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

1. GRANT/AGREEMENT NO.	2. MODIFICATION NO.	3. PERIOD OF PERFORMANCE	4. AUTHORITY
NRC-38-09-907	/	FROM: 7/1/2010 TO: 6/30/2011	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	Public State-Controlled Institution of Higher ED DUNS: 603503991	The Research Foundation CUNY Convent Avenue and 14th Street New York, NY 10031

8. PROJECT TITLE:
Introducing a Nuclear Engineering Concentration at The City College of New York Department of Mechanical and Chemical Engineering

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 See Program Description AND APPENDIX A-PROJECT GRANT PROVISIONS	[X] PROGRESS AND FINAL [ ] FINAL ONLY [ ] OTHER (Conference Proceedings)	The Research Foundation CUNY Attn: Yiannis Andreopoulus Email: andre@ccny.cuny.edu 212-650-5206

12. NRC PROGRAM OFFICE (NAME and ADDRESS)	13. ACCOUNTING and APPROPRIATION DATA	14. METHOD OF PAYMENT
NRC Attn: Randi Neff Office of Human Resources MS: GW5A6 (301) 492-2301 11545 Rockville Pike Rockville, Maryland 20852	APPN. NO: 31X0200 B&R NO: 0-8415-5C1116 JOB CODE: T8453 BOC NO: 4110 OFFICE ID NO: RFPA: HR-09-907-001	[ ] 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	$150,000	NRC	$150,000	This action provides funds for Fiscal Year in the amount of See Page Two
PREVIOUS OBLIGATION		RECIPIENT		
TOTAL	$150,000	TOTAL	$150,000	

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

U.S. Nuclear Regulatory Commission
Div. of Contracts
Attn: Sheila Bumpass
Mail Stop: TWB-01-B10M
Rockville MD 20852

18.	19. NRC CONTRACTING OFFICER
Signature Not Required	Sheila Bumpass 7/1/2010 (Signature) (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 ADM002

ATTACHMENT A - SCHEDULE

A.1 PURPOSE OF GRANT

The purpose of this Grant is to provide support to the "Introducing a Nuclear Engineering Concentration at The City College of New York Department of Mechanical and Chemical Engineering" as described in Attachment B entitled "Program Description."

A.2 PERIOD OF GRANT

1. The effective date of this Grant is July 1, 2010. The estimated completion date of this Grant is June 30, 2011.

2. Funds obligated hereunder are available for program expenditures for the estimated period: July 1, 2010 – June 30, 2011.

A. GENERAL

1. Total Estimated NRC Amount:	$150,000
2. Total Obligated Amount:	$150,000
3. Cost-Sharing Amount:	$0
4. Activity Title:	Introducing a Nuclear Engineering Concentration at The City College of New York Department of Mechanical and Chemical Engineering
5. NRC Project Officer:	Randi Neff
6. DUNS No.:	603503991

B. SPECIFIC

RFPA No.:	HR-09-907-001
FFS:	N/A
Job Code:	T8453
BOC:	4110
B&R Number:	0-8415-5C1116
Appropriation #:	31X0200
Amount Obligated:	$150,000

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
Direct Participant Cost	$103,364.00
Indirect Cost	$46,636.00
Yearly Total	**$150,000.00**

All travel must be in accordance with the The Research Foundation CUNY Travel Regulations or the US Government Travel Policy absent Grantee's travel regulation.

A.4 AMOUNT OF AWARD AND PAYMENT PROCEDURES

1. The total estimated amount of this Award is $150,000 for one year period.

2. NRC hereby obligates the amount of $150,000 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

Introducing a Nuclear Engineering Concentration at The City College of New York Department of Mechanical and Chemical Engineering

Introducing a Nuclear Engineering Concentration at The City College of New York Departments of Mechanical and Chemical Engineering

Principal Investigator:	Yiannis Andreopoulos Department of Mechanical Engineering, City College of New York Convent Avenue and 140lh Street, New York, NY 10031	(212) 650-5206 andre@ccny.cuny.edu
CO- Pri nci pal Investigator:	Sanjoy Banerjee Department of Chemical Engineering, City College of New York Convent Avenue and 140lh Street, New York, NY 10031	(212) 650-5728 banerjee@che.ccny.cuny.edu
Co-Principal Investigator:	Masahiro Kawaji Department of Mechanical Engineering, City College of New York Convent Avenue and 140lh Street, New York, NY 10031	(212) 650·5220 kawaji@ccny.cuny.edu
Co-Principal Investigator:	Feridun Delale Department of Mechanical Engineering; City College of New York Convent Avenue and 140lh Street, New York, NY 10031	(212) 650-5224 delale@ccny.cuny.edu
Co-Principal I nvesti gato r:	Taehun Lee Department of Mechanical Engineering, City College of New York Convent Avenue and 140'h Street, New York, NY 10031	(212) 650-6122 thlee@ccny.cuny.edu
Collaborators:	Dr. William Horak & Dr. David Diamond Brookhaven National Laboratory, Sciences & Technology Department, Upton NY	(631) 344-2627 diamond@bnl.gov

Project objectives and benefits

Support is requested for the continuation of an effort to establish a concentration in nuclear engineering in the existing mechanical and chemical engineering curricula. The new concentration contains four elective courses in reactor physics and engineering, reactor thermal hydraulics, nuclear power plant safety and nuclear power plant design and operation

and will provide laboratory and computer based simulation experience to the students. The reactor physics course offered this semester enrolled close to 35 undergraduate students which show that the new nuclear engineering concentration has made a highly successful start. Laboratory experience for the students will be provided through an experiment designed to demonstrate two-phase flow phenomena. Three additional modules are being developed and will be introduced in four core courses in order to provide exposure of nuclear engineering to all engineering students. The four courses are part of the undergraduate curriculum and also available to Master's students who are allowed to take two advanced level undergraduate courses. A unique feature of the proposed educational activities will be the use of teaching methodologies based on interactive collaborative hands-on learning experiences and techniques which have been practiced for more than six years and made possible through'" previous support from National Science Foundation. The completion and integration of the proposed curricular development will provide the students of a minority and Hispanic Serving~ Institution with the necessary experience and skills in nuclear engineering to enter careers in the nuclear industry and will satisfy a national need. The Energy Science and Technology) Department of Brookhaven National Laboratory and Mitsubishi Nuclear Energy System~ collaborate in the present educational development.

I. **Introduction**

In this renewal application we propose to continue developing the new Nuclear Engineering concentration which started in July of 2009 with the award of Year 1 funding through NRC's grant NRC-38-09-907.

According to a Nuclear Energy Institute report [1) the prospects for construction of more than 30 new nuclear power plants over the next 15 to 20 years in addition to the 107 existing licensed ones present enormous career opportunities for skilled workers in the United States. Despite new efficiency policies and higher energy prices in Annual Energy Outlook 2009 [2) energy use is projected to grow from 101.9 quadrillion Btu in 2007 to 113.3 quadrillion Btu in 2030. When combined with the increased use of renewables· and a reduction in projected additions of new coal-fired conventional power plants, energy-related CO_2 emissions are predicted to grow at 0.3 percent per year from 2007 to 2030 in the reference case of [2], reaching a level of 6,410 million metric tons in 2030.

This outlook combined with the recent events with the highly fluctuating oil prices and the need to reduce oil use and import dependence lead to prospects of resurgence of nuclear energy which will result in an increased demand for skilled labor at all levels. It is expected that each new reactor will require between 1,400 and 1,800 workers for construction with peak employment of up to 2,300 workers. Once built, these 31 potential power plants would require 12,400 and 21,700 permanent, full-time workers to operate the plants and additional supplemental labor for maintenance and outages.

The analysis provided in [1] also indicates that if the industry were to construct the 31 reactors that are currently being discussed for license applications, this would require 43,400 to 55,800 workers during construction with peak employment of up to 71,300.

There is growing demand for skilled technical workers across all sections of the energy sector. American industry faces increased competition for skilled talent and the nuclear industry is not an exception. Salaries in the skilled fields commonly range from $65,000-$85,000 annually and salaries for nuclear engineers are among the highest for all engineering disciplines, according to the Department of Labor's Bureau of Labor Statistics.

In addition, the nuclear industry is also challenged by an aging work force, with nearly 50 percent of workers age 47 or older who will be eligible to retire during the next 10 years. Along with plans for industry growth, the expected attrition of a large portion of the industry's total work force has prompted an unprecedented recruitment *effort* throughout the industry. Still, recruitment into skilled crafts remains a significant challenge for the nuclear industry. In today's era, many high school students are directed almost exclusively toward four-year degree

programs.

By improving awareness of skilled craft jobs in the energy sector and changing misperceptions about them is undoubtedly expected to lead to more students electing to enter engineering careers and enjoy long-term, high-wage employment.

Increasing public recognition of the value of nuclear energy as a clean, reliable electricity source [3] is leading more young people to identify nuclear energy as a career path. A recent Department of Energy study found that enrollments in undergraduate nuclear energy programs have grown to more than 1,900 in the 2006-07 academic year, compared to fewer than 500 eight years ago. Graduate enrollments also have jumped to more than 1,100 in the 2006-07 year versus just 220 in 1998-99.

The availability of Year's 1 funding was pivotal in launching the new Nuclear Engineering concentration in the curricula of Mechanical and Chemical Engineering Departments. It is very gratifying to report that the new NE concentration has made a highly successful start with close to 35 undergraduate students enrolled in the reactor physics course which is the first course offered this semester. If one considers that typical enrollment for required courses is about 25 students, this enrollment is very remarkable for an elective course. With the help of a concurrent scholarship grant funded also by NRC, 14 undergraduate students have been selected through a competitive process to receive scholarships. Most of the scholarship winners are from minority groups and half are women. Many have outstanding grades with GPA's over 3.5, so the quality of students attracted to NE has been excellent and beyond our expectations. In addition, some of these students are interested in pursuing graduate studies in nuclear engineering at City College, which suggest that the prospects of developing a high-quality graduate program in nuclear engineering in the near future are very high.

Goals and Outcomes

The City University of New York, the largest urban university in the US with 220,000 full time students and 230,000 continuing education students, has selected the energy field as one of its major research and education .thrust areas by establishing the Energy Institute at its flagship campus, The City College of New York and investing a substantial amount of resources in the subject. The Energy Institute is located at the Grove School of Engineering and its founding director Distinguished Professor Sanjoy Banerjee has been recruited from UC Santa Barbara. The College has also recruited several new faculty members in the area of energy, including Professor Masahiro Kawaji from the University of Toronto who is leading the nuclear engineering effort.

The Department of Mechanical Engineering has a long history and tradition in curriculum innovations. NSF provided funding to introduce micro-, nano-, bio-technology, and intelligent systems throughout its curriculum with a 3-year, $1.5M grant. Engineering Coalition of Schools for Excellence & Leadership (ECSEL), another NSF funded activity created design modules and infused design experience into the freshman courses through a 10-year, $4M grant. The Mechanical Engineering curriculum at CCNY currently offers four concentration areas to its students with four elective courses each: energy, aerospace, solid mechanics and manufacturing.

The Chemical Engineering Department has a long tradition of excellence in training both undergraduate and graduate students. Over the years it has received funding to provide research opportunities to undergraduate students through an NSF REU program and to train students in interdisciplinary way PhD students through the soft material IGERT (NSF) program.

The two Departments of Mechanical and Chemical engineering have collaborated in the past to develop teaching methodologies for interdisciplinary learning by sponsoring interdisciplinary design projects with participating students from both departments.

Due to an increased interest in the energy area and with the availability of Year's 1 funding from NRC, a new collaboration between the two departments has been initiated in an effort to expand their course offerings into Nuclear Engineering. The proposed activities intend to continue the effort of implementing the introduction of Nuclear Engineering concentration in

Mechanical Engineering with courses cross-listed in Chemical as well as Electrical Engineering. Our current curriculum allows students to select four elective courses. Building on this curricular structure, the proposed activities intend to complete the development of a concentration in Nuclear Engineering.

Overall Objectives

The educational objective of the nuclear engineering concentration is to provide skills needed for employment in nuclear power industry and provide background for graduate studies in the field of nuclear engineering. In addition, since CCNY is a minority and a Hispanic Serving Institution, the proposed educational development will provide minority students with the necessary experience and skills in Nuclear Engineering to enter careers in the nuclear power industry.

The Curriculum Reform Initiative

In 2003, National Science Foundation awarded the Department of Mechanical Engineering a three year curriculum reform educational grant entitled "Redefining Mechanical Engineering: Systemic Reform of the Mechanical Engineering Program at City College". This reform effort accomplished three complimentary objectives: a) introduced emerging technologies that are revolutionizing the practice of engineering such as, MEMS, Advanced Materials, Computer Aided Engineering (CAE), Intelligent Systems/ Electronics, Biotechnology, Micro- and Nanotechnology and Nontraditional Energy, into the curriculum; b) tested new teaching methodologies focused on student learning and c) attempted new methods in recruiting and retaining _students to help increase the emerging technological workforce for industry. A distinguishing feature of this project was the collaboration with ASME, which as the premier organization of the mechanical engineering profession has provided meaningful feedback on the impact of the curriculum reform on the practice of engineering and helped in the dissemination of results.

II. Project Description

The goal of the proposed educational development is to extend the current engineering curricula into Nuclear Engineering. It includes the following activities and tasks:

1. We have started the implementation of our plans to introduce a **Nuclear Engineering concentration** in the existing undergraduate mechanical and chemical engineering curricula which will consist of the following four courses:
   - 1.1 **Reactor Physics and Engineering:** This course covers the basic principles of nuclear reactors including fission reaction, neutron diffusion theory, reactor criticality, reactivity effects, reactor types, and nuclear fuels. This course is offered this spring 2010 semester.
   - 1.2 **Reactor Thermal Hydraulics:** This course describes the thermal aspects of nuclear power plants including heat generation and thermal analysis of fuel elements, single-phase fluid mechanics/pressure drop in rod bundles, single-phase heat transfer, two-phase flow, and boiling and condensation heat transfer. In addition, heat transport loops of various reactor types are analyzed. This course is being developed and it will be offered in fall of 2010.
   - 1.3 **Nuclear Power Plant Safety:** Principles of nuclear reactor safety are covered including different types of accidents such as reactivity accidents and loss-of-coolant accidents, radiation protection, and regulatory aspects such as the licensing process, the concept of defence in depth, general design criteria, accident analysis, and probabilistic risk assessment.
   - 1.4 **Nuclear Power Plant Design and Operation:** This course integrates the principles of reactor physics, thermal-hydraulics, reactor safety, instrumentation, materials,

environmental impact, and economic optimization. Topics include material issues in plant design and operations, aspects of thermal design, fuel depletion and reactivity control. PC-based nuclear power plant simulators will be used to gain knowledge of the operational characteristics of various reactor types.

1.5 In addition, the existing **Capstone Senior Design Sequence** can be part of the nuclear engineering experience. Currently all mechanical engineering students enroll in a two semester capstone design course. Students in nuclear engineering concentration will have an opportunity to carry out a nuclear engineering related design project. These courses will be cross listed in the chemical and electrical engineering curricula.

2. Provide **laboratory and computer based simulation experience** as part of the proposed activities. Laboratory experiments in boiling and energy conversion will be introduced and a computer laboratory with simulation software such as TRACE, FLUENT, PCTRAN or other commercially available packages (e.g. COMSOL) will be created.
3. Development of nuclear engineering related **modules** which will be introduced in the core courses such as, heat transfer, fluid mechanics, energy conversion, and senior design of both chemical and mechanical engineering curricula. This will provide exposure to nuclear engineering to all early level engineering students.
4. Make available these courses to students at the **Master's** level. Our current curriculum allows Master's students to take two ME-500 level undergraduate courses. Master's students with an interest in nuclear engineering will have the opportunity to take two undergraduate courses in addition to the existing electives. We have placed the four courses mentioned above in the undergraduate curriculum. Undergraduate and graduate students completing the nuclear engineering concentration will receive a Certificate in Nuclear Engineering.

Under the present undergraduate enrollment levels and without accounting for any growth, it is anticipated that 10 to 15 students per year out of 40 graduates per year in total will be graduating in nuclear engineering. Based on previous experience our original projection has been that each of the proposed courses will attract about 15 to 20 students every time it is offered. The fact that the current enrollment of the new reactor physics and engineering is 35 undergraduate students provides confidence to revise the projected enrollments upwards. Thus, in addition to students completing the Nuclear Energy concentration, there will be many students who will be graduating with one, two or possibly three nuclear engineering courses in their transcripts.

New Courses Description

1. **Reactor Physics and Engineering**

The development of this course has started in year #1 of this effort and it is completed. It is offered this semester with an enrollment of 35 undergraduate students from both mechanical and chemical engineering. It is also available to Master's level students as well. Separate but related modules will be developed for the prerequisite courses, and senior design course.

2. **Course in Reactor Thermal Hydraulics**

This course is being developed in year #1 of the current NRC grant duration with the objective to provide students with knowledge of the fundamentals of two-phase flow and heat transport required for the analysis, design, and safe operation of the nuclear power plant systems using experimental and computational tools. This course will be offered in Fall 2010.

The course begins with an overview of Light Water Reactor (LWR) systems, followed by a brief review of basic thermodynamic design, fluid dynamics, and heat transfer of the nuclear power plant systems, since people often come to the course with varying backgrounds. After an introduction to these basic topics, fundamentals of two-phase flow dynamics seen in nuclear reactor systems will be discussed. This will include two-phase flow patterns and regimes, governing equations for two-phase flow dynamics, constitutive relationship and correlation for void fraction, and closure relationships for interfacial transport terms. At this point, students will

be exposed to their first experimental lab session on two-phase boiling heat transfer inside a pipe, in which they will be able to observe different flow regimes and transition from one regime to another. A related computational lab session will be offered, which makes use of the commercial CFD software such as Fluent©. It will permit students to model two-phase flows inside a pipe in different regimes under different flow conditions and better grasp fundamental physical understanding of flow dynamics.

The next module of the course will deal with fundamentals of heat transfer with phase change. Topics covered here will include governing equations, pool boiling, forced convective boiling, condensation, correlation for two-phase heat transfer coefficient, thermal hydraulic design of fuel elements, subchannel thermal hydraulics, and thermal hydraulic design analysis methods for LWR. Students will participate in a steam turbine experiment to observe energy conversion process from one sort to another. Several lectures will be devoted to the simulation tools such as TRACE, PARC, or other commercially available packages (e.g., PCTRAN©) to provide students with an operational experience of the nuclear power plant systems. Finally, students will carry out a thermal hydraulic design project in the advanced LWR cores. We expect a variety of topics ranging from fundamental boiling two-phase flow phenomena to design optimization in the system level.

This course will be available to students from both mechanical and chemical engineering and at the Master's level as well. Separate but related modules will be developed for the prerequisite courses, and senior design course.

3. Nuclear Power Plant Safety

This course will be developed during the performance period of this renewal application which corresponds to year #2 and #3 of the original proposal. The objective of this course is to provide the students with knowledge of the principles and methods of evaluating the safety of nuclear power plants including safety philosophies, general design criteria based on the concept of defense in depth and engineered safety systems, and regulatory requirements for the design, construction and safe operation of nuclear power plants. Different types of operational transients and reactor accidents will be studied along with the deterministic and probabilistic models of risk analysis, aging and life extension issues. These studies will enable the students to acquire the skills needed to prepare and evaluate a Safety Analysis Report.

The course begins with an overview of nuclear reactor safety with an emphasis on the importance of safe design and operation of nuclear reactors as illustrated by the events which occurred during the accidents at Three Mile Island and Chernobyl nuclear power plants. The students are then introduced to the safety philosophy followed during the design, construction and operation of nuclear power plants. In order to understand the regulatory aspects of nuclear safety, the processes involved in siting, reactor licensing, and Construction and Operating License (COL) application are studied in detail.

For safe reactor operation, certain design aspects unique to nuclear power plants such as reactivity coefficients and reactivity control, redundancy and diversity, and engineered safety features are described. The aspects of the current and GEN-IV reactor designs will be examined. To understand how to assess the safety of each reactor design, safety analyses of design basis events, beyond design basis events, and severe accidents are examined. Computer simulations of selected operational transients and accident sequences are conducted using the safety analysis codes such as TRACE and PCTRAN to be made available in the computer laboratory.

PCTRAN is a PC-based simulation code using reduced thermal hydraulic nodes for transient prediction. The code has been ordered and will soon be installed on 20 Windows-based PC's. Concepts of neutron multiplication, criticality, feedback, decay heat and Xenon poisoning can be demonstrated. In conventional PWR and BWR models, normal operation of start-up, power ramp and shutdown, operational transients and accidents such as loss-ofcoolant accidents can be simulated at a speed faster than real-time. The severe accident model allows core-melt and containment failure in the event of multiple failures of the emergency core cooling system or human error. The models for advanced reactors such as AP1 000, ABWR and

Economical and Simplified BWR (ESBWR) will also be used to study the safety features of different reactor types.

Probabilistic risk assessment methods will be studied to understand how risks due to earthquakes, fires and tornadoes, can be evaluated and managed by risk-informed decision-making processes.

Finally, radiological consequences of nuclear reactor accidents will be studied by predicting radiological releases from severe accidents and offsite dose dispersion with the integrated PCTRAN simulation system.

4. Nuclear Power Plant Design and Operation

This course will be also developed during the performance period of this renewal application. The objectives of the course are to provide students with knowledge of the design and operation of nuclear power plants by integrating the studies of nuclear reactor physics, and thermal-hydraulics with practical aspects of instrumentation, material selection, structural analysis, environmental impact. and economic optimization. The students will acquire the skills needed to integrate and optimize the design and operation of a complex industrial system.

The course will begin with an overview of nuclear power plant systems that can be classified into Light Water Reactors, Heavy Water Reactors, Gas Cooled Reactors and Liquid Metal Cooled Fast

Reactors. Various design parameters pertaining to the thermal hydraulics and neutronics of nuclear reactors will be examined in detail to understand their effects on the operational characteristics and safety of different reactor types. The reactor instrumentation, engineered safety features, materials selection, structural analysis and the plant operation are studied to understand how they meet the safety regulations. The new design features of tGENIV reactors will be examined.

PC-based nuclear power plant simulators will be extensively used to gain knowledge of the design and operational characteristics of various reactor types. For example, PCTRAN is a PC-based simulation code that can be run on a Windows-based PC. Concepts of neutron multiplication, criticality, feedback, decay heat and Xenon poisoning can be demonstrated to understand the operational behavior of nuclear reactors. In conventional PWR and BWR models, normal operation of start-up, power ramp and shutdown, as well as operational transients and accidents such as loss-of-coolant accidents can be simulated at a speed faster than real-time. The models for advanced reactor designs such as AP1000, ABWR and Economical and Simplified BWR (ESBWR) will also be used to study their operational characteristics.

Finally, the effects of radiation on various materials used in nuclear power plants, component aging and life extension issues are studied in connection with plant maintenance work and economics.

Course Offering Schedule

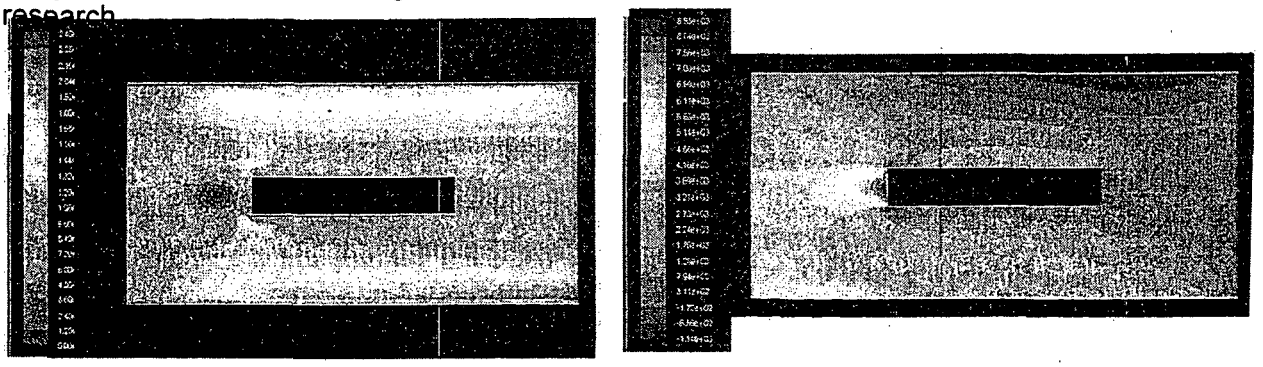
The Executive Committee in collaboration with the mechanical and chemical engineering departments has made arrangements to incorporate the introduction of this NE sequence of courses described above into the course offerings schedule. The first course on reactor physics and engineering is offered already this spring 2010 semester. The current plan is to offer the thermal hydraulics course in fall of 2010. The course on nuclear power plan design and operation will be also offered in fall 2010 while the fourth course on nuclear power safety will be offered in the following spring 2011 semester together with the reactor physics and engineering. This will complete the introduction of the four courses into the regular course offerings schedule. In the semesters subsequent to spring 2011, two courses in NE will be offered each semester as shown in Table 1 where the initial introductory period is shown together with the long term scheduling of the four NE courses.

Cours	Spring 2010	Fall 2010	Spring 2011	Fall 2011	Spring	Fall 2012
Reacto Physic and Engineering	y		Y		Y	
Reacto Therm Hydraulics		y		y		y
Nuclea Power Pla Safety			y		Y	
Nuclea Power Pla Design and Operation		y		y		y

3.

Laboratory and Computer Based Simulation
Experience *1. Computer Laboratory*

A new computational facility is under development which will provide a platform to carry out simulations and assignments related to the four new courses, special projects and research.



PCTRAN, which is a PC based simulation package for transient effects in reactor safety analysis.
TRACE, a more in depth reactor safety analysis software.
FLUENT, a general purpose fluid-flow solver which can handle two-phase flow and heat transfer problems.
COMSOL, a multiphysics software to address diffusion problems and provide solutions to differential equations.

2. Laboratory Experiments

Laboratory experience for the students will be provided through' two experiments specially designed to demonstrate two-phase flow phenomena and a steam turbine operation. The **two-phase flow experimental setup** will be designed in house by students and will be focused on flow boiling phenomena. The major components of the **steam turbine experiment** will be purchased and they will be put together in a setup with students' help.

Description of Modules
In the present context module is a stand alone lecture unit with class room material corresponding to 1.5-3 hour lecturing time. The objective of each of these modules is to introduce an overview of nuclear engineering to all students in mechanical and chemical engineering. This will be accomplished by incorporating these modules into the required core courses of fluid mechanics, heat

transfer, energy conversion and senior design. We plan to develop three modules each adapted for the corresponding core course.

Module 1: Fluid Mechanics in Nuclear Engineering (to be introduced in the first fluid mechanics courses: ME-35600 & ChE-341 00)

Module 2: Heat Transfer in Nuclear Engineering (to be introduced in the heat transfer and processes courses: ME-43300 & ChE-34600)

Module 3: Introduction to Nuclear Engineering (to be introduced in the energy conversion and senior design courses: ME-53600, ME-47300, ChE-49500, &ChE-49812)

The modules will include some basic scientific and engineering principles involved followed by information about nuclear power generation for electricity or propulsion. Specific applications will be discussed where efficiencies and cost will be introduced. Particular emphasis will be placed on how core course subjects are used and applied in nuclear engineering. The modules will be introduced after the 10th week of each course, so that most of the material has been covered and the students will be in a position to understand how these topics are applied in nuclear engineering.

Work on the development of these modules has been initiated and preliminary discussions have been held to determine their objectives.

III. New teaching methodologies

The discussion below is mostly based on the experience gained with the recent curriculum reform activities which were carried out under the NSF grant mentioned above. These activities allowed the faculty to experiment with various approaches to teaching as a response to the fact that education has undergone a shift from programmed learning and information processing approaches to knowledge building and transfer. Instead of focusing on how information is received, stored and recalled, learning is now turning to how knowledge is constructed generated and compiled within the mind of the learner and the interactions that the learner has within a cultural and social context. A consensus has emerged among cognitive psychologists and educational researchers that traditional teacher-centered instructional methods are generally ineffective in motivating students to learn, promoting understanding, addressing prior concepts, or even conveying information (National Research Council, 2003, p.26 in [4]). Research to support these conclusions has come from a variety of subject areas and educational levels, including college physics [5]. However, very little if any of this research has come from the field of engineering. The key element which makes engineering unique as discipline is the design content of its curriculum. As Bucciarelli [6] points out in his study of working engineers, industry practice is rarely reduced to the set-piece formulas and algorithms of traditional engineering education: "Most engineering practitioners know that designing is not simply a matter of synthesizing solutions to independent problem sets. Although few of the complexities of engineering design show up in the undergraduate classroom, the working world of engineers is filled with negotiations across specialties, with decision making under uncertainty within contexts in which scientific principle is mixed in with social, political, and financial 'constraints'"(Bucciarelli, 1996, p. 110 in [6]).

A recent compendium of conclusions from cognitive research argues for the design of learning environments that incorporate three major principles: they must be learner centered, knowledge centered and assessment centered. "Teachers who are learner-centered recognize the importance of building on the conceptual and cultural knowledge that students bring with them to the classroom." (National Research Council, 2000, p.134 in [7]) Knowledge-centeredness implies a broad understanding of ideas in context: "Ideas are best introduced when students see a need or reason for their use. This helps them see relevant uses of knowledge to make sense of what they are learning." (Ibid, p. 139) Assessment involves far more than traditional tests, papers and homework: "Effective teachers continually attempt to learn about their students' thinking and understanding. They do a great deal of on-line monitoring of both group work and individual work ... Appropriately designed assessments can help teachers realize the need to rethink their teaching practices." (Ibid, p. 140-141)

The proposed courses will be developed to reflect current knowledge about how people learn. In addition, they will incorporate the same understandings about effective pedagogy. The basic repertory of strategies is summarized below:

Cooperative Learning: Research suggests that students often learn from one another as well as from the instructor [8]. More generally, students who work cooperatively gain valuable experience in constructing knowledge the same way that engineers do: through participation in intellectual communities of practice. Collaborative learning can take many forms. Students may work in groups, in class or in lab, on traditional textbook or lab problems; they might work cooperatively on homework problems outside of class; or they could be challenged to solve deeper, more conceptual problems, such as the design of an experiment or prediction of a result. One group assignment, for instance, may be the development of physical intuition of a two phase pipe flow undergoing a 90 degrees turn. The students will be assigned different boundary conditions and at the end they have to compare their results and conclude on how initial or boundary conditions affect the exit properties of the flow.

Project-based learning: A major criticism of traditional instruction is that knowledge is fragmented into a multitude of component parts, with little if any opportunity to see how these fit together. For example, a typical textbook problem presents the data for analysis according to some predetermined algorithm, but may not suggest how the data was acquired, ways in which it might not conform to theory, possible sources of error, or implications for engineering applications. Students are often left on their own in fitting these pieces together, and many students rarely do. These problems generally include elements of analysis, simulation, and design; and often, design of an experiment and/or design, construction, and evaluation of a prototype. In almost all courses of the proposed concentration projects will be assigned which will be closely related to specific applications in nuclear engineering. Two reactor design projects will be assigned, for instance, in the Thermal Hydraulics course to groups of 3 students. The first will be based on transient operations and the second on the design of an advanced LWR. Students will apply projectbased strategies by presenting problems more holistically, retaining the incomplete specifications, error sources and other uncertainties that characterize engineering practice.

Research methods: science and engineering content are too often presented as established fact, offering little hint of where current knowledge came from. Early research experiences can also serve as powerful incentives for students to pursue graduate studies, and ultimately research careers, and lead to personal relationships with faculty mentors. Some aspects of research that may be undertaken by students in the present nuclear engineering concentration development include literature searches, experiments, simulation, data analysis, and presentation of research outcomes. Particularly interesting assignments in high heat transfer rates may require the students to research liquid metal cooled fast reactors in which high power density does not allow the use of pressurized water as coolant since not only has inferior heat transfer characteristics but also it tends to slow down neutrons and absorb them.

Laboratory experience: conventional laboratory "experiments" are often designed to produce predetermined results, which simply confirm or demonstrate theoretical conclusions that are already known. One symptom of this problem is that students could write an acceptable laboratory report without ever visiting the lab. Another is that data tables have already been set up for the students, and all they are expected to do is fill in the blanks. Far more learning can take place if the results of an experiment are not known in advance, and there are discrepant events that do not conform to the theory already presented. In the two laboratory setups under consideration here, the students will have the opportunity to organize the experiment by themselves. No assignments of the type "measure the temperature at certain locations" will be given. Instead a more generic openended question will be posed on how, for instance, the heat transfer rate is affected by increasing the mass flow rate. The students will have again to measure temperature at various locations but now they have to decide the locations where the

temperature should be measured in order to provide answers to the question. They *have* to look for patterns in the data, and draw their own inferences about the meaning. Another important component of laboratory experience will be home experiments, where students as part of their coursework conduct experiments at home and collect engineering data without the use of specialized equipment and instruments and then compare the results to those predicted by theory (Jiji, *et. al, [9]).*

Independent Learning: engineering fields are constantly changing and students will soon be called upon to learn new knowledge for themselves. Life-long learning is now required in all graduates of engineering schools. The present curriculum strongly encourages self-teaching, both in the context of traditional courses, and also for independent study credit. The proposed nuclear concentration will be developed to produce the same educational outcomes which include life-long learning. In addition, activities that can be pursued independently, with appropriate faculty mentoring, will be encouraged and supported. Such activities may include reverse engineering of existing products, data collection and analysis, literature and Internet searches, design projects and research assignments.

Drs. Andreopoulos and Banerjee jointly direct the project. They are responsible for accomplishing all the tasks associated with objectives and goals of the proposed educational development. An ad-hoc Executive Committee has been formed with Drs. Kawaji, Delale and Lee as members. The Executive Committee meets monthly and as necessary to oversee progress and implementation of the proposed activities.

Distance learning: Web based asynchronous technologies will be used for online delivery of course material through the web site *mindffush.com*. Student participants will access course materials on their own schedule. The technologies include E-mail and Message Board Forums.

VI. Collaboration

City College has contacted the nearby Brookhaven National Laboratory and solicited collaboration along the objectives and goals of the present educational proposal and beyond. In particular the following collaborations were agreed upon:

1. Guest lectures from BLN who can provide relevant information in presentations during regular classes or during our seminar periods.
2. Internships and research opportunities at BNL for our undergraduate students through the competitive Science Undergraduate Laboratory Internship (SULI) program described at http://www.bnl.gov/education or with support from CCNY.
3. Course instructors who are willing to teach one full course with compensation fully provided by CCNY.
4. Visits to BNL.
5. Training and research for faculty through BNL's Faculty and Students Team (FAST) program.

A letter of support from BNL's Dr. William Horak, Chair, Engineering Sciences & Technology Department is appended at the end of the document.

As a result of this agreement an extended collaboration between BNL scientists and CCNY faculty and students has started during the year #1 of this grant duration. In particular, CCNY faculty members visited our BNL partners and collaborators and participated in a workshop on *"Advanced Materials under Extreme Environments for the Next Generation Energy Systems"* held at BNL on September 25 and 26 2009. One BNL Scientist has been invited and visited CCNY on October 8, 2009 and presented a seminar to the students on *"Nuclear Enerm Renaissance and Next Generation Reactor Systems Technical Challenges and Perceptions"* Dr. David Diamond, from BNL's Energy Sciences & Technology Department, visited CCNY or December 4, 2009 and presented a seminar entitled *"Neutronics Methods to Help Resolve Fue Safety".* He also discussed with NE students existing opportunities for summer internships a BNL.

Scientists and engineers from both BNL and CCNY also participated in joint researd proposals to DoE.

Print Materials, Videotapes and Videoclips. The lectures will be taped and put in video modules for further possible dissemination. This is a limited version of distance learning since class room lectures will not be discontinued.

Industry and National Labs Visits: Field trips to industries are an essential part of engineering curricula. Visits to nuclear power plants including the Indian Point power plant and to the Brookhaven National Laboratory will be arranged in spring, 2010 so that the students have an opportunity to see the practice of nuclear engineering.

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 (now 2CFR 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 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.

As part of the FY 2010 HR curriculum development grant awards, in addition to the customary performance progress report requested on the SF-PPR, SF-PPR-B, and SF-PPR-E forms, HR requires the following metrics to be reported on by the awardees as follows:

1. Overall number of new courses developed in NRC designated STEM areas;
2. Number of students enrolled in new STEM courses;
3. Number of these enrolled students retained in STEM major.

§ 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.

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."