

RFP for RPM Pre-Bid Conference Question Summary

1. Q: Can NPCC provide bidders with actual model files (e.g., Excel files, optimization code, etc.) to permit bidders to have a better understanding of the existing model formulation? As documentation is somewhat limited, having the actual model files could help bidders to better understand the current model formulation.

A: Council staff will make an effort to post at least a portion of the model files and documentation on running the model. However, the current version of the model is difficult to set up and run. Redevelopment should not require reference to these files or the capacity to run the existing model. Source code is spread across several different technologies currently, so access to legacy development software may be required.

2. Q: Do you expect this to be a desktop application or a client-server or web application that can have multiple simultaneous users?

A: We are open to proposals for any of these approaches. The current model requires a considerable amount of processor cycles and is split between virtual machines so any proposal should address how processing power can be scaled and how multiple cores/processors/computers can be incorporated into the proposed model.

3. Q: Would there be just one license? How would that work with the viewing issue? Just want people to be able to view the output or to actually use the model?

A: Several members of council staff will need access to the model. The Council is also interested in providing access to the model for participants in its power planning process. We would support other entities having access to the model, e.g., for Northwest utilities' use for their own integrated resource planning purposes, but this may extend beyond the scope of this RFP. We would like proposers to set forth how they propose to make the model accessible.

4. Q: Does NPCC have, or can it create, a concise summary of the optimization problem(s)? Some limited information is provided in various referenced appendices and review documents, but information contained in those documents is not currently sufficient to fully understand the model formulation. For example, the following would be helpful.

- a. Precise definition of the objective function(s) (including time horizon(s) over which the problem(s) is optimized, etc.)**
- b. Precise list of constraints to the optimization problem(s)**
- c. Precise list of all decision variables**
- d. Discussion of any "dynamic" elements of the model (e.g., where future decisions may or may not be a function of past uncertain elements)**

A: We encourage bidders to look carefully at the documents identified in the RFP including the RPM implementation review document prepared by Doug Logan and presented to the SAAC in November 2013. The document contains a good schematic of the overall model, structure and

components of it and talks about how a number of pieces fit together. The link to the document is included in the RFP.

This topic takes us to the heart of the RPM analysis process, which produces a set of viable resource expansion strategies for the Council to consider (i.e., the efficient frontier).

The RPM methodology involves a two-step process. In the first step, the model assesses *costs* and *risks* of multiple resource *plans*. The plans are assessed using a Monte Carlo approach in which the 20-year operation of the regional power supply portfolio is simulated over 750 futures with different “draws” of futures. *Cost* is defined as the average present value cost of the plan over all futures. *Risk* is defined as the average present value cost of the ten-percent highest-cost futures (TVar90).

A resource *plan* is defined to be the earliest build-out schedule for a set of new resources, which typically includes energy efficiency, wind, demand response, natural gas-fired generation, etc. A plan represents a sort of supply curve for the model to assess but is limited not only by resource type and magnitude but also by earliest availability. The model includes decision variables that allow it to choose whether to build, delay or cancel new resources identified in the plan, depending on what conditions it observes in each of the 750 futures. That is, the model differs from standard Monte Carlo approaches in that it incorporates uncertainty in the decision to build resources and in a given future may first decide to build a resource and then later in the computation decide to cancel that resource build. The cost and risk values for this plan represent a single point in the feasibility space, where cost is plotted along the x-axis and risk is plotted along the y-axis.

The second process incorporates cost and risk values from previously assessed plans to find least-cost, risk-constrained plans using a stochastic non-linear optimization technique. In the current model Pareto optimality is used. (Pareto optimality is a state of allocation of resources in which it is impossible to make any one individual better off without making at least one individual worse off. Given an initial allocation of resources among a set of many, a change to a different allocation that makes at least one individual less risky without making any other individual worse off is called a Pareto improvement. An allocation is defined as “Pareto efficient” or Pareto optimal” when no further improvements can be made.) This second process involves finding a more cost-effective or less risky plan using the previous plans for reference. For example, a less risky plan may include many smaller sized units as opposed to a single large unit.

After the model selects a new plan using this technique, the first process is repeated and another point in the feasibility space is calculated. From all plans that yield the same average risk, the best (or most viable) is the one with the least cost. The efficient frontier, which represents viable solutions, lies along the left edge of the feasibility space (that is, the set of least cost plans for various levels of risk).

The objective of the RPM is to develop a set of viable resource expansion strategies for Council members to consider.

This is the current manifestation of the particular RPM modeling logic. The Council is open to modifications to this method that make it more straightforward while continuing to address strategic risk and recognize uncertainty inherent in long-term forecasts.

5. Q: Is NWPCC amenable to proposals that may suggest modifications to existing model formulation that may improve the robustness of the solution and/or model run-times? Or, is NPCC only interested in 100% replication of the existing formulation as a starting point?

A: We touch on this in the RFP and in the response to the previous question. We recognize that given a hard deadline of the council requiring a usable model by February 2015 that it is unlikely that 100 percent of the existing functionality of the RPM model will be completed and robust and ready to go by 2015. So, bidders are encouraged to include in their proposals how much of the methodology they can commit to deliver by February 2015.

Improving model operations is a goal for the Council. The RPM itself has evolved over the years, so a number of changes have been made. It's the underlying concepts we are interested in; we are not looking for duplication of the platform.

6. Q: How many concurrent users would use the RPM tool?

A: Three to five Council staff will need to use the model. This will likely involve multiple users concurrently working on data inputs, modifying run cases, etc. However, we do not require concurrent multiple user access to individual model runs.

7. Q: Would Vendor own IP right for code modification?

A: This may vary depending on the bidders' proposal, including the software development approach. For example, if a bidder proposes to subsidize some of the development cost in exchange for the rights to market the model to other clients, the Council would be willing to forego certain rights to the intellectual property. We invite respondents to address this topic under the software redevelopment approach section of their bids.

8. Q: It appears from the review documents that the model simulates hourly dispatch for 1 week per quarter, though that discussion does not appear in the Appendices as far as we can tell. Can you clarify how the model deals with the dispatch problem, especially with respect to the time element?

A: The RPM simulates the region's power system operation (dispatch) on a quarterly basis for a 20-year study horizon. For each quarter, the model will dispatch sufficient resources, including potential imports, to meet that quarter's energy and capacity needs. In other words, the purpose for this model is not to perform an hourly or sub-hourly dispatch simulation. Instead, it's more of a strategic and risk analysis model.

9. Q: Does \$300,000.00 budget cover modification and annual license?

A: That is something we would like bidders to speak to in their proposals.

10. Q: Does the Council have an existing set of questions, scenarios, and risks to be used to test and validate the tool, or do they expect to develop to develop these with the team during the project.

A: We anticipate test data sets will be used during the model development process. We may use data inputs from the Sixth Northwest Power Plan to evaluate how the new model does compared to results obtained from the version of model used for that plan.

11. Q: Is there a budget for annual license?

A: Consider that in your proposals. The Council is funded by annual funding through the Bonneville Power Administration; we are not a multi-billion dollar per year proprietary trading shop or a cost-of-service utility with a large budget for this type of work. So the Council is not in a position to provide lavish annual revenues to a vendor. In addition, we encourage prospective bidders to consider that this work may provide a good opportunity for the vendor to build its market visibility and attractiveness to other clients who may be interested in using RPM and/or the vendor's services for their own planning processes.

12. Q: A great deal of work has clearly gone into the model over many years and into review during the past year. In particular, the review provides details and priorities on proposed changes. To what extent does the Council envision this project largely as a matter of implementing these proposed changes?

A: The Council has done a lot of work reviewing and documenting the model but not a lot has been done recently in terms of modifying the model. There is no backlog of major changes to the existing RPM. We are interested in getting as much of the highest value aspects of the RPM method in a model we can use in 2015.

13. Q: Some of the reviews of the model contained a list and prioritization of work--is that what the Council is looking for?

A: The RPM review panel's report from December 2012 focused on how the Council communicates and uses the RPM model. It also addressed data management.

We are looking to have the redeveloped version of RPM be supportable with an adjunct data management system we will be developing over time. So initially there may be some interim approaches to data management that we can integrate into a parallel data management system. Council wants the model to have a layer of abstraction as to how it handles data--being able to connect to an external database and pull the information into the model. We want that capability rather than to develop an actual database that will be used in a proprietary manner with the model.

Given the timeline and budget, we also appreciate that a highly polished user interface by February 2015 may not be feasible. A rudimentary, usable version by February 2015 may be sufficient.

14. Q: Can our proposals also include dimensions to address limitations of the RPM?

A: Yes.

15. Q: Would Council provide all input data? Or the Vendor has to provide data?

A: The Council will provide the majority of the input data.

16. Q: As a follow-up, would the bidder be expected to develop new inputs to the model? Or, would inputs be provided to the bidder by NPCC?

A: The Council will provide the inputs.

17. Q: Will workshops by vendor be needed and should be considered as part of the development process.

A: The System Analysis Advisory Committee would likely be engaged at various points during the development of the product. The vendor would need to present in a workshop style format at several check-in meetings with the SAAC whose meetings are public. Council staff will be engaged throughout the process with the vendor.

18. Q: How does AURORAxmp tool fit in the current RPM model?

A: The Council uses AURORAxmp for wholesale power market analyses and price forecasting. The current version of RPM uses the price forecasts as input. There are also data that are used by both the AURORAxmp and RPM, but we don't run the models on a linked basis.

19. Q: The model is for the BPA area and other utilities. How many assets or megawatts do you have in the RPM?

A: The Council's footprint is Idaho, Montana (west of the Continental Divide), Oregon, and Washington. The region's power system annual energy loads run about 20,000 aMW and winter peaks can be in the mid 30,000 MW range. BPA is a subset of that. There are six investor-owned utilities and over 100 publicly-owned utilities in the Pacific Northwest and the Council's power plan covers that footprint.

Hydro capacity is about 60%, with about 20% coal and gas. Energy efficiency is substantial as reflected in loads. The region's power system is also connected with California and Canada so we do model those exchanges. We have 250 hydro projects in the northwest but the RPM models them in aggregate. The Council's GENESYS model does a more detailed simulation of individual projects and GENESYS feeds into the RPM, the monthly generation from the hydro under various water conditions and it also passes to the RPM a sustained period peaking capability for monthly amounts of energy. Inside the RPM there is some limited ability to move that hydro around provided by peaking and minimum generation provided through other sources. We don't anticipate the redeveloped RPM to simulate individual hydro projects.

The Council has been a national leader in planning for energy efficiency as a true resource; over 5,000 MW of energy efficiency currently and the Sixth Northwest Power Plan has over 6,000 MW of energy efficiency to be developed during 2010-2030. Much of the model looks at cost-effectiveness of energy efficiency including energy efficiency's ability to deal with uncertainty and risk. The current RPM has enabled the Council to do that and that is a central requirement for the capability of this model -- to be able to evaluate energy efficiency as a robust method for doing that including its risk mitigation and risk management attributes.

20. Q: What is the number of actual assets involved?

A: The proposed model should be able to simulate the dispatch and expansion of all resources in the states of Idaho, Montana, Oregon and Washington. As noted above, this includes a number of assets combined into aggregate representations.

21. Q: You have mentioned the importance of data management and usability. Very important. But also noted the "optimization under uncertainty" algorithm. Are you looking for, or open to, suggested improvements in the underlying algorithm?

A: People are free to propose improvements that streamline and simplify the algorithm. However, the Council is not interested in moving to a fundamentally different analytic approach.

22. Q: To what extent are you looking for expanded treatment of transmission with neighboring regions?

A: The Council is a power resource planning organization so we coordinate with Columbia Grid, Northern Tier Transmission Group and WECC on reflecting transmission plans. We may get into some look at locating new resources at different subregions in the northwest but we don't intend to do significant transmission modeling with this tool.

Currently the RPM breaks the Northwest region (as defined in the Power Act) into two sections, east and west. The model also simulates imports and exports with neighboring regions, i.e. Canada and California. The RPM is a transportation model with respect to transmission. The only anticipated and desired change is to split out the southern Idaho portion from the east node to make the Northwest a three-node region.

23. Q: Is all the demand projection endogenous, or does RPM include demand projection, including future distributed gen, energy efficiency, and demand response?

A: We look at risk and uncertainties and this is the core of the method we ask people to review. The model is not the ultimate decider, it's a model that explicitly recognizes all long-term forecasts are uncertain. So we do not expect to develop correct forecasts. There are 750 different futures evaluated but many different price/demand streams evaluated for each of those futures so you end up with 750 distributions of cost.

Demand projections over the 20-year study horizon for the RPM are endogenous. They come from the Council's long-term load forecasting model and represent frozen efficiency loads, that

is, future loads without the effects of new energy efficiency or demand response. Both of those resources are modeled explicitly in the RPM. Monthly peak, average and minimum loads are provided for the 20-year horizon from the Council's medium forecast. For each future, the RPM creates a unique load path that does not necessarily follow a low, medium or high forecast. Any particular load path can show extended years of higher or lower growth or both.

24. Q: Can you offer any insight regarding current model run-times? Some documents indicate 24-30 hours. Does that sound right? Is that with or without distributed computing?

A: The current version of the RPM model can easily take 24 to 30 hours or more to run and it is distributed across multiple virtual machines. As noted, the council is interested in streamlining the model run times.

25. Q: How does GENESYS fit in the RPM?

A: The GENESYS model provides various data inputs to the RPM and it may also be used as an RPM postprocessor to check regional resource adequacy for certain resource plans. Inputs provided by GENESYS to RPM include:

1. Monthly average hydro generation for major hydroelectric projects for 80 different water conditions
2. Aggregated monthly average hydro generation for small hydro for 80 different water conditions
3. Aggregated hydro sustained-peaking capability as a function of monthly hydro energy for various sustained periods (2 hours, 4 hours and 10 hours)
4. Aggregated minimum hydro generation as a function of monthly hydro energy
5. A minimum annual average energy load/resource balance, which represents the minimum threshold for an adequate power supply
6. Not yet incorporated, a minimum seasonal surplus peaking capacity margin, which represents the minimum threshold for an adequate power supply

The RPM (or preprocessor) converts the monthly plant-specific average hydro generation into aggregate seasonal values for each Northwest node.

26. Q: One question: it is mentioned that the source code must be delivered. Is it viable to deposit it in an Escrow Account instead?

A: The RFP addresses multiple scenarios for software development. Under the scenario where the Council pays a fee and the vendor completes a stand-alone model for us we would expect delivery of the source code. Under the circumstances where the vendor alters or creates a proprietary model we would expect to negotiate this item in the contract. We are willing to consider a wide variety of proposals in relation to this question.

27. Q: Will all the data used by the model be fixed during the project or does the Council envisage that it will be updated during that time? If so, does the Council expect the team to

be involved in any updates or improvements in the input data?

A: Please see responses to previous questions regarding model data to be used during the software development process. Also note that the Council will expect the redeveloped version of RPM to function properly using updated data input values.

28. Q: Would the original lead author of the model be available to the team to assist in understanding it during the course of the project?

A: The Council is dedicated to the success of the RPM redevelopment. It is committed to ensuring that a highly capable resource planning modeler with knowledge of RPM will be directly involved during the redevelopment of RPM. The extent of such involvement may vary depending on the capabilities of the various respondents and the particulars of their proposals.

29. Q: Is NPCC interested in proposals using existing modeling solutions (tailored to NPCC)? Or, is following the logic of the existing model a requirement?

A: Please see responses to earlier question that touch on this topic. There are some fundamental concepts that must be part of the model that is delivered, particularly the strategic risk analysis methodology. These concepts are part of the current model but it is not required or expected that all the logic of the current model be reproduced. If an existing model can be altered to meet these fundamental requirements then we are receptive to that proposal.

30. Q: Is the Council happy with the format and accessibility of the existing Access database or do they want the team to improve the structure and/or implementation as part of this project?

A: The existing Access database is not an ideal solution. The preference is to store and manage the data separate from the model. The proposal should expect that external data are available. The process of building a data repository for multiple models, including the proposed model, will be happening concurrently.

31. Q: Someone asked if there was a concise description of the formulation of the optimization that is solved by OptQuest, including the objective function, decision variables, and constraints. It was mentioned that there is a description of this in a certain document. I thought I heard that it was in the "RPM Implementation Review" by Douglas Logan, but I cannot find such a description in that document, nor in the Appendix L describing the Portfolio model, nor "RPM Portfolio model review". I suspect that all bidders would much appreciate if you could identify where we can find this description.

A: OptQuest is used throughout the model as an engine for optimization. The equations that are sent to the optimization engine are not currently collected in one place. It is not anticipated that the redevelopment would entail recreating these optimizations. Rather, where there is room to simplify the expression of the optimization, this would be the preferred redevelopment path. Current documentation should be considered for methodological guidance. Implementation is expected to be very different than the current model.

32. Q: We appreciate that NWPCC is willing to provide some of the model files relating to the RPM. To clarify, we note that the model documentation (e.g., Appendix L of the 5th Power Plan) often references specific rows, columns, and user-defined-functions (UDFs) within an Excel workbook. At a minimum, it would be important for the bidder to see this workbook, including any Visual Basic UDFs (which are typically embedded in the Excel workbook file) that may be required to understand the spreadsheet. Seeing the Excel workbook is important to ensuring we fully understand the scope of the project and will help us to prepare a proposal that is most likely to meet the needs of NWPCC at least cost. Other code or files (e.g., optimization files) are not necessarily required, but having access to the underlying Excel workbook would be critical. Is NWPCC able to provide that Excel workbook to facilitate our proposal development?

A: We have uploaded the files that were used for the RPM process in the Sixth Plan. It would be good to look at the files in the directory “Directions for using RPM and utilities” for context. The main model file to be looked at is in the “L814” directory and is an Excel file “L814.xls”. While we hope these files can provide some context, parsing through the entire code base of the current model is a monumental task. We hope this helps facilitate responses to the RFP. It is not intended to be used as the primary source of information for the redevelopment process.

The files are posted on FTP at <ftp.nwccouncil.org>. The username is ftpguest and the password is ftpcouncil13.