NOTE:

This document contains three performance work statements to independently, externally peer review the modeling used to inform the Columbia River Systems Operations Environmental Impact Statement, 2020.

The Environmental Impact Statement effort was conducted by three co-lead federal agencies: the U.S. Army Corps of Engineers (USACE), the Bureau of Reclamation (Reclamation), and the Bonneville Power Administration (BPA). For peer review, the USACE is the lead agency that managed the peer review process, and Reclamation and BPA provided input and guidance to ensure that the review process followed Office of Management and Budget (OMB) and agency requirements for peer review.

In accordance with the OMB and Reclamation peer review requirements, this document is posted on Reclamation's public Peer Review Agenda website. Reclamation's contact for this peer review effort is Michele Porter, mporter@usbr.gov, 208-378-5380.

PERFORMANCE WORK STATEMENT
COLUMBIA RIVER SYSTEM OPERATIONS
ECOLOGICAL MODEL REVIEW

NORTHWESTERN DIVISION
INDEPENDENT EXTERNAL PEER REVIEW

1. TITLE

Independent External Peer Review (IEPR) for the Columbia River System Operations (CRSO) Ecological Model Review.

2. GENERAL

The U.S. Army Corps of Engineers (USACE), Bonneville Power Administration (BPA) and Bureau of Reclamation (Reclamation) (Co-lead Agencies) are jointly developing a comprehensive EIS, referred to as the CRSO EIS, to evaluate long-term system operations and configurations of 14 multiple purpose projects that are operated as a coordinated system within the interior Columbia River basin in Idaho, Montana, Oregon, and Washington. USACE was authorized by Congress to construct, operate and maintain 12 of these projects for flood risk management, navigation, power generation, fish and wildlife conservation, recreation, and municipal and industrial water supply purposes. USACE projects that will be included in the EIS are Libby, Albeni Falls, Dworshak, Chief

Joseph, Lower Granite, Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, The Dalles, and Bonneville. Reclamation was authorized to construct, operate and maintain 2 of these projects for the purposes of irrigation, flood risk management, navigation, power generation, recreation, and other beneficial uses. Reclamation projects include Hungry Horse and Grand Coulee. BPA is responsible for marketing and transmitting the power generated by these dams. Together, these Co-lead Agencies are responsible for managing the system for these various purposes, while meeting their other statutory and regulatory obligations.

The Co-lead Agencies will use this EIS to assess and update their approach for long-term system operations and configurations through the analysis of alternatives and evaluation of potential effects to the human and natural environments.

The scope and scale of this project, its potential to impact human life safety, interest on the part of the Governors of Montana, Idaho, Washington, and Oregon, 19 Federally-recognized tribes, connection to on-going litigation on the Federal Columbia River Power System, as well as the likelihood for the project to result in public dispute, drive a requirement for a heightened level of review and meets the criteria of a highly influential scientific assessment in OMB and Reclamation peer review policies. Due to the level of complexity and controversy associated with the project, it is expected that Expert Peer Reviewers will be required for some aspects of the review. In addition, conflict of interest will need to be carefully evaluated due to the nature and scope of the project. Areas of conflict may include current employment by Federal or State governments, participation in developing the subject project, a publicly documented statement advocating for or against the subject project, current or future interests in the subject project or future benefits from the project, and paid or unpaid participation in litigation against the USACE, Reclamation, or BPA.

3. OBJECTIVES

The objective for this performance work statement (PWS) is to conduct an IEPR of the ecological models used in the study in accordance with procedures described in the Department of the Army, U.S. Army Corps of Engineers peer review policy, Engineer Circular (EC) No. 1165-2-217, Review Policy for Civil Works, dated February 20, 2018, and the Office of Management and Budget Final Information Quality Bulletin for Peer Review released December 16, 2004.

IEPR is one of the important procedures used to ensure the quality of published information meets the standards of the scientific and technical community. Peer review typically evaluates clarity of hypotheses, validity of the research design, quality of data collection procedures, robustness of the methods employed, appropriateness of the methods for the hypotheses being tested, extent to which the conclusions follow from the analysis, and strengths and limitations of the overall product.

The IEPR will be limited to technical review and will not involve policy review. The IEPR will be conducted by subject matter experts (i.e., IEPR Panel members) with extensive

experience in USACE planning, engineering, economics, and environmental issues relevant to the project.

The Review Panel members will be "charged" with responding to specific technical questions as well as providing a broad technical evaluation of the overall project. Per EC 1165-2-217, Paragraph 11, reviewers should identify, explain, and comment upon assumptions that underlie all the analyses, as well as evaluate the soundness of models, surveys, investigations, and methods.

All review, documents, and information sharing will be handled electronically via electronic mail, electronic file transfer which may utilize a File Transfer Protocol web site. The following references to USACE regulations shall be followed in conducting the IEPR. The EC and ER documents are available at http://www.publications.usace.army.mil/Portals/76/Publications/EngineerCirculars/EC 1165-2-217.pdf?ver=2018-05-01-105219-217 and http://www.publications.usace.army.mil/USACEPublications/EngineerRegulations.aspx, respectively.

- USACE EC1165-2-217, Civil Works Review, dated February 20, 2018
- USACE ER 1110-1-8159, Engineering and Design, DrChecks, May 10, 2001
- Office of Management and Budget's guidelines, Final Information Quality Bulletin for Peer Review, issued December 16, 2004 memorandum M-05-03.

3a. MODEL REVIEW

The primary goal of ecological model review and approval is to establish that models, analyses, results, and conclusions are theoretically sound, computationally accurate, based on reasonable assumptions, well-documented and in compliance with the requirements of Office of Management and Budget (OMB) Peer Review Bulletin (Reference 3f). The use of a reviewed model does not constitute technical review of the planning product. Independent technical review of the selection and application of the model and the input data is still the responsibility of the users.

The primary criterion identified for model approval is technical soundness. Technical soundness reflects the ability of the model to represent or simulate the processes and/or functions it is intended to represent. The performance metrics for this criterion are related to theory and computational correctness. In terms of the theory, a quality ecological model should: 1) be based on validated and accepted "state of the art" theory; 2) properly incorporate the conceptual theory into the software code; and, 3) clearly define the assumptions inherent in the model. In terms of computational correctness, a quality ecological model should: 1) employ proper functions and mathematics to estimate functions and processes represented; and, 2) properly estimate and forecast the actual parameters it is intended to estimate and forecast. Other criteria for quality ecological models are efficiency, effectiveness, usability and clarity in presentation of results. A well-

documented quality ecological model will stand the tests of technical soundness based on theory and computational correctness, efficiency, effectiveness, usability and clarity in presentation of results.

The fish models to be reviewed as part of the Columbia River System Operations Study include the following:

1. NOAA Fisheries

    a. Comprehensive Passage (COMPASS) Model. This model was developed by scientists from throughout the Pacific Northwest. The purpose of the model is to predict the effects of alternative operations of Snake and Columbia River dams on salmon survival rates, expressed both within the hydrosystem and latent effects which may occur outside the hydrosystem. Accordingly, the model has the following capabilities: 1) realistically simulate survival and travel time through the hydrosystem under variable river conditions; 2) produce results in agreement with available data, particularly PIT-tag data; 3) allow users to simulate the effects of alternative management actions; 4) operate on sub-seasonal time steps; 5) produce an estimate of uncertainty associated with model results; 6) estimate hydrosystem-related effects that may occur outside of the hydrosystem.

        At NOAA Fisheries' request, the Independent Scientific Advisory Board (ISAB) reviewed the COMPASS model through multiple reviews (ISAB 2006-2, ISAB 2006-6, ISAB 2006-7, ISAB 2008-3).

    b. Interior Columbia Basin Life-Cycle Modeling (LCM). The LCM model incorporates COMPASS outputs for evaluating alternative recovery actions in the Columbia River Basin. Specifically, the LCM models the numerous factors affecting salmon and steelhead returns in the Columbia River Basin. The LCM report builds from previous efforts that modeled hydrosystem and climate effects on salmonid population viability, and expands those efforts to cover more populations and habitat actions, as well as improved representation of climate effects, hatchery spawners, spatial interactions, and effects of toxics.

        At NOAA Fisheries' request, the ISAB reviewed the LCM model through multiple reviews (ISAB 2013-5, ISAB 2017-1)

2. Fish Passage Center

    a. Comparative Survival Study (CSS) Model. The CSS Model was developed to estimate survival probability of salmon and steelhead from their outmigration as smolts to their return to freshwater as adults – referred to as smolt-to-adult return rate (SAR).

        The Columbia River Basin Fish and Wildlife Program calls for a regular system of independent and timely science reviews of the Fish Passage Center's (FPC)

analytical products. These reviews include evaluations of the Comparative Survival Study's draft annual reports. The ISAB has reviewed these reports annually beginning eight years ago with the evaluation of the CSS's draft 2010 Annual Report and most recently the draft 2017 Annual Report (ISAB 2010-§., ISAB 2011-5, ISAB 2012-7, ISAB 2013-4, ISAB 2014-5, ISAB 2015-2, ISAB 2016-2, ISAB 2017-2).

3. University of Washington Columbia Basin Research

a. Total Dissolved Gas (TOG) . This document describes a model to assess the relative impacts of the hydrosystem operations on total dissolved gas (TOG) generation and its effects on juvenile fish passing through the hydrosystem. The information also provides a relative measure of the potential impacts of TOG exposure in the hydrosystem on survival of fish in the estuary and ColumbiaRiver plume.

The TOG model uses the COMPASSsmolt passage model (Zabel et al. 2008) to simulate the fish movement and TOG exposure based on flow, spill and TOG provided from models developed by other groups involvedin the CRSO analysis. The model characterizes the effect TOG on juvenile fish passage with three metrics:

1. Mortailty due to gas bubble disease
2. Reach Average TOG Exposure
3. Cumulative Passage TOG Exposure

Government-Furnished Information - USAGE will provide a minimum of the following documents for review by the IEPR Panel:

Table 1: CRSO Ecological Model Review Documentation

CRSO Ecological Model Review Documentation	Anticipated Date of Report/Data	Approximate Number of Pages
NOAA COMPASS Documentation		
COMPASS Model - Main Documentation	June 2019	30
COMPASS Model - Application Software (BASH or another modern Linux/Unix shell with the awk and sed utility languages and a current version of the "R" programming language included)	June 2019	--
COMPASS Model - Appendix 1. PIT-tag data	June 2019	13
COMPASS Model - Appendix 2. Calibration of Survival and Migration Models	June 2019	20
COMPASS Model - Aooendix 3. Model Diaanostics	June 2019	57

COMPASS Model - Appendix 4. Dam Passage Algorithms	June 2019	15
COMPASS Model - Appendix 5. Dam Survival Parameters	June 2019	65
COMPASS Model - Appendix 6. Hydrology	June 2019	19
COMPASS Model - Appendix 7. Arrival Timing at Lower Granite Dam	June 2019	30
COMPASS Model - Aooendix 8. Sensitivity Analysis	August2019	12
Total		**261**
NOAA Life-Cycle Modeling Documentation		
LCM Model Documentation	June 2019	772
LCM Model Application Software	September 2019	--
Tot a l		**772**
Fish Passage Center Comparative Survival Study Model Documentation		
Letter Overview of CSS Model Documentation	June 2019	4
Introduction to CSS PowerPoint Presentation. 2018. Background and Overview of Modeling	June 2019	241
CSS Model Documentation - 2018 Annual Report	June 2019	248
CSS Model Documentation - Experimental Spill Management: Models, Hypotheses, Study Design, and Response to ISAB	June 2019	139
CSS Model Application Software (includes code for CSS cohort mode ls a n d CSS - L i feCyc le.tp l fi le)	June 2019	--
Tot a l		**6 3 2**
Univ e rsi ty of Washington Total Dissolved Gas Modeling Documentation		
TOG Model Documentation	June 2019	17
TOG Model Application Software (PERL must be installed. R must be installed. COMPASS must be installed with executable in the working directory)	June 2019	--
Total		**17**
Total number of paaes to be reviewed		**1,682[1]**

Table 2: CRSO Ecological Model Reference Documentation

Additional Supporting Documentation[1]		
Zabel, et al. 2008. Comprehensive passage (COMPASS) model: a model of downstream migration and survival of	June 20 19	11

juvenile salmonids through a hydropower system. Hydrobiologia, 609: 289-300[2]		
Northwest Power and Conservation Council. ISAB 2006-2. Review of NOAA Fisheries' COMPASS Model. [2]	June 2019	16
Northwest Power and Conservation Council. ISAB 2006-6. Review of NOAA Fisheries' COMPASS Model. [2]	June 2019	6
Northwest Power and Conservation Council. ISAB 2006-7. Review of NOAA Fisheries' COMPASS Model. [2]	June 2019	14
Northwest Power and Conservation Council. ISAB 2008-3. Review of NOAA Fisheries' COMPASS Model. [2]	June 2019	20
Northwest Power and Conservation Council. ISAB 2013-5. Review of NOAA Fisheries' Interior Columbia Basin Life-Cycle Modeling.[2]	June 2019	30
Northwest Power and Conservation Council. ISAB 2010-5. Review of the Comparative Survival Study (CSS) 2010 Annual Report. [2]	June 2019	13
Northwest Power and Conservation Council. ISAB 2011-5. Review of the Comparative Survival Study (CSS) 2011 Annual Report. [2]	June 2019	13
Northwest Power and Conservation Council. ISAB 2012-7. Review of the Comparative Survival Study (CSS) 2012 Annual Report. [2]	June 2019	24
Northwest Power and Conservation Council. ISAB 2013-4. Review of the Comparative Survival Study (CSS) 2013 Annual Report.[2]	June 2019	30
Northwest Power and Conservation Council. ISAB 2014-5. Review of the Comparative Survival Study (CSS) 2014 Annual Report. [2]	June 2019	21
Northwest Power and Conservation Council. ISAB 2015-2. Review of the Comparative Survival Study (CSS) 2015 Annual Report. [2]	June 2019	20
Northwest Power and Conservation Council. ISAB 2016-2. Review of the Comparative Survival Study (CSS) 2016 Annual Report.[2]	June 2019	25
Northwest Power and Conservation Council. ISAB 2017-1. Review of the Comparative Survival Study (CSS) 2018 Annual Report.[2]	June 2019	152
Northwest Power and Conservation Council. 2018. ISAB Review of the Comparative Survival Study (CSS) Draft 2018 Annual Report.[2]	June 2019	29
Total		424[1,2]

1. The actual number of pages provided to the panel for review may differ from this estimate by plus or minus 20%.
2. For Reference Only. These documents are provided for context only and Panel members are not asked or expected to directly comment on these documents.

4. SPECIFIC TASKS

There are some instances when concurrence or approval by USACE is necessary to assure policy compliance with EC 1165-2-217. However, the following tasks shall be

performed independent of government supervision, direction, or control of the technical considerations of this review:

Task 1: Work Plan to Conduct IEPR

The Contractor shall prepare a draft and final work plan that describes the process for conducting the IEPR for the project. The work plan will include screening criteria for Panel members, working schedule, selection of Panel members, Review Charge to Panel members (provided by USACE to include in final work plan), communication and meetings with USACE project team, quality control, and compilation/dissemination of Review Panel members' comments. The Contractor shall conduct the IEPR in accordance with the work plan to ensure that all services are performed, reviewed, and provided in a manner that meets professional engineering quality standards. Also included in this task will be one conference call to discuss the USACE comments on the draft work plan. If needed, the Contractor can coordinate with the study Project Manager and IEPR Lead, via conference call, to ask questions about key events in the timeline leading up to the completion of the decision document and supporting documentation. The Work Plan will not include a site visit for the Review Panel at any time during the IEPR process. Both the draft and final work plan must be thoroughly reviewed by the appropriate contracting staff and submitted free of grammatical errors, references to other projects, font inconsistencies, and misspelling of words.

The process to prepare Corps decision documents is complex and the coordination with the IEPR schedule involves many factors, some of which are outside of the control of the District Project Delivery Team and the Review Management Organization. The Government does not guarantee that it will provide materials and information or be available for meetings on the dates in the working schedule. The Contractor is responsible for any necessary contingencies to accommodate Government-caused delays of up to three (3) months in delivering materials and information. After USACE and the Contractor agree on the schedule for a meeting date, the Contractor is responsible for any necessary contingencies to accommodate up to two (2) schedule changes requested by the Corps for each meeting.

Task 2: IEPR Panel

The Contractor shall identify Model Review Panel members based on the descriptions below. The final selection of the Panel will be based on screening criteria included in the work plan (Task 1). The Contractor will provide USACE with the final list of IEPR Panel members, including their credentials.

Each model reviewer should be a professional from academia, a public agency (excluding USACE, Reclamation, and BPA), private firm, or similar vocation with at least ten (10) years of experience in their area of expertise and have at least a M.S. degree (reviewers with a Ph.D. are preferred) in one or more fields directly applicable to one or more focal areas listed below and worked extensively within the Pacific Northwest (direct experience with salmonid ecology, restoration, or ecological modeling is preferred). All panel

members should be familiar with large, complex water resources projects with high public and interagency interests. Panel members should demonstrate experience in numerical ecological modeling for salmonids, impact assessment methodologies, and assessing and informing planning and management decisions associated with salmonid resources. The technical qualifications that are required for the model review panel include the following:

Quantitative Ecologist #1. The Review Panel Member should be quantitative ecologist with demonstrable understanding and experience of the following:

- Researching and analyzing observed behavior in the context of life history variability, both within and among populations and species.
- Focus on salmon mortality processes and behavioral ecology of salmon populations.
- Focus on ecological simulation modeling of organismal migrations.
- Research, analysis, and publication of salmon ecology and evaluating habitat quality.

Quantitative Ecologist #2. The Review Panel Member should be quantitative ecologist with demonstrable understanding and experience of the following:

- Developing models of population dynamics, spatial and temporal movement patterns.
- Development and use of ecological models to support habitat evaluation assessments for the purposes of informing management, planning, and restoration decisions.

Integrated Ecological Modeling Specialist. The Review Panel Member should have demonstrable understanding and experience of the following:

- Applies a wide range of techniques including theoretical modeling, numerical simulations, lab experiments, and field work to understand the role of decision making spatially and temporally in fish migration.
- Explore and apply coupled ecological and engineering models.
- Researches and explores the roles of coupling ecological and physical process to predict environmental responses to fish passage projects.
- Familiarity with R, PERL, BASH (or another modern Linux/Unix shell with the awk and sed utility languages) software/programming language

Fish Passage Biologist. The Review Panel Member should have demonstrable understanding and experience of the following:

- Study, analysis, and modeling of fish movement, fish passage barriers, design, and effects in large riverine settings
- Computational fluid dynamics in aquatic ecosystems combined with principles of engineering hydraulics (i.e., ecohydraulics)

Mathematical Statistician. The Review Panel Member should have demonstrable understanding and experience of the following:

- Use of statistical methods and mathematical modeling to describe ecological processes and inform management decisions and environmental impact studies.
- Survival estimation of juvenile and adult fish species using capture-recapture methods, and on developing models to describe fish passage.
- Research, analysis, and publication of salmon ecology and evaluating habitat quality.
- Familiarity with R, PERL, BASH (or another modern Linux/Unix shell with the awk and sed utility languages) software/programming language

The Contractor will provide the USACE with the final list of IEPR Panel members, including their credentials. The final selection will be based on availability, technical credentials, and absence of perceived or actual conflict of interest. The IEPR Panel members shall not have any financial or litigation association with the USACE, Reclamation, or BPA; the State where the study/project is located; the design A-E, or their engineering teams, subcontractors, or construction contractors. The Review Panel members shall fully disclose any known or potential conflict of interest that may arise from the performance of the work. Areas of conflict may include current employment by Federal or State governments, participation in developing the subject project, a publicly documented statement advocating for or against the subject project, current or future interests in subject project or future benefits from the project, and paid or unpaid participation in litigation against the USACE, Reclamation, or BPA.

The Contractor will prepare a scope of work for each Review Panel member. A request for quotation, including the scope of work and conflict of interest inquiry will be prepared and sent to each reviewer. Upon receipt of the potential reviewers' written quotations indicating willingness to participate and the absence of a conflict of interest, the Contractor will establish contracts with the peer reviewers at agreed upon rates and hours to ensure/secure participation.

Task 3: Meetings

A kick-off teleconference between USACE personnel and Contractor personnel will be conducted after the notice to proceed (NTP) is issued. The intent of this meeting is to define the IEPR roles for USACE and the Contractor.

An additional kick-off teleconference will be held after final selection of the model Review Panel members. This meeting will be between USACE personnel, Contractor personnel, and the IEPR Panel members. The purpose of this meeting is for USACE to familiarize the Review Panel members with the intended purpose of the models and how the software performs, and to discuss the specific objectives of the review. All of the Review Panel members will participate.

Contractor staff and all IEPR Panel members will participate in a teleconference at the

approximate midpoint of the model review process. The purpose of this meeting is to allow Review Panel members to ask clarifying questions of USACE in order to assist in the development of comments and to potentially eliminate the total number of Final Panel Comments. All meetings under this Task shall be arranged and hosted by the Contractor.

Task 4: Conduct IEPR

The Contractor will provide the Review Panel members with copies of the technical documents for review listed above in Section 3. USACE will provide these documents to the Contractor for distribution to the Review Panel members. The Contractor will prepare and deliver a letter to instruct the Review Panel members to undertake the reviews including a template format for responding to Review Charge questions. The letter also will outline the steps and deadlines which will include a list of the documents for review listed in Section 3, Table 1. Working with USACE, the Contractor will respond to any Review Panel member questions or information requests during the review process. The Contractor will document all communications between USACE and the Review Panel members.

The assessment of the model shall determine the degree to which the models can be described as technically sound relative to its intended use and design objectives, computationally correct, and usable for the identified purpose. Specifically, we ask the reviewers to consider their individual reviews in terms of quality of the basic model development process including: 1) conceptualization, 2) quantification (mathematical relationships), 3) evaluation of the usefulness of the model in terms of its ability to simulate system behavior, and 4) application usefulness in terms of the model's ability to provide information to address questions about the system and future scenarios. The reviewers are asked to comment on any aspects of the model that potentially affect its technical quality, computational accuracy, and usability as a potential producer of information to guide management decisions.

The Review Panel members will complete their review and provide comments to the Contractor. When the individual Review Panel member comments have been received from the Review Panel members, the Contractor will collate the individual Review Panel member comments and ensure that they are complete and responsive to the Review Charge. The Contractor will identify the overall issues and themes that were either identified by multiple Review Panel members or repeatedly by one Review Panel member, comments that indicated conflicting Review Panel member opinions, and other noteworthy comments. Then, the Contractor will convene one or more group Review Panel comment review meetings via teleconference with the IEPR Panel members to discuss the Review Panel's comments. The goal of the meeting is to provide a forum for Panel members to discuss the comments and agree (or agree to disagree) on the comments of highest priority, identify which issues should be carried forward as "Final Panel Comments," decide who will lead the development of those final comments, and to address any contradictory comments. This meeting will ensure the exchange of technical information among the Review Panel members, many of whom will be from diverse

scientific backgrounds. This information exchange provides additional context to Review Panel members and is considered crucial in the development of a comprehensive IEPR Final Report.

Task 5: Prepare IEPR Report

The Contractor shall consolidate the comments (see Task 4) to eliminate redundant or overlapping comments and to identify dissenting or diverging comments. Each comment will be formatted into a 4-part comment including the following:

1) a clear statement of the concern;
2) the basis for the concern;
3) the significance of the concern (the importance of the concern with regard to project implementability);
4) a description of additional research that would appreciably influence the conclusions and, when appropriate, the actions necessary to resolve the concern.

The Contractor will prepare the Model Review Report and submit it to the Corps for review. The report will assess the degree to which the model has technical quality, system quality, and usability. The Contractor will prepare and submit the final panel comments in the Model Review Report.

The Contractor shall prepare a final report of the Review Panel findings. The report shall have an executive summary describing the recommendations and resolutions. Following the executive summary the report shall list in detail all the referenced criteria, computations, comments made, and all other pertinent information along with IEPR Panel recommendations and final resolution. The Model Review Report should use the following general outline:

1.0 Introduction

- 1.1. Model Purpose and Summary
- 1.2. Model Evaluation Assessment Criteria and Approach
- 1.3. Summary of Findings

2.0 Technical Quality Assessment

- 2.1. Review of Model Documentation Quality
- 2.2. Review of Theory and External Model Components
- 2.3. Review of Representation of the System
- 2.4. Review of Analytical Requirements
- 2.5. Review of Model Assumptions and Limitations

3.0 System Quality Assessment

- 3.1. Review of Model Calculations/Formulas
- 3.2. Review of Testing/Evaluation Process

4.0 Usability Assessment

- 4.1. Review of Operating Requirements of the Model
- 4.2. Review of Input Availability and Output Understandability
- 4.3. Review of Condition Characterization Usefulness
- 4.4. Review of Model Usefulness in Selecting Alternatives

5.0 Model Assessment Summary

6.0 Conclusions

7.0 List of Preparers

8.0 References

Sections 1.0 and 2.0 of the report will provide basic background information on the model and the review approach. Sections 3.0 through 4.0 will only contain the final panel comments that are related to specific model assessment criteria. If there are no comments for a given assessment criterion, the report will state that no issues were identified related to that criterion. Section 5.0 and 6.0 will summarize the key concerns identified during the model review and the conclusions with regards to recommendations for resolution.

The report is intended to provide final documentation of the peer review process. The report will also include a summary of the Review Panel members' qualifications and a brief discussion of the methodology used to conduct the IEPR. The Contractor will submit the IEPR Final Report to the IEPR Lead for review and acceptance of the product. Once the IEPR Lead accepts the product, he/she will forward the product to the Project Delivery Team for development of responses. The Final IEPR Report must be submitted no later than 45 days from the report review documents submittal to the panel. The final report outline previously approved by the Government will be used for all reports with any agreed-to modifications required.

The Contractor is expected to provide internal quality control and quality assurance of the IEPR report to ensure they are complete, free from obvious errors, grammatically correct, and of high and professional quality.

Task 6: Comment/Response.

The Contractor shall provide the IEPR Final Panel Comments to USACE in Microsoft Word format via email. The IEPR Final Panel Comments provided in Microsoft Word format should include the corresponding sections and page numbers in the report documentation, as appropriate, in order to assist the USACE project delivery team to

develop responses to Final Panel Comments. In addition, the Contractor will enter the IEPR Final Panel Comments into DrChecks. USACE will submit clarifying questions to the Contractor to coordinate with the IEPR Review Panel, if necessary. The Contractor and USACE will participate in a teleconference call to discuss the comment/response process.

USACE will provide draft evaluator responses to the Contractor in Microsoft Word format via email. In response to the 4-part comment submitted by the IEPR Review Panel, USACE should submit a "concur" or "non-concur" evaluation to each Final Panel Comment and include a concise, standalone statement as to why the response was "concur" or "non-concur." In addition, in response to each IEPR Final Panel Comment Recommendation for Resolution, USACE shall include a statement to "adopt" or "not adopt", along with a response describing how and where the report documentation would/would not be expanded, revised, or changed. If recommendations are not accepted, the reported reason for the rejection shall be documented in the draft evaluator responses. The Contractor shall coordinate a teleconference call with USACE and the IEPR Panel to discuss USACE's draft evaluator responses to the IEPR Final Panel Comments.

Following the teleconference call, USACE will submit final responses to the IEPR Final Panel Comments. In addition, USACE will enter final responses to Final Panel Comments into DrChecks. The Contractor shall receive backcheck responses to draft evaluator responses from the IEPR Review Panel. All responses provided by the USACE and IEPR Panel members will be labeled as "concur" or "non-concur" to indicate agreement or non-agreement, respectively. The Contractor shall enter the IEPR Panel backcheck responses to the USACE final responses to Final Panel Comments into DrChecks. The Contractor will provide USACE with a .pdf printout of the DrChecks project file once all IEPR comments are closed following backcheck responses. In addition, the Contractor will provide the Microsoft Word file containing the final iteration of the IEPR Final Panel Comments, the USACE final evaluator responses to IEPR Final Panel Comments, and the IEPR Panel backcheck responses to the USACE final evaluator responses.

5. REPORTING REQUIREMENTS

The Contractor shall provide all document reproduction. Electronic submittals shall contain all electronic files in both Microsoft Word and Adobe PDF formats. The briefings for the teleconferences will be furnished in Microsoft PowerPoint or Adobe PDF format. Reports generated by the peer review Contractor or their subcontractors shall not be released for publication or dissemination without the Contracting Officer's written approval following coordination with the Contracting Officer's representative. The USACE will determine which documents to publish in the public domain. The Contractor shall provide monthly status updates to USACE. Status updates will include the status of efforts associated with this PWS as well as any changes to scope and schedule. These updates will be informal and normally conducted through electronic mail messages.

All of the electronic submittals (whether draft or final) must be thoroughly reviewed by the appropriate contracting staff prior to submittal to USACE and/or the IEPR Lead. The Contractor is expected to provide internal quality control and quality assurance for all deliverables to ensure they are complete, free from obvious errors, grammatically correct, and of high and professional quality.

6. QUALIFICATION REQUIREMENTS

The Contractor shall have the following qualifications:

a. Experience establishing and administering Review Panels;
b. Be qualified as an Internal Revenue Code Section 501(c)(3) organization and be exempted from Federal tax under Section 501(a), of the Internal Revenue Code of 1986;
c. Shall be a scientific or professional society, a firm specializing in peer review, or a non-profit organization with experience in peer review;
d. Is an independent science and technology organization;
e. Shall be free from conflicts of interest with the CRSO Ecological Model Review, including all associated operating projects and cooperating agencies.
f. Does not carry out or advocate for or against Federal water resources projects; and,
g. Proven ability to deliver under significant time constraints.

7. PLACE AND PERIOD OF PERFORMANCE, AND TRAVEL

a. Place of Performance. A majority of the work will be conducted at the Contractor's facilities.
b. Period of Performance. The performance period shall be from the date of the NTP through 31 January 2021.
c. Travel: No travel is required.

8. RESTRICTIONS

There are no known conflicts of interest with the Columbia River System Operations CRSO Ecological Model Review and IEPR Panel members that are assembled.

9. AUTHORITIES STATEMENT

No person other than the Government Contracting Officer has the authority to make changes to this contract action that impact cost or schedule. Authority from the Contracting Officer to the contractor to make changes that impact cost or schedule will be in the form of an official, signed modification.

10. RELEVANCE

T he U .S. Army Corps of Engineers is a division of the U.S. Army.

11. CAPABILITY STATEMENT

The peer review must be completed by reviewers external to the Government, thus the requesting agency does not have the necessary in-house capability to perform the tasks specified in this PWS.

12. POINTS OF CONTACT

IEPR CONTACTS			CONTRACTING / STUDY CONTACTS	
Name	**Rachel Mesko**		Name	**Anastasiya Kononova**
Title	IEPR Lead (Technical Point of Contact)		Title	Contracting Officer's Representative
Agency	USACE, St. Paul District		Agency	USACE, Baltimore District
Office	CEMVP-PD-F		Office	CENAB-PL-P
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PERFORMANCE WORK STATEMENT
COLUMBIA RIVER SYSTEM OPERATIONS
ECONOMIC MODELS

NORTHWESTERN DIVISION
INDEPENDENT EXTERNAL PEER REVIEW

1. TITLE

Independent External Peer Review (IEPR) of the Economic Models used for the Columbia River System Operations (CRSO).

2. GENERAL

The U.S. Army Corps of Engineers (USACE), Bonneville Power Administration (BPA) and Bureau of Reclamation (Reclamation) (Co-lead Agencies) are jointly developing a comprehensive Environmental Impact Statement (EIS), referred to as the CRSO EIS, to evaluate long-term system operations and configurations of 14 multiple purpose projects that are operated as a coordinated system within the interior Columbia River basin in Idaho, Montana, Oregon, and Washington. USACE was authorized by Congress to construct, operate and maintain 12 of these projects for flood risk management, navigation, power generation, fish and wildlife conservation, recreation, and municipal and industrial water supply purposes. USACE projects that will be included in the EIS are Libby, Albeni Falls, Dworshak, Chief Joseph, Lower Granite, Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, The Dalles, and Bonneville. Reclamation was authorized to construct, operate and maintain 2 of these projects for the purposes of irrigation, flood risk management, navigation, power generation, recreation, and other beneficial uses. Reclamation projects include Hungry Horse and Grand Coulee. BPA is responsible for marketing and transmitting the power generated by these dams. Together, these Co-lead Agencies are responsible for managing the system for these various purposes, while meeting their other statutory and regulatory obligations.

The Co-lead Agencies will use this EIS to assess and update their approach for long-term system operations and configurations through the analysis of alternatives and evaluation of potential effects to the human and natural environments.

The scope and scale of this project, its potential to impact human life safety, interest on the part of the Governors of Montana, Idaho, Washington, and Oregon, 19 Federally-recognized tribes, connection to on-going litigation on the Federal Columbia River Power System, as well as the likelihood for the project to result in public dispute, drive a requirement for a heightened level of review and meets the criteria of a highly influential scientific assessment in OMB and Reclamation peer review policies. Due to the level of complexity and controversy associated with the project, it is expected that Expert Peer Reviewers will be required for some aspects of the review. In addition,

conflict of interest will need to be carefully evaluated due to the nature and scope of the project. Areas of conflict may include current employment by Federal or State governments, participation in developing the subject project, a publicly documented statement advocating for or against the subject project, current or future interests in the subject project or future benefits from the project, and paid or unpaid participation in litigation against the USACE, Reclamation, or BPA.

3. OBJECTIVES

The objective for this performance work statement (PWS) is to conduct an IEPR of the economic models used in the study in accordance with procedures described in the Department of the Army, U.S. Army Corps of Engineers peer review policy, Engineer Circular (EC) No. 1165-2-217, Review Policy for Civil Works, dated February 20, 2018, and the Office of Management and Budget Final Information Quality Bulletin for Peer Review released December 16, 2004.

IEPR is one of the important procedures used to ensure the quality of published information meets the standards of the scientific and technical community. Peer review typically evaluates clarity of hypotheses, validity of the research design, quality of data collection procedures, robustness of the methods employed, appropriateness of the methods for the hypotheses being tested, extent to which the conclusions follow from the analysis, and strengths and limitations of the overall products.

The IEPR will be limited to technical review and will not involve policy review. The IEPR will be conducted by subject matter experts (i.e., IEPR Panel members) with extensive experience in USACE planning, engineering, economics, and environmental issues relevant to the project.

The Review Panel members will be “charged” with responding to specific technical questions as well as providing a broad technical evaluation of the overall project. Per EC 1165-2-217, Paragraph 11, reviewers should identify, explain, and comment upon assumptions that underlie all the analyses, as well as evaluate the soundness of models, surveys, investigations, and methods.

All review, documents, and information sharing will be handled electronically via electronic mail, electronic file transfer which may utilize a File Transfer Protocol web site. The following references to USACE regulations shall be followed in conducting the IEPR. The EC and ER documents are available at http://www.publications.usace.army.mil/Portals/76/Publications/EngineerCirculars/EC_1165-2-217.pdf?ver=2018-05-01-105219-217 and http://www.publications.usace.army.mil/USACEPublications/EngineerRegulations.aspx, respectively.

- USACE EC1165-2-217, Civil Works Review, dated February 20, 2018
- USACE ER 1110-1-8159, Engineering and Design, DrChecks, May 10, 2001
- Office of Management and Budget’s guidelines, Final Information Quality Bulletin

for Peer Review, issued December 16, 2004 memorandum M-05-03.

3a. MODEL REVIEW

The primary goal of model review is to establish that models, analyses, results, and conclusions are theoretically sound, computationally accurate, based on reasonable assumptions, well-documented and in compliance with the requirements of Office of Management and Budget (OMB) Peer Review Bulletin (Reference 3f). The use of a reviewed model does not constitute technical review of the planning product. Independent technical review of the selection and application of the model and the input data is still the responsibility of the users.

The primary criterion identified for model approval is technical soundness. Technical soundness reflects the ability of the model to represent or simulate the processes and/or economic system it is intended to represent. The performance metrics for this criterion are related to use of current state of the practice procedures and computational correctness. In terms of the state of the practice, a quality model should: 1) be based on validated and accepted “state of the art” practices; 2) properly incorporate the conceptual theory into the software code; and, 3) clearly define the assumptions inherent in the model. In terms of computational correctness, a quality model should: 1) employ proper functions and mathematics to estimate functions and procedures; and, 2) properly estimate and forecast the actual parameters it is intended to estimate and forecast. Other criteria for quality models are efficiency, effectiveness, usability and clarity in presentation of results. A well-documented quality model will stand the tests of technical soundness based on theory and computational correctness, efficiency, effectiveness, usability and clarity in presentation of results.

The economic models to be reviewed as part of the CRSO include the following:

1. CRSO Recreation Analysis Model

This model was developed through consultation with USACE staff, other cooperating agencies, and CRSO reservoir recreation managers. The method is based on an approach used for the Missouri River Recovery Management Plan Environmental Impact Statement. In general, model evaluates how changes in reservoir, river, and wildlife habitat conditions under CRSO EIS alternatives could affect visitation, recreational opportunities and the value of the recreation experience. More specifically, model uses outputs from the hydrology and hydraulics (H&H) analysis, which simulates reservoir operations and river conditions under each CRSO EIS alternative within a Monte Carlo framework. Reservoir elevation data from the H&H analysis are compared to minimum usable boat ramp elevations required for accessibility to estimate the associated impacts to water-based visitation at reservoirs.

2. Snake Columbia Economic Navigation Tool (SCENT)

The Snake Columbia Economic Navigation Tool (SCENT) is a model that calculates the additional transportation costs attributable to changes in flows and available draft on the commercially navigable portions of the Columbia and Snake Rivers due to possible changes being studied in the CRSO study. River flows are measured in cubic feet per second (cfs) and are provided by the hydraulic and hydrology team as output from a hydrologic simulation model. Simultaneously, available drafts at key river locations are provided based on river levels and channel bottom elevations. Transportation costs are the additional shipping costs for moving goods on the river and are provided by the navigation team. SCENT links the hydrology and navigation cost data to calculate the additional transportation costs for alternative water management plans.

SCENT is the final calculator in a series of worksheets, programs, and models that reformat and combine raw data from a variety of sources into data that is used in the calculation of the additional transportation costs that could result from changes in water release plans. The major part of the modeling effort by planning was to develop shipping cost for commercial vessel trips on the waterway system. The major part of the effort by the H&H section was to develop flows in the river under different possible release scenarios. SCENT is a relatively simple computational model that links the H&H data to the economic navigation data to calculate the change in shipping costs due to changes in river flows.

3. Transportation Optimization Model (TOM)

The transportation model developed to measure the impact of alternative river navigation scenarios is a constrained optimization model designed to capture the choices currently facing grain shippers that utilize the Columbia-Snake Navigation System (CSNS), particularly the navigable portions of the Snake River system. The model focuses on goods that are shipped in the region surrounding the Snake River shallow draft portion of the CSNS, recognizing that the Snake River shallow draft channel is predominately used to move grain (wheat) downriver and fuel upriver. There are other commodities moved in smaller volumes, but wheat and fuel comprise more than 90 percent of the tonnage moved on the Snake River. Therefore, the model is designed to capture the choices faced by shippers moving grain and fuel to market.

Generally, data compiled from a variety of sources, including a survey of shippers in the region, provide the necessary information to parameterize the model and to establish the constraints and choice alternatives, representing current conditions, as they would exist under the No Action Alternative.

The model is then used to assess the movements of shipments under a dam breach scenario where navigation on the Lower Snake River would be eliminated. Under MO3, it is assumed that a portion of the navigation channel would be inoperable, therefore affected shippers would be required to utilize a different transportation mode or combination of modes (e.g. shuttle rail, connector rail, roadway, Columbia River shallow and/or deep draft channel). Therefore, the model is used to evaluate the flow of goods

from origin points, through intermediate destinations, and ultimately through final destinations.

Government-Furnished Information – USACE will provide a minimum of the following documents for review by the IEPR Panel:

Table 1: CRSO Economic Model Review Documentation

CRSO Economic Model Review Documentation	**Anticipated Date of Report/Data**	**Approximate Number of Pages**
CRSO Recreation Analysis Model – Model Overview and Summary	December 2019	3
CRSO Recreation Analysis Model – Main Model Documentation	December 2019	74
CRSO Recreation Analysis Model – Application Calculator (.xlsx)	December 2019	n/a
SCENT – Model Documentation	December 2019	64
SCENT – Application Software (.exe) [2]	December 2019	n/a
TOM – Model Documentation	December 2019	16
TOM – 2019 Columbia Snake River Navigation Survey	December 2019	322
TOM – Application Software (.exe) and Spreadsheets (.xlsx)	December 2019	n/a
Total number of pages to be reviewed		479[1]

1. *The actual number of pages provided to the panel for review may differ from this estimate by plus or minus 20%.*

2. *The SCENT application software code and user interface has been previously reviewed. It is being provided to better understand the functionality of the model and assist during review.*

4. SPECIFIC TASKS

There are some instances when concurrence or approval by USACE is necessary to assure policy compliance with EC 1165-2-217. However, the following tasks shall be performed independent of government supervision, direction, or control of the technical considerations of this review:

Task 1: Work Plan to Conduct IEPR

The Contractor shall prepare a draft and final work plan that describes the process for conducting the IEPR for the project. The work plan will include screening criteria for Panel members, working schedule, selection of Panel members, Review Charge to Panel members (provided by USACE to include in final work plan), communication and meetings with USACE project team, quality control, and compilation/dissemination of Review Panel members' comments. The Contractor shall conduct the IEPR in

accordance with the work plan to ensure that all services are performed, reviewed, and provided in a manner that meets professional engineering quality standards. Also included in this task will be one conference call to discuss the USACE comments on the draft work plan. If needed, the Contractor can coordinate with the study Project Manager and IEPR Lead, via conference call, to ask questions about key events in the timeline leading up to the completion of the decision document and supporting documentation. The Work Plan will not include a site visit for the Review Panel at any time during the IEPR process. Both the draft and final work plan must be thoroughly reviewed by the appropriate contracting staff and submitted free of grammatical errors, references to other projects, font inconsistencies, and misspelling of words.

The process to prepare Corps decision documents is complex and the coordination with the IEPR schedule involves many factors, some of which are outside of the control of the District Project Delivery Team and the Review Management Organization. The Government does not guarantee that it will provide materials and information or be available for meetings on the dates in the working schedule. The Contractor is responsible for any necessary contingencies to accommodate Government-caused delays of up to three (3) months in delivering materials and information. After USACE and the Contractor agree on the schedule for a meeting date, the Contractor is responsible for any necessary contingencies to accommodate up to two (2) schedule changes requested by the Corps for each meeting.

Task 2: IEPR Panel

The Contractor shall identify Model Review Panel members based on the descriptions below. The final selection of the Panel will be based on screening criteria included in the work plan (Task 1). The Contractor will provide USACE with the final list of IEPR Panel members, including their credentials.

Each model reviewer should be a professional from academia, a public agency (excluding USACE, Reclamation, and BPA), private firm, or similar vocation with at least ten (10) years of experience in their area of expertise and have at least a M.S. degree (reviewers with a Ph.D. are preferred) in one or more fields directly applicable to one or more focal areas listed below and worked previously within the Pacific Northwest is preferred. All panel members should be familiar with large, complex water resources projects with high public and interagency interests. Panel members should demonstrate experience in economic modeling on large riverine systems pertaining to recreation, transportation, and navigation modeling. The technical qualifications that are required for the model review panel include the following:

Economist (Recreation, SCENT, TOM models). The reviewer should have demonstrable understanding and experience of the following:

- Applied transport economics (navigation and shipping)
- Allocation of resources within a transportation network
- Estimating demand for transportation

- Estimating demand for recreation
- Evaluating how changes in reservoir, river, and/or habitat conditions can affect visitation, recreational opportunities and the value of the recreation experience
- Navigation, transportation, and recreation economic modeling is preferred

Transportation Modeling Specialist (SCENT & TOM). The reviewer should have demonstrable understanding and experience of the following:

- Deep and shallow draft riverine navigation and transportation economic analysis and modeling
- Navigation shipping survey methods
- Knowledge of and familiarity using travel demand modeling and analysis, project-level alternatives analysis and traffic operations analysis
- Examining large amounts of navigation data and constructing models that solve complex transportation problems.
- Expertise should include experience in Pacific Northwest transportation planning, operations analysis, and mathematics.
- Expertise in general equilibrium modeling is preferred.

Spreadsheet and Software Auditor/Specialist (Recreation and TOM models). The reviewer should have demonstrable understanding and experience of the following:

- Developing and testing of spreadsheets and user interface software for purposes of characterizing functionality and ease of use, identifying computational errors, characterizing susceptibility to deliver flawed results, and developing recommendations for best spreadsheet or software coding practices.
- Experience in development and review of spreadsheets for computational accuracy.
- Development and review of models applied using the General Algebraic Modeling System (GAMS) programming language/software package is required.
- Experience with economic modeling spreadsheets or software is preferred.

The Contractor will provide the USACE with the final list of IEPR Panel members, including their credentials. The final selection will be based on availability, technical credentials, and absence of perceived or actual conflict of interest. The IEPR Panel members shall not have any financial or litigation association with the USACE, Reclamation, or BPA; the State where the study/project is located; the design A-E, or their engineering teams, subcontractors, or construction contractors. The Review Panel members shall fully disclose any known or potential conflict of interest that may arise from the performance of the work. Areas of conflict may include current employment by Federal or State governments, participation in developing the subject project, a publicly documented statement advocating for or against the subject project, current or future interests in subject project or future benefits from the project, and paid or unpaid participation in litigation against the USACE, Reclamation, or BPA.

The Contractor will prepare a scope of work for each Review Panel member. A request for quotation, including the scope of work and conflict of interest inquiry will be prepared and sent to each reviewer. Upon receipt of the potential reviewers' written quotations indicating willingness to participate and the absence of a conflict of interest, the Contractor will establish contracts with the peer reviewers at agreed upon rates and hours to ensure/secure participation.

Task 3: Meetings

A kick-off teleconference between USACE personnel and Contractor personnel will be conducted after the notice to proceed (NTP) is issued. The intent of this meeting is to define the IEPR roles for USACE and the Contractor.

An additional kick-off teleconference will be held after final selection of the model Review Panel members. This meeting will be between USACE personnel, Contractor personnel, and the IEPR Panel members. The purpose of this meeting is for USACE to familiarize the Review Panel members with the intended purpose of the models and how the software performs, and to discuss the specific objectives of the review. All of the Review Panel members will participate.

Contractor staff and all IEPR Panel members will participate in a teleconference at the approximate midpoint of the model review process. The purpose of this meeting is to allow Review Panel members to ask clarifying questions of USACE in order to assist in the development of comments and to potentially eliminate the total number of Final Panel Comments. All meetings under this Task shall be arranged and hosted by the Contractor.

Task 4: Conduct IEPR

The Contractor will provide the Review Panel members with copies of the technical documents for review listed above in Section 3. USACE will provide these documents to the Contractor for distribution to the Review Panel members. The Contractor will prepare and deliver a letter to instruct the Review Panel members to undertake the reviews including a template format for responding to Review Charge questions. The letter also will outline the steps and deadlines which will include a list of the documents for review listed in Section 3, Table 1. Working with USACE, the Contractor will respond to any Review Panel member questions or information requests during the review process. The Contractor will document all communications between USACE and the Review Panel members.

The assessment of the model shall determine the degree to which the models can be described as technically sound relative to its intended use and design objectives, computationally correct, and usable for the identified purpose. Specifically, we ask the reviewers to consider their individual reviews in terms of quality of the basic model development process including: 1) conceptualization, 2) quantification (mathematical

relationships), 3) evaluation of the usefulness of the model in terms of its ability to simulate system behavior, and 4) application usefulness in terms of the model's ability to provide information to address questions about the system and future scenarios. The reviewers are asked to comment on any aspects of the model that potentially affect its technical quality, computational accuracy, and usability as a potential producer of information to guide management decisions.

The Review Panel members will complete their review and provide comments to the Contractor. When the individual Review Panel member comments have been received from the Review Panel members, the Contractor will collate the individual Review Panel member comments and ensure that they are complete and responsive to the Review Charge. The Contractor will identify the overall issues and themes that were either identified by multiple Review Panel members or repeatedly by one Review Panel member, comments that indicated conflicting Review Panel member opinions, and other noteworthy comments. Then, the Contractor will convene one or more group Review Panel comment review meetings via teleconference with the IEPR Panel members to discuss the Review Panel's comments. The goal of the meeting is to provide a forum for Panel members to discuss the comments and agree (or agree to disagree) on the comments of highest priority, identify which issues should be carried forward as "Final Panel Comments," decide who will lead the development of those final comments, and to address any contradictory comments. This meeting will ensure the exchange of technical information among the Review Panel members, many of whom will be from diverse scientific backgrounds. This information exchange provides additional context to Review Panel members and is considered crucial in the development of a comprehensive IEPR Final Report.

Task 5: Prepare IEPR Report

The Contractor shall consolidate the comments (see Task 4) to eliminate redundant or overlapping comments and to identify dissenting or diverging comments. Each comment will be formatted into a 4-part comment including the following:

1) a clear statement of the concern;
2) the basis for the concern;
3) the significance of the concern (the importance of the concern with regard to project implementability);
4) a description of additional research that would appreciably influence the conclusions and, when appropriate, the actions necessary to resolve the concern.

The Contractor will prepare the Model Review Report and submit it to the Corps for review. The report will assess the degree to which the model has technical quality, system quality, and usability. The Contractor will prepare and submit the final panel comments in the Model Review Report.

The Contractor shall prepare a final report of the Review Panel findings. The report shall have an executive summary describing the recommendations and resolutions. Following the executive summary the report shall list in detail all the referenced criteria, computations, comments made, and all other pertinent information along with IEPR Panel recommendations and final resolution. The Model Review Report should use the following general outline:

1.0 Introduction
    1.1. Model Purpose and Summary
    1.2. Model Evaluation Assessment Criteria and Approach
    1.3. Summary of Findings
2.0 Technical Quality Assessment
    2.1. Review of Model Documentation Quality
    2.2. Review of Theory and External Model Components
    2.3. Review of Representation of the System
    2.4. Review of Analytical Requirements
    2.5. Review of Model Assumptions and Limitations
3.0 System Quality Assessment
    3.1. Review of Model Calculations/Formulas
    3.2. Review of Testing/Evaluation Process
4.0 Usability Assessment
    4.1. Review of Operating Requirements of the Model
    4.2. Review of Input Availability and Output Understandability
    4.3. Review of Condition Characterization Usefulness
    4.4. Review of Model Usefulness in Selecting Alternatives
5.0 Model Assessment Summary
6.0 Conclusions
7.0 List of Preparers
8.0 References

Sections 1.0 and 2.0 of the report will provide basic background information on the model and the review approach. Sections 3.0 through 4.0 will only contain the final panel comments that are related to specific model assessment criteria. If there are no comments for a given assessment criterion, the report will state that no issues were identified related to that criterion. Section 5.0 and 6.0 will summarize the key concerns identified during the model review and the conclusions with regards to recommendations for resolution.

The report is intended to provide final documentation of the peer review process. The report will also include a summary of the Review Panel members' qualifications and a brief discussion of the methodology used to conduct the IEPR. The Contractor will submit the IEPR Final Report to the IEPR Lead for review and acceptance of the product. Once the IEPR Lead accepts the product, he/she will forward the product to the Project Delivery Team for development of responses. The Final IEPR Report must be submitted no later than 45 days from the report review documents submittal to the panel. The final report outline previously approved by the Government will be used for all reports with any agreed-to modifications required.

The Contractor is expected to provide internal quality control and quality assurance of the IEPR report to ensure they are complete, free from obvious errors, grammatically correct, and of high and professional quality.

Task 6: Comment/Response.

The Contractor shall provide the IEPR Final Panel Comments to USACE in Microsoft Word format via email. The IEPR Final Panel Comments provided in Microsoft Word format should include the corresponding sections and page numbers in the report documentation, as appropriate, in order to assist the USACE project delivery team to develop responses to Final Panel Comments. In addition, the Contractor will enter the IEPR Final Panel Comments into DrChecks. USACE will submit clarifying questions to the Contractor to coordinate with the IEPR Review Panel, if necessary. The Contractor and USACE will participate in a teleconference call to discuss the comment/response process.

USACE will provide draft evaluator responses to the Contractor in Microsoft Word format via email. In response to the 4-part comment submitted by the IEPR Review Panel, USACE should submit a "concur" or "non-concur" evaluation to each Final Panel Comment and include a concise, standalone statement as to why the response was "concur" or "non-concur." In addition, in response to each IEPR Final Panel Comment Recommendation for Resolution, USACE shall include a statement to "adopt" or "not adopt", along with a response describing how and where the report documentation would/would not be expanded, revised, or changed. If recommendations are not accepted, the reported reason for the rejection shall be documented in the draft evaluator responses. The Contractor shall coordinate a teleconference call with USACE and the IEPR Panel to discuss USACE's draft evaluator responses to the IEPR Final Panel Comments.

Following the teleconference call, USACE will submit final responses to the IEPR Final Panel Comments. In addition, USACE will enter final responses to Final Panel Comments into DrChecks. The Contractor shall receive backcheck responses to draft evaluator

responses from the IEPR Review Panel. All responses provided by the USACE and IEPR Panel members will be labeled as “concur” or “non-concur” to indicate agreement or non-agreement, respectively. The Contractor shall enter the IEPR Panel backcheck responses to the USACE final responses to Final Panel Comments into DrChecks. The Contractor will provide USACE with a .pdf printout of the DrChecks project file once all IEPR comments are closed following backcheck responses. In addition, the Contractor will provide the Microsoft Word file containing the final iteration of the IEPR Final Panel Comments, the USACE final evaluator responses to IEPR Final Panel Comments, and the IEPR Panel backcheck responses to the USACE final evaluator responses.

5. REPORTING REQUIREMENTS

The Contractor shall provide all document reproduction. Electronic submittals shall contain all electronic files in both Microsoft Word and Adobe PDF formats. The briefings for the teleconferences will be furnished in Microsoft PowerPoint or Adobe PDF format. Reports generated by the peer review Contractor or their subcontractors shall not be released for publication or dissemination without the Contracting Officer’s written approval following coordination with the Contracting Officer’s representative. The USACE will determine which documents to publish in the public domain. The Contractor shall provide monthly status updates to USACE. Status updates will include the status of efforts associated with this PWS as well as any changes to scope and schedule. These updates will be informal and normally conducted through electronic mail messages.

All of the electronic submittals (whether draft or final) must be thoroughly reviewed by the appropriate contracting staff prior to submittal to USACE and/or the IEPR Lead. The Contractor is expected to provide internal quality control and quality assurance for all deliverables to ensure they are complete, free from obvious errors, grammatically correct, and of high and professional quality.

6. QUALIFICATION REQUIREMENTS

The Contractor shall have the following qualifications:

a. Experience establishing and administering Review Panels;
b. Be qualified as an Internal Revenue Code Section 501(c)(3) organization and be exempted from Federal tax under Section 501(a), of the Internal Revenue Code of 1986;
c. Shall be a scientific or professional society, a firm specializing in peer review, or a non-profit organization with experience in peer review;
d. Is an independent science and technology organization;
e. Shall be free from conflicts of interest with the CRSO study, including all associated operating projects and cooperating agencies.
f. Does not carry out or advocate for or against Federal water resources projects; and,
g. Proven ability to deliver under significant time constraints.

7. PLACE AND PERIOD OF PERFORMANCE, AND TRAVEL

a. Place of Performance. A majority of the work will be conducted at the Contractor's facilities.
b. Period of Performance. The performance period shall be from the date of the NTP through 28 February 2021.
c. Travel: No travel is required.

8. RESTRICTIONS

There are no known conflicts of interest with the CRSO and IEPR Panel members that are assembled.

9. AUTHORITIES STATEMENT

No person other than the Government Contracting Officer has the authority to make changes to this contract action that impact cost or schedule. Authority from the Contracting Officer to the contractor to make changes that impact cost or schedule will be in the form of an official, signed modification.

10. RELEVANCE

The U.S. Army Corps of Engineers is a division of the U.S. Army.

11. CAPABILITY STATEMENT

By public law WRDA 2007 (Public Law 110-114), Section 2034, the peer review must be completed by reviewers external to the Government, thus the requesting agency does not have the necessary in-house capability to perform the tasks specified in this PWS.

12. POINTS OF CONTACT

IEPR CONTACTS			CONTRACTING / STUDY CONTACTS	
Name	**Rachel Mesko**		Name	**Anastasiya Kononova**
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Name	**Nate Richards**		Name	**Leah Hauenstein**
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Phone	309-794-5286		Phone	206-316-3169

Name	**Jesse Granet**		Name	
Title	RMO Contact (Alternate Point of Contact)		Title	
Agency	USACE, Northwestern Division		Agency	
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PERFORMANCE WORK STATEMENT
COLUMBIA RIVER SYSTEM OPERATIONS
POWER ANALYSIS MODELS

NORTHWESTERN DIVISION
INDEPENDENT EXTERNAL PEER REVIEW

1. TITLE

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The Co-lead Agencies will use this EIS to assess and update their approach for long-term system operations and configurations through the analysis of alternatives and evaluation of potential effects to the human and natural environments.

The scope and scale of this project, its potential to impact human life safety, interest on the part of the Governors of Montana, Idaho, Washington, and Oregon, 19 Federally-recognized tribes, connection to on-going litigation on the Federal Columbia River Power System, as well as the likelihood for the project to result in public dispute, drive a requirement for a heightened level of review and meets the criteria of a highly influential scientific assessment in OMB and Reclamation peer review policies. Due to the level of complexity and controversy associated with the project, it is expected that Expert Peer Reviewers will be required for some aspects of the review. In addition,

conflict of interest will need to be carefully evaluated due to the nature and scope of the project. Areas of conflict may include current employment by Federal or State governments, participation in developing the subject project, a publicly documented statement advocating for or against the subject project, current or future interests in the subject project or future benefits from the project, and paid or unpaid participation in litigation against the USACE, Reclamation, or BPA.

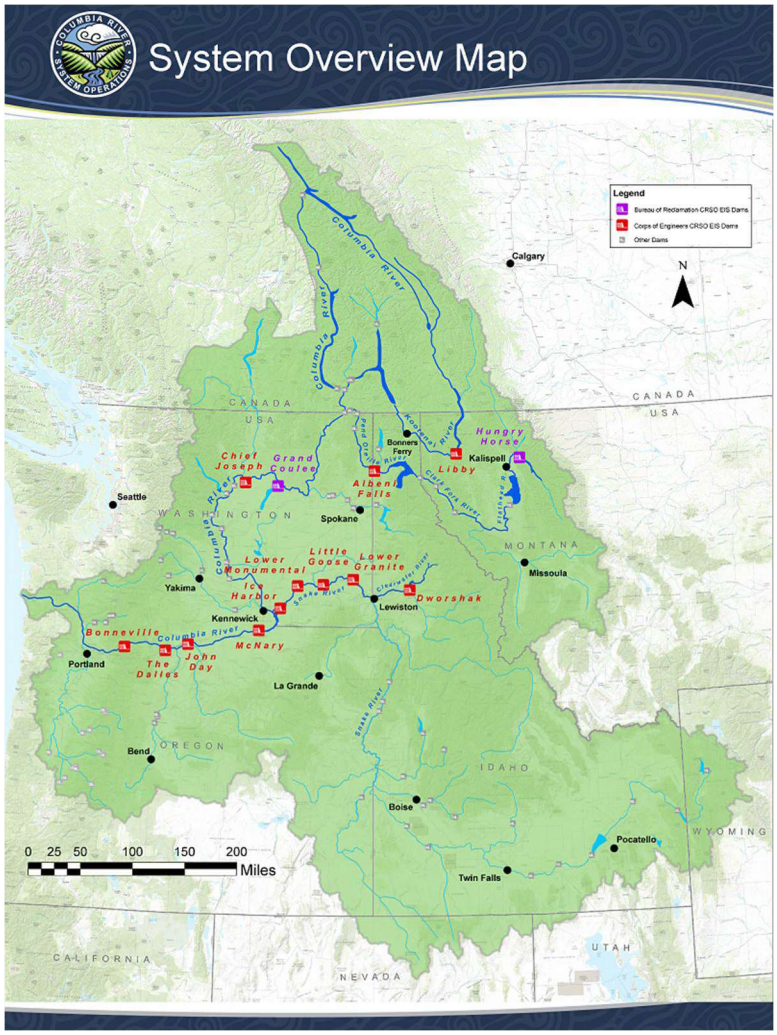


Figure 1. Columbia River System Operations

3. OBJECTIVES

The objective for this performance work statement (PWS) is to conduct an IEPR of the Power Analysis Models used in the study (refer to 3a below) in accordance with procedures described in the Department of the Army, U.S. Army Corps of Engineers peer review policy, Engineer Circular (EC) No. 1165-2-217, Review Policy for Civil Works, dated February 20, 2018, and the Office of Management and Budget Final Information Quality Bulletin for Peer Review released December 16, 2004.

IEPR is one of the important procedures used to ensure the quality of published information meets the standards of the scientific and technical community. Peer review typically evaluates clarity of hypotheses, validity of the research design, quality of data collection procedures, robustness of the methods employed, appropriateness of the methods for the hypotheses being tested, extent to which the conclusions follow from the analysis, and strengths and limitations of the overall product.

The IEPR will be limited to technical review and will not involve policy review. The IEPR will be conducted by subject matter experts (i.e., IEPR Panel members) with extensive experience in USACE planning, engineering, economics, and environmental issues relevant to the project.

The Review Panel members will be "charged" with responding to specific technical questions as well as providing a broad technical evaluation of the overall modeling frameworks. Per EC 1165-2-217, Paragraph 11, reviewers should identify, explain, and comment upon assumptions that underlie all the analyses, as well as evaluate the soundness of models, surveys, investigations, and methods.

All review, documents, and information sharing will be handled electronically via electronic mail, electronic file transfer which may utilize a File Transfer Protocol web site. The following references to USACE regulations shall be followed in conducting the IEPR. The EC and ER documents are available at http://www.publications.usace.army.mil/Portals/76/Publications/EngineerCirculars/EC_1165-2-217.pdf?ver=2018-05-01-105219-217 and http://www.publications.usace.army.mil/USACEPublications/EngineerRegulations.aspx, respectively.

- USACE EC1165-2-217, Civil Works Review, dated February 20, 2018
- USACE ER 1110-1-8159, Engineering and Design, DrChecks, May 10, 2001
- Office of Management and Budget's guidelines, Final Information Quality Bulletin for Peer Review, issued December 16, 2004 memorandum M-05-03.

3a. MODEL REVIEW

The primary goal of model review is to establish that models, analyses, results, and conclusions are theoretically sound, computationally accurate, based on reasonable assumptions, well-documented and in compliance with the requirements of Office of Management and Budget (OMB) Peer Review Bulletin (Reference 3f). Independent technical review of model selection (i.e., decision to use a particular model) and application of the model and the input data is still the responsibility of the agency and users.

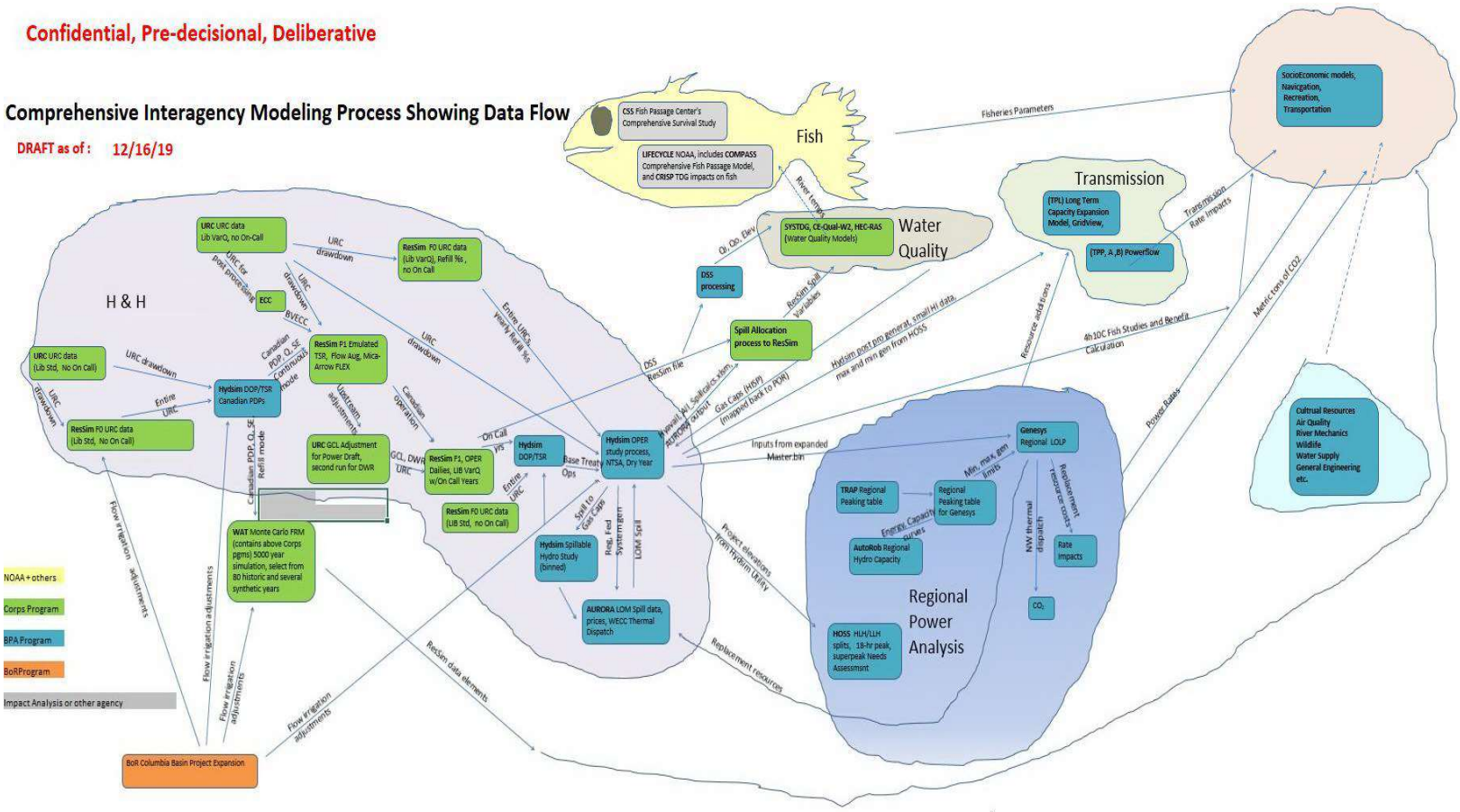
The primary criterion identified for model approval is technical soundness. Technical soundness reflects the ability of the model to represent or simulate the processes and/or functions it is intended to represent. The performance metrics for this criterion are related

to theory and computational correctness. In terms of the theory, a quality model should: 1) be based on validated and accepted "state of the art" practices and methodologies; 2) properly incorporate (through system quality testing procedures) the model framework (e.g., equations, parameters, functions) into software, if applicable; and, 3) clearly define the assumptions inherent in the model. In terms of computational correctness, a quality model should: 1) document proper functions and mathematics to estimate functions and processes represented; and, 2) properly estimate and forecast the actual parameters as intended. Other criteria for quality models are efficiency, effectiveness, usability and clarity in presentation of results. A well-documented model will stand the tests of technical soundness based on theory and computational correctness, efficiency, effectiveness, usability and clarity in presentation of results.

The Bonneville Power Administration power analysis models that will be reviewed as part of the Columbia River System Operations Study are listed below and include Hydro System Simulator (HYDSIM), Hourly Operations System Simulator (HOSS), Loss of Load Probability Model (Genesys), Power Rate Analysis Model (RAM2020), and Transmission Long-Term Rates Analysis Model. Another primary analysis model is AURORA. This model is described below to provide context for the overall modeling methodology but it is not a part of this independent review. Included in the list (see #1) is a conceptual layout of all the models used in the CRSO to provide clarity on interrelationships and dependencies among models. Each model includes standalone narrative documentation and background information to provide an overview of the modeling methodology and context for model application. The modeling software is not available outside of BPA premises and/or computers. Therefore, the main review element will include reviewers traveling to BPA and spending a week with the model developers, model application specialists, and BPA leadership to gain an understanding of the technical quality, system quality, and usability of the models and methodologies. The specifics are outlined in Section 4, Task 4.

Bonneville Power Administration Models

1. **CRSO Overall Modeling Process and Flow –** The modeling process utilized is very comprehensive and is dependent on multiple agencies and input into multiple modeling systems. (See Figure 2). The overall models incorporate a complex web of data and inputs which culminate in a series of outputs used in the development of the EIS. Figure 2 provides a schematic containing a detailed overview of how the various CRSO modeling processes are interrelated and provides clarity on dependencies and flow among the various models. The focus for this review revolves around the H&H and Regional Power Analysis categories. Other categories including environmental, ecological modeling, socioeconomic modeling, navigation modeling, and EIS specifics are being reviewed via other review mechanisms.



2. **Hydrology and Hydraulic Models –** Overall, the H&H models are used to evaluate how each alternative under consideration in the EIS is expected to change reservoir elevations, water releases from the dams, including spill, flow and stages (water levels) in the river channel downstream of the 14 federal Columbia River System projects.

   a. **Hydro System Simulator (HYDSIM) -** Hydsim is a seasonal planning model developed by the Bonneville Power Administration's Power Services. It is a computer model for simulating seasonal operation of the Pacific Northwest Hydroelectric System. Hydsim uses initial reservoir content, operating requirements, fixed operation targets, and non-power operating requirements to compute average generation, average streamflow, and ending reservoir content at each project for a study period. Utility programs process data before and after a Hydsim run. Physical characteristics of each project are provided by annual Pacific Northwest Coordination Agreement (PNCA) data submittals from regional utilities and government agencies involved in the coordination and operation of regional hydro projects. The HYDSIM model incorporates these operating characteristics along with power and non-power requirements to provide project by project monthly energy generation estimates for the Federal system's regulated hydro projects for FY 2020-2021.

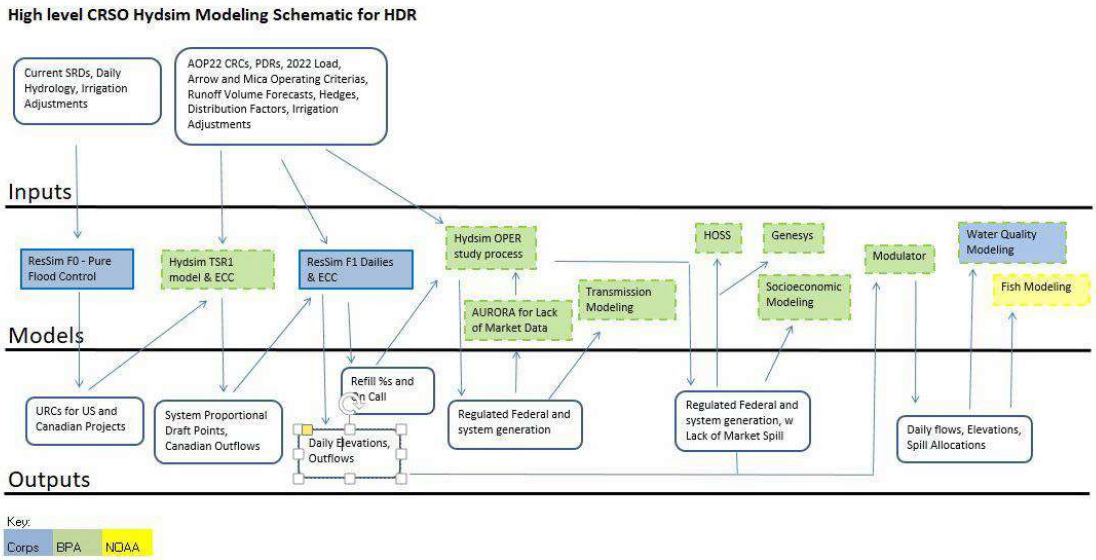
b. AURORA – AURORA is not a model requiring review by this panel. However, the model is used in the overall modeling methodology and knowledge/experience with this software will be required to understand the relationships and dependencies among models. We provide this description of the model to provide context and understanding for the entire modeling process. AURORA is a production cost model that forecasts electricity markets and has been used by BPA in every Rate Case since 2000. The AURORA model was originally developed by the company EPIS http://epis.com/aurora/ and became well known and recognized in the United States and Canada as the standard for electricity market forecasts.

BPA models all of the Western Interconnection at the zonal level (46 zones), typically low sampling rate (15% - 50% of hours) with forecast horizons from 1-2 months to 20 years. Resource builds are generated by:

- Taking latest EPIS (Energy Exemplar) database, checking additions and retirements over the horizon of the rate period against Velocity Suite, EIA's database of planned and sited resources, BPA's Transmission Interconnection Queue, WECC's Transmission Expansion Planning Policy Committee, the California Energy Commission, and the California Public Utilities Commission.

- Use AURORA capacity expansion logic to make economic retirements and ensure sufficient thermal resources to meet planning targets throughout Western Interconnection for the forecast horizon.

- Operations evaluations for treaty, fish, and maintenance considerations



3. **Regional Power Analysis Models -** BPA uses their Power Analysis models to evaluate the impacts of the alternatives to generation and transmission of power across the larger context of Pacific Northwest regional power resources of which the 14 federal Columbia River System projects are a subset. For example, this evaluation will determine if an alternative modifies the operations of hydroelectric or other generation facilities and any impacts on the Bonneville Power Administration's ability to meet its power supply obligations.

   a. **Hourly Operations System Simulator (HOSS) -** HOSS is a VAX-based model that simulates:

      - the hourly operation of federal hydro resources to meet the hourly hydro load, project constraints and daily forebay targets such that heavy load hour generation is as high as possible given the objectives of the operation

      - the federal hydro system's response to hourly load shapes without human intervention

      - fish spill at federal projects as described by the biological opinion.

      HYDSIM can be used as a seasonal planning tool for HOSS for multiple water conditions. As such, it provides the status (for example, forebays and inflows) of each project at the beginning of each month. The next month's status is used as a target to be met, if possible. There is also the option of using results from the 90-Day model for initial values and end-of-week targets. An hourly loads program (HRLYLOADS) provides hourly load forecasts for the federal and NWGU systems.

      HOSS performs daily planning to develop project discharge targets for each hour of the current day. The hourly operation then uses these daily planning targets to simulate the operation of each project within its operating constraints. HOSS has logic that can simulate federal nonfirm transactions that will adjust the hydro load on each hour in response to the hydro conditions.

      HOSS is used to study hourly operations for simulation periods of up to 28 days.

   b. **Resource Adequacy Model (GENESYS) -** GENESYS (GENeration Evaluation SYStem) was developed by the Northwest Power and Conservation Council (NWPCC) in cooperation with BPA. It is used to perform studies for adequacy assessments. GENESYS simulates the operation of the hydro system and other generating resources, using Monte Carlo sampling to model uncertainty in loads, streamflows, wind and solar generation, and forced outages of thermal resources. Across multiple combinations of these stochastic variables, the likelihood of a curtailment is the loss-of-load-probability (LOLP). Adequacy is assessed by evaluating the LOLP against an adequacy standard. The model

dispatches on a 14 period basis, a user-defined window (e.g. 2 days), daily, and hourly. In the periodic dispatch, GENESYS incorporates the HYDSIM kernel to model and constrain the hydro system on a 14 period basis, and the HYDSIM rule curves are used to establish relatively priced blocks of available hydro energy. Both hydro and thermal resources are stacked together based on relative pricing. The resource stack is aligned to the average load (net of load reduction resources and firm contracts), and any necessary off-peak purchases are determined. In the user-defined window dispatch, proportional amounts of hydro and thermal energy from the period dispatch are used. In the daily dispatch, average hydro and thermal from the window dispatch along with shaping limitations for sustained peaking are used. The hourly dispatch is constrained by hourly hydro availability from the daily dispatch along with marginal hydro pricing from the window dispatch. Thermal is dispatched after being subject to forced outages, and demand response and energy storage resources (batteries) are dispatched within their constraints to try to meet any remaining unserved load. Any load still unserved is identified as a curtailment.

c. **Power Rate Model (RAM2020) -** For the Columbia River System Operations (CRSO) Environmental Impact Statement (EIS), Bonneville Power Administration's (Bonneville's) power rates model from the BP-20 rate case (RAM2020) computes Bonneville's expected power rates under the No Action Alternative (NAA) and the various multi-objective (MO) alternatives for FY2022.

   RAM2020 was developed for the BP-12 rate case (then called RAM2012), which was the first rate case implementing the Tiered Rates Methodology to establish Bonneville's firm power rates applicable to power sales under the Regional Dialogue contracts for the delivery period of FY 2012-2013. The model was built in Microsoft Excel, and performs basic arithmetic necessary to compute power rates. Beyond basic arithmetic, certain values must be iterated, which uses substitution and iteration to achieve convergence. Bonneville power rates setting is a complicated process requiring adherence to both statutory mandates of the Northwest Power Act, and the Tiered Rates Methodology, Bonneville's long term rate design that was established pursuant to section 7(i) of the Northwest Power Act and approved by the Federal Energy Regulatory Commission in 2008.

   For the CRSO analysis, changes to costs, generation, power sales which were modeled for the NAA and each MO were incorporated into the model from the BP-20 rate case, with all other inputs taken from the BP-20 rate case values. These results were then utilized as inputs to the socioeconomic analysis for the CRSO EIS.

   RAM2020 is a group of computer applications that perform most of the computations that determine Bonneville's proposed power rates. RAM Core, a spread sheet-based model, has three main steps that perform the calculations necessary to develop Bonneville's wholesale power rates: Cost of Service Analysis (COSA), Rate Directives, and Rate Design.

a) Cost of Service Analysis. This step ensures that Bonneville's proposed rates are consistent with cost of service principles and comply with Bonneville's statutory rate directives. The COSA Step determines the costs associated with the three resource pools (Federal base system (FBS), residential exchange, and new resources) used to serve sales load and then allocates those costs to the rate pools (Priority Firm Power (PF), Industrial Firm Power (IP), New Resource Firm Power (NR), and Firm Power Products and Services (FPS)). In addition, the COSA allocates the costs of conservation and other Bonneville programs to the rate pools.

b) Rate Directives. The Northwest Power Act requires that some rate adjustments be made after the initial allocation of costs to ensure that the rate levels for the individual rate pools (PF Preference, PF Exchange, IP, NR, and FPS) have the proper relationship to each other. The primary rate adjustments are described in sections 7(b) and 7(c) of the Northwest Power Act. The Rate Directives Step of RAM2020 performs these rate adjustments. The amount of PF Public rate protection and the levels of the IP and NR rates are set using the 2012 settlement of legal issues associated with the Residential Exchange Program.

c) Rate Design. In the COSA and Rate Directive steps, costs are allocated to the various rate pools. Upon completion of these steps, a certain amount of costs has been allocated to the PF Preference pool. Section 7(e) affords Bonneville wide latitude in the design of rates to collect the costs allocated to each rate pool. The Tiered Rate Methodology (TRM) specifies a cost allocation methodology for PF Preference costs allocated in the COSA and Rate Directives steps. RAM accomplishes this separate cost allocation through a process of mapping costs (including net residential exchange costs) and revenue credits (including IP and NR revenues, if any) to the Tier 1 Composite, Non-Slice, Slice, and Tier 2 costs pools. It also demonstrates by "proof" that cost allocations under the TRM and the COSA and Rate Directives steps are equivalent in terms of aggregate costs recovered from the PF Preference, PF Exchange, IP, and NR rates. To provide a crosswalk of the differences between COSA allocations and TRM allocations, the mapping for each is shown in RAM2020 using unique database keys.

d)

4. Power Transmission

a. Long-Term Transmission Rates Model - For the Columbia River System Operations (CRSO) Environmental Impact Statement (EIS), Bonneville Power Administration's (Bonneville) long-term transmission rates model was utilized to conduct a transmission rate pressure[1] sensitivity analysis on the various multi-

[1] For the purposes of this documentation, the term 'rates' applies to Bonneville transmission rates unless specified otherwise in the text.

objective alternatives. Specifically, the model was used to calculate long-term cumulative rate pressure for each of the multi-objective alternatives in order to compare the effects of the alternatives on transmission rates to the rates under the no action alternative. This document is intended to describe how the model was utilized in the CRSO EIS analysis and provide technical information on the model itself.

The long-term transmission rates model is designed for long-term alternative analysis to estimate potential rate pressures over time based on changes to costs, sales, or rate design. The model is based on the transmission rates model used for setting rates in Bonneville rate proceedings, which was built in Microsoft Excel using inputs from sales forecasts and revenue requirements. The long-term model is designed to provide comparisons of potential rate pressure over time between alternatives and is not designed to be a forecast of future rates.

For the CRSO analysis, changes to costs and sales were modeled over the time periods in question without any assumptions about changes to rate design. The cumulative rate pressures over time were calculated for each alternative and compared to the rates under the no action alternative. These results were then utilized as inputs to the socioeconomic analysis for the CRSO EIS.

Government-Furnished Information – USACE will provide a minimum of the following documents for review by the IEPR Panel:

Table 1: CRSO Model Review Documentation: BPA Power Analysis Models

CRSO Model Review Documentation	Anticipated Date of Report/Data	Approximate Number of Pages
Hydro System Simulator (HYDSIM) Model Documentation		
General Guidelines for Running the Updated OPER Study Process for CRSO	January 2020	39
Quick User Guide for Plant Editor Version 1.0	January 2020	46
File Utilities Quick User Guide	January 2020	31
Hourly Operations System Simulator (HOSS) Model Documentation		
HOSS User Guide	January 2020	43
HOSS Training Guide	January 2020	13
Loss-of-Load Probability Model Documentation (Genesys)		
Genesys Version 9 Documentation	January 2020	15
2013 Genesys Changes		5
Power Rate Model (RAM 2020)		
RAM2020: Power Rates Model Documentation	January 2020	31
Long-Term Transmission Rates Analysis Model		
Long-Term Transmission Rates Model Documentation	January 2020	8

Additional Supporting Documentation[1]		
Genesys Final Code		8 MB of software code
HOSS Code Documentation		65 MB of software code
HOSS Flow Charts		58
Total number of pages to be reviewed		231[2]
Total number of reference pages		58[1,2]
Grand total of review pages and reference pages		289[2]

1. *For Reference Only. These documents are provided for context only and Panel members are not asked or expected to directly comment on these documents.*

2. *The actual number of pages provided to the panel for review may differ from this estimate by plus or minus 20%.*

4. SPECIFIC TASKS

There are some instances when concurrence or approval by USACE is necessary to assure policy compliance with EC 1165-2-217. However, the following tasks shall be performed independent of government supervision, direction, or control of the technical considerations of this review:

Task 1: Work Plan to Conduct IEPR

The Contractor shall prepare a draft and final work plan that describes the process for conducting the IEPR. The work plan will include screening criteria for Panel members, working schedule, selection of Panel members, Review Charge to Panel members (provided by USACE to include in final work plan), communication and meetings with USACE project team, quality control, and compilation/dissemination of Review Panel members' comments. The Contractor shall conduct the IEPR in accordance with the work plan to ensure that all services are performed, reviewed, and provided in a manner that meets professional engineering quality standards. Also included in this task will be one conference call to discuss the USACE comments on the draft work plan. If needed, the Contractor can coordinate with the study Project Manager and IEPR Lead, via conference call, to ask questions about key events in the timeline leading up to the completion of the decision document and supporting documentation. The Work Plan will include a site visit for the Review Panel during the IEPR process (see Task 4). Both the draft and final work plan must be thoroughly reviewed by the appropriate contracting staff and submitted free of grammatical errors, references to other projects, font inconsistencies, and misspelling of words.

The process to prepare Corps decision documents is complex and the coordination with the IEPR schedule involves many factors, some of which are outside of the control of the District Project Delivery Team and the Review Management Organization. The Government does not guarantee that it will provide materials and information or be available for meetings on the dates in the working schedule. The Contractor is responsible

for any necessary contingencies to accommodate Government-caused delays of up to three (3) months in delivering materials and information. After USACE and the Contractor agree on the schedule for a meeting date, the Contractor is responsible for any necessary contingencies to accommodate up to two (2) schedule changes requested by the Corps for each meeting.

Task 2: IEPR Panel

The Contractor shall identify Model Review Panel members based on the descriptions below. The final selection of the Panel will be based on screening criteria included in the work plan (Task 1). The Contractor will provide USACE with the final list of IEPR Panel members, including their credentials.

Each model reviewer should be a professional from academia, a public agency (excluding USACE, Reclamation, and BPA), private firm, or similar vocation with at least ten (10) years of experience in their area of expertise and have at least a M.S. degree (reviewers with a Ph.D. are preferred) in one or more fields directly applicable to one or more focal areas listed below and worked within the field of hydroregulation, modeling, predicting anticipated power output given a various water conditions (i.e., riverine H&H), power rate analysis and cost assessments, and who possess a basic understanding of the Pacific Northwest River System and the concepts used to analyze hydro system regulation. The technical qualifications that are required for the model review panel include the following:

Hydroelectric Power Utilities Engineer - the reviewer should have extensive experience and knowledge in the following:

- Engineering theory and practices relating to power generation, transmission, distribution, and marketing.
- Electric utility operation and management
- Engineering studies to determine markets for electric power, methods for supplying power, and power load growth and power rates.
- Designs and cost estimates of power transmission systems for hydroelectric generating plants.
- Revenue forecasting, revenue risk analysis, and commercial business analysis for Transmission Revenue Forecasting

Economist - the reviewer should have extensive experience and knowledge in the following:

- Industry power marketing and economics, including the market for and value of electric power, methods of marketing power and rates, agreements.
- Experience with power market rates and cost assessments
- Experience in the management, maintenance and development of a suite of risk models for Monte Carlo simulation of electricity market prices

- Familiarity with AURORAxmp inputs/outputs. A fundamental understanding of this methodology is needed to understand the overall modeling methodology and ensure it is being utilized and aligned properly with the other models.
- Developing, implementing, or preparing power, transmission and ancillary service rates, rate adjustments, rate designs, and related forecasts, allocations, strategies, and industry evaluations for hydropower operations.
- Experience with methodologies for determining costs associated with the investment or operation and maintenance facilities for Federal and non-Federal entities

Hydroelectric Operations Research Analyst - the reviewer should have extensive experience and knowledge in the following:

- Experience with hydro-regulation studies for the Columbia River System Operation process and other customers. Extensive hydro-regulation study experience in other similar large river basins may be substituted for direct CRSO experience.
- Experience developing, implementing, and reviewing hydro regulation optimization models that consolidate external factors such as weather data, water levels, and market prices with system infrastructure and generate optimized plans for operational facilities, such as the opening and closing of gates, reservoir water level regulation, and hydro turbine operation.

Hydroregulation Analyst/Hydrology and Hydraulics Specialist - the reviewer should have extensive experience and knowledge in the following:

- All aspects of hydrology and hydraulic engineering including a thorough understanding of regulated systems as well as regional water management operations.
- Development and application of complex hydroregulation models used to hydraulic models used to rapidly calculate a river system's response to a variety of streamflow and operating conditions.
- Time-dependent nature of hourly hydro regulation capability.
- Model cascading through multiple dams as part of connected riverine and reservoir systems
- Interaction between assignment of reserves and system capacity

The Contractor will provide the USACE with the final list of IEPR Panel members, including their credentials. The final selection will be based on availability, technical credentials, and absence of perceived or actual conflict of interest. The IEPR Panel members shall not have any financial or litigation association with the USACE, Reclamation, or BPA; the State where the study/project is located; the design A-E, or their engineering teams, subcontractors, or construction contractors. The Review Panel members shall fully disclose any known or potential conflict of interest that may arise from the performance of the work. Areas of conflict may include current employment by Federal or State governments, participation in developing the subject project, a publicly

documented statement advocating for or against the subject project, current or future interests in subject project or future benefits from the project, and paid or unpaid participation in litigation against the USACE, Reclamation, or BPA.

The Contractor will prepare a scope of work for each Review Panel member. A request for quotation, including the scope of work and conflict of interest inquiry will be prepared and sent to each reviewer. Upon receipt of the potential reviewers' written quotations indicating willingness to participate and the absence of a conflict of interest, the Contractor will establish contracts with the peer reviewers at agreed upon rates and hours to ensure/secure participation.

Task 3: Meetings

A kick-off teleconference between representatives from USACE, Bureau of Reclamation, and Bonneville Power Administration and the Contractor will be conducted after the notice to proceed (NTP) is issued. The intent of this meeting is to define the IEPR roles for USACE and the Contractor.

An additional kick-off teleconference meeting will be held after final selection of the Review Panel members. This meeting will be between USACE, Bureau of Reclamation, and Bonneville Power Administration personnel, Contractor personnel, and the IEPR Panel members. The purpose of this first meeting is for USACE to familiarize the Review Panel members with the models, available information, and to discuss the specific objectives of the review, including the in-person review workshop. All of the Review Panel members will participate.

USACE, Bureau of Reclamation, and Bonneville Power Administration personnel along with Contractor staff and all IEPR Panel members will participate in a post-workshop teleconference. The purpose of this teleconference is to discuss preliminary results from the in-person workshop, ask clarifying questions of USACE, Bureau of Reclamation, and Bonneville Power Administration in order to assist in the development of comments and to potentially eliminate the total number of Final Panel Comments. All meetings under this Task shall be arranged and hosted by the Contractor.

Up to two (2) additional teleconferences may be necessary given the overall review methodology being used. For example, an additional teleconference may be necessary prior to the in-person review to ensure roles, responsibilities, review charge, and logistics.

Task 4: Conduct Review

The overall review of the models will include pre-workshop review of available technical documents, in-person review at the Bonneville Power Administration (BPA), Portland, OR, office, and post-workshop review of any potential additional documentation and information obtained during the workshop.

All Review Panel members are required to conduct the pre-workshop review of available documents, attend in person and fully participate during the in-person review at BPA, and complete the post-workshop review. Contractor staff required to attend includes the Project Manager.

Prior to the face-to-face review period, the Contractor will provide the Review Panel members with copies of the technical documents in order to gain a general understanding of the models and use the read-ahead documents to prepare for the in-person review. These documents are listed above in Section 3. USACE will provide these documents to the Contractor for distribution to the Review Panel members. The Review Panel members are also encouraged to investigate/research additional information needed to have a firm understanding of the models, methods, and context for which they are used. Working with USACE, the Contractor will respond to any Review Panel member questions or information requests during this initial review period. The Contractor will document all communications between USACE and the Review Panel members.

The expectation of the in-person model review workshop is that the reviewers, to the best of their ability given the limited documentation and in-person review, will be able to ascertain the degree to which the models can be described as technically sound relative to its intended use and design objectives; aligned with state of the practice principles, models, methodologies, and calculations; and usable for the identified purpose.

For each model, BPA points of contact will be available to present an overview of each model including the development, evaluation, application, and use of results, provide a live demonstration of the model uses, provide hands-on guidance as to the use of the models, explain any evaluation and validation procedures (i.e., system quality test plans) to ensure computational correctness, and answer any questions the reviewers have. A general list of questions is included in the charge to serve as a starting point for evaluation of the models. However, the reviewers are encouraged to ask any questions of the model developers and model analysts at their discretion in an attempt to gather as much information as needed to determine model quality.

Following the in-person model review workshop, reviewers will close out their review of the models by evaluating all information gained during the workshop including, but not limited to, additional documentation, spreadsheets, application information; feedback and discussions held with model POCs; and/or model specific research completed to finalize review comments.

Below is a proposed agenda to serve as a guide for reviewers during their review. Reviewers will have latitude in the questions they ask and the process they need to follow in order to maximize efficiency and effectiveness of the review.

Location: Bonneville Power Administration
Portland, OR

Purpose: A workshop that provides an opportunity for the study team, sponsor, and stakeholders to consult and collaborate on the study scope.

Expectations:

1) Reviewers will work with BPA and model POCs to conduct as detailed a review of each model as possible given the unique circumstances.
2) Reviewers have latitude to adjust questions, approach, and agenda to maximize effectiveness of the review.
3) BPA POCs will be available during the week to host reviewers and provide information necessary to complete the reviewer to the best of the reviewers ability.

Day 1 TRAVEL

Day 2

0800 - 1200 Welcome and Introductions

Overview of the power analysis modeling framework – all models

Goal: explain and understand the overall relationships, objectives, feedbacks

Individual model overview presentations for each model

Goal: explain the detailed aspects of conceptualization, quantification, and evaluation utilized during model development, application, and operation and maintenance

1200 - 1300 LUNCH

1300 - 1700 Application Overview and Examples

Goal: provide context for who, what, when, and why the power analysis models are used

Reviewer only meeting

Goal: meet to debrief the findings from the day, discuss concerns/issues thus far in the review, and develop questions to investigate in Day 3

Day 3 – (proposed to include HYDSIM and begin Regional Power Models, although based on progress and overall modeling framework this may be adjusted to be more efficient for understanding and review)

0800 - 1200 Reviewers and BPA Model POCs meet to discuss, run, and Q&A each model individually

Goal: This session should allow the reviewers to perform a deep-dive of the modeling process and intricacies of each model. The expectations are that reviewers will be able to understand input requirements, flow process, results, review additional

documentation, view code (if applicable and necessary), and run the models, if appropriate.

1200 - 1300 LUNCH

1300 - 1600 *(Cont.)* Reviewers and BPA Model POCs meet to discuss, run, and Q&A each model individually

Goal: This session should allow the reviewers to perform a deep-dive of the modeling process and intricacies of each model. The expectations are that reviewers will be able to understand input requirements, flow process, results, review additional documentation, view code (if applicable and necessary), and run the models, if appropriate.

1600 – 1700 Reviewer only meeting

Goal: meet to debrief the findings from the day, discuss concerns/issues thus far in the review, and develop questions to investigate in Day 4

Day 4 – (proposed to include remaining Regional Power Models and Long-Term Transmission Rates Model. Schedule and sequence may be adjusted based on prior days progress and/or to be more efficient for understanding and review.)

0800 - 1200 Reviewers and BPA Model POCs meet to discuss, run, and Q&A each model individually

Goal: This session should allow the reviewers to perform a deep-dive of the modeling process and intricacies of each model. The expectations are that reviewers will be able to understand input requirements, flow process, results, review additional documentation, view code (if applicable and necessary), and run the models, if appropriate.

1200 - 1300 LUNCH

1300 - 1500 *(Cont.)* Reviewers and BPA Model POCs meet to discuss, run, and Q&A each model individually

Goal: This session should allow the reviewers to perform a deep-dive of the modeling process and intricacies of each model. The expectations are that reviewers will be able to understand input requirements, flow process, results, review additional documentation, view code (if applicable and necessary), and run the models, if appropriate.

1500 – 1700 Reviewer only meeting

Goal: Following all individual model reviews reviewers will meet independent of USACE, BOR, and BPA to discuss and debrief

amongst themselves the findings from the overall review. This may include, but is not limited to, discussion of concerns and issues from the reviews and discussion of any element requiring additional investigation following the workshop. This is not a debrief back to BPA, nor does it include a presentation. The debrief results will be used in the report.

Day 5 Travel

The Review Panel members will complete their review to the best of their ability given the in-person review circumstances and provide comments to the Contractor. When the individual Review Panel member comments have been received from the Review Panel members, the Contractor will collate the individual Review Panel member comments and ensure that they are complete and responsive to the Review Charge. The Contractor will identify the overall issues and themes that were either identified by multiple Review Panel members or repeatedly by one Review Panel member, comments that indicated conflicting Review Panel member opinions, and other noteworthy comments. Then, the Contractor will convene one or more group Review Panel comment review meetings via teleconference with the IEPR Panel members to discuss the Review Panel's comments. The goal of the meeting is to provide a forum for Panel members to discuss the comments and agree (or agree to disagree) on the comments of highest priority, identify which issues should be carried forward as "Final Panel Comments," decide who will lead the development of those final comments, and to address any contradictory comments. This meeting will ensure the exchange of technical information among the Review Panel members, many of whom will be from diverse scientific backgrounds. This information exchange provides additional context to Review Panel members and is considered crucial in the development of a comprehensive IEPR Final Report.

Task 5: Prepare IEPR Report

The Contractor shall consolidate the comments (see Task 4) to eliminate redundant or overlapping comments and to identify dissenting or diverging comments. Each comment will be formatted into a 4-part comment including the following:

1) a clear statement of the concern;
2) the basis for the concern;
3) the significance of the concern (the importance of the concern with regard to project implementability);
4) a description of additional research that would appreciably influence the conclusions and, when appropriate, the actions necessary to resolve the concern.

The Contractor will prepare the Model Review Report and submit it to the Corps for review. The report will assess the degree to which the model has technical quality, system

quality, and usability. The Contractor will prepare and submit the final panel comments in the Model Review Report.

The Contractor shall prepare a final report of the Review Panel findings. The report shall have an executive summary describing the recommendations and resolutions. Following the executive summary the report shall list in detail all the referenced criteria, computations, comments made, and all other pertinent information along with IEPR Panel recommendations and final resolution. The Model Review Report should use the following general outline:

1.0 Introduction
- 1.1. Model Purpose and Summary
- 1.2. Model Evaluation Assessment Criteria and Approach
- 1.3. Summary of Findings

2.0 Technical Quality Assessment
- 2.1. Review of Model Documentation Quality
- 2.2. Review of Theory and External Model Components
- 2.3. Review of Representation of the System
- 2.4. Review of Analytical Requirements
- 2.5. Review of Model Assumptions and Limitations

3.0 System Quality Assessment
- 3.1. Review of Model Calculations/Formulas
- 3.2. Review of Testing/Evaluation Process

4.0 Usability Assessment
- 4.1. Review of Operating Requirements of the Model
- 4.2. Review of Input Availability and Output Understandability
- 4.3. Review of Model Usefulness in Making Decisions

5.0 Model Assessment Summary

6.0 Conclusions

7.0 List of Preparers

8.0 References

Section 1.0 the report will provide basic background information on the model and the review approach. Sections 2.0 through 4.0 will contain a summary of the review results and concerns/issues related to specific model assessment criteria. If there are no comments for a given assessment criterion, the report will state that no issues were identified related to that criterion. Section 5.0 and 6.0 will summarize the key concerns

identified (i.e., final panel comments) during the model review and the conclusions with regards to recommendations for resolution.

The report is intended to provide final documentation of the peer review process. The report will also include a summary of the Review Panel members' qualifications and a brief discussion of the methodology used to conduct the IEPR. The Contractor will submit the IEPR Final Report to the IEPR Lead for review and acceptance of the product. Once the IEPR Lead accepts the product, he/she will forward the product to the Project Delivery Team for development of responses. The Final IEPR Report must be submitted no later than 45 days from Day 1 of the in-person workshop. The final report outline previously approved by the Government will be used for all reports with any agreed-to modifications required.

The Contractor is expected to provide internal quality control and quality assurance of the IEPR report to ensure they are complete, free from obvious errors, grammatically correct, and of high and professional quality.

Task 6: Comment/Response.

The Contractor shall provide the IEPR Final Panel Comments to USACE in Microsoft Word format via email. The IEPR Final Panel Comments provided in Microsoft Word format should include the corresponding sections and page numbers in the report documentation, as appropriate, in order to assist the USACE, Bureau of Reclamation, and Bonneville Power Administration modeling teams to develop responses to Final Panel Comments. In addition, the Contractor will enter the IEPR Final Panel Comments into DrChecks. USACE will submit clarifying questions to the Contractor to coordinate with the IEPR Review Panel, if necessary. The Contractor and USACE, Bureau of Reclamation, and Bonneville Power Administration staff will participate in a teleconference call to discuss the comment/response process.

USACE will provide draft evaluator responses to the Contractor in Microsoft Word format via email. In response to the 4-part comment submitted by the IEPR Review Panel, USACE should submit a "concur" or "non-concur" evaluation to each Final Panel Comment and include a concise, standalone statement as to why the response was "concur" or "non-concur." In addition, in response to each IEPR Final Panel Comment Recommendation for Resolution, USACE shall include a statement to "adopt" or "not adopt", along with a response describing how and where the report documentation would/would not be expanded, revised, or changed. If recommendations are not accepted, the reported reason for the rejection shall be documented in the draft evaluator responses. The Contractor shall coordinate a teleconference call with USACE, Bureau of Reclamation, and Bonneville Power Administration staff and the IEPR Panel to discuss USACE's draft evaluator responses to the IEPR Final Panel Comments.

Following the teleconference call, USACE will submit final responses to the IEPR Final Panel Comments. In addition, USACE will enter final responses to Final Panel Comments into DrChecks. The Contractor shall receive backcheck responses to draft evaluator

responses from the IEPR Review Panel. All responses provided by the USACE and IEPR Panel members will be labeled as “concur” or “non-concur” to indicate agreement or non-agreement, respectively. The Contractor shall enter the IEPR Panel backcheck responses to the USACE final responses to Final Panel Comments into DrChecks. The Contractor will provide USACE with a .pdf printout of the DrChecks project file once all IEPR comments are closed following backcheck responses. In addition, the Contractor will provide the Microsoft Word file containing the final iteration of the IEPR Final Panel Comments, the USACE final evaluator responses to IEPR Final Panel Comments, and the IEPR Panel backcheck responses to the USACE final evaluator responses.

5. REPORTING REQUIREMENTS

The Contractor shall provide all document reproduction. Electronic submittals shall contain all electronic files in both Microsoft Word and Adobe PDF formats. The briefings for the teleconferences will be furnished in Microsoft PowerPoint or Adobe PDF format. Reports generated by the peer review Contractor or their subcontractors shall not be released for publication or dissemination without the Contracting Officer’s written approval following coordination with the Contracting Officer’s representative. The USACE will determine which documents to publish in the public domain. The Contractor shall provide monthly status updates to USACE. Status updates will include the status of efforts associated with this PWS as well as any changes to scope and schedule. These updates will be informal and normally conducted through electronic mail messages.

All of the electronic submittals (whether draft or final) must be thoroughly reviewed by the appropriate contracting staff prior to submittal to USACE and/or the IEPR Lead. The Contractor is expected to provide internal quality control and quality assurance for all deliverables to ensure they are complete, free from obvious errors, grammatically correct, and of high and professional quality.

6. QUALIFICATION REQUIREMENTS

The Contractor shall have the following qualifications:

a. Experience establishing and administering Review Panels;
b. Be qualified as an Internal Revenue Code Section 501(c)(3) organization and be exempted from Federal tax under Section 501(a), of the Internal Revenue Code of 1986;
c. Shall be a scientific or professional society, a firm specializing in peer review, or a non-profit organization with experience in peer review;
d. Is an independent science and technology organization;
e. Shall be free from conflicts of interest with the Columbia River System Operations study, including all associated operating projects and cooperating agencies.
f. Does not carry out or advocate for or against Federal water resources projects; and,
g. Proven ability to deliver under significant time constraints.

7. PLACE AND PERIOD OF PERFORMANCE, AND TRAVEL

a. Place of Performance. A majority of the work will be conducted at the Contractor's facilities.
b. Period of Performance. The performance period shall be from the date of the NTP through 13 March 2021.
c. Travel: Travel to BPA Offices in Portland, OR is required. Refer to the description of Task 4 for additional information.

8. RESTRICTIONS

There are no known conflicts of interest with the Columbia River System Operations and IEPR Panel members that are assembled.

9. AUTHORITIES STATEMENT

No person other than the Government Contracting Officer has the authority to make changes to this contract action that impact cost or schedule. Authority from the Contracting Officer to the contractor to make changes that impact cost or schedule will be in the form of an official, signed modification.

10. RELEVANCE

The U.S. Army Corps of Engineers is a division of the U.S. Army.

11. CAPABILITY STATEMENT

By public law WRDA 2007 (Public Law 110-114), Section 2034, the peer review must be completed by reviewers external to the Government, thus the requesting agency does not have the necessary in-house capability to perform the tasks specified in this PWS.

12. POINTS OF CONTACT

IEPR CONTACTS			CONTRACTING / STUDY CONTACTS	
Name	**Rachel Mesko**		Name	**Anastasiya Kononova**
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