

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

September 24, 2014

Dr. Yong Yang
University of Florida
219 Grinter Hall
PO Box 115500
Gainesville, FL 32611

VIA Electronic Mail:
yongyang@ufl.edu

SUBJECT: GRANT NO: NRC-HQ-60-14-G-0014

Dear Dr. Yang:

Pursuant to the authority contained in the Federal Grant and Cooperative Grantee Act of 1977 and the Atomic Energy Act of 1954, the Nuclear Regulatory Commission (NRC) hereby awards to the University of Florida (hereinafter referred to as the "Grantee" or "Recipient"), the sum of \$475,031.00 to provide support for "Synergistic effect of Thermal Aging and Low Dose Irradiation on the Cast Stainless Steels and Stainless Steel Welds".

This award is effective as of the date of this letter and shall apply to expenditures made by the Grantee furtherance of program objectives during the period beginning with the effective date of September 30, 2014 and ending September 29, 2017.

This award is made to the Recipient on condition that the funds will be administered in accordance with the terms and conditions as set forth in Attachment A (the Schedule); Attachment B (the Program Description); and Attachment C (the Standard Provisions); all of which have been agreed to by your organization.

Please ensure individuals selected as beneficiaries of support under this grant meet the legal requirements consistent with recent Supreme Court Decisions including *Fisher, Gratz, and Grutter*.

Please sign the enclosed grant to acknowledge your receipt of the award, and return as a pdf file to Mr. Daniel App by email at Daniel.App@nrc.gov.

Sincerely yours,

Sheila Bumpass

Sheila Bumpass
Grants Officer
Acquisition Management Division

Attachments:
Attachment A – Schedule
Attachment B – Program Description
Attachment C – Standard Terms and Condition

TEMPLATE - ADM001

SUNSI REVIEW COMPLETE

OCT 01 2014

ADM002

Grant and Cooperative Agreement

CHOOSE ONE:

- COOPERATIVE AGREEMENT
 GRANT

CHOOSE ONE: EDUCATION FACILITIES RESEARCH SDCR TRAINING

1. GRANT/COOPERATIVE AGREEMENT NUMBER NRC-HQ-60-14-G-0014		2. SUPPLEMENT NUMBER		3. EFFECTIVE DATE 09/30/2014		4. COMPLETION DATE	
5. ISSUED TO NAME/ADDRESS OF RECIPIENT (No., Street, City/County, State, Zip) UNIVERSITY OF FLORIDA DIVISION OF SPONSORED RESEARCH 219 GRINTER HALL GAINESVILLE FL 326115500				6. ISSUED BY U.S. NRC - HQ Mailing Address: Acquisition Management Division Mail Stop: 3WFN-05-C64MP Washington DC 20555-0001			
7. TAXPAYER IDENTIFICATION NO. (TIN)				9. PRINCIPAL INVESTIGATOR/ORGANIZATION'S PROJECT OR PROGRAM MGR. (Name & Phone) Dr. Yong Yang Email: Yongyang@ufl.edu Phone: 352-846-3791			
8. COMMERCIAL & GOVERNMENT ENTITY (CAGE) NO.							
10. RESEARCH, PROJECT OR PROGRAM TITLE Synergistic Effect of Thermal Aging and Low Dose Irradiation on the Cast Stainless Steels at Stainless Steel Welds							
11. PURPOSE See Schedule							
12. PERIOD OF PERFORMANCE (Approximately) 09/30/2014 through 09/29/2017							
13A. AWARD HISTORY		13B. FUNDING HISTORY					
PREVIOUS		\$0.00		PREVIOUS		\$0.00	
THIS ACTION		\$475,031.00		THIS ACTION		\$327,705.00	
CASH SHARE		\$0.00		TOTAL		\$327,705.00	
NON-CASH SHARE		\$0.00					
RECIPIENT SHARE		\$0.00					
TOTAL		\$475,031.00					
14. ACCOUNTING AND APPROPRIATION DATA 2014-X0200-FEEBASED-60-60D001-11-6-213-1032-4110							
PURCHASE REQUEST NO.		JOB ORDER NO.		AMOUNT		STATUS	
RES-14-0456							
15. POINTS OF CONTACT							
	NAME		MAIL STOP	TELEPHONE		E-MAIL ADDRESS	
TECHNICAL OFFICER	SARAH B. SHAFFER			301-251-7942		SARAH.SHAFER@NRC.GOV	
NEGOTIATOR							
ADMINISTRATOR	DANIEL APP			301-287-0939		Daniel.App@nrc.gov	
PAYMENTS							
16. THIS AWARD IS MADE UNDER THE AUTHORITY OF: PURSUANT TO SECTION 31B AND 141B OF THE ATOMIC ENERGY ACT OF 1954, AS AMENDED							
17. APPLICABLE STATEMENT(S), IF CHECKED: <input type="checkbox"/> NO CHANGE IS MADE TO EXISTING PROVISIONS <input type="checkbox"/> FDP TERMS AND CONDITIONS AND THE AGENCY-SPECIFIC REQUIREMENTS APPLY TO THIS GRANT				18. APPLICABLE ENCLOSURE(S), IF CHECKED: <input type="checkbox"/> PROVISIONS <input type="checkbox"/> SPECIAL CONDITIONS <input type="checkbox"/> REQUIRED PUBLICATIONS AND REPORTS			
UNITED STATES OF AMERICA				COOPERATIVE AGREEMENT RECIPIENT			
CONTRACTING/GRANT OFFICER SHEILA H. BUMPASS <i>Sheila Bumpass</i>		DATE 09/24/2014		AUTHORIZED REPRESENTATIVE		DATE	

Grant and Cooperative Agreement

ITEM NO. (A)	ITEM OR SERVICE (Include Specifications and Special Instructions) (B)	QUANTITY (C)	UNIT (D)	ESTIMATED COST	
				UNIT PRICE (E)	AMOUNT (F)
	<p>CFDA Number: 77.009</p> <p>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 (OBM Circular A110).</p> <p>Delivery: 09/29/2017</p> <p>Delivery Location Code: NRCHQ</p> <p>US NUCLEAR REGULATORY COMMISSION- MAIL PROCESSING CENTER 4930 BOILING BROOK PARKWAY ROCKVILLE MD 20852 USA</p> <p>Payment: ASAP GRANT FUNDS REIMBURSEMENT SYS US TREASURY</p> <p>Period of Performance: 09/30/2014 to 09/29/2017</p>				

ATTACHMENT A - SCHEDULE**A.1 PURPOSE OF GRANT**

The purpose of this Grant is to provide support to the "Synergistic effect of Thermal Aging and Low Dose Irradiation on the Cast Stainless Steels and Stainless Steel Welds."

A.2 PERIOD OF GRANT

1. The effective date of this Grant is September 30, 2014. The estimated completion date of this Grant is September 29, 2017.

A.3 GENERAL

1. Total Estimated NRC Amount:	\$475,031.00
2. Total Obligated Amount:	\$327,705.00
3. Activity Title:	Synergistic effect of Thermal Aging and Low Dose Irradiation on the Cast Stainless Steels and Stainless Steel Welds
4. NRC Project Officer:	Sarah Shaffer
5. NRC Technical Analyst:	Dr. Appajosula Rao
6. DUNS No.:	969663814

A.4 BUDGET

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

	Year 1	Year 2	Year 3
Personnel	\$ 5,082.00	\$ 5,234.00	\$ 5,391.00
Fringe	\$ 2,777.00	\$ 2,860.00	\$ 2,946.00
Travel	\$ 7,500.00	\$ 7,500.00	\$ 7,500.00
Supplies	\$ 3,500.00	\$ 3,500.00	\$ 3,500.00
Contractual	\$ 65,000.00	\$ 65,000.00	\$ 65,000.00
Other Direct Costs	<u>\$ 54,762.00</u>	<u>\$ 38,498.00</u>	<u>\$ 39,711.00</u>
Total Direct Cost	\$138,621.00	\$ 122,592.00	\$124,048.00
Indirect Cost	<u>\$ 43,645.00</u>	<u>\$ 22,847.00</u>	<u>\$ 23,278.00</u>
Total	\$ 182,266.00	\$ 145,439.00	\$147,326.00

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

A.5 AMOUNT OF AWARD AND PAYMENT PROCEDURES

1. The total estimated amount of this Award is \$475,031.00 for the three year period.
2. NRC hereby obligates the amount of \$327,705.00 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 Grants 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

Project Title: Synergistic effect of Thermal Aging and Low Dose Irradiation on the Cast Stainless Steels and Stainless Steel Welds

1. Objectives:

It is aimed to provide a strong technical basis for ensuring that appropriate aging management strategies, from a materials point of view, are in place for the planned life extensions by considering the long-term thermal aging and neutron irradiation effects on the duplex stainless steels. By performing a systematic microstructural characterization on aged and irradiated cast stainless steels and austenitic stainless steel welds, particular in a low dose range at PWR operating temperatures, the proposal investigators are to determine whether there is a synergistic effect between the thermal aging and neutron irradiation. To further correlate the microstructural evolution with mechanical properties, micro/nano indentation and uniaxial tensile tests will be conducted on selected specimens.

2. Background:

Extending service of Light Water Reactors (LWRs) to beyond 60 years will demand a high integrity of materials and components in reactors. The accurate evaluation and prediction of materials performance under anticipated operation conditions are of particular importance for ensuring the safe operation of nuclear power plants over their extended lifetime. Cast stainless steels (CASSs) and austenitic steels welds consist of, a dual-phase microstructure of austenite and ferrite, and are widely used in LWRs. as primary pressure boundary and reactor vessel internal components; i.e. primary coolant pipes, elbows, valves bodies, and pump casings. The most common CASS alloys in service are CF3 (CF3A/M) and CF8 (CF8A/M) series, and they contain approximately 19% Cr and 9% Ni, 0.03% C in CF3 while 0.08% C in CF8. The austenitic stainless weld deposits are used in PWR internals, typically as types 308 or 308L. As compared with CASS materials, the austenitic stainless steel welds generally contains a lower volume fraction of δ -ferrite in the range of 5-15% and lower chromium content. The ferrite phase improves the tensile strength, castability, weldability and stress-corrosion cracking resistance. Duplex stainless steel components perform well in service with relatively few degradation modes, however, it has long been known that the potential significant embrittlement can present

due to the precipitation of fine second phases and decomposing of ferrite phase upon extended long-term thermal aging at temperatures of 280-350°C.

The ferrite phase is less stable under thermal aging as compared with austenite phase. Earlier studies performed at Argonne National Laboratory [1-3] have concluded five metallurgical processes that contribute to the thermal-aging embrittlement of the ferrite phase, i.e., spinodal decomposition, nucleation and growth of α' , G , γ_2 , and $M_{23}C_6$ carbides, while the primary embrittlement mechanism of aged duplex stainless steel is formation of Cr-rich α' phase. And the effects of thermal aging on mechanical properties include increases in tensile strength, hardness but decreases in ductility, fracture toughness and impact strength. Austenitic stainless steel welds share a very similar embrittlement mechanism with CASS upon thermal aging. Previous work on the thermally aged, unirradiated 316 SS welds also consistently showed that the spinodal decomposition is the primary aging mechanism of the duplex weld materials [4]. In addition, a 40% reduction in toughness was recorded for in-situ tests, compared to in-air tests. Spinodal decomposition resulted in fracture toughness that initially increased, then decreased with increasing aging time. Tests were conducted at 300°C, 400°C, and 400°C on welds with two different delta-ferrite contents to investigate whether a change in mechanism took place with increased temperature, and to quantify the effect of ferrite number (FN) on mechanical and SCC properties. As noted in the ERPI technical report (MRP-276) [5], particularly for the austenitic stainless steel welds which can be in the high fluence regions of the PWR internals (e.g. core barrel welds) and under high residual stress, there are two concerns regarding the long-term performance of austenitic stainless steel welds: 1. *Is there a synergistic effect between irradiation and thermal aging embrittlement?* and 2. *Are the existing high fluence data enough to confirm that the lower bound fracture toughness for austenitic stainless steel welds will saturate in a similar way as the wrought austenitic stainless materials?* Table 1 lists some the key structural components anticipated for a high fluence of neutrons exposure in a Westinghouse reactor, and those components are susceptible to potential radiation embrittlement [6].

The synergistic effect from thermal aging and neutron irradiation on the degradations of these representative weld specimens has not yet been fully understood, particularly at LWR relevant temperatures. As reviewed by Wilkes [7], it was experimentally and theoretically shown that disordering from irradiation competes with the process of thermal ordering. The resulting phase structure is strongly dependent on the defect production rate and the irradiation temperature, which determine the concentration of defects and their mobility. Either the radiation accelerates the approach to thermal equilibrium, or radiation-induced non-equilibrium phase precipitation happens. The underlying mechanisms of microstructural change in 304SS welds can be further complicated by the elements of Mn, Mo and Si. One recent study shows that 6.4 MeV Fe³⁺ ion irradiation at 300°C can suppress spinodal decomposition, by decreasing the fluctuation of Cr concentration in the Cr-rich α' phase [8]. However, Miller et al [9] studied the effect of neutron irradiation on spinodal decomposition of a Fe-Cr model alloy, and it was found that the spinodal decomposition in a Fe-32% Cr alloy was significantly enhanced by neutron irradiation at dose of 0.03 dpa at 290°. The controversy regarding radiation's effect on the spinodal decomposition of aged ferrite can be attributed to the difference of incident particles, dose rate, temperature and the material itself. However, the true mechanism shall be subjected to further studies. Correlated with microstructural evolution, radiation and thermal aging would significantly change the mechanical properties of the materials, including ductility, fracture toughness, yield strength, and susceptibility to SCC. For example, the defects and dislocation loops produced by irradiation, normally glissile in larger-grained steels, could become trapped as the weld metal undergoes spinodal decomposition, leading to more sessile behavior and a higher degree of embrittlement. As another example, any boron impurities in the weld metals would stabilize

voids nucleated during irradiation by helium generation, leading to increased void swelling. The duplex stainless steels used as weld metals for 304SS would yield locally varying degrees of radiation damage, as the onset of void swelling for ferrite and austenite are quite different.

Preliminary results

Through the collaboration between the university of Florida and Argonne National Laboratory, some preliminary results were obtained. The cast stainless steel CF-3 with 23% volumetric fraction of ferrite was studied for conditions of as-cast, aged, cast-irradiated, and aged-irradiated. The chemical composition of the material is listed as in wt.%: Ni (8.59), Si (1.13), P (0.015), S (0.005), Mn (0.63), C (0.023), N (0.028), Cr (20.18), Mo (0.34) and Fe (bal.). The aging was performed at 400°C for 10,000 hours, and irradiation was performed in the Halden reactor at 280°C to 0.08 dpa (5.6×10^{19} n/cm², E>1 MeV). The characterizations were mainly focused on the spinodal decomposition and nano-sized G-phase precipitation in δ -ferrite by using an atom probe tomography (APT).

Figure 1 (a) of APT images clearly shows that both thermal aging and irradiation can separately induce the spinodal decomposition of the ferrite, while the thermal aging plus neutron irradiation shows an exaggerated effect by increasing the extent of Cr-Fe separation. The concentration-frequency curves in fig. 1 (b) quantitatively displays that the evolution of Cr-Fe distribution from a normal distribution of as-cast into a binomial distribution (for the extreme case as the Cr and Fe totally separate from each other, the distribution peaks will be located at the concentration of 0 and 100%, respectively). There is no doubt that the neutron irradiation with a low dose rate can drive the metastable ferrite further into thermal equilibrium.

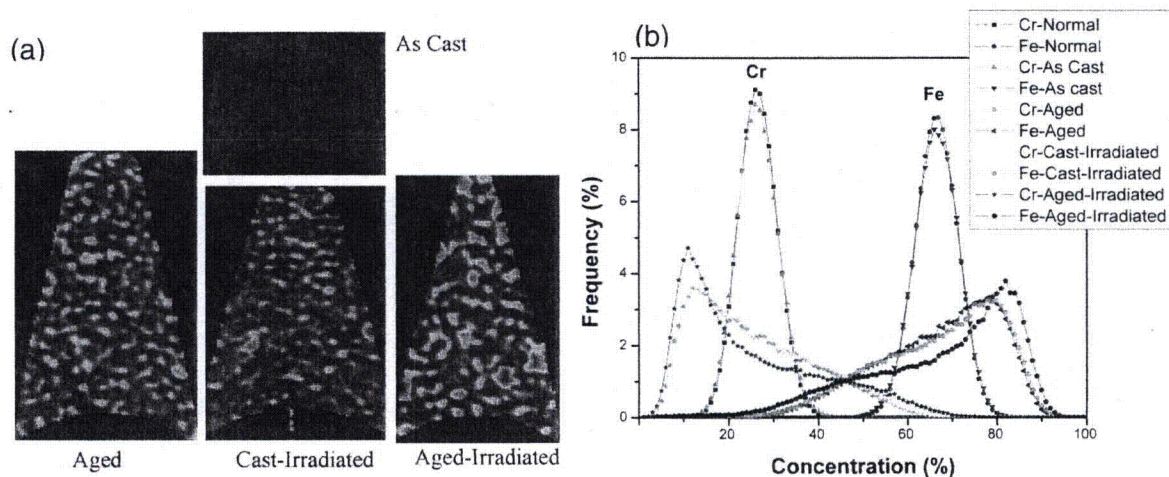


Figure 1. (a) spinodal decomposition shown in the APT images and (b) Cr-Fe elemental distribution.

The G-phase precipitates also behavior in a similar way as that of spinodal decomposition upon thermal aging, neutron irradiation and the combination of those two. As demonstrated in fig. 2, both thermal aging and irradiation would introduce the precipitation of G-phase, which is rich in Mn, Ni and Si, while the synergy of thermal and irradiation significantly promoted the volume of G-phase under such a low dose of 0.08 dpa. The average size of G-phase precipitates in the aged and irradiated specimen is nearly two times larger than that in the aged only specimen. Moreover, the maximum precipitate size is nearly eight times larger.

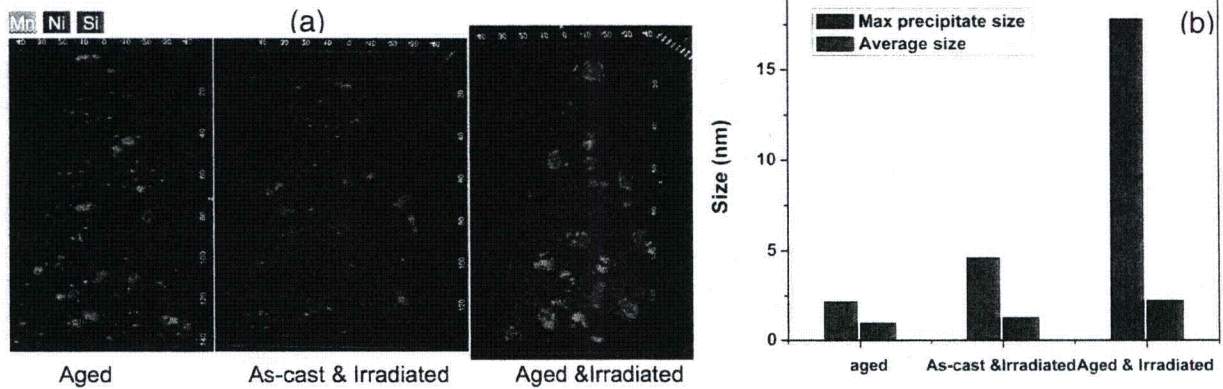


Figure 2. (a) G-phase precipitates in aged, cast-irradiated and aged-irradiated CF-3, and (b) the maximum and average sizes of G-phase precipitate.

Even though our preliminary results suggest a possible synergistic effect between thermal aging and neutron irradiation, a confirmative conclusion requires much more comprehensive and systemic studies on different dose levels, ferrite contents, and various welding conditions.

Table 1. Westinghouse components identified as CASS and Structural Welds for potential irradiation embrittlement [6].

Assembly/Component Name	Material Category	Material Type/Grade	Structural Weld	Neutron Fluence Region ⁽¹⁾	Embrittlement Screening	MRP-191/ MRP-227 ⁽²⁾
Upper Internals Assembly						
Control Rod Guide Tube Assemblies and Flow Downcomers						
Flanges-lower	Austenitic SS /CASS	304/CF8	Yes	Region 3	TE/IE	Primary
Mixing Devices						
Mixing devices	CASS	CF8	Yes	Region 3	TE/IE	Category A
Upper Plenum						
UHI flow column bases	CASS	CF8	No	Region 3	TE/IE	Category A
Upper Support Column Assemblies						
Column bases	CASS	CF8	No	Region 3	TE/IE	Category A
Lower Internals Assembly						
Bottom Mounted Instrumentation (BMI) Column Assemblies						
BMI column bodies	Austenitic SS	304 SS	Yes	Region 5	IE	Expansion
BMI column cruciforms	CASS	CF8	No	Region 5	TE/IE	No Additional Measures
BMI column extension tubes	Austenitic SS	304 SS	Yes	Region 5	IE	No Additional Measures
Lower core barrel	Austenitic SS	304 SS	Yes	Region 4	IE	Expansion
Upper core barrel	Austenitic SS	304 SS	Yes	Region 4	IE	Expansion
Flux Thimbles (Tubes)						
Flux thimble tube plugs	Austenitic SS	304 SS	Yes	Region 5	IE	No Additional Measures
Flux thimbles (tubes)	Austenitic SS	316 SS	Yes	Region 5	IE	Existing
Lower Core Plate and Fuel Alignment Pins						
Lower core plate	Austenitic SS	304 SS	Yes	Region 5	IE	Existing
XL lower core plate	Austenitic SS	304 SS	Yes	Region 4	IE	Existing
Lower Support Column Assemblies						
Lower support column bodies	CASS	CF8	No	Region 5	TE/IE	Expansion

Notes:

1. The neutron fluence regions are defined as follows:

- Region 1: fluence < 1×10^{20} n/cm²
- Region 2: 1×10^{20} n/cm² ≤ fluence < 7×10^{20} n/cm²
- Region 3: 7×10^{20} n/cm² ≤ fluence < 1×10^{21} n/cm²
- Region 4: 1×10^{21} n/cm² ≤ fluence < 1×10^{22} n/cm²
- Region 5: 1×10^{22} n/cm² ≤ fluence < 5×10^{22} n/cm²
- Region 6: 5×10^{22} n/cm² ≤ fluence

2. The MRP-191 categorization in this table is Category A. The MRP-227 categorizations in this table are Primary, Expansion, Existing, and No Additional Measures.

Therefore, it is desired to perform a systematic study on the aged and irradiated CASS and austenitic stainless steel welds to determine whether there is a synergistic effect and its applicable dose range. In addition, the related mechanical properties should also be quantified using a combination of conventional tensile test and novel micro/nano mechanical test, and the correlation between microstructural evolution and mechanical behavior shall be established.

3. Logical path to accomplishing scope:

Research will be mainly focused on the microstructural characterizations including spinodal decomposition, precipitation in grain and at grain boundaries by using TEM and APT. The radiation-induced dislocations will also be quantified including the hardening effect from irradiation. The micro/nano instrumented indentation will be used to obtain the hardening as well as the associated embrittlement behavior from austenite and ferrite phases, separately. The uniaxial tensile testes will performed on selected specimen for benchmarking the micro/nano mechanical tests.

3.1 Materials:

Table 2 lists the available materials, their conditions, doses and chemical compositions. Among those specimens, only CF-3 cast stainless steel with 23% ferrite content irradiated to 0.08 dpa was preliminarily examined using APT, while the rest is yet to be studied. The materials contain different contents of ferrite and carbon concentrations with a distinct variation. All the neutron irradiations were conducted in Halden reactor at 280°C. The materials are in the shape of 3 mm TEM disc or miniature tensile specimen. The control samples with zero doses are also included.

Table 2. List of available materials and their conditions.

Material Condition		Materials Type	Dose	Mn	Si	P	S	Mo	Cr	Ni	N	C	N _b
As cast	Aged	CF-3, ~23% ferrite	Un-irradiated	0.63	1.13	0.015	0.005	0.34	20.18	8.59	0.028	0.023	-
As cast	Aged	CF-3, ~14% ferrite	0.08 dpa (5×10^{19} n/cm ²)	0.57	0.92	0.012	0.005	0.35	19.49	9.4	0.052	0.009	-
As cast	Aged	CF-8, ~24% ferrite	3 dpa (2×10^{21} n/cm ²)	0.64	1.07	0.021	0.014	0.31	20.46	8.08	0.062	0.063	-
As weld		308L weld	TBD										

* Materials were preliminarily examined using APT for the dose of 0.08 dpa.

3.2 Microstructural characterizations

With the objective of developing fundamental understanding of the synergistic effects on the duplex microstructures, characterizations will be focused on the evolution of dislocation loops, G-phase precipitation, spinodal decompositions and radiation induced phase boundary segregation when present. Transmission electron microscopy (TEM) and atom probe tomography (APT) are widely considered to be the most effective techniques for such study. By using APT, the thermal aging and irradiation induced redistribution of Cr elements in the ferrite and related ultra fine precipitates will be quantified. High mass resolution is essential to characterize the α/α' spinodal decomposition due to the low contrast between Fe and Cr in iron-rich α phase and chromium-rich α' phase, respectively. The wavelength of oscillating Cr concentration can be a characteristic fingerprint for quantifying the decomposition of ferrite and related α' phase. The dislocation loops, lines, or networks will be imaged in dark field with appropriate diffraction conditions using TEM. Scanning transmission electron microscopy (STEM) will be used to collect high-resolution, chemically sensitive, atomic number (Z-) contrast images, by combining the energy dispersive spectroscopy (EDS) and electron energy loss spectroscopy (EELS) techniques. Elemental mapping will be performed on selected grain boundaries to evaluate composition gradients. For all materials, TEM and APT specimens can be prepared from specific zones in and around the ferrite and phase boundaries using a focused ion beam (FIB).

3.3 Micro/nano-scale mechanical tests:

The micro-hardness of the samples will be evaluated to study the embrittlement. As illustrated in fig. 3, the quantitative relationships between hardness increase and irradiation hardening, and

between yield stress change and Charpy transition temperature shifts (TTS) were developed by Odette, et al [10-12]. For this proposed project, the thermal aging and irradiation induced hardening will be correlated with transition temperature shift (TTS) in the embrittlement modeling.

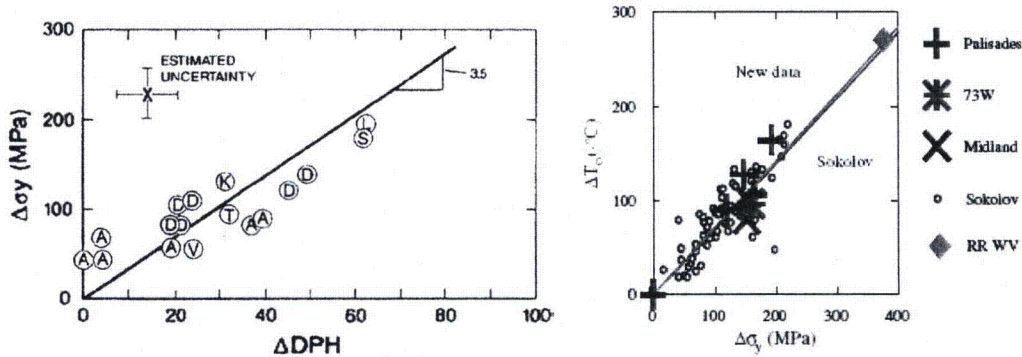


Figure 3. Correlations between irradiation hardening, measured yield strength $\Delta\sigma_y$ and microhardness (ΔDPH) changes; and between yield strength changes and shifts in the reference temperature ΔT_0 for irradiated RPV steels.

The micro/nano-indentation will be performed by using a Hysitron TriboIndenter. With a semi-dynamic load as an example shown in Fig. 4, the Young's modulus of irradiated specimen can be obtained using a simple linear regression model [13]. The nano-indentation can be performed in an automatic-mapping manner, which will provide a statistically significant result by conducting a large amount of measurements for each condition. More importantly, the micro/nano indentation can be performed on each individual phase as illustrated in Fig 4, this would provide a methodology for de-coupling the response of ferrite from the austenite matrix.

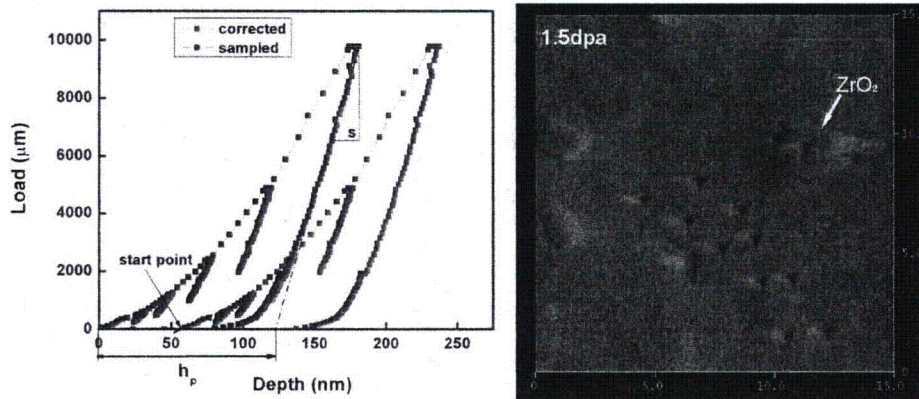


Figure 4. Nano-indentation on irradiated ZrN with a semi-dynamic load (un-published work).

3.4 Other mechanical tests:

Uniaxial tensile test on selected specimens will be conducted, and the stress vs. strain curves would provide the properties including ultimate tensile strength (UTS), yield strength and elongation. The stress corrosion cracking tests are being conducted on all those materials in a parallel program and results can also be used for a comparison purpose while those SCC tests are not in the scope of the current proposal. The fracture surface will be examined to further understand the failure mode and fracture behavior after thermal aging, neutron irradiation or a combination.

4. Deliverable and timeline:

Deliverables will include a comprehensive set of microstructural and mechanical property data of CASS and welds, and physically-based models that link the microstructural parameters and fracture behavior of materials. Deliverables will also include monthly update, quarterly and annual reports of progress and scientific findings. Publications upon the approval from NRC will be aimed at national and international conferences and in open scientific journals.

Task	Y1 Q1	Y1 Q2	Y1 Q3	Y1 Q4	Y2 Q1	Y2 Q2	Y2 Q3	Y2 Q4	Y3 Q1	Y3 Q2	Y3 Q3	Y3 Q4
Microstructural characterization and mechanical tests on control specimens	█	█	█	█	█	█						
TEM studies on CF-3 ~23% ferrite (0.08dpa)	█											
TEM and APT on CF-3, ~14% ferrite (0.08dpa)		█										
TEM and APT on CF-8, ~14% ferrite (0.08dpa) and 304L weld			█	█	█							
Micro/nano indentation on low dose specimens				█	█	█	█					
Microstructural characterization and mechanical tests on control specimens							█	█	█	█	█	
TEM and APT studies on CF-3 ~23% and 14% ferrite (3 dpa)						█	█					
TEM and APT studies on CF-8 ~14% and welds (3 dpa)								█	█	█		
Micro/nano indentation on high dose specimens, uniaxial tensile tests and fracture analysis										█	█	
Final report											█	█

5. Multiple PIs leadership plan:

The proposed collaboration between the Research University and DOE national laboratory will take full advantage of world-class facilities located at each institution, and each investigator will bring his unique expertise and complement each other. The proposed research with the involvement of PhD graduate student will provide a great avenue for training the next generation of workforce.

Dr. Yang from the University of Florida is the lead principle investigator and will have the overall responsibility for the program. He will oversee the overall project planning, execution and managing. He will also supervise one graduate student to mainly perform the microstructural characterization and micro/nano characterization. Co-PI, Dr. Chen at the Argonne National Laboratory will coordinate the procurement of irradiated specimens (0.08 dpa specimens are

currently in-housed, while the 3-dpa specimen will be shipped to ANL). In addition, he will work with ANL technicians to conduct the uniaxial tensile tests on selected specimens and related fractographic examinations using a SEM.

Bi-weekly teleconference technical meetings for the entire research team will be held to discuss recent research results and future directions. Additional meetings among a smaller subset of the research team will be organized as necessary. The graduate student from UF will spend at least one month every summer at ANL to take the cross training and conduct the collaboration work.

It has to be noted that, although this proposed research has a strong connection with the existing regulatory research being conducted at ANL, there is no direct overlap between those two program and the proposed work scope is not financially supported. Nevertheless, if awarded, the results from those two separate programs shall be shared to leverage the impact from each other.

Facility available for proposed study:

The University of Florida houses materials characterization and analysis facility. The instruments include FEG-SEM (FEI XL-40, JEOL 6335, JEOL 6400-1/2), FIB (Strata-DB235), WDS (JEOL Superprobe 733), TEM (JEOL200CX and JEOL 2010F), TriboIndenter (HysitronTriboIndenter), and X-Ray Diffraction (Philips APD 3720, HT APD 3720, and XPert MRD). The Nuclear Materials Research Laboratory at UF is equipped with cutting-edge sample preparation equipment and material testing equipment. In addition, the capability for preparing radioactive metallic TEM specimen has been developed and the TEM observation on radioactive specimen can also be performed on campus site.

Argonne National Laboratory: The IML in Argonne's Nuclear Engineering Division has four air-atmosphere, centi-curie beta-gamma hot cells and glove boxes. Each cell is equipped with movable doors that allow the cell equipment to be easily installed, removed, and reconfigured to support the mission of the cell. The facility was designed to conduct post-irradiation examinations of structural materials for reactor development. It has capabilities for handling, testing and analyzing irradiated materials. Also available are a shielded scanning and transmission electron microscope and a radiological fume hood to examine radioactive materials. The Electron Microscopy Center (EMC) under Center for Nanoscale Materials (CNM) is an Analytical Electron Microscopy Facility consisting of electron microscopes that are optimized for high resolution and/or analytical work, including FEI Tecnai F20ST analytical TEM and STEM, Philips CM30T analytical TEM, Hitachi S-4700-II high resolution SEM, Zeiss 1540XB dual-beam focused ion beam (FIB) and FEI Quanta 400F high resolution environmental SEM. The IVEM-Tandem Facility at the EMC is the unique facility in the United States featuring high quality TEM interfaced to two ion accelerators for in-situ ion beam studies.

In addition, the access to the FIB/TEM/APT at Macs (**CAES/INL**) facility can be gained through the ATR-Rapid Turnaround Proposal program.

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: 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

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.

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

2. Award Package

§ 215.41 Grantee responsibilities.

The Grantee is obligated to conduct 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.

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 and obtained from the NRC Grants Officer in advance of the change or obligation of funds. All requests for NRC prior approval, including requests for extensions to the period of performance, should be made, in writing (which includes submission by e-mail), to the designated Grants Specialist and Program Office 30 days before the proposed change. The request should be signed by 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 will 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 \$100,000.00 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 listed as Exclusion on SAM (<http://sam.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.

The Grantee 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 will 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 regulations. 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 will 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.

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.

Patent Notification Procedures - If the NRC or its 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, EO 12889 requires NRC to notify the owner. 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 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, such as data, databases or software are determined by 2 CFR 215.36. 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

Grantee shall follow established provisions in 2 CFR 215.53.

Conflict Of Interest Standards

Conflict of Interest Standards for this award will 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 will follow provisions as established in 2 CFR 215.60-62.

Monitoring and Reporting § 215.50-53

Grantee Financial Management systems must comply with the 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, will be added to funds committed to the project by the NRC and Grantee and used to further eligible project or program objectives or deducted from the total project cost allowable cost as directed by the Grants Officer or the terms and conditions of award.
- Budget Revision – 2 CFR 215.25
 - The Grantee is required to report deviations from the approved budget and program descriptions in accordance with 2 CFR 215.25 and request prior written approval from the Program Officer and the Grants Officer.
 - The Grantee is not authorized to rebudget between direct costs and indirect costs without written approval of the Grants Officer.
 - The Grantee is authorized to transfer funds among direct cost categories up to a cumulative 10 percent of the total approved budget. The Grantee is not allowed to transfer funds if the transfer would cause any Federal appropriation to be used for purposes other than those consistent with the original intent of the appropriation.
 - Allowable Costs – 2 CFR 215.27

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 the following:

1. Grants_FFR.Resource@NRC.gov (NOTE: There is an underscore between Grants and FFR);
2. RESGrants.Resource@NRC.gov;
3. Technical Analyst; and
4. Grants Officer.

Period of Availability of Funds 2 CFR § 215.28

If 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.

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.

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.

Automated Standard Application For Payments (ASAP) Procedures

Unless otherwise stated, grantee payments are made using the Department of Treasury's Automated Standard Application for Payment (ASAP) system <http://www.fms.treas.gov/asap/index.html>, through preauthorized electronic funds transfers. To receive payments, 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 is required to make ASAP withdrawals: (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).

II. Audit Requirements

Audits

Organization-wide or program-specific audits are 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." Grantees are subject to the provisions of OMB Circular A-133 if they expend \$500,000.00 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 are 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 \$500,000.00 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 Progress (Technical) Reports

The Grantee shall submit performance (technical) reports electronically to the NRC Project Officer and Grants Officer on a quarterly 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. The report should be submitted electronically to the following:

1. Grants_PPR.Resource@NRC.gov (NOTE: There is an underscore between Grants and PPR);
2. RESGrants.Resource@NRC.gov;
3. Technical Analyst; and

4. Grants Officer.

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

Unsatisfactory Performance

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

Failure to comply with the award provisions may result in a negative impact on future NRC funding. In addition, the Grants Officer may withhold payments; change the method of payment from advance to reimbursement; impose special award conditions; suspend or terminate the grant.

Other Federal Awards With Similar Programmatic Activities

The Grantee will immediately notify the Project Officer and the Grants Officer in writing if after award, other financial assistance is received to support or fund any portion of the program description stated in the NRC award. NRC will not pay for costs that are funded by other sources.

Prohibition Against Assignment By The Grantee

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

Site Visits

The NRC, through authorized representatives, has the right to make site visits to review project accomplishments and management control systems and to provide technical assistance as 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.

IV. Miscellaneous Requirements

Criminal and Prohibited Activities

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.)

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.

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.

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 encouraged to purchase American-made equipment and products with funding provided under this award.

Increasing Seat Belt Use in the United States

EO 13043 requires Grantees to 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

EO 13513 requires Grantees to 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 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)).

EXECUTIVE COMPENSATION REPORTING

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 \$25,000.00 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 \$25,000.00 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.sam.gov>.

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

c. *Reporting of Total Compensation of Subrecipient Executives.*

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

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

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

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

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

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

i. To the recipient.

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

d. *Exemptions*

If, in the previous tax year, you had gross income, from all sources, under \$300,000.00, 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 \$10,000.00.