

# Brief Documentation of NORM (version 7-16-99) the Non-Operating Risk Model

Model developed by Byrne Lovell – BPA-KP-7; 503-230-3930  
[belovell@bpa.gov](mailto:belovell@bpa.gov)

## **Contents:**

- Introduction and the Context of BPA's Risk Analysis
- Overview of BPA's Monte Carlo Modeling Approach
- The Risks Modeled in NORM
- How to Run NORM

## **Introduction and the Context of BPA's Risk Analysis**

BPA has been modeling “operating risks” for years, and has included this modeling in its last several Rate Cases. “Operating risks” are uncertainties related to the operation of the Federal power system. Chief among these are streamflow, the market price of electricity at any moment, the load BPA must serve, and the actual output of WNP-2. BPA currently models these uncertainties with the “Riskmod” program. The “ToolKit” uses the output of Riskmod, along with other inputs, to assess the Treasury Payment Probability, a primary indicator of BPA's projected financial well-being.

As BPA was preparing *Issues 98* and looking ahead to the 1999 Power Rate Case, it was clear that there were important risks, or uncertainties, that were not being modeled, and that might deserve their own category apart from the operating risks. A prominent example of these risks is the uncertainty over Fish & Wildlife program costs. BPA must set its rates for the 2002 to 2006 rate period before the region has adopted a plan for enhancing the survival of threatened and endangered fisheries. The range of financial impacts of the F&W Alternatives developed in the Three Sovereigns process is quite large – on the order of \$300 million from the least- to the most-expensive (five-year average). To incorporate that uncertainty in *Issues 98* and the 1999 Rate Case, BPA has developed a new risk tool named NORM. NORM's output is now used as another input for the ToolKit.

NORM's risks are only those of BPA's Power Business Line, and of the Corporate parts of BPA to the extent uncertainties there will be passed through to the PBL. TBL risks are not included. Uncertainty over the expense PBL will pay TBL due to the currently unknown rate TBL will charge PBL is included, but the impacts of TBL revenue uncertainty on BPA's financial picture are excluded.

## **Overview of BPA's Monte Carlo Modeling Approach**

BPA's traditional approach to modeling risks is to use *Monte Carlo* modeling. In this technique, the Monte Carlo model runs through a number of *games*. In

each game, each of the uncertainties is assigned a random value based on input specifications for that uncertainty. After all of the games have been run, the data on the set of games can be analyzed and summarized in various ways, or passed to other tools.

NORM is a straight-forward extension of this approach to a new set of risks. NORM itself is written in Excel 97 with the @Risk add-in package. Excel 97 can be purchased by itself, or as part of Office 97, from Microsoft. @Risk is a product of the Palisade Corporation ([www.palisade.com](http://www.palisade.com)).

Each of the risks is specified on the main page, worksheet “Main”, with additional data for the Fish and Wildlife uncertainties on worksheet “F&W\_Data”. For the most part, these uncertainties are modeled using @Risk’s “riskdiscrete” function. This function takes two arrays as inputs, one listing the possible values the uncertainty can take, the other the respective probabilities of those values. For example, the operation of a single die would be described thusly (fractions rounded off):

`<die> =RiskDiscrete(A1:F1,A2:F2)`

with the values 1, 2, 3, 4, 5, and 6 in cells A1 to F1, and identical (we hope!) probabilities of 17% in each of the cells A2 to F2. When @Risk is run, each game will have a value for the function “drawn” randomly from the set of six possible value according to those probabilities. If 1000 games are run, there should be about 167 games where the value is 1, and about the same number with each of the other values. The actual number may vary slightly, but not much. The larger the number of games, the more closely the actual count is likely to approach the “expected” number (probability x number of games).

***The Risks Modeled in NORM***

Here is a list of the risks modeled by NORM at this time (7-16-99):

- Deviations are expressed in annual average amounts. Negative amounts indicate a decrease in net revenues, positive amounts indicate an increase in net revenues.
- All NORM risk values represent deviations or changes from the deterministic values in the Revenue Requirement we are putting together for the Rate Case. This documentation does not address those deterministic values.
- Transmission risks and contributions to reserves have been removed from the analysis, resulting in a PBL-only risk analysis.
- The distributions of the risks (possible values and associated probabilities) were developed by the BPA organizations and staff most expert in the area of each risk.

Input	Probability	Deviation (\$ Millions)
Achievement of Cost Review Recommendation #1 re: Reduce staffing and support costs of power marketing and other PBL functions not directly related to operation of the Federal power system	25%	\$0
	50%	-\$4.5
	25%	-\$8.9
Achievement of Cost Review Recommendation#6 re: development of	15%	\$0

a consolidated/integrated capital asset management strategy for the FCRPS: <i>managing COE/Bureau of Reclamation O&amp;M expense</i>	75%	-\$5.7
	10%	-\$18.7
Achievement of Cost Review Recommendation #6 re: development of a consolidated/integrated capital asset management strategy for the FCRPS: <i>enhancing COE/Bureau of Reclamation revenues</i>	50%	\$0
	35%	\$5
	15%	\$15
Achievement of Cost Review Recommendation #7 re: WNP-2: Aggressive cost management, flexible response to market conditions - <i>O&amp;M Expenses</i>	10%	\$0
	40%	-\$14
	50%	-\$4
Achievement of Cost Review Recommendation #7 re: WNP-2: Aggressive cost management, flexible response to market conditions - <i>Revenue enhancements</i>	40%	\$12
	40%	\$7
	20%	\$4
Potential for required increase in payments to WNP-2 Decommissioning fund	30%	\$0
	50%	-\$2
	20%	-\$4
Uncertainty re: generation's costs for transmission, since transmission business line will re-set rates before FY 2002	40%	\$0
	20%	-\$10
	10%	-\$25
	20%	\$10
	10%	\$25
Achievement of Cost Review Recommendation #9 re: Potential achievement of some legislative efficiencies (AEP)	70%	\$0
	30%	\$7
Achievement of Cost Review Recommendation #8 re: Reduction of administrative and other internal support service costs	10%	-\$1
	50%	-\$2
	30%	-\$4
	10%	-\$7
Costs of separation	50%	\$0
	30%	-\$2
	20%	-\$4
Conservation and Renewables "make good" funds for renewables and low income weatherization	15%	\$0
	15%	-\$1
	20%	-\$2
	20%	-\$3
	10%	-\$4
	10%	-\$5
	10%	-\$6
Interest rate risk - Potential change in interest expense due to uncertainty re: interest rates (The risk is expressed in terms of percentage points of potential deviation from interest rates assumed for new obligations in the repayment study. See Chapter 6 of Documentation for Revenue Requirement Study, WP-02-E-BPA-02A.)	5%	-2.00%
	10%	-1.25%
	20%	-0.75%
	30%	0.00%
	20%	0.75%
	10%	1.25%
	5%	2.00%

### **How to Run NORM**

To run NORM, follow these steps:

1. Launch @Risk. This sometimes works better by starting with Excel *not running*. Then choose @Risk from the Windows Start Menu (@Risk is probably in the *Palisade Decision Tools* menu group).

2. Update the risk descriptions if desired.
3. Specify the output cells: select the cells that are colored, and then select @Risk's "Add the selected cell as @Risk outputs" command. There should be a bar of small icons just under the menu bar in Excel that invoke @Risk commands. There should be pop-up descriptions for the icons. Add the five aggregate cells first, then the fish key cell.
4. Specify the @Risk settings you want to use (select @Risk's "Change @Risk settings" - small icon is handy for this). The only one you really need to specify is the number of games.
5. Select @Risk's "Run Simulation" - small icon.
6. Examine and/or save the output if you wish. The ToolKit needs to have NORM output in spreadsheet format. To save the results as a spreadsheet, click on the @Risk button on the Task Bar (not Excel), and select "Reports to Worksheets" from the "Results" menu. For "Select Results to Place in Excel", "Data" is the only item required, though you may want more. Picking "Data" will cause @Risk to create a worksheet named "Data" in the new workbook; this is the worksheet name that the ToolKit will be looking for. Bring the new workbook to the front when @Risk is finished creating it and putting data into it, and save it in the location you want with the name you want. In the ToolKit you can specify both the path and the name for the NORM file, so NORM and the ToolKit do not need to be in the same folder (directory).