

INTERAGENCY AGREEMENT		1. IAA NO. NRC-HQ-60-17-T-0006			PAGE OF 1 15	
2. ORDER NO.		3. REQUISITION NO. RES-17-0422		4. SOLICITATION NO.		
5. EFFECTIVE DATE 07/01/2017		6. AWARD DATE 07/19/2017		7. PERIOD OF PERFORMANCE 07/01/2017 TO 06/30/2022		
8. SERVICING AGENCY ENERGY IDAHO OPERATIONS OFFICE UNITED STATES DEPT OF ALC: DUNS: 048105530 +4: 1955 FREMONT AVE IDAHO FALLS ID 834021510  POC Laurie Acosta TELEPHONE NO. 208-526-5909				9. DELIVER TO WALTER LESCHEK US NUCLEAR REGULATORY COMMISSION OFFICE OF NUCLEAR REGULATORY RESEARCH 11555 ROCKVILLE PIKE ROCKVILLE MD 20852		
10. REQUESTING AGENCY ACQUISITION MANAGEMENT DIVISION ALC: 31000001 DUNS: 040535809 +4: US NUCLEAR REGULATORY COMMISSION ONE WHITE FLINT NORTH 11555 ROCKVILLE PIKE ROCKVILLE MD 20852-2738  POC Sandra Nesmith TELEPHONE NO. 301-415-6836				11. INVOICE OFFICE US NUCLEAR REGULATORY COMMISSION TWO WHITE FLINT NORTH 11545 ROCKVILLE PIKE MAILSTOP T9-B07 ROCKVILLE MD 20852-2738		
12. ISSUING OFFICE US NRC - HQ ACQUISITION MANAGEMENT DIVISION MAIL STOP TWFN-8E06M WASHINGTON DC 20555-0001				13. LEGISLATIVE AUTHORITY Energy Reorganization Act of 1974		
				14. PROJECT ID		
				15. PROJECT TITLE TASK 6 - SAPHIRE CODE MAINTENANCE AND QA ACTIVITIES		
16. ACCOUNTING DATA 2017-X0200-FEEBASED-60-60D002-60B205-1052-11-6-213-253D-11-6-213-1052						
17. ITEM NO.	18. SUPPLIES/SERVICES		19. QUANTITY	20. UNIT	21. UNIT PRICE	22. AMOUNT
	Agreement No. NRC-HQ-60-17-D-0005 Task Order No. NRC-HQ-60-17-T-0006  Title: Task 6 - SAPHIRE Code Maintenance and QA Activities  The NRC and Idaho National Laboratory (INL) hereby enter into this Agreement for the project entitled "Task 6 - SAPHIRE Code Maintenance and QA Activities."  Continued ...					
23. PAYMENT PROVISIONS			24. TOTAL AMOUNT \$270,093.00			
25a. SIGNATURE OF GOVERNMENT REPRESENTATIVE (SERVICING)			25a. SIGNATURE OF GOVERNMENT REPRESENTATIVE (REQUESTING) 			
25b. NAME AND TITLE		25c. DATE	26b. CONTRACTING OFFICER MORIE E. GUNTER-HENDERSON		26c. DATE 07/19/2017	

Period of Performance: July 1, 2017 - June 30, 2022

Consideration and Obligations:

(a) Authorized Cost Ceiling \$2,346,177.00

(b) The amount presently obligated with respect to this DOE Agreement is \$270,093.00.00. When and if the amount(s) paid and payable to the DOE Laboratory hereunder shall equal the obligated amount, the DOE Laboratory shall not be obligated to continue performance of the work unless and until the NRC Contracting Officer shall increase the amount obligated with respect to this DOE Agreement. Any work undertaken by the DOE Laboratory in excess of the obligated amount specified above is done so at the DOE Laboratory's sole risk.

The following documents are hereby made a part of this Agreement:

Attachment: 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.

Notwithstanding the agreement effective dates and period of performance start dates stated elsewhere in the agreement, the effective date of the agreement and start date of the period of performance are the last date of signature by the parties.

- [ ] Fee Recoverable Work
- [ X ] Non-fee Recoverable Work

INL PM: Michael Calley  
michael.calley@inl.gov, (208) 526-9230  
Continued ...

INL PI: James Knudsen  
james.knudsen@in.gov, (208) 526-6432  
  
NRC COR: Walter Leschek  
walter.leschek@nrc.gov, (301) 415-0844  
  
DUNS: 040535809 TAS: 31X0200.320  
ALC: 31000001  
Master IAA: NRCHQ6017D0005

00001

Award and Authorized Ceiling  
Line Item Ceiling: \$2,346,177.00  
Incrementally Funded Amount: \$270,093.00

2,346,177.00

The total amount of award: \$2,346,177.00. The obligation for this award is shown in box 24.

## STATEMENT OF WORK (SOW)

<b>NRC Agreement Number</b>  NRC-HQ-60-17-D-0005	<b>NRC Agreement Modification Number</b>  	<b>NRC Task Order Number (If Applicable)</b>  NRC-HQ-60-17-T-0006	<b>NRC Task Order Modification Number (If Applicable)</b>  
<b>Project Title</b> Task 6 - SAPHIRE Code Maintenance and Quality Assurance Activities			
<b>Job Code Number</b>  	<b>B&amp;R Number</b> 2017-60-11-6-213-1052 Operating reactors		<b>Servicing Agency</b> Idaho National Laboratory (INL)
<b>NRC Requisitioning Office</b> RES		<b>Period of Performance</b> 07/01/2017 to 6/30/2022	
<b>NRC Form 187, Contract Security and Classification Requirements</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> Not Applicable		<input type="checkbox"/> Involves Proprietary Information <input type="checkbox"/> Involves Sensitive Unclassified	
<input checked="" type="checkbox"/> Non Fee-Recoverable		<input type="checkbox"/> Fee-Recoverable (If checked, complete all applicable sections below)	
<b>Docket Number (If Fee-Recoverable/Applicable)</b>  		<b>Inspection Report Number (If Fee Recoverable/Applicable)</b>  	
<b>Technical Assignment Control Number (If Fee-Recoverable/Applicable)</b>  		<b>Technical Assignment Control Number Description (If Fee-Recoverable/Applicable)</b>  	

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**CONTRACTING OFFICER'S REPRESENTATIVE**

Contracting Officer's Representative (COR)

Name: Walter C. Leschek  
Agency: U.S. Nuclear Regulatory Commission  
Office: Office of Nuclear Regulatory Research (RES)  
Mail Stop: TWFN 10A12  
Washington, DC 20555-0001  
E-Mail: Walter.Leschek@nrc.gov  
Phone: 301-415-0844

Alternate Contracting Officer's Representative (ALT COR)

Name: Jeffery J. Wood  
Agency: U.S. Nuclear Regulatory Commission  
Office: Office of Nuclear Regulatory Research (RES)  
Mail Stop: TWFN 10A12  
Washington, DC 20555-0001  
E-Mail: Jeffery.Wood@nrc.gov  
Phone: (301) 415-0953

**GOVERNMENT-FURNISHED PROPERTY (GFP)**

None required

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## DESCRIPTION/SPECIFICATIONS/WORK STATEMENT

### 1.0 BACKGROUND

SAPHIRE (Systems Analysis Programs for Hands-on Integrated Reliability Evaluations) is a computer code used by the U.S. Nuclear Regulatory Commission (NRC) for building and running Probabilistic Risk Assessment (PRA) models. The PRA models are known as Standardized Plant Analysis Risk (SPAR) models. The Idaho National Laboratory (INL) developed SAPHIRE under contract to the NRC. SAPHIRE has evolved into a state-of-the-art software package with applications in several risk-informed regulatory activities. The current version of SAPHIRE is Version 8. Version 8 was designed to meet current NRC program needs such as those related to Standardized Plant Analysis Risk (SPAR) model development, the Significance Determination Process (SDP) program, the Risk Assessment Standardization Project (RASP), as well as the Accident Sequence Precursor (ASP) Program. SAPHIRE will continue to evolve to address new requirements.

The SAPHIRE Software Quality Assurance (SQA) program for code maintenance and quality assurance activities requires synergy between experienced computer programmers and SPAR model developers. The computer programmers must know how to work with Modula-2, Delphi, and SAGE software needed to maintain and modify the SAPHIRE software. The SPAR model developers work with the SQA team leader to ensure that SAPHIRE works properly.

The NRC performs an annual audit of the implementation of the SQA program against the guidance of NUREG/BR-0167, Software Quality Assurance Program and Guidelines. The audit normally includes:

- SAPHIRE Quality Assurance audit
- Review of SAPHIRE Website users' access
- Status of SAPHIRE development

### 2.0 OBJECTIVE

The objectives of this Task 6 are to:

- Continue activities of the SAPHIRE Software Quality Assurance (SQA) Team to improve current practices and documentation, and to maintain these improvements
- Provide code maintenance and general user support
- Update NUREG/CR reports for SAPHIRE

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### 3.0 SCOPE OF WORK/TASKS

INL shall provide all resources necessary to accomplish the tasks and deliverables described in this Statement of Work (SOW). The INL must continue to provide Technical Assistance Services for SAPHIRE Code Maintenance and Quality Assurance Activities.

INL shall continue to provide Technical Assistance Services that include the following items: (1) Continue SAPHIRE SQA team activities to improve current practices and documentation, and to maintain these improvements; (2) Provide code maintenance and general user support; and (3) Update NUREG/CR reports for SAPHIRE.

#### Task 1 SAPHIRE SQA Team Activities

SAPHIRE SQA practices shall continue to be improved as discussed in the subtasks below.

##### Subtask 1.1 Reviews, Tests, and Code Walkthroughs

The activities of the SQA Team in this subtask include, but are not limited to the following:

- Perform or assist in peer reviews or code walkthroughs.
- Review test results and perform tests.
  - Tests performed may be static, functional, or acceptance testing as appropriate.
  - Determine if commercial software is available to assist in performing these tests and, if so, request purchase via the NRC ALT COR for NRC COR approval.
- Perform Preliminary Design Review (PDR) and Critical Design Review (CDR) activities:
  - Write formal documentation on SAPHIRE PDRs and CDRs describing what these reviews are and how and when these reviews will be done.
    - This documentation shall include coordination between the INL and the NRC as appropriate.
  - Coordinate PDRs and CDRs.
  - Document these reviews, tests, and code walkthroughs.
    - Identify and describe new software features that have been reviewed and tested.

##### Subtask 1.2 Oversight on SAPHIRE SQA Activities

The SQA Team shall provide oversight on SQA activities, including but not limited to the following:

- Maintaining and implementing the SAPHIRE Software Quality Assurance Plan consistent with the requirements of NUREG/BR-0167, "Software Quality Assurance Program and Guidelines."

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- Level 1 software in NUREG/BR-0167 applies to technical application software used in a safety decision by the NRC
  - Ensuring that the revision control system (RCS) is up to date and contains all important documentation and other files.
  - Writing a document on what the RCS is and lists its contents.
  - Maintaining and updating software developer tools and documents that may include but are not limited to the following:
    - A data dictionary
    - Software metrics to improve software quality
    - Coding guidelines
    - Developer procedures and standards
  - Reviewing and updating SAPHIRE QA documentation, accounting for relations between documentation, and including the following documentation (as well as others as applicable):
    - Acceptance Test Plan
    - Configuration Management Plan
    - QA Plan
    - Project Plan
    - RTM (Requirements Traceability Matrix)
    - RTM software package reports
    - System Test Plan
    - Change Design and Testing Procedures
    - Software Verification and Validation (SV&V) Plan
    - SDP (Significance Determination Process) Interface training manual
    - SAPHIRE, "New Features and Capabilities Overview"
  - Documenting SAPHIRE SQA activities in a report, which can consist of several documents submitted via one cover letter, that shall include the following items:
    - Action taken to ensure that the RCS is up-to-date and contains all important documentation and other files
    - Documentation stating what the RCS is and listing its contents
    - Action taken to review and update SAPHIRE QA documentation accounting for relations between documentation. Include the following documentation (as well as others as applicable):
      - Acceptance Test Plan
      - Configuration Management Plan
      - QA Plan
      - Project Plan
      - RTM (Requirements Traceability Matrix)
      - RTM software package reports
      - System Test Plan
      - Change Design and Testing Procedures
      - Software Verification and Validation (SV&V) Plan
      - SDP (Significance Determination Process) Interface training manual
      - SAPHIRE, "New Features and Capabilities Overview"



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- Supporting an annual NRC audit of the SQA implementation against requirements of NUREG/BR-0167, “Software Quality Assurance Program and Guidelines.”
  - Implementing SQA improvements at the request of the NRC ALT COR and approval by the NRC COR.

#### Subtask 1.3 Support NRC Presentations and Meetings.

- Provide support for NRC presentations and meetings at the request of the NRC ALT COR and approval by the NRC COR.

#### Subtask 1.4 Support SAPHIRE Improvements for New SPAR Model Features Being Developed, Including those for Use in Level-2 and Level-3 PRA Analyses, via the following.

- Monthly reviews of SAPHIRE Improvements with the SPAR model development team.
- Shakedown testing of pre-release improved versions by INL expert users to test those features of the program that can't be tested in an automated fashion.
- Review of design specifications and SQA maintenance and documentation of associated design reviews.

### Task 2 Code Maintenance and General Support

Code maintenance and general support shall be provided to support NRC users as needed.

#### Subtask 2.1 Bug Fixes and Maintenance Activities

This task includes, but is not limited to:

- Correcting programming errors identified.
  - Applicable SQA procedures shall be followed.
  - Programming errors that are corrected shall be documented.
- Providing general code maintenance, such as maintaining code functionality (e.g., MAR-D input, printing, user-interface features, etc.).
- Review and improve legacy code, as appropriate, to make the code more maintainable.
- Maintain the SAPHIRE Risk Application Program Interface (API) as appropriate.
- Maintaining SAPHIRE help documentation

#### Subtask 2.2 General Support Activities

This subtask provides general support for NRC SAPHIRE users including, but not limited to the following:

- Providing incremental builds of SAPHIRE for NRC staff review.

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- Make a new SAPHIRE build available to SAPHIRE users at the request of the NRC ALT COR and approval by the NRC COR.
  - Make incremental builds available on the SAPHIRE Website at the request of the NRC ALT COR and approval by the NRC COR.
  - Provide a document describing each new build of SAPHIRE that is made available for general release on the SAPHIRE Website.
    - o The documentation shall include the SAPHIRE revision number, a summary of the coding errors that have been resolved, and new software features.
  - Perform necessary activities related to configuration/maintenance of the local area network (LAN) server where SAPHIRE software and SPAR models are stored for access by NRC users.
  - Update the LAN server with the most current versions of the SAPHIRE software and SPAR models at the request of the NRC ALT COR and approval by the NRC COR.
  - Perform general project-management activities for this project.
  - Maintain and update the SAPHIRE Users Group and SPAR model distribution websites at the request of the NRC ALT COR and approval by the NRC COR.
  - Maintain and update as needed the SAPHIRE Users Group Website Security Plan.
  - Maintain and review user's access to the SAPHIRE website.

### Task 3          Update NUREG/CR Series Reports for the Current SAPHIRE Version

INL shall update the following publicly available SAPHIRE NUREG/CR Report Series for the Current SAPHIRE Version.

- NUREG/CR-7039, Volume 1: Overview and Summary. ( ADAMS ML11195A298)
- NUREG/CR-7039, Volume 2: Technical Reference. (ML11195A299)
- NUREG/CR-7039, Volume 3: User's Guide. (ML11195A300)
- NUREG/CR-7039, Volume 4: Tutorial. (ML11195A128)
- NUREG/CR-7039, Volume 5: Workspaces. (ML11195A129)
- NUREG/CR-7039, Volume 6: Quality Assurance. (ML11195A130)
- NUREG/CR-7039, Volume 7: Data Loading. (ML11195A131)

INL shall review relevant design documentation and SAPHIRE IV&V reports to ensure that applicable new and improved features are described in the NUREGs. INL shall provide the NRC ALT COR a draft copy of the NUREG volumes for review and incorporation of comments prior to finalizing the reports.

## **4.0 LIST OF DELIVERABLES**

INL shall submit deliverables in compliance with the following table.

The deliverables shall be submitted electronically to the COR and ALT COR.

When preparing the Updated SAPHIRE NUREG/CR Reports, the INL shall follow the guidance given in

- Section 15.0, Standards for Contractors who Prepare NUREG-Series Manuscripts, of
  - NRC Agreement Number NRC-HQ-60-17-D-0005:
    - SPAR Model, SAPHIRE, and PRA Technical Support.

The following table lists deliverables and estimated due dates.

It is recommended that the Last Deliverables not be at the end of the Period of Performance so as to allow NRC acceptance and follow up with the INL as necessary, and to permit time for the final MLSR and IPAC to be submitted to the NRC.

<b>Task Number</b>	<b>Deliverable Description</b>	<b>Due Dates</b>
1	Report documenting the SAPHIRE SQA Team Activities Reports. The report shall include: <ul style="list-style-type: none"> <li>• Reviews, Tests, and Code Walkthroughs</li> <li>• Oversight on SAPHIRE SQA Activities</li> <li>• Support NRC Presentations and Meetings</li> <li>• Support SAPHIRE Improvements for New SPAR Model Features Being Developed, Including Those for Use in Level-2 and Level-3 PRA Analyses</li> </ul>	10/30/2017 02/28/2018 06/30/2018 10/30/2018 02/28/2019 06/30/2019 10/30/2019 02/28/2020 06/30/2020 10/30/2020 02/28/2021 06/30/2021 10/30/2021 02/28/2022 05/14/2022
2	Report documenting Code Maintenance and General Support Reports <ul style="list-style-type: none"> <li>• Bug Fixes and Maintenance Activities</li> <li>• General Support Activities</li> </ul>	10/30/2017 02/28/2018 06/30/2018 10/30/2018 02/28/2019 06/30/2019 10/30/2019 02/28/2020 06/30/2020 10/30/2020 02/28/2021 06/30/2021 10/30/2021 02/28/2022 05/14/2022

3	Draft Updated SAPHIRE NUREG/CR Reports	10/30/2021
3	Revised draft Updated SAPHIRE NUREG/CR Reports	02/28/2022
3	Final SAPHIRE NUREG/CR Reports	05/14/2022
1, 2, and 3	Final Brief Summary Report via Email	05/14/2022

## 5.0 ESTIMATED LABOR CATEGORIES, KEY PERSONNEL AND LEVELS OF EFFORT

**5.1 Labor Categories, Requirements and Key Personnel.** Personnel working under this agreement/order shall meet the minimum requirements for experience and education as shown in the following table.

Labor Category at INL	Position Minimum Requirements	Key Personnel* (yes or no)
C30 - Data Base Engineering	Experienced computer programmers (Modula-2, Delphi, and SAGE), are needed to maintain and update SAPHIRE (i.e., 5 or more years). These programmers must be familiar with SAPHIRE applications, the SPAR model program, and plans for developing and implementing advanced PRA methods.	Yes
C38 - Software Analysis/Integration	Experienced computer programmers (Modula-2, Delphi, and SAGE), are needed to maintain and update SAPHIRE (i.e., 5 or more years). These programmers must be familiar with SAPHIRE applications, the SPAR model program, and plans for developing and implementing advanced PRA methods.	Yes
X23 - Probabilistic Risk Analysis (PRA)	PRA Analysts and Senior PRA Analysts who have a very strong technical background (i.e., 5 or more years) in PRA, extensive experience with SPAR models (i.e., 5 or more years), and who are familiar with the standardized methods and conventions used to construct SPAR models. These people are needed to test updated versions of SAPHIRE that can't be tested in an automated fashion.	Yes

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## 6.0 CERTIFICATION AND LICENSE

Not Applicable (N/A)

## 7.0 MEETINGS AND TRAVEL

Estimated Travel for DOE INL staff is shown in the following table.

Fiscal Year	Destination	Purpose	Number of Trips	Number of Staff	Duration (Days Including Travel)
FY 2018	NRC HQ	Review of Contract Tasks	1	1	3
FY 2019	NRC HQ	Review of Contract Tasks	1	1	3
FY 2020	NRC HQ	Review of Contract Tasks	1	1	3
FY 2021	NRC HQ	Review of Contract Tasks	1	1	3

All travel requires written Government approval from the CO, unless otherwise delegated to the COR.

DOE INL personnel will be authorized travel expenses consistent with the Federal Travel Regulation (FTR) and the limitation of funds specified for the travel within this agreement/order.

Foreign travel for the DOE INL] personnel requires a 60-day lead time for NRC approval. For prior approval of foreign travel, the servicing agency must submit to the COR an NRC Form 445, "Request for Approval of Official Foreign Travel." NRC Form 445 is available in the MD 11.7 Documents library and on the NRC Web site at: <http://www.nrc.gov/reading-rm/doc-collections/forms/>. All foreign travel requires prior written approval from the NRC Executive Director for Operations (EDO).

## 8.0 REPORTING REQUIREMENTS

The DOE INL is responsible for structuring the deliverables to current agency standards. The DOE INL must submit deliverables free of spelling and grammatical errors and shall conform to requirements stated in this section.

### 8.1 Monthly Letter Status Report (MLSR)

The DOE INL must provide a Monthly Letter Status Report (MLSR) by the 20<sup>th</sup> of the month, which consists of a technical progress report and financial status report. This report will be used by the NRC to assess the adequacy of the resources utilized by the DOE INL to accomplish the work contained in this SOW and to provide status of the DOE INL progress in achieving tasks and producing deliverables. The report shall include agreement/order summary information, work completed during the specified

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period, milestone schedule information, problem identification and resolution, travel plans, and staff hour summary. Copies must be sent to the COR, ALT COR, AMD at ContractsPOT.Resource@nrc.gov, and RES/DRA at RESDRAMLSR.Resource@nrc.gov.

A separate MLSR must be submitted for this Task Order along with a summary MLSR for Agreement Number NRC-HQ-60-17-D-0005, even if no work has been performed during a reporting period. Once NRC has determined that all work on this Task Order is completed and that final costs are acceptable, this Task Order may be omitted from the MLSR for Agreement Number NRC-HQ-60-17-D-0005.

The Final Brief Summary Report summarizing the work performed and the results and conclusions derived shall be submitted to the COR and ALT COR via email by February 28, 2022.

The MLSR must include the following: Agreement Number; Task Order Number, Agreement Title; Task Order Title, Agreement Period of Performance; Task Order Period of Performance, COR's name, telephone number, and email address; ALT CORs name, telephone number, and email address, full name and address of the DOE INL, DOE-INL Principal Investigator's name, telephone number, and e-mail address; DOE-INL Co-Principal Investigator's name, telephone number, and e-mail address (if applicable), and reporting period. The MLSR must include additional information discussed in the NRC's preferred MSLR template that DOE INL has available.

## **9.0 REQUIRED MATERIALS, FACILITIES, HARDWARE/SOFTWARE**

(N/A)

## **10.0 APPLICABLE PUBLICATIONS (CURRENT EDITIONS)**

The Updated NUREG/CR Series Reports for the Current SAPHIRE Version shall be of archival quality and comply with the requirements of NRC Management Directive 3.7 "NUREG-Series Publications." The document shall be technically edited consistent with NUREG-1379, Rev. 2 (May 2009) "NRC Editorial Style Guide." The goals of the "NRC Editorial Style Guide" are readability and consistency for all agency documents. The NUREG/CR report shall conform to the format guidance, as specified in NUREG-0650, "Preparing NUREG-Series Publications," Rev. 2 (January 1999). A draft NUREG/CR report shall be submitted to NRC for review and comment.

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## **11.0 DATA RIGHTS**

The NRC shall have unlimited rights to and ownership of all deliverables provided under this agreement/order, including reports, recommendations, briefings, work plans and all other deliverables. All documents and materials, to include the source codes of any software, produced under this agreement/order are the property of the NRC with all rights and privileges of ownership/copyright belonging exclusively to the NRC. These documents and materials may not be used or sold by the servicing agency without prior written authorization from the CO. All materials supplied to the NRC shall be the sole property of the NRC and may not be used for any other purpose. This right does not abrogate any other Government rights.