



Idaho National Laboratory

Seismic Hazard Definition: SSHAC Level 1 PSHA at MFC

Suzette Payne, Idaho National Laboratory
May 27, 2015 – CNS Seismic Lessons Learned Panel

Objectives

- **Perform a Senior Seismic Hazard Analysis Committee (SSHAC) Level 1 probabilistic seismic hazard analysis (PSHA)**
- **Produce the mean-centered definition of the seismic hazard with appropriate treatment of uncertainties and technical justification for:**
 - **Rock conditions at the Materials and Fuels Complex (MFC)**
 - **Soil specific conditions for the Fuels Manufacturing Facility (FMF)**

Background

- **The Seismic Risk Assessment (SRA) Project is developing a risk-informed methodology**
- **The SRA Project selected a SSHAC Level 1 PSHA study for defensible estimates of ground motions**
- **Defensible ground motion estimates will be inputs to a Seismic Probabilistic Risk Analysis (SPRA)**
- **The candidate nuclear facility is the Fuels Manufacturing Facility (FMF) at the Materials and Fuels Complex (MFC) at INL**

SSHAC Level 1 PSHA Components

- **Compiling data and information from literature, existing studies, and conferring with the technical community**
- **Developing Seismic Source Characterization (SSC) and Ground Motion Characterization (GMC) models**
- **Following the SSHAC Evaluation and Integration processes**
- **Assigned roles and responsibilities consistent with SSHAC process**
- **Defined and scheduled key tasks and activities in a Work Plan**

SSC Models

- **Seismic sources characterized by geometries, recurrence rates, maximum magnitudes, and associated uncertainties**
- **Evaluating and updating INL original source models**
 - Regional source zones; Updating earthquake catalog
 - Local fault sources (Lost River, Lemhi, and Beaverhead)
 - Volcanic Zones
 - Eastern Snake River Plain (host) zone
- **Including evaluations of new source models**
 - Distant fault sources
 - Centennial Shear Zone
 - Potential fault offset for the basalt discontinuity between ATR and INTEC

GMC Models

- **Characterized by models expressing variations in ground motion amplitude as a function of distance, magnitude, and other factors**
- **Applying the Southwestern U.S. GMC model**
 - Specifically developed for normal faulting
 - Has SSHAC Level 3 pedigree and Hazard Input Document
 - Will be adjusted to MFC site conditions
- **Using available earthquake recordings and information for MFC and INL**
 - 54 earthquakes of magnitudes 3.0-5.0 from 1983 to 2015 and distributed azimuthally around INL
 - Data inverted for MFC site and regional parameters
 - Shear-wave velocities measured for ANL-1 borehole at MFC

SSHAC Model Development

- **Following the Evaluation and Integration processes to develop SSC and GMC models**
- **Considering and evaluating data, models, and methods proposed by the larger technical community that are relevant**
 - **Seismic Evaluation Team (SET) recommendations and previous sensitivity analyses**
- **Integration represents the center, body, and range of technically defensible interpretations**
- **Following the approaches documented in the Work Plan completed March 20, 2015**

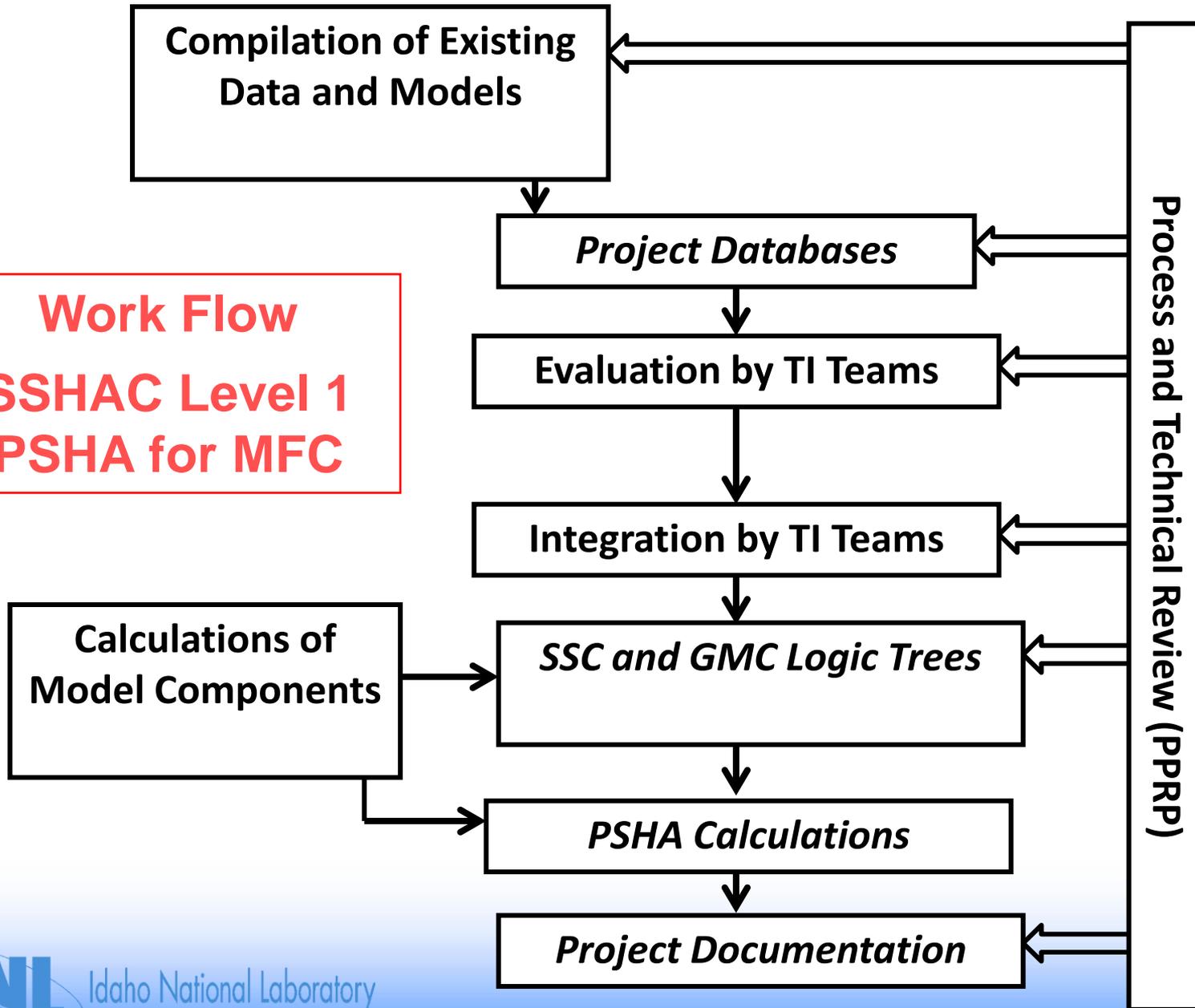
SSHAC L1 PSHA Roles and Responsibilities

Role	Participant (Organization)	Responsibilities
Project Manager	Lannie Workman (BEA)	Coordinates organizational and administrative aspects of the Seismic Risk Assessment Project (SRA).
Project Technical Performer	Suzette Payne (BEA)	Manages project work and delivery of the products from the SSHAC Level 1 PSHA to the SRA project (Figure 3).
Quality Engineer	Evert Mouser (BEA)	Reviews development and implementation of Quality Assurance requirements of the SRA.
SSC and GMC Technical Integration (TI) Teams	Ryan Coppersmith (CCI) Suzette Payne Robert Youngs (AMEC-FW) Valentina Montaldo Falero (AMEC-FW)	Develops the SSC and GMC models and logic-trees to define inputs to the PSHA calculations. Performs Evaluation and Integration processes to develop SSC and GMC models. Develops the Hazard Input Document and provides it to Hazard Analyst.
Hazard Analyst	Valentina Montaldo Falero Robert Youngs	Executes all PSHA calculations and deaggregations for sensitivity studies and documenting the final hazard results.
Data Base Manager	Ryan Coppersmith Suzette Payne	Establishes and manages all the data and information collected by the TI Teams.
Specialty Contractor	Walt Silva (PE&A)	Uses data to calculate parameters and associated uncertainties for GMC models at the direction of the GMC TI Team.
Resource and Proponent Experts	Ryan Coppersmith Suzette Payne Robert Youngs Valentina Montaldo Falero	When applicable, fill the responsibilities of resource and proponent experts. As a Resource Expert, presents data in an impartial manner to the TI Teams for their use in the evaluation process. As a Proponent Expert, advocate a particular model or method for the consideration by the TI Teams.

Participatory Peer Review Panel

- **Members are Kevin Coppersmith and Adrian Rodriguez-Marek**
- **Provide procedural and technical reviews from start to finish**
- **Technical reviews ensure:**
 - **Full range of data, models, and methods have been considered**
 - **Technical decisions are adequately justified**
 - **Hazard Input Document is complete and adequate for the PSHA calculations**
- **Procedural reviews ensure:**
 - **Implementation of the Work Plan**
 - **The MFC SSHAC Level 1 PSHA conforms to the SSHAC process**

Work Flow
SSHAC Level 1
PSHA for MFC



Schedule for SSHAC Level 1 PSHA

Task or Activity	Target or Completion Date
Field trip and Work Plan meeting	February 23-25, 2015
INL regional earthquake recordings sent to Specialty Contractor	March 18, 2015
Work Plan completed	March 20, 2015
Updated earthquake catalog	April 23, 2015
Completing HID to send to Hazard Analyst	End of May
PPRP review preliminary hazard results and sensitivities at INL	July 7, 2015
Presentation to SRA project at INL	July 8, 2015
Finalize SSC and GMC models	July 17, 2015
Draft Report	July 31, 2015
Final hazard calculations and sensitivity analyses	August 28, 2015
Final report to PPRP	September 10, 2015
PPRP Closure Letter with final report	September 18, 2015
Final report issued and sent to SRA project	September 21, 2015

SSHAC Level 1 Products

- **Preliminary and final seismic hazard products**
 - **Rock outcrop conditions for MFC**
 - **Site-specific soil surface for FMF**
- **Dissection of hazard uncertainty contributions**
- **Seismic hazard fractiles**
- **Mean seismic hazard curves at annual frequencies of exceedance 10^{-2} – 10^{-8} per year**
- **Horizontal mean Uniform Hazard Spectra (UHS) at return periods 1,000, 2,500, and 10,000 yrs**

Products for SRA Project

- **Impacts to the hazard from changes in**
 - **Data, models, and methods (Crit. 1)**
 - **Hazard input models (Crit. 2)**
 - **Mean hazard (Crit.3)**
 - **Technical basis (Crit. 4)**
- **Comparisons of SSHAC Level 1 mean-centered hazard and Design Basis Earthquake levels for MFC (Crit. 5)**

Benefits for future PSHA Update

- **Provides an organized, structured, and documented PSHA**
 - **Compiled new and existing data**
 - **Considered new models and methods**
 - **Evaluated hazard sensitivities**
 - **Identified significant issues and key uncertainties**
 - **Produced the mean-centered definition of the seismic hazard with appropriate treatment of uncertainties and technical justification**
- **Prioritizes data collection to reduce uncertainties**
- **Starting point for the next SSHAC Level PSHA**