

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

1. GRANT/AGREEMENT NO. NRC-HQ-11-G-38-0037	2. MODIFICATION NO.	3. PERIOD OF PERFORMANCE FROM: 08/4/2011 TO: 08/3/2014	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:046705849 NAICS:611310	7. RECIPIENT NAME, ADDRESS, and EMAIL ADDRESS University of California-Irvine Office of Research 5171 California Ave, Ste 150 Irvine, CA 92697-7600	
8. PROJECT TITLE: Nuclear Engineering Faculty Development Project			
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 University of California Irvine Attn: Mikael Nilsson Assistant Professor, Chemical Engineering and Materials Science Email: nilssonm@uci.edu 949-824-6082	
12. NRC PROGRAM OFFICE (NAME and ADDRESS) NRC Attn: Nancy Hebron-Isreal Office of Human Resources MS: GW5E03 (301) 492-2231 11545 Rockville Pike Rockville, Maryland 20852	13. ACCOUNTING and APPROPRIATION DATA APPN. NO: 31X0200 B&R NO: 2011-84-51-K-164 JOB CODE: T8460 BOC NO: 4110 OFFICE ID NO: RPPA, HR-11-140 FAIMS: GRC073	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>\$390,000.00</u> PREVIOUS OBLIGATION _____ TOTAL <u>\$390,000.00</u>	16. TOTAL FUNDING AGREEMENT NRC <u>\$390,000.00</u> RECIPIENT <u>\$90,000.00</u> TOTAL <u>\$480,000.00</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: Mark Lohmann email: Mark.Lohmann@NRC.GOV Mail Stop: TWB-01-B10M Rockville MD 20852			
18. Signature Not Required		19. NRC CONTRACTING OFFICER <u>Sheila Bumpass</u> <u>8/4/2011</u> (Signature) (Date) NAME (TYPED) <u>Sheila Bumpass</u> TITLE <u>Contracting Officer</u> TELEPHONE NO. <u>301-492-3484</u>	
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 - ADMIN

SUNSI REVIEW COMPLETE

AUG 09 2011

ADMIN002

ATTACHMENT A - SCHEDULE

A.1 PURPOSE OF GRANT

The purpose of this Grant is to provide support to the "University of California Irvine Faculty Development Program" as described in Attachment B entitled "Program Description."

A.2 PERIOD OF GRANT

1. The effective date of this Grant is August 4, 2011. The estimated completion date of this Grant is August 3, 2014.
2. Funds obligated hereunder are available for program expenditures for the estimated period: August 4, 2011 – August 3, 2014.

A. GENERAL

- | | |
|--------------------------------|--|
| 1. Total Estimated NRC Amount: | \$390,000.00 |
| 2. Total Obligated Amount: | \$390,000.00 |
| 3. Cost-Sharing Amount: | \$90,000.00 |
| 4. Activity Title: | University of California Irvine Faculty
Development Program |
| 5. NRC Project Officer: | Nancy Hebron-Isreal |
| 6. DUNS No.: | 046705849 |

B. SPECIFIC

- | | |
|-------------------|------------------|
| RFPA No.: | HR-11-140 |
| FFS: | N/A |
| Job Code: | T8460 |
| BOC: | 4110 |
| B&R Number: | 2011-84-51-K-164 |
| Appropriation #: | 31X0200 |
| Amount Obligated: | \$390,000.00 |

A.3 BUDGET

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

Personal	\$94,009.00
Fringe Benefits	\$52,930.00
Travel	\$58,804.00
Equipment	\$33,163.00
Supplies	\$36,283.00
Other	<u>\$81,600.00</u>
Total Direct Charges	\$356,789.00
Indirect Charges	<u>\$123,211.00</u>
TOTAL	\$480,000.00

A.4 AMOUNT OF AWARD AND PAYMENT PROCEDURES

1. The total estimated amount of this Award is \$480,000.00 for the three year period. Of which NRC will contribute \$390,000.00 and the University of California Irvine will contribute \$90,000.00
2. NRC hereby obligates the amount of \$390,000.00 for program expenditures during the period set forth above and in support of the Budget above. The Grantee will be given written notice by the Contracting Officer when additional funds will be added. NRC is not obligated to reimburse the Grantee for the expenditure of amounts in excess of the total obligated amount.
3. Payment shall be made to the Grantee in accordance with procedures set forth in the Automated Standard Application For Payments (ASAP) Procedures set forth below.

Attachment B – Program Description

PROGRAM DESCRIPTION

The Nuclear Program at University of California Irvine:

The PI of this project is a recently hired assistant professor at University of California, Irvine (UC Irvine) whose research is in nuclear fuel separations. The funds requested in this proposal will be used to help develop his career by supporting a graduate student, travel to meetings and maintaining his research. Additional financial support will be provided by the PI's institution in form of funds for summer programs and equipment. Our intention, by the activities described, is to structure a nuclear science and engineering program, supporting students and the surrounding industry. UC Irvine already has important pieces of infrastructure in place to support such an endeavor including the UC Irvine TRIGA reactor facility, which serves as the foundation for a nuclear program. Our goal is to ensure that UC Irvine plays a part in securing the nations need for highly skilled and trained individuals and excellent researchers in the field of nuclear science and engineering technology. In the immediate area around Irvine there are several nuclear related industries with who we have been in contact with and who have expressed a strong interest and support to our efforts. These include General Atomics and the San Onofre Nuclear Generating Station, which both may provide job opportunities and direct ties to the nuclear industry, important for attracting students. History and near term plans
Historically the UC Irvine TRIGA nuclear reactor has been used to support nuclear chemistry related research and 1-2 undergraduate radiochemistry courses every year. In the past there was also an active training program for reactor operators using the reactor facility. This program has recently been revived, as described below.

The school that has been the most active in the nuclear field is obviously the school of physical sciences, and especially the Chemistry department, where the reactor is housed. In recent years the Henry Samueli School of Engineering has initiated an effort in increasing the research and education in nuclear waste and materials management. Two recent hires is the department of Chemical Engineering and Materials Science (ChEMS) and Civil and Environmental Engineering (CEE) introduced the research areas of nuclear waste separation processes and radionuclide migration, respectively.

Two new courses are now being offered on a semi-annual basis from the department of chemical engineering and materials science. The first course, offered in winter 2010, focused on the chemistry and technology of the nuclear fuel cycle and received excellent attendance and feedback. The second course that will be offered in winter 2011 will be a more fundamental nuclear chemical engineering course covering the basics of radiochemistry but with an

emphasis on calculus and problem solving. These new courses are being developed while keeping in mind the already established radiochemistry courses and synergy between the classes is pursued. In the near future we will ensure that we advertise our program to students so that we can increase the number of recruits interested in pursuing a career in nuclear science. Incoming PhD graduate students in the ChEMS department are required to rotate for the first year in 3 different labs. This improves the chances of students who may be uncertain of the nuclear career paths to get exposure and education in the area before making a decision of joining a lab. Both the PI and co-PI were recently involved in the ChaMP program within the school of physical sciences where first year PhD students are given the chance to carry out a short (1week) project. This year 9 students chose to carry out a radiochemistry related project offered to them, spearheaded by Professor A.J. Shaka in Chemistry. The feedback was very positive and when given the opportunity to visit the reactor facility all students (besides the 9 who chose radiochemistry) and a good number of faculty members involved in the program showed up.

Although the ChEMS department at UC Irvine is relatively young, its undergraduate program is ABET accredited for Bachelors of Science degrees in both Chemical Engineering, ChE and Materials Science and Engineering, MSE (and a popular MSE minor) and the current undergraduate student enrollment is at 255, which accounts for a significant surge of 70% in the last four years. At the graduate level, ChEMS offers M.S. and PhD degrees in ChE and MSE with concentrations in Materials Manufacturing Technology and Interdisciplinary Concentration in Environmental Engineering. The department has been able to recruit excellent faculty members and nurture them into independent researchers. The faculty is diverse in gender with 4 female members and ethnicity for it is composed of Asian (7 members), Caucasian (6), Hispanic (2), and Middle Eastern (2) heritages at both senior and junior ranks.

With the current economic situation at the University of California, as well as the state of California overall, new hires are unfortunately few and far in between. However, as the economy recovers we will be poised to propose that a future hire will be made in the nuclear area supporting our nascent program. Once we are ready to hire a new faculty member in this field we will take into account the research already conducted at UC Irvine by faculty involved in the nuclear field as well as faculty in near-related fields such as materials science, environmental science etc. This way we will ensure that incoming faculty members will not become "islands" without any colleagues to collaborate with, and that recruited faculty does not overlap too much with those already established at UC Irvine. Important fields that we see a growing interest in are nuclear forensics, for non-proliferation and security issues, soil mechanics, for working on repository issues, and advanced materials for nuclear fuels and reactors.

Assistant professors are expected to fulfill all requirements in research, teaching and service as parts of the tenure requirements. In addition to a mid-career appraisal generally occurring during the fourth year and a tenure review generally in the sixth or seventh year, the University of California system has a thorough and rigorous academic personnel review process every two years, which translates into four step promotions for an assistant professor. This multi-level merit review system, which involves contributions from the individual, the department, the Dean, Academic Senate committees, and the Chancellor or Vice Chancellor, evaluates faculty on four main criteria: teaching; research and creative work; professional competence and activity; and University and public service.

Long term plans and Program sustainability we will expand our research and education activities and work with nearby universities and industry to promote education across campus boundaries and offer cutting edge research facilities and opportunities at UC Irvine. Recently a research grant was awarded for collaboration between California State University at Long Beach (CSULB) and UC Irvine and we will capitalize on this established research collaboration and expand it to education. CSULB, as a minority serving institute, will have the opportunity to

send students for training and for taking courses in our program. This would also open up for students from CSULB applying for the PhD graduate program at UC Irvine.

We will continue to gather industry support and identify a core group of faculty to initiate a larger interdisciplinary research and education effort directed from UC Irvine in the field of nuclear science and engineering. The work proposed here has already captured the attention of the UC Irvine medical school and the departments of radiology and radiation oncology have given their support to our activities and future collaborations will be investigated. We also plan to investigate the possibility to get the recently formed UCI School of Law interested in having their students receive education in nuclear related issues. This would increase the awareness and ensuring that future law practitioners have an understanding of nuclear energy production and the nuclear fuel cycle, important for future expansion of the industry.

The thrust towards carbon neutral energy sources has received much attention at UC Irvine with the recent establishment of the Environmental Institute in conjunction with the already existing Advanced Power and Energy Program. UC Irvine's nascent nuclear program fits within the missions of these units extremely well and has the potential to strengthen nuclear energy education and R&D in the densely populated southern California region. We see no problems in sustaining a nuclear curriculum and the fact that the student interest is increasing has opened the possibility of establishing an undergraduate minor in nuclear science and technology. Before the end of this project we also intend to establish a cross-disciplinary graduate concentration (MS and PhD) in nuclear chemistry/chemical engineering. Offering incoming students a nuclear related education will naturally increase the number of graduates who seek a future career in a nuclear related field. If interest in the program continues to increase, we plan to establish further educational opportunities and research collaborations across campus and between different campuses in this region.

Description of courses and nuclear curriculum

In the Chemistry department two courses titled "Radioisotope techniques" and "Nuclear and Radiochemistry" are offered every year to upper level undergraduates and graduate students. This covers basic and advanced radiochemistry and the undergraduate course also have a substantial lab part. The TRIGA reactor is used to train students in nuclear activation analysis and some radiation detectors are used, mainly to analyze the samples. Furthermore reactor operator training has recently restarted with a current student pool of 4 students. In the ChEMS department 2 new courses described above are offered semi-annually and contain a large portion of nuclear technology and engineering as well as mathematical treatments of nuclear chemical problems. The CEE department offers a course in hydrologic computational modeling which includes transport of material in surface and ground water. This course has elements of migration of radioactive isotopes and considerations for final repository studies.

We have plans for the development of a practical course aimed at teaching undergraduate and graduate students an understanding of the detection and measurement of ionizing radiation. This course would combine theoretical lectures, practical laboratory work and computer simulations to ensure familiarity with the full range of measurement and detection options. This course would be part of a year-long sequence of courses including nuclear chemistry, reactor operations, and visits to operating power reactors.

Research Background and Problem Addressed:

Non-carbon-based sources of energy will become increasingly common if not mandatory, as time goes on. In response, a renaissance for nuclear power production has been anticipated to occur in the US in the near future as fossil fuels become a more costly source of energy and the release of CO₂ becomes critically detrimental to the environment. However, a major concern persists with regard to the disposal of the spent nuclear fuel. As a result, a concept implementing a closed nuclear fuel cycle has gained renewed interest in the US. Further motivation is provided by the fact that the energy potential of spent nuclear fuel currently stored

in the US is equal to that contained in over six billion barrels of oil^[1]. The chemical separation of uranium and plutonium from dissolved fuel is already practiced on a commercial scale in England, France and Japan, and there are many years of experience in running these processes. For the separation of transplutonium elements advanced separation techniques are employed and new methodologies are being developed. A solvent extraction separation technique is common to many of these processes, often designed to preferentially extract desired constituents from the nitric acid solution. Valuable resources may be recovered for potential recycle and/or separated to isolate highly radiotoxic or mobile components for disposal.

Complete removal of long-lived radiotoxic isotopes from the spent nuclear fuel requires separation of all minor actinides present in the spent nuclear fuel, e.g. Am and Cm. A common first step to achieve this is the co-extraction of trivalent actinides and lanthanides from other fission products, which can be accomplished by using ligands containing oxygen coordination sites, e.g. diamides, carboxylic acids and phosphoric acids. The second step is the separation of americium and curium from lanthanides, which may be realized by utilizing subtle differences between An(III) and Ln(III). Ligands used for this separation include nitrogen containing reagents such as DTPA and EDTA, used in the so called TALSPEAK-process (Trivalent Actinide/Lanthanides Separation by Phosphorus Extractants and Aqueous Complexants)^[2,3], as well as pyridine based extraction reagents such as BTP and BTBP, used in the so called SANEX-BTP (Selective Actinide Extraction) process^[4,5].

Many of the complexing agents and separation techniques studied for these separations have also been used for production and purification of isotopes for medical purposes. Specific examples found in the open literature^[6-8] describe the use of variations of polyaminocarboxylates (DTPA and DOTA), polyaminophosphates (EDTMP) and phosphoric acid (HDEHP) for complexing contrasting agents such as gadolinium and other radiolanthanides such as samarium-153 and holmium-166^[9]. In the proposed project we intend to utilize the combined knowledge and experience existing at the University of California in the field of separation systems for actinides and lanthanides with the production of radioactive isotopes and hot atom chemistry. Our plan is to study pathways of separation of lanthanides away from other byproducts formed either in irradiation of targets for medical isotope production or from spent nuclear fuel.

Radioactive lanthanides for medical treatments

The World Nuclear Organization (www.world-nuclear.org/info/inf55.html) lists 26 radionuclides used in medical applications as "reactor produced". Of these, seven are rare earth elements: ¹⁶⁵Dy, ¹⁶⁹Er, ¹⁶⁶Ho, ¹⁷⁷Lu, ¹⁵³Sm, and ¹⁶⁹Yb and ¹⁷⁷Yb. Generally medically useful quantities of radionuclides per patient application range from 0.1 to 100 millicuries and achieving that total activity using a neutron source with a flux of the order of 10¹² neutrons/cm²-s may require irradiating substantial amounts of target material. Lanthanides are normally only present in the human body in trace amounts being a non-essential metal ion. They have been found to accumulate in different organs such as the kidney, liver and spleen^[6]. Care must be taken when working with lanthanides, either as a contrasting agent for MRI (such as gadolinium) or as a radiolanthanide for cancer treatment, not to exceed certain total amounts of metal ion in the body. Thus, one of the major problems encountered in the production of radioactive lanthanide isotopes for medical purposes is achieving high enough specific activity so that the total concentration remains low. A solution to this problem is one of the focus areas of the work proposed here.

Szillard Chalmers Process

The Szillard Chalmers process is a method to separate radioactive ions away from a bulk of non-radioactive ions by neutron capture. The Szillard Chalmers effect^[10] occurs as a result of nuclear recoil in an atom. Commonly, it has been observed and studied following radiative neutron capture (n, γ reactions). During neutron irradiation the target atom capturing a neutron to

form a compound nucleus receives an increase in energy due to the binding energy of the neutron. If a (n,γ) reaction occurs most of this energy is released by the gamma radiation, and depending on the mass of the product nucleus there will be a certain amount of recoil energy of this nucleus. This energy is often in the order of 100 to 1000 eV, depending on the mass (low mass results in high recoil energy). Chemical bonds usually have energies of a few eV and thus the recoil energy is enough to break normal chemical bonds and eject the product nucleus away from its original position. This means that the product nucleus may be in a chemical state that can be separated away from the bulk of the target material. This requires certain target materials as well as a capture medium suitable to accommodate the product nucleus and stop it from reforming its original bonds with the target. If the product nucleus is radioactive, and the atom does not reform chemical bonds, then the product is chemically separated from its nonradioactive target, thus enhancing the specific activity of the produced isotope. Ideally, the product would be "carrier free". The process is visualized in Figure 1.

The process is delineated as having two distinct steps: the first results in direct recoil of the capturing atom/nucleus from the target matrix; the second is its interaction with a surrounding "capture matrix". Each matrix can have a unique chemical/physical structure. Much effort in the 1950's through 1970's^[11,12] was by chemists wishing to understand the parameters of the process in a variety of chemical environments, but the focus was largely on the "retention" or how many of the radioactive atoms could be considered to become recombined or "retained" in the target matrix, while minimizing the number to be found within the capture matrix.

Figure 1. Szilard Chalmers Recoil Process. Holmium-acetyl-acetone (Acac) complex irradiated by neutrons undergoing activation of the holmium followed by disengagement of the hot holmium atom from the acetyl-acetone complex. The overall reaction mechanism is given above.

Recently, some interest^[13] has been shown in re-examining the Szilard Chalmers method with the goal of maximizing the specific activity of the product radionuclide, ^{166}Ho . There is considerable potential for such experiments when due consideration is given to the following notions:

- a) Separating the process of production of radionuclide at high specific activity from the production of final usable radiopharmaceutical is advantageous as it affords better control over both processes.
- b) A weakly bonded target system with as simple chemical molecular structure as possible should favor higher recoil yields with less overall complexity of contamination from the target into the capture matrix.

Conclusion: weaker complexes of a target element should afford such advantage.

- c) A "clean" capture matrix (such as water) that has little susceptibility for damage in the reactor radiation field is advantageous in providing a cleaner and higher specific activity product. This matrix can be treated to allow valence state differences to be adjusted and to prepare the nuclide for subsequent synthesis of a radiopharmaceutical.

As mentioned above a recent study used the Szilard Chalmers method to produce isotopically pure ^{166}Ho from neutron irradiation of ^{165}Ho . By producing a lipophilic salt of holmium complexed with different organic ligands and irradiating the salt either dry or in contact with water some enrichment of ^{166}Ho over ^{165}Ho was achieved up to a factor of over 100. The ligands used in that work were either oxygen donors, e.g. carboxylic acids, or nitrogen donors, e.g. pyridyl based ligands. Lanthanides strongly bound to ligands with oxygen donors such as carboxylates. DTPA and EDTA having 5 and 4 carboxylic acid groups, respectively are regularly used in the purification of lanthanides. DTPA is also a key component in the TALSPEAK process selectively retaining actinides over lanthanides in an aqueous phase.

The use of the Szilard Chalmers method requires that the lanthanides are initially in a target matrix in contact with an immiscible second capture matrix. This could constitute of an

organic or solid lipophilic phase so the lanthanide atom capturing the neutron would be released from its chemical bonded state and transfer irreversibly to an aqueous phase. Lipophilic extraction reagents selective for lanthanides include malonamides, glycolamides and phosphine oxides such as DMDOHEMA (dimethyl dioctyl hexaethoxy malonamide), TODGA (trioctyl diglycolamide) and CMPO (carbamoyl methyl phosphine oxide) that have been investigated as potential reagents for treatment of spent nuclear fuel, having selectivity for trivalent lanthanides and actinides. Extraction chromatography resins have been developed based on TODGA^[14] and are commercially available from Eichrom Technologies^[15]. An organic phase or chromatographic resin loaded with lanthanides could be used as a target matrix in the proposed method. Ligands based on pyridine and triazines have been developed within the European Union research projects NEWPART, PARTNEW and EUROPART^[16,17]. Ligands of BTP (bistriazine pyridine) and BTBP (bis-triazine bis-pyridine) type have shown selectivity of trivalent actinides over trivalent lanthanides. However, these ligands does have some affinity for the trivalent lanthanides albeit less than actinides. One characteristic of certain BTP molecules is the slow kinetics of extraction, sometimes requiring hours to complete extraction of trivalent metals^[18]. However, the complexes once formed have shown excellent stability and stripping of the metal ions has proven difficult. By loading an organic phase containing BTP with lanthanides a matrix for neutron irradiation may be produced. The lanthanide atom capturing a neutron would break apart from the BTP ligand and transfer to the aqueous phase where re-extraction into the organic phase would be very slow. BTPB molecules have been successfully deposited on solid support creating extraction chromatography resins^[19], potentially useful in these applications as well.

Technical Approach:

The work proposed here focuses on studying and testing new approaches to separation of lanthanides and production of high specific activity radiolanthanides by irradiation of suitable targets in a Szilard-Chalmers method. The study of retention and optimized kinetics for acquiring the highest specific activity will add the benefit of fundamental understanding of complexation of different lanthanides with complexing reagents used for spent nuclear fuel treatment. Improved understanding of the 4f elements may guide us in the challenging separation of 4f and 5f elements. This project will be carried out by one graduate student researcher under the supervision of Dr. Mikael Nilsson, a recently hired junior faculty member at UC Irvine. Dr. George Miller will serve as a mentor and support the activities by assisting with tasks requiring the use of the TRIGA reactor facility.

Task 1. Identify/confirm initial target matrices, and mechanisms for complexation - retention.

A number of different complexation reagents and combinations thereof, from the open literature, will be tested for their suitability of active reagent in a target matrix for neutron irradiation.

Different combinations of aqueous complexants (e.g. DPTA, DOTA, EDTMP) will be considered in the capture matrix. This may result in an improved yield due to less retention of the radioisotope back to the target matrix. We will test the stability and metal ion retention of possible lanthanide containing targets outside the neutron radiation field to identify suitable matrices and separation techniques. Gamma radiation of the target material can be carried out to investigate the degradation by ionizing radiation that will occur during neutron irradiation.

Task 2. Perform Szilard Chalmers reactions using preferred targets (selected in Task 1) and different capture matrices.

Perform neutron irradiation of different lanthanide targets in different capture matrices. Separate and analyze yields and specific activity of product. Use conditions to create minimum quantity detectable (sub-microcurie) to minimize handling problems.

Task 3. Investigate the feasibility and efficiency of combinations of target and capture matrix for separation of 4f and 5f elements.

The subtle difference in the trivalent actinides, Am(III) and Cm(III), from the lanthanides often requires exotic separation systems containing several active components. Successful combinations for effective lanthanide complexation found and tested in Task 1 and 2 will be tested for separation of Am and Cm from the lanthanides or for separation of Am from Cm, an even more challenging task.

Task 4. Research issues that may arise as a result of scale-up.

Irradiate successful materials (target and capture matrices selected from Task 1) to greater exposure at levels progressively up to millicurie quantities. Identify and resolve handling problems, assay carefully for contamination issues, and any signs of target or capture matrix breakdown giving additional contaminants, either chemical or radionuclide type. This information will be collected in a database to allow fuller consideration of choices of target and capture matrices.

Benefits and Outcomes:

This project has the potential to benefit two fields in nuclear chemistry. If we are successful in identifying and developing methods for producing high-specific activity radioisotopes this would allow for larger facilities to scale up our methods and supply these radioisotopes, provided of course that studies are carried out to seek FDA approval for using these methods to produce radioisotopes for clinical trials. At the very least we can locally produce small amounts of radioisotopes for the medical school for labeling studies, synthesis of radio labeled drugs and approved animal studies.

Increasing the understanding of 4f-5f element complexation and solution chemistry is important for successful implementation of advanced nuclear fuel cycles. Although this challenge has been pursued for some time with limited success, it is clear that there are still important discoveries to be made using the target and capture matrices identified in the proposed tasks. The approach of combining extraction chromatography or liquid extraction with aqueous complexing reagents has been given attention for advanced fuel cycles but less so for radioisotope production. A systematic study combined with collecting the results in a database will serve as an invaluable tool for future investigations.

Students involved in this project will receive training in production, detection and handling of radioactive isotopes. Students will also be offered the opportunity to train as reactor operators and graduate students will be given the opportunity to become teaching assistants (TA's) for our radiochemistry courses, described above.

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://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. § 215.40-48

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.
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- o 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:

Faculty Development Awards

1. Number of new faculty hired and currently eligible faculty supported in NRC designated STEM areas.

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/excomp.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.