DEVELOPMENT AND TESTING OF A DECISION FRAMEWORK AND DECISION TOOL FOR DETERMINING FUEL CYCLE PREFERENCES

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Since 2011, the Electric Power Research Institute (EPRI) has worked to develop a suite of tools for comparing nuclear fuel cycle (NFC) options to support planning and decision-making for advanced NFCs and reactor technology energy research, development, and demonstration (RD&D). The capstone of this effort is the EPRI Decision Framework, intended to provide a generic structure and method for assembling and ordering the available, relevant information for conducting and recording transparent, auditable comparisons of NFC options. EPRI is collaborating with Vanderbilt University (VU) to develop a Decision Tool, which represents a specific implementation of the EPRI Decision Framework to aid in the strategic evaluation of NFCs. During Day 1 of the 2014 EPRI Nuclear Fuel Cycle Assessment Workshop, held at VU from July 22-23, 2014, a specific application of the EPRI Decision Tool was piloted to demonstrate its utility and flexibility for eliciting and structuring a comparison of NFC options for generating electricity. Feedback provided by participants was evaluated to create a path forward for further refinement of the Decision Tool.

I. INTRODUCTION

I.A. Project Background and Motivation

Time, the pursuit of advanced nuclear fuel cycle (NFCs) and reactor technologies does not appear to be urgent or even relevant under the current political and economic conditions. Yet, for these NFCs and technologies to be truly available to meet future energy needs and replacement of the aging reactor fleet by the mid-21st century, an execution of meaningful, viable and targeted RD&D programs cannot be delayed [1]. Since 2011, the Electric Power Research Institute (EPRI) has been developing a suite of tools for assessing NFC options to support planning and decision-making for advanced NFCs and reactor technology energy RD&D. The capstone of this effort is the EPRI Decision Framework, intended to provide a generic structure and method for assembling and ordering the available, relevant information for conducting and recording transparent, auditable comparisons of NFC options as one basis for defining a preferred technology RD&D program. The EPRI Decision Framework provides a structure to inform RD&D planning and decision-making in a disciplined and transparent fashion. Prudent RD&D planning and decision-making is necessary to bring advanced NFCs and reactor technologies to the point where they could be deployed, which is complicated by the challenging environment in which it must occur: exceptionally long implementation timeframes, diverse sets of stakeholder interests and perspectives, and multiple parallel development needs encompassing technology as well as supporting infrastructures and institutional issues [2].

Since 2013, EPRI has collaborated with VU to develop the Tool. The tool will implement the Decision Framework using an established decision analysis methodology and off-the-shelf software to provide a well-structured problem definition, a defensible methodology for quantifying and analyzing results from the methodology, and an effective, simple user interface to facilitate aggregation of multiple assessment results [3].

I.B. EPRI's Decision Framework

The EPRI Decision Framework has been developed iteratively. The first iteration in 2011 featured favorability and uncertainty figure-of-merit (FOM) ranges [4], which evolved to a color-coded "stoplight" system for ease of communicating results to a wide audience [5]. In the next and current iteration, the EPRI Decision Framework structure is organized around a three-level hierarchy. The first (least-detailed) level is strategic assessment, which involves the alignment of NFC options with vision and objectives (the "what?" and "why?"). The second level is tactical assessment, which involves the evaluation of gaps and sequencing of RD&D for implementation (the "how?"). The third (most-detailed) level is the readiness evaluation level where technology, infrastructure and institutional aspects of NFC assessment are considered. At the readiness evaluation level, technology readiness levels can be used to evaluate the fuel cycle's maturity [5,6].

II. DESCRIPTION OF WORK

The Tool is a specific implementation of the EPRI Decision Framework to aid in the comparison of NFCs. Sub-sections A and B describes the development and implementation of the Tool, while sub-sections C, D, and E discuss the demonstration carried out at the 2014 EPRI Nuclear Fuel Cycle Assessment Workshop held at VU on July 22-23, 2014 (the Workshop).

II.A. EPRI Decision Tool Structure

The current version of the Tool was configured to answer the question: "With respect to sustainably producing electric power, which NFC option would be the most preferred?" Three NFC alternatives were selected for comparison: a once-through cycle (OTC), a modified open cycle (MOC), and a closed fuel cycle using fast reactors (abbreviated as FFCC herein). A brief description of each fuel cycle is presented below.

Alternative 1, Once Through Cycle (OTC) Utilizing Uranium Oxide Fuel in Light Water Reactors (LWRs): The OTC represents the current NFC in the United States. Natural uranium is recovered, purified, converted to uranium hexafluoride, and enriched to increase the concentration of U-235. The enriched uranium is then converted to the dioxide form and fabricated into uranium dioxide (UOX) fuel which is used in LWRs to produce electric power. After discharge from the reactor, used nuclear fuel (UNF) is stored in water pools until pool capacity limitations necessitate transfer of sufficiently cool UNF to onsite dry storage while awaiting transportation to a geologic repository for permanent disposal. Separation and recycling of fissile content remaining in used fuel does not occur for the OTC.

Alternative 2, Modified Open Cycle (MOC) Utilizing Reactor-Grade Plutonium as Mixed Uranium-Plutonium Oxide Fuel in LWRs: This is a NFC in which mixed (plutonium and uranium) oxide fuel is used to constitute part of the core in LWRs. This NFC is currently used in a number of countries in Europe, as well as in Japan. This NFC operates much like the UOX NFC described in Alternative 1. However, instead of a fuel consisting of only enriched uranium oxide, about 40% of the fuel is made from depleted uranium dioxide combined with plutonium dioxide using plutonium recovered by reprocessing UOX fuel. Used MOX nuclear fuel is assumed to be stored in water pools for several years and then transferred to dry storage casks. Eventually, the used MOX fuel is assumed to be sent to a deep geological repository for disposal, as with UOX fuel described in Alternative 1.

Alternative 3, Fast Fully Closed Cycle (FFCC) Utilizing Reactor-Grade Plutonium as Mixed Uranium-Plutonium Oxide Fuel in Sodium-Cooled Fast Reactors: This is a NFC in which MOX fuel designed for fast reactors is used in a sodium-cooled fast reactor (SFR). The discharged MOX fuel is reprocessed to recover uranium and plutonium for re-use in SFRs. This NFC is "fully closed" because it produces as much plutonium as it consumes (or more) although it does require an external source of uranium. Burning minor actinides was not considered. For this NFC it is assumed that 100% of the nuclear energy comes from SFRs. Low-level waste and repository wastes (for example high-level waste, and greater-than-class-C low-level waste) would be generated during the operation of the fuel cycle as with the MOC.

Other assumptions include [7]:

- The reactor design for the OTC and MOC is a late Generation III pressurized water reactor (PWR)
- Weapons-grade MOX [8] is successfully being used in a LWR (meaning that the LWR has been licensed for operation with partial weapons-grade (WG)-MOX cores containing up to 40% MOX.

In order to determine which alternative can best meet the objective stated above in the form of a question, five top-level comparison criteria were developed [4]. Four of these criteria were elaborated by developing sub-criteria for each. Table I presents the top-level criteria and their associated sub-criteria. Vanderbilt University then developed "criteria papers" for each criterion to provide a consistent, transparent and informed basis for comparatively rating fuel cycles by the users of the Decision Tool.

TABLE I. Criteria and Sub-Criteria for the EPRI Decision Tool Demonstration

Criterion	Associated Sub-Criterion
Resource Utilization	Minimizing Uranium Utilization
	Managing/Optimizing Plutonium Inventory
Proliferation Resistance and Security	None
Waste Management	Minimizing LLW, other than Mill Tailings
	Minimizing Mill Tailings
	Minimizing Repository Waste (HLW, TRU, GTCC)
Fuel Cycle Safety	Minimizing Occupational Radiological Exposure during Routine Operations
	Minimizing Public Radiological Exposure during Routine Operations
	Minimizing Calculated Consequences of Potential Accidents
Economic Competitive-ness	Minimizing Capital Costs
	Minimizing Fuel, Operations, and Maintenance Costs
	Status of Developing and Deploying the Technology
	Applicability and Status of Existing Licensing Framework for the Technology

II.B. Decision Making Methodology

The Tool was grounded in a scientifically defensible decision-making theory to enhance reproducibility across different groups of participants [9,10]. Multi-criteria decision making (MCDM) methods have been used frequently for energy decision-making applications, where multiple criteria interact with each other in a complex manner [11-14]. Vanderbilt University analyzed various MCDM tools and selected the analytical hierarchy process (AHP) for Decision Tool development. comparisons determines which of each pair of criteria at the highest level is more preferred with regard to the objective. This is done for each possible pair. The preferences are then combined to establish the importance of each criteria in the form of weighting factors. Next, a similar pairwise comparison is performed, except for the second-level criteria under each top-level criterion. This establishes a second level weighting factors. This step is repeated for lower criteria levels in the hierarchy until exhausted. Finally, pairwise comparisons are used to determine the relative preference of each alternative for each of the lowest-level criteria.

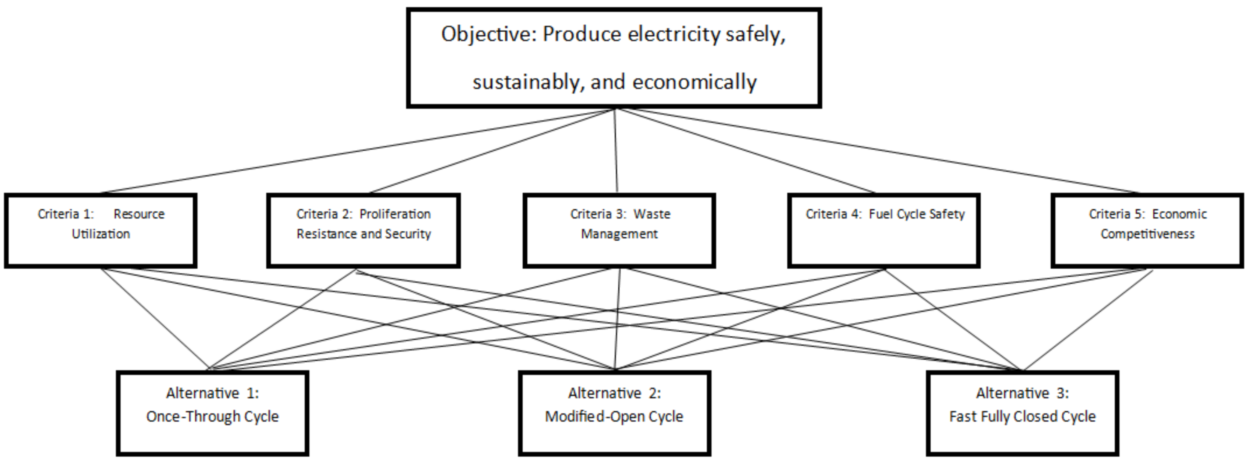

Figure I. Objective, criteria, and alternative in an AHP-style hierarchy

AHP has been applied to a number of studies pertaining to electricity production and nuclear energy. For example, the Republic of Korea has employed AHP to inform its nuclear energy policies [15] and to allocate nuclear R&D funding [16]. In the case of allocating funding, the use of AHP allows those participating in the evaluation to determine preferences which can be used to allocate resources between options instead of simply identifying one option [14].

The AHP involves a hierarchical structure containing an objective, one or more criteria levels, and alternatives to be compared using the criteria to determine how well each alternative meets the objective. The AHP uses pairwise comparisons [17] of criteria and alternatives (elements), generally on a scale of 1 to 9, with each participant determining the extent to which each the compared elements is more important or preferred (providing a judgment). For example, if the preference for one element is the same as for another element, a 1:1 ratio value is assigned. If the participant's preference for one element is much greater than for another element a 9:1 ratio value is assigned

Preferences are determined by each participant using a series of pairwise comparisons. The first set of pairwise

The hierarchy developed for the Tool is shown in Figure I. This figure represents the AHP hierarchy relationship between the objective, criteria, and alternatives. This diagram three NFC options are shown as being compared against each other with respect to the five top-level criteria described above and not the sub-criteria for simplicity.

II.C. AHP Implementation

Expert Choice™, which is commercially available decision support software, was selected to elicit participants' judgments. It was selected for its features such as: foundation on the AHP methodology; documented previous applications to similar problems in the energy and nuclear technology domains [18,19]; ability to be used for web-based elicitation of preferences; and built-in graphical capability for analysis and communication of results [10].

For some sub-criteria, quantitative data was provided in the criteria papers, e.g., waste volumes. The quantitative data were related to the pairwise comparison scale using a conversion approach. In this approach, a lower value was preferred (e.g., lower uranium consumption, less waste, lower doses, lower costs, etc.)

for each of the quantitative parameters. Given two data values x and y, which represents the qualitative data for each NFC, a ratio "R" of the lower of the two values was determined and expressed as a percentage:

$$R = \frac{\min(x,y)}{\max(x,y)} * 100\%$$

Ranges of values for R were assigned to bins, which were then assigned values in the pairwise scale and provided to participants. However, participants were not obligated to use to the suggested scale, and in fact, several participants did not use the scale and provided the rationale for their differing evaluation which was an anticipated part of the demonstration and was encouraged.

III. Elicitation of Participant Preferences

During Day 1 of the Workshop a pilot application of the Tool was carried out. The purpose of the elicitation was *not* to determine which NFC is best. Instead, it was intended to demonstrate the ability of the Tool to illustrate and explain the preferences of the participants as individuals and as a group and to collect input to guide improvements to the Tool. Fifteen participants from government, industry and academia provided input in a moderator-led elicitation. After the elicitation, participants were encouraged to fill out a survey on the Tool.

To familiarize workshop participants with the Tool and the software, a simple practice exercise was performed using an automobile purchase example. The participants proceeded through the two steps: the "weighting scale" portion and the "preference" portion. This example considered the individual comparison of three car types/models and using three criteria: style, price, and fuel economy. No Sub-criteria were included. Both qualitative (style) and quantitative (price and fuel economy) criteria were included. Judgments were informed by a criteria paper. Participants were told to use the data provided in the criteria paper or to use their own judgment. They were given unique IDs for anonymity and accessed ExpertChoice™ using individual laptops. The participants were led through the software exercise by a moderator, who navigated through the questions and allowed all the participants to answer the same question at the same time.

After familiarizing the participants with the software and elicitation process, the participants were led through the Tool to compare, the OTC, MOC, FFCC to determine which the most preferred with respect to the objective of producing electric power. Prior to this portion elicitation process, participants were provided an overview of the Tool and its use in the OTC-MOC-FFCC comparison. Additionally, a summary of the criteria papers was provided. These papers had been sent to participants prior to the workshop as "read ahead" material. Participants were given the opportunity to ask questions about the criteria papers or other aspects of the upcoming evaluation.

The moderator-led evaluation began with participants first weighting criteria on their importance and then comparing which NFC with regards to each criterion. The participants were led through the series of pairwise comparisons by the moderator who read from a script for consistency in presentation, and requested confirmation from participants that they had completed answering (or if they required more time) before moving on to the next question. Technical assistance was available in the room to help with any hardware or software issues.

The software allowed participants to provide feedback in the form of comments. Participants were encouraged to leave comments about any topic, including evaluation of the Tool, concerns about the data or assumptions, and feedback about the elicitation process. When answering the quantitative questions, participants were especially encouraged to provide input if their answers deviated from the data provided and/or if they had technical knowledge that differed from the information in the criteria papers. For context, participants were also encouraged to provide rationale for their answers to guide improvement of the Tool.

After providing input on one of the elements, participants were able to see an intermediate summary of their input. The moderator asked participants to make a note if the priorities they saw did not reflect their expectations. If the expected preference was not observed, participants were allowed to go back and re-evaluate their answers at the end of the elicitation which occurred in only a couple of cases. The elicitation took approximately 2.5 hours. Breaks occurred at regular intervals to avoid fatigue.

III.A. Raw Elicitation Results

The results of the elicitation was the collective preference of the participants form each of the three NFC options and the participants' collective criteria weighting factors for the top-level criteria as shown in Figures II and III. The OTC was the most-preferred alternative, followed by the FFCC and then the MOC. Economic Competitiveness was the criterion having the largest weight, while proliferation resistance and security was the criterion having the smallest weight. There were minimal differences between the participant sectors NFC preference (see Table II). All groups identified the OTC as the preferred alternative with a similar degree of preference.

Table II. Collective fuel cycle preferences by participant sector (in %)

NFC	Industry	Academia	EPRI & Associates	DOE National Labs
OTC – Once Through UOX in PWRs	41.6	40.2	41.9	43.5
MOC – Reactor Grade MOX in PWRs	24.7	26.8	20.5	24.2
FFCC – Fast Fully Closed Fuel Cycle	33.8	33.0	37.6	32.3

There were significant variations in the weighting factors among the participant sectors (see Table III). Economic Competitiveness was rated as important by all participant groups, although DOE and Industry participants made Fuel Cycle Safety the largest weighted criterion. Proliferation Resistance and Security was the criterion having the smallest weighting factor for most participant sectors, with the exception of DOE National Laboratories. In fact, National Laboratory participants gave this criterion over three times as much weight strongly, bringing it close to Fuel Cycle Safety and Economic Competitiveness. National Laboratory participants gave Resource Utilization the smallest weight. Waste Management received a large relative weight from the Academia sector.

Table III. Collective criteria priorities by participant sector (in %)

Criterion	Industry	Academia	EPRI & Associates	DOE National Labs
Resource Utilization	17.1	10.6	18.5	9.8
Proliferation Resistance & Security	6.7	5.9	4.3	21.7
Waste Management	11.1	23.0	9.0	13.8
Fuel Cycle Safety	34.0	19.0	22.0	28.6
Economic Competitiveness	31.0	41.7	46.3	26.0

IV. ANALYSIS OF ELICITATION RESULTS

A sensitivity analysis was carried out to see how changes in the responses of the elicitation would have impacted the results and is described in Section IV.A. Then, comments provided by participants during the elicitation and in the subsequent workshop survey were analyzed and the results are given in Sects. IV.B and IV.C, respectively.

IV.A. Sensitivity Analysis

Sensitivity analyses were performed to determine changes in NFC preferences resulting from changes to criteria weights. The analyses sought to identify whether "breaking points" in criteria-level weights could create an equal preference between the OTC and FFCC (no modification of the criteria weighting resulted in the MOC being the most preferred NFC). Results of the sensitivity analyses are presented below.

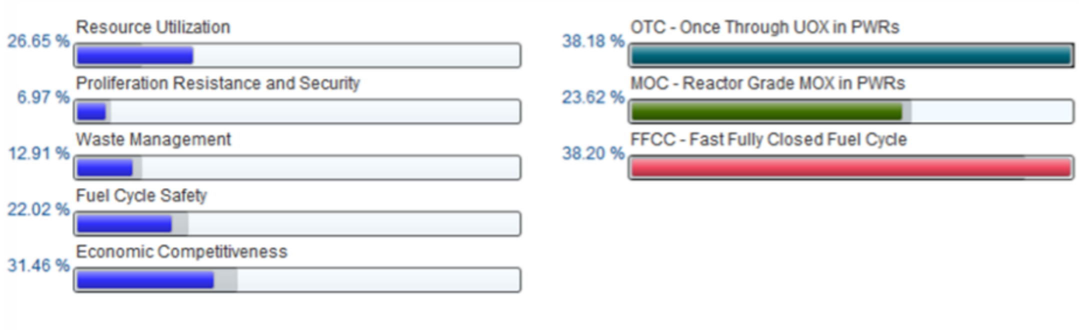

Figure II. Priority results with change in resource utilization criterion

IV.A.1. Resource Utilization

An increase in Resource Utilization's weighting from just the reference value of 15% to about 27% would yield an equal preference for the OTC and the FFCC. This situation could occur if there was increased concern about being able to obtain uranium or plutonium to produce nuclear fuel. For example, some uranium resources are found in countries that may not make their ores available.

IV.A.2. Proliferation Resistance and Security

Collective NFC preferences were not strongly sensitive to changes in the weighting of the Proliferation Resistance and Security criterion. Even a decrease to zero caused only a very slight increase (0.8%) in the FFCC's preference. This suggests that these three NFCs are perceived to perform similarly with respect to this criterion.

IV.A.3. Waste Management

Increase in the weight of the Waste Management criterion from 15% to 29%, would produce an equal preference for the OTC and FFCC. Currently, there is no a geologic repository for UNF and HLW in the US; the prioritization of Waste Management could increase if disposal remains unresolved and/or the costs or capacity of interim storage become problematic.

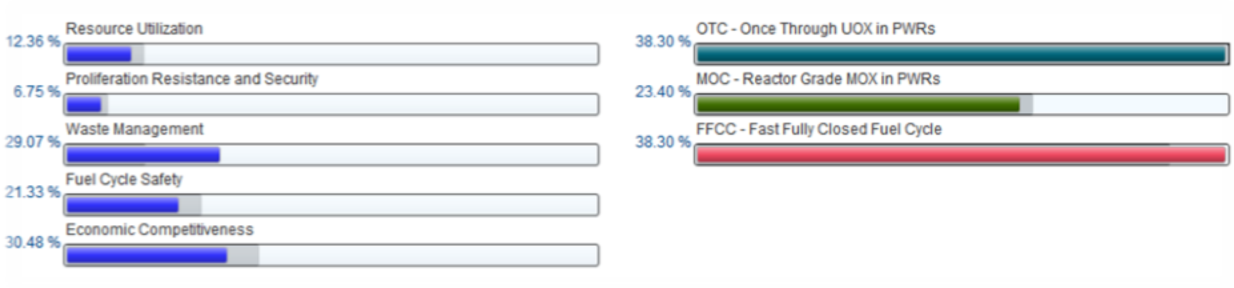

Figure III. Priority results with change in waste management criterion

IV.A.4. Fuel Cycle Safety

The NFC preferences were not strongly sensitive to the weighting of Fuel Cycle Safety. A decrease in Fuel Cycle Safety's weighting to zero caused the FFCC's preference to increase by 2.7% and did not have a great impact on the overall preferences for the NFC options.

IV.A.5. Economic Competitiveness

Reducing the weight of the Economic Competitiveness criterion from 36.5% to 19.8% would yield a nearly equal preference of the OTC and the FFCC. While economic factors are not expected to become unimportant, their relative significance could decrease if one or more other criteria became decisively more important.

IV.A.6. Sensitivity Analysis Summary

An increase in the weight of the Resource Utilization or Waste Management criteria, or a decrease in the weight of Economic Competitiveness could increase the preference for the FFCC to the point that it becomes equal to that of the OTC. Thus, there is a conceivable set of weighting factors for which the FFCC would become the more preferred NFC. The weights of the Proliferation Resistance and Security and Fuel Cycle Safety criteria did not have a strong impact on the overall result under any circumstance.

IV.B Evaluation of Comments about the Decision Tool

Feedback during the elicitation was encouraged to allow the participants an opportunity to explain why certain judgments were made, to explain why participants may have deviated from quantitative results provided in the criteria papers, and to provide feedback on the overall effectiveness and structure of the elicitation. Over 240 comments were left by participants. Analysis of the results revealed that a substantial number of participants provided rationale for their ratings. The feedback from participants yielded valuable information that will be used in the further refinement of the Tool. Figure IV presents the breakdown of comments by criterion.

The content analysis was performed using data labeling or indexing as detailed in GAO guidance on content analysis [20]. Content analysis software (ATLAS.ti) was used to perform record-keeping functions and to allow for simple occurrence counting and tracking [21]. The ATLAS.ti code structure uses abbreviations or shorthand versions of the concepts (phrases) to mark and count instances of their occurrence. The topics receiving the most occurrences of comments were the Economic Competitiveness criterion, the Minimizing Repository Waste sub-criterion, the Resource Utilization criterion, the Minimizing Calculated Consequences of Potential Accidents sub-criterion, and the Fuel Cycle Safety criterion, in the order listed.

Regarding the Economic Competitiveness criterion, the content analysis of the 73 comments indicated that many participants believed that capital cost remains a more significant barrier than fuel cycle or other operating costs. Some participants did not find it meaningful to distinguish between the best estimates of costs because the associated uncertainties are often quite large. Additionally, several comments suggested that the "Applicability and Status of Existing Licensing Framework" and the "Technology and Status of Developing and Deploying the Technology" sub-criteria are not easily compared to monetary costs, perhaps warranting their movement to a new criterion. A number of participants stated that it was challenging to compare between the OTC and FFCC with regards to metrics such as licensing, given the overwhelmingly greater experience and infrastructure associated with the OTC.

There were 25 comments on Minimizing Repository Waste. Based on content analysis, the most frequent comments were concerned with the use of waste volume as a metric, often suggesting that volume may not be the best metric to gauge waste management performance. Proposed alternatives to volume were provided and included mass, heat, activity, and toxicity. However, other participants defended the use of volume since it tends to scale more linearly with the cost of disposal. A number of participants disagreed with some information and assumptions presented in the Waste Management criteria paper. In some cases, these participants had experience and/or knowledge of alternate data that caused them to deviate from the provided quantitative data for particular waste volumes (Greater-than-Class C, reprocessing from the MOC and FFCC wastes) and selected a different preference as to which NFC produced less waste.

Comments were provided relating to both sub-criteria under Resource Utilization: Managing/Optimizing Plutonium Inventory and Minimizing Uranium Utilization. For uranium utilization, some participants disagreed with the amount of uranium estimated for use in the FFCC. For the Managing/Optimizing Plutonium Inventory, sub-criterion, comments relayed the participants use of on their own expert opinion of NFC and described when that opinion was inconsistent with the criteria papers when providing answers.

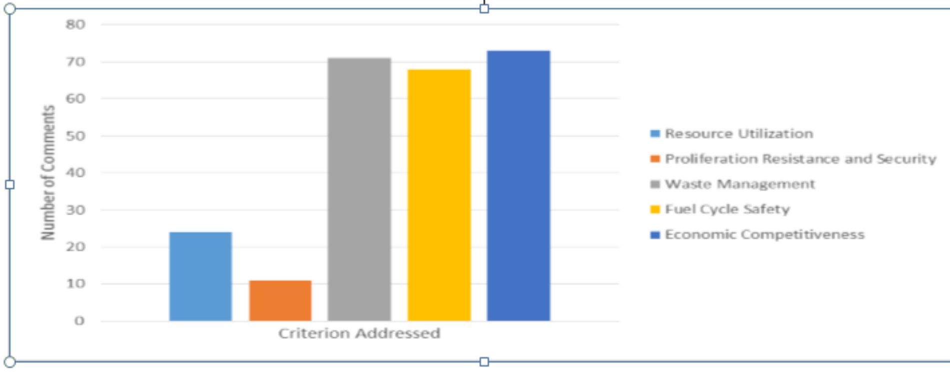

Figure IV. Distribution of comments by criterion

For Minimizing Calculated Consequences of Potential Accidents under the Fuel Cycle Safety criterion, in the case of design-basis accidents (DBAs), participants commented that it was difficult to use a single set of DBAs that was applicable to all NFC options. Each NFC has different operational characteristics, which could cause different types of accident scenarios. The "pressure versus sodium" comment reprises a discussion of several participants' views on tradeoffs between the high pressures experienced in LWRs versus much lower pressures in SFRs.

The Fuel Cycle Safety criterion received the third largest number of comments (68). Based on content analysis, with respect to evaluating the potential radiation exposures during routine operations (both public and occupational), some participants commented that regardless of the type of NFC deployed, a regulatory framework would be in place to ensure that these exposures remain below a required limit. Participants commented that the differences in radiological dose between the NFCs would be minimal when compared to these regulatory thresholds.

IV.C Analysis of the Survey on the Decision Tool

A survey was given to participants to evaluate the Tool and workshop in the following categories: organization, moderation, software, criteria papers, and criteria. Concerning Organization: participants felt that the overall elicitation process was well-planned and well-organized. Moderation: participants felt the moderator set a good tempo and that the delivery was well structured, but there was some issue with the length of time that participants required to answer the question (some took longer than others). Software and criteria: participants stated that use of the criteria papers was a successful way to frame the criteria, but they cautioned that the Waste Management criteria paper did not use the same assumptions as other criteria. This affected the participants' ability to consistently compare the NFCs. Also, participants advised that the Economic Competitiveness criterion should be split into technology-development-related and NFC cost-related sub-criteria. Some participants suggested the conversion scheme from data to pairwise ratings needed modification, specifically noting that a single relationship is not necessarily appropriate for all quantitative scales (e.g., a 50% increase in capital costs might be perceived differently than a 50% difference in uranium utilization). A participant suggested that the two elicitations could be performed, with and without the pre-defined quantitative conversions to AHP values to evaluate the value pre-defined conversions.

V. FUTURE WORK

The elicitation at the Workshop was successful based on the value of the insightful feedback that was received. The Tool was demonstrated to be capable of being practical for use to collect the judgments of a diverse group of individuals at one time. Participants' comments on the Tool in combination with the survey results provided valuable information that will be used to improve the Tool and prepare it for the next implementation. Several steps are planned to further develop the Tool based on review of collected comments including revising the criteria structure, updating criteria papers to address the new structure and detailed comments, performing elicitation dry runs to test these revisions and updates, and performing an elicitation with group of EPRI-identified nuclear industry professionals.

The criteria and criteria papers will be revised to improve and clarify the Tool's structure. All criteria papers will be updated to incorporate consistent NFC assumptions. Quantitative data, when available, will be used as comparison metrics. However, when quantitative data is limited, qualitative information will be used. Feedback indicated that the Mill Tailings sub-criterion was too closely correlated with the Resource Utilization criterion; therefore, mill tailings will most likely be removed from the Waste Management criterion and a discussion within to the Resource Utilization criterion will be added. Participants also discussed that the four Economic Competitiveness sub-criteria may not fit in a cohesive manner underneath one criterion. EPRI and VU will evaluate whether Applicability and Status of Existing Licensing Framework and the Status of Developing and Deploying the Technology should be placed in a separate criterion. Upon completing the criteria revision, the criteria papers will be revised to reflect the changes.

To determine if the updates to the criteria papers have improved the effectiveness of the Tool, dry runs will be conducted. Once testing is completed, an elicitation of a large group of EPRI of utility and industry advisors will occur. Feedback will be used to further update the Decision Tool.

In the future, the Tool can be used to determine preferences for Generation IV reactor and fuel cycle technologies to demonstrate that it can be used to provide an important basis for decisions on RD&D programs at both the NFC and technology levels. Potential NFCs to be compared in this assessment could include SFR, gas-reactor, and molten-salt-reactor based NFCs. Such a comparison is tentatively scheduled for the 2015 workshop.

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