

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

1. GRANT/AGREEMENT NO. NRC-HQ-11-G-38-0052	2. MODIFICATION NO.	3. PERIOD OF PERFORMANCE FROM: 8/22/2011 TO: 8/31/2013	4. AUTHORITY Pursuant to Section 31b and 141b of the Atomic Energy Act of 1954, as amended
5. TYPE OF AWARD <input checked="" type="checkbox"/> GRANT <input type="checkbox"/> COOPERATIVE AGREEMENT	6. ORGANIZATION TYPE Public State-Controlled Institution of Higher ED DUNS: 075050765 NAICS:611310	7. RECIPIENT NAME, ADDRESS, and EMAIL ADDRESS Louisiana State University Office of Sponsored Programs, 202 Himes Hall Baton Rouge, LA 70803	
8. PRDJECT TITLE: Welding and Nondestructive Evaluation Technology for Nuclear Engineering Applications			
9. PROJECT WILL BE CONDUCTED PER GOVERNMENT'S/RECIPIENT'S PROPOSAL(S) DATED See Program Description AND APPENDIX A-PROJECT GRANT PROVISIONS	10. TECHNICAL REPORTS ARE REQUIRED <input checked="" type="checkbox"/> PROGRESS AND FINAL <input type="checkbox"/> FINAL ONLY <input type="checkbox"/> OTHER (Conference Proceedings)	11. PRINCIPAL INVESTIGATOR(S) NAME, ADDRESS and EMAIL ADDRESS Dr. M.A Wahab Department of Mechanical Engineering Email: wahab@me.lsu.edu 225-578-5823	
12. NRC PROGRAM OFFICE (NAME and ADDRESS) NRC Attn: Tanya Parwani-Jaimes Office of Human Resources MS: GW5A06 (301) 492-2308 11545 Rockville Pike Rockville, Maryland 20852 Email: Tanya.Parwani-Jaimes@NRC.GOV	13. ACCOUNTING and APPROPRIATION DATA APPN. NO: 31X0200 B&R NO: 2011-84-51-K-134 JOB CODE: T8453 BDC ND: 4110 OFFICE ID NO: RFPA: HR-11-263 FAIMIS GR0050	14. METHOD OF PAYMENT <input type="checkbox"/> ADVANCE BY TREASURY CHECK <input type="checkbox"/> REIMBURSEMENT BY TREASURY CHECK <input type="checkbox"/> LETTER OF CREDIT <input checked="" type="checkbox"/> OTHER (SPECIFY) Electronic ASAP.gov (See Remarks in Item #20 "Payment Information")	
15. NRC OBLIGATION FUNDS THIS ACTION <u>\$279,035.00</u> PREVIOUS OBLIGATION _____ TOTAL <u>\$279,035.00</u>		16. TOTAL FUNDING AGREEMENT NRC <u>\$279,035.00</u> RECIPIENT <u>\$0.00</u> TOTAL <u>\$279,035.00</u> This action provides funds for Fiscal Year in the amount of See Page Two	
17. NRC ISSUING OFFICE (NAME, ADDRESS and EMAIL ADDRESS) U.S. Nuclear Regulatory Commission Div. of Contracts Attn: Shashi Malhotra Email: Shashi.Malhotra@NRC.GOV Mail Stop: TWB-01-B10M Rockville MD 20852			
18. Signature Not Required		19. NRC CONTRACTING OFFICER <div style="text-align: right;"><i>Sheila Bumpass</i> <u>8/22/2011</u> (Signature) (Date) NAME (TYPED) <u>Sheila Bumpass</u> TITLE <u>Contracting Officer</u> TELEPHONE NO. <u>301-492-3484</u></div>	
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 "Welding and Nondestructive Evaluation Technology for Nuclear Engineering Applications" as described in Attachment B entitled "Program Description."

A.2 PERIOD OF GRANT

1. The effective date of this Grant is August 22, 2011. The estimated completion date of this Grant is August 31, 2013.
2. Funds obligated hereunder are available for program expenditures for the estimated period: August 22, 2011 – August 31, 2013.

A. GENERAL

- | | |
|--------------------------------|---|
| 1. Total Estimated NRC Amount: | \$279,035.00 |
| 2. Total Obligated Amount: | \$279,035.00 |
| 3. Cost-Sharing Amount: | \$0.00 |
| 4. Activity Title: | Welding and Nondestructive Evaluation
Technology for Nuclear Engineering
Applications |
| 5. NRC Project Officer: | Tanya Parwani-Jaimes |
| 6. DUNS No.: | 075050765 |

B. SPECIFIC

- | | |
|-------------------|------------------|
| RFPA No.: | HR-11-263 |
| FFS: | N/A |
| Job Code: | T8453 |
| BOC: | 4110 |
| B&R Number: | 2011-84-51-K-134 |
| Appropriation #: | 31X0200 |
| Amount Obligated: | \$279,035.00 |

A.3 BUDGET

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

Personnel	\$109,313
Fringe Benefit	20,665
Travel	3,000
Equipment	40,000
Supplies	21,448
Other	<u>6,000</u>
Total Direct Cost	\$200,426
Indirect Costs (49%)	<u>\$ 78,609</u>
Total	\$279,035

A.4 AMOUNT OF AWARD AND PAYMENT PROCEDURES

1. The total estimated amount of this Award is \$279,035 for the one-year period.
2. NRC hereby obligates the amount of \$279,035 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

PROGRAM DESCRIPTION

1. INTRODUCTION:

While Louisiana's economy depends heavily upon industries based on petroleum, gas pipelines, chemicals, and mining-related activities, the state is not a major producer of undergraduate (UG) or graduate degrees in Welding Engineering. The present proposal to the Nuclear Regulatory Commission (NRC) by Louisiana State University (LSU) describes a strategic approach to create structures or course curriculum that allow the students to gain valuable expertise in the areas of **welding engineering and nondestructive evaluation (NDE) technology**. These topics are useful to energy industries such as nuclear power, gas pipelines, and marine and offshore, construction, shipbuilding, and other industries. In doing so, the project will provide a variety of activities geared towards attracting and developing talented and motivated students who would be valuable to our local industries in the future, such as, our particular nuclear energy industry.

This is an NRC-supported curriculum development program proposal lead by Dr. M.A. Wahab as the PI and Drs. Aymán M. Okeil and Su-Seng Pang as Co-PIs. This project will create teaching resources in the areas of Welding and Nondestructive Evaluation technologies from both well-established and newly researched state-of-the-art materials. Jointly, the PI and Co-PIs have made significant contributions in these proposed fields. The principal thrust of this developmental program is to create educational infrastructure in the areas of: (i) design, modeling, and analysis of materials welding & joining; and (ii) the development and analysis of NDE techniques. This project will develop the much-needed expertise in the areas of experimental and computational weld modeling, NDE analysis, and signal processing techniques. The materials covered in this project are critically important for design and maintenance of nuclear power plants and other fabrication industries mentioned above.

A revival of the nuclear industry is expected as part of the effort to address ballooning national and worldwide energy needs, leading to projections of increased demand for appropriately trained engineers. In Louisiana, *Entergy Corp.* foresees a major need for engineers with appropriate background to replace an ageing specialist workforce and to support new plants currently under design. The *Shaw Group, Inc.* with substantial presence in this region is already involved in the design of one such plant. It is noteworthy that since the effective phase-out of LSU's *Nuclear Science* programs some 46-years ago, a regional void has developed with respect to education in our geographical locations. The closest potentially competing program is at Texas A&M; all others are based well to the north and east. Among the earlier courses offered by LSU's Nuclear Science Center, there have been no Welding and no NDE related courses offered. The expertise of the PI (Wahab) is in the weld processes and weld modeling area; while Co-PI Okeil's expertise is in the NDE and welded structures and Co-PI Pang's expertise is in the joining technology. The PI/Co-PIs would like to introduce this course to our LSU and Southern University (SU) students and to practicing engineers.

This proposal is based upon the extensive experience and a well-qualified team of investigators participating in the project, infrastructure provided by LSU, and existing strong collaborations among the university faculty at LSU and SU, local industry, and motivated students. The project allows the implementation of a *communication-intensive* (C-I) course to enhance the scope and quality of Undergraduate (UG) education. Enhanced visual-aid-technology and innovative program modules will be used for teaching. Engineering Communication-Studio and Mechanical Engineering Studio will be used where group-work, technical writing, and oral presentation training as well as discipline-specific communication training will be given to UG/graduate students. This project offers a new and transformative approach of learning. A measurable evaluation plan will strengthen the students' learning. The general impacts will include an increased interest of faculty members in the improvement of engineering education, an increase in recruitment in the job market for students trained in this curriculum especially among the Hispanics and afro-American minorities, economically disadvantaged men, and women; and an increase in the number of strong research students in engineering disciplines. Through careful documentation and dissemination of the project results, this will have wider applications across the country. Finally, benefit will be achieved by all participants in the project including UG students through the adaptations of communication-intensive teaching materials and techniques, who will be equipped with the most recent knowledge to contribute to their prospective organizations.

2. GOALS, OBJECTIVES, PROJECT COMPONENTS, TARGET PARTICIPANTS, PROJECT BENEFITS, AND PROGRAM STRATEGY:

2.1 Goals and Objectives

The major goals of this project include: (i) Train both UG and graduate students (GS) in the areas mentioned above thereby increasing their knowledge-base of the discipline and make them more valuable to industry-needs; (ii) Improve UG student achievement in engineering and motivate high-achieving UG students to enter into graduate programs; and to have increased access to educational and career opportunities in engineering; (iii) Support newly designed advanced course curriculum, increase infrastructure support at LSU, and increase collaboration among LSU, SU, and local industries; and (iv) Achieve high levels of participants' satisfaction through innovative C-I course modules, and create programs that are nationally replicable. The major objectives include: (i) Institutionalize new forms of university-industry collaboration, and create professional learning communities that bridge the university and industry cultures; (ii) Enhance exchanges in engineering education between industry and universities through stronger collaboration with local industry; and (iii) Involve UG students with advanced elective course modules; increase qualifications of UG students by enhancing their professional skills in written and oral communications.

2.2 Project Components

The project will establish an exemplary course curriculum in the much-needed areas of Welding and NDE for both UG and GS in engineering at LSU and SU. Two main aspects will be covered within the broad project spectrums: (i) creating learning materials and teaching strategies and (ii) implementing educational innovations. This project will develop new course materials and innovative course-delivery tools using communication-intensive delivery via extensive visual aids, online education modules supported by LSU's online course management system (*Moodle*), on-site short-courses for industry professionals, and condensed summer workshop at LSU, innovative hands-on style experiments, and computational project-oriented curriculum. Industry-sponsored mini-projects will be introduced within this program along with the lecture modules. Solutions will be sought by students for industry-sponsored projects through innovations, ideations, and functional decomposition of the projects similar to Capstone design philosophy. After the end of NRC-support period, the developed course will be offered as

a regular course within LSU's Mechanical Engineering (ME) curriculum. Extensive efforts will be made to disseminate the results of this program to the broader student audience and engineering professionals through "Weblink" specifically designed for this course and available as "online" materials. Initially this course will be offered as an established ME-Elective course and once being fully developed, university certification will be lodged and processed for regular.

2.3 Target Participants

The course will draw students from high-achieving ME and Civil & Environmental Engineering (CEE) senior UG students, (both ME and CEE departments are the *Foundation of Excellence* at LSU), UG students from Industrial Engineering and Construction Management Engineering at LSU, UG engineering students from SU, Master's and PhD students at LSU, Science and Technology students, minority and women engineering and science students, practicing engineers from various industries in and around Louisiana and Southern states.

2.4 Project Benefits

The expected benefits will be in developing course materials that will fill the gap in Welding and NDE technology education. In addition, graduates will be encouraged to return to the University for Higher Degrees in computational weld mechanics and NDE research areas. The curricula development will address the most recent industry needs with a special emphasis on nuclear industry. All relevant welding processes, national, and international Welding-Codes will be discussed. The ME Department has an established weld testing and evaluation facility, which can accommodate microscopic examination, measurement of post-weld residual stresses, and weld discontinuities in structures. Students are exposed from fundamentals to the most advanced techniques in Welding and NDE through hands-on lab training program.

2.5 Program Strategy

This program will include development of two levels of UG courses; (i) a "Basic" and (ii) an "Advanced" course in Welding and NDE analysis. The goals will be to establish an engineering educational program that will enrich the experience of our students and make them marketable to related industry sectors. Engineering students and practicing engineers from local industry sectors will share courses, cross-pollinate in laboratories, and contribute to the development of the program guided by participating LSU-faculty. Excellently designed courses, extensive laboratory experience, and industrial internships will be essential aspects of the program. The funding requested will be utilized to design the courses, upgrade the student laboratories, and implement the program.

3. PROGRAM ACTIVITIES:

The following three major tasks will be implemented:

3.1 Task #1: Academic Year Courses

Each semester a course will be offered during the project period. Delivery will consist of a single semester ME-elective course (lectures plus labs.), available from Fall-2011. The Fall-course will be a "**Basic**" course containing fundamentals in Welding and NDE; and the Spring-2012 course will be an "**Advanced**" level course. These courses will be available to senior UG and first year graduate (MS/PhD) students with an expected enrollment of 20 to 25 students; two to three students will form project groups and will work on industry-sponsored projects; will present two in-class seminars and a final report which will meet the basic requirement of a Communication-Intensive (C-I) course within LSU; and the project results will be presented in the annual LSU Mechanical Engineering Graduate Students Research Conference. Course materials will be delivered through audio-visual labs where presentation through PowerPoint, prototypes display using computer animation, Digital Portfolio development for student groups and display in 3-D modes through computer simulations will be used. Course materials will be

available on CDs/Video tapes and online links through "Moodle" course management system, and most importantly, a graduate teaching assistant/faculty mentor will be available for further clarifications on any unresolved points during the semesters. CDs and Videos will be prepared and edited by mechanical engineering technical/computer support personnel.

3.2 Task #2: On-Site Industry Short Course

Professional development short course (2-days) will be provided to engineers on-site (within Southern region), with an enrollment of 10 to 15 professionals. The Lecture Materials/Course Notes will be available on video cassettes and downloadable materials through Moodle system. The course delivery will be evaluated and the participants' comments will be taken into consideration for continuing improvement and for producing revised course materials. Such courses have been delivered at *Entergy Corp.* earlier.

3.3 Task #3: LSU Summer Workshop

One 6-hours workshop (2-modules) training will be available to practicing engineers from industry during summer semester as a Professional Development course; will be offered through LSU's Continuing Education Program with an expected enrollment of 15 to 20 students. The course will be evaluated and industry-participants and their sponsoring industry managers will be contacted to evaluate the effectiveness of the program. Within the Summer program, two/three organized trips to industrial sites around Baton Rouge will be arranged, where large scale welding operations are routinely carried out. Participants in the short course (Task #2) and the workshop (Task #3) will also receive *Professional Development hours*; a current requirement by most registration boards for license renewal.

4. COURSE CURRICULUM:

4.1 Integration of Course Topics into Welding and NDE

Welding and NDE, two most important practical engineering topics are intrinsically related, will be integrated into this NRC curriculum development program. Welding has given tremendous flexibility in engineering design for joining metallic parts into single integral structural component. To understand the severity of existing flaws, cracks, inhomogeneities, and other deformities within these welded structures NDE plays a crucial role. To improve life-cycle, fatigue/thermal fatigue lives, corrosion cavities, avoiding brittle failures in welded structures, weld procedures must be carried out carefully as per welding codes thereby avoiding weld discontinuities. Whether these weld procedures are carried out correctly, NDE must be carried out to ensure structural integrity. Therefore these two topics are inherently linked and engineering graduates must have the required knowledge. Since there have been many new research activities in these topics which are not currently available in any textbooks, teaching materials for this NRC-sponsored project must be organized from new research perspectives. Research undertaken by the PI/Co-PIs and by others who have made significant new contributions in these areas will be included in this course curriculum. During the curriculum development process, we plan to consult our industrial partners and nuclear engineering professionals and other researchers (such as Pacific Northwest National Lab (PNNL) researchers for NDE weld-monitoring segments) to determine the most appropriate topics.

4.2 Part-I: Welding

Welding and joining are the key processes in the manufacturing base of an industrialized nation. The welding of engineering materials pervades virtually all sectors of manufacturing, ranging from heavy fabrication in off-shore platforms, nuclear, pressure vessels, ship-building, and construction industries, etc. Welding technologies have crucial bearing on the quality, reliability, and cost-effectiveness of products so that developments towards improving these processes can have significant impacts on individual competitiveness, and on the overall US economy. Studies indicate that 50% of gross national products make use of welding in some

way. Despite the fact that the welding technology is of critical importance to the manufacturing industries in and around Louisiana, LSU unfortunately, does not produce specialist 'welding engineering graduates'. This course will provide an initial step to provide education and training in this very important technology. An essential element of this project's education and training program will be the provision of continuing education which will assist professional engineers to keep themselves up-to-date with recent developments in welding and NDE technology. The continuing competitiveness of US industry requires that its engineers maintain their skill base.

4.2(a) Fundamentals of Welding and Joining - Basic Course (Faculty Mentors: Wahab and Pang): The following major topics will be covered for Welding segment of the Basic Level course: i) Physics of Welding - energy sources of welding, arc characteristics, metal transfer, physical properties of metals; ii) Heat Flow in Welding - peak temperatures, typical weld thermal cycles, thermal characteristics; iii) Welding Metallurgy - general metallurgy, phase transformations, heat treatments, heat-affected-zone, weldability testing; iv) Weld Design and Testing/Evaluation of Joints - weld design methodologies, mechanical testing, Codes and standards; v) Post-weld Residual Stresses, Distortions, Fatigue Analysis of Welded Structures - measurements of residual stresses, and distortions; vi) Weld Processes: Gas Tungsten Arc (GTA) Welding - fundamentals of the process, process variables, welding procedures; Gas Metal Arc (GMA) Welding - welding procedures, Gas Metal Arc narrow gap welding; Submerged Arc Welding - general process applications, operating variables, welding procedures, weld quality; Plasma Arc Welding - materials, joint designs, welding procedures; Manual Metal Arc Welding (Oxyfuel) flame effect on metal; Friction-Stir-Welding (FSW) technology and procedures; and vii) Weld Design and Fracture mechanics of welded structures: various joint configurations, weld defects, deformities, etc., brittle failure evaluation techniques; viii) Weld equipment and Safety in welding.

4.2(b) Computational Weld Mechanics - Advanced Course (Faculty Mentor: Wahab): This will be an advanced level course on weld modeling to implement numerical methods of calculating the thermal cycle in the near-weld region of GMAW. Computational weld mechanics is a growing field of research endeavour, and the one that is becoming more significant in international welding research. Refined numerical tools are the ideal and cost-effective way to test process variations such as weld procedure; and may ultimately become the 'virtual' welding machine. Forecasting thermal cycles during welding is a key step to the prediction of macrostructural changes and the distortion/residual stresses. The PI has over 150 journal and conference publications in this area of research and has written key reviews, has delivered keynote addresses in international conferences; and is currently engaged in writing a research monograph on "*Computational Weld Mechanics*". This course on advanced welding will give students insights into the computational weld modeling; and practical hands-on aspects will be introduced through experimental lab sessions. This section will advance the numerical simulation of fusion welding processes, through an improved application of commercial finite element methods to the study of both fluid flow and heat transfer within the GMA weld-pool. In GMA welding, heat from the arc and from the transferred metal droplets is dissipated in the weld pool by both conduction and convection. Representing the welding process with an appropriate heat distribution is the major difficulty since it combines both the real non-uniform distribution of heat from the arc and the transferred droplets, together with adjustments to approximate the convective flow and allow model simplification. Two related modelling strategies are: (i) development of conduction based models; and (ii) development of a model for flow in a GMA weld pool. The conduction based models will be introduced to develop heat-source descriptions reflecting physical processes taking place within the weld pool, empirically linking these to process parameters, in order to reduce the need for arbitrary fitting parameters. Various types of heat-source descriptions have been used in the past, and new ones developed, which split the total arc energy into parts, roughly reflecting the importance and nature of droplet transfer.

4.2(c) Students' Project Tasks: Using computational weld mechanics concepts, students will be able to develop the following computational strategies and verify the concepts that will be developed during lectures in this module. The objectives are to: (i) produce models for complex joints and weld types; and (ii) 3D quasi-steady-state conduction models will be introduced. Various methods of representing the welding heat distribution will be developed and applied for V-butt and fillet joints. The Fig.1 (Schematic of modeling strategies) shows the general modeling approach that will be introduced within this project from which students will be able to find new initiatives to improve modeling and validate their own program strategies. To improve the speed of transient models through minimizing the required mesh, the strategy illustrated in Fig.1 may be used. The following general topics will be covered in Computational Weld Mechanics: (i) Computer Simulation of Welding Processes Introduction to computational weld mechanics, computational geometry, models for welding heat sources, models for welding heat transfer, modeling thermal stresses and distortions; (ii) Thermal Analysis of Welds - weld heat source, modeling weld heat source, heat transfer in welds, transient models, finite element solutions with prescribed temperature, interpretation of computational results; and (iii) Welded Structures and Applications of Welding in Industrial Field- welds procedure, analysis of weld structure, and thermal analysis outside the weld pool, microstructure evolution, and fracture mechanics of welded structures.

4.3 PART-II: Non-Destructive Evaluation (NDE) of Engineering Systems

NDE is a fast growing field both on the research and application fronts that allows examining components without disruptions while in service without changing or destroying their usefulness. Graduating engineers with proper training on the state-of-the-art NDE tools and techniques is prudent in today's world where the complexity of engineering systems is only increasing and the condition of existing systems is only deteriorating. Fracture loads and structural component life are extremely sensitive to preexisting flaws, defects and damages, NDE plays a key role in preventing structure failures, especially critical attention is important for welded structures. In fracture analysis of welded structures it is assumed that every single welded structure contains flaws or discontinuities; and their severity must be ascertained through nondestructive evaluations and analysis. The following general course topics will be covered as part of the course curriculum in Welding and NDE:

4.3(a) NDE Course Curriculum - Basic Course (Faculty Mentors: Okell and Pang): Two main NDE techniques relevant to structural health assessment of welded joints will be incorporated in this course: (i) General methods for detecting damage in structures and (ii) Advanced digital signal processing techniques in NDE. The NDE module that will be developed through the proposed effort which will cover the latest of the reviewed techniques with the goals of preparing graduates: (i) with knowledge of NDE alternatives currently available; (ii) who have been trained in laboratory testing using NDE equipments; and (iii) whose training is truly multidisciplinary (material fracture, structural reliability and integrity, and digital signal processing). To achieve these goals, an NDE module will be integrated with the welding module in a two-semester course sequence. The Basic course will introduce the fundamentals of NDE techniques available for inspection of welds. In the second semester, NDE module will cover advanced NDE topics such as digital signal processing. A **Demonstration-Testbed (DTB)** will also be developed for hands-on instruction and training, which will be used in conjunction with both the instruction modules.

4.3(b) NDE for Damage Detection: In the simplest weld inspection technique, Liquid (Dye) Penetrant Inspection (LPI) method, where only cracks that reach the metal surface can be detected. The method makes use of capillary action by applying a bright-colored (usually red)

low surface tension fluid on to the surface and allowing sufficient time for the dye to penetrate any existing flaws. After wiping off the extra dye, a developer is applied to help draw out the dye that has penetrated through small cracks. Visual inspection can then detect the location of flaws by spotting the discoloration of the developer agent. Fig.2 shows a schematic of the LPI technique. In the case of ferrous materials, magnetic particle inspection is preferred for its subsurface detection capability. Deeper defects can be detected using other NDE methods, such as Impact-Echo (I-E) method. By using a point source receiver internal flaws can be detected. Application of I-E technique can be used to locate flaws within several material types such as metals. The impact source produces waves that reflect from opposite surface or internal flaws such as cracks. The reflected waves are acquired using a receiver from which information about the depth and extent of the flaw can be determined. Energy leakage of waves and defect geometry can also be used for the inspection welds. In this technique guided waves are reflected from breaks or major defects, and are used to determine the condition of the inspected material. Recently, Phased-Array-Ultrasonic-Testing (PAUT-Fig.3) appeared as a new development in NDE. PAUT striking advantage is its ability of scanning images of tested components in time. Internal anomalies such as corrosion, cracks, and voids of various shapes can be successfully detected using PAUT.

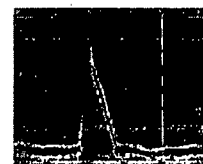
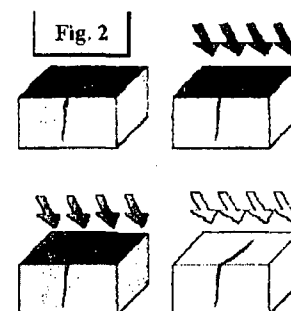


Figure 3: PAUT: (a) diffraction and reflection of ultrasound due to defects and (b) scanned image.

4.3(c) NDE Determining Stress-State - Advanced Course (Faculty Mentor: Okeil): This

course material will be developed for Spring-2012 for the advanced level Welding and NDE course. Even though the majority of the available NDE applications focus on determining material properties and detecting defects, but investigation of the *stress-state of materials* and structures has been another important concept in nondestructive structural health assessment. High stress levels in materials may lead deformations or premature fatigue cracking. These phenomena are common in nuclear power plant's conditions. Critical stress locations, or hot-zones/hot-spots, are mostly caused by the applied stresses, residual stresses, and/or a combination of both. Instead of measuring the average stresses across the thickness of a material, the use of critically refracted waves (Fig.4)



can be used to measure the effect of near-surface stress (where the transducers are placed). Acoustic

emission method, thermal inspection, and advanced optical techniques will also be covered in this advanced NDE modules during the second semester course. Residual stresses, equivalent to material's yield strength that could exist in materials when no external forces are acting upon them and they are free from restraint. High residual stresses can become potential sites for crack initiation and propagation. For this reason, measurement of applied residual stresses has been

a main area of interest in NDE. Stresses in materials cannot be directly measured by NDE methods but instead, the stress is related to the measure of secondary quantity such as elastic strain, speed of sound, and magnetic signature that is directly dependent on the stress level. X-Rays have a low depth of penetration in metals which allows the measurement of stresses in sub-surface zone of about 10 micrometer depth only. Therefore this method is generally used

for surface and weld detections in nuclear and aerospace industries. Ultrasonic inspection is the most commonly used NDE method for stress measurements and it overcomes the challenges to stress measurement techniques mentioned above since it has almost no restriction on the material to be tested, offers very portable in-situ testing solutions and allows engineers to make deep stress measurements with very high signal penetration strength. Ultrasonic stress measurements methods rely on the changes in the wave velocity due to applied stresses according to the Theory of Acoustoelasticity.

4.3(d) Digital Signal Processing in NDE: Digital Signal Processing (DSP) method processes signals by digital means have experienced rapid development during the past decades. Many researchers developed reliable NDE tools that rely on DSP methods, such as Fast Fourier Transform and Wavelet Transform to investigate signals and extract its specific features. These and other transforms such as the Chirp-Z Transform (CZT) method, which has been used in our lab, will be also addressed. The objective of this section is to investigate the application of DSP for detecting and identifying the nature of the *state of stress* and defects in welded components by interpreting the ultrasonic signals. New course materials will be produced which will cover all recent knowledge in the NDE technology for quality assurance in welding processes.

4.3(e) Incorporating Comments from Last Year's NRC Reviewers: It was suggested by last year's NRC grant reviewers in response to our application that we contact PNNL to seek their advice on NDE aspects of the course. Accordingly, the PI contacted Dr. Steven Doctor of PNNL and seeks his suggestions on the nondestructive evaluation techniques to improve the inspection of components located in nuclear power plants; since this will signal the advance warnings concerning material degradation that may be occurring as reactors age. Since then, information has been collected, updated, and will be incorporated into our course for NDE segment of the curriculum development. The initial importance is placed with the monitoring of existing welding first, and then research materials will be covered on the aspects of new weld design and how expert systems could be effectively used to monitor the gradual degradation of the weldments strength due high temperature nuclear environment. The PNNL will be approached again to seek their suggestions in this regard which will enable the investigators to cover materials relating to more effective NDE tools for nuclear environment.

4.3(f) Demonstration Testbed (DTB): It is proposed that a hands-on *Demonstration Testbed* (DTB) be established for instructional purposes of various NDE techniques. The DTB can also serve as a platform for evaluating new NDE as they become available to assess their applicability to welding applications. Specimens with various configurations of welded specimens covering a wide range of damage levels will be obtained. The 'real' conditions of the specimens will be determined by experts in the field of weld inspections and will be documented in an expert database to serve as the reference to other activities that will take place in the DTB. For example, task grades can be assigned by comparing the student's choice of an NDE technique and assessment of the specimen's condition to the documented condition by the expert database. The actual condition of the specimen will not be shared with the students until their assessment is completed and submitted to the instructor. The specimens in the DTB will be use as: (i) an instructional tool, and (ii) as an *NDE Challenge*, where students will be given the freedom to choose any of the available NDE devices individually or collectively to assess the condition of a specimen. The DTB concept has been used by leaders in this field such as BAM (Federal Institute for Materials Research and Testing, Berlin, Germany). It is now the time to bring such a concept into our classroom. The research team also plans to use the DTB as an exploratory platform for new NDE technologies that are rapidly changing and continuously offering new devices to the industry which will allow students to stay up-to-date with the state-of-the-art NDE technologies.

4.3(g) NDE Course Outline: It is proposed that two NDE course modules be developed and

integrated with Welding instructional modules. The proposed modules will be offered in a two-semester sequence; in the first semester (Module-I), fundamental NDE techniques available for inspection of welds will be covered. Materials will also include NDE techniques to improve the inspection of components located in nuclear power plants for both existing and new welds in nuclear environment. The DTB will be used in instructional activities as described above. The Module-II will cover advanced NDE techniques with state-of-the-art devices, where students will be introduced to the theory behind each device and provide them with open-source algorithms that can be used for interpreting raw data. Understanding the core technologies of NDE devices avoids offers an alternative for learning how to use NDE *Black Boxes*; a job that any training workshop can deliver. Advantages and limitations of each technique will also be presented. Students will also be required to write an individual report about an NDE-related topic that includes latest NDE developments. From the project reports (i) individuals can learn more about an extra topic of their choice; and (ii) students can improve their oral, written, and technological communication skills. LSU offers a program called *Communication across the Curriculum (CxC)*

Module I:		Lectures	DTB	Lectures
Introduction		x		1.00
Review of NDE Techniques		x		
Liquid Penetrant Test		x	x	1.00
Magnetic Particle Inspection		x	x	1.00
Impact-Echo (I-E) method		x		1.00
Ultrasonic Testing (Thickness)		x	x	1.00
Ultrasonic Testing (Flaw Detection)		x	x	1.00
Other NDE Techniques, (X-rays, Radars, etc.)		x		2.00
NDE-improving inspection of nuclear power plants components		x		1.00
Module II:		Lectures	DTB	Lectures
Introduction		x		1.00
Advanced NDE Techniques		x		
Phased-Array Ultrasonic Testing (PAUT)		x	x	1.00
Digitization of Raw Ultrasonic Signals		x	x	2.00
Algorithms for Signal Processing		x	x	1.00
NDE Challenge (Acoustic Emission)		x	x	2.00
Project Presentations		x		3.00
Dates	Key Activities			
July 2011	Start of curriculum development program. Select course contents into Welding and NDE topics suitable for first basic course; see format from other US university curriculum and			

to assist and improve communication in the classroom, through which students can seek help from CxC in communication studios around campus. The PI (Wahab) and Co-PI (Okeil) both have four courses already approved through CxC and will work diligently to have the proposed course certified as well. Table 1 lists an outline for both NDE modules described above.

Table 1: NDE Course Outline

5. LABORATORY EXPERIMENTAL PROGRAM IN WELDING AND NDE: (Faculty Mentors: Wahab, Okeil, and Pang):

In engineering, hands-on training must be imparted for any new technology, thereby students will have increased appreciation of the working and procedural steps of the

equipments/machines, components etc. Combinations of lectures and labs will be included in the course curriculum to impart in-depth understanding to the students. A total of six laboratory sessions will be designed in this curriculum development program during the first year. Additional two more experiments on Welding and NDE will be added during the second year of the program. The labs will include the following sessions:

5.1 Welding Labs (Faculty Mentors: Wahab and Pang)

- 1 Familiarization of basic welding equipments and Manual Metal Arc Welding (MMAW), Bead-on-plate formations, Effects of weld parameters, extent of HAZ identification
 - 2 Gas Tungsten Arc Welding (GTAW), effects of control parameters, microstructural study
 - 3 Gas Metal Arc Welding (GMAW), effects of control parameters, microstructural study
 - 4 Repair Welding, Residual Stress Measurements (*This lab will be added during the Second year of the program*)
-

Nondestructive Evaluation Labs (Faculty Mentors: Okeil and Pang)

- 1 Damage detection through Visual and Liquid Penetrant, Boroscopic examinations, magnetic particle inspections methods
- 2 Damage Detection in Structures by Pulse-Echo/Ultrasonic testing (thickness) ,
- 3 Detection for flaws by Ultrasonic testing, Phased Array Ultrasonic, Digitization of Ultrasonic signals
- 4 Damage detection through Acoustic Emission, Algorithm for signal processing (*This lab will be added during the second year of the program*),

In Welding area, the experiments will cover the basic welding principles and applications; and students will be able to build a number of projects using MMAW, GMAW, and GTAW. Labs 5 to 8 will cover the NDE aspects and testing of welded structures. The objectives will be to familiarize with the most common weld-discontinuities and NDE methods of locating them, reasons as to why welds and welded structures must be tested. We plan to separate the laboratory course into two sections. A set of 3-lab experiments in NDE and 3-experiments in Welding will be common to both UG and graduate students alike; but the graduate students will require performing more rigorous analysis and numerical modeling of the labs in their reports. In addition, we will introduce additional experiments to our graduate students who will require particular weld design projects relating to nuclear engineering.

5.3 Laboratory Facilities

A major emphasis during the curriculum development program will be to upgrade our experimental facilities and student laboratory courses and will address the most recent industry needs, with a special emphasis on nuclear industry. Hands-on training will be imparted to enrolled students. Both ME and CEE departments have weld-testing and evaluation facilities, microscopic examination, and ultrasonic techniques for the measurement of post-weld residual stresses and weld-discontinuities in structures. During Summer of 2011, general welding experiments will be developed. In addition to the research/teaching programs and student labs in ME and ME-workshop are well-equipped with high quality machine shop equipments, numerical controlled machines, GMAW, GTAW, and MMA welding machines; and in Civil Engineering we have excellent facilities for NDE facilities as well as trained personnel in machine shops and structures lab.

6. TIMELINE/MILESTONE AND BENCHMARK SCHEDULES:

Table-2 shows the major milestone and benchmark within two year's project period.

Table 2: Timeline/Milestone and Benchmark Schedules

Module I:	Lectures	DTB	Lectures
Introduction	x		1.00
Review of NDE Techniques	x		
Liquid Penetrant Test	x	x	1.00
Magnetic Particle Inspection	x	x	1.00
Impact-Echo (I-E) method	x		1.00
Ultrasonic Testing (Thickness)	x	x	1.00
Ultrasonic Testing (Flaw Detection)	x	x	1.00
Other NDE Techniques, (X-rays, Radars, etc.)	x		2.00
NDE-improving inspection of nuclear power plants components	x		1.00
Module II:	Lectures	DTB	Lectures
Introduction	x		1.00

Module I:		Lectures	DTB	Lectures
Introduction		x		1.00
Review of NDE Techniques		x		7
Liquid Penetrant Test		x	x	1.00
Magnetic Particle Inspection		x	x	1.00
Impact-Echo (I-E) method		x		1.00
Ultrasonic Testing (Thickness)		x	x	1.00
Ultrasonic Testing (Flaw Detection)		x	x	1.00
Other NDE Techniques, (X-rays, Radars, etc.)		x		2.00
NDE-improving inspection of nuclear power plants components		x		1.00
Module II:		Lectures	DTB	Lectures
Introduction		x		1.00
Advanced NDE Techniques		x		
Phased-Array Ultrasonic Testing (PAUT)		x	x	1.00
Digitization of Raw Ultrasonic Signals		x	x	2.00
Algorithms for Signal Processing		x	x	1.00
NDE Challenge (Acoustic Emission)		x	x	2.00
Project Presentations		x		3.00
Dates	Key Activities			
July 2011	Start of curriculum development program. Select course contents into Welding and NDE topics suitable for first basic course; see format from other US university curriculum and other international experiences. Complete relevant curriculum development forms and procedures for university approvals as an Elective course in ME for senior ME UG students and First year graduate course (4xxx series).			
July 2011	Advertise through ME and LSU publicity office the intentions to offer the Course.			
July 2011	Begin planning new course content on aspects of Welding and NDE. Begin designing new laboratory program jointly with CEE (NDT-2 labs) and ME (Welding-2 labs).			
July 2011	Begin designing additional new lab experiment in ME (Welding-1 more lab) and one more lab in NDE (CEE). Contact relevant industry for possible practicing engineers enrolling for Summer course in 2012 and explore students for possible Master program			
Aug. 2011	Begin teaching First new course (Basic Course) at UG level/ MS & PhD first year graduate students levels.			

ACADEMIC FOCUS AND TARGETED STUDENTS:

The new curriculum development program on Welding and NDE will be offered as part of the current ME program at LSU, leading to BS, MS, and PhD degrees in ME. An important component of the program will be to offer off-campus short courses for industry professionals, on demand. The course modules will be available on-line through LSU's "Moodle" course management system and will be delivered in-class environment; after-hours access will be provided through E-mails, "Skype," and telephone links with the Instructors and Teaching Assistant. The video conferencing facilities ("Skype") will help students to discuss their problems with the course Instructors. This course will be offered each semester as a single-semester, 3-point credit course with 2-Design points to UG and first year graduate students in engineering as an ME-Elective course. The first basic course will be introduced in Fall-2011. The advanced course will be delivered in Spring-2012. These two courses will be alternatively offered every other semester in subsequent years. This program will also have a dedicated "Outreach" program and through which, course materials will be delivered in modular form to the practicing engineers. The selected industry professionals will come from nuclear industry, pressure vessels, boiler industry, gas and oil pipeline industry, maritime and ship building, highway and rail bridge engineers, etc. Dr. Pang, the Co-PI, will be the overall outreach program coordinator.

Drs. Wahab and Okeil have expertise in Welding and NDE respectively, and are qualified to teach the fundamentals and advanced courses in these areas. The PI has over 30-years of research, teaching, and consulting experiences and have published over 150 journal and refereed conference publications specifically in the areas of welding processes, welded structures, modeling in computational weld mechanics, and fatigue and fracture evaluation of welded structures. The PI has delivered three keynote addresses in international conferences on various welding process and weld modeling. The Co-PI, Dr. Okeil has extensive research credentials in the area of NDE for engineering structures, also published extensively. Dr. Pang, Co-PI, is nationally recognized for outreach and mentoring activities dealing with mentoring of under-privileged minority students into the course. The PI/Co-PIs have excellent research publications, totaling over 400, and teaching records in the area of weld design, NDE and mechanical design and materials. Currently, several PhD and MS Students are actively undertaking higher research degrees in the areas of welding, fracture mechanics and structural fatigue, and NDE under the supervision of the PI and Co-PIs.

We will target primarily ME and CEE students, and science honor students including afro-American and Hispanic minority and women students with interests in Welding and NDE. An important ingredient in building up our Welding program will be of involving students with faculty members in real research and industry-sponsored projects. NRC funding will be augmented with funding from our industrial partners. This will enable us to sustain our teaching program, provide research opportunities for our students, and establish a viable and visible welding program that attracts sufficient high quality students to meet the industry needs and attracts sufficient external funding to support these students. Graduate students will enroll in MS program in ME. The requirements for MS degree are embedded within our ME-program and the students will be able to select several optional courses within ME sub-disciplines: materials, thermal, and systems groups. The final thesis should be selected from Welding and NDE topics. An MS thesis, whose quality is sufficient for publication in an appropriate peer-reviewed scientific journal, is required for the MS degree. The Master thesis is considered complete upon: (i) the student's delivery of a public seminar, (ii) the student's passing an Oral examination on the thesis by members of the Examining Committee and other interested faculty, and (iii) the final written thesis having been approved by all members of the student's Examining Committee. The Examining Committee may require that at least one paper, reporting on part or the entire thesis be submitted for publication in a refereed scientific journal prior to final approval of the thesis. Entering MS students may petition to waive some course requirements from ME-MS program if similar courses were taken previously (e.g., transferring students from other programs). The thesis requirement may be substituted by a semester project under special circumstances, as will be discussed with our industrial partners.

7.1 Welding and NDE as Stand-Alone Module

A significant need for future graduates exists in Louisiana to ensure the continued safe operation of existing nuclear power plants and the design, construction, and operation of new plants. The expected output will be in the form of course materials development in welding and NDE. This curriculum development is planned to be a stand-alone course and students will be able to enroll for this course as UG and graduate students in engineering. Several modules of this course will be developed and will be available for in-class delivery and on-line to the enrolled students. The in-class modules will be presented to the students at LSU and SU. The course, curricula development, and outreach program will be undertaken by the PI, Co-PIs, and a Teaching Assistant will be working during the semesters only and will collect information, conduct lab sessions, and will involve mentoring and grading; and a part-time web designer will design the web and maintain web-based materials. The management team will consist of the PI and Co-PIs. The management team will meet on a monthly basis to plan and discuss the progress of the project activities, including the suggestion of policies and procedures as well as

assistance in the evaluation and dissemination of this project. The management team will address sustainability questions, will collect and interpret evaluative data. The management team will also have open discussions with our ME Industrial Board Panel members and will seek their advice and suggestions. The module Instructors will be required to complete an annual questionnaire to document both objective and subjective improvement of their advisees.

7.2 Nuclear Radiation and Safety Course

LSU has already running a new program in Nuclear Engineering and Health Physics in Fall-2010. The program is offered by the Dept. of Physics. Currently, several courses being offered on nuclear safety and health physics related courses. The Department of Physics has expertise in nuclear physics and radiation detection. ME students will have the options to choose several courses on nuclear radiation safety and environmental protections related courses. This course on Welding & NDE will contain components relating to welding environment and safety issues. Modules will be prepared on the various safety aspects and health hazards of welding, and basic precautions will be discussed within this course modules.

8. INNOVATIVE APPROACHES TO ENHANCE STUDENTS' LEARNING:

Students' learning strategies will center on faculty mentors, promoting high quality teaching through practical approach to teaching. The following reforms in new initiatives will be adopted: *(i) Focus Groups* - Special Focus Groups comprised of three/four students will be formed and brief discussion will be held fortnightly with every Focus Group. Discussions will mainly focus on learning strategies and identify any difficulty students are encountering and remedial actions needed. Focus group will help faculty to identify struggling students having difficulties in learning the course materials. *(ii) Mid-Semester Students' Feedback* -This is an essential tool for new course offerings. It will mainly focus on soliciting feedback related to course materials, learning strategies, project evaluation strategies, effectiveness of tutorial and laboratory sessions, and students' perceptions of course directions will be collected at mid-semester. *(iii) "Moodle" Course Management System* -Students will be encouraged to use Moodle's "Discussion Board," individual, and Group E-mail systems. Course materials which need more discussion to improve knowledge will be posted on the Discussion Board by students and faculty; and students will be encouraged to make contributions to the Discussion Board. *(iv) Publication Club* -This Club will be formed to encourage students to work on interesting practical projects assigned to every group and two discussions/meetings per month will take place to discuss the strategies of journal/conference publications. The purpose of the Club would be to disseminate the results and understanding on the topics from the literature and provide a forum for meaningful discussions. Faculty mentors will evaluate the quality of the group presentation. Final papers will be reviewed by the faculty mentors. One of the major aims of the journal club members is to work more efficiently and to be productive in their learning strategies. *(v) Personal Mentoring Scheme* -Students will be encouraged to meet with the faculty/Instructor/Teaching Assistant as need arises. Faculty mentor will then provide guidance and help to resolve the problem. Faculty will identify weak and struggling students and special attention will be extended to those students. *(vi) "Communication-Intensive (C-I)" Course at LSU* - This Course will implement both written and oral presentation processes involving a communication initiative and a certification process. We will develop an assessment program to critically review the impacts of this "C-I" course in the oral presentation and writing skills gained by the students.

9. ASSESSMENT/EVALUATION PLAN, SUSTAINABILITY, INSTITUTIONAL CAPABILITY, INFRASTRUCTURE:

This proposal is the first step in establishing a sustained program to provide well-trained graduates for the nuclear power industry and other welding fabrications industry within the southern region. Proposals will be submitted in 2011 to the NRC's Faculty Development and Scholarship and Fellowship programs, coupled with some financial support from our industry

partners and the State of Louisiana, are expected to provide the resources to attract a new faculty/or a post doctoral fellow to establish active and continuing research programs, and set up a self-sustaining program after the project period. This will help produce around 15/20 students per year, able to enter the nuclear power industry with Welding and NDE knowledge. Also, an NSF-TUES education grant will be submitted in 2011 where funds can be requested to expand our teaching activities and support will be requested for a faculty/post-doc position.

The PI, Wahab has all basic equipments for MMAW, GMAW, and GTAW facilities. Students will receive basic training on how to use these facilities. PI also has various types of structural weld testing and specimen preparation facilities for micrographs, tensile and fatigue testing facilities with an MTS universal testing facilities. Co-PI (Okeil) has built the first versatile ultrasonic testing system at LSU. The system comprises of parametric broadband frequency Pulser/Receiver, contact transducers and shear wave and a PC with a high-resolution high-speed digitizing board. The facilities will allow performing tests on any weld related discontinuity and structural strength tests in static or in dynamic modes. LSU-ME has Center for microstructural work which will be used for all types of micro structural characterization (SEM, TEM, EDAX, XRD, XPS) studies.

In the computer lab, we have several high performance multi-processor Unix-workstations. We have excellent computing, data processing and numerical modeling facilities and a CAD lab where all drafting and design could be carried out; we also have a variety of multimedia equipment available for students' checkout. The main quantifiable assessment criterion will be the number of graduates who leave our ME program with a Welding and NDE training and go on to work with our industrial partners. We will work together with industry to develop longer lasting collaborative projects and to enhance UG/graduate education in Louisiana. All course modules and the labs will be fully developed during the project period. The PIs will work closely with the LSU Foundation to secure endowments that will allow sustaining and expanding the NRC activities. The Core elements of this project can draw significant support from the Board of Regents' "Education Enhancement Program," which shares many common goals with the NRC program. LSU's Engineering Program now has strong links with Corporations and we expect to secure significant industrial support to continue this NRC program. LSU-Office of Public Affairs directs communications strategy, manages marketing and advertising efforts, handles media relations, and produces digital imaging for promotional use. We will work with this Office to disseminate the unique story of the project to local and national audiences. **After the end of NRC-support period, the developed course will be offered as a regular course within LSU's Mechanical Engineering (ME) curriculum.**

Overall Evaluation Plans - The success of the proposed NDE course will be assessed using the following several metrics and are summarized below:

- (1) Surveys of students' knowledge of NDE techniques before and after taking the course will be evaluated by the investigators, the PI and the Co-PIs. These surveys will provide a perspective of the depth and breadth of students' knowledge. It will also provide insight into the students' confidence in what they learned in the proposed course.
- (2) A database of students who have taken the course will be established. The database will track the students after passing the course to evaluate the degree to which the students have utilized the NDE knowledge, whether it is for their degree research requirements (graduate students), or for job duties (undergraduate students).
- (3) External reviews that assess the quality of student course deliverables (e.g. reports) will be sought. These reviews will provide the research team with an independent evaluation of the proposed course.
- (4) Employers feedback, including employers who hired the graduates who undertook the course of Welding and NDT as well as sponsors of the practicing engineers who took the course for promoting their knowledge base will also be sought by the research team to address any

weaknesses or current industry demands. In other words, the content of the proposed course, while clearly outlined, is not a rigid offering. Rather, it will adapt to results from different evaluation metrics.

(5) All feedbacks received from the students, employers and the industry sponsors will be discussed with the ME-Industrial Advisory Board and the decision to continue as a Regular Course in ME program will be discussed and their suggestions will be incorporated into this new Course in ME program.

10. ADDRESSING NRC CRITERIA ON COLLABORATIVE LINKAGES:

We would like to emphasize our approaches to collaborative links with Southern University (SU). In this proposal special emphasis is placed on the quality of education-supports provided to our students from both LSU and SU through collaborative initiatives and partnerships between these two Institutions. We have long-standing strong collaborative links between LSU and SU through our NSF-supported joint faculty members and over 20 SU graduate students and many senior UG ME students working within several federally supported grants i.e. NASA-EPSCoR/DOE etc. supervised by the PI, Co-PI and joint faculty members. Dr. Pang also has significant NSF education-supported grants jointly with SU faculty and has strong research collaborations. Many SU students take courses from LSU; and students use our common research and teaching lab facilities. The letter from Dr. Samuel I. Ibekwe, Professor and Chair of Mechanical Engineering at SU only reinforces these long-standing collaborative relationships with LSU. This NRC supported effort certainly will bring this great opportunity to the doorsteps of SU students; and will enhance and cross-pollinate the overall quality of the educational experiences of both LSU and SU engineering graduates.

This NRC-supported grant will also reinforce the collaborative efforts between LSU and our local industries; and will create a very special collaborative bond with *"The Entergy Corporation"* -State's largest Nuclear power generation industry. Entergy Corp. is an integrated energy company engaged primarily in electric power generation and retail distribution operations, owns and operates 30,000 megawatts of electric generating capacity nuclear power plants, which is the second largest nuclear generator in the United States. Its River Bend Station is a 996-megawatt nuclear generating facility located 30 miles north of LSU and employs over 500 people. The supporting letter from John Wheeler (Sr. Manager, Nuclear Workforce Planning, Entergy Nuclear) confirms their supports and our strong collaboration with Entergy. The similar efforts could easily be extended to State's several other major weld-fabricators, gas pipe line industries, and nuclear fabricator, especially to *The Shaw Groups Inc.* who has substantial activities in Louisiana and strongly supports our education program (attached supporting letter from Gary Graphia, Exec. VP & Chief Operating Officer, The Shaw Groups).

One of our principal aims is also to recruit students from minorities, women, and underrepresented groups into this NRC supported program and we are pleased to have received strong support from Dr. Isiah M. Warner, Vice Chancellor for LSU's Office of Strategic Initiatives (OSI) (letter of support attached). Through OSI office we will receive assistance in recruiting, mentoring, support in organizing local LSU conferences, participation in OSI-sponsored activities, as well as some resources for minority and women students'.

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 CFR 220, 2 CFR 225, and 2 CFR 230 this URL to the Office of Management and Budget Cost Circulars is included for reference to:

A-21 (now 2 CFR 220)

A-87 (now 2 CFR 225)

A-122 (now 2 CFR 230)

A-102:

http://www.whitehouse.gov/omb/circulars_index-ffm

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.

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 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

§ 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 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 VI 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 VI, 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's 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 should 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, 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://epis.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. § 215.40-48

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 must be in accordance with the Grantee's Travel Regulations or the US Government Travel Policy and Regulations at: www.gsa.gov/federaltravelregulation and the per diem rates set forth at: www.gsa.gov/perdiem, absent Grantee's travel regulation. Travel costs for the grant must be consistent with provisions as established in Appendix A to 2 CFR 220 (J.53). All other travel, domestic or international, must not increase the total estimated award amount.

Domestic Travel:

Domestic travel is an appropriate charge to this award and prior authorization for specific trips are not required, if the trip is identified in the Grantee's approved program description and approved budget. Domestic trips not stated in the approved budget require the written prior approval of the Grants Officer, and must not increase the total estimated award amount.

All common carrier travel reimbursable hereunder shall be via the least expensive class rates consistent with achieving the objective of the travel and in accordance with the Grantee's policies and practices. Travel by first-class travel is not authorized unless prior approval is obtained from the Grants Officer.

International Travel:

International travel requires **PRIOR** written approval by the Project Officer and the Grants Officer, even if the international travel is stated in the approved program description and the approved budget.

The Grantee shall comply with the provisions of the Fly American Act (49 USC 40118) as implemented through 41 CFR 301-10.131 through 301-10.143.

Property and Equipment Management Standards

Property and equipment standards of this award shall follow provisions as established in 2 CFR 215.30-37.

Procurement Standards

Procurement standards of this award shall follow provisions as established in 2 CFR 215.40-48

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 and retain title 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 for this award shall follow OCOI requirements set forth in Section 170A of the Atomic Energy Act of 1954, as amended, and provisions set forth at 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 an intra-agency Appeal Board to review a grantee appeal of an agency action, if required, which will consist of the program office director, the Deputy Director of Office of Administration, and the Office of General Counsel.
- 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 215.60-62.

Monitoring and Reporting § 215.50-53

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 or deducted from the total project cost allowable cost as directed by the Grants Officer or the terms and conditions of award.
- Budget Revision – 2 CFR 215.25
 - The Grantee is required to report deviations from the approved budget and program descriptions in accordance with 2 CFR 215.25, and request prior written approval from the Program Officer and the Grants Officer.
 - The Grantee is not authorized to rebudget between direct costs and indirect costs without written approval of the Grants Officer.
 - The Grantee is authorized to transfer funds among direct cost categories up to a cumulative 10 percent of the total approved budget. The Grantee is not allowed

to transfer funds if the transfer would cause any Federal appropriation to be used for purposes other than those consistent with the original intent of the appropriation.

- o Allowable Costs – 2 CFR 215.27

b. Federal Financial Reports

The Grantee shall submit a "Federal Financial Report" (SF-425) on a quarterly basis for the periods ending March 31, June 30, September 30, and December 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 is due within 90 days after expiration of the award. The report should be submitted electronically to:

Grants FFR@NRC.GOV. **(NOTE: There is an underscore between Grants and FFR).**

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 should 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 may 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 on a semi-annual basis unless otherwise authorized by the Grants Officer. Performance reports should be sent to the Program Officer at the email address indicated in Block 12 of the Notice of Award, and to Grants Officer at:

Grants_PPR.Resource@NRC.GOV. **(NOTE: There is an underscore between Grants and PPR).**

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 Office of Human Resources requires the submission of the semi-annual progress report on the SF-PPR, SF-PPR-B, and the SF-PPR-E forms. The submission for the six month period ending March 31st is due by April 30th, or any portion thereof. The submission for the six month period ending September 30th is due by October 31st or any portion thereof.

d. 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.

As part of the FY 2010 HR 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:

Curriculum Development Awards

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.

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 hereby 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 Leadership of Reducing Text Messaging While Driving

Pursuant to EO 13513, Grantees should encourage employees, sub-awardees, and contractors to adopt and enforce policies that ban text messaging while driving company-owned, rented vehicles or privately owned vehicles when on official Government business or when performing any work for or on behalf of the Federal Government.

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 from 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."

Trafficking In Victims Protection Act Of 2000 (as amended by the Trafficking Victims Protection Reauthorization Act of 2003)

Section 106(g) of the Trafficking In Victims Protection Act Of 2000 (as amended as amended, directs on a government-wide basis that:

"any grant, contract, or cooperative agreement provided or entered into by a Federal department or agency under which funds are to be provided to a private entity, in whole or in part, shall include a condition that authorizes the department or agency to terminate the grant, contract, or cooperative agreement, without penalty, if the grantee or any subgrantee, or the contractor or any subcontractor (i) engages in severe forms of trafficking in persons or has procured a commercial sex act during the period of time that the grant, contract, or cooperative agreement is in effect, or (ii) uses forced labor in the performance of the grant, contract, or cooperative agreement." (22 U.S.C. § 7104(g)).

Award Term

2 CFR 170.220 directs agencies to include the following text to each grant award to a non-federal entity if the total funding is \$25,000 or more in Federal funding.

Reporting Subawards and Executive Compensation.

a. Reporting of first-tier subawards.

1. *Applicability.* Unless you are exempt as provided in paragraph d. of this award term, you must report each action that obligates \$25,000 or more in Federal funds that does not include Recovery funds (as defined in section 1512(a)(2) of the American Recovery and Reinvestment

Act of 2009, Pub. L. 111-5) for a subaward to an entity (see definitions in paragraph e. of this award term).

2. Where and when to report.

i. You must report each obligating action described in paragraph a.1. of this award term to <http://www.fsrs.gov>.

ii. For subaward information, report no later than the end of the month following the month in which the obligation was made. (For example, if the obligation was made on November 7, 2010, the obligation must be reported by no later than December 31, 2010.)

3. What to report. You must report the information about each obligating action that the submission instructions posted at <http://www.fsrs.gov> specify.

b. Reporting Total Compensation of Recipient Executives.

1. Applicability and what to report. You must report total compensation for each of your five most highly compensated executives for the preceding completed fiscal year, if—

i. the total Federal funding authorized to date under this award is \$25,000 or more;

ii. in the preceding fiscal year, you received—

(A) 80 percent or more of your annual gross revenues from Federal procurement contracts (and subcontracts) and Federal financial assistance subject to the Transparency Act, as defined at 2 CFR 170.320 (and subawards); and

(B) \$25,000,000 or more in annual gross revenues from Federal procurement contracts (and subcontracts) and Federal financial assistance subject to the Transparency Act, as defined at 2 CFR 170.320 (and subawards); and

iii. The public does not have access to information about the compensation of the executives through periodic reports filed under section 13(a) or 15(d) of the Securities Exchange Act of 1934 (15 U.S.C. 78m(a), 78o(d)) or section 6104 of the Internal Revenue Code of 1986. (To determine if the public has access to the compensation information, see the U.S. Security and Exchange Commission total compensation filings at <http://www.sec.gov/answers/execomp.htm>.)

2. Where and when to report. You must report executive total compensation described in paragraph b.1. of this award term:

i. As part of your registration profile at <http://www.ccr.gov>.

ii. By the end of the month following the month in which this award is made, and annually thereafter.

c. Reporting of Total Compensation of Subrecipient Executives.

1. *Applicability and what to report.* Unless you are exempt as provided in paragraph d. of this award term, for each first-tier subrecipient under this award, you shall report the names and total compensation of each of the subrecipient's five most highly compensated executives for the subrecipient's preceding completed fiscal year, if—

i. in the subrecipient's preceding fiscal year, the subrecipient received—

(A) 80 percent or more of its annual gross revenues from Federal procurement contracts (and subcontracts) and Federal financial assistance subject to the Transparency Act, as defined at 2 CFR 170.320 (and subawards); and

(B) \$25,000,000 or more in annual gross revenues from Federal procurement contracts (and subcontracts), and Federal financial assistance subject to the Transparency Act (and subawards); and

ii. The public does not have access to information about the compensation of the executives through periodic reports filed under section 13(a) or 15(d) of the Securities Exchange Act of 1934 (15 U.S.C. 78m(a), 78o(d)) or section 6104 of the Internal Revenue Code of 1986. (To determine if the public has access to the compensation information, see the U.S. Security and Exchange Commission total compensation filings at <http://www.sec.gov/answers/execomp.htm>.)

2. *Where and when to report.* You must report subrecipient executive total compensation described in paragraph c.1. of this award term:

i. To the recipient.

ii. By the end of the month following the month during which you make the subaward. For example, if a subaward is obligated on any date during the month of October of a given year (*i.e.*, between October 1 and 31), you must report any required compensation information of the subrecipient by November 30 of that year.

d. *Exemptions*

If, in the previous tax year, you had gross income, from all sources, under \$300,000, you are exempt from the requirements to report:

i. Subawards,

and

ii. The total compensation of the five most highly compensated executives of any subrecipient.

e. *Definitions.* For purposes of this award term:

1. *Entity* means all of the following, as defined in 2 CFR part 25:

i. A Governmental organization, which is a State, local government, or Indian tribe;

- ii. A foreign public entity;
- iii. A domestic or foreign nonprofit organization;
- iv. A domestic or foreign for-profit organization;
- v. A Federal agency, but only as a subrecipient under an award or subaward to a non-Federal entity.

2. *Executive* means officers, managing partners, or any other employees in management positions.

3. *Subaward*:

- i. This term means a legal instrument to provide support for the performance of any portion of the substantive project or program for which you received this award and that you as the recipient award to an eligible subrecipient.
- ii. The term does not include your procurement of property and services needed to carry out the project or program (for further explanation, see Sec. __.210 of the attachment to OMB Circular A-133, "Audits of States, Local Governments, and Non-Profit Organizations").
- iii. A subaward may be provided through any legal agreement, including an agreement that you or a subrecipient considers a contract.

4. *Subrecipient* means an entity that:

- i. Receives a subaward from you (the recipient) under this award; and
- ii. Is accountable to you for the use of the Federal funds provided by the subaward.

5. *Total compensation* means the cash and noncash dollar value earned by the executive during the recipient's or subrecipient's preceding fiscal year and includes the following (for more information see 17 CFR 229.402(c)(2)):

i. *Salary and bonus*.

ii. *Awards of stock, stock options, and stock appreciation rights*. Use the dollar amount recognized for financial statement reporting purposes with respect to the fiscal year in accordance with the Statement of Financial Accounting Standards No. 123 (Revised 2004) (FAS 123R), Shared Based Payments.

iii. *Earnings for services under non-equity incentive plans*. This does not include group life, health, hospitalization or medical reimbursement plans that do not discriminate in favor of executives, and are available generally to all salaried employees.

iv. *Change in pension value*. This is the change in present value of defined benefit and actuarial pension plans.

v. *Above-market earnings on deferred compensation which is not tax-qualified.*

vi. Other compensation, if the aggregate value of all such other compensation (e.g. severance, termination payments, value of life insurance paid on behalf of the employee, perquisites or property) for the executive exceeds \$10,000.