U.S. NUCLEAR REGULATORY COMMISSION
NOTICE OF GRANT/ASSISTANCE AWARD

1. GRANT/AGREEMENT NO.	2. MODIFICATION NO.	3. PERIOD OF PERFORMANCE	4. AUTHORITY
NRC-27-10-1123		FROM: 09/30/2010 TO: 09/29/12	Pursuant to Section 31b and 141b of the Atomic Energy Act of 1954, as amended

5. TYPE OF AWARD	6. ORGANIZATION TYPE	7. RECIPIENT NAME, ADDRESS, and EMAIL ADDRESS
[X] GRANT [ ] COOPERATIVE AGREEMENT	Duns: 056282296	HOWARD UNIVERSITY, INC. WHUR-FM 2400 6TH ST NW WASHINGTON DC 200590002

8. PROJECT TITLE:
Development of A New Course on Nuclear Power with Emphasis on Safety Critical Application in Digital Instrumentation and Control

9. PROJECT WILL BE CONDUCTED	10. TECHNICAL REPORTS ARE REQUIRED	11. PRINCIPAL INVESTIGATOR(S) NAME, ADDRESS and EMAIL ADDRESS
PER GOVERNMENT'S/RECIPIENT'S PROPOSAL(S) DATED 05/05/2010 AND APPENDIX A-PROJECT GRANT PROVISIONS	[X] PROGRESS AND FINAL [ ] FINAL ONLY [ ] OTHER (Conference Proceedings)	Dr. Charles Kim Howard University Office of Sponsored Programs 576 W Street, NW Washington, DC 20059

12. NRC PROGRAM OFFICE (NAME and ADDRESS)	13. ACCOUNTING and APPROPRIATION DATA		14. METHOD OF PAYMENT
U.S. Nuclear Regulatory Commission Ms. Tuwanda Smith Mail Stop 03H8 (301) 415-7394 Office of Small Business & Civil Rights 6003 Executive Boulevard Rockville, MD 20852	APPN. NO: B&R NO: JOB CODE: BOC NO: OFFICE ID NO:	31X0200 07P-15-5C1-161 L2284 4110 SDB-27-10-1123 FFS: SBCID338	[ ] ADVANCE BY TREASURY CHECK [ ] REIMBURSEMENT BY TREASURY CHECK [ ] LETTER OF CREDIT [X] OTHER (SPECIFY) Electronic ASAP.gov (See Remarks in Item #20 "Payment Information")

15. NRC OBLIGATION FUNDS		16. TOTAL FUNDING AGREEMENT	
THIS ACTION	$110,000.00	NRC	$220,000.00
PREVIOUS OBLIGATION		RECIPIENT	$0.00
TOTAL	$110,000.00	TOTAL	$220,000.00

This action provides funds for Fiscal Year 2010 in the amount of

17. NRC ISSUING OFFICE (NAME, ADDRESS and EMAIL ADDRESS)

U.S. Nuclear Regulatory Commission
Div. of Contracts
Attn: Mr. Michael Mills (301) 492-3621
Mail Stop: TWB-01-B10M
Washington, DC 20555
Michael.Mills@nrc.gov

18.
Acceptance of or objections to the Terms and Conditions of Award must be Emailed to the NRC Issuing Office (Block #17) within three (3) business days following the Award issue date. NRC considers lack of response as acceptance by the grantee of the terms and conditions of award.

19. NRC CONTRACTING OFFICER
Sheila Bumpass (Signature) 9/29/2010 (Date)
NAME (TYPED) Sheila Bumpass
TITLE Contracting Officer
TELEPHONE NO. 301-492-3484

20. PAYMENT INFORMATION

Payment will be made through the Automated Standard Application for Payment (ASAP.gov) unless the recipient has failed to comply with the program objectives, award conditions, Federal reporting requirements or other conditions specified in 2 CFR 215 (OMB Circular A110).

21. Attached is a copy of the "NRC General Provisions for Grants and Cooperative Agreements Awarded to Non-Government Recipients.
Acceptance of these terms and conditions is acknowledged when Federal funds are used on this project.

22. ORDER OF PRECEDENCE
In the event of a conflict between the recipient's proposal and this award, the terms of the Award shall prevail.

23. By this award, the Recipient certifies that payment of any audit-related debt will not reduce the level of performance of any Federal Program.

TEMPLATE - ADM001 SUNSI REVIEW COMPLETE OCT 04 2010 ADM002

ATTACHMENT A - SCHEDULE

A.1 PURPOSE OF GRANT

The purpose of this Grant is to provide support to Howard University for the project "entitled "Development of a New Course on Nuclear Power with Emphasis on Safety Critical Application in Digital Instrumentation and Control."

A.2 PERIOD OF GRANT

1. The effective date of this Grant is September 20, 2010. The estimated completion date of this Grant is September 29, 2012.

2. Funds obligated hereunder are available for program expenditures for the estimated period: September 30, 2010 – September 29, 2011. Continued funding is subject to the availability of additional funding.

A. GENERAL

1. Total Estimated NRC Amount:	$220,000.00
2. Total Obligated Amount:	$110,000.00
3. Cost-Sharing Amount:	$ 0.00
4. Activity Title:	"Development of a New Course on Nuclear Power with Emphasis on Safety Critical Application in Digital Instrumentation and Control."
5. NRC Project Officer:	Tuwanda Smith
6. DUNS No.:	044507085

B. SPECIFIC

RFPA No.:	SDB-27-10-1123
FFS:	SBC10338
Job Code:	L2284
BOC:	4110
B&R Number:	07P-15-5C1-161
Appropriation #:	31X0200
Amount Obligated:	$110,000.00

A.3 BUDGET

Revisions to the budget shall be made in accordance with Revision of Grant Budget in accordance with 2 CFR 215.25.

	Year 1	Year 2
Personnel	*$62,050*	*$62,700*
Fringe Benefits	*$ 7,682*	*$ 7,682*
Travel	*$ 4,500*	$ 4,500
Supplies	*$11,654*	$11,215
Total Direct Charges	***$85,886***	**$86,097**

Indirect Charges	*$24,114*	$23,903
TOTAL	***$110,000***	***$110,000***

A.4 AMOUNT OF AWARD AND PAYMENT PROCEDURES

1. The total estimated amount of this Award is $220,000.00 for a two (2) year period.

2. NRC hereby obligates the amount of $110,000.00 for program expenditures during the period set forth above and in support of the Budget above. The Grantee will be given written notice by the Contracting Officer when additional funds will be added. NRC is not obligated to reimburse the Grantee for the expenditure of amounts in excess of the total obligated amount.

3. Payment shall be made to the Grantee in accordance with procedures set forth in the Automated Standard Application for Payments (ASAP) Procedures set forth below.

Attachment B – Program Description

1. Introduction

Background
After 15 years of dormancy, the commercial nuclear power industry in the United States observes its resurgence, with 28 new plants at 19 sites and five different plant designs proposed. The industry faces new challenging issues of instrumentation and controls, security and safety interfaces, and new licensing processes. The digital instrumentation and control (I&C) systems have developed tremendously during the past few decades, and the nuclear power generation community has shown carefully but gradually moving away from analog instrumentation towards this digital I&C technology. The rapid computerization in both new and older nuclear power plant (NPP)s by the phase-out of analog technology has resulted in software becoming an important component of NPP design, operation and maintenance. As a result, software reliability plays a crucial role in the safety of NPPs. The achievement of software reliability requires a concerted effort by means of quality assurance. The software quality assurance in NPPs has received considerable attention because of the increasing use of software based I&C systems and continuing difficulty in establishing quantifiable measures for software reliability.

Needs and Objectives
The reliability of computer based control systems has created a new set of concerns, since the failure of a single component, such as a processor or a network card, could disable major functions of the system and cripple the whole plant. Software recovery and ways to develop systems that are tolerant to the "unknown" are continually sought. Therefore, it is vital that the systems deployed today can tolerate tomorrow the kinds of problems that we have never even imagined [1]. Hence, reliability of software and safety against anomalies in nuclear power plant application continue to be of concern. This new situation urgently requires a timely supply of capable engineers who can deal with issues towards the nuclear power industry and nuclear regulatory agencies with working knowledge of the practical aspects of safety against failures in the I&C systems.

The challenge of training students within the nuclear power field and attracting them to the operation and research in nuclear power I&C has two facets. One is to seek the solution to the shortage of qualified engineers in nuclear science and engineering; the other is to provide broad

interdisciplinary knowledge for the students in the field [2]. Therefore, as stressed in the 2004 U.S. House of Representatives hearing on nuclear science and engineering, for a solution, it is imperative to make a giant first step that "would develop a more comprehensive suite of mechanisms that can be implemented to diversify and to add excitement to the field" [3].

The Unique Position of the Investigators and their Institution

This proposal aims to diversify and to add excitement for non-nuclear engineering students to the nuclear engineering field so that they can (1) position themselves to continue towards an advanced degree in this discipline and (2) be exposed to and find employment and research opportunities in the nuclear safety area. The practical approach of achieving these goals is to offer a new course related to this discipline for all engineering students at Howard University as an engineering elective course as a part of their graduation requirement. The course to be developed has two components: "Nuclear Power Engineering" and "Safety-Critical Application of Hardware and Software."

In terms of capability of offering "nuclear power engineering" to general engineering students, the PI and Co-PI and Howard University are in a unique situation. Although, Howard University does not have a nuclear engineering department and neither the PI nor the Co-PI are nuclear engineering researchers/teachers, there are many strengths which can overcome these weaknesses. Having no nuclear engineering department means that all engineering students can be impacted by the proposed goal of exposing non-nuclear engineering students to the nuclear field. The university's strategic location in the nation's capital has the advantage of attracting numerous scholars and experts to the campus for speech/presentation events.

The PI's experience in forming and utilizing an expert network for the guest speaker series in his senior design courses over last 2 years, which have seen more than half dozen speakers every semester in the class, verifies that the advantage is real and can be further cultivated for this new course development and offering. Moreover, the PI's background in power engineering is closely related to nuclear power plant operation and control. This unique position and experience of the PI and the university is expected to easily form a "nuclear expert network" to help the development of "nuclear power engineering" and to actually invite them to the class to teach the part to the students.

For "safety-critical application of hardware and software", the PI and the Co-PI are qualified to develop a learning module on the subject. They have worked for many years in the hardware and software reliability areas. The PI has worked with computer applications and embedded computing with emphasis on hardware, and the Co-PI has focused his research career with emphasis on software and systems engineering, and co-developed the Keiller-Littlewood Software Reliability growth model.

Objectives and Goals of the Project

This project will develop a new course in nuclear power safety with emphasis on safety-critical application in digital instrumentation and control and offer the course to the engineering students at Howard University. The course content will comprises of two major components: (1) nuclear power safety and (2) hardware/software reliability with safety critical application in instrumentation and control in nuclear reactor. The first component will be covered and taught by nuclear power experts of the "nuclear expert network", which is to be formed during the project period. The second component will be developed by the PI and Co-PI through the project.

2. Formation and Utilization of a Nuclear Expert Network

Prior Success in Expert Network for Classes

The unique location of Howard University has provided unique benefit for the students. The experts in local area working for government agencies and national laboratories have been always advocates of learning and have visited classrooms of the university with emerging technologies and great insights. Also helpful have been national experts elsewhere who have frequently traveled to Washington DC area for their own purposes but at the same time are willing to visit the university to share their knowledge for the students.

The PI took advantage of the unique benefit of the strategic location of the university in his senior design class. For the last few years, he has formed a senior design advisor network and utilized it for guest presentations for the students. The network is composed of a variety of personnel in government, industry, and academia. Last semester alone, his class has had 9 such guest presentations with subject ranging from smart and micro-grid, to lunar satellite attitude control, to wireless communication, to electric transmission and reliability, and to risk management. As of the spring semester of 2010, the guest presentation list is still growing with more strength and with new speakers. From the guest presentations, the students have gained not only the content knowledge they needed for their problem solving but also the practical learning, which would have not been possible if the speakers were not real world experts.

The successful experience of the PI's classes of senior design exemplified the unique opportunity of forming and utilizing an expert network for teaching a course for broad audience with focused subjects but wide applications.

Formation of Nuclear Expert Network

In the first year period of the project, a nuclear expert network will be formulated and organized by the initiation of the investigators. The formation will start from within. While the university does not have a nuclear engineering department, it does have a few nuclear engineering degree awarded professors in the engineering school. Most notably, Dr. Emmanuel Glakpe, a professor in the mechanical engineering department, has received a Ph.D. in nuclear engineering. Because of his numerous projects, he cannot join this proposal as an investigator, but he has been a strong advocate of offering a nuclear power related course at Howard University. Dr. Glakpe, along with a professor from the chemical engineering department, will serve as the main focus of the internal (on campus) nuclear experts for the network. Dr. Glakpe will also seek external experts for the network. (Dr. Glapke's letter of acceptance of the role is attached in the Appendix.)

For external experts, the investigators will include a colleague at Prairie View A&M University (PVAMU), another HBCU, in Texas. Dr. Sukesh Aghara is the director of the Nuclear Education Institute at PVAMU and has worked to introduce nuclear science and engineering at the university. Dr. Aghara and his colleagues in the Nuclear Education Institute will serve as the initial focal of the external experts in the network. (Dr. Aghara's letter of the acceptance of the role is attached in the Appendix.) In addition, the investigators of the proposal will actively seek experts in the greater Washington DC area.

3. Nuclear Safety in Digital Instrumentation and Control

The main course development area of the project is the safety education module in digital instrumentation and control. In this section the subject and its importance are discussed.

Digital I&C

A nuclear power plant has a central control room where operators collect, detect, analyze, monitor, and verify many bits of information from multiple indicators and alarms. The major operations in the control room include plant monitoring, plant control, and plant protection actions. Plant monitoring systems monitor plant variables and provide data to other systems and to the plant operators for use in controlling the operation of the plant. Typical examples include monitoring and displaying the status of fluid temperatures and pressures. Plant control systems are used to control all the normal operations of the plant such as startup, power operations, shutdowns, and plant upsets. Typical examples include controlling feed-water and steam, turbine generators, circuit breakers, pumps, and valves throughout the plant. On the other hand, the plant protection systems are an additional, separate layer of systems that monitor the plant variables. A typical example is to take action automatically, when the plant monitoring and control systems have not kept the plant within a predefined set of conditions, to rapidly protect the reactor of the plant by reactor trip or "scram". All the control room operations are supported by I&C systems.

The majority of the I&C systems which monitor and control today's NPPs are largely based on process technology from the 1950s and 1960s. Since the time of the commissioning of the first NPP, three generations of I&C systems have been installed. The first used analog technology for instrumentation and relay based equipment for control. The second generation used discrete or integrated solid state equipment for both functions and the latest uses digital equipment for both [4]. Currently, more NPPs are beginning to apply advanced I&C technology in all aspects of operation and maintenance.

Digital Technology and Common Mode Failure

Software used in NPPs for whether simple combinational logic such as reactor trip functions or more elaborate sequential logic such as actuating engineered safety features must be ensured that required actions are taken and unnecessary trips are avoided. Software errors are an important contributor to system failure. A number of software errors have been found in operating NPP software, and it has been found that the failure due to software errors occurred as often as hardware failures and that software errors tended to be difficult to prevent because they may occur only when an unusual set of inputs exists. Because of the potentially far greater consequences of accidents, the NPP I&C systems must be relied upon to reduce the likelihood of even low-probability events.

Worse yet, digital technology faces another safety issue that common mode software failure may fail redundant safety systems compromising safety functions [4]. Common-mode failure or common cause failures are multiple component failures having the same cause of external or internal influences. External causes may involve operational, environmental, or human factors. The internal one may be a design error inside the supposedly independent hardware/software components [5]. Since software based I&C is known to be vulnerable especially to common-mode failure, the system requires to not only design with redundancy in hardware and operating systems in order to overcome single failures in the hardware but also deploy some kind of diversification strategy in application software to ensure prevention, mitigation or containment of radioactive releases in the event of an abnormal plant transient or an accident.

Defense-in-Depth

Defense-in-depth is a fundamental principle of NPP design and operation for preserving the three basic safety functions: controlling the power, cooling the fuel, and confining the radioactive materials. All safety activities are subject to layers of overlapping provisions so that if a failure

occurred it would be compensated for or corrected without causing harm to individuals or the public at large. The defense in depth concept, when properly applied, ensures that no single human or mechanical failure could lead to injury of the public and that even combinations of failures which are only remotely possible would lead to little or no injury. For safety-critical applications, defense in depth includes the use of redundancy, diversity, separation and failure to safety or fail-safe [6].

Out of these four approaches of defense in depth, we are more interested in diversity against common mode failure for this course module development project. The main reason is that the benefit of redundancy can be defeated by common mode failure and that the separation and fail-safe are more difficult to realize in academic environments or experiments. Diversity, in particular, has been rigorously attempted to mandate by regulatory agencies in North American and Europe. The U.S. Nuclear Regulatory Commission (USNRC) considers software design errors to be credible common-mode failures that must be specifically included in the evaluation, and firmly requires that applicant shall "assess the defense-in-depth and diversity of the proposed instrumentation and control system to demonstrate that vulnerabilities to common-mode failures have been adequately addressed." In addition, the Canadian Atomic Energy Control Board (AECB)'s draft regulatory guide C-138, Software in Protection and Control Systems, requires that "the system may need to be designed to use multiple, diverse components performing the same or similar functions". The AECB draft regulatory guide agrees with the USNRC with respect to recognizing the possibility of common-mode software failure and requiring steps, with diversity measures, to be taken to reduce that possibility [7].

In software, common-mode failures are generally a result of specification errors, not simple programmer errors. Simple programmer faults are less subtle than are specification errors and usually be detected and fixed easily. Whenever specification errors are present, they are likely to results in faults that cause outputs to occur satisfying the definition for common-mode failure. Emphasis is to ensure that the specifications are complete and correct that the human errors related to safety critical systems are properly handled [1].

Design and Functional Diversities

The basic principle of diversity to protect against common mode errors is to use hardware and/or software components with a different internal design but performing the same function ("design diversity approach") or to use hardware and/or software components that perform completely different functions for the same upper level purpose ("functional diversity approach"). In the design diversity approach, multiple versions of software of different algorithms can be written for the same function. For hardware, processors and operating systems from completely different architectures and designs can be employed for the same function [8].

The functional diversity involves components that perform completely different functions at the component level with, very importantly, different requirements. Diversity in this case involves using different principles of operation or physical principles to satisfy the same system-level requirements. An example of functional diversity, in the reactor scram control case, is the use of high "reactor power to flow" ratio to cause a reactor trip using control rods, and high coolant temperature to cause a reactor trip using boron concentration [9].

Development of Nuclear Safety Education Module for Digital I&C

This safety centered education module development will focus on the defense-in-depth principle of design and functional diversity in both hardware and software. The course module will be composed of (a) Digital system developments systems for/of MCS (Microprocessor Control Unit) , FPGA (Field Programmable Gate Array), and PLC, (b)PLC (Programmable Logic

Controller) based Reactor Control HIL ("Hardware in the loop"), and (c) a manual for the module.

The module would employ diverse design architectures by implementing three different digital control systems such as PLC, MCU, and FPGA based digital system along with design and functional diversity in control application software. In case of software, the course module will impose different behavioral requirements for the same function. For example, in comparison of two numbers, it will require one program check to see whether two numbers are equal and another program select the larger of two numbers. Further, the course module will adopt syntactic diversity with differences in the syntax or lexical structure of the programs as a way of providing diversity in software for the training of students in the safety-critical applications in digital systems. Demonstration of software analysis tools that employs fault injection to performance fault tolerance assessment of safety critical systems will be conducted.

The target experiment is the reactor scram control. The reactor control system will be featured by soft controls on compact PLC as an HIL for digital embedded system to provide convenient lab and experimentation environment which responds and displays appropriately connected with diverse architectures of PLC, MCU, and FPGA with software diversity to emphasize the prevention of common mode failure. In the experiment, typically, a scenario would be generated in the HIL such a way that the designed digital system responds for reactor scram control in which students are required to test and measure common mode failure incidents under different combinations of hardware and software configurations. The scenario would include different reactor scram cases with set points and coincidence logic combinations according to the detailed scram conditions. The instrumentation for the reactor shutdown will be provided in the HIL module to supply the necessary signals for the rector shutdown system

4. A New Course of Nuclear Power with Emphasis on Preserving Safety

Academic Focus

The academic focus of the proposed new course is to offer an introductory nuclear safety course, with emphasis on safety-critical application of hardware and software in digital instrumentation and control, to the minority students of the college of engineering at Howard University where there is no nuclear engineering department. The developed course will be available to all engineering students as an engineering science elective course which, in every department, serves as a degree requirement course. The course will be taught by two groups of experts. The introductory components related to the general nuclear power and safety and operation would be taught by the pool of nuclear power experts under the organization and coordination of the PI and Co-PI of the proposal. The second component, the main course module that will be developed in the first year period, will be taught by the PI and the Co-PI with practical and hands-on training in real hardware and software environment. Through the course, the students will get easy exposure to nuclear engineering in general and nuclear safety in particular. They would also get better employment and research opportunities in this expanding and important area of engineering.

Utilization of the New Course

Upon the completion of the formation of the nuclear expert network, of the selection of the experts and their presentation topics, and of the safety-critical application teaching module, in the first year of project period, the new course will be offered in the first semester of the second (and the last) project year. The target audience will be all engineering students at Howard University.

Broader Impacts

The new course offering provides a rare and much needed opportunity of learning nuclear power and nuclear power safety for the non-nuclear engineering students at Howard University, an HBCU. From the diverse guest speakers of expertise in nuclear power, they are expected to learn practical knowledge on the subject with real world perspective, which makes their learning active and long-lasting. The developed course module on software/hardware reliability experiment system will provide them with experiences of real-world tasks in the critical area of fault tolerant in safety-critical system application. Also, students would be exposed to the real safety-critical environment of NPP and, specifically, reactor control systems.

Assessment of the Project

The project has two outcomes to achieve: (1) the effectiveness of the learning model of combining guest speakers for general subject knowledge gain and the in-depth learning with experiments from the in-house developed learning module; and (2) the number of students who takes the new course. In addition, sustaining the course after the end of the project is an outcome to achieve over the long period of time. Actually, the first two outcomes are to achieve and to sustain the course and disseminate it to other minority institutions and the broader community. The assessment instrument for the first outcome includes student surveys for the acceptance of the new teaching model and students grades on general understanding of nuclear power and nuclear safety. It also includes surveys for the expert speakers for their views and experiences on the effectiveness of the course teaching model. For the second outcome, the assessment instrument is simply the number of students enrolled and received grades from the course. For the survey design, Dr. Veronica Thomas of Education Department at Howard University will help the investigators as she did for the PI in their Tablet PC and Mobile Studio project assessment [10].

5. Tasks and Timelines

In the 2-year project period, the following tasks are planned to achieve the goal and the outcomes.

Formation of Nuclear Expert Network (October 2010 – May 2011)

During the entire first year period of the project, formulation of the nuclear expert network will continue along with other activities described below. The formation will start from on-campus expert, such as Dr. Emmanuel Glakpe, and move on to include external experts including Dr. Sukesh Aghara. Then, the investigators will expand and fill the network with experts from government agencies, industry, and academia. The target goal of the number of experts for the network is 15. The target goal of the number of the guest presentations by the experts in the first course offering is six (6) in the following subject areas: nuclear engineering introduction, nuclear safety, nuclear power operation, digital instrumentation and control, nuclear reactor and control, and nuclear licensing.

Course Module Development 1 - Digital System Setup (October 2010 – February 2011)

The development system of the selected hardware platform will be developed using a PC-based system which supports the coding of the hardware platforms and the evaluation of the codes. The task for the development system includes the selection of the specific platform under consideration and the proper development environment for the platform. Specifically, as an MCU, an Atmel ATmega16 controller will be considered while a Xilinx Spartan will be studied as an FPGA. In addition, a PLC from GE or Siemens is considered as the third hardware platform. In the selection process, a decision-matrix will be applied with different attributes with safety and

reliability as the top priorities.

Course Module Development 2 - Reactor HIL Development (March 2011 – September 2011)
The HIL of reactor will be developed to work as a pseudo-reactor of pressurized water reactor (PBR) protection channel system using the platform of PLC. PLCs are relatively simple, generally accepting a few input signals and performing only a few control functions, and their availability of low cost has had a significant impact on NPP control systems. With matured communication systems, they are increasingly being incorporated in distributed control system designs for NPPs. Modern PLCs offer flexible input and output choices and control programs can be developed with a program loader which writes and loads the program into PLC. A logic solver reads the states of sensors through input modules, uses this information to solve the logic and writes the resulting output states to output devices through output modules. At nuclear plants, PLCs first found applications in the non-nuclear portions but they are now increasingly being used within the nuclear application. An interesting application of PLCs in safety was to implement trip parameters which require extensive conditioning and trip parameters of reactor power. For our use of PLC in the reactor scram control HIL development, we will take advantage of the flexible relay ladder logic (RLL) programming of PLC for controlling the real-time event-driven safety system. The main reactor control will be developed and implemented as the HIL simulator following the logic channel matrix for reactor trip so that it simulates reactor shutdown instrumentation and control with scenarios following the industry practices. The logic of the sequence will be derived from the established reactor I&C process available from reactor instrumentation and control guides such as reference [11].

Nuclear Expert Network Workshop (May 2011)
A 1-day workshop at Howard University is planned to discuss, among the investigators and the members of the nuclear expert network, the course contents and to consult the content and the direction of the safety-critical learning module. All internal and external experts are to be invited for their inputs. The result and consensus will be applied in the finalization of the course content and the module development. Over the same workshop period, the internal experts and college administrators will join together to discuss about and conclude the way the course would be offered in the engineering college.

Course Manual Development (June 2011 – August 2011)
The course manual will include the subjects of guest speaker presentations determined by the workshop and the safety-critical course module experimentation. In addition to the theory and practice of hardware and software reliability, the course manual will also include the standards for safety-critical application of digital systems. For industry independent standard, the standard IEC 61508 "Functional safety of electrical / electronic / programmable electronic safety-related systems (E/E/PES)"will be included to cover basic functional safety [12]. Also included will be the following three IEC standards [4]: (a) IEC 880 "Software for Computers in the Safety Systems of Nuclear Power Stations", (b) "IEC 987 Programmed Digital Computers Important to Safety for Nuclear Power Plants", and (c) "IEC 1513 Nuclear Power Plants: Instrumentation and Control: Systems Important to Safety: General Requirements for Computer-Based Systems".

First Offering of the New Course (August 2011 – May 2012)
With the completed digital hardware system setup, excited and willing guest speakers, and the online available electronic course manual, the investigators will offer the new course for the first time in the Fall 2011 semester by cross-listing for all engineering students. During the course, surveys will be taken from the students and the guest speakers to measure the acceptance level of the course, the number of students taking the course, and to receive instant responses and feedback for a quick resolution of any foreseeable problems and difficulties. At the end of

the course, a professionally designed survey will be conducted for a comprehensive analysis of the acceptance and effectiveness of the unique teaching model of the nuclear safety education of non-nuclear engineering students at Howard University. The finding and comment from the surveys will be combined as a revision request for betterment of the course.

Course Content and Module Revision (June 2012 – August 2012)
Over the summer, the investigators will implement the requested revision to the course content and the safety-critical learning module and revise the course manual accordingly. Also, the nuclear expert network will be filled and replenished with new experts while keeping the existing members. At the end of the summer, which is the end of the project period, a revised course will be ready for another course offering opportunity. Also, the investigators will report the findings and lessons of the project, submit papers to nuclear education related conferences, and make the information available on the project's web page.

Second Course Offering (September 2012)
The second offering of the course will be launched in Fall 2012 semester.

6. Institutional Capability and Commitment

Capability and Commitment
The unique location of Howard University can provide strength in forming the nuclear expert network with internal and external experts and inviting them to give guest presentations for the students of the new course. The PI's successful experience in forming and utilizing a expert network for guest speaker series in his senior design courses exemplifies the strength of the unique location of the university, and the PI is confident that he can further cultivate the network for this new course development and offering.

The Department of Electrical and Computer Engineering at Howard University will provide necessary hardware such as laptops when needed and IT support to complete and maintain the course module. Additionally, the department ensures that the new course would be fully implemented in the computer engineering and computer science curriculum. The department's full-time lab technician will maintain and administer the equipment and facility for the course module in good and working condition for the entire project period and afterwards. The Department of Systems and Computer Sciences department would also provide the necessary support when needed. (The supporting letters from the chairs of both departments are attached in the Appendix.)

The School of Engineering and Computer Sciences is also committed to the proposed new course in nuclear power. Dr. Ramesh Chawla, a professor of Chemical Engineering and the Director of Engineering School supports the new course offering as a next level focused course on nuclear safety and safety-critical I&C to the basic science course of nuclear engineering he and his colleagues are currently developing. (Dr. Chawla's supporting letter is attached in the Appendix.) In addition, the College of Engineering, Architecture, and Computer Sciences (CEACS) is equally committed to the new course in nuclear safety. (The supporting letter from the Dean of CEACAS is attached in the Appendix.)

Dissemination and Assessment
There will be a dedicated web page for the project, and its content would be updated as progress is made and milestones are achieved. In addition to the broadcast of the project progress over the Internet, direct outreach to the Howard University community would be made

through the invitation of faculty members to the nuclear expert network and to the workshop. The experts in the nuclear expert are expected to become the evangelists of the course and the course teaching model, which would be the most effective dissemination of the project. In the greater academic community, the final result will be presented at engineering education conferences.

The project's two outcomes will be assessed throughout the course offering period to measure the effectiveness of the learning model of combining guest speakers for general subject knowledge gain and the in-depth learning with experiments from the in-house developed learning module as well as the number of students who take the new course. Over the course, surveys will be taken from the students and the guest speakers to measure the acceptance level of the course and the number of students taking the course. At least one comprehensive survey will be designed and conducted by an educational specialist of Howard University. The assessment result will be a guideline for a revision process of the course content and the safety-critical course modules. The assessment result will be presented in the engineering education community and the Web for wide dissemination of the project result.

7. Conclusions

The proposal aims to develop a new course on nuclear power in order to effectively teach and train students of all engineering departments at Howard University with emphasis on the concept of hardware/software diversity for common mode failures and the realistic practice of the concept in the situation of rector scram control in nuclear power plant operation. A unique teaching model is applied in offering the new course. The model seeks to teach the new course by combining quest experts who teach general nuclear engineering concepts and theories, which, elsewhere, would have been taught by nuclear engineering professors, and the investigators who teaches a specific area of software/hardware reliability in digital instrumentation and control. The location of Howard University makes this new approach of learning and teaching possible. The new course will be offered to all engineering students at Howard University as an interdisciplinary engineering elective course. The effectiveness of the new course and the number of students taking the course would be assessed for a better and sustainable course. This project makes a great impact in the underrepresented minority students at Howard University in their leaning and their enhanced employment opportunities in the nuclear power area.

8. References

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Attachment C – Standard Terms and Conditions

The Nuclear Regulatory Commission's Standard Terms and Conditions for U.S. Nongovernmental Grantees

Preface

This award is based on the application submitted to, and as approved by, the Nuclear Regulatory Commission (NRC) under the authorization 42 USC 2051(b) pursuant to section 31b and 141b of the Atomic Energy Act of 1954, as amended, and is subject to the terms and conditions incorporated either directly or by reference in the following:

- Grant program legislation and program regulation cited in this Notice of Grant Award.
- Restrictions on the expenditure of Federal funds in appropriation acts, to the extent those restrictions are pertinent to the award.
- Code of Federal Regulations/Regulatory Requirements - 2 CFR 215 Uniform Administrative Requirements For Grants And Agreements With Institutions Of Higher Education, Hospitals, And Other Non-Profit Organizations (OMB Circulars), as applicable.

To assist with finding additional guidance for selected items of cost as required in 2 CRF 220, 2 CFR 225, and 2 CFR 230 these URLs to the Office of Management and Budget Cost Circulars are included for reference:

A-21 (now 2CFR 220):	http://www.whitehouse.gov/omb/circulars/a021/print/a021.html
A-87 (now 2CFR 225:	http://www.whitehouse.gov/omb/circulars/a087/print/a087-all.html
A-122 (now2 CFR 230	http://www.whitehouse.gov/omb/circulars/a122/print/a122.html
A-102, SF 424:	http://www.whitehouse.gov/omb/circulars/a102/print/a102.html

Form 990: http://www.irs.gov/pub/irs-pdf/i990-ez.pdf

Any inconsistency or conflict in terms and conditions specified in the award will be resolved according to the following order of precedence: public laws, regulations, applicable notices published in the Federal Register, Executive Orders (EOs), Office of Management and Budget (OMB) Circulars, the Nuclear Regulatory Commission's (NRC) Mandatory Standard Provisions, special award conditions, and standard award conditions.

By drawing funds from the Automated Standard Application for Payment system (ASAP), the recipient agrees to the terms and conditions of an award.

Certifications and representations. These terms incorporate the certifications and representations required by statute, executive order, or regulation that were submitted with the SF424B application through Grants.gov.

I. Mandatory General Requirements

The order of these requirements does not make one requirement more important than any other requirement.

1. Applicability of 2 CFR Part 215

a. All provisions of 2 CFR Part 215 and all Standard Provisions attached to this grant/cooperative agreement are applicable to the Grantee and to sub-recipients which meet the definition of "Grantee" in Part 215, unless a section specifically excludes a sub-recipient from coverage. The Grantee and any sub-recipients must, in addition to the assurances made as part of the application, comply and require each of its sub-awardees employed in the completion of the project to comply with Subpart C of 2 CFR 215 Part 180 and include this term in lower-tier (subaward) covered transactions.

b. Grantees must comply with monitoring procedures and audit requirements in accordance with OMB Circular A-133. < http://www.whitehouse.gov/omb/circulars/a133_compliance/08/08toc.aspx >

2. Award Package

Grant Performance Metrics:

The Office of Management and Budget requires all Federal Agencies providing funding for educational scholarships and fellowships as well as other educational related funding to report on specific metrics. These metrics are part of the Academic Competitiveness Council's (ACC) 2007 report and specifically relates to Science, Technology, Engineering, and Mathematics (STEM) curricula.

Service Agreement

A signed service agreement and resume are required for all student recipients of scholarships or fellowships funded by the US Nuclear Regulatory Commission. The Service Agreement is attached to the Terms and Conditions.

§ 215.41 Grantee responsibilities.
The Grantee is obligated to conduct such project oversight as may be appropriate, to manage the funds with prudence, and to comply with the provisions outlined in 2 CFR 215.41 Within this framework, the Principal Investigator (PI) named on the award face page, Block 11, is responsible for the scientific or technical direction of the project and for preparation of the project performance reports. This award is funded on a cost reimbursement basis not to exceed the amount awarded as indicated on the face page, Block 16., and is subject to a refund of unexpended funds to NRC.

The standards contained in this section do not relieve the Grantee of the contractual responsibilities arising under its contract(s). The Grantee is the responsible authority, without recourse to the NRC, regarding the settlement and satisfaction of all contractual and administrative issues arising out of procurements entered into in support of an award or other agreement. This includes disputes, claims, protests of award, source evaluation or other matters of a contractual nature. Matters concerning violation of statute are to be referred to such Federal, State or local authority as may have proper jurisdiction.

Subgrants
Appendix A to Part 215—Contract Provisions

Sub-recipients, sub-awardees, and contractors have no relationship with NRC under the terms of this grant/cooperative agreement. All required NRC approvals must be directed through the Grantee to NRC. See 2 CFR 215.180 and 215.41.

Nondiscrimination
(This provision is applicable when work under the grant/cooperative agreement is performed in the U.S. or when employees are recruited in the U.S.)

No U.S. citizen or legal resident shall be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity funded by this award on the basis of race, color, national origin, age, religion, handicap, or sex. The Grantee agrees to comply with the non-discrimination requirements below:

Title VI of the Civil Rights Act of 1964 (42 USC §§ 2000d et seq)
Title IX of the Education Amendments of 1972 (20 USC §§ 1681 et seq)
Section 504 of the Rehabilitation Act of 1973,as amended (29 USC § 794)
The Age Discrimination Act of 1975, as amended (42 USC §§ 6101 et seq)
The Americans with Disabilities Act of 1990 (42 USC §§ 12101 et seq)
Parts II and III of EO 11246 as amended by EO 11375 and 12086.
EO 13166, "Improving Access to Services for Persons with Limited English Proficiency."
Any other applicable non-discrimination law(s).

Generally, Title VII of the Civil Rights Act of 1964, 42 USC § 2000e et seq, provides that it shall be an unlawful employment practice for an employer to discharge any individual or otherwise to discriminate against an individual with respect to compensation, terms, conditions, or privileges of employment because of such individual's race, color, religion, sex, or national origin. However, Title VII, 42 USC § 2000e-1(a), expressly exempts from the prohibition against discrimination on the basis of religion, a religious corporation, association, educational institution, or society with respect to the employment of individuals of a particular religion to perform work connected with the carrying on by such corporation, association, educational institution, or society of its activities.

Modifications/Prior Approval
NRC prior written approval may be required before a Grantee makes certain budget modifications or undertakes particular activities. If NRC approval is required for changes in the grant or cooperative agreement, it must be requested of, and obtained from, the NRC Grants Officer in advance of the change or obligation of funds. All requests for NRC prior approval must be made, in writing (which includes submission by e-mail), to the designated Grants Specialist and Program Office no later than 30 days before the proposed change. The request must be signed by both the PI and the authorized organizational official. Failure to obtain prior approval, when required, from the NRC Grants Officer may result in the disallowance of costs, termination of the award, or other enforcement action within NRC's authority.

Lobbying Restrictions
The Grantee will comply, as applicable, with provisions of the Hatch Act (5 U.S.C. §§1501-1508 and 7324-7328) which limit the political activities of employees whose principal employment activities are funded in whole or in part with Federal funds.

The Grantee shall comply with provisions of 31 USC § 1352. This provision generally prohibits the use of Federal funds for lobbying in the Executive or Legislative Branches of the Federal Government in connection with the award, and requires disclosure of the use of non-Federal funds for lobbying.

The Grantee receiving in excess of $100,000 in Federal funding shall submit a completed Standard Form (SF) LLL, "Disclosure of Lobbying Activities," regarding the use of non-Federal funds for lobbying within 30 days following the end of the calendar quarter in which there occurs any event that requires disclosure or that materially affects the accuracy of the information contained in any disclosure form previously filed. The Grantee must submit the SF-LLL, including those received from sub-recipients, contractors, and subcontractors, to the Grants Officer.

§ 215.13 Debarment And Suspension.
The Grantee agrees to notify the Grants Officer immediately upon learning that it or any of its principals:

(1) Are presently excluded or disqualified from covered transactions by any Federal department or agency;

(2) Have been convicted within the preceding three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, tax evasion, receiving stolen property, making false claims, or obstruction of justice; commission of any other offense indicating a lack of business integrity or business honesty that seriously and directly affects your present responsibility;

(3) Are presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph (1)(b); and

(4) Have had one or more public transactions (Federal, State, or local) terminated for cause or default within the preceding three years.

b. The Grantee agrees that, unless authorized by the Grants Officer, it will not knowingly enter into any subgrant or contracts under this grant/cooperative agreement with a person or entity that is included on the Excluded Parties List System (http://epls.arnet.gov).

The Grantee further agrees to include the following provision in any subgrant or contracts entered into under this award:

'Debarment, Suspension, Ineligibility, and Voluntary Exclusion

The Grantee certifies that neither it nor its principals is presently excluded or disqualified from participation in this transaction by any Federal department or agency. The policies and procedures applicable to debarment, suspension, and ineligibility under NRC-financed transactions are set forth in 2 CFR Part 180.'

Drug-Free Workplace
The Grantee must be in compliance with The Federal Drug Free Workplace Act of 1988. The policies and procedures applicable to violations of these requirements are set forth in 41 USC 702.

Implementation of E.O. 13224 -- Executive Order On Terrorist Financing
The Grantee is reminded that U.S. Executive Orders and U.S. law prohibits transactions with, and the provision of resources and support to, individuals and organizations associated with terrorism. It is the legal responsibility of the Grantee to ensure compliance with these Executive Orders and laws. This provision must be included in all contracts/sub-awards issued under this grant/cooperative agreement.
Award Grantees must comply with Executive Order 13224, Blocking Property and Prohibiting Transactions with Persons who Commit, Threaten to Commit, or Support Terrorism. Information about this Executive Order can be found at: www.fas.org/irp/offdocs/eo/eo-13224.htm.

Procurement Standards. § 215.40
Sections 215.41 through 215.48 set forth standards for use by Grantees in establishing procedures for the procurement of supplies and other expendable property, equipment, real property and other services with Federal funds. These standards are furnished to ensure that such materials and services are obtained in an effective manner and in compliance with the provisions of applicable Federal statutes and executive orders. No additional procurement standards or requirements shall be imposed by the Federal awarding agencies upon Grantees, unless specifically required by Federal statute or executive order or approved by OMB.

Travel
Travel is an appropriate charge to this award and prior authorization for specific trips are not required, as long as the trip is identified in the Grantee's original program description and original budget. All other travel, domestic or international, must not increase the total estimated award amount. Trips that have not been identified in the approved budget require the written prior approval of the Grants Officer.

Travel will be in accordance with the US Government Travel Regulations at: www.gsa.gov/federaltravelregulation and the per diem rates set forth at: www.gsa.gov/perdiem.

Travel costs to the grant must be consistent with provisions as established in Appendix A to 2 CFR 220 (J.53)

Property Management Standards
Property standards of this award shall follow provisions as established in 2 CFR 215.30.

Equipment procedures shall follow provision established in 2 CFR 215.34.

Procurement Standards
Procurement standards of this award shall follow provisions as established in 2 CFR 215.40.

Intangible and Intellectual Property
Intangible and intellectual property of this award shall generally follow provisions established in 2 CFR 215.36.

Inventions Report - The Bayh-Dole Act (P.L. 96-517) affords Grantees the right to elect title and retain ownership to inventions they develop with funding under an NRC grant award ("subject inventions"). In accepting an award, the Grantee agrees to comply with applicable NRC policies, the Bayh-Dole Act, and its Government-wide implementing regulations found at Title 37, Code of Federal Regulations (CFR) Part 401. A significant part of the regulations require that the Grantee report all subject inventions to the awarding agency (NRC) as well as include an acknowledgement of federal support in any patents. NRC participates in the trans-government Interagency Edison system (http://www.iedison.gov) and expects NRC funding Grantees to use this system to comply with Bayh-Dole and related intellectual property reporting requirements. The system allows for Grantees to submit reports electronically via the Internet. In addition, the invention must be reported in continuation applications (competing or non-competing).

Patent Notification Procedures- Pursuant to EO 12889, NRC is required to notify the owner of any valid patent covering technology whenever the NRC or its financial assistance Grantees, without making a patent search, knows (or has demonstrable reasonable grounds to know) that technology covered by a valid United States patent has been or will be used without a license from the owner. To ensure proper notification, if the Grantee uses or has used patented technology under this award without license or permission from the owner, the Grantee must notify the Grants Officer. This notice does not necessarily mean that the Government authorizes and consents to any copyright or patent infringement occurring under the financial assistance.

Data, Databases, and Software - The rights to any work produced or purchased under a NRC federal financial assistance award are determined by 2 CFR 215.36. Such works may include data, databases or software. The Grantee owns any work produced or purchased under a NRC federal financial assistance award subject to NRC's right to obtain, reproduce, publish or otherwise use the work or authorize others to receive, reproduce, publish or otherwise use the data for Government purposes.

Copyright - The Grantee may copyright any work produced under a NRC federal financial assistance award subject to NRC's royalty-free nonexclusive and irrevocable right to reproduce, publish or otherwise use the work or authorize others to do so for Government purposes. Works jointly authored by NRC and Grantee employees may be copyrighted but only the part authored by the Grantee is protected because, under 17 USC § 105, works produced by

Government employees are not copyrightable in the United States. On occasion, NRC may ask the Grantee to transfer to NRC its copyright in a particular work when NRC is undertaking the primary dissemination of the work. Ownership of copyright by the Government through assignment is permitted under 17 USC § 105.

Records retention and access requirements for records of the Grantee shall follow established provisions in 2 CFR 215.53.

Organizational Prior Approval System
In order to carry out its responsibilities for monitoring project performance and for adhering to award terms and conditions, each Grantee organization shall have a system to ensure that appropriate authorized officials provide necessary organizational reviews and approvals in advance of any action that would result in either the performance or modification of an NRC supported activity where prior approvals are required, including the obligation or expenditure of funds where the governing cost principles either prescribe conditions or require approvals.

The Grantee shall designate an appropriate official or officials to review and approve the actions requiring NRC prior approval. Preferably, the authorized official(s) should be the same official(s) who sign(s) or countersign(s) those types of requests that require prior approval by NRC. The authorized organization official(s) shall not be the principal investigator or any official having direct responsibility for the actual conduct of the project, or a subordinate of such individual.

Conflict Of Interest Standards of this award shall follow provisions as established in 2 CFR 215.42 Codes of Conduct.

Dispute Review Procedures
a. Any request for review of a notice of termination or other adverse decision should be addressed to the Grants Officer. It must be postmarked or transmitted electronically no later than 30 days after the postmarked date of such termination or adverse decision from the Grants Officer.

b. The request for review must contain a full statement of the Grantee's position and the pertinent facts and reasons in support of such position.

c. The Grants Officer will promptly acknowledge receipt of the request for review and shall forward it to the Director, Office of Administration, who shall appoint a review committee consisting of a minimum of three persons.

d. Pending resolution of the request for review, the NRC may withhold or defer payments under the award during the review proceedings.

e. The review committee will request the Grants Officer who issued the notice of termination or adverse action to provide copies of all relevant background materials and documents. The committee may, at its discretion, invite representatives of the Grantee and the NRC program office to discuss pertinent issues and to submit such additional information as it deems appropriate. The chairman of the review committee will insure that all review activities or proceedings are adequately documented.

f. Based on its review, the committee will prepare its recommendation to the Director, Office of Administration, who will advise the parties concerned of his/her decision.

Termination and Enforcement. Termination of this award by default or by mutual consent shall follow provisions as established in 2 CFR 215.60,

Monitoring and Reporting § 215.51

a. Grantee Financial Management systems must comply with the established provisions in 2 CFR 215.21

- Payment – 2 CFR 215.22
- Cost Share – 2 CFR 215.23
- Program Income – 2 CFR 215.24
  - Earned program income, if any, shall be added to funds committed to the project by the NRC and Grantee and used to further eligible project or program objectives.
- Budget Revision – 2 CFR 215.25
  - In accordance with 2 CFR 215.25(e), the NRC waives the prior approval requirement for items identified in sub-part (e)(1-4).
  - The Grantee is not authorized to rebudget between direct costs and indirect costs without written approval of the Grants Officer.
  - Allowable Costs – 2 CFR 215.27

b. **Federal Financial Reports**

Effective October 1, 2008, NRC transitioned from the SF–269, SF–269A, SF–272, and SF–272A to the Federal Financial Report (SF-425) as required by OMB:
http://www.whitehouse.gov/omb/fedreg/2008/081308_ffr.pdf
http://www.whitehouse.gov/omb/grants/standard_forms/ffr.pdf
http://www.whitehouse.gov/omb/grants/standard_forms/ffr_instructions.pdf

The Grantee shall submit a "Federal Financial Report" (SF-425) on a quarterly basis for the periods ending 3/31, 6/30, 9/30, and 12/31 or any portion thereof, unless otherwise specified in a special award condition. Reports are due no later than 30 days following the end of each reporting period. A final SF-425 shall be submitted within 90 days after expiration of the award.

Period of Availability of Funds 2 CFR § 215.28

a. Where a funding period is specified, a Grantee may charge to the grant only allowable costs resulting from obligations incurred during the funding period and any pre-award costs authorized by the NRC.

b. Unless otherwise authorized in 2 CFR 215.25(e)(2) or a special award condition, any extension of the award period can only be authorized by the Grants Officer in writing. Verbal or written assurances of funding from other than the Grants Officer shall not constitute authority to obligate funds for programmatic activities beyond the expiration date.

c. The NRC has no obligation to provide any additional prospective or incremental funding. Any modification of the award to increase funding and to extend the period of performance is at the sole discretion of the NRC.

d. Requests for extensions to the period of performance shall be sent to the Grants Officer at least 30 days prior to the grant/cooperative agreement expiration date. Any request for extension after the expiration date shall not be honored.

Automated Standard Application For Payments (ASAP) Procedures

Unless otherwise provided for in the award document, payments under this award will be made using the Department of Treasury's Automated Standard Application for Payment (ASAP) system < http://www.fms.treas.gov/asap/ >. Under the ASAP system, payments are made through preauthorized electronic funds transfers, in accordance with the requirements of the Debt Collection Improvement Act of 1996. In order to receive payments under ASAP, Grantees are required to enroll with the Department of Treasury, Financial Management Service, and Regional Financial Centers, which allows them to use the on-line method of withdrawing funds from their ASAP established accounts. The following information will be required to make withdrawals under ASAP: (1) ASAP account number – the award number found on the cover sheet of the award; (2) Agency Location Code (ALC) – 31000001; and Region Code. Grantees enrolled in the ASAP system do not need to submit a "Request for Advance or Reimbursement" (SF-270), for payments relating to their award.

Audit Requirements

Organization-wide or program-specific audits shall be performed in accordance with the Single Audit Act Amendments of 1996, as implemented by OMB Circular A-133, "Audits of States, Local Governments, and Non-Profit Organizations." http://www.whitehouse.gov/omb/circulars/a133/a133.html Grantees are subject to the provisions of OMB Circular A-133 if they expend $500,000 or more in a year in Federal awards.

The Form SF-SAC and the Single Audit Reporting packages for fiscal periods ending on or after January 1, 2008 must be submitted online.

1. Create your online report ID at http://harvester.census.gov/fac/collect/ddeindex.html
2. Complete the Form SF-SAC
3. Upload the Single Audit
4. Certify the Submission
5. Click "Submit."

Organizations expending less than $500,000 a year are not required to have an annual audit for that year but must make their grant-related records available to NRC or other designated officials for review or audit.

III. Programmatic Requirements

Performance (Technical) Reports

a. The Grantee shall submit performance (technical) reports electronically to the NRC Project Officer and Grants Officer as specified in the special award conditions in the same frequency as the Federal Financial Report unless otherwise authorized by the Grants Officer.

b. Unless otherwise specified in the award provisions, performance (technical) reports shall contain brief information as prescribed in the applicable uniform administrative requirements 2 CFR §215.51 which are incorporated in the award.

c. The submission for the six month period ending March 31st is due by April 30th. The submission for the six month period ending September 30th is due by October 31st.

Unsatisfactory Performance

Failure to perform the work in accordance with the terms of the award and maintain at least a satisfactory performance rating or equivalent evaluation may result in designation of the Grantee as high risk and assignment of special award conditions or other further action as specified in the standard term and condition entitled "Termination".

Failure to comply with any or all of the provisions of the award may have a negative impact on future funding by NRC and may be considered grounds for any or all of the following actions: establishment of an accounts receivable, withholding of payments under any NRC award, changing the method of payment from advance to reimbursement only, or the imposition of other special award conditions, suspension of any NRC active awards, and termination of any NRC award.

Other Federal Awards With Similar Programmatic Activities

The Grantee shall immediately provide written notification to the NRC Project Officer and the Grants Officer in the event that, subsequent to receipt of the NRC award, other financial assistance is received to support or fund any portion of the program description incorporated into the NRC award. NRC will not pay for costs that are funded by other sources.

Prohibition Against Assignment By The Grantee

The Grantee shall not transfer, pledge, mortgage, or otherwise assign the award, or any interest therein, or any claim arising thereunder, to any party or parties, banks, trust companies, or other financing or financial institutions without the express written approval of the Grants Officer.

Site Visits

The NRC, through authorized representatives, has the right, at all reasonable times, to make site visits to review project accomplishments and management control systems and to provide such technical assistance as may be required. If any site visit is made by the NRC on the premises of the Grantee or contractor under an award, the Grantee shall provide and shall require his/her contractors to provide all reasonable facilities and assistance for the safety and convenience of the Government representative in the performance of their duties. All site visits and evaluations shall be performed in such a manner as will not unduly delay the work.

IV. Miscellaneous Requirements

Criminal and Prohibited Activities

a. The Program Fraud Civil Remedies Act (31 USC §§ 3801-3812), provides for the imposition of civil penalties against persons who make false, fictitious, or fraudulent claims to the Federal government for money (including money representing grant/cooperative agreements, loans, or other benefits.)

b. False statements (18 USC § 287), provides that whoever makes or presents any false, fictitious, or fraudulent statements, representations, or claims against the United States shall be subject to imprisonment of not more than five years and shall be subject to a fine in the amount provided by 18 USC § 287.

c. False Claims Act (31 USC 3729 et seq), provides that suits under this Act can be brought by the government, or a person on behalf of the government, for false claims under federal assistance programs.

d. Copeland "Anti-Kickback" Act (18 USC § 874), prohibits a person or organization engaged in a federally supported project from enticing an employee working on the project from giving up a part of his compensation under an employment contract.

American-Made Equipment And Products
Grantees are herby notified that they are encouraged, to the greatest extent practicable, to purchase American-made equipment and products with funding provided under this award.

Increasing Seat Belt Use in the United States
Pursuant to EO 13043, Grantees should encourage employees and contractors to enforce on-the-job seat belt policies and programs when operating company-owned, rented or personally-owned vehicle.

Federal Employee Expenses
Federal agencies are generally barred from accepting funds from a Grantee to pay transportation, travel, or other expenses for any Federal employee unless specifically approved in the terms of the award. Use of award funds (Federal or non-Federal) or the Grantee's provision of in-kind goods or services, for the purposes of transportation, travel, or any other expenses for any Federal employee may raise appropriation augmentation issues. In addition, NRC policy prohibits the acceptance of gifts, including travel payments for Federal employees, from Grantees or applicants regardless of the source.

Minority Serving Institutions (MSIs) Initiative
Pursuant to EOs 13256, 13230, and 13270, NRC is strongly committed to broadening the participation of MSIs in its financial assistance program. NRC's goals include achieving full participation of MSIs in order to advance the development of human potential, strengthen the Nation's capacity to provide high-quality education, and increase opportunities for MSIs to participate in and benefit form Federal financial assistance programs. NRC encourages all applicants and Grantees to include meaningful participations of MSIs. Institutions eligible to be considered MSIs are listed on the Department of Education website:
http://www.ed.gov/about/offices/list/ocr/edlite-minorityinst.html

Research Misconduct
Scientific or research misconduct refers to the fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results. It does not include honest errors or differences of opinions. The Grantee organization has the primary responsibility to investigate allegations and provide reports to the Federal Government. Funds expended on an activity that is determined to be invalid or unreliable because of scientific misconduct may result in a disallowance of costs for which the institution may be liable for repayment to the awarding agency. The Office of Science and Technology Policy at the White

House published in the Federal Register on December 6, 2000, a final policy that addressed research misconduct. The policy was developed by the National Science and Technology Council (65 FR 76260). The NRC requires that any allegation be submitted to the Grants Officer, who will also notify the OIG of such allegation. Generally, the Grantee organization shall investigate the allegation and submit its findings to the Grants Officer. The NRC may accept the Grantee's findings or proceed with its own investigation. The Grants Officer shall inform the Grantee of the NRC's final determination.

Publications, Videos, and Acknowledgment of Sponsorship

Publication of the results or findings of a research project in appropriate professional journals and production of video or other media is encouraged as an important method of recording and reporting scientific information. It is also a constructive means to expand access to federally funded research. The Grantee is required to submit a copy to the NRC and when releasing information related to a funded project include a statement that the project or effort undertaken was or is sponsored by the NRC. The Grantee is also responsible for assuring that every publication of material (including Internet sites and videos) based on or developed under an award, except scientific articles or papers appearing in scientific, technical or professional journals, contains the following disclaimer:

> "This [report/video] was prepared by [Grantee name] under award [number] from [name of operating unit], Nuclear Regulatory Commission. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the view of the [name of operating unit] or the US Nuclear Regulatory Commission."

2010 Scholarship Program
Service Agreement

1. This service agreement is required for all student recipients of scholarships (hereinafter referred to as the "recipient") funded by the U.S. Nuclear Regulatory Commission (NRC) through Howard University.

2. This agreement confirms the recipient's obligations to maintain satisfactory academic progress and serve 6 months in nuclear-related employment for each full year of academic support. The employment may be with nuclear-related industry, State agencies, Department of Energy laboratories, the NRC or other Federal agencies, or academia in the recipients' sponsored fields of study.

3. The scholarship recipient must:

   a. remain matriculated in the degree program for the field of study for which the scholarship was approved,

   b. maintain satisfactory academic progress in the recipient's field of study, and

   c. maintain a course load of at least 12 credit hours per semester as a full-time student in good standing.

4. If a recipient fails to maintain satisfactory academic progress, the scholarship will be terminated and the recipient could be obligated to repay the NRC the full amount of the scholarship/fellowship.

5. If a recipient receives any subsequent scholarship(s) through this program, the service obligation periods will be consecutive.

6. At the discretion of the NRC, the service obligation period may be delayed to allow the recipient to continue a subsequent degree program immediately following that sponsored under this program. For example, if a recipient receives a scholarship to earn a baccalaureate degree, he/she may request and be permitted to delay fulfilling their service obligation until after they complete a subsequent terminal degree program. Any such requests must be made to the NRC before a student enrolls in a subsequent degree program. If a student enrolls in a subsequent degree program before or without NRC approval, and the NRC does not subsequently approve the request, the NRC will not be held liable for any expenses incurred to dis-enroll, or for failure to otherwise meet the terms of this service obligation. Recipients only incur a service obligation to NRC for funded periods of study.

7. If the student receives no employment offers or does not accept any of the offers received, the student is not relieved of the service obligation, unless, pursuant to this service agreement, the student applies for and receives a waiver from the NRC. Implicit in the waiver request is data or explanation by the student that efforts to secure employment in a nuclear-related field were undertaken. This can be in the form of job searches, referrals, etc. Absent a waiver from the NRC, rejection of one or more job offers could trigger the service agreement obligation.

8. If a recipient voluntarily leaves the employment of an approved employer in a field related to nuclear power during the period of obligated post-academic service, the recipient may immediately become liable to the U.S. Government for repayment of the entire amount of the assistance provided under the scholarship for which the service obligation has not been fulfilled.

9. By accepting this scholarship/fellowship, I agree to provide the NRC with current contact information (address, telephone, email), and employment information, subject to the provisions of the Privacy Act, for as long as I remain under obligated service. This information will be used solely for the purposes of verifying appropriate nuclear related employment in compliance with the service obligation requirements of this service agreement. In accordance with the Privacy Act, providing this information is voluntary; however, failure to do so may result in removal from the scholarship/fellowship program and/or repayment of all scholarship/grant money received. Contact information should be reported to: eduscholar@nrc.gov.

10. By signing this agreement, the recipient certifies that he or she has read this agreement and agrees to all of the obligations it entails.

Scholarship Recipient	Date
Institution Program Coordinator	Date
NRC Office of Small Business & Civil Rights Minority Serving Institutions' Program	Date