I-10. Facilitator Considerations

It is essential that one or more qualified facilitators be assigned to any dam or levee safety risk analysis. Facilitators are assigned to teams to assist them through a potential failure mode analysis (PFMA) and risk analysis process. The facilitator contributes to the process by bringing experience with risk analyses, consistency in approach, knowledge of latest technology in risk analyses, and serves as a resource to the design team for technical input and questions. The facilitator must be experienced and generally familiar with most aspects of dam or levee behavior. In addition, certain skills are needed to guide a team through the process.

Key Concepts

Facilitation is a critical part of the process to develop credible risk estimates during an assessment of risk. In general, the facilitator(s):

- Meets with the team prior to a risk analysis to ensure engineering analyses are completed to support the team analysis and ensure the team composition is appropriate to develop credible risk estimates;
- Facilitates the team risk analysis, helping the team develop potential failure modes (see section on Potential Failure Mode Analysis), event trees (see section on Event Trees), strategies for estimating risks, and developing ranges of likelihood and consequence estimates; and
- Reviews and certifies the final report ensuring (1) that there is enough description that someone picking up the report 5 or 10 years in the future can understand what the team was thinking and why, (2) that all team estimates have been properly represented and transcribed into the report, (3) that all math has been performed in accordance with sound risk analysis principles and checked, and (4) that the results are adequately portrayed, and the case has been made as to why they make sense. (The facilitator is not typically the author of the report, but can be.)

The facilitator(s)s shoulder a heavy load as they are primarily tasked to ensure:

- Agency's methodologies are followed to develop risk estimates
- The methods used during the analysis are consistent with current practice
- Alternative viewpoints are elicited, discussed, and recorded
- The team contains the appropriate staff to arrive at a credible risk estimate
- The final report contains failure modes that are adequately described
- The case built reflects the information developed during the risk assessment
- The case built follows the principles described in Reclamation's Public Protection Guidelines or USACE Tolerable Risk Guidelines

The facilitator chairs the risk analysis meeting to ensure the meeting stays on track and that the team focuses on the issues to be addressed. The facilitator may have kick-off discussions on the objectives of the risk analysis (client's needs); team makeup; constraints of time, manpower, lack of knowledge; bias; or work already accomplished (including previous risk analyses).

The facilitator monitors the flow of the meeting and initiates adjustments during the meeting to help maintain focus. The facilitator may make use of the flip chart format and the verbal descriptors provided in the section on Subjective Probability and Expert Elicitation during the meeting to help the team in formulating their probability estimates. Flip charts are useful in that they provide a permanent record of the team discussions, and allow the facilitator to capture important points of the discussion without having to direct a note-taker. The facilitator also works with the recorder and event tree analyst throughout the meeting to ensure the proper information is being collected for future documentation. Some facilitators find it useful to have the recorder take notes that are projected on a screen so that they are captured digitally for the report. When using this approach, it is important to be careful that the team does not get bogged down in a "word-smithing" session.

It is advantageous to have two facilitators be present for the typical issue evaluation risk analysis. This permits both facilitators to remain focused throughout the process by switching off and supporting the facilitation process. It also provides senior level knowledge to help facilitate difficult areas of the risk analysis that are specific to a given engineering practice, and provides an opportunity for less experienced facilitators to learn from more senior facilitators. This practice of using two facilitators, and the associated cost, has proven to be value added. For some risk analyses, the co-facilitators may not be needed.

Skills Typical of Facilitators

Not everyone can be a facilitator, nor will everyone want to be one. Attributes of potentially successful facilitators include:

- Objectivity: the person is capable of expressing or involving the use of facts without distortion by personal feelings or prejudices.
- Open-mindedness: receptive of arguments or ideas; not harmfully critical.
- Perseverance: able to persist in an undertaking in spite of counter influences, opposition, time constraints or discouragement.
- Diplomatic: skilled at conferring with opposing parties to arrive at consensus of opinion or at agreement upon the stasis of an argument if agreement is not possible.
- Insightful: capable of understanding (1) a wide range of engineering principles and their application to dam or levee safety risk analysis, and (2) the big picture in terms of how risks are impacted by various assumptions, data, or arguments.

Additionally, the person should be technically competent, able to work under pressure, well organized, and should demonstrate a desire for continued learning. Facilitators also generally have a broad technical background. It is difficult to guide a group of experienced engineers, geologists, hydrologists, seismologists, and operators unless the facilitator has a technical background sufficient to elicit relevant opinions and subjective probability estimates. Facilitators are generally engineers, but can be geologists or other disciplines.

However, not every engineer with a solid technical background makes a good facilitator. Facilitators also need the personality and perseverance to handle difficult situations and difficult people, determine the relative importance of pieces of information and

discussions. They need to be able to accelerate or slow the process when necessary, need to understand the philosophies that underlie the methodologies, and need to be able to elicit divergent opinions from those reluctant to give them.

Facilitators should have a working knowledge of the following list of subjects, and they should be experts in several subjects. Facilitators should strive to know:

- Agency risk analysis methodology (as outlined in this manual and other references)
- Basic probability concepts (see Basics of Probability and Statistics, and various other sections in this manual)
- How to develop load ranges (see section on Event Trees)
- How the risk calculation software used for the analysis generally works
- How to develop, elicit, and understand probability distributions (see sections on Probabilistic Stability Analysis, and Subjective Probability and Expert Elicitation)
- How to make the case to support the risk estimates (see section on Building the Case)
- How to describe failure modes from initiator, through step by step development, to reservoir breach (see section on Potential Failure Mode Analysis)
- When it is not appropriate to add risks based on conditional probabilities (see section on Combining and Portraying Risks)
- How to develop an event tree (see section on Event Trees)
- When additional load ranges are needed (see section on Event Trees)
- How to weight analysis results for a given load range (see section on Event Trees)
- What kind of distributions are available and how to use them (see sections on Probabilistic Stability Analysis, and Subjective Probability and Expert Elicitation)
- How to input uncertainty in the seismic loading and flood loading (see section on Event Trees)
- How to identify major risk contributors (see section on Combining and Portraying Risks)
- How to identify sensitive parameters and perform sensitivity analyses of the risks (see section on Probabilistic Stability Analysis)
- What residual risk is and how to identify if it is significant (see section on Event Trees)
- How to recognize whether events or variables are truly independent, and if not, how to handle correlations (see section on Basics of Probability and Statistics, and Probabilistic Stability Analysis)
- When the risk analysis team is not an appropriate qualified group to make the estimates (see section on Subjective Probability and Expert Elicitation)
- When to make separate risk estimates to account for uncertainty
- Bernoulli's equation for annualizing failure probability
    - $p_n = 1 - (1 - p)^n$
    - where p_n is the probability of occurrence in n years and p is the annual probability of occurrence
- How to combine risks (see section on Combining and Portraying Risks)
- How to present the risk results (see section on Combining and Portraying Risks)

- About overconfidence and anchoring biases (see section on Subjective Probability and Expert Elicitation)
- About model uncertainty (see section on Probabilistic Stability Analysis)
- How risks are evaluated (see section on Risk Guidelines)

Training and Mentoring

There is currently no training course, university degree, or group of courses that contains enough information to certify a successful facilitator. There are courses that augment existing skills, but most of the training is done during and following risk assessments. Facilitators are typically selected with the cooperation of management from individuals that show an interest and promise as a potential facilitator.

Training to be a facilitator is a learn-by-doing process. At an absolute minimum, a facilitator needs to:

- Attend 2 team risk assessments;
- Attend 2 additional team risk assessments and write the reports (can be concurrent with previous requirement); and
- Facilitate 2 additional team risk assessments while being monitored and assisted by a facilitator

Even if these minimum requirements are met, it does not automatically follow that the person completing them will be certified as a facilitator. The co-facilitator(s) will be consulted before recommending certification. The typical facilitator has 20 years of dam or levee engineering experience and approximately 10 years of experience attending, estimating, facilitating, and documenting risk assessments. Attempts should be made to match facilitators-in-training with appropriate risk assessments to develop their skills. Facilitation is a critical skill and the relative scarcity of these individuals generally regulates the number of risk assessments completed in any year.

Training Suggestions

Although there are no specific training requirements apart from those listed above, the following is suggested to aid training potential facilitators:

- Read Reclamation's public protection guidelines or USACE tolerable risk guidelines, and attend Best Practices Training and become familiar with Best Practices Manual.
- Participate in team risk analyses as a relevant technical expert.
- Participate as a Team Leader to plan and organize a risk analysis, set the agenda, interact with facilitators, gather and distribute reports and other information to be used in the risk analysis, write the risk analysis report and report of findings, and present the findings to the decision-makers.
- Participate as risk analysis Co-Facilitator (matched with experienced risk facilitator). Interact with the Team Leader to set the risk analysis agenda and to ensure all required data are available. Provide input to, review and comment on documentation generated at end of risk analysis.
- Participate in post mortem discussions of the risk analyses they attended or co-facilitated as well as those facilitated by others.
- Participate in 1 to 3 more risk analyses as Co-Facilitator in addition to the time outlined above.

- Demonstrate proficiency in basic methodology and probability concepts, joint probabilities, event tree development, load ranges and weighting, operation of Precision Tree and @Risk or DAMRAE, development of distributions, uncertainty and sensitivity analysis, combining risks, and risk identification.
- Show ability to build the case for the numbers generated.

Typical Risk Analysis Meeting/Documentation Agenda

1. Introduction of team members and their responsibilities
2. Reviews of:
    a. Dam
    b. Geology
    c. Appurtenant structures
    d. Instrumentation data
    e. Operations of the reservoir and dam
    f. Flood routings
    g. Seismicity
    h. What's downstream and potential consequences
    i. Currently postulated dam safety deficiencies
3. Discuss, identify, describe, and fully documment potential failure modes – for initial risk analyses the potential failure modes should be screened so that only the "risk-driver" potential failure modes are carried forward for quantitative estimates (see section on Semi-Quantitative Risk Analysis)
4. Develop event trees for credible potential failure modes, as appropriate
    a. Develop load ranges, where applicable
    b. Develop probability estimate distributions for each node
    c. Review team's estimates
5. Develop or review loss of life estimates
    a. Population at risk
    b. Warning time estimates, flood travel time and severity, evacuation
    c. Loss of life
    d. Economic and other significant consequences
6. Review risk analysis calculations and results
7. Discuss presentation of the results, the conclusions reached, and the recommended actions. As part of this discussion consider the following questions:
    a. What failure modes create the highest risk?
    b. What load range increments are associated with the highest estimates?
    c. Where are the highest consequences and why (consider assumed evacuation rates, etc.)?
    d. What are the uncertainties for the highest risk?
    e. What data or analysis would reduce the uncertainly?
    f. What is the anticipated range of results from gathering more data/performing more analysis?
    g. How would these outcomes impact risk?
    h. Where do we go? What will it cost?
8. Build the case for the risk estimates and the path forward
9. Brief decision maker(s) on the result of the analysis

10. Set future schedules
    a. Draft report sections written
    b. Review
    c. Next meeting to discuss final results
    d. Draft report and Decision Document
    e. Agency review
    f. Final report and Decision Document