

U. S. DEPARTMENT OF ENERGY, OFFICE OF SCIENCE
INTEGRATED SUPPORT CENTER—CHICAGO OFFICE

NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)
ENVIRONMENTAL EVALUATION NOTIFICATION FORM

To be completed by "Applicant," i.e., organization receiving funds and/or implementing Federal Actions as defined by 40 CFR § 1508.18. For assistance, refer to "Instructions for Preparing ISC-CH F-560, Environmental Evaluation Notification Form."

Solicitation/Award No. (if applicable): DE-SC0018033

Organization Name: Tennessee Technological University

Title of Proposed Action: Modular Approaches to "Click" Complexants for Chemoselective Minor Actinide Separations

Total DOE Funding/Total Funding: \$440,804.00

I. Project Description: *(Use explanation pages if additional space is required)*

A. Proposed Project/Action (if applicable, delineate Federally funded/Non-Federally funded portions)

Please see attached.

B. Would the project proceed without Federal funding?

Yes No

If "yes," use explanation page.

II. Description of Affected Environment: *(Use explanation pages if additional space is required)*

Necessary space to conduct the proposed research is available in the TTU Chemistry Department, Foster Hall, where the PI has 280 ft² of dedicated research space (FH 301) including access to (1 × 6) linear feet fume hood for performing reactions as well as two (2 × 3) linear feet hoods for concentration and purification of intermediates. Additional hood space [(2 × 6) and (1 × 8) linear feet] (FH 101 and 301, respectively) is frequently utilized in other Foster Hall laboratories on a routine basis, as necessary. Necessary inert gas, water, vacuum, storage, and benchtop space amenable to high productivity is also available. Presently, over 2100 ft² of laboratory space is devoted to radiochemical research. The area is divided into two counting and instrumentation rooms and two wet laboratories: one wet laboratory space is utilized for work with nonradioactive materials, and the other space is employed for radiotracer work. TTU maintains a TN Radioactive Material License (#R-71004-G09) allowing the use of β / γ- and some alpha emitters

III. Preliminary Questions:

- | | Yes | No |
|---|--------------------------|-------------------------------------|
| A. <u>Is the DOE-funded work routinely administrative or <i>entirely</i> advisory or a "paper study?"</u> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

If "Yes", ensure that the description in Section I reflects this and go directly to Section V.

- | | | |
|--|-------------------------------------|-------------------------------------|
| B. <u>Is there any potential whatsoever for: (<i>Provide an explanation for each "Yes" response</i>)</u> | | |
| 1. Work to be performed outdoors? | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 2. Major modification of a building interior? | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 3. Threat of violation of applicable statutory, regulatory, or permit requirements for environment, safety, and health? | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 4. Siting, construction or major expansion of waste treatment, storage, or disposal facilities? | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 5. Disturbance to hazardous substances, pollutants, or contaminants preexisting in the environment? | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 6. The presence of any environmentally-sensitive resources? | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 7. Potential for high consequence impacts to human health or the environment? | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 8. The work being connected to another existing/proposed activity that could potentially create a significant impact? | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 9. Nearby past, present, and/or reasonably foreseeable future actions such that collectively significant impacts could result? | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 10. Scientific or public controversy, uncertainty over potential impacts, or conflicts regarding resource usage? | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

If "No" to ALL Section III.B. questions, go directly to Section V.

IV. Potential Environmental Effects: (*Provide an explanation for each "Yes" response*)

- A. Sensitive Resources: Could the proposed action potentially result in changes and/or disturbances to any of the following resources?

- | | Yes | No |
|--|--------------------------|-------------------------------------|
| 1. Threatened/Endangered Species and/or Critical Habitats | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 2. Other Protected Species (e.g., Burros, Migratory Birds) | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 3. Sensitive Environments (e.g., Tundra/Coral Reefs/Rain Forests) | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 4. Cultural or Historic Resources | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 5. Important Farmland | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 6. Non-Attainment Areas for Ambient Air Quality Standards | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 7. Class I Air Quality Control Region | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 8. Special Sources of Groundwater (e.g. Sole Source Aquifer) | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 9. Navigable Air Space | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 10. Coastal Zones | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 11. Areas with Special National Designation (e.g. National Forests, Parks, Trails) | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 12. Floodplains and/or Wetlands | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

- B. Regulated Substances/Activities: Would the proposed action involve any of the following regulated items or activities?

- | | | |
|--|--------------------------|-------------------------------------|
| 13. Natural Resource Damage Assessments | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 14. Invasive Species or Exotic Organisms | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 15. Noxious Weeds | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 16. Clearing or Excavation (indicate if greater than one acre) | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 17. Dredge or Fill (under Clean Water Act, Section 404, greater than one acre) | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

B. Regulated Substances/Activities: Would the proposed action involve any of the following regulated Items or activities? (continued)

	Yes	No
18. Noise (in excess of regulations)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
19. Asbestos Removal	<input type="checkbox"/>	<input checked="" type="checkbox"/>
20. Polychlorinated biphenyls (PCBs)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
21. Import, Manufacture, or Processing of Toxic Substances	<input checked="" type="checkbox"/>	<input type="checkbox"/>
22. Chemical Storage/Use	<input checked="" type="checkbox"/>	<input type="checkbox"/>
23. Pesticide Use	<input type="checkbox"/>	<input checked="" type="checkbox"/>
24. Hazardous, Toxic, or Criteria Pollutant Air Emissions	<input type="checkbox"/>	<input checked="" type="checkbox"/>
25. Liquid Effluents	<input type="checkbox"/>	<input checked="" type="checkbox"/>
26. Spill Prevention/Surface Water Protection	<input type="checkbox"/>	<input checked="" type="checkbox"/>
27. Underground Injection	<input type="checkbox"/>	<input checked="" type="checkbox"/>
28. Hazardous Waste	<input checked="" type="checkbox"/>	<input type="checkbox"/>
29. Underground Storage Tanks	<input type="checkbox"/>	<input checked="" type="checkbox"/>
30. Radioactive or Radioactive Mixed Waste	<input checked="" type="checkbox"/>	<input type="checkbox"/>
31. Radiation Exposure	<input checked="" type="checkbox"/>	<input type="checkbox"/>
32. Nanoscale Materials	<input type="checkbox"/>	<input checked="" type="checkbox"/>
33. Genetically Engineered Microorganisms/Plants or Synthetic Biology?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
34. Ozone Depleting Substances	<input type="checkbox"/>	<input checked="" type="checkbox"/>
35. Greenhouse Gas Generation/Sustainability	<input type="checkbox"/>	<input checked="" type="checkbox"/>
36. Off-Road Vehicles	<input type="checkbox"/>	<input checked="" type="checkbox"/>
37. Biosafety Level 3-4 Laboratory	<input type="checkbox"/>	<input checked="" type="checkbox"/>
38. Research on Human Subjects or other Vertebrate Animals	<input type="checkbox"/>	<input checked="" type="checkbox"/>
39. Facility footprint exceeds 5,000 Square Feet	<input type="checkbox"/>	<input checked="" type="checkbox"/>

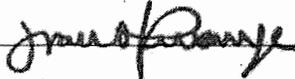
C. Other Relevant Information: Would the proposed action involve the following?

	Yes	No
40. Disproportionate Nearby Presence of Minority and/or Low Income Populations	<input type="checkbox"/>	<input checked="" type="checkbox"/>
41. Existing, Modified, or New Federal/State Permits	<input checked="" type="checkbox"/>	<input type="checkbox"/>
42. Involvement of Another Federal Agency (e.g. license/permit, funding, approval)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
43. Action in a State with NEPA-type law	<input type="checkbox"/>	<input checked="" type="checkbox"/>
44. Expansion of Public Utilities/Services	<input type="checkbox"/>	<input checked="" type="checkbox"/>
45. Depletion of a Non-Renewable Resources	<input type="checkbox"/>	<input checked="" type="checkbox"/>
46. Subject to an Existing Institutional Work Planning and Control Process	<input type="checkbox"/>	<input checked="" type="checkbox"/>
47. Other Pertinent Information Which Could Impact Human Health or the Environment	<input type="checkbox"/>	<input checked="" type="checkbox"/>

V. Applicant Certification that to the best of their knowledge all information provided on this form is accurate:

Does this disclosure contain classified, confidential, or other exempt information that DOE would not be obligated to disclose pursuant to the Freedom of Information Act? Yes No

A. Organization Official (Name and Title): Dr. Francis Otuonve, Associate VP for Research

Signature:  Date: 9/5/17

e-mail: research@ntech.edu Phone: 931-372-3374

B. Optional Secondary Approval (Name and Title): _____

Signature: _____ Date: _____

e-mail: _____ Phone: _____

Remainder to be completed by DOE

VI. DOE Concurrence/Recommendation/Determination:

A. DOE Project Director/Program Manager or Contract/Grant Management Specialist:

Has the Applicant completed the Form correctly?
Does an existing Generic Categorical Exclusion apply?
If yes, indicate: _____

Yes No

Name and Title: Michael Hill, Contracting Officer

Signature: Michael Hill Date: 9/7/17

B. DOE NEPA Team Review:

Is the class of action identified in the DOE NEPA Regulations (Appendices A-D to Subpart D (10 CFR § 1021))?
If yes, specify the class(es) of action: B3.6

Yes No

Name and Title: _____

Signature: _____ Date: _____

C. DOE Counsel (if requested):

Name and Title: _____

Signature: _____ Date: _____

D. DOE NEPA Compliance Officer:

The preceding pages are a record of documentation required under DOE Final NEPA Regulation, 10 CFR § 1021.400.

- Action may be categorically excluded from further NEPA review. I have determined that the proposed action meets the requirements for Categorical Exclusion referenced above.
- Action requires approval by Head of the Field Organization. Recommend preparation of an Environmental Assessment.
- Action requires approval by Head of the Field Organization or a Secretarial Officer. Recommend preparation of an Environmental Impact Statement.

Comments/limitations if any:

NEPA Compliance Officer:

Name: Peter R. Siebach

Signature: Peter R. Siebach Date: 9/13/2017

I.

A.

A primary focus of the three-year U.S. Department of Energy (DOE), Basic Energy Sciences, Separations and Analysis submission entitled: *Modular Approaches to "Click" Complexants for Chemoselective Minor Actinide Separations* proposed by principal investigator Prof. Jessie D. Carrick of Tennessee Technological University, Cookeville, TN and co-principal investigators Prof. Cory A. Hawkins, also of TTU, and Prof. David A. Dixon of The University of Alabama is the synthetic construction of novel molecular entities for chemoselective minor actinide separations. The development of separations processes for the remediation of spent nuclear fuel (SNF) from weapons production and legacy waste is of significance to the country. The ultimate goal of the team's work is to computationally design, efficiently synthesize, and experimentally validate a complexant molecule in a strategic manner to: (1) enable selective complexation on a kinetically viable time scale, (2) achieve organic layer solubility of the complexed ion in relevant diluents while avoiding the use of phase modifiers, and (3) prevent third-phase formation, and (4) maintain robust radiolytic stability while facilitating effective chemoselective minor-actinide separations in support of DOE's strategic objectives.

The previously described goals will be accomplished by: (1) developing a fundamental understanding of Am^{3+} coordination to bis-1,2,3-triazolylpyridines for minor-actinide separations leveraging convergent synthetic methods, (2) forming an understanding of the complexant mode of action by using appropriate characterization techniques, (3) measuring the rate of complexation of modular heterocycles with relevant ions in minor-actinide separations, (4) developing descriptors from computational electronic structure approaches to understand complexant/ion interactions to guide the preparation of more efficacious materials, and (5) developing structure-activity relationships of modular heterocycles in minor-actinide separations. The broader scientific educational impacts of this work include the training and mentoring of one postdoctoral fellow, one graduate student, and at least nine undergraduate students in the synthesis, characterization, separation science, and theoretical computation of novel end products. These efforts will help to train the next generation of scientists for work in organic synthesis or computational chemistry with a focus on developing expertise in chemical separations. The interdisciplinary nature of the proposed work enables efficient collaboration towards the previously stated objectives.

Accomplishing the above goals will enable the design of new complexants built on the best available science. The design process will be coupled with the application and development of novel synthetic organic chemistry approaches and strategic characterization of materials including separations capabilities for both thermodynamics and kinetics. This will enable the design of materials for multi-phase systems. Judicious placement of key molecular functionalities by using novel synthetic approaches based on fundamental design principles can lead to molecules that have better separation efficacy, improved rates for separations, enhanced control of multi-phase behavior, and improved radiolytic stability.

IV.

B.

21.

The proposed work will involve the synthesis, production, and manipulation of novel molecules for which the full physical property and biological effects to humans are unknown. All staff are required to complete annual safety training as well as site specific

safety training on a yearly basis in compliance with existing statutes. The TTU Chemical Hygiene plan (attached) governs specific actions pursuant to the use of toxic substances and will be adhered to by all staff members. All staff are mandated to comply with the existing guidelines in addition to wearing proper personal protective equipment necessary for a specific task.

IV.

B.

22.

TTU maintains chemical inventories for each campus laboratory which are updated on an annual basis and describe all chemicals stored in an investigator's assigned laboratory space. Proper procedure pursuant to the TTU Chemical Hygiene plan and existing statutes are followed for the storage and use of chemicals required for the proposed work including, but not limited to: storage of chemicals predicated on reactivity, compatibility, or incompatibility, maintenance of streamlined, minimal chemical quantities to support the proposed work, as well as storage of bulk solvents in the appropriate flame-resistant flammable cabinets.

IV.

B.

28.

Hazardous waste will be generated in small quantities as a result of the proposed work. The TTU Hazardous Waste and Satellite Accumulation Guide and existing statutes inform the necessary policy and procedures required for the safe handling and storage of hazardous waste. TTU contracts with an external, permitted provider to remove accumulated hazardous waste from the university on a biannual basis. All hazardous waste generated is documented and stored in an appropriate container with secondary containment in the faculty member's assigned satellite waste accumulation space. The TTU Chemistry Department maintains a hazardous waste accumulation area for the department pursuant to the aforementioned guidelines. Each faculty member on campus who generates hazardous waste is subject to an annual inspection of their assigned laboratory spaces by the TTU Environmental Health and Safety Coordinator, Sarah Difurio, M.S. The PI's assigned spaces have been inspected and approved for occupation for the 2017-18 academic year.

IV.

B.

30.

The TTU Chemistry Department maintains a Tennessee Radioactive Material License (#R-71004-G24-39), which allows the use of a wide variety of β / γ -emitting isotopes, as well as smaller quantities of certain alpha emitters for research. It also permits, under Rules of Tennessee Department of Environmental and Health Radiological Division (Chapter 0400-20-05, Standards for Protection Against Radiation), the disposal of radioactive waste generated by the licensee in several means and under specific conditions, including by release in sanitary sewage (0400-20-05-.122), treatment of disposal by incineration (0400-20-05-.123), or transfer for disposal (0400-20-05-.125).

This laboratory chooses, at this time, to collect and dispose of radioactive and radioactive mixed wastes solely for transfer to a state-bonded waste collector (consignee) pursuant to the rules regulations described by section 0400-20-05-.125. All collection procedures are carried-out by and manifests are maintained by the licensee, to be transferred to the consignee upon change of custody.

IV.

B.

31.

The licensee maintains a source-specific radiation safety-training module for personnel that plan to work in the radiological laboratory. Documentation of this training is recorded and preserved in the records of this laboratory. A current account with the NIST certified Sierra Radiation Dosimetry Services (Austin, TX) provides quarterly service of dosimetry badges worn at all times by personnel working in this lab. Occupational radiation safety exposure reports are received from the vendor, recorded for personnel right-to-know and filed with lab records. The licensee also maintains protocols and procedures for ensuring areas and surfaces outside of designated contamination areas are not contaminated by radioactive materials. Records of swipe tests for these purposes are maintained along with other records for assurance of radiological safety and compliance with NRC and Tennessee state rules regarding these facilities and under the current Tennessee Radioactive Material License (#R-71004-G24-39, expiry: 31 July 2024).

IV.

B.

41.

Relevant information to address this section with respect to licenses, etc. may be found in IV., B., 30 and 31 above.