FFRDC Team's Expert Elicitation

Summary of Observations of the Expert Elicitation by two NAS Committee Members and NAS Staff Officer

Presentation prepared for
July 23-25 meetings of

NAS Committee on Supplemental Treatment of Low-Activity Waste at the Hanford Nuclear Reservation

FFRDC Team Met to Elicit Its Experts on Key Attributes Affecting Choice Among SLAW Management Options

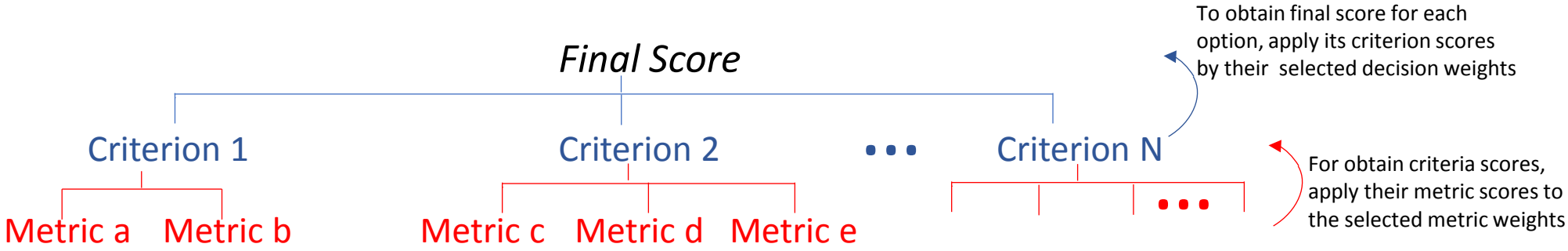
- Meeting took place at SRS site office building on May 1-3, 2018
- Most or all of key FFRDC team members attended and all actively participated
- 2 NAS Committee members and the NAS Study Director attended to observe only
  - Anne Smith (member)
  - Barry Scheetz (member)
  - Charles Ferguson (study director)

Overview of Sequence of Events During Expert Elicitation Meeting

- "Analytic Hierarchy Process" (AHP) adopted as the basis for the elicitation process
  - "A structured framework to optimize multicriteria decision making when several options are available"
- AHP process was led/facilitated by Bob Jubin
  - Jubin has used AHP in prior work
  - Structure and elicited AHP scoring assumptions were recorded in AHP spreadsheet (projected onto screen throughout meeting)
- All other FFRDC team members participated in all segments of the elicitation process
  - Before elicitation started, each FFRDC technical lead for the SLAW options presented on the technology, challenges, prior applications, etc.
    - Questions and discussion freely flowed from entire FFRDC group
  - Elicitation of assumptions was done as a group exercise
    - Some deference (but not absolute) given to the opinions of the technical leads
    - Areas of disagreement were recorded, to be considered in later sensitivity analysis

Basic Steps of AHP: A Scoring Process

- Define the options to be compared
- Define key "criteria" (i.e., attributes) that, as a group, define the degree to which each option may be viewed as preferable
  - Examples of criteria: cost, technical achievability, schedule, etc.
  - Criteria are to be assigned categorical "scores" (1 to 5)
- For each criterion, identify "metrics" that, when rated (also 1 to 5), are combined to determine score for the criterion
  - This reflects the "hierarchy" aspect of the option ranking process
  - Assign weights by which metric scores are to be combined to obtain criteria scores
- Assign weights by which the criteria scores are to be combined to provide a final rating for comparing/ranking the options
  - The AHP tool automates the estimation of numerical weights by eliciting responses to a series of pairwise trade-off questions regarding the criteria and the metrics, respectively.
- Assign metric scores
- Review resulting ranking of final scores (produced by AHP tool) and its sensitivity weights and metric scores to select the preferred option



Some Specific Elements of This AHP

- Group ranked 3 basic waste form options (vitrification, grout, FBSR) with intention to score several variants, e.g.,
  - bulk vs. Joule-heated melter vitrification
  - On-site vs. WCS disposal of waste form
- About 10 “criteria” were established to evaluate each option
  - Generally followed the list of “lines of inquiry” in the FFRDC plan
  - Cost was a single criterion (scored 1 to 5) with no attempt to elicit a $ estimate
  - It was observed by at least one participant that many of the other criteria were modifiers or uncertainties on the ultimate cost
  - Uncertainty itself was treated as a criterion and/or metric rather than as a range of values for a specific criterion score
- Most criteria had several metrics and were not directly scored
  - E.g., “Cost” score was derived from a technology development cost score (13% weight), a capital cost score (54% weight), and an operating cost score (33% weight)
- Some of the metrics were defined in relative terms (“higher than average”) and others in absolute terms (“high”)
  - There was discussion about whether the scores for the relative metrics needed to always include a 1 and a 5.

Difference of FFRDC's Process from Traditional "Expert Elicitation"

- Decision analysis defines expert elicitation as a set of formal procedures for obtaining from subject matter expert(s) a subjective probability distribution regarding the true value of a parameter or future outcome
  - Was developed for use in decision situations where existing data and models cannot provide information important to the evaluation of alternative options
- Key elements of traditional expert elicitation not found in the FFRDC's AHP approach
  - The potential true value of a well-defined specific metric or outcome is elicited, not a score ("clairvoyance test")
  - Uncertainty in the true value is what is elicited – uncertainty is not one of multiple criteria that are scored
  - The process of elicitation is structured to mitigate several well-established forms of cognitive or heuristic biases in such judgments
  - Although multiple experts may provide their judgments, their elicitations are usually done individually
    - To address individual biases
    - To avoid introducing further (inter-personal effect) biases
- Process-related differences aside, the FFRDC's AHP process has not elicited uncertainty on the part of the FFRDC experts regarding their scores for the criteria

Subjective Uncertainty Versus Value Judgments

- The AHP process elicits two types of subjective inputs to a decision
  - Scores on criteria
  - Weights by which criteria scores are combined
- The weights are value judgments, the assignment of which is considered to be the responsibility of the decision maker, not the responsibility of the subject matter experts
- The FFRDC team has assigned both scores and weights in its AHP process
  - Uncertainty on the part of the FFRDC experts was not elicited for either the scores or the weights