Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Defense Health Agency	Date: May 2017
Appropriation/Budget Activity 0130: *Defense Health Program I* BA 2: *RDT&E*	**R-1 Program Element (Number/Name)** PE 0603002DHA *I Medical Advanced Technology (AFRRI)*

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
Total Program Element	1.559	0.282	0.310	0.332	-	0.332	0.338	0.345	0.352	0.359	Continuing	Continuing
030A: *CSI - Congressional Special Interests*	0.031	0.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
242A: *Biodosimetry (USUHS)*	0.918	0.169	0.186	0.199	-	0.199	0.202	0.206	0.210	0.214	Continuing	Continuing
242B: *Radiation Countermeasures (USUHS)*	0.610	0.113	0.124	0.133	-	0.133	0.136	0.139	0.142	0.145	Continuing	Continuing

A. Mission Description and Budget Item Justification

For the Uniformed Services University of the Health Sciences/ Armed Forces Radiobiology Research Institute (USUHS/AFRRI), this program supports applied research for advanced development of biomedical strategies to prevent, treat and assess health consequences from exposure to ionizing radiation. It capitalizes on findings under PE 0602787HP, Medical Technology, and from industry and academia to advance novel medical countermeasures into and through pre-clinical studies toward newly licensed products. Program objectives focus on mitigating the health consequences from exposures to ionizing radiation(alone or in combination with other injuries) that represent the highest probable threat to US forces in current tactical, humanitarian and counterterrorism mission environments. Findings from basic and developmental research are integrated into focused advanced technology development studies to produce the following: (1) protective and therapeutic strategies; (2) novel biological markers and delivery platforms for rapid, field-based individual medical assessment; and (3) experimental data needed to build accurate models for predicting casualties from complex injuries involving radiation and other battlefield insults. The AFRRI, because of its multidisciplinary staff and exceptional laboratory and radiation facilities, is uniquely positioned to execute the program as prescribed by its mission.

B. Program Change Summary ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
Previous President's Budget	0.305	0.310	0.332	-	0.332
Current President's Budget	0.282	0.310	0.332	-	0.332
Total Adjustments	-0.023	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.023	-			

Congressional Add Details ($ in Millions, and Includes General Reductions)

	FY 2016	FY 2017
Project: 030A: *CSI - Congressional Special Interests*		
Congressional Add: *473A – Program Increase: Restore Core Research Funding Reduction (USUHS)*	0.000	-

Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Defense Health Agency	Date: May 2017
Appropriation/Budget Activity 0130: *Defense Health Program I* BA 2: *RDT&E*	**R-1 Program Element (Number/Name)** PE 0603002DHA *I Medical Advanced Technology (AFRRI)*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2016	FY 2017
Congressional Add Subtotals for Project: 030A	0.000	-
Congressional Add Totals for all Projects	0.000	-

Change Summary Explanation

FY 2015: Realignment from Defense Health Program, Research, Development, Test and Evaluation (DHP RDT&E), PE 0603002-Advanced Technology (AFRRI) (-$0.024 million) to DHP RDT&E PE 0605502-Small Business Innovation Research (SBIR) / Small Business Technology Transfer (STTR) Program (+$0.024 million).

FY 2015: Restore core research funding to the DHP RDT&E, PE 0603002-Advanced Technology (AFRRI) (+$0.031 million).

FY 2016: No Change.

FY 2017: No Change.

FY 2018: No Change.

Exhibit R-2A, RDT&E Project Justification: FY 2018 Defense Health Agency			Date: May 2017
Appropriation/Budget Activity 0130 / 2	R-1 Program Element (Number/Name) PE 0603002DHA / *Medical Advanced Technology (AFRRI)*	Project (Number/Name) 030A / *CSI - Congressional Special Interests*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
030A: *CSI - Congressional Special Interests*	0.031	0.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

The FY15 DHP Congressional Special Interest (CSI) funding is directed toward core research initiatives in Program Element (PE) 0603002 - Medical Advanced Technology (AFRRI). Because of the CSI annual structure, out-year funding is not programmed.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017
Congressional Add: 473A – Program Increase: Restore Core Research Funding Reduction (USUHS)	0.000	-
FY 2016 Accomplishments: No Funding Programmed.		
Congressional Adds Subtotals	0.000	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: FY 2018 Defense Health Agency			Date: May 2017
Appropriation/Budget Activity 0130 / 2	R-1 Program Element (Number/Name) PE 0603002DHA / *Medical Advanced Technology (AFRRI)*	Project (Number/Name) 242A / *Biodosimetry (USUHS)*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
242A: *Biodosimetry (USUHS)*	0.918	0.169	0.186	0.199	-	0.199	0.202	0.206	0.210	0.214	Continuing	Continuing

A. Mission Description and Budget Item Justification

For the Uniformed Services University of the Health Sciences/Armed Forces Radiobiology Research Institute (USU/AFRRI), this program supports applied research for advanced development of biomedical strategies to prevent, treat and assess health consequences from exposure to ionizing radiation. It capitalizes on findings under PE 0602787HP, Medical Technology, and from industry and academia to advance novel medical countermeasures into and through pre-clinical studies toward newly licensed products. Program objectives focus on mitigating the health consequences from exposures to ionizing radiation (alone or in combination with other injuries) that represent the highest probable threat to US forces in current tactical, humanitarian and counterterrorism mission environments. Findings from basic and developmental research are integrated into focused advanced technology development studies to produce the following: (1) protective and therapeutic strategies; (2) novel biological markers and delivery platforms for rapid, field-based individual medical assessment; and (3) experimental data needed to build accurate models for predicting casualties from complex injuries involving radiation and other battlefield insults. The AFRRI, because of its multidisciplinary staff and exceptional laboratory and radiation facilities, is uniquely positioned to execute the program as prescribed by its mission.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Biodosimetry (USUHS)	0.169	0.186	0.199
Description: Biodosimetry (USUHS): For the Uniformed Services University of the Health Sciences (USUHS), this program supports applied research for advanced development of biomedical and biophysical strategies to assess health consequences from exposure to ionizing radiation. It capitalizes on findings under PE 0602787HP, Medical Technology, and from industry and academia to advance novel biological markers and delivery platforms for rapid, field-based individual dose assessment and experimental data needed to build accurate models for predicting casualties from complex injuries involving radiation and other battlefield insults.			
FY 2016 Accomplishments: Contributed efforts using radiation-responsive biomarkers in higher order animal and human models for diagnostic biodosimetry applications; developed and reported on algorithm using multiple human blood cell types (i.e., lymphocytes, neutrophils, platelets) for radiation dose assessment. Participated in several exercises successfully demonstrating ability to report rapidly on dose assessment using cytogenetic chromosome-aberration assay; reported on status of AFRRI's cytogenetic biodosimetry capability for dose assessment using metaphase-spread dicentric chromosome aberration and premature chromosome condensation assays. Developed and applied radiation risk and injury categorization (RRIC) algorithm using hematology and serum chemistry parameters for triaging minipigs exposed to TBI lethal and nonlethal radiation doses between days 0-30 days; compared minipig and non-human primate RRIC models. Sustained efforts to provide DOD end-users improved radiation diagnostic tools; maintained access to diagnostic worksheets and software applications on Institute's Biodosimetry Tools website; and transitioned WinFRAT software application for use on smart phones (Mobile FRAT). Reported on current status and utility for use of emerging			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Defense Health Agency		Date: May 2017
Appropriation/Budget Activity 0130 / 2	**R-1 Program Element (Number/Name)** PE 0603002DHA / *Medical Advanced Technology (AFRRI)*	**Project (Number/Name)** 242A / *Biodosimetry (USUHS)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
biodosimetry assays on DOD's concept of operations for biodosimetry tools in operational environments. Participated in first exercise and successfully used early-phase clinical signs and symptoms for triaging suspected radiation patients based on results from human radiation accident registry. Contributed in efforts to justify establishment and design of scope of operations for DOD Biodosimetry Network to provide multiple parameter biodosimetry capability. Completed 4 mouse experiments using special housing partition chambers for prolonged irradiations that had not been used before. Mouse experiments completed used lower dose rates than had been used previously, with irradiations lasting up to 3 hours. ***FY 2017 Plans:*** Sustain efforts to develop and validate biodosimetry tools useful in operational environments. Establish use of PCC assay for assessment of partial-body exposure including use of protein nucleic acid (PNA) centromeric probes for identification of dicentric aberrations in PCC assay; expand upon radiation calibration curves using PCC assay. Sustain participation in exercises and establishment of clinical laboratory certification.Initiate efforts via collaboration with NATO collaborator to establish and evaluate baboon radiation dose-response database archive for use in extending radiation risk and injury categorization (RRIC) algorithm. Report on nonhuman primate radiation dose response and acute radiation syndrome scoring system. Develop enhancements (ARS severity score) to DOD radiation diagnostic software tools useful for military applications. Evaluate effects of radioprotectant on radiation risk categorization (RRIC) algorithm based on blood counts and blood chemistries using irradiated nonhuman primate archived data. Assess cytokines in sera from mice irradiated at low dose rate in FY2016. ***FY 2018 Plans:*** Continue evaluation of baboon radiation biomarker database utility to predict hematopoietic acute radiation syndrome severity. Perform internal assessment of quality control program for dose assessment by cytogenetics in support of clinical laboratory certification. Develop algorithm using blood cell counts and biochemical biomarkers in NHP radiation dose response model. Initiate efforts to evaluate blood samples from human radiation therapy patients using panel of radiation-responsive biomarkers. Evaluate effects of radioprotectant on radiation risk categorization (RRIC) algorithm based on blood counts and blood chemistries using irradiated nonhuman primate archived data. Perform and report on an evaluation to validate the utility of the human biomarker model. Delivery an updated software tools incorporating human radiation risk and dose tool. Report on laboratory's competence in inter-comparison exercises for radiation dose assessment. Report on recent developments and use of AFRRI's Biodosimetry Tools. Obtain CLIP certification for performance of the dicentric assay for dose assessment. Report on use of AFRRI's suite of biodosimetry tools in a radiological exercise.			
Accomplishments/Planned Programs Subtotals	0.169	0.186	0.199

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: FY 2018 Defense Health Agency		Date: May 2017
Appropriation/Budget Activity 0130 / 2	**R-1 Program Element (Number/Name)** PE 0603002DHA / *Medical Advanced Technology (AFRRI)*	**Project (Number/Name)** 242A / *Biodosimetry (USUHS)*

D. Acquisition Strategy

N/A

E. Performance Metrics

By FY 2016
- Report on current status of AFRRI's capability and capacity to perform dose assessment by cytogenetics.
- Participate in annual performance evaluations to demonstrate accuracy in dose assessment by cytogenetics.
- Continue studies evaluating new radiation-responsive biomarkers in animal models for early-phase and organ-specific damage and their applicability in humans.
- Continue to create human baseline database for evaluated biomarkers for use in human radiation accident cases.
- Release Mobile FRAT smart phone apps for iPhone and Android operating systems.

By FY 2017
- Report on development and use of AFRRI's FRAT application for utility in triage diagnostics of suspected radiation casualties.
- Test ability of PCC assay for assessment of high-dose partial-body exposures.
- Continue evaluating new predictive radiation-responsive biomarkers in NHP models for ARS outcome and their applicability in humans.
- Continue to create human baseline database for evaluated biomarkers for use in human radiation accident cases.
- Establish large animal models (i.e., baboon, Rhesus monkey) radiation biomarker database archive linked to severity of acute radiation syndrome.

By FY2018
- Model radiation risk and injury categorization (RRIC) algorithm using large animal models (i.e., baboon, Rhesus monkey) radiation dose response databases to predict hematopoietic ARS; initiate comparison of RRIC algorithm with human radiation accident data.
- Report use of multiple radiation-responsive endpoints using premature chromosome condensation assay for radiation dose assessment.
- Provide enhanced and updated radiation software application.

By FY2019
-Perform and report on an evaluation to validate the utility of the human biomarker model.
-Delivery an updated software tools incorporating human radiation risk and dose tool.
-Report on laboratory's competence in inter-comparison exercises for radiation dose assessment.
- Report on recent developments and use of AFRRI's Biodosimetry Tools.

By FY2020
- Obtain CLIP certification for performance of the dicentric assay for dose assessment.
- Report on use of AFRRI's suite of biodosimetry tools in a radiological exercise.

Exhibit R-2A, RDT&E Project Justification: FY 2018 Defense Health Agency			Date: May 2017
Appropriation/Budget Activity 0130 / 2	R-1 Program Element (Number/Name) PE 0603002DHA / *Medical Advanced Technology (AFRRI)*	Project (Number/Name) 242B / *Radiation Countermeasures (USUHS)*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
242B: *Radiation Countermeasures (USUHS)*	0.610	0.113	0.124	0.133	-	0.133	0.136	0.139	0.142	0.145	Continuing	Continuing

A. Mission Description and Budget Item Justification

Radiation Countermeasures (USU): For the Uniformed Services University of the Health Sciences (USU), this program supports applied research for advanced development of biomedical strategies to prevent and treat health consequences from exposure to ionizing radiation. It capitalizes on findings under PE 0602787HP, Medical Technology, and from industry and academia to advance novel medical countermeasures into and through pre-clinical studies toward newly licensed products. Program objectives focus on preventing or mitigating the health consequences from exposures to ionizing radiation alone or in combination with other injuries, in the context of probable threats to US forces in current tactical, humanitarian and counterterrorism mission environments. Findings from basic and developmental research are integrated into highly focused advanced technology development studies yielding protective and therapeutic strategies.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Radiation Countermeasures (USUHS)	0.113	0.124	0.133

Description: Radiation Countermeasures (USU): For the Uniformed Services University of the Health Sciences (USU), this program supports applied research for advanced development of biomedical strategies to prevent and treat health consequences from exposure to ionizing radiation. It capitalizes on findings under PE 0602787HP, Medical Technology, and from industry and academia to advance novel medical countermeasures into and through pre-clinical studies toward newly licensed products. Program objectives focus on preventing or mitigating the health consequences from exposures to ionizing radiation alone or in combination with other injuries, in the context of probable threats to US forces in current tactical, humanitarian and counterterrorism mission environments. Findings from basic and developmental research are integrated into highly focused advanced technology development studies yielding protective and therapeutic strategies.

FY 2016 Accomplishments:

Evaluated efficacy biomarkers of Ex-RAD using in vitro and mouse models. Several pathway molecules identified. Evaluated and compared prophylactic efficacy of DeltaGold® (American River Nutrition) with gamma-tocotrienol, as single dose administered subcutaneously in mouse model and found to be as efficacious. Evaluated toxicity and established prophylactic efficacy of single dose of PrC-210 (aminothiol analog of amifostine, WR 2721), administered orally, in mouse model as radioprotectant. Established and confirmed radioprotective prophylactic efficacy of TPOm (a thrombopoietin mimetic, RWJ-800088, Janssen R&D) and BBT-059 (PEGylated IL-11 analog, Bolder Biotech Inc.), administered subcutaneously in mouse model. Determined optimum drug dose of TPOm and BBT-059 to achieve optimum prophylactic efficacy. Demonstrated accelerating recovery from radiation-induced peripheral blood cytopenia with both TPOm and BBT-059. Demonstrated effect of TPOm in protecting bone marrow progenitor cells from radiation damage. Evaluated differentially regulated radiation-induced microRNAs in serum with or without CDX-301 treatment, identifying 4 target signaling pathways (ERK, MAP2K, Smad2/3 and insulin) from IPA network

Exhibit R-2A, RDT&E Project Justification: FY 2018 Defense Health Agency		Date: May 2017
Appropriation/Budget Activity 0130 / 2	**R-1 Program Element (Number/Name)** PE 0603002DHA / *Medical Advanced Technology (AFRRI)*	**Project (Number/Name)** 242B / *Radiation Countermeasures (USUHS)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
analysis. Determined efficacy of CDX-301 in gastrointestinal recovery after radiation exposure. Completed evaluation of efficacy of combined pharmaceutical regimen against radiation combined injury (irradiation followed immediately by skin wound trauma). Completed determination of effectiveness of combined therapy of G-CSF and ALXN4100TPO, a thrombopoietin receptor agonist, to mitigate or inhibit long-term deleterious responses to radiation combined injury. Completed determination of effectiveness of combined therapy of peg-G-CSF and ALXN4100TPO, a thrombopoietin receptor agonist, to mitigate or inhibit long-term deleterious responses to radiation combined injury. Completed preparation of peg-G-CSF experiment with irradiation immediately followed by skin wound trauma. PGC-1 (a regulator for NF-kB) was upregulated in ileum of combined injured mice on day 1. Similarly, Nrf-2 (a stimulator for ATP production) was increased as well. ***FY 2017 Plans:*** Determine optimum dose and schedule for PrC-210 to achieve optimum radioprotective survival efficacy. Determine dose-reduction factor of PrC-210 with optimum dose and time. Determine effect of PrC-210 on accelerating recovery from radiation-induced peripheral blood cytopenia. Determine optimum schedule of subcutaneous administration (prophylactic) of TPOm and BBT-059 at optimum dose to achieve optimum radioprotective survival efficacy. Determine dose-reduction factor of TPOm and BBT-059 with optimum dose and time. Demonstrate effect of BBT-059 in protecting bone marrow progenitor cells from radiation damage. Evaluate effect of TPOm on endothelial dysfunction markers (Thrombomodulin, ICAM-1, Endothelin-1, E-Selectin, MMP-9, sVCAM-1 and PAI-1) in mouse serum. Evaluate effect of TPOm in inducing cytokines/chemokines using 23-plex cytokine Luminex assay. Evaluate radiation-induced long non-coding RNAs (lncRNAs) in mouse spleen and study effect of CDX-301. Study down-stream proteins of ERK, MAP2K, and Smad2/3 pathway using western blot in mouse spleen and jejunum and test effect of CDX-301. Evaluate toxicity and survival efficacy of phenyl butyrate in mouse model for prophylactic radiation countermeasure. Conduct the peg-G-CSF experiment with irradiation immediately followed by skin wound trauma. Continue to perform PGC-1α, NF-#B, and MAPK on radiation sensitivity variations among species. ***FY 2018 Plans:*** Continue to elucidate mechanisms underlying radioprotective efficacy by CDX-301. Continue to discover mechanisms of TPOm on survival improvement after radiation by profiling cytokine/chemokine and signal transduction pathway activation, and miRNA regulation. Demonstrate effect of PrC-210 in protecting bone marrow progenitor cells from radiation damage. Investigate mechanisms of BBT-059 on survival improvement after radiation by profiling cytokine/chemokine and signal transduction pathway activation, and miRNA regulation. Will continue to gather data on cytokine concentrations to understand radiation sensitivity variations among species. Will continue to gather data on Nrf and ATP levels to understand radiation sensitivity variations among species. Will gather data on mitochondrial remodeling to understand radiation sensitivity variations among species. Will gather data on miRNA-696 dynamic changes to understand radiation sensitivity variations among species. Will analyze and integrate data to provide insight of radiation sensitivity variations among species, specifically biomarkers to indicate the sensitivity.			
Accomplishments/Planned Programs Subtotals	0.113	0.124	0.133

Exhibit R-2A, RDT&E Project Justification: FY 2018 Defense Health Agency		Date: May 2017
Appropriation/Budget Activity 0130 / 2	**R-1 Program Element (Number/Name)** PE 0603002DHA / *Medical Advanced Technology (AFRRI)*	**Project (Number/Name)** 242B / *Radiation Countermeasures (USUHS)*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

By FY 2016
- Continue biomarker identification for radiation countermeasure efficacy.
- Determine whether efficacy of DeltaGold® and gamma-tocotrienol is comparable.
- Test TPOm, BBT-059 and PrC-210 as potential radiation countermeasures in CD2F1 in mouse model.
- Assess accelerated recovery from peripheral blood cytopenia by TPOm and BBT-059.
- Predict miRNA targeted signaling pathways when treated with CDX-301 administered prior to radiation.
- Complete evaluation of therapeutic effects of G-CSF and ALXN4100TPO on survival after radiation combined injury.
- Complete evaluation of peg-G-CSF and Alxn4100TPO co-therapy after irradiation-wound combined injury.

By FY 2017
- Complete DRF (dose reduction factor) of TPOm, BBT-059 and PrC-210.
- Study effect of TPOm on radiation-induced endothelial dysfunction.
- Study downstream effect of CDX-301 on signaling targets of ERK, MAP2K, and Smad2/3
- Evaluate efficacy of Phenyl butyrate in CD2F1 mice.
- Identify lncRNAs in spleen from mice treated with CDX-301.
- Complete evaluation of peg-G-CSF and Alxn4100TPO co-therapy after irradiation-wound combined injury.
- Complete publication of peg-G-CSF and Alxn4100TPO co-therapy after irradiation-wound combined injury.
- Evaluate cellular PGC-1α, NF-#B, and MAPK measurements in spleen, ileum, lung, and heart of mice and minipigs after irradiation.

By FY 2018
- Understand molecular pathways involved in radioprotection by TPOm, BBT-059.
- Understand molecular pathways involved in radioprotection by BBT-059.
- Understand effect of PrC-210 on recovery of radiation-induced depletion of peripheral blood cells and bone marrow progenitor cells.
- Characterize dynamic changes in miRNA regulation in radiation-wound combined injured mice treated with ghrelin.
- Measure IL-18 and IL-BP in serum and various tissues in minipigs after 1.75 Gy.
- Measure cytokines and chemokines in serum and various tissues in mice after 9.5 Gy.

By FY 2019
- Evaluate Nrf1, Nrf2, and ATP in various tissues in minipigs after 1.75 Gy.
- Evaluate Nrf1, Nrf2, and ATP in various tissues in mice after 9.5 Gy.

Exhibit R-2A, RDT&E Project Justification: FY 2018 Defense Health Agency		Date: May 2017
Appropriation/Budget Activity 0130 / 2	**R-1 Program Element (Number/Name)** PE 0603002DHA / *Medical Advanced Technology (AFRRI)*	**Project (Number/Name)** 242B / *Radiation Countermeasures (USUHS)*

By FY 2020
- Evaluate TFAM, DRP1, OPA1 and Mfn1 in various tissues in minipigs after 1.75 Gy.
- Evaluate TFAM, DRP1, OPA1 and Mfn1 in various tissues in mice after 9.5 Gy.

By FY 2021
- Evaluate miRNA-696 in serum and various tissues in minipigs after 1.75 Gy.
- Evaluate miRNA-696 in serum and various tissues in mice after 9.5 Gy.

By FY 2022
- Predict miRNA targeted signaling pathways using IPA in minipigs after 1.75 Gy.
- Predict miRNA targeted signaling pathways using IPA in mice after 9.5 Gy.
- Compare two species for their similarities and differences.