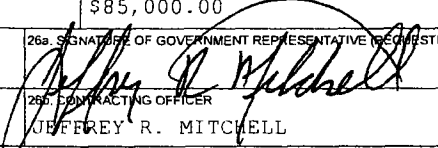


|   |  |  |   |  |               |
|---|--|--|---|--|---------------|
| <b>INTERAGENCY AGREEMENT</b>  |  | 1. IAA NO.<br>NRC-HQ-60-11-I-0003/M0006  |   | PAGE 1 OF 2  |               |
| 2. ORDER NO.  |  | 3. REQUISITION NO.<br>RES-14-0387  |   | 4. SOLICITATION NO.                                  |               |
| 5. EFFECTIVE DATE<br>07/15/2014   |  | 6. AWARD DATE<br>07/15/2014  |   | 7. PERIOD OF PERFORMANCE<br>09/01/2011 TO 03/31/2015 |               |
| 8. SERVICING AGENCY<br>NAVAL SURFACE WARFARE CENTER NSWC<br>ALC:<br>DUNS: +4:<br>INDIAN HEAD EXPLOSIVE ORDINANCE DIS<br>TECHNOLOGY DIVISION<br>1767 STRAUSS AVE STE 201<br>INDIAN HEAD MD 20640-5150<br><br>POC Pam Speake<br>TELEPHONE NO. 301-744-6771  |  |  | 9. DELIVER TO<br>HERNANDO CANDRA<br>US NUCLEAR REGULATORY COMMISSION<br>MAIL STOP CSB C5 C7<br>11555 ROCKVILLE PIKE<br>ROCKVILLE MD 20852                                       |  |               |
| 10. REQUESTING AGENCY<br>ACQUISITION MANAGEMENT DIVISION<br>ALC: 3100001<br>DUNS: 040535809 +4:<br>US NUCLEAR REGULATORY COMMISSION<br>ONE WHITE FLINT NORTH<br>11555 ROCKVILLE PIKE<br>ROCKVILLE MD 20852-2738<br><br>POC Lisa Kauffman<br>TELEPHONE NO 301-287-0852                                   |  |  | 11. INVOICE OFFICE<br>US NUCLEAR REGULATORY COMMISSION<br>ONE WHITE FLINT NORTH<br>11555 ROCKVILLE PIKE<br>MAILSTOP O3-E17A<br>NRCIPACRESOURCENRCGOV<br>ROCKVILLE MD 20852-2738 |  |               |
| 12. ISSUING OFFICE<br>US NRC - HQ<br>ACQUISITION MANAGEMENT DIVISION<br>MAIL STOP 3WFN-05-C64MP<br>WASHINGTON DC 20555-0001   |  |  | 13. LEGISLATIVE AUTHORITY<br>Energy Reorganization Act of 1974  |  |               |
|   |  |  | 14. PROJECT ID<br>V6241   |  |               |
|   |  |  | 15. PROJECT TITLE<br>SNFP VULNERABILITIES TO THREATS  |  |               |
| 16. ACCOUNTING DATA<br>2014-X0200-FEEBASED-60-60D001-11-2-130-V6241-252A  |  |  |   |  |               |
| 17.<br>ITEM NO  | 18.<br>SUPPLIES/SERVICES   | 19.<br>QUANTITY  | 20.<br>UNIT   | 21.<br>UNIT PRICE                                    | 22.<br>AMOUNT |
|   | NRC-HQ-60-11-I-0003<br>Master IAA: N/A<br>The purpose of this modification is to (1) add additional within scope tasks, (2) accept NSWC's proposal, dated July 2, 2014, (3) extend the period of performance through March 31, 2015, (4) increase the authorized cost ceiling by \$85,000.00 from \$416,000.00 to \$501,000.00, and (5) provide incremental funding in the amount of \$85,000.00. Accordingly, this agreement is modified as follows:<br><br>Continued ... |  |   |  |               |
| 23. PAYMENT PROVISIONS  |  | 24. TOTAL AMOUNT<br>\$85,000.00  |   |  |               |
| 25a. SIGNATURE OF GOVERNMENT REPRESENTATIVE (SEE INSTRUCTIONS)<br><b>BUTLER DANIEL L</b><br>1136596850<br><small>Digitally signed by BUTLER DANIEL L 1136596850<br/>DN: cn=USN, o=U.S. Government, ou=DoD, ou=PKI,<br/>ou=USN, cn=BUTLER.DANIELL.1136596850<br/>Date: 2014.08.08 13:06:06 -0400</small> |  | 26a. SIGNATURE OF GOVERNMENT REPRESENTATIVE (REQUESTING)<br> |   |  |               |
| 25b. NAME AND TITLE<br>DANIEL L BUTLER, Funds Management Team Lead  |  | 25c. DATE  |   | 26c. DATE<br>7/15/2014                               |               |
|   |  | 26b. CONTRACTING OFFICER<br>JEFFREY R. MITCHELL  |   |  |               |

TEMPLATE - ADM001

SUNSI REVIEW COMPLETE

AUG 21 2014

ADM002

The Modified Statement of Work is hereby incorporated into this Agreement.

The new Authorized Cost Ceiling is \$501,000.00.

This modification provides incremental funding in the amount of \$85,000.00, thereby increasing the total obligations from \$416,000.00 to \$501,000.00.

Attachment No. 1: Modified Statement of Work

Period of Performance: 09/01/2011 through 03/31/2015.

All other terms and conditions remain unchanged.

## **MODIFIED STATEMENT OF WORK**

Job code No.V6241

**TITLE:** Spent Nuclear Fuel Pool (SNFP) Vulnerabilities to Postulated Security Threats

### **SCOPE OF WORK**

The purpose of this modification is to add subtasks to Task 3. This modification also updates the deliverable schedule to allow Indian Head engineering/scientist staff to work on the newly defined SubTasks 3.5 to 3.7 as described below.

The following three, more specific, subtasks are needed to address a recent revision to User Need NSIR 2009-001 that examines potential spent fuel vulnerabilities to postulated security threats. This revision requires additional underwater detonation modeling with the Dysmas software to characterize specific explosive effects on spent fuel. These subtasks level of effort is an addition to Task 3: "Parametric Modeling and Analysis", listed in the previous SOWs.

Due to the nature of the work undertaken in this agreement, there is no planned travel anticipated during the execution of this effort.

#### **SubTask 3:5 Development of a representative "homogenized" model for the fuel assemblies (Eulerian element)**

Modeling the response of the fuel assembly to this treat is difficult due to the small dimension of the fuel rod that holds a stack (approximately 12 feet tall) of small fuel pallets inside it. There are about 3500 fuel assemblies which each containing about 100 rods in the pool. Although the Dysmas software is a fully coupled fluid-structure code, a fully couple model of all the individual fuel assembly and pallets in the surrounding water is far too large to attempt. The small diameter of the rods would dictate a very small time step in the calculations, while the large dimension of the pool would dictate a very large number of finite element and fluid cells. Therefore, the number of fluid-structure interfaces would be untractable and not commensurate with the accuracy needed to assess the threats.

Under this subtask the NSWC Indian Head scientists shall develop a manageable alternative approximate method to model the response of the fuel assembly to the treat. The assembly shall be modeled using an equivalent homogeneous material that represents the fuel pallet, zirconium tube (fuel rod), stainless steel canister and water in it.

This subtask shall include the following:

- Analyze component drawings and material properties

- Derive equivalent mixed density
- Derive mixed equation of state (Pressure vs. Density)
- Derive equivalent mixed strength model
- Verify and test this model on a single fuel canister

#### SubTask 3:6 Modify Strength Model in the Dysmas Euler Code and Generate Fuel Assembly and Fuel Rack Input

The DYSMAS code suite does not have an option for processing a "pool" like, water-filled fuel assembly geometry. Having the proper deformed shape and initial stress of the assembly is necessary for properly loading the air and water on the front and back sides of the canister skin. NSWCIH shall modify the Dysmas code to add a feature to calculate the initial stress state of the assemblies and rack due to static pressure and weight.

This subtask shall include the following:

- Modify DYSMAS to "initialize" stress state due to weight
- Verify/test this model on single fuel canister
- Modify the existing hydrostatic load routine
- Generate Dysmas input file
- Test for large (~3500) number of blocks of Euler cells

#### SubTask 3:7 Model/Run/Debug full-up calculations

Under this task NSWC Indian Head shall predict the energy deposition into the fuel material as well as general motion of the fuel material (not the structural response of the building).

This subtask shall include the following:

- Create a simplified pool model (i.e., it is not necessary to use the pool model used to assess the pool structure)
- Run/Debug the model
- Generate the results identified in SubTask 3.6.

### **DELIVERABLES/SCHEDULES**

| <b>Tasks</b>   | <b>Original Statement of Work</b> | <b>Modified Statement of Work</b> |
|--|-----------------------------------|-----------------------------------|
| Task 1:<br>Review of SNFP configuration<br>Kickoff meeting<br>Develop calculation matrix | 11/1/2011                         | 11/1/2011 (No change)             |

| <b>Tasks</b>   | <b>Original Statement of Work</b> | <b>Modified Statement of Work</b>   |
|--|-----------------------------------|---|
| Task 2:<br>Develop SNFP-like sample calc.<br>Install Dysmas at NRC | 11/1/2011                         | 11/1/2011 (sample calc.)<br>9/1/2013, partially installed<br>on 3/25/2013 |
| Dysmas training  |                                   | 12/1/2013 (Training)  |
| Task 3:<br>Parametric Analysis                                     | 5/1/2012                          | 9/1/2014  |
| Task 4:<br>Briefing and Draft report                               | 7/1/2012                          | 12/30/2014  |