

ATTACHMENT A - SCHEDULE

A.1 PURPOSE OF GRANT

The purpose of this Grant is to provide support to the "Radiological Sciences Program" as described in Attachment B entitled "Program Description."

A.2 PERIOD OF GRANT

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

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

A. GENERAL

1. Total Estimated NRC Amount:	\$129,000
2. Total Obligated Amount:	\$129,000
3. Cost-Sharing Amount:	\$0
4. Activity Title:	Nuclear Sector Technician Education and Placement Project
5. NRC Project Officer:	Randi Neff
6. DUNS No.:	940020381

B. SPECIFIC

RFPA No.:	HR-10-980
FFS:	N/A
Job Code:	T8453
BOC:	4110
B&R Number:	0-8415-5C1116
Appropriation #:	31X0200
Amount Obligated:	\$129,000

A.3 BUDGET

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

	Year 1
Personnel	\$130,000.00
Fringe Benefits	\$3,356.00
Equipment	\$63,574.00
Supplies	\$2,000.00
Total Direct Charges	\$106,903.00
Indirect Charges	\$22,097.00
Yearly Total	\$129,000.00

All travel must be in accordance with the University of Massachusetts Travel Regulations or the US Government Travel Policy absent Grantee's travel regulation.

A.4 AMOUNT OF AWARD AND PAYMENT PROCEDURES

1. The total estimated amount of this Award is \$150,000 for the (1) year period.
2. NRC hereby obligates the amount of \$150,000 for program expenditures during the period set forth above and in support of the Budget above. The Grantee will be given written notice by the Contracting Officer when additional funds will be added. NRC is not obligated to reimburse the Grantee for the expenditure of amounts in excess of the total obligated amount.
3. Payment shall be made to the Grantee in accordance with procedures set forth in the Automated Standard Application For Payments (ASAP) Procedures set forth below.

Attachment B – Program Description

B.1 Objectives

There has been a substantial decline in the educational opportunities and infrastructure for nuclear science and engineering in the past 20 years in the United States. This decline comes at a time when a dramatic increase is projected in the number of nuclear scientists, engineers, and technicians required to serve the needs of the U.S. government and the nuclear industry in the near future. Universities with research reactors and associated Health Physics and Nuclear Engineering programs are an essential part of the infrastructure that is necessary for providing the current and future workforce for the nuclear industry. As one of only approximately 25 universities in the United States with an operating nuclear research reactor, the University of Massachusetts Lowell (UML) remains invaluable as an educational and training asset for the nuclear industry. UML also has active Health Physics (a.k.a., Radiological Sciences) and Nuclear Engineering programs, but currently these programs are not operating to their full potential due to a lack of support from the previous university administration. In recognition of expected growth in the nuclear power industry, the new university administration has made a strong commitment to invigorate the nuclear science education programs at UML. The focus of this proposal therefore is to design and implement curriculum development for the UML Radiological Sciences Program to help develop its full potential as a major conduit for the future nuclear workforce in Health Physics and related disciplines.

The commitment of the new UML administration to nuclear education programs has been demonstrated by the recent hiring of a senior faculty member (E. Sajo, formerly of Louisiana State University) in the Radiological Sciences Program and the expressed intent to hire more faculty members for this program in the near future. These actions will help to revitalize the Radiological Sciences Program, permitting substantial academic growth and the opportunity to update and expand the program curriculum. Our objectives therefore are to substantially improve the current UML Radiological Sciences academic curriculum and laboratory capabilities at both the undergraduate and graduate levels to meet the current and future demands of the nuclear industry. In addition, the proposed curriculum development will proceed in compliance with accreditation criteria for Health Physics programs specified by the Accreditation Board for Engineering and Technology (ABET), and will satisfy the academic requirements for certification by the American Board of Health Physics (ABHP). The requested funding will be used to update several existing courses, develop new courses, and upgrade course laboratory equipment. The duration of the project is two years, and the curriculum efforts will be sustained through the attainment and ongoing efforts to maintain ABET accreditation, an annual review of the curriculum development program, and ongoing efforts to satisfy the academic requirements for ABHP certification.

The new curriculum detailed herein will leverage courses developed at Louisiana State University (LSU) which recently received NRC support. The new curriculum also will help to produce professionals with broad-based expertise in the nuclear sciences who can face

technical challenges in research, development, and operational areas of the nuclear industry, which include the continued safe operation of existing nuclear power plants, the design of new generation nuclear power plants, the improvement of plant performance, the startup of new nuclear facilities, the safe disposal of radioactive waste, and other advanced industrial and medical applications of nuclear technology. This proposal is part of a continuing initiative by the new UML administration to maintain and strengthen its nuclear science and engineering curriculum and infrastructure. This grant also will reinforce the importance of our nuclear science and engineering academic programs and the value of the UML Research Reactor, Tries, page 2

while sending an important signal to prospective students, other educational institutions, and the public about the importance of nuclear energy as a safe and reliable energy source and of nuclear technology as an important tool in industry, medicine, and research.

B.2 Overview of the UML Radiological Sciences Program

The UML Radiological Sciences Program in the Department of Physics and Applied Physics has been recognized nationally as one of the strongest health physics academic programs over the past 35 years, and during this time 241 B.S., 306 M.S., and 42 Ph.D. degrees were awarded to 469 alumni (with some alumni attaining multiple degrees). Our alumni have built rewarding careers in Health Physics and related fields at nuclear power plants, national laboratories, local and national companies, universities, and medical facilities around the country, and are an invaluable asset for enhancing the program's reputation and helping our graduates find employment and mentoring.

The Department of Physics and Applied Physics offers a B.S. degree in Physics with a *Radiological Health Physics Option*, an M.S. degree in *Radiological Sciences and Protection*, and a Ph.D. degree in *Physics with a Radiological Sciences Option*. A new Ph.D. degree program also is available to health physics students in Biomedical Engineering and Biotechnology (BMEBT) with a *Medical Physics/Radiological Sciences Option*. The BMEBT program offers a multi-campus University of Massachusetts degree, and students can attend classes at the Lowell, Dartmouth, Worcester, and/or Boston campuses to complete this degree. Two of the 42 Ph.D. degrees awarded to date were from the BMEBT program.

Due to unfavorable and shortsighted public perception of nuclear energy in the 1980's and 1990's, the previous UML administration chose not to replace retiring faculty in the Radiological Sciences Program. This decision led to increasing and unprecedented workloads for the two remaining full-time faculty (C. French and M. Tries), who still accommodate a large student population and continue to offer the required courses necessary for these degrees, albeit with significant help from adjunct faculty (Dr. David Medich). With the new administration recognizing the substantial need of the nuclear industry for educated personnel, UML recently began a cluster-hiring initiative in which three new faculty members are planned for the Radiological Sciences Program. One of these faculty members (E. Sajo) has been hired already and began faculty duties in January 2010. The addition of these new faculty members will effectively double the size of the program, and will permit the updating of several existing courses and the development of new courses that reflect the needs of the nuclear industry and the different expertise contributed by the new faculty members. Further, the hiring initiative will bring the size of the involved faculty to a critical mass that will allow the program to pursue national accreditation for all of the academic degrees offered under Radiological Sciences. Our current B.S. degree requires a total of 120 credit-hours, with 27 credit-hours of core courses in health physics, offered at the junior and senior level. Our current M.S. degree in *Radiological Sciences and Protection* requires 30 credit-hours which includes nine credit-hours of research for the *Thesis Option* or three credit-hours of research and a comprehensive examination for the *Project Option*. A new, third option to the M.S. degree has been approved for 2010 that will create a Professional Science Master's (PSM) degree that is consistent with

the guidelines of the Sloan Foundation. This option requires a total of 34 credit-hours, a professional health physics internship, a comprehensive examination similar to that required for the M.S. degree under the *Project Option*, and in lieu of research, business cross-training is required via management courses from the UML MBA degree program and an advanced communications course. The Ph.D. degree in Physics with the *Radiological Sciences Option*, requires 60 graduate credit-hours. Current enrollment in these programs is 12 B.S., 20 M.S., and 24 Ph.D. candidates for a total of 56 students. It is clear that such comprehensive degree options coupled with a large student enrollment cannot be sustained over the long term without additional faculty. The new faculty also will have an active role in updating existing courses and developing new courses as they assimilate into the Radiological Sciences Program.

B.3 Curriculum Development: Undergraduate Level

B.3.1 Current Undergraduate Curriculum

All UML physics undergraduate students generally take the same sequence of study during their freshman and sophomore years. Specialization usually begins in the junior year and continues through the senior year for the various options to the B.S. degree in Physics. Table 1 below contains a list of required and elective didactic courses currently offered by the faculty (full-time and adjunct) of the Radiological Sciences Program for undergraduate students in their junior and senior years. These courses are necessary to attain a B.S. degree in Physics with the *Radiological Health Physics Option* from UML. As part of the curriculum development program, several key courses listed in Table 1 will be reviewed critically and updated, and will remain part of the UML health physics curriculum as discussed later in this section.

The *Introduction to Radiological Sciences* course is used to introduce students to working practices in the field of health physics, which is accomplished through field trips to local facilities that use radioactive materials, laboratory exercises, and class discussions. This course also provides students with basic radiation protection theory, procedures, terminology, and survey equipment.

The *Nuclear Instrumentation* course is used to introduce students to the operating principles and applications of nuclear radiation detection systems, including detector theory, electronic signal processing, and measurement and data reduction techniques. The systems covered include gas-filled detectors, inorganic and organic scintillators, and high-purity germanium detectors, for the detection of alpha, beta, gamma, and neutron radiation. This course also covers hypothesis testing, detection limits, and detector dead time.

The *Mathematical Methods* and *Numerical Methods of Radiological Sciences* courses provide an overview of applied mathematical concepts that are useful in radiological sciences and protection, including special techniques for radiation physics and radiation dosimetry and shielding, with emphasis on computer applications and numerical problem solving techniques.

The *Health Physics Internship* consists of an applied work experience as a health physics technician at a government laboratory or radiation facility of a suitable commercial, medical, educational, or research institution. These internships often take place under the supervision of alumni of the UML Radiological Sciences Program, and are extremely valuable for establishing professional contacts and obtaining practical work experience. Research carried out in a future M.S. project or thesis often originates from the *Health Physics Internship*.

The *Radiation Safety and Control I* and " courses are used to provide a theoretical basis for radiological sciences and protection, with a rigorous presentation of the fundamentals of radiation physics including nuclear reactions, radioactivity and the kinetics of radioactive decay, natural and man-made radiation sources, the characteristics and measurement of ionizing radiation, radioactivity analysis, radiation dose quantities and measurement, external and internal radiation dosimetry, and radiation protection regulations and techniques. Students also experience applied radiation protection through a contamination control and assessment

exercise that takes place in a realistic industrial setting inside the UML Research Reactor and involves the use of protective clothing and respiratory protection while performing a comprehensive evaluation of contamination and dose levels due to the presence of a short-lived radionuclide (Na-24).

The *Radiation Biology* course provides a comprehensive coverage of the resultant physical, chemical, and biological effects due to the interactions of ionizing radiations in organic systems. These effects are discussed for the sub-cellular and cellular levels, through whole organisms including insects, mammals, and humans. This course is essential for understanding the basic concepts of risk assessment associated with radiation exposure, the biological principles of radiation protection standards, and the fundamentals of radiation use in medicine. The elective courses play an important role in providing students with a comprehensive understanding of the major areas and problem-solving techniques that are applicable to health physics. The *Radiochemistry* course provides the theory and application of several analytical techniques, including precipitation, solvent extraction, ion exchange chromatography, and electrodeposition, to the separation and analysis of radioactive substances in various sample media. This course also covers some common radiation detection systems, measurement and data reduction techniques, radiotracer and isotope dilution techniques, neutron activation analysis, and radio-immunoassay.

The *Certification Preparation for Radiological Sciences* course covers advanced problem solving in radiological sciences including strategies for preparing for and taking professional certification examinations. The *MCNP for Radiological Sciences* course is a fairly recent addition to the curriculum, and provides the theory and application of the Monte Carlo N-Particle (MCNP) radiation transport computer code to radiological sciences and protection, with emphasis on radiation dosimetry and shielding problems.

The *Reactor Health Physics* course provides students with a comprehensive understanding of the radiation safety concerns for the UML Research Reactor, with an emphasis on practical experience. Students become familiar with reactor systems, instrumentation, radiation sources, radiation hazards during normal operations, maximum hypothetical accidents, and the theory and operation of survey meters used to assess radiation levels, radiation dose, and the effectiveness of radiation shielding. This course was established in the summer of 2009 as part of a previous NRC education grant (see Summary of Results From Past NRC Research Funding below), and is the most recent addition to the UML Radiological Sciences curriculum.

In addition, the Radiological Sciences Program also offers an undergraduate elective course titled *Radiation and Life*, which is a general education science course intended for nonscience majors. This course provides students with an overview of ionizing and nonionizing radiation sources, radiation effects, radiation safety, and nuclear power. This course also has a corequisite laboratory in which students measure radiation from a variety of sources and determine activity concentrations in several environmental samples including radon levels in the air of their own homes. Students in this course also study the effects of ionizing radiation on the germination and growth rate of irradiated seeds.

B.3.2 Proposed Undergraduate Curriculum

Proposed changes to the current curriculum will focus on applied physics and experiential learning, and will be assessed with respect to the fundamental and specialized needs of the nuclear industry, and the requirements of ABET accreditation and ABHP certification. An Advisory Board of distinguished industry representatives will be formed and

consulted to evaluate the proposed curriculum changes as part of efforts to improve the program. The mandates of the Advisory Board will be to help the UML Radiological Sciences Program to achieve ABET accreditation, to sustain the PSM degree, and to make recommendations on curriculum development and faculty hires with a focus on the current and future needs of the nuclear industry. In addition, the curriculum development process also will be beneficial to students in other areas of nuclear science, in particular undergraduate and graduate students in the UML Nuclear Engineering Program. These students often take the *Nuclear Instrumentation, Radiochemistry, and MCNP for Radiological Sciences* courses. Senior faculty in the UML Nuclear Engineering Program will be consulted to ensure continuity and compatibility with their program and the proposed curriculum development.

The required undergraduate courses provide an excellent physics-based foundation for graduate studies while also preparing terminal B.S. students for a career in health physics and other technical fields. The four-credit courses in particular will be improved in several areas. Much of the equipment used in the laboratories for the *Nuclear Instrumentation and Radiation Safety and Control* courses was purchased in the late 1970's and early 1980's, and now is about 30 years old. As components fail, the number of fully functioning laboratory stations becomes smaller and smaller. In some cases old data sets are given to the students in lieu of taking measurements due to a lack of functioning equipment. A major portion of the curriculum development funding therefore is requested to modernize most of the laboratory equipment and experiments for these courses. Specifically, the upgraded *Nuclear Instrumentation* laboratory will have eight stations that will include an ensemble of standard components for analog signal processing, and shared components for digital signal processing. The major radiation detection systems will include: gas-filled detectors (ion chambers, proportional counters, and Geiger-Mueller detectors), organic and inorganic scintillators, and semiconductors. The new laboratory equipment will be augmented by detection equipment that was purchased as part of a recently completed project (see Summary of Results From Past NRC Research Funding below). The combination of new and existing detection equipment is the most cost-effective means for establishing a modern nuclear instrumentation laboratory that can be used by multiple courses. The *Nuclear Instrumentation* course content also will be made more applicable to health physics applications rather than pure physics. In particular, emphasis will be placed on experiential learning through the increased use of conventional data acquisition and analysis software, and on combining detector response to contamination and dose assessment, including surface contamination, bioassay, and minimum detectable intake and dose. In addition, the *Radiation and Life* elective course also would benefit by making use of some of the new laboratory equipment.

There are literally hundreds of pages of handouts for the *Radiation Safety and Control* courses that will be edited and revised as part of the curriculum development. These handouts are combined thematically into about a dozen bound volumes and cover a wide range of topics, including: atomic and nuclear physics, basic radiation cross sections and interactions, radioactive decay kinetics, air sampling, statistics, and internal and external radiation dosimetry. The students would benefit greatly from a comprehensive review, reorganization, and editing of this material. The revised *Radiation Safety and Control* course also will cover typical challenges faced by a Radiation Safety Officer, including management and compliance practices, licensing, auditing, quality assurance, and applied health physics for radiation safety programs at commercial, academic, medical, or research institutions, which would be particularly beneficial to students in the new PSM degree program. In addition, there will be more emphasis on the use of survey meters to assess contamination and dose levels, and on classroom participation (including oral presentations of assigned problems).

The *Radiochemistry* course content will be reviewed and edited with more emphasis placed on environmental sample analysis, including sample collection and identification, interpretation of results, and quality control.

The *MCNP for Radiological Sciences* course will be revised substantially to make it more broad-based, and provide a fundamental understanding of the Monte Carlo method as applied to radiation transport computations. This revision would require that the students take a radiation transport course first (see Section B.4.2 below), which is envisioned to be offered at the graduate level and at the senior undergraduate level. The current Monte Carlo course (98.385), however, is offered at the junior level for undergraduates. Therefore this course will be renumbered as 95.485 and renamed as *Monte Carlo Simulation of Radiation Transport*. These changes also will benefit UML nuclear engineering students and physics students in related programs.

In addition to a review and update of the existing courses, there are two new courses that would be incorporated into the undergraduate physics curriculum that would be beneficial to our students and to the nuclear industry. A new, three credit-hour *Physics of Radiation and Nuclei* course is proposed to take the place of the three credit-hour *Modern Physics* course that students take in the Fall of their sophomore years. With an emphasis on atomic and nuclear physics, this course would be more appropriate for students in the *Radiological Health Physics Option*, and would eliminate the need to review some of this material in the *Radiation Safety and Control I* course. This minor curriculum change at the sophomore level would only require the approval of the Physics Undergraduate Committee. In addition, a new *Health Physics Capstone* course will be incorporated into the senior year sequence, which will be beneficial to the students and will comply with ABET accreditation criteria. This course will provide students in the *Radiological Health Physics Option* with an undergraduate capstone experience through basic independent research that will involve critical thinking, problem solving, report writing, and presentation skills.

B.4 Curriculum Development: Graduate Level

B.4.1 Current Graduate Curriculum

The sequence of courses taken by graduate students varies depending on their educational background, and certain courses may be waived if similar and recent courses have been completed successfully. A certain amount of overlap is built-in to the curriculum to accommodate graduate students from other disciplines, such as biology, chemistry, or industrial hygiene.

UML graduate students must maintain a minimum of nine credits to remain full-time, and therefore the elective health physics courses also have a prominent role in graduate studies. Note that the required *Nuclear Instrumentation, Radiation Safety and Control I and II*, and *Radiation Biology* courses (as well as some elective courses) have different course numbers in Tables 4 and 5 than in Tables 1 - 3, meaning that these courses are offered with both undergraduate and graduate sections (referred to as "co-listed" courses). The different sections usually meet at the same time, and naturally an increased work load and more advanced work are required of the graduate students in these courses.

In addition to the *Graduate Seminar in Radiological Sciences*, *Graduate Health Physics Internship*, *Graduate Project in Radiological Sciences*, and *Thesis Research in Radiological Sciences* courses, the two additional courses that are listed in Tables 4 and 5 are *External Radiation Dosimetry and Shielding* and *Internal Radiation Dosimetry and Bioassay Assessment*. These courses are offered only at the graduate level and are the most demanding courses offered by the Radiological Sciences Program. The *External Radiation Dosimetry and Shielding* course provides the theory and application of dosimetry and shielding for ionizing radiation sources outside the human body. Differential cross-sections, energy transfer and absorption coefficients, kerma, attenuation, and buildup are discussed in detail for photons. Cross-sections, kerma factors, removal coefficients, diffusion, and point-source dose functions for fissioning

sources are discussed for neutrons. Beta dosimetry concepts include stopping power, pointsource dose functions, and the effects of attenuating materials. Heat generation and temperature profiles are discussed for irradiated materials and radioactive substances. Dosimetry concepts and barrier requirements also are described for particle accelerators, radiotherapy facilities, and medical x-ray imaging facilities. Students in this course are required to solve many complex dosimetry and shielding problems based on realistic radiation hazards, many of which pertain to the UML Research Reactor.

The *Internal Radiation Dosimetry and Bioassay Assessment* course is designed to teach the fundamental knowledge and skills needed to design and administer an internal dosimetry and bioassay program as part of an overall radiation safety program. This course is based on current U.S. standards and regulations and the topic areas include: internal radiation protection philosophy and practices, standards and regulations for internal radiation dosimetry, International Commission on Radiation Protection (ICRP) Publication 30 reference man dosimetry, kinetics for reference man metabolic models, derivation of Annual Limits on Intake (ALIs) and Derived Airborne Concentrations (DACs), intake retention functions, excretion functions, statistics applicable to internal radiation dosimetry, Medical Ionizing Radiation Dosimetry (MIRD), and current recommendations of the ICRP. This course also requires extensive problem solving by students including many dose reconstruction problems based on actual worker bioassay data.

B.4.2 Proposed Graduate Curriculum

A new co-listed graduate course titled, *Radiation Transport*, is proposed that would provide a detailed treatment of radiation fields as solutions of the Boltzmann equation describing photon, electron, and neutron transport. Variables from the transport theory are related to radiation parameters such as kerma and dose, and differential cross sections are introduced from first principles. The existing *MCNP for Radiological Sciences* course will be revised significantly at both the undergraduate and graduate levels to complement the *Radiation Transport* course, thus completing a comprehensive two-semester sequence on radiation transport and simulation. The proposed *Radiation Transport* and *Monte Carlo Simulation of Radiation Transport* courses make use of the expertise of the recently hired faculty member, thus significantly leveraging the efforts of LSU in this area. In addition, both courses can make use of the same existing computer equipment.

The content of the pure graduate courses (*External Radiation Dosimetry and Shielding* and *Internal Radiation Dosimetry and Bioassay Assessment*) will be changed to reflect the new courses developed under this proposal, and to reflect the needs of the nuclear industry. More emphasis will be placed on advanced neutron shielding techniques and on the use and evaluation of new and current software programs for dose assessment. Additional homework assignments also will be required, and practice exams will be provided. The four-credit graduate courses (*Nuclear Instrumentation* and *Radiation Safety and Control*) and other co-listed courses described above will be reviewed and edited with emphasis placed on a more rigorous distinction between undergraduate and graduate requirements, and more applied content with respect to ABHP certification requirements. It is advantageous to review and update the co-listed courses at both the undergraduate and graduate levels at the same time. Likewise the new equipment for the undergraduate laboratories will simultaneously benefit graduate students in the co-listed courses.

B.5 Future Curriculum Development

The curriculum development efforts will be sustained beyond the funding period by the faculty of the UML Radiological Sciences Program through the attainment and ongoing efforts to maintain ABET accreditation, an annual review of the curriculum development program, and

ongoing efforts to satisfy educational requirements for ABHP certification. Curriculum review will be increasingly important as additional faculty members are hired and their expertise is added to the program. In particular, there are three additional curriculum changes that would be beneficial to the program, and that will influence future faculty hiring decisions. These curriculum changes consist of reestablishing two three-credit courses (*Data Reduction and Error Analysis* and *Environmental Radiation and Nuclear Site Criteria*) and a one-credit laboratory (*Radiochemistry Laboratory*). These courses and laboratory were offered by the Radiological Sciences Program in the past, but have not been taught in many years due to a lack of personnel. The *Data Reduction and Error Analysis* course would cover applicable data analysis techniques, including curve-fitting and variance propagation, which would reduce the need to cover these materials in other courses. This course would replace the required probability and statistics course (92.386) shown in Table 2. The *Environmental Radiation and Nuclear Site Criteria* course would provide an overview of the sources, distribution, environmental transport, dose projections, and environmental impact of radiations associated with the nuclear fuel cycle. The *Radiochemistry Laboratory* would provide practical applications of the radiochemical techniques covered in *Radiochemistry*, with emphasis on proper laboratory procedures and handling of radioactive samples.

B.6 Project Timeline

June 2010 Begin funded curriculum development program

- Review and update existing undergraduate courses
- Design new undergraduate courses
- Purchase and setup new laboratory equipment
- Convene a meeting of the Advisory Board
- Consult with faculty in the UML Nuclear Engineering Program
- Apply for ABET accreditation
- Submit initial Performance Report

Sept. 2010 Begin teaching new and revised undergraduate courses

June 2011 Finish funded curriculum development program

- Review and update existing graduate courses
- Design new graduate courses
- Setup new laboratory equipment
- Convene a meeting of the Advisory Board
- Consult with faculty in the UML Nuclear Engineering Program
- Establish curriculum development review schedule
- Submit final Performance Report

Sept. 2011 Begin teaching new and revised graduate courses

B.7 University Support

The UML Radiological Sciences Program is physically and administratively incorporated into the university's Radiation Laboratory which is a major research center in the Department of Physics and Applied Physics, and includes the UML Research Reactor, a van de Graaff accelerator, and the Pinanski Building. The Chancellor of UML has continually supported the Radiation Laboratory by providing the infrastructure and logistical support for the operation of the Pinanski Building, hiring reactor and accelerator staff and radiation safety personnel, providing graduate student support, allowing release time from teaching for the Radiation Laboratory co-director, and providing base operating costs to the Radiation Laboratory. In addition, the Co-Director of the Radiation Laboratory (Professor Gunter Kegel) has provided a letter of support for this proposed project (see attachments).

The university has demonstrated its support for the Radiological Sciences Program through the recent hiring of a senior faculty member, and the expressed intent to hire two

additional tenure-track faculty members. The university recently renovated three faculty offices, one classroom, and one laboratory for the Radiological Sciences Program, all on the second floor of the Pinanski Building. The classroom can accommodate about 15 students comfortably, and includes a white-board, over-head and computer projectors, and a graphics tablet. The Radiological Sciences Program also has a student computer laboratory with six computer stations, a nuclear instrumentation laboratory, a health physics/medical physics laboratory, a radiochemistry laboratory, and additional research laboratory space in the Pinanski Building.

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 these URLs to the Office of Management and Budget Cost Circulars are included for reference:

A-21 (now 2CFR 220): <http://www.whitehouse.gov/omb/circulars/a021/print/a021.html>
A-87 (now 2CFR 225): <http://www.whitehouse.gov/omb/circulars/a087/print/a087-all.html>
A-122 (now 2CFR 230): <http://www.whitehouse.gov/omb/circulars/a122/print/a122.html>
A-102, SF 424: <http://www.whitehouse.gov/omb/circulars/a102/print/a102.html>
Form 990: <http://www.irs.gov/pub/irs-pdf/i990-ez.pdf>

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

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

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

I. Mandatory General Requirements

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

1. Applicability of 2 CFR Part 215

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

b. Grantees must comply with monitoring procedures and audit requirements in accordance with OMB Circular A-133. <

http://www.whitehouse.gov/omb/circulars/a133_compliance/08/08toc.aspx >

2. Award Package

Grant Performance Metrics:

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

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

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

§ 215.41 Grantee responsibilities.

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

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

Subgrants

Appendix A to Part 215—Contract Provisions

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

Nondiscrimination

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

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

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

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

Modifications/Prior Approval

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

Lobbying Restrictions

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

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

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

§ 215.13 Debarment And Suspension.

The Grantee agrees to notify the Grants Officer immediately upon learning that it or any of its principals:

- (1) Are presently excluded or disqualified from covered transactions by any Federal department or agency;
- (2) Have been convicted within the preceding three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, tax evasion, receiving stolen property, making false claims, or obstruction of justice; commission of any other offense indicating a lack of business integrity or business honesty that seriously and directly affects your present responsibility;
- (3) Are presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph (1)(b); and
- (4) Have had one or more public transactions (Federal, State, or local) terminated for cause or default within the preceding three years.

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

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

'Debarment, Suspension, Ineligibility, and Voluntary Exclusion

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

Drug-Free Workplace

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

Implementation of E.O. 13224 -- Executive Order On Terrorist Financing

The Grantee is reminded that U.S. Executive Orders and U.S. law prohibits transactions with, and the provision of resources and support to, individuals and organizations associated with terrorism. It is the legal responsibility of the Grantee to ensure compliance with these Executive Orders and laws. This provision must be included in all contracts/sub-awards issued under this grant/cooperative agreement.

Award Grantees must comply with Executive Order 13224, Blocking Property and Prohibiting Transactions with Persons who Commit, Threaten to Commit, or Support Terrorism. Information about this Executive Order can be found at: www.fas.org/irp/offdocs/eo/eo-13224.htm.

Procurement Standards. § 215.40

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

Travel

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

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

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

Property Management Standards

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

Equipment procedures shall follow provision established in 2 CFR 215.34.

Procurement Standards

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

Intangible and Intellectual Property

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

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

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

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

Copyright - The Grantee may copyright any work produced under a NRC federal financial assistance award subject to NRC's royalty-free nonexclusive and irrevocable right to reproduce, publish or otherwise use the work or authorize others to do so for Government purposes. Works jointly authored by NRC and Grantee employees may be copyrighted but only the part authored by the Grantee is protected because, under 17 USC § 105, works produced by Government employees are not copyrightable in the United States. On occasion, NRC may ask the Grantee to transfer to NRC its copyright in a particular work when NRC is undertaking the primary dissemination of the work. Ownership of copyright by the Government through assignment is permitted under 17 USC § 105.

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

Organizational Prior Approval System

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

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

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

Dispute Review Procedures

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

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

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

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

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

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

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

Monitoring and Reporting § 215.51

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

- Payment – 2 CFR 215.22
- Cost Share – 2 CFR 215.23
- Program Income – 2 CFR 215.24
 - Earned program income, if any, shall be added to funds committed to the project by the NRC and Grantee and used to further eligible project or program objectives.

- Budget Revision – 2 CFR 215.25
 - In accordance with 2 CFR 215.25(e), the NRC waives the prior approval requirement for items identified in sub-part (e)(1-4).
 - The Grantee is not authorized to rebudget between direct costs and indirect costs without written approval of the Grants Officer.
 - Allowable Costs – 2 CFR 215.27

b. Federal Financial Reports

Effective October 1, 2008, NRC transitioned from the SF–269, SF–269A, SF–272, and SF–272A to the Federal Financial Report (SF-425) as required by OMB:

http://www.whitehouse.gov/omb/fedreg/2008/081308_ffr.pdf

http://www.whitehouse.gov/omb/grants/standard_forms/ffr.pdf

http://www.whitehouse.gov/omb/grants/standard_forms/ffr_instructions.pdf

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

Period of Availability of Funds 2 CFR § 215.28

- a. Where a funding period is specified, a Grantee may charge to the grant only allowable costs resulting from obligations incurred during the funding period and any pre-award costs authorized by the NRC.
- b. Unless otherwise authorized in 2 CFR 215.25(e)(2) or a special award condition, any extension of the award period can only be authorized by the Grants Officer in writing. Verbal or written assurances of funding from other than the Grants Officer shall not constitute authority to obligate funds for programmatic activities beyond the expiration date.
- c. The NRC has no obligation to provide any additional prospective or incremental funding. Any modification of the award to increase funding and to extend the period of performance is at the sole discretion of the NRC.
- d. Requests for extensions to the period of performance shall be sent to the Grants Officer at least 30 days prior to the grant/cooperative agreement expiration date. Any request for extension after the expiration date shall not be honored.

Automated Standard Application For Payments (ASAP) Procedures

Unless otherwise provided for in the award document, payments under this award will be made using the Department of Treasury’s Automated Standard Application for Payment (ASAP) system < <http://www.fms.treas.gov/asap/> >. Under the ASAP system, payments are made through preauthorized electronic funds transfers, in accordance with the requirements of the Debt Collection Improvement Act of 1996. In order to receive payments under ASAP, Grantees are required to enroll with the Department of Treasury, Financial Management Service, and Regional Financial Centers, which allows them to use the on-line method of withdrawing funds from their ASAP established accounts. The following information will be required to make withdrawals under ASAP: (1) ASAP account number – the award number found on the cover sheet of the award; (2) Agency Location Code (ALC) – 31000001; and Region Code. Grantees