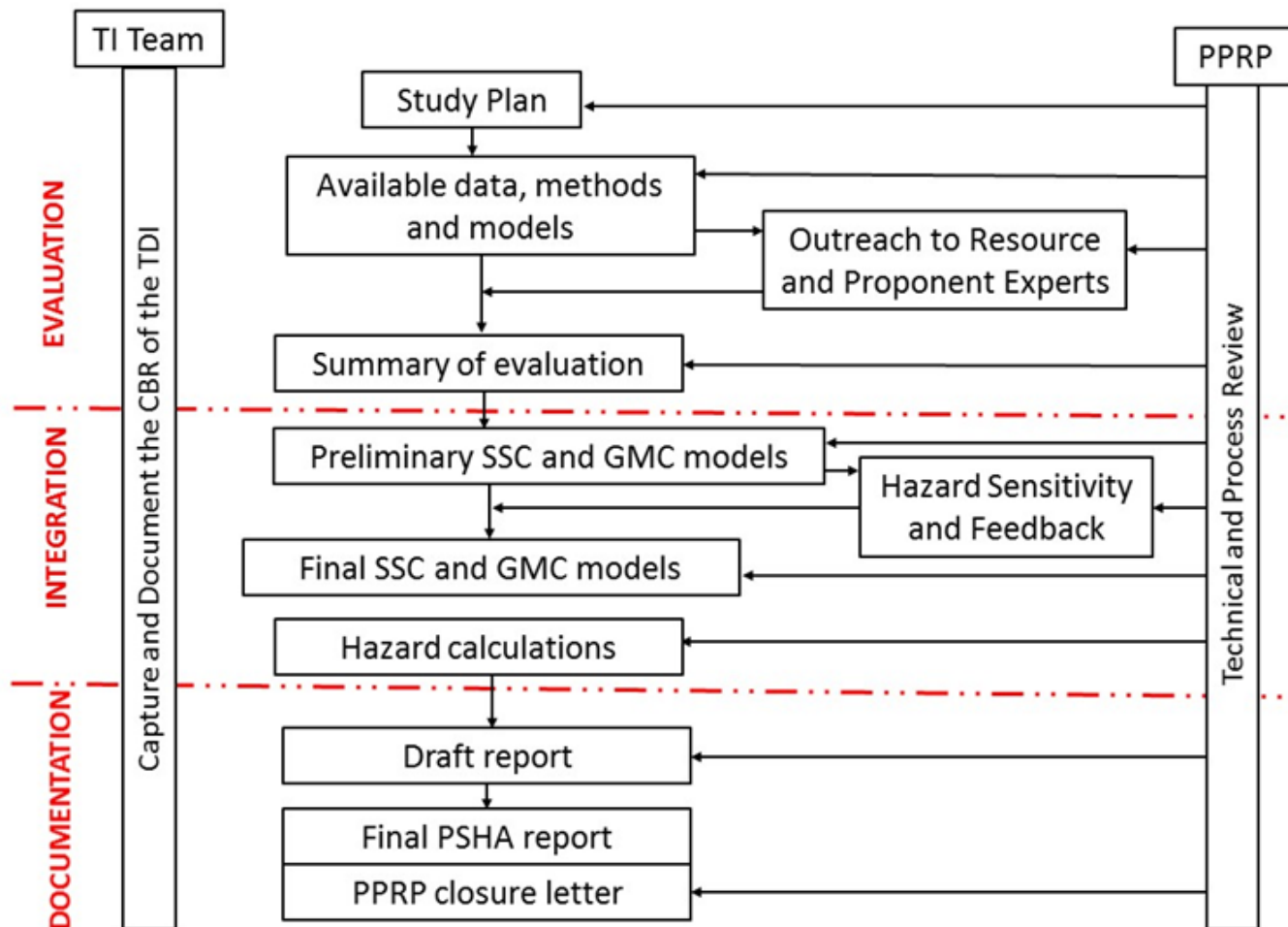
SSC: Seismic source characterization

GMC: Ground motion characterization team

PSHA: Probabilistic seismic hazard analysis

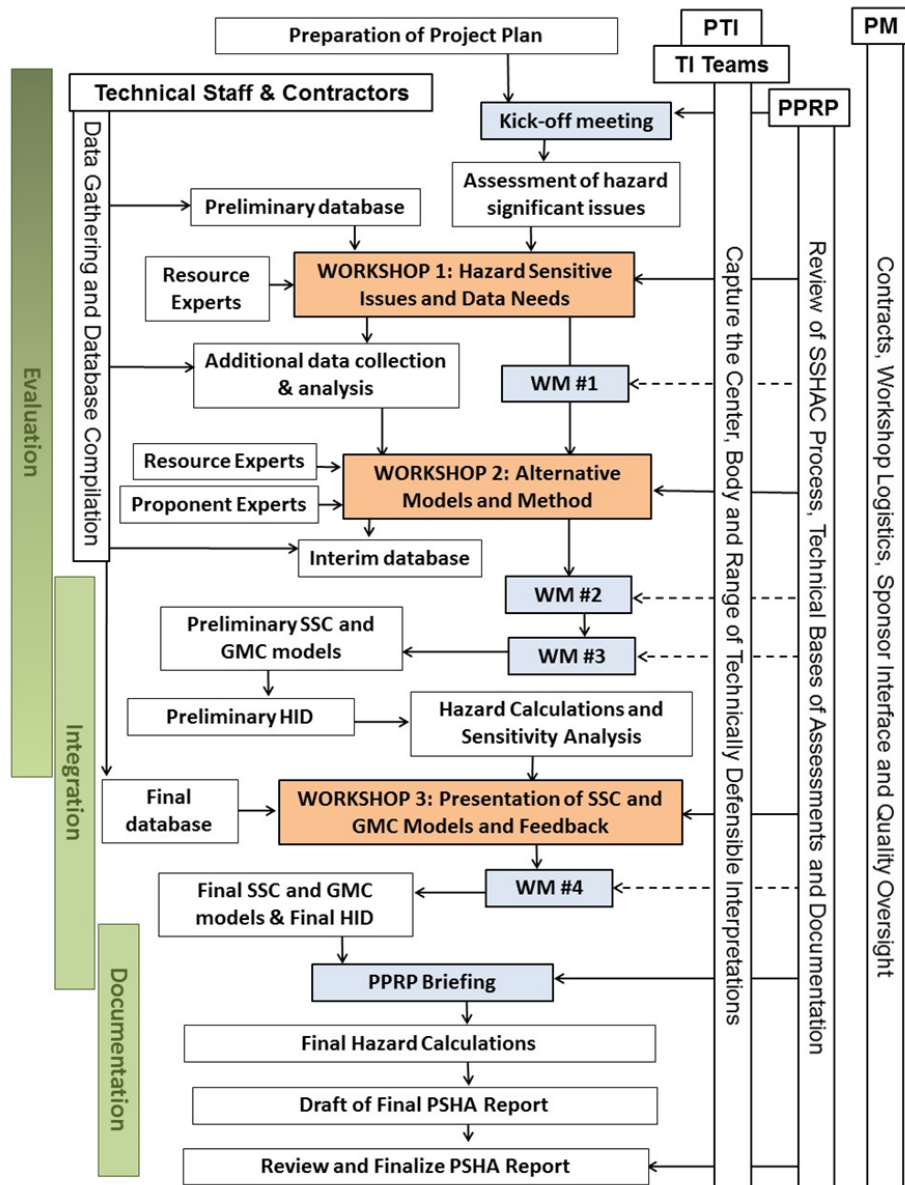
CBR of the TDI: Center, body, and range of technically defensible interpretations

SSHAC Level 2 Project Workflow



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SSHAC Level 3 Project Workflow



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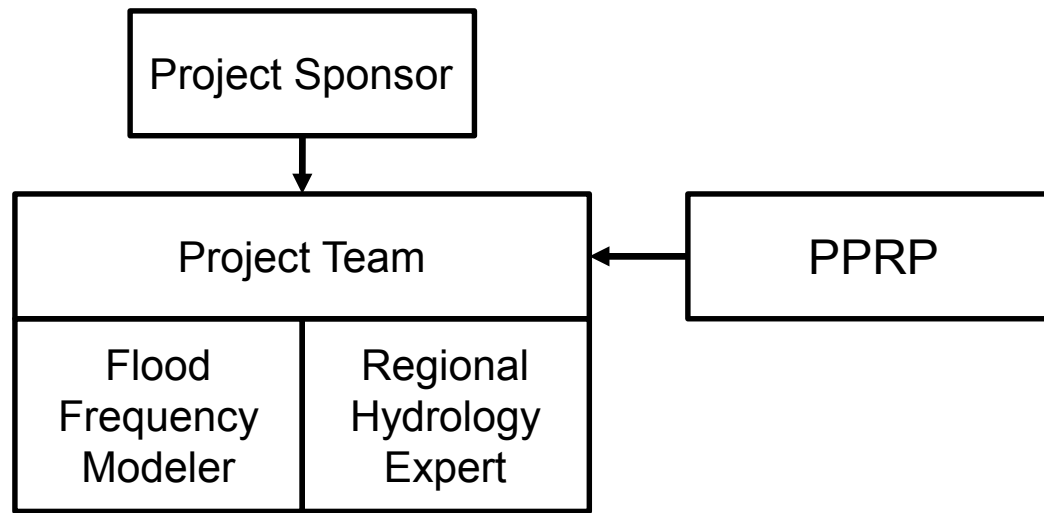
SHAC-F Levels – Redefined with Purpose of Assessment (After NUREG-2213 Table 3-1)

Riverine Floods	SHAC-F Level 1	SHAC-F Level 2	SHAC-F Level 3
Purpose	Screening (e.g., binning flood hazards in high or low risk categories)	Update existing Level 3 or refined analysis for screening	Support design PRA for licensing new and built plants
	Significance Determination		
Expected Outcome	Family of Discharge/Elevation Hazard Curves relevant to the system you are analyzing (need to revisit)	Family of Hazard Curves plus associated effects	Family of Hazard Curves plus associated effects
Data	<ul style="list-style-type: none"> • Stage/Discharge Data • (systematic at site data including historic information) • Regional and Paleo data if available • (flood frequency) • Use what you have 	<ul style="list-style-type: none"> • Discharge Data • Regional Data • Historic and Paleo data • (flood frequency) • Use what you have • More extensive effort to find and assemble existing data • Contact resource experts for simulation model data 	<ul style="list-style-type: none"> • Discharge Data • Regional Data • Historic and Paleo data • (flood frequency) • Use what you have • More extensive effort to find and assemble existing data • Contact resource experts for simulation model data
Models	<ul style="list-style-type: none"> • Screening flood frequency model • Conceptual Model • ACM – L1 • Statistical Models • Process understanding influencing data • Single population • Regionalization • Nonstationarity 	<ul style="list-style-type: none"> • ACM – L2 • Consider spatial variation • Simulation models 	<ul style="list-style-type: none"> • Conceptual Model • ACM – L3 • Statistical plus simulation • Spatiotemporal resolution of model predictions to support PRA • Locations of SSCs
Principal Sources of aleatory variability	Streamflow	Streamflow (possibly precipitation, basin initial conditions)	Streamflow, precipitation, basin initial conditions,
Principal sources of epistemic uncertainty	Measurement uncertainty in discharge data, alternative statistical models, parameter uncertainty	Measurement uncertainty in discharge data, alternative statistical models, parameter uncertainty in simulation model parameters	Measurement uncertainty in discharge data, alternative statistical models, parameter uncertainty in simulation model parameters

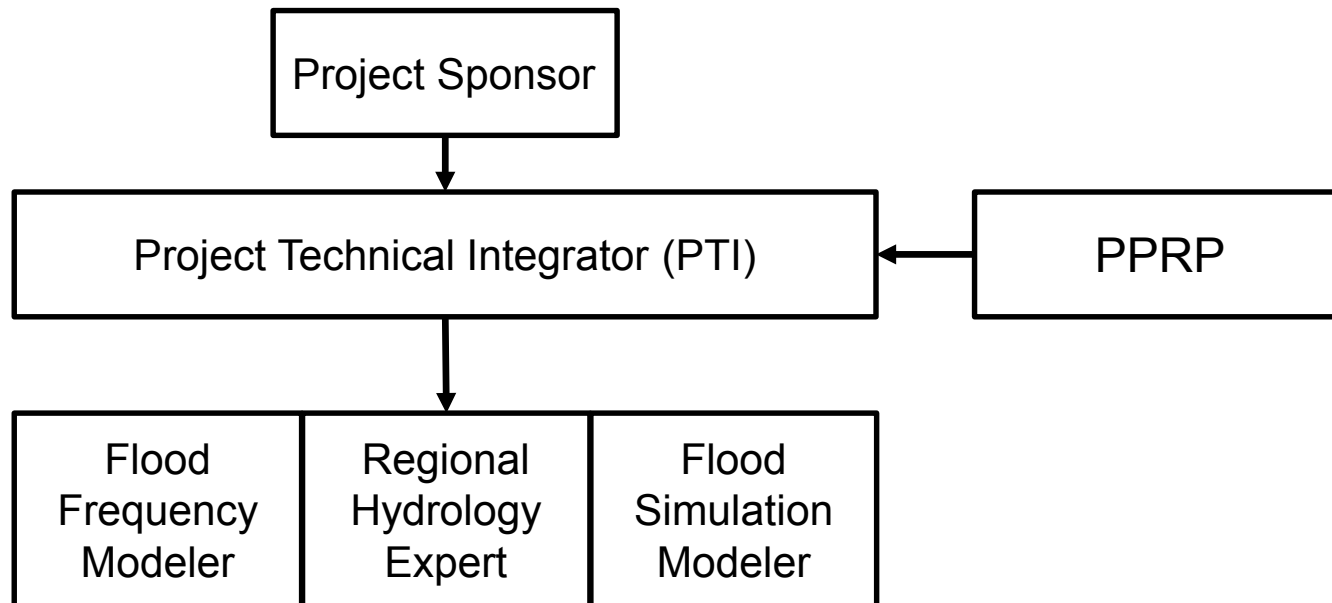
SHAC-F Levels – Redefined with Purpose of Assessment (After NUREG-2117 Rev. 2 Table 3-1) (cont.)

Riverine Floods	SHAC-F Level 1	SHAC-F Level 2	SHAC-F Level 3
TI Team Makeup	Small TI Team (e.g., two-one in flood frequency modeling, one in regional hydrologic modeling)	Small TI Team; possibly multiple teams (e.g., probabilistic modeler, precipitation frequency analyst, and runoff/hydraulic modeler)	Larger TI Team members (alternative models may require additional TI team members, e.g., probabilistic modeler, precipitation frequency analyst, and runoff/hydraulic modeler)
PPRP	Small PPRP Team (e.g., two-one for flood frequency modeling review and one for regional hydrologic modeling review)	Two or more reviewers (e.g., one/more for flood frequency, one/more for simulation modeling, one/more for regional hydrologic modeling); Feedback on preliminary models; Communication with PPRP during evaluation and integration	Larger team of reviewers (e.g, precipitation and runoff experts, experts in use of potential runoff/hydraulic models, PRA expert); Feedback on preliminary models; Engagement during evaluation and integration process; PPRP briefing of final model
Others from Table 3-1 in NUREG-2213	****	****	****

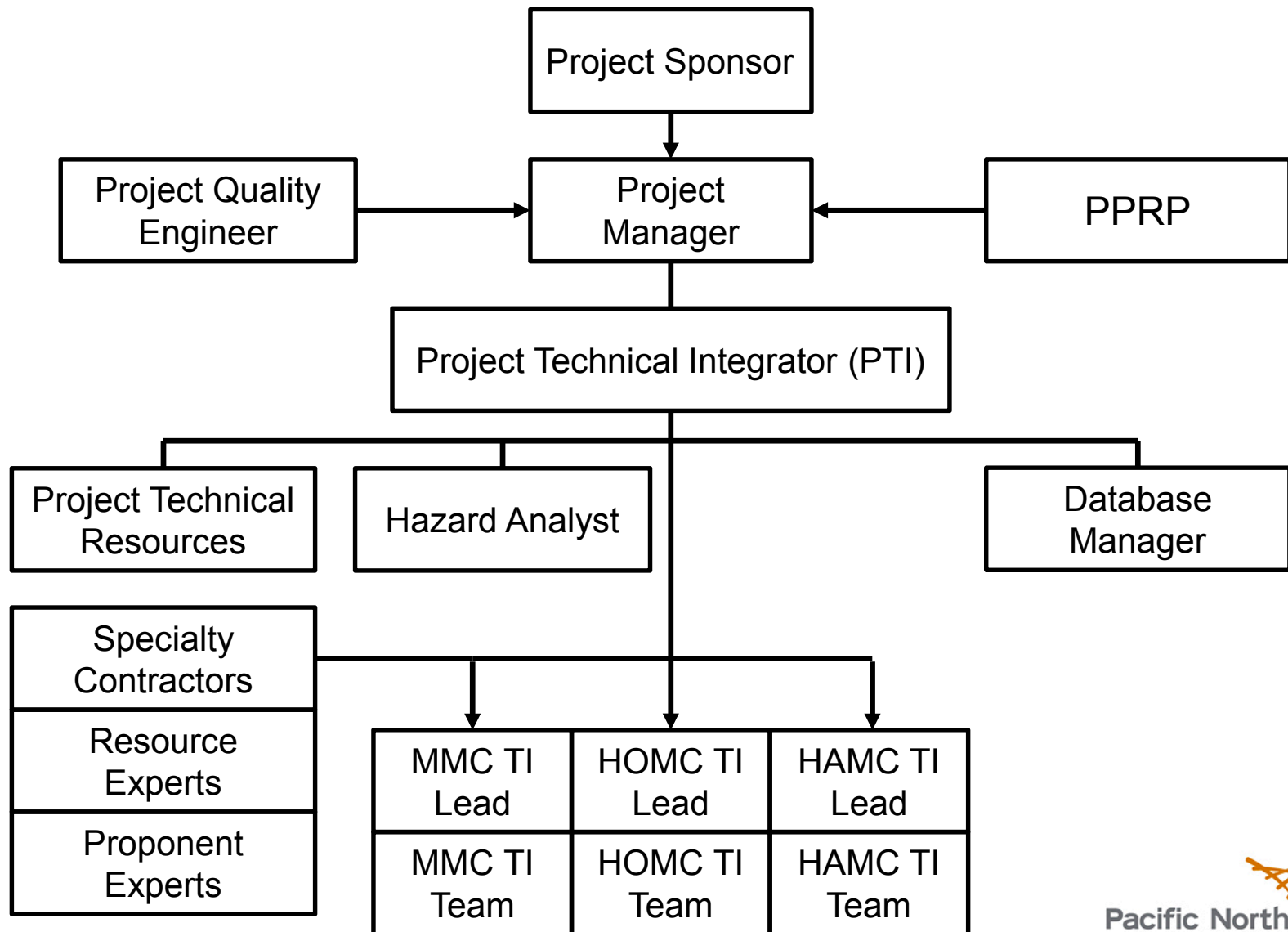
Riverine PFHA Project Structure – SHAC-F Level 1



Riverine PFHA Project Structure – SHAC-F Level 2



Riverine PFHA Project Structure – SHAC-F Level 3



Conclusions

- ◆ LIP PFHA Virtual Study provided insights that are unique to the flooding problem
- ◆ Site-specific nature of flooding requires careful consideration of level of effort for PFHA
- ◆ Tying SHAC-F levels to purpose of the assessment is needed
 - Proposed SHAC-F Levels now align with NRC regulatory needs and are consistent with updated SSHAC guidance
 - Proposed riverine PFHA project structures for the three SHAC-F levels are being developed

Questions?

