INTERAGENCY AGREEMENT	1. IAA NO	PAGE	OF
	NRC-HQ-20-14-D-0017/M0005	1	2

2. ORDER NO	3. REQUISITION NO	4. SOLICITATION NO

5. EFFECTIVE DATE	6. AWARD DATE	7. PERIOD OF PERFORMANCE
12/29/2016	12/29/2016	05/05/2014 TO 06/30/2017

8. SERVICING AGENCY
PACIFIC NORTHWEST NAT LAB
ALC:
DUNS: +4:
US DEPARTMENT OF ENERGY
PACIFIC NORTHWEST SITE OFFICE
PO BOX 350 MS K9-42
RICHLAND WA 99352

POC Genice Madera
TELEPHONE NO 509-372-4010

9. DELIVER TO
KEVIN HELLER
US NUCLEAR REGULATORY COMMISSION
ONE WHITE FLINT NORTH BUILDING
11555 ROCKVILLE PIKE
MAIL STOP O-10B3
ROCKVILLE MD 20852

10. REQUESTING AGENCY
ACQUISITION MANAGEMENT DIVISION
ALC: 31000001
DUNS: 040535809 +4:
US NUCLEAR REGULATORY COMMISSION
TWO WHITE FLINT NORTH
11545 ROCKVILLE PIKE
MAIL STOP T-5E3
ROCKVILLE MD 20852-2738
POC Carolyn A. Cooper
TELEPHONE NO 301-415-6734

11. INVOICE OFFICE
US NUCLEAR REGULATORY COMMISSION
ONE WHITE FLINT NORTH
11555 ROCKVILLE PIKE
MAILSTOP O3-E17A
ROCKVILLE MD 20852-2738

12. ISSUING OFFICE
US NRC - HQ
ACQUISITION MANAGEMENT DIVISION
MAIL STOP TWFN-5E03
WASHINGTON DC 20555-0001

13. LEGISLATIVE AUTHORITY
Energy Reorganization Act of 1974

14. PROJECT ID
J4433

15. PROJECT TITLE
REVIEW OF AURORA-B: AN EVALUATION MODEL FOR BOILI

16. ACCOUNTING DATA
N/A

17. ITEM NO	18. SUPPLIES/SERVICES	19. QUANTITY	20. UNIT	21. UNIT PRICE	22 AMOUNT
	NRC-HQ-20-14-D-0017 Master IAA: N/A The purpose of this modification is to 1) incorporate a within scope change to add two new tasks in accordance with Attachment 1; and 2) extend the period of performance of the subject agreement from December 31, 2016 through June 30, 2017. These two actions are being taken at no extra cost to the Government. Accordingly, the subject agreement is hereby modified: TOTAL AUTHORIZED CEILING AMOUNT: $231,469.00 Continued ...				

23 PAYMENT PROVISIONS	24 TOTAL AMOUNT
	$0.00

25a SIGNATURE OF GOVERNMENT REPRESENTATIVE (SERVICING)	26a SIGNATURE OF GOVERNMENT REPRESENTATIVE (REQUESTING)
	Carolyn A Cooper

25b NAME AND TITLE	25c. DATE	26b CONTRACTING OFFICER	26c. DATE
		CAROLYN A COOPER	12/29/2016

TEMPLATE - ADM001

SUNSI REVIEW COMPLETE JAN 13 2017

ADM002

DEPARTMENT OF ENERGY- PNSO ACCEPTANCE

1. TO	2. AGREEMENT NUMBER	3. AMOUNT *(as Listed on Agreement)*
NRC Office of Nuclear Reactor Regulation	**NRCHQ2014D0017/A5**	**$0.00**

4. The Agreement identified above is accepted and the items requested will be provided as follows: (Check as Applicable)

a. ❄ ALL ITEMS WILL BE PROVIDED THROUGH REIMBURSEMENT (Category I)

b. O ALL ITEMS WILL BE PROCURED BY THE DIRECT CITATION OF FUNDS (Category II)

c. O ITEMS WILL BE PROVIDED BY BOTH CATEGORY I AND CATEGORY II AS INDICATED BELOW

d. O THE ACCEPTANCE, FOR CATEGORY I ITEMS, IS QUALIFIED BECAUSE OF ANTICIPATED CONTINGENCIES AS TO FINAL PRICE. CHANGES IN THIS ACCEPTANCE FIGURE WILL BE FURNISHED PERIODICALLY UPON DETERMINATION OF DEFINITIZED PRICES, BUT PRIOR TO SUBMISSION OF BILLINGS.

5. O AGREEMENT ITEM NUMBER(S) IDENTIFIED IN BLOCK 13, "REMARKS," IS NOT ACCEPTED *(IS REJECTED)* FOR THE REASONS INDICATED.

6. TO BE PROVIDED THROUGH REIMBURSEMENT CATEGORY I			7. TO BE PROCURED BY DIRECT CITATION OF FUNDS CATEGORY II		
ITEM NO. a.	QUANTITY b.	ESTIMATED PRICE c.	ITEM NO. a.	QUANTITY b.	ESTIMATED PRICE c.
		$0.00			
d. **TOTAL ESTIMATED PRICE**		**$0.00**	e. **TOTAL ESTIMATED PRICE**		

8. ANTICIPATED DATE OF OBLIGATION FOR CATEGORY II ITEMS	9. GRAND TOTAL ESTIMATED PRICE OF ALL ITEMS

10. FUNDS DATA *(Check if Applicable)*

a. O ADDITIONAL FUNDS IN THE AMOUNT OF $ ARE REQUIRED (See justification in Block 13)

b. O FUNDS IN THE AMOUNT OF $ ARE NOT REQUIRED AND MAY BE WITHDRAWN

11. REMARKS

Action authorized to support DOE Project No. 60277K

12. ACCEPTING ACTIVITY	13. TYPED NAME AND TITLE OF AUTHORIZED OFFICIAL	
U.S. Department of Energy **Pacific Northwest Site Office** **P.O. Box 350 (Mail Stop K9-42)** **Richland, WA 99352**	**Genice . Madera, Contracting Officer**	
	14. SIGNATURE Genice Madera	15. DATE **1/4/2017**

(unchanged)
TOTAL AMOUNT OF OBLIGATIONS TO DATE: $231,469.00 (unchanged)
PERIOD OF PERFORMANCE: May 5, 2014 through June 30, 2017 (changed)

The Statement of Work is deleted in its entirety and replaced with the following document in lieu thereof:

Attachment 1, Revised Statement of Work

This agreement is entered into pursuant to the authority of the Energy Reorganization Act of 1974, as amended (42 U.S.C 5801 et seq.). This work will be performed in accordance with the NRC/DOE Memorandum of Understanding dated November 24, 1998. To the best of our knowledge, the work requested will not place the DOE and its contractor in direct competition with the domestic private sector.

All other terms and conditions of the subject Agreement remain unchanged.

Fee Recoverable: Yes TAC: M22979

NRC-HQ-20-14-D-0017
Modification No. 5
Attachment 1

Revised Statement of Work

Title: Review of AURORA-B: An Evaluation Model for Boiling Water Reactors; Application To Transient and Accident Scenarios. Revision 0, ANP-10300P

DOE Lab Agreement No.: NRC-HQ-20-14-D-0017

Budget & Reporting No.: 11-4-151 Job Code: J4433

Nuclear Regulatory Commission (NRC) Issuing Office: (NRR)/Division of Safety Systems (DSS) Office of Nuclear Reactor Regulation

NRC COR: Kevin Heller, (Kevin.Heller@nrc.gov), (301)415-8379

Fee Recoverable: Yes

TAC Numbers: ME2979

Docket Number: N/A

DOE Laboratory: Pacific Northwest National Laboratory (PNNL)

Type of Contract/Order: DOE Lab Agreement

Period of Performance (including option items/periods): Date of award – June 30, 2017

BACKGROUND

AURORA-B is a comprehensive evaluation model for predicting the dynamic response of boiling water reactors (BWRs) during transients, postulated accident, and beyond design-basis accident scenarios. However, the scope does not include LOCA, instability events, control rod withdrawal error, BWR control rod drop scenario, and the later stages of ATWS. The operating domain for the evaluation model is up to and including operation at extended power uprate conditions with expanded power and flow windows. The AURORA-B evaluation model contains a multi-physics code system based on several computer codes, or "component calculational devices"; a version of the pressurized water reactor thermal-hydraulic system code S-RELAP5 that has been extended for applicability to BWRs (such as a new Jet Pump model, improvements to original interfacial drag and heat & mass transfer models, new pressure drop models and BWR critical power correlations, etc.), a neutron kinetics module known as MB2-K that is coupled to the core simulator code MICROBURN-B2, and the RODEX4 fuel thermal-mechanical code.

The AURORA-B evaluation model is designed to be broadly applicable to many BWR events and calculational procedures (e.g. deterministic or statistical procedures). However, the relevant event characteristics differ depending on the event scenario and the criteria that are being evaluated. The differences in events, criteria, and calculational procedures are addressed by defining specific application methodologies. Therefore, the NRC needs to obtain the technical accuracy and adequacy of the component calculational devises and methodologies comprising the model.

OBJECTIVE

The objective of this task order is to obtain expertise from PNNL to assist the NRC staff in determining the technical adequacy of the AURORA-B Evaluation Model and its application methodology. **The objective of this modification is to add two new tasks. Tasks 10 and 11 are being added due to the additional support needed to facilitate ACRS subcommittee and ACRS full committee reviews. NRR/DSS decided to have this work completed under the subject agreement.**

TECHNICAL AND OTHER SPECIAL QUALIFICATIONS REQUIRED

Resume's on File

WORK REQUIREMENTS AND SCHEDULE

Using the criteria and guidelines found in Standard Review Plan (SRP) Chapter 4 and Chapter 15, review the AREVA AURORA-B Evaluation Model topical report and specifically:

Tasks	Completion Schedule
1. Review and evaluate the AURORA-B Evaluation Model to determine the adequacy and technical accuracy of included models, assess the qualification of the component calculational devices over the Evaluation Model application range, ensure an adequate or justifiable conservatism within the combination of modeling uncertainties, and identify the need for additional information or clarification and prepare a technical letter report.	Complete
a. RAIs prepared to date. b. RAIs prepared to date. c. RAIs prepared to date. d. RAIs prepared to date. e. RAIs prepared to date. f. RAIs prepared to date.	
2. Perform a review of the technical basis for the AURORA-B Evaluation Model. Review the benchmarking and validation of the AURORA-B Evaluation Model to ensure the acceptability of the code system. Identify the need for additional information or clarification and prepare a technical letter report.	Complete
3. Perform a review of the empirical database in support of the validation of the AURORA-B Evaluation Model, and identify any limitations. Determine if the benchmarking and empirical databases support the expected application of the AURORA-B Evaluation Model. Identify the need for additional information or clarification and prepare a technical letter report.	Complete

4. Prepare for, and travel to, NRC Headquarters to meet with NRC staff, discuss open items, and generate a revised/clarified open item list.	Complete
5. Based on the work performed to date and the latest comments received from the NRC on open items, prepare a technical evaluation report (TER). a. Draft. b. Incorporate NRC comments into the draft TER.	Complete
6. Prepare for and attend a draft RAI audit with NRC and AREVA staff in Richland, Washington to discuss the draft RAIs with AREVA, and afterwards generate a final, polished set of RAIs for official submittal and an updated draft TER that incorporates comments and information gained from the audit.	Complete
7. Review and evaluate the responses to the request for additional information and: a. Determine if responses adequately addressed the issues. b. As necessary, perform independent confirmatory calculations to verify AREVA's calculations and to determine adequacy of the statistical analysis.	Complete
8. Participate in conference calls with AREVA as necessary to assist in the resolution of any remaining open issues.	Complete
9. Based on the work performed to date and the latest comments received from the NRC on open items, prepare the final TER. a. Draft. b. Incorporate NRC comments and prepare the final TER.	Complete
10. Travel to NRC headquarters and support NRC staff in presenting review materials and fielding questions to an ACRS subcommittee meeting.	**Fourth quarter of calendar year 2016, or as appropriate.**
11. If necessary, travel to NRC headquarters and support NRC staff in presenting review materials and yielding questions to an ACRS full committee meeting.	**First quarter of calendar year 2017.**

DELIVERABLES

The work required is described in detail below and in Attachment 1.

Technical Reporting Requirements

NOTE: All reports are to be submitted electronically using MS WORD or a compatible software program to the COR with a copy provided to the Contracting Officer. The transmittal letter and cover page shall contain the DOE Lab Agreement number, the job code number (JCN), the task order number, the title, and the NRC technical assignment control (TAC) number(s).

1. At the completion of Task 1, submit a technical letter report that contains the results of the evaluation of the adequacy, technical accuracy, and qualification of the models and component calculational devices, any open items, and conclusions with any limitations. Provide a separate list of request for additional information (RAIs) (if required) and the basis for the request.

2. At the completion of Task 2, submit a technical letter report that contains the results of the evaluation of the benchmarking and empirical databases support, any open items, and conclusions with any limitations. Provide a list of RAIs (if required) and the basis for the request.

3. At the completion of Task 3, submit a technical letter report that contains the results of the evaluation of the code system adequacy based on the benchmarking and validation, any open items and conclusions with any limitations. Provide a separate list of RAIs information (if required) and the basis for the request.

4. At the completion of Task 4, submit a trip report that contains a summary of the significant highlights of the meeting reflecting insights on possible resolution of the open items and noting disposition of the items presented and reviewed at the meeting. Include a copy of the slides or other visuals used during the presentation supporting the highlight (not necessary if the staff indicates they already have them) and any responses to staff questions raised during or after the meeting.

5. At the completion of Task 5, submit a TER, draft and final as appropriate, that contains a summary of the work performed, the results attained, and conclusions drawn following the outline, format, and content shown in Attachment 2. List any open or unresolved items, and provide a compiled list of RAIs (if required) and the basis for the request.

6. At the completion of Task 6, submit a revised draft TER that incorporates the comments and information gained from the draft RAI audit meeting with NRC and AREVA staff. The draft TER should follow the outline, format, and content shown in Attachment 2. List any open or unresolved items, and provide a compiled list of RAIs (if required) and the basis for the request.

7. At the completion of Task 7 and 8, submit a report that contains a summary of the adequacy of the responses supplied to the RAIs and any major discrepancies. The report should also include the major highlights of any necessary conference calls with AREVA, including noting the resolution of any RAI responses discussed, issues or concerns raised by staff, and any unresolved open items.

8. At the completion of task 9, submit a TER, draft and final as appropriate, that contains a summary of the work performed, the results attained, and conclusions drawn following the outline, format, and content shown in Attachment 2. List any open or unresolved items. As part of the final deliverable, submit a CD-ROM containing the input decks and output files from any benchmark or independent calculations used as a technical basis within the TER.

Monthly Letter Status Report

Include the following on distribution:
Jeremy.Dean@nrc.gov
Kevin.Heller@nrc.gov
RidsNrrDss.Resource@nrc.gov

MEETINGS AND TRAVEL

Two, one-person, three-day trips to NRC Headquarters to support ACRS committee meetings.

The total level of effort for the trips, is 58 hours. This is based on 13 hours for preparation and travel for one person to the each meeting, eight hours for each meeting, and 8 hours for return travel. Further information regarding the justification for this travel along with a more detailed breakdown of the hours involved is provided in the "Assumptions and Understandings" section, below.

NRC-FURNISHED MATERIALS

A copy of the document(s) containing the topical report ANP-10300P, Revision 0 will be provided to the PNNL Project Manager by the COR upon award of the task order.

NOTE: These documents contain proprietary information and they must be safeguarded against unauthorized disclosure. After completion of work, the documents will be destroyed, and confirmation of such emailed to the COR with a copy to the Contracting Officer and including the date and manner in which the documents are destroyed.

KEY PERSONNEL

Kenneth Geelhood – Expert Engineer, project Manager, Pacific Northwest national Laboratory, Resume – on file

Judith Cuda – Senior-level Engineer, Pacific Northwest national Laboratory, Resume – on file

Andrew Prichard – Senior-level Engineer, Pacific Northwest national Laboratory, Resume – on file

Bruce Schmitt – Senior-level Engineer, Pacific Northwest national Laboratory, Resume – on file

OTHER APPLICABLE INFORMATION

License Fee Recovery

The work under this task order is license fee recoverable.

Assumptions and Understandings

The level of effort expected to produce the final TER was less than anticipated. This resulted in an excess of funds on the contract in the amount of ~$31,700. These excess funds were originally intended to be de-obligated.

However, the ACRS has expressed interest in reviewing AURORA-B in both a subcommittee meeting and a full committee meeting. This interest was expressed in the final few months of the original contract's time frame. Since PNNL staff played a major role in the review efforts of AURORA-B, their support in the ACRS committee meetings is needed. In order to meet the time frame expected for the ACRS committee meetings to take place, the contract period of performance has been increased until June 30th, 2017. Additional effort will also be needed for the PNNL staff to support the ACRS meetings. The level of effort needed to support the meetings has been estimated at 88 hours technical staff more than the previous proposal's 1,523 hours technical staff, which yields a total of 1,611 hours technical staff. This figure is based on 13 hours of preparation and travel for one person to each meeting (total of two meetings), 8 hours attending each meeting, and 8 hours return travel from each meeting and 30 hours preparation and presentation time for the remaining engineering staff for the subcommittee meeting only. This increase in technical hours is covered by the excess funds on the contract. As such, no increase in the contract's ceiling is needed.

After the completion of Task 5, NRC staff recognized that while AREVA staff had gained a thorough understanding of the types of information being sought to satisfy the open items and the likelihood of multiple rounds of RAIs had been reduced, the substantial number of open items generated would require additional contractor support for determining the adequacy of AREVA's responses to them. Additional effort would also be needed in incorporating the responses into the TER. The level of effort for the review of the RAI responses and their inclusion into the TER (Tasks 7 – 9) has been estimated by the NRC staff as 590 hours technical staff more than the previous proposal's 933 hours technical staff, which yields a total of 1,523 hours. This figure is based on 1-2 hours of effort per RAI response for its review and inclusion into the TER, and 4 hours each for those RAI responses requiring confirmatory calculations/determination of statistical adequacy. Time is also allotted for conference calls between the contractor staff and AREVA staff to help close any potential remaining open items. Additionally, the period of performance has been increased until September 30th, 2015 in order to facilitate AREVA's phased RAI response plan wherein they will provide RAI responses in groups of related material.

After the completion of Task 4, it was apparent that the technical breadth and depth of the open items generated was extensive. NRC staff recognized there was a great potential for miscommunication, misunderstanding, and misinterpretation of what information could satisfy the open items. In order to avoid multiple rounds of RAIs, much conflict over technical definitions, and to facilitate communication NRC staff feel a draft RAI audit meeting with PNNL and AREVA would be beneficial. Feedback from the Topical Report Pilot program has found that these draft RAI audit meetings for understanding have been very effective at streamlining the review process and providing clear communication between NRC staff and vendors. The

level of effort for the draft RAI audit (Task 6) has been determined jointly by PNNL and NRC to be 175 hours technical staff more than the previous proposal of 818 hours, which yields a total of 993 hours technical staff. Of the additional effort, approximately 15 hours are in draft RAI pre-audit prep, 80 hours in actual audit discussion (3 days with 3 – 4 PNNL staff), and 80 hours for generation of the final, polished RAIs and a draft TER than incorporates discussion and information gained from the audit. NRC believes it is more beneficial to capture the scope of the work conducted thus far and the discussions had during the audit than not. Additionally, the period of performance has been extended until October 31, 2014 in order to facilitate times for the draft RAI audit.

After additional review, the level of effort has been determined jointly by PNNL and NRC to be 818 hours technical staff, which is an effort of 170 hours more than the previous proposal by PNNL of 648 hours under J4433T11. Of the additional effort, approximately 60 hours are in the discussion and revision of the open items list, largely stemming from the unanticipated need to review the applicability and verification of models and correlations found in a couple of the reference documents, specifically EMF-2100 and EMF-2102, that are related to AOOs for which the AURORA-B evaluation model will be applied. The remaining 110 hours of additional effort are in Task 5: the generation of a TER that adequately captures the areas which have been reviewed and indicates where the need for additional information exists (e.g. the Open Items/RAIs). Given the large nature of the topical, NRC believes it is more beneficial to capture the scope of the work conducted thus far in the TER than to generate a TER outline.

As for the level of effort assumption for Task 2, it is understood that the vendor should be providing sufficient empirical data to justify their results and conclusion; otherwise, an RAI should be generated; no other empirical data should be considered other than what is provided by the vendor.

ATTACHMENT 1
SCHEDULE AND DELIVERABLES

The schedule of deliverables for Tasks 1 through 11 is outlined below.

TASK	DELIVERABLE	SCHEDULE (business days)
1	A technical letter report that contains the results of the evaluation of the adequacy, technical accuracy, and qualification of the models and component calculational devices, any open items, and conclusions with any limitations. A list of request for additional information (RAIs) (if required) and the basis for the request.	Four weeks after award of the task order for Subtask a. and every four weeks for each following Subtask.
2	A technical letter report that contains the results of the evaluation of the benchmarking and empirical databases support, any open items, and conclusions with any limitations. Provide a list of RAIs (if required) and the basis for the request.	Four weeks after the completion of Task 1.
3	A technical letter report that contains the results of the evaluation of the code system adequacy based on the benchmarking and validation, any open items and conclusions with any limitations. Provide a separate list of RAIs information (if required) and the basis for the request.	Four weeks after the completion of Task 2.
4	A trip report.	One week after the trip.
5-A	A draft TER.	Three weeks after receiving NRC comments or after completion of Task 4, whichever is later.
5-B	A revised draft TER incorporating NRC comments.	Two weeks after receipt of NRC comments on draft TER.
6	A final, polished set of RAIs for official submittal and an updated draft TER that incorporates the work completed thus far including comments and information gained from the draft RAI audit.	Two weeks after completion of draft RAI audit meeting.
7-A	A summary of the adequacy of the responses supplied to the RAIs and any major discrepancies	Eight weeks after receipt of all RAI responses
7-B	A summary of the adequacy of the responses supplied to the RAIs and any major discrepancies	Twelve weeks after completion of Task 7a

SCHEDULE AND DELIVERABLES (CONTINUED)

TASK	DELIVERABLE	SCHEDULE (business days)
8	A summary including the major highlights of any necessary conference calls with AREVA	To be mutually agreed upon after the receipt of responses to Task 7
9-A	A draft TER	Three weeks after receiving NRC comments or after completion of Task 4, whichever is later.
9-B	A revised TER incorporating NRC comments.	Two weeks after receipt of NRC comments on draft TER.
10	**N/A**	**Fourth quarter calendar year 2016, or as appropriate.**
11	**N/A**	**If needed, first quarter calendar year 2017.**

ATTACHMENT 2
CONTENT, OUTLINE, AND FORMAT FOR TECHNICAL EVALUATION REPORT

1.0 Introduction

Summary of Work Performed: Describe the requested action. Outline the methodology used (by the PI) for evaluating the topical report.

2.0 Regulatory Evaluation and Criteria

Describe the regulatory guidance found in SRP Chapter 4, Chapter 5, and any other relevant Sections of the SRP.

3.0 Technical Evaluation

Document your evaluation of the AURORA-B Evaluation Model topical report modeling and algorithms along with the supporting empirical database used for benchmarking and validation.

Document any independent calculations performed in support of assessing the AURORA-B Evaluation Model. Provide a direct comparison of your independent results to those presented in the topical report.

Document any additional sources of empirical data used as a basis for evaluating the AURORA-B Evaluation Model. Include the "essence" of any RAIs in the appropriate sections of the TER.

Document the basis for acceptability of the AURORA-B Evaluation Model methodology.

4.0 Conclusion

Clearly define any limitation or conditions related to the future application of the AURORA-B Evaluation Model performance and application methodology.

5.0 RAIs

List any generated RAIs and the basis for the request.