INTERAGENCY AGREEMENT	1. IAA NO. NRC-HQ-60-15-D-0013	PAGE 1 OF 2

2. ORDER NO.	3. REQUISITION NO. RES-15-0331	4. SOLICITATION NO.

5. EFFECTIVE DATE 06/26/2015	6. AWARD DATE 06/26/2015	7. PERIOD OF PERFORMANCE 07/31/2015 TO 07/30/2017

8. SERVICING AGENCY
BROOKHAVEN NATIONAL LABORATORY
ALC:
DUNS: 027579460 +4:
BROOKHAVEN SITE OFFICE
PO BOX 5000 BLDG 464
UPTON NY 11973-5000

POC Kim Nekulak
TELEPHONE NO. 631-344-7439

9. DELIVER TO
DABIN KI
US NUCLEAR REGULATORY COMMISSION
TWO WHITE FLINT NORTH
11545 ROCKVILLE PIKE
MAIL STOP T-10A12
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

15. PROJECT TITLE
ADAPTIVE AUTOMATION

16 ACCOUNTING DATA
2015-X0200-FEEBASED-60-60D002-17-6-161-1031-253D

17. ITEM NO.	18. SUPPLIES/SERVICES	19. QUANTITY	20. UNIT	21. UNIT PRICE	22. AMOUNT
	NRC-HQ-60-15-D-0013 The NRC and the DOE Laboratory (PNNL) hereby enter into this Agreement for the project entitled, "Potential Applications for and Assessment of Adaptive Automation in Nuclear Power Plant Processes." The period of performance of this agreement is from July 31, 2015 through July 30, 2017. NRC COR: DaBin Ki (301)415-2358 Continued ...				

23. PAYMENT PROVISIONS	24. TOTAL AMOUNT $150,000.00

25a. SIGNATURE OF GOVERNMENT REPRESENTATIVE (SERVICING)	26a. SIGNATURE OF GOVERNMENT REPRESENTATIVE (REQUESTING)
Kim Nekulak	Carolyn Cooper
25b. NAME AND TITLE: Kim Nekulak, Contracting Officer	25c. DATE: JUL 15 2015
26b. CONTRACTING OFFICER: CAROLYN A. COOPER	26c. DATE: 6/26/2015

TEMPLATE - ADM001

SUNSI REVIEW COMPLETE

JUL 27 2015

ADM002

PNNL PI: John O'Hara (631)344-3638

Consideration and Obligations:

(a) Authorized Cost Ceiling is $340,876.00
(b) The amount presently obligated with respect to this DOE Agreement is $150,000.00. When and if the amount(s) paid and payable to the DOE Laboratory hereunder equals the obligated amount, the DOE Laboratory shall not be obligated to continue performance of the work unless and until the NRC Contracting Officer increases 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 No. 1: Statement of Work
Attachment No. 2: DOE Standard Terms and Conditions

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.

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

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.

ALC: 31000001 TAS: 31X0200.320 DUNS: 040535809

Master IAA: N/A

STATEMENT OF WORK

NRC Agreement Number	NRC Agreement Modification Number	NRC Task Order Number (If Applicable)	NRC Task Order Modification Number (If Applicable)
NRC-HQ-60-15-D-0013	N/A	N/A	N/A

Project Title		
Potential Applications for, and Assessment of, Adaptive Automation in Nuclear Power Plant Processes		
Job Code Number	**B&R Number**	**DOE Laboratory** Brookhaven National Laboratory (BNL)
NRC Requisitioning Office Office of Nuclear Regulatory Research		

NRC Form 187, Contract Security and Classification Requirements ☐ Applicable ☒ Not Applicable	☐ Involves Proprietary Information ☐ Involves Sensitive Unclassified
☒ Non Fee-Recoverable	☐ Fee-Recoverable (If checked, complete all applicable sections below)
Docket Number (If Fee-Recoverable/Applicable) N/A	**Inspection Report Number (If Fee Recoverable/Applicable)** N/A
Technical Assignment Control Number (If Fee-Recoverable/Applicable) N/A	**Technical Assignment Control Number Description (If Fee-Recoverable/Applicable)** N/A

1.0 BACKGROUND

Adaptive Automation (AA) is currently being developed for a variety of non-nuclear applications, including military aviation and unmanned vehicles. Although the way that designs are implemented varies greatly, all of these systems have the goal of optimizing system performance by helping a human user appropriately manage his or her workload and focus attention on the task that is most appropriate at any given time. Basically, adaptive automation dynamically adjusts the allocation of functions among the user and the automation. These adjustments can be made based on a variety of "triggering conditions", such as operator's judgment, operator factors (such as psycho-physiological measures, dynamic workload assessment, and task-performance measures), and critical events or setpoints based on measured parameters, or a combination thereof. For example, if the adaptive automation senses that the operator's workload is high, the automation might take on additional responsibilities to allow the operator to focus on a more limited set of important tasks. In circumstances where the overall workload may be low, tasks can also be reassigned to operators to keep them meaningfully engaged in the monitoring and control of the system for improved situation awareness, manageable workload, and skill retention.

Systems that incorporate adaptive automation have not yet been proposed in applications for new nuclear power reactors or in modifications to existing nuclear power plants (NPPs). However, such systems are likely to be of substantial interest within the commercial nuclear power community because of their potential to decrease operator workload and possibly the number of operators required to safely operate a NPP. Such aims can be achieved through more conventional forms of automation. However, adaptive automation has the potential added benefit of addressing known challenges associated with highly automated systems, specifically reduced situation awareness on the part of user and degradation over time in the user's ability to manually operate the system. Both of these challenges have important safety implications as they adversely affect the ability of the operator to effectively respond to perturbations of the system or to safely recover from failures within the system.

The potential benefits of adaptive automation are likely to be of particular interest to designers or/and potential owner/operators of small modular reactors (SMRs). Minimizing crew sizes has been a priority objective for SMR designs as the ratio of operators to number of reactor modules being operated is reportedly a critical factor in the economic viability of this class of reactors. As a consequence, the general operating concept for SMRs is that a single operator or small crew would oversee the operation of multiple reactor modules. One initial SMR design proposal is a single crew operating up to 12 reactors. In such circumstance, one might see adaptive automation assisting an operating crew during a plant transient by increasing its control over stable reactor modules while the crew diverts attention to the unit that is experiencing a transient. When the transient has stabilized, the tasks associated with all units can then be reassigned to the crew to keep them actively engaged and aware of all units. The potential economic and safety benefits made possible by implementing adaptive automation make it likely that licensees will consider its use in future applications.

However, the current regulations and guidance provide U.S. Nuclear Regulatory Commission (NRC) staff only with tools appropriate for assessing the static assignment of functions to either the operator or to the automation. The current guidance does not address how dynamic function allocation should occur and under which circumstances it may or may not be acceptable. Other industries are identifying and developing strategies to implement adaptive automation. However, there are only a few real-world applications of adaptive automation at this point. As a result, operating experience with real-world applications is limited.

Through this human factors (HF) research project, NRC is seeking to gain a better understanding of the interaction of operators with automation. This has implications for nearly all areas currently addressed by NUREG-0711, "Human Factors Engineering Program Review Model." Under 10 CFR 50.34, applicants are required to design control rooms using "state-of-the-art human factors principles." While the current state-of-the-art in automation design includes adaptive automation systems, the methods to measure the effectiveness and ultimately the safety of these systems are still being developed. For example, Function Allocation (FA) is a part of the NRC's Human Factors Engineering (HFE) review to help ensure that the licensee has a rational basis for assigning plant functions to either automatic control or to manual control by the operator. The FA is a living analysis that can change as modifications to the plant occur. However, adaptive automation can be considered "continuous function re-allocation." Currently,

NUREG-0711 does not address dynamic function re-allocation that occurs in adaptive systems and may not be sensitive to human performance problems associated with re-allocation of functions.

For Instrumentation & Control (I&C), adaptive automation can help change the focus of traditional I&C systems which have been primarily focused on sensing various NPP parameters as it may require that the NPP control systems sense and interpret parameters associated with the operators (i.e., heart rate, or skin conductivity). Unique algorithms and software are also likely to be developed to support an adaptive system. Adaptive automation may also require new techniques to be developed to complete Probabilistic Risk Analysis (PRA). Research in this area would provide a technical basis for the assessment of algorithms used in adaptive automation applications. The use of adaptive automation will shift some of the responsibility of decision making to the automation. This shift will cause the NPP systems to become more technologically complex and will likely introduce a variety of new failure modes. This research is intended to expand NRC's understanding of failure modes of decision making software and how the human will interact with a semi-autonomous system.

An important issue in adaptive automation is the conditions that trigger changes in automation and the relative roles of operators and automation in performing tasks. The questions of how and when the change of task assignment should occur are not easy to answer. The effects on system performance may vary depending on how the transition from one level of automation to another occurs. As noted earlier, there are several ways that this could happen. Another issue identified is responsibility. Responsibility is a term used to consider which agent (the operator, automation, the COL, etc.) is responsible in the case of a failure. In NPPs, the licensed operator has ultimate responsibility for the safe operation of the unit and timely responses to NPP conditions. He or she is responsible to detect conditions adverse to safety regardless of the actions of automation and to return the NPP to a safe condition. NPP using adaptive automation as a way to reduce control room staffing for multiple units may be challenging the current responsibility paradigm described above. There are questions such as, who should be responsible if the automation fails? Or, is it still the responsibility of the operator to maintain the safe operation of the NPP even if it is physically impossible for the operator to do so? If the number or duration of operational tasks that must be completed exceeds the physical and mental capabilities of the available operators then the operator has no choice but to rely on the automation to ensure that all tasks will be completed.

The above issues, when considered in the nuclear power operations context have potential safety implications and suggest that the introduction of adaptive automation in the nuclear power industry should receive careful and comprehensive regulatory review. Adaptive automation could affect operator performance, and therefore, plant safety. As such, researching the potential applications for, and assessment of, adaptive automaton in NPP processes has been approved as a long-term research project because this issue could provide fundamental insights and technical information needed to address potential technical issues or identified gaps to support the NRC's anticipated future needs.

2.0 OBJECTIVE

The objective of this research is to perform a scoping study to address the potential importance of adaptive automation within the nuclear industry to both new nuclear power reactors and modifications to existing nuclear power plants. Specifically, technical expertise from BNL is required to assist NRC staff in addressing the following questions:

1. What are the potential applications for adaptive automation in nuclear plants?
2. What are the potential performance benefits and safety implications of these applications?
3. What types of triggering conditions can be used and what are the relative advantages and disadvantages of each?
4. What types of measures of system, operator, and crew performance might be needed to implement adaptive automation for the identified potential applications and what are the associated challenges with obtaining and using such measures?
5. What are the significant human-system interface design considerations for implementing adaptive automation (e.g., communicating and negotiating re-allocation of functions)?
6. What challenges might these applications present to the NRC's existing regulatory framework/processes?

3.0 SCOPE OF WORK

BNL shall provide all resources necessary to accomplish the tasks and deliverables described in this statement of work (SOW). This research project entails conducting a study that consists of literature research, interviews during site visits, and an Expert Panel Workshop to evaluate the likelihood to implement adaptive automation within the nuclear industry, in both new reactors and in plant modifications, by using surrogate industries to identify potential areas of concern. The study will include assessing whether the experience and results of using adaptive automation in other industries are applicable to the nuclear industry.

Finally, if the use of adaptive automation is likely in NPP applications, the technical and regulatory concerns for adopting the technology will be identified, and if appropriate, recommendations will be made for follow-on research to address these concerns. This project also contains an optional task to prepare a NUREG Report that documents the results of the study.

4.0 SPECIFIC TASKS

BNL shall perform the following tasks:

Task 1 – Identify the State-of-the-Art in Adaptive Automation

A. The purpose of this task is to address questions 3, 4 & 5 as stated in Section 2.0, Objectives. BNL shall conduct a literature search and review the materials collected to address the following questions:

- What types of triggering conditions can be used and what are the relative advantages and disadvantages of each?
- What types of measures of system, operator, and crew performance might be needed to implement adaptive automation and what are the associated challenges with obtaining and using such measures?
- What are the significant human-system interface design considerations for implementing adaptive automation (e.g., communicating and negotiating re-allocation of functions)?

B. The laboratory shall, at a minimum, address the following topic areas in the report:

1. Dynamic function allocation

   A system can be designed such that the operator or machine responsible for performing a task always is the same (i.e. static allocation) or the task can be performed either by automatic systems or by the operator based on situational considerations (e.g., overall operator workload). For example, automation may assume control over lower priority tasks when the operator's workload increases to a level where it would be difficult to perform all their current work. A key consideration for adaptive automation systems is who decides when the responsibility for a task changes from the user to the machine or vice versa, and on what basis. Additionally, there is some distinction between adaptable automation and adaptive automation. In the case for adaptive automation, the automation adjusts based on some triggering condition (discussed below). Therefore, additional research on how automation should occur and under which circumstances it may or may not be acceptable is necessary.

2. Triggering conditions

   In adaptive automation, triggering conditions refer to the factors that are responsible for determining when the responsibility for a task changes from a human operator to a machine, or vice versa, and on what basis. These conditions can be based on operator factors such as psycho-physiological measures, dynamic workload assessment, or task-performance measures. Triggering conditions can also be set on the presence of critical events or reaching a setpoint(s) of measured parameter(s). More research is required to identify the appropriate triggering mechanisms for automation changes, and how they should be implemented to minimize any disruptions to the operator's performance when the change occurs.

3. Human-System Interface (HSI)

   Research has shown that the operator's use of automation is influenced by HSI design along with other factors. Therefore the proper design of the HSIs is vital to the success of operators in fulfilling automation-related tasks. Developing guidelines for reviewing HSIs for monitoring and control of automation are essential to the NRC.

4. Degraded conditions and failures

   Automation can mask failures and degraded conditions in other plant systems when it compensates for them. This can lead to a loss in situation awareness and may be problematic when the situation reaches a point where the automation can no longer compensate and the operator has to take over.

5. Measurement of team performance (when team includes automation)

   While there are many potential benefits for making automation a team player, it can be challenging. For example, there can be issues in an operator's trust in automation, understanding, overreliance and confidence. Additional research needs to be completed on the principles for supporting teamwork with automation.

6. AA system evaluation

   Further research is needed for verification and validation methods for evaluating AA systems.

C. In order to provide answers to these questions, the laboratory shall perform the following tasks:

   (1) Review the literature
   (2) Interview experts
   (3) Conduct a limited number of site visits to sites employing state-of-the-art AA systems

D. Additionally, the laboratory shall take into consideration the following:
   - Existing systems employing AA
   - Systems being developed to utilize AA
   - Research on applications of AA

E. The laboratory shall document the results of Task 1 efforts in a technical letter report.

Estimated Completion Date: March, 2016

Task 2 – Identify Potential Application of Adaptive Automation in the Commercial Nuclear Industry and Its Potential Implications

A. The purpose of this task is to address questions 1 & 2 as stated in Section 2.0, Objectives. BNL shall use the literature search from Task 1 to address the following questions:

- What are the potential applications for adaptive automation in nuclear plants?
- What are the potential performance benefits and safety implications of these applications?

B. In order to provide answers to these questions, the laboratory shall perform the following tasks:

(1) Review the literature
(2) Interview experts in NPP vendor and research organizations
(3) Conduct a limited number of site visits (if current AA applications being developed in the industry are identified)

C. The laboratory shall document the results of Task 2 efforts in a technical letter report.

Estimated Completion Date: July, 2016

Task 3: Identify Implications for Regulatory Guidance

A. The task shall address Question 6 as stated in Section 2.0, Objectives.

- What challenges might these applications present to the NRC's existing regulatory framework/processes?

B. The laboratory shall evaluate the findings from Task's 1 and 2 with respect to how well the NRC's HFE guidance, mainly NUREG's 0700 and 0711, currently addresses Adaptive Automation.

C. The laboratory shall document the results of Task 3 efforts in a technical letter report.

Completion Date: November, 2016
Level of Effort: 100 hours

Task 4: Expert Panel Workshop

A. BNL shall participate in an expert panel workshop that will be made up of a cross-section of knowledgeable industry stakeholders, e.g., vendors, utilities, regulators, laboratory personnel as well as NRC personnel. The NRC will be responsible for hosting the meeting, but BNL must provide technical and some administrative support (e.g., note-taking) to this meeting.

B. Utilizing the results from the first 3 tasks, the panel will address the objectives of the study and discuss any gaps or concerns, and provide recommendations.

C. The laboratory shall integrate the results of this task into a comprehensive technical report documenting the results of all project tasks.

Completion Date: March, 2017

Task 5: Develop a NUREG/CR (OPTIONAL TASK)

As requested by the NRC COR, BNL shall prepare a draft and final NUREG/CR that consolidates the technical letter reports developed under the agreement consistent with NUREG-0650, Rev. 2, Preparing NUREG-Series Publications.

Completion Date: June, 2017

5.0 DELIVERABLES SCHEDULE

The following table states the deliverables required for this project.

Task	Deliverable	Due Date
1 - 4	Draft Technical Letter Report; electronically submitted to COR & Alternate COR	NLT 30 working days from agreed upon date
1 - 4	Final Technical Letter Report; electronically submitted to COR & Alternate COR	NLT 10 working days after resolution of comments
5 (optional)	Draft NUREG/CR; electronically submitted to COR & Alternate COR	NLT 30 working days from agreed upon date
5 (optional)	Final NUREG/CR; electronically submitted to COR & Alternate COR	NLT 10 working days after resolution of comments
TBD	Conference paper for review/approval; submitted electronically to COR & Alternative COR	60 working days before the start of the conference

6.0 TECHNICAL AND OTHER SPECIAL QUALIFICATIONS REQUIRED

Senior Human Factors Analyst with knowledge and experience in the field of HFE with special expertise in the application of HFE to NPPs including the role of HFE in the NRC's regulatory process. BNL shall provide a project manager to oversee the effort and ensure the timely submittal of accurate and complete deliverables.

7.0 MEETINGS AND TRAVEL

The following are a list of anticipated travel under this agreement.

Kick-off meeting

- Frequency: 1 time during the length of the agreement
- Destination: NRC Headquarters in Rockville, MD
- Number of staff: up to 2
- Number of days: 1

Site visits to interview experts

- Frequency: 3 times during the length of the agreement
- Destination: TBD
- Number of staff: 1
- Numbers of days: 5

Expert Panel Workshop

- Frequency: 1 time during the length of the agreement
- Destination: NRC Headquarters in Rockville, MD
- Number of staff: up to 2
- Number of days: 5

Presentation at an applicable conference

- Frequency: 1 time during the length of the agreement
- Destination: TBD
- Number of staff: 1
- Number of days: up to 5

No foreign travel is required under this agreement.

All travel requires prior written approval from the COR.

At the discretion of the COR, meetings may be conducted at BNL or via telephone or video conference.

8.0 REPORTING REQUIREMENTS

The DOE Laboratory is responsible for structuring the deliverable to follow agency standards. The current agency standard is Microsoft Office Suite 2010. The current agency Portable Document Format (PDF) standard is Adobe Acrobat 9 Professional. Deliverables must be submitted free of spelling and grammatical errors and conform to requirements stated in this section.

Monthly Letter Status Reports

In accordance with Management Directive 11.7, NRC Procedures for Placement and Monitoring of Work with the U.S. Department of Energy, the DOE Laboratory must electronically submit a Monthly Letter Status Report (MLSR) by the 20th day of each month covering the prior's month's effort to the COR with copies to the Contracting Officer (CO) and to the Acquisition Management Division ContractsPOT.Resource@nrc.gov. If a project is a task ordering agreement, a separate MLSR must be submitted for each task order with a summary project MLSR, even if no work has been performed during a reporting period. Once NRC has determined that all work on a task order is completed and that final costs are acceptable, a task order may be omitted from the MLSR.

The MLSR must include the following: agreement number; task order number, if applicable; job code number; title of the project; project period of performance; task order period of performance, if applicable; COR's name, telephone number, and e-mail address; full name and address of the performing organization; principal investigator's name, telephone number, and e-mail address; and reporting period. At a minimum, the MLSR must include the information discussed in Attachment 1.

9.0 PERIOD OF PERFORMANCE

The estimated period of performance for this work is July 31, 2015 through July 30, 2017.

10.0 CONTRACTING OFFICER'S REPRESENTATIVE

The COR monitors all technical aspects of the agreement/task order and assists in its administration. The COR is authorized to perform the following functions: assure that the DOE Laboratory performs the technical requirements of the agreement/task order; perform inspections necessary in connection with agreement/task order performance; maintain written and oral communications with the DOE Laboratory concerning technical aspects of the agreement/task order; issue written interpretations of technical requirements, including Government drawings, designs, specifications; monitor the DOE Laboratory's performance and notify the DOE Laboratory of any deficiencies; coordinate availability of NRC-furnished material and/or GFP; and provide site entry of DOE Laboratory personnel.

Contracting Officer's Representative

Name: Ms. DaBin Ki
Agency: U.S. Nuclear Regulatory Commission
Office: RES/DRA/HFRB
Mail Stop: CSB 4C07M
Washington, DC 20555-0001
E-Mail: DaBin.Ki@nrc.gov
Phone: 301-251-7920

Alternate Contracting Officer's Representative

Name: Mr. Stephen Fleger
Agency: U.S. Nuclear Regulatory Commission
Office: RES/DRA/HFRB

Mail Stop: CSB 4C07M
Washington, DC 20555-0001
E-Mail: Stephen.Fleger@nrc.gov
Phone: 301-251-7905

11.0 MATERIALS REQUIRED

N/A

12.0 NRC-FURNISHED PROPERTY/MATERIALS

N/A

13.0 RESEARCH QUALITY

The quality of NRC research programs are assessed each year by the Advisory Committee on Reactor Safeguards. Within the context of their reviews of RES programs, the definition of quality research is based upon several major characteristics:

Results meet the objectives (75% of overall score)

- Justification of major assumptions (12%)
- Soundness of technical approach and results (52%)
- Uncertainties and sensitivities addressed (11%)

Documentation of research results and methods is adequate (25% of overall score)

- Clarity of presentation (16%)
- Identification of major assumptions (9%)

It is the responsibility of the DOE Laboratory to ensure that these quality criteria are adequately addressed throughout the course of the research that is performed. The NRC COR will review all research products with these criteria in mind.

14.0 STANDARDS FOR LABORATORYS WHO PREPARE NUREG-SERIES MANUSCRIPTS

The U.S. Nuclear Regulatory Commission (NRC) began to capture most of its official records electronically on January 1, 2000. The NRC will capture each final NUREG-series publication in its native application. Therefore, the DOE Laboratory shall submit the final manuscript that has been approved by the COR in both electronic and camera-ready copy.

The final manuscript 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.

All format guidance, as specified in NUREG-0650, "Preparing NUREG-Series Publications," Rev. 2 (January 1999), will remain the same with one exception. The DOE Laboratory shall no longer be required to include the NUREG-series designator on the bottom of each page of the manuscript. The NRC will assign this designator when we send the camera-ready copy to the printer and will place the designator on the cover, title page, and spine. The designator for each report will no longer be assigned when the decision to prepare a publication is made. The NRC's Publishing Services Branch will inform the COR for the publication of the assigned designator when the final manuscript is sent to the printer.

For the electronic manuscript, the DOE Laboratory shall prepare the text in Microsoft Word, and use any of the following file types for charts, spreadsheets, and the like.

File Types to be Used for NUREG-Series Publications	
File Type	File Extension
Microsoft®Word®	.doc
Microsoft® PowerPoint®	.ppt
Microsoft®Excel	.xls
Microsoft®Access	.mdb
Portable Document Format	.pdf

This list is subject to change if new software packages come into common use at NRC or by our licensees or other stakeholders that participate in the electronic submission process. If a portion of the manuscript is from another source and the DOE Laboratory cannot obtain an acceptable electronic file type for this portion (e.g., an appendix from an old publication), the NRC can, if necessary, create a tagged image file format (file extension.tif) for that portion of the report. Note that the DOE Laboratory shall continue to submit original photographs, which will be scanned, since digitized photographs do not print well.

If the DOE Laboratory chooses to publish a compact disk (CD) of the publication, place on the CD copies of the manuscript in both (1) a portable document format (PDF); (2) a Microsoft Word file format, and (3) an Adobe Acrobat Reader, or, alternatively, print instructions for obtaining a free copy of Adobe Acrobat Reader on the back cover insert of the jewel box.

15.0 OTHER CONSIDERATIONS

References/Attachments N/A

Access to Non-NRC Facilities/Equipment N/A

Applicable Publications N/A

Controls over document handling and non-disclosure of materials N/A