ATTACHMENT D

WAIVER REQUESTS RELATED TO RISK ANALYSIS AND STRATEGY SELECTION 4 CSR 240-22.070

I. BACKGROUND

Chapter 22 rules related to the consideration of environmental risk and uncertainty in the IRP process are primarily described in 4 CSR 240-22.070. When read in its entirety, 4 CSR 240-22.070 describes the main steps of a classic decision-analysis process. A classic decision analysis process first performs a deterministic assessment of a particular decision, second, applies a battery of sensitivity analyses to all of the uncertain inputs ("factors"), and third, develops a decision tree that applies probabilities to all of the sensitive uncertain factors to perform a probabilistic assessment of the decision in question. Other elements of a classic decision analysis include consideration of whether to gather more information on any of the uncertain factors before finalizing a decision ("value of information"), incorporation of the decision-maker's subjective assessments of risk and risk preferences in order to choose an option given the uncertainties that all of the options face, and examination of the probabilistic results to understand what outcomes of uncertain factors could alter the plan in the future ("contingencies"). The various sections of 4 CSR 240-22.070 would cause each of the above steps to be performed in an integrated resource planning (IRP) process to which they apply.

However, 4 CSR 240-22.070 also has several requirements that are a highly specific application of such a decision analysis process. At the time the rules were written, the Commission determined that these specifics were appropriate. However, twenty years later, the range of options for utility planning, and the circumstances affecting power markets have changed substantially, and some of the specific requirements of 4 CSR 240-22.070, if adhered to as currently stated, would hinder AmerenUE from using what it considers to be the most effective application of the decision analysis approach to IRP today. For example, 4 CSR 240-22.070 lists specific uncertain factors that must be addressed in sensitivity analysis. That list does not include some of the uncertain factors that are expected today to be the most critical, a salient one being the potential for future carbon emissions limits. Unfortunately, it is not possible to simply add carbon policy to the list of uncertain factors to be included in the sensitivity analysis phase, and thereby bring the rules of the process up to date. Rather, if carbon limitations were to be imposed, this event would have direct and indirect effects on many of the other listed uncertain factors. It could also cause some other, unlisted factors to become critical uncertain factors. The interrelatedness of many critical uncertain factors around the outcome of potential carbon policy calls for a more advanced form of sensitivity analysis described in decision analysis textbooks, called joint sensitivity analysis. The specificity of some of the requirements of 4 CSR 240-22.070 makes it difficult to readily incorporate joint sensitivity analysis and related aspects of addressing climate policy uncertainty into the IRP process.

AmerenUE believes that joint sensitivity analysis is well suited to address the highly interrelated uncertainties that utilities face in performing sound resource planning. The approach described below is rapidly becoming the standard method that U.S. utility decision makers are using to estimate business risks from potential climate policy. AmerenUE has proposed specific alternatives to the Chapter 22 requirements that it believes are necessary to enable application of the more up-to-date environmental and risk analysis approach, and it requests that these modifications be granted as waivers from Chapter 22 rules. In developing a sound approach for addressing environmental uncertainty and risk in today's world, AmerenUE is also striving to create consistency across the entire IRP process. Thus, AmerenUE requests waivers from Chapter 22 rules prior to 4 CSR 240-22.070 where uncertainties are addressed in earlier stages of the IRP process, as well as waivers related to 4 CSR 240-22.070 which is specific to risk.

II. DESCRIPTION OF SCENARIO-BASED UNCERTAINTY ANALYSIS PROCESS

Attachment 1 to this document contains a pictorial representation of the flow of analysis activity that will be used to capture the overall requirements for deterministic analysis, sensitivity analysis, and probabilistic analysis in 4 CSR 240-22.070, and which encompass the core elements of any classic decision analysis. For purposes of exposition, the total process is segmented into three steps. Steps 1 and 2 lie within the deterministic phase of the decision analysis cycle, and Step 3 comprises the probabilistic and informational phases of the decision analysis cycle.

<u>Step 1</u>

An important feature of the process outlined in Attachment 1 is its reliance on a set of scenarios that will each reflect an integrated, internally consistent set of energy and environmental input assumptions. This foundation is built in “Step 1”, where a probability tree is developed to describe multiple combinations of critical uncertain factors that have interrelated impacts on multiple energy and environmental projections that are key to an IRP analysis. Each endpoint of the probability tree is an individual integrated scenario. One of the uncertain factors in the probability tree will be the future carbon policy outcome itself, and other uncertain factors in the tree will include other important modifiers of the impact of carbon policy, and/or other uncertain outcomes that also can have significant impacts on the interrelated set of energy and environmental projections that can affect resource plan performance and IRP decisions.

The probability tree shown in “Step 1” is a device to describe a set of scenarios (and their associated likelihoods) that a sound IRP process should explicitly consider. A sound IRP should chart a course from the present moment that balances the variety and range of risks reflected in the full set of scenarios. A sound IRP also, to the extent possible, would be flexible to be adapted to any of the futures represented by any single branch of the probability tree (but with emphasis being given to adaptability to respond to the outcomes that otherwise would result in the more negative impacts to the company and its ratepayers). Thus, the most important feature for a sound IRP in the face of highly interrelated sources of uncertainty is to base the entire process of constructing and winnowing out candidate resource plans on a range of internally consistent scenarios. This contrasts to the approach prescribed in Chapter 22 rules that would incorporate the information in the probability tree only in the probabilistic phase.

Step 1 begins with the development of a probability tree that will produce a set of future energy and environmental projections that are all mutually consistent with a particular set of future policy and technology developments. In the technical language of decision analysis, these scenarios will be used for joint sensitivity analysis during the deterministic phase of the analysis. (All “sensitive” scenarios found in the joint sensitivity analysis will also be carried through to the probabilistic phase of Step 3. However, in Step 3, the probability tree would be enlarged to include any uncertain factors that are independent of those affecting the scenarios but which are found to be critical uncertain factors in additional individual sensitivity analyses that occur in Step 2).

AmerenUE will develop mutually consistent sets of input assumptions for each scenario through the application of an integrated model of the energy and environmental system. Such a model needs to be able to simultaneously simulate interactions in fuel markets, energy demands, electricity generation system operation, non-electricity sector outcomes, macroeconomic activity levels, and responses to emissions limits that may be applied to sources throughout the economy, and not just to electricity generators. Thus, the scenarios in the probability tree in Step 1 will actually be analyzed as a set of model runs (e.g., eight runs, in the illustrative example of the attachment) using an integrated energy-environmental model with the above capabilities. The output of each model run (i.e., for each scenario in the tree) will be an integrated set of projections of key inputs to a standard analysis to select a resource plan. Each integrated set will include projections through the planning horizon of electricity load growth, changes in wholesale electricity prices, emissions allowance prices (for SO_2, NO_x, mercury, and CO_2) natural gas prices, coal prices, and AmerenUE's optimal emissions control retrofits (and their timing).

The development of a probability tree of interrelated energy and environmental critical uncertain factors by AmerenUE is thus a major modeling activity in its own right, although using national-scale models. In contrast, the modeling used for the analysis and selection of an acquisition resource strategy for AmerenUE is more local in scope, at the system and regional level, although this modeling exercise uses as inputs, results from the national-scale modeling. Thus, AmerenUE separates the development of the scenarios and associated integrated modeling of those scenarios into its own step (i.e., Step 1) of the IRP process that will precede the development of candidate resource plans on a deterministic basis (i.e., in Step 2). Additionally, AmerenUE recognizes that it cannot know *a priori* what types of uncertain events will have the most effect on the variation of integrated projections, although it is almost certain that one of these will be the carbon policy uncertainty. In Step 1, the sensitivity of the scenario outputs will be explored for a number of different uncertain factors that can affect integrated energy systems. The final probability tree will be developed to include the uncertain factors that have the most effect on the interrelated projections of resource plan performance. The tree shown in Attachment 1 is therefore merely illustrative of the general concept, and the final tree may have quite different branches.

Step 2

Once finalized, the integrated projections for each of the scenarios in the probability tree developed under Step 1 will be used in Step 2 (see Attachment 1) to identify candidate resource plans. This will be done for each scenario, one by one, so that the final set of candidate resource plans will include at least two resource plans that would be desirable alternatives under each of the scenarios *if the scenario were deterministically known*. All other remaining uncertain factors will be subjected to individual sensitivity analysis during Step 2, in the manner already provided for in the rules. Thus, the deterministic analysis process in Step 2 is expected to be fully consistent with that established in the IRP Chapter 22 rules. The only new aspect of this process is the iterative use of each of the scenarios and associated inputs for critical uncertain factors to select a set of candidate resource plans for probabilistic evaluation (i.e., for the risk analysis). This is an enhancement to the currently prescribed process because it performs joint as well as individual sensitivity analysis, and it does so for a more comprehensive set of uncertain factors than those specifically identified in the rules.

Step 3

Step 3 starts at the point where probabilistic analysis is initiated. This is the analysis that helps a decision maker choose among the candidate resource plans by balancing their risks (i.e., the potential downside due to uncertainties) against maximizing their expected outcomes on multiple IRP objectives. Chapter 22 rules specify that this be done using a sequential decision tree in which resource decisions at each time step into the future are interleaved analytically with potential new information on the critical uncertain factors. However, under the scenario-based approach described here, each of the candidate resource plans going into Step 3 will be defined as a sequence of resource investments over the full modeling horizon into the future. That is, each candidate to assess is already a full “plan” and not a single resource acquisition at a single point in time. The set of these resource plans will have been created in Step 2 to include entire sequences of resource acquisitions throughout the planning horizon that each makes sense in at least one of the potential future scenarios. The task in Step 3 is thus to choose which candidate plan is the best plan for the company to select as its working vision of the resource acquisitions that are expected to best satisfy its future resource needs.

In Step 3, the expected benefits and the probability distribution of the benefits of each of these candidate plans will be assessed probabilistically using the probability tree from Step 1, but now expanded to include any other independent uncertain factors identified as critical in Step 2. This probabilistic evaluation will provide company decision makers with information to help them identify which future course of investments appears to be the best path given present uncertainties. Certainly, as the subjective assessments by AmerenUE’s decision-makers of probabilities of the future scenarios evolve, the company's management may wish to change its plan. The likelihood of needing to shift to a new plan at a future time, and the most likely plans that might be shifted to, can be assessed by considering which plans are preferred under each of the different scenarios. The analysis will therefore also highlight the alternative best options contingent on different future outcomes of the uncertain factors. As a result, the probabilistic analysis conducted in Step 3 will support not only an explicit determinations by AmerenUE of what it considers its preferred resource plan; it will also support decisions regarding (1) what activities AmerenUE needs to initiate today to enable it to follow the preferred resource plan, and (2) what activities AmerenUE needs to engage in to preserve its options to shift to any of the other resource plans that the analysis finds to have a significant chance of later emerging as a preferred plan.

In this way, the IRP process would be adapted to incorporate the important new challenge of addressing interrelated ("joint") uncertainties while remaining consistent with the goals of accomplishing a sound decision-analytic approach to managing uncertainty and risk. AmerenUE has identified each waiver request that it believes is needed to implement this approach. In addition, AmerenUE has provided a definition for the term "probability tree." This term does not appear in 4 CSR 240-22.020 but is used in several of the waiver requests. AmerenUE also makes waiver requests that will allow it to apply the scenario-based approach consistently throughout the IRP process, thus resulting in a more streamlined overall approach to management of uncertainties in its IRP.

In the following text, AmerenUE has identified changes in redline format, with deletions struck out, and requested insertions underlined.

III. ADDITIONAL DEFINITION REQUESTED IN CHAPTER 22

Many of the waiver requests use the term "probability tree". The definition of "probability tree" within the context of the waiver requests is as follows:

> "Probability Tree: a discrete summary of the range of all potential combinations of outcomes and their likelihoods for a set of critical uncertain factors, represented as a sequence of nodes with branches emanating from them. Each critical uncertain factor is represented by one node, with one or more branches reflecting different possible values or value ranges that the uncertain variable may take on, and the probability of each possible outcome. The endpoints of the tree

are called scenarios, as each one reflects a specific, mutually exclusive combination of outcomes for each of the critical uncertain factors. The probabilities associated with each branch of a tree will be objectively based if the parameter is one that is subject to random variability, or it will be subjective in the case of future events that are simply unknown at present."

IV. WAIVER REQUESTS

The following waiver requests apply to 4 CSR 240-22.070, which are a part of the rule most specific to the treatment of risk analysis.

(1) 4 CSR 240-22.070 (1)

Current Requirement:
The utility shall use the methods of formal decision analysis to assess the impacts of critical uncertain factors…This assessment shall include a decision-tree representation of the key decisions and uncertainties associated with each alternative resource plan.

Proposed Alternative:
AmerenUE will use the methods of formal decision analysis to assess the impacts of critical uncertain factors…This assessment shall include a probability tree representation of uncertainties associated with each alternative resource plan.

Rationale:
See discussion in Section II above.

(2) 4 CSR 240-22.070 (2)

Current Requirement:
Before developing a detailed decision-tree representation of each resource plan, the utility shall conduct a preliminary sensitivity analysis to identify the uncertain factors that are critical to the performance of the resource plan.

Proposed Alternative:
Before developing a detailed probability tree analysis of each resource plan, AmerenUE will conduct a preliminary sensitivity analysis to identify the uncertain factors that are critical to the performance of the resource plan.

Rationale:
See discussion in Section II above.

(3) 4 CSR 240-22.070 (3)

Current Requirement:
For each alternative resource plan, the utility shall construct a decision-tree diagram that appropriately represents the key resource decisions and critical uncertain factors that affect the performance of the resource plan.

Proposed Alternative:
AmerenUE will construct a probability-tree diagram that appropriately represents the interdependent critical uncertain factors that affect the performance of the resource plans.

Rationale:
See discussion in Section II above.

(4) 4 CSR 240-22.070 (4)

Current Requirement:
The decision-tree diagram for all alternative resource plans shall include at least two (2) chance nodes for load growth uncertainty over consecutive subintervals of the planning horizon. The first of these subintervals shall be not more than (10) years long.

Proposed Alternative:
AmerenUE is requesting a complete waiver from the requirement of section 4 CSR 240-22.070 (4).

Rationale:
Under the proposed approach, AmerenUE would seek a waiver from this requirement in its entirety, as it would not be relevant given the waiver sought under 4 CSR 240-22.070 (3). Load growth uncertainty would, however, still be represented in the scenarios, and so it would be included in the probabilistic assessment under 4 CSR 240-22.070 (5).

(5) 4 CSR 240-22.070 (5)

Current Requirement:
The utility shall use the decision-tree formulation to compute the cumulative probability distribution of the values of each performance measure…

Proposed Alternative:
AmerenUE will use the probability-tree formulation to compute the cumulative probability distribution of the values of each performance measure…

Rationale:
See discussion in Section II above.

(6) 4 CSR 240-22.070 (11) (A)

Current Requirement:
As part of its reporting requirements, the utility is required to furnish:
A decision-tree diagram for each of the alternative resource plans along with narrative discussions of the following aspects of the decision analysis:

1. A discussion of the sequence and timing of the decisions represented by decision nodes in the decision tree; and
2. An explanation of how the critical uncertain factors were identified, how the ranges of potential outcomes for each uncertain factor were determined and how the subjective probabilities for each outcome were derived.

Proposed Alternative:
AmerenUE will furnish a probability-tree diagram applied to each of the alternative resource plans along with narrative discussions of the following aspects of the decision analysis:

1. A discussion of the sequence and timing of the decisions represented by each alternative resource plan, and how the set of resource plans was developed to be responsive to the range of uncertainties in the probability tree; and
2. An explanation of how the critical uncertain factors were identified, how the ranges of potential outcomes for each uncertain factor were determined and how the subjective probabilities for each outcome were derived.

Rationale:
See discussion in Section II above.

ATTACHMENT 1.

ILLUSTRATION OF SCENARIO-BASED PROCESS FOR HANDLING ENVIRONMENTAL AND OTHER RISKS IN IRP