

# DOE Office of Science (SC) Fusion Energy Sciences (FES) Fusion Nuclear Science and Technology Program Status and plans for tritium research

Presented by:

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35<sup>th</sup> Tritium Focus Group (TFG) meeting

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## Research Interest

The research interest in tritium science in the Office of Fusion Energy Sciences (FES) is in its use as the primary fuel for a self-heated burning plasma; to understand and manage the associated safety and processing issues; and to develop efficient breeder materials, models of tritium's affect on material properties, permeation windows, and permeation barriers, exhaust purification systems, tritium isotope separation systems, detritiation systems, tritium accountancy tools and models to support safety assessments.



## **Background: SBIR solicitation language**

### **Current research activities:**

- Status and progress of the SBIR solicitation and funded R&D:
- Nano-engineered solid tritium breeder fuel by a small business in California. \$150K (FY12)+ \$1M (FY13-FY14).
- Numerical simulation of fluid flow under Magneto-Hydro-Dynamic (MHD) influence.
- International Collaborations.

### **Challenges/Issues:**

- Should a FES-funded University performing tritium research be added to the TFG?
- Fundamental Research Exclusion for publication of university research.
- Applying export control and SNM controls for fusion energy tritium R&D.
- Do current export control and SNM guidelines adequately define boundaries?

### **Potential future research & collaborations**

- Seeking collaboration from TFG on areas of common interest in tritium research.

### **Backup Slides: tritium questions to be answered**

- Panel discussion of questions.

**SBIR topics are in plasma-facing components, blanket materials and systems, superconducting magnets and materials, structural materials and coatings, other.**

The blanket material systems topic seeks to address the challenges in harnessing fusion power, and developing the fusion fuel cycle technology through an advanced breeding blanket, which is designed to breed, extract, and process the nuclear fuel and heat energy necessary for a self-sufficient, electricity-generating reactor. The blanket is a complex, multi-function, multi-material engineered system (structure, breeder, multiplier, coolant, insulator, tritium processing), with many scientific and technological issues in need of resolution. Proposals are requested that address the following issues that include but are not limited to:

- Innovative solid fusion breeder fuel materials development and simulation tools
- Innovative liquid fusion breeder and/or coolant materials development and simulation tools
- Advanced materials and tools for simulation and analysis of breeder blanket material and component behavior in the fusion nuclear environment including thermofluid, MHD, and thermomechanical simulation of coolant flows and structural responses
- Innovative materials and tools for simulation and analysis of materials and systems for tritium processes including creation, extraction, separation, purification, management and containment
- Diagnostic sensors for blanket systems that are compatible with the fusion environment
- Neutronic simulation and analysis tools that go beyond the current state of the art.

## SBIR blanket materials and systems solicitation, (continued)

More detail on the topics of interest follow: **Solid breeder** material concepts that advance as many as possible of the following criteria:

- (1) high breeder material densities (up to~80%);
- (2) high thermal conductivities (as opposed to point contacts between pebbles);
- (3) better thermal contact, such as reliable joined contact, with cooling structures (instead of point contacts between pebbles and wall);
- (4) the absence of major geometry changes between beginning-of-life and end-of life (such as sintering in pebble beds) in the presence of high neutron fluence;
- (5) structural integrity in freestanding and self-supporting structures with significant thermo-mechanical flexibility;
- (6) high breeding ratios that benefit from increased breeder and multiplier material densities (typically lithium and beryllium) and preferably leverage existing R&D in nano and micro engineered materials, such as those developed for advanced lithium ion batteries; and tools for simulation and analysis of materials and systems for solid breeders that leverage advanced computational techniques.

## SBIR blanket materials and systems solicitation, (continued)

More detail on the topics of interest follow: **New liquid breeder** material concepts that advance as many as possible of the following criteria:

- (1) new liquid breeder materials that have a high breeding capacity;
  - (2) that are not influenced by the magnetohydrodynamic (MHD) effect;
  - (3) can operate at high temperatures (400-700 deg C);
  - (4) are not 87 corrosive to the materials used in planned fusion systems (RAFM steels, ODS steels, NFAs, SiC);
  - (5) are conducive to tritium extraction, and tools for simulation and analysis of materials and systems for liquid breeders that leverage advanced computational techniques
- **Innovative materials and tools** for solving specific challenges, such advanced simulation and analysis tools for thermofluid, MHD, and thermomechanical coolant flows and material responses.
  - Also insulating the flowing liquid metal breeder/coolant against MHD and thermal effects with **Flow Channel Inserts (FCI)**. These materials have a low electrical conductivity (1 to 50  $\Omega$ -1m-1). FCI structural loading is low, but they must be able to withstand radiation damage and thermal stresses from through-surface temperature differences in the range of 150-300K, over a thickness of 3 to 15 mm depending on designs.

## **SBIR blanket materials and systems solicitation, (continued)**

- Materials, simulations and tools needed for managing tritium used in the fusion fuel cycle in a safer and more efficient manner are needed. Early experiments can be performed using hydrogen as a surrogate, but more advanced technology development will likely need to be partnered with a national laboratory with the ability to handle tritium.
- Current solid breeders operate with a He purge gas at approximately 8 MPa, and liquid metal breeders at a partial pressure of approximately 0.3 Pa.
- Tritium extraction technologies including permeator materials and extraction methods need to distinguish between the different species for more efficient trapping and desorption from the He purge gas that operate at better than 40% efficiency on the first pass.
- An advanced purification system to remove impurities at better than 90% efficiency on the first pass is needed along with tritium barrier and management materials. An integrated multi-physics simulation tool to model tritium chemistry, tritium transport through materials, permeation rates, tritium concentration and flux in materials and systems, at different irradiation levels which goes beyond the current state of the art available domestically and internationally
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## **SBIR blanket materials and systems solicitation, (continued)**

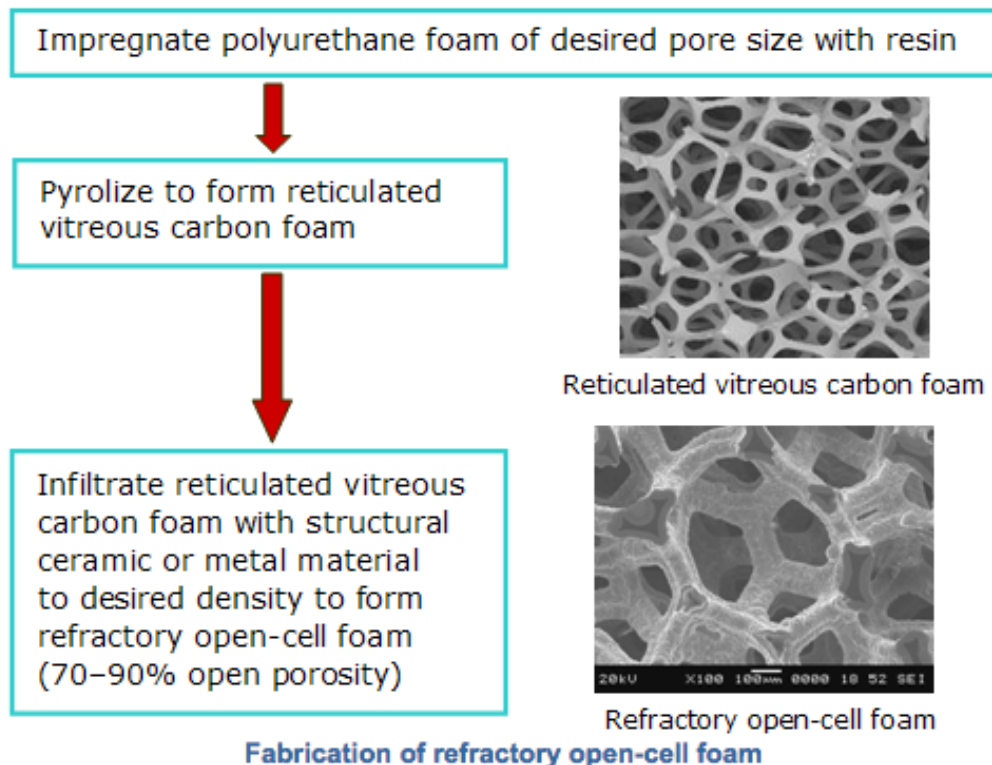
- Diagnostics for the blanket system are needed, including liquid metal flow sensors that are able to accurately measure the velocity profile across the whole cross-section, and tritium concentration sensors.
- Neutronic and safety simulation and analysis tools for determining radiation-induced material damage, tritium breeding efficiency, and worker radiation exposure conditions under a fusion environment with a peak 14 MeV neutron source are needed. The fusion neutronic environment is different, and harsher than the fission environment.
- Simulation and analysis tools that advance the state of the art to enable effective prediction of the fusion Tritium Breeding Ratio (TBR), material damage effects, such as swelling and creep, and prediction of the effectiveness of fusion radiation shields and barriers designed to limit worker and remote handling equipment exposure to the radiation environment, are critical to the safe adoption of fusion power.
- Ideally these tools are plug-ins, or compatible modules within existing commercial design software codes for structural, thermal, fatigue, or fluid flow, or safety analyses, such as Ansys®, Fluent®, Nastran®, LS-DYNA®, to enhance the integration, validation, and adoption of the tools.



## SBIR blanket materials and systems, progress

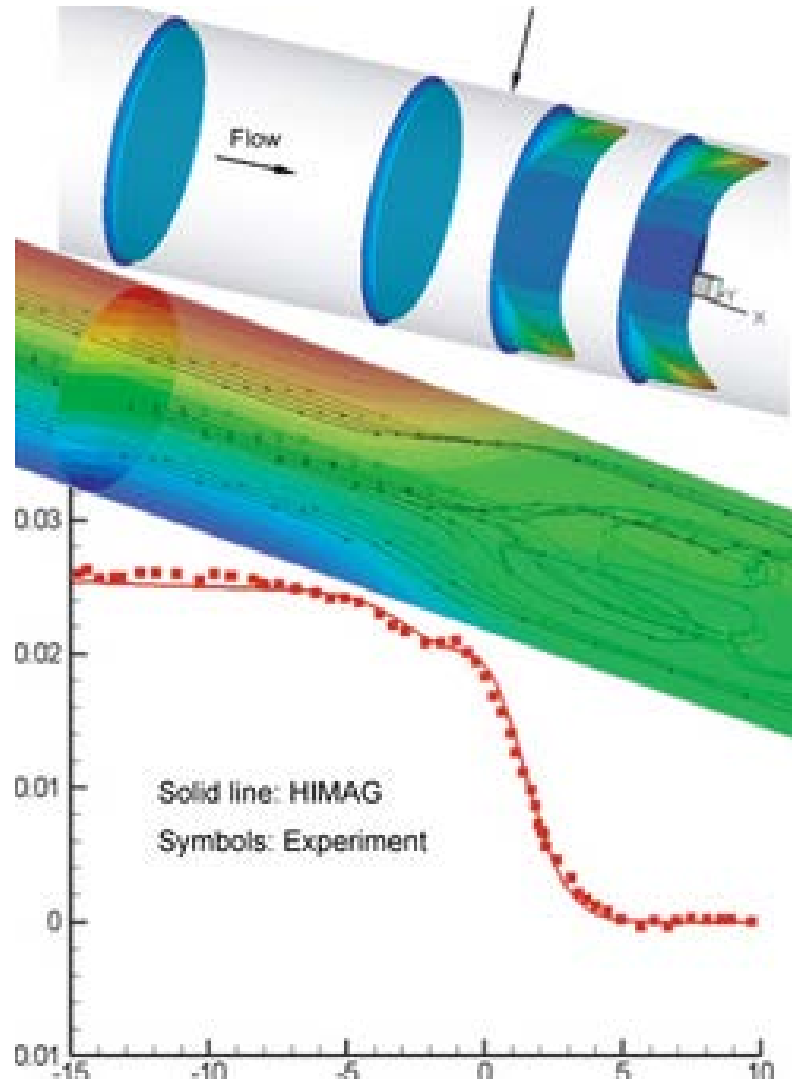
### Fabrication of Refractory Open-Cell Foam

Ultramet pyrolyzes a polymer foam to create a reticulated vitreous carbon foam that has unique physical, thermal, and electric properties. Refractory metals and ceramics can then be infiltrated into the foam to tailor the material properties for specific applications.





## SBIR blanket materials and systems, progress



## International collaboration with South Korea

### Expected Outcome from UCLA-NFRI Collaboration

#### On Track to Complete the Expected Outcome- NFRI to Comment

- Material Database of functional materials of KO TBM
- Pebble bed thermomechanics modeling
- Tritium behavior modeling of functional materials
- Tritium inventory modeling of KO TBS TES
- D/T Permeation for KO structural material
- D/T related properties for KO functional materials
- MELCOR Code Usage w/ input files
- MELCOR calculation documentation
- GAMMA-FR V/V with MELCOR

#### Still to be defined

- [Task 3] Joint Assessment of TBS Instrumentation Development for TBM
- Neutron measurement instrumentation
  - Tritium measurement instrumentation

## International collaboration with South Korea (continued)

### UCLA Planned Year 2 Activities

#### Main focus of this period highlighted Green

Task2.1 Tritium behavior modeling of functional materials including breeder, reflector, multiplier

- Tritium inventory in breeder, Be, reflector as a function of time
  - Residence time approach (as a part of output from Task 2.2)
- **A physics modeling (MISTRAL's approach) for breeder tritium release estimations**
  - **received Franco's MISTRAL code last February**
    - **Identify/acquire important parameters needed for tritium release estimation (partially done and summarized in the mid-term progress report. Will revisit using MISTRAL code. A major problem is the uncertainty associated with the material property.)**

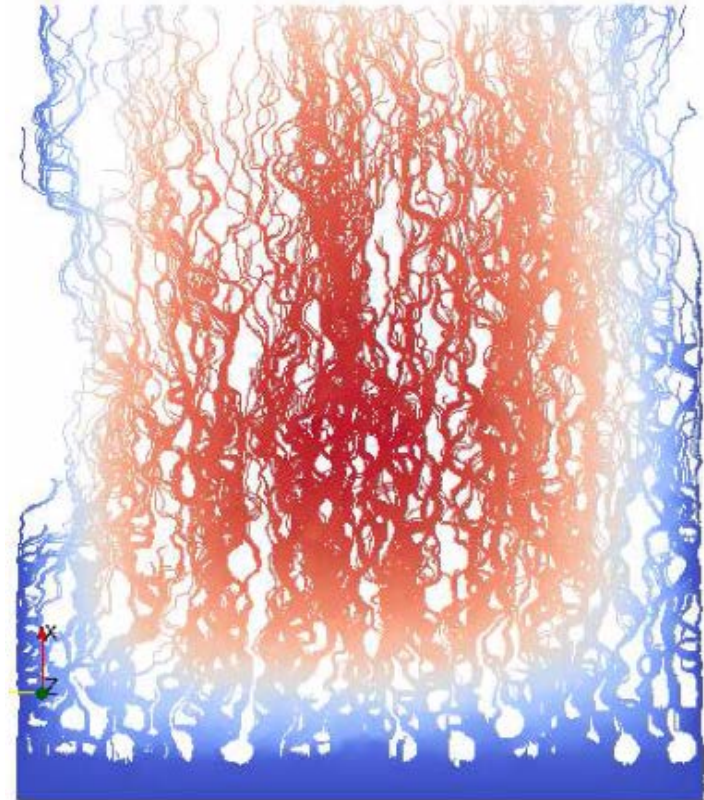
Task2.2 Tritium inventory trajectory modeling of KO TBS TES

- Sub-module and four submodules model integration to estimate time dependent (ITER inductive operational scenarios with Q=10 and 400 sec pulse)
  - tritium inventory for FS structure, breeder, Be, graphite, and shield
  - tritium concentration in He coolant
  - tritium concentration in He purge
  - **tritium leakages through piping in port cell area**
- **Numerical model development for diffuser (compare with experimental data), getter**
- **Design analysis of CMS, RTMS and include H<sub>2</sub>O in the TBM purge gas analysis (Isotope compositions now include HTO, HT, H<sub>2</sub>O, and H<sub>2</sub>)**

Task2.3 Deuterium and tritium experiments

- **Pre-analysis of tritium permeation experiments for the KO structural material ARAA using deuterium based on February design)**
- Experiments at INL

## International collaboration with South Korea (continued)



## Federal agencies with export control responsibilities

### United States Government Departments and Agencies with Export Control Responsibilities

U.S. Department of Commerce's Bureau of Industry and Security (BIS) administers and enforces export controls on dual-use and certain munitions items for the Department of Commerce through the Export Administration Regulations (EAR) under the authority of the International Emergency Economic Powers Act (IEEPA). via Federal Register publications.

Title	Date Last Modified
Category 0 - Nuclear Materials Facilities & Equipment [and Miscellaneous Items]	2014-12-30

**Department of State, Directorate of Defense Trade Controls (DTC):**

Department of State, which controls the export of defense (munitions) articles and defense services subject to the International Traffic in Arms Regulations (ITAR)

**Department of the Treasury, Office of Foreign Assets Control (OFAC):**

OFAC administers and enforces economic and trade sanctions against targeted foreign countries, terrorism sponsoring organizations, and international narcotics traffickers. The OFAC Web site provides information on these sanctions as well as the complete list of Specially Designated Nationals and Blocked Persons (the "SDN list").

## Federal agencies with export control responsibilities (continued)

**Nuclear Regulatory Commission, Office of International Programs:**

Licenses nuclear material and equipment.

**Department of Energy, Office of Arms Controls and Nonproliferation, Export Control Division,** which controls exports and re-exports and licenses nuclear technology and technical data for the production of nuclear power and special nuclear materials.

**Defense Technology Security Administration:**

The Defense Technology Security Administration (DTSA) administers the development and implementation of Department of Defense (DoD) technology security policies on international transfers of defense-related goods, services and technologies.

### **International/Government Export Control Web sites**

**Wassenaar Arrangement:**

Provides links and information on the export controls of the various participating countries.



## Commerce control list – Tritium

### ELECTRONIC CODE OF FEDERAL REGULATIONS

**e-CFR data is current as of April 30, 2015**

Title 15 → Subtitle B → Chapter VII → Subchapter C → Part 774 → Appendix

Title 15: Commerce and Foreign Trade  
PART 774—THE COMMERCE CONTROL LIST

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SUPPLEMENT NO. 1 TO PART 774—THE COMMERCE CONTROL LIST

CATEGORY 0—NUCLEAR MATERIALS, FACILITIES, AND EQUIPMENT [AND MISCELLANEOUS ITEMS]

A. “END ITEMS,” “EQUIPMENT,” “ACCESSORIES,” “ATTACHMENTS,” “PARTS,” “COMPONENTS,” AND “SYSTEMS”

**0A002 Power generating or propulsion equipment “specially designed” for use with space, marine or mobile “nuclear reactors”.**  
(These items are “subject to the ITAR.” See 22 CFR parts 120 through 130.)



## Commerce control list - Tritium (continued)

**1A225** Platinized catalysts “specially designed” or prepared for promoting the hydrogen isotope exchange reaction between hydrogen and water for the recovery of **tritium** from heavy water or for the production of heavy water.

### LICENSE REQUIREMENTS

*Reason for Control:* NP, AT

Control(s)	Country Chart (See Supp. No. 1 to part 738)
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

### LIST BASED LICENSE EXCEPTIONS (SEE PART 740 FOR A DESCRIPTION OF ALL LICENSE EXCEPTIONS)

LVS: N/A

GBS: N/A

CIV: N/A

### LIST OF ITEMS CONTROLLED

*Related Controls:* (1) See ECCNs 1E201 (“use”) and 1E202 (“development” and “production”) for technology for items controlled by this entry. (2) Equipment “specially designed” or prepared for the production of heavy water is subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110).

*Related Definitions:* N/A

*Items:* The list of items controlled is contained in the ECCN heading.

## Commerce control list - Tritium (continued)

**1B231** **Tritium** facilities or plants, and equipment therefor, as follows (see List of Items Controlled).

LICENSE REQUIREMENTS

*Reason for Control:* NP, AT

tritium
Previous

Control(s)	Country Chart (See Supp. No. 1 to part 738)
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

LIST BASED LICENSE EXCEPTIONS (SEE PART 740 FOR A DESCRIPTION OF ALL LICENSE EXCEPTIONS)

*LVS:* N/A

*GBS:* N/A

*CIV:* N/A

LIST OF ITEMS CONTROLLED

*Related Controls:* (1) **Tritium**, **tritium** compounds, and mixtures containing **tritium** are subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110). (2) See ECCNs 1E001 (“development” and “production”) and 1E201 (“use”) for technology for items controlled by this entry.

*Related Definitions:* N/A

*Items:* a. Facilities or plant for the production, recovery, extraction, concentration, or handling of **tritium**;

b. Equipment for **tritium** facilities or plant, as follows:

b.1. Hydrogen or helium refrigeration units capable of cooling to 23 K (–250 C) or less, with heat removal capacity greater than 150 watts; or

b.2. Hydrogen isotope storage and purification systems using metal hydrides as the storage, or purification medium.

## Commerce control list - Tritium (continued)

**1C235** **Tritium, tritium** compounds, mixtures containing **tritium** in which the ratio of **tritium** to hydrogen atoms exceeds 1 part in 1,000, and products or devices containing any of the foregoing.

### LICENSE REQUIREMENTS

*Reason for Control:* NP, AT

Control(s)	Country Chart (See Supp. No. 1 to part 738)
NP applies to entire entry	NP Column 1.
AT applies to entire entry	AT Column 1.

### LIST BASED LICENSE EXCEPTIONS (SEE PART 740 FOR A DESCRIPTION OF ALL LICENSE EXCEPTIONS)

LVS: N/A

GBS: N/A

CIV: N/A

### LIST OF ITEMS CONTROLLED

*Related Controls:* (1) See ECCNs 1E001 (“development” and “production”) and 1E201 (“use”) for technology for items controlled by this entry. (2) Also see ECCN 1B231. (3) **Tritium** that is byproduct material (e.g., produced in a nuclear reactor) is subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110).

*Related Definitions:* N/A

*ECCN Controls:* (1) This entry does not control **tritium, tritium** compounds, and mixtures that are byproduct material (e.g., produced in a nuclear reactor)—such materials are subject to the licensing jurisdiction of the Nuclear Regulatory Commission (see Related Controls paragraph for this entry). (2) This entry does not control a product or device containing less than  $1.48 \times 10^3$  GBq (40 Ci) of **tritium**.

*Items:* The list of items controlled is contained in the ECCN heading.

## Commerce control list - Tritium (continued)

**3A231 Neutron generator systems, including tubes, having both of the characteristics described in this ECCN (see List of Items Controlled).**

LICENSE REQUIREMENTS

*Reason for Control:* NP, AT, foreign policy

Control(s)	Country chart (see Supp. No. 1 to part 738)
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1
Russian industry sector sanctions apply to entire entry	See §746.5 for specific license requirements and license review policy.

LIST BASED LICENSE EXCEPTIONS (SEE PART 740 FOR A DESCRIPTION OF ALL LICENSE EXCEPTIONS)

LVS: N/A

GBS: N/A

CIV: N/A

LIST OF ITEMS CONTROLLED

*Related Controls:* See ECCNs 3E001 (“development” and “production”) and 3E201 (“use”) for technology for items controlled under this entry.

*Related Definitions:* N/A

*Items:* a. Designed for operation without an external vacuum system; and

b. Utilizing electrostatic acceleration to induce:

b.1. A **tritium**-deuterium nuclear reaction; or

b.2. A deuterium-deuterium nuclear reaction and capable of an output of  $3 \times 10^9$  neutrons/s or greater.

## University Fundamental Research Exclusion

FISCHER & ASSOCIATES

### 3. How Do Controls Impact PIs, Researchers, and Operational Personnel?

#### Key Point

- All outbound exports must be classified for license determination.
- As to laboratory access: the situation depends on whether UC is conducting fundamental research and, if so, whether this research either:
  - Uses any research tools classified under ITAR or proprietary tools, or
  - Data restricted under an NDA and export controlled under either the EAR or ITAR.

#### Fundamental Research Exclusion (FRE) – EAR/Public Domain – ITAR

- Basic and applied research in science and engineering conducted at a U.S. research institution, the results of which ordinarily are published and shared broadly within the scientific community.
  - "Applied" here is defined as activity short of proprietary commercialization.

#### Public Domain Definition (ITAR)

- Generally accessible to the public through:
  - Publication in periodicals, books, print, electronic, or other media available for general distribution (including websites that provide free uncontrolled access) or to a community of persons interested in the subject matter, such as those in a scientific or engineering discipline, either free or at a price that does not exceed the cost of reproduction and distribution;
  - Readily available at libraries open to the public or at university libraries;
  - Patents and published patent applications available at any patent office;
  - Release at an open conference, meeting, seminar, trade show, or other open gathering held in the U.S. (under ITAR) or anywhere (under EAR). Note, a conference or gathering is "open" if all technically qualified members of the public are eligible to attend and attendees are permitted to take notes or otherwise make a personal record of the proceedings and presentations.
  - ITAR: general descriptions/marketing material relating to function/purpose of defense article.

## University research restrictions

FISCHER & ASSOCIATES

### > 3. HOW DO CONTROLS IMPACT PIS, RESEARCHERS, AND OPERATIONAL PERSONNEL?

#### Benefit to Using These Exemptions

- Even if results of the research might otherwise be export controlled under the EAR and ITAR and, therefore, subject to deemed export restrictions as to who could participate in the research, the FRE/Public Domain exclusions allow access by foreign nationals to research results.
  - Positions the research on the same footing as self-invention or unrestricted, UC-funded research.

#### Caveat

- Absolutely no restrictions can be accepted from a corporate or government sponsor (prime of flow-down) that:
  - Directly or indirectly prohibits dissemination or publication of research results, or
  - Mandates foreign national restrictions as to who can access research (if there will be foreign national participation).

#### Certain Temporary Restrictions Do Not Compromise the FRE

- Limited pre-publication review by research sponsors is acceptable within a reasonable timeframe but only to:
- Prevent inadvertent divulgence of proprietary information or government classified information (as having been mutually defined) and provided by the sponsor, or
- Ensure that pre-defined proprietary content will not compromise the sponsor's patent rights.

#### UC's Position on Accepting Restricted Funding

- In compliance with UC's nondiscrimination policy, UC *only* conducts fundamental research without publication or citizenship restrictions.
- However, this must be distinguished from non-research activities, such as service activities, which may be proprietary and/or export controlled.



## University information and conference exclusion

FISCHER & ASSOCIATES

### > 3. HOW DO CONTROLS IMPACT PIS, RESEARCHERS, AND OPERATIONAL PERSONNEL?

#### What About Research Instruments Necessary to Conduct the Research?

- If the research instrument or operational data being used falls under the EAR dual use regulations, then the FRE allows unrestricted access by foreign nationals to such items for research purposes: no deemed export results, requiring prior license authority.
- However, if the research instrument or operational data falls under ITAR jurisdiction, the FRE or public domain exclusion does not apply to the ITAR research tool or operational data: access remains restricted to foreign nationals until such time as the university obtains license or authorization to allow access or disclose the data
  - Options: use or defense service license
  - Technology Control Plan (TCP) to restrict access
- Key thing to remember: The ITAR access restriction applies, notwithstanding the fact the no publication or citizenship restrictions were accepted as part of the Agreement, i.e. the research results are still eligible for publication.

#### Educational Information Exclusion - EAR and ITAR

- "Educational information" released by instruction in catalogue courses or professional conferences where all technically qualified members of the public are eligible to attend and attendees are permitted to take notes of proceedings.
- However, same ITAR principle applies to research tools and operational data where incorporated into course of study.

#### Conference Exclusion

- Research results may be presented at professional conferences abroad, addressing data published or to be published.
  - Does not cover a "defense service" - - disclosure of ITAR data otherwise restricted or knowingly training a foreign military entity or representative on EAR applications for a defense purpose.

#### Bona Fide Employee Exemption

- Under ITAR: where foreign national is a full time university employee, is not a foreign national of the 126.1 prohibited countries, and resides in the US (for example, an H1 visa holder), the employee may have access to ITAR restricted data (not otherwise restricted by funding Agreement) for background purposes.
  - However, employee is subject to same non-transfer, technology control restrictions that a US person would be.
- Use of this Exemption requires review by the Export Control Officer.



## University minimizing impact of export control restrictions

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### 4. How Does UCLA Remain Compliant and Operate within a “Business as Normal” Context?

#### Remain Knowledgeable of Export Requirements

- Make sure that all personnel affected by these regulations are sufficiently trained to identify export issues that arise during the course of normal research activities.

#### Avoid Unintended Restrictive Clauses in Sponsored Agreements (including post Agreement scope modifications)

- These may occur in contracts, grants or cooperative agreements:
  - Federal sponsor (primary or flow through via industry or other research institution);
  - Industrial sponsor (as initiated by industrial sponsor or flow through from federal sponsor);
  - Research institution (flow through from industry or federal agency).

#### Seek Help in Obtaining Licenses for Outbound Transfers and ITAR Access Prior to Export Activity

- Work with UC’s Export Control function to scope license requirements.
  - Shipment of Equipment Abroad – Since the FRE *only* applies to technology and technical data, a license may be necessary to export equipment depending on ITAR or EAR requirements.
  - *Carrying* or transmitting export controlled technical data or development software - for example, loading cryptography development software or proprietary export controlled information on a laptop or sending it abroad to a destination for which the data is controlled.
    - Distinguishable from exporting FRE data results (must be uncontrolled results only) which does not require a license.
  - See Section 5 about specific OFAC licensing requirements.
  - Access by foreign nationals to ITAR research tools or instruments used in outside of fundamental research scope.
  - Expanding allowable access (beyond US PI) under an NDA which covers export controlled data or instruments.
- UC’s staff support plays an important role in identifying potentially controlled activities : Procurement, HR, IT, Tech Transfer, etc.

## University compliance guidelines (continued)

### FISCHER & ASSOCIATES

#### > 4. HOW DOES UCLA REMAIN COMPLIANT AND OPERATE WITHIN A "BUSINESS AS NORMAL" CONTEXT?

##### **Managing Non-Disclosure Agreements (NDA):**

An NDA containing a confidentiality clause and/or an export control clause (should the data being provided be controlled) does not per se compromise FRE or public domain status, provided that:

- Purpose of the NDA is to safeguard proprietary background information and does not restrict research results.
- Where the purpose of the NDA is to safeguard data that is both proprietary *and* export controlled, PI and sponsor need to discuss amount of information and the extent to which the project can be performed with either no transfer of data to the PI, or transfer to only one or two PI's, but not the balance of the research team — i.e., consistent with the data being used strictly for background purposes.
- Note: As a practical matter it is better not to accept export controlled data where it can be avoided. Accepting ITAR data, even for background purposes, will require the PI or researcher to assume the responsibility of safeguarding the technology from inappropriate IT and physical access.

##### **What Can I Take with Me When I Travel?**

Use License Exception TMP (Tools of Trade).

- Applies to usual and reasonable kinds/quantities of tools (commodities/software) for use by exporter.
- Must remain under effective control exporter or exporter's employee (physical possession, locked in safe, guarded).
  - Would generally not apply to laboratory equipment that cannot be protected.
- Must accompany exporter when traveling or be shipped within one month before departure or any time after departure, and be returned no later than one year post export.
- Does not apply to:
  - OFAC terrorist supporting embargoed countries such as Cuba and Sudan (See OFAC rules below).
  - ITAR instruments.

##### **Fabrication and Service Contracts**

- Fabrication and Service activity for an industry partner or federal sponsor outside fundamental research does not qualify for the FRE.
- Hence access to certain laboratory instruments, tech data and results may be restricted from foreign nationals who might otherwise participate in fundamental research activities.
  - Particular attention should be paid to whether laboratory instruments and fabrication results are export controlled under EAR and/or ITAR.

## University compliance guidelines (continued)

FISCHER & ASSOCIATES

### > 4. HOW DOES UCLA REMAIN COMPLIANT AND OPERATE WITHIN A "BUSINESS AS NORMAL" CONTEXT?

#### **Special Considerations Applicable to Software and Encryption**

Make self-created software "publicly available" so as to be excluded from the EAR.

- Must have arisen during or resulted from fundamental research as defined by the EAR.
- Source code and machine readable code must be publicly available.
- Software and related technical data are published when available for general distribution/community subscription either for free or at a registration price that does not exceed the cost of reproduction and distribution.
- Contract terms for release of the developed software.
  - There should be no conditions placed on the research.
  - Should be the intent of the research team to publish its findings in scientific literature or elsewhere.
  - If the contract requires that a private corporation review the findings of the research team with the intent of controlling what results are to be released in open literature, then the research is considered proprietary. The research is not considered fundamental.

#### **Special Encryption Rules**

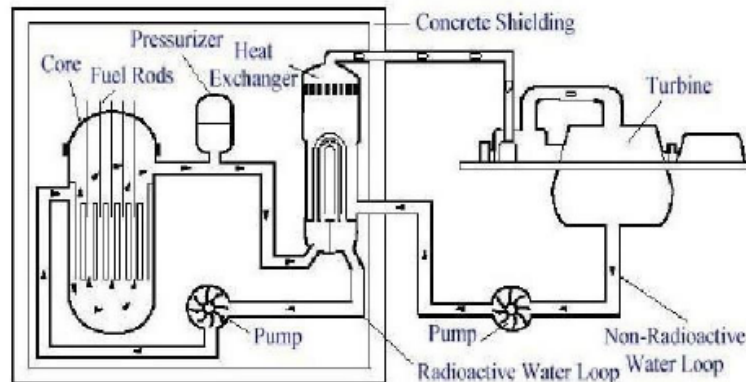
- Encryption software is consistently called out in the EAR to alert that stricter rules apply; government takes a conservative approach to cryptographic controls, including removing some items from the Fundamental Research Exclusion ("FRE").
  - Where the FRE does not apply, a "deemed export" situation arises with regard to T4 foreign nationals.
- Encryption software is controlled for its functional capacity – not for the informational content it supports.
- Category 5, Part 2 captures cryptography and where it has a higher level of control, supersedes other CCL categories that may have otherwise applied to underlying software.
- Items not covered by the FRE/Public Domain exclusions.
  - Software and related technology controlled under ECCN 5D002 for "EI" (Encryption Items) reasons.
  - Mass market encryption software with symmetric key length exceeding 64-bits, controlled under ECCN 5D002.

## NRC compliance guidelines for nuclear items

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### 5. Nuclear-related Export Control Regulations

What Are the Regulations Governing Nuclear Items, Software, and Technology (and related activities)?



Nuclear Steam Supply System (NSSS)

"Balance of Plant"

NSSS		"Balance of Plant"
Equipment NRC	Software, Technology, Services/Activities DOE (NNSA)	Equipment, Software, Technology, Etc. Department of Commerce-EAR

## NRC compliance guidelines for nuclear items (continued)

FISCHER & ASSOCIATES

### >5. NUCLEAR-RELATED EXPORT CONTROL REGULATIONS

#### Nuclear Regulatory Commission (NRC) 10 CFR Part 110

NRC purview includes Nuclear Steam Supply System *equipment*.

#### 110.8-Equipment and Facilities (Includes detailed appendices with lists of items)

- Nuclear reactors and especially designed or prepared equipment and components for nuclear reactors. (See Appendix A to this part.)
- Plants for the separation of isotopes of uranium (source material or special nuclear material) including gas centrifuge plants, gaseous diffusion plants, aerodynamic enrichment plants, chemical exchange or ion exchange enrichment plants, laser based enrichment plants, plasma separation enrichment plants, electromagnetic enrichment plants, and especially designed or prepared equipment, other than analytical instruments, for the separation of isotopes of uranium.
- Plants for the separation of the isotopes of lithium and especially designed or prepared assemblies and components for these plants.
- Plants for the reprocessing of irradiated nuclear reactor fuel elements and especially designed or prepared assemblies and components for these plants.
- Plants for the fabrication of nuclear reactor fuel elements and especially designed or prepared assemblies and components for these plants.
- Plants for the conversion of uranium and plutonium and especially designed or prepared assemblies and components for these plants.
- Plants for the production, separation, or purification of heavy water, deuterium, and deuterium compounds and especially designed or prepared assemblies and components for these plants.
- Plants for the production of special nuclear material using accelerator-driven subcritical assembly systems capable of continuous operation above 5 MWe thermal.

#### 110.9-Nuclear Materials

- Special Nuclear Material.
- Source Material.
- Byproduct Material.
- Deuterium.
- Nuclear grade graphite for nuclear end use.



## Commerce (EAR) compliance guidelines

FISCHER & ASSOCIATES

### Department of Commerce (EAR) 15 CFR 700-799

Department of Commerce purview includes:

- "Balance of plant" items and technology.
- Uranium depleted in the isotope-235 and incorporated in commodities solely to take advantage of high density or pyrophoric characteristics
- Bulk zirconium, rotor and bellows equipment, maraging steel, nuclear reactor related equipment, including process control systems and simulators.

Relevant Commerce Control List Entries:

#### Category 0-Nuclear Facilities, Materials & Equipment

Examples: ECCN 0D999.b-Software for radiation transport calculations/modeling. Subject to EAR.  
ECCN 0A002-Power generating or propulsion equipment "specially designed" for use with space, marine or mobile "nuclear reactors".  
**Subject to ITAR.**  
ECCN 0D001-Software specially designed or modified for the development, production, or use of commodities described in 0A002.  
**Subject to ITAR.**

Heading Note: Certain "software" for the "development," "production," or "use" of nuclear related commodities is subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110).

#### Category 1-Special Materials & Related Equipment, etc.

Examples: ECCN 1A227-High-density (lead glass or other) radiation shielding windows [...] and "specially designed" frames therefor. Subject to EAR.  
ECCN 1E201-Technology for the use of items controlled by 1A227 (and others). Subject to EAR.  
**Note: Equipment "specially designed" or prepared for nuclear reactors and reprocessing facilities is subject to the export licensing authority of the Nuclear Regulatory Commission.**  
ECCN 1A290- Depleted uranium (any uranium containing less than 0.711% of the isotope U-235) in shipments of more than 1,000 kilograms in the form of shielding contained in X-ray units, radiographic exposure or teletherapy devices, radioactive thermoelectric generators, or packaging for the transportation of radioactive materials.

#### Category 2-Materials Processing

Examples: ECCN 2A290- Generators and other equipment "specially designed", prepared, or intended for use with nuclear plants. Subject to EAR.  
ECCN 2A291- Equipment, except items controlled by 2A290, related to nuclear material handling and processing and to nuclear reactors, and "parts," "components" and "accessories" therefor. Subject to EAR.  
"2E" ECCNs controlling related technology.

## Commerce (EAR) compliance guidelines (continued)

### FISCHER & ASSOCIATES

#### Department of Commerce (EAR) 15 CFR 700-799

Department of Commerce purview includes:

- "Balance of plant" items and technology.
- Uranium depleted in the isotope-235 and incorporated in commodities solely to take advantage of high density or pyrophoric characteristics
- Bulk zirconium, rotor and bellows equipment, maraging steel, nuclear reactor related equipment, including process control systems and simulators.

Relevant Commerce Control List Entries:

#### Category 0-Nuclear Facilities, Materials & Equipment

Examples: ECCN 0D999.b-Software for radiation transport calculations/modeling. Subject to EAR.  
ECCN 0A002-Power generating or propulsion equipment "specially designed" for use with space, marine or mobile "nuclear reactors".  
**Subject to ITAR.**  
ECCN 0D001-Software specially designed or modified for the development, production, or use of commodities described in 0A002.  
**Subject to ITAR.**

Heading Note: Certain "software" for the "development," "production," or "use" of nuclear related commodities is subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110).

#### Category 1-Special Materials & Related Equipment, etc.

Examples: ECCN 1A227-High-density (lead glass or other) radiation shielding windows [...] and "specially designed" frames therefor. Subject to EAR.  
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#### Category 2-Materials Processing

Examples: ECCN 2A290- Generators and other equipment "specially designed", prepared, or intended for use with nuclear plants. Subject to EAR.  
ECCN 2A291- Equipment, except items controlled by 2A290, related to nuclear material handling and processing and to nuclear reactors, and "parts," "components" and "accessories" therefor. Subject to EAR.  
"2E" ECCNs controlling related technology.



## Department of State compliance guidelines

FISCHER & ASSOCIATES

### >5. NUCLEAR-RELATED EXPORT CONTROL REGULATIONS

#### Department of State (ITAR) 22 CFR parts 120 through 130

Department of State purview includes nuclear weaponry including naval nuclear propulsion equipment/technology.

- Uranium depleted in the isotope-235 and incorporated in defense articles.
- Power generating or propulsion equipment specially designed for use with space, marine or mobile nuclear reactors.
- Radomes designed to withstand a combined thermal shock greater than 100 cal/sq cm accompanied by a peak over pressure of greater than 50 kPa, usable in protecting missiles against nuclear effects (e.g., Electromagnetic Pulse (EMP), X-rays, combined blast and thermal effects), and usable for missiles.
- Software specially designed or modified for the development, production, or use of power generating or propulsion equipment specially designed for use with space, marine or mobile nuclear reactors.

## NNSA compliance guidelines

FISCHER & ASSOCIATES

### >5. NUCLEAR-RELATED EXPORT CONTROL REGULATIONS

#### DOE-National Nuclear Security Administration (NNSA) 10 CFR Part 810

DOE purview includes Nuclear Steam Supply System-related *technology, software, services/activities*.

- Applies to all persons subject to the jurisdiction of the United States who engage directly or indirectly in the production of special nuclear material outside the United States.
- Applies to activities conducted either in the United States or abroad by such persons or by licensees, contractors or subsidiaries under their direction, supervision, responsibility or control.
- Applies, but is not limited to, activities involving nuclear reactors and other nuclear fuel cycle facilities for the following: fluoride or nitrate conversion; isotope separation (enrichment); the chemical, physical or metallurgical processing, fabricating, or alloying of special nuclear material; production of heavy water, zirconium (hafnium-free or low-hafnium), nuclear-grade graphite, or reactor-grade beryllium; production of reactor-grade uranium dioxide from yellowcake; and certain uranium milling activities.
- Does not apply to exports licensed by the Nuclear Regulatory Commission.

Controlled activities include:

- Engaging directly or indirectly in the production of special nuclear material with certain countries.
- Providing sensitive nuclear technology for an activity in any foreign country.
- Engaging in or providing assistance or training in any of the following activities with respect to any foreign country.
  - Designing production reactors, accelerator-driven subcritical assembly systems, or facilities for the separation of isotopes of source or SNM (enrichment), chemical processing of irradiated SNM (reprocessing), fabrication of nuclear fuel containing plutonium, or the production of heavy water;
  - Constructing, fabricating, operating, or maintaining such reactors, accelerator-driven subcritical assembly systems, or facilities;(3) Designing, constructing, fabricating, operating or maintaining components especially designed, modified or adapted for use in such reactors, accelerator-driven subcritical assembly systems, or facilities;
  - Designing, constructing, fabricating, operating or maintaining major critical components for use in such reactors, accelerator-driven subcritical assembly systems, or production-scale facilities; or
  - Designing, constructing, fabricating, operating, or maintaining research reactors, test reactors or subcritical assemblies capable of continuous operation above five megawatts thermal.
  - Training in the activities listed immediately above.

## NNSA controlled software compliance guidelines

FISCHER & ASSOCIATES

### >5. NUCLEAR-RELATED EXPORT CONTROL REGULATIONS

#### NNSA Controlled Software:

- All use of NNSA controlled code must be licensed by RSICC regardless of nationality.
  - Nationals from 810.8 countries who intend to use NNSA controlled code will be subject to deemed export requirements and require specific authorization.
- Includes software controlled and licensed through RSICC, such as MCNP-DSP, MCNP-POLIMI, MCNP5/MCNPX, MCNPDATA, MCNPXS, etc.
  - May also include controlled compilation data provided as part of software license.
- Current Agreement Language: "In addition to the stated requirement of Part 810, it is the Department of Energy's Office of Nonproliferation and International Security (NA-24) policy to review and as appropriate authorize and approve requests (for all RSICC codes) from "Foreign Persons" from countries listed in Part 810.8, or to those destinations."
  - Part 810.8 has been revised. Countries requiring this level of review and approval currently include: Afghanistan, Albania, Algeria, Andorra, Angola, Armenia, Azerbaijan, Bahrain, Belarus, Benin, Botswana, Burkina Faso, Burma (Myanmar), Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, China, People's Republic of Comoros, Congo (Zaire), Cuba, Djibouti, Equatorial Guinea, Eritrea, Gabon, Georgia, Guinea, Guinea-Bissau, Haiti, India, Iran, Iraq, Israel, Kenya, Kuwait, Kyrgyzstan, Laos, Liberia, Libya, Macedonia, Mali, Marshall Islands, Mauritania, Micronesia, Moldova, Mongolia, Mozambique, Niger, Oman, Pakistan, Palau, Qatar, Russia, Rwanda, Sao Tome and Principe, Saudi Arabia, Seychelles, Sierra Leone, Somalia, Sudan, Syria, Tajikistan, Tanzania, Togo, Turkmenistan, Uganda, Uzbekistan, Vanuatu, Yemen, Yugoslavia.

#### Compliance requirements at UCLA:

- All RSICC licensing requests should be copied to Claudia Modlin.
- All licensees are subject to UCLA's TCP for the safeguard of this controlled software.
  - TCP also covers IT support personnel who might not require a license to install software on a server, but must remain aware of control parameters.
    - Example: IDRE limits MCNP code installation support to 3 designated US persons on IT team.
- Failure to comply represents a violation under 810.15 and can result in civil fines and/or criminal culpability (as referenced in Section 222 of the Atomic Energy Act).

#### Recent update to Part 810 introduces new exemptions:

- Exports authorized by the Department of State (DOS) or Department of Commerce (DOC), or the Nuclear Regulatory Commission (NRC);
- Transfer of "publicly available information," "publicly available technology," and the results of "fundamental research";
- Assistance for certain mining and milling activities, and certain fusion reactors because these activities do not involve the production or use of special nuclear material;
- Production or extraction of radiopharmaceutical isotopes when the process does not involve special nuclear material; and
- Transfers to lawful permanent residents of the United States or recipients of political asylum.

## NNSA controlled software compliance guidelines Nonproliferation and international security (NA-24) Radiation Safety Information Computational Center (RSICC)



United States Department of Energy  
Radiation Safety Information Computational Center (RSICC)  
Software Export Control Agreement

UT-Battelle, LLC (UT-Battelle) manages and operates the Oak Ridge National Laboratory under its Prime Contract No. DEAC05-00OR22725 with the United States Department of Energy ("DOE"), an agency of the United States Government.

UT-Battelle intends to grant to the licensee identified below ("Licensee") a license to the RSICC Software also identified below (the "Software") under a separate Single User Software License.

As consideration for the license to the Software, Licensee hereby acknowledges and agrees to comply with all United States Export Control laws, regulations, and policies with respect to the Software and accompanying documents. Distribution of the Software or accompanying documents to any company or citizen of Cuba, Iran, North Korea, Sudan, and Syria is prohibited. Diversion contrary to U.S. law is prohibited.

Licensee represents and warrants that the "Intended Use" of the Software will not be directly or indirectly related to any one or more of the following areas:

- Military, Space Craft, Satellites, Missiles, and associated hardware, software or technical data unless authorized and approved by U.S. Government Sponsorship without Foreign Involvement
- Weapons of Mass Destruction or their precursors (Nuclear, Chemical & Biological)
- Activities subject to U.S. Department of Commerce prohibitions, including but not limited to those activities described in General Prohibitions (15 CFR Part 736) or Control Policy: End-User/End-Use based (15 CFR Part 744).

Licensee warrants that he/she is not identified or listed, and is not a citizen of a country identified or listed, in either the U.S. Government Consolidated Screening List ([http://export.gov/erreg\\_main\\_023148.asp](http://export.gov/erreg_main_023148.asp)) or any of the following:

- Entity List, U.S. Department of Commerce, 15 CFR Part 744, Supplement No. 4,
- The Denied Persons List, U.S. Department of Commerce, 15 CFR Part 764, <http://www.bis.doc.gov/dpl/deniallist.asp>
- Unverified List, U.S. Department of Commerce, [http://www.bis.doc.gov/Enforcement/Unverified\\_list/unverified\\_parties.html](http://www.bis.doc.gov/Enforcement/Unverified_list/unverified_parties.html)
- Terrorist Supporting Countries, U.S. Department of Commerce, Part 740, Supplement No. 1, Country Group E.
- Specially Designated Nationals and Blocked Persons, Office of Foreign Assets Control (OFAC), U.S. Department of the Treasury, [http://www.ofac.gov/ofac/enforcement/ofac\\_sdn/t1\\_sdn.pdf](http://www.ofac.gov/ofac/enforcement/ofac_sdn/t1_sdn.pdf)
- Lists of Parties Debarred for U.S. Arms Export Control Act (AECA) and/or U.S. International Traffic in Arms Regulations (ITAR) Convictions, <http://www.pndbce.state.gov/compliance/debar.html> and [http://www.pndbce.state.gov/compliance/debar\\_admin.html](http://www.pndbce.state.gov/compliance/debar_admin.html)
- Nonproliferation Sanctions - Bureau of International Security and Non-proliferation, <http://www.state.gov/s/in/c15221.htm>

The Software falls under one or more of the following Export Control jurisdictions:

- United States Department of Energy (DOE) 10 CFR 810 - (RELAP, MCNP, and MCNP derivative codes) - For reference to DOE Regulations, please refer to: [http://www.access.gpo.gov/nara/cfr/waisidx\\_08/10cfr810\\_08.html](http://www.access.gpo.gov/nara/cfr/waisidx_08/10cfr810_08.html). - In addition to the stated requirements of Part 810, it is the Department of Energy's Office of Nonproliferation and International Security (NA-24) policy to review and as appropriate authorize and approve requests (for all RSICC codes) from "Foreign Persons" from countries listed in Part 810 & or to those destinations.
- United States Department of Commerce Title 15, Commerce and Foreign Trade, Chapter VII B Bureau of Export Administration, Parts 730 through 774. For reference to the Commerce Regulations, please refer to: [http://www.access.gpo.gov/bis/cfr/par\\_data.html](http://www.access.gpo.gov/bis/cfr/par_data.html).

Licensee represents and warrants that the certifications made by Licensee in the RSICC Registration Form and the Software/Data Order Form are true, accurate and complete.

**References:**

The references identified herein are not under the control of UT-Battelle and are subject to change. The links provided are directed to web sites that may provide relevant export control information and are provided only as a convenience to the Licensee.

Software Package: \_\_\_\_\_ Software ID: \_\_\_\_\_

Name: (type or print) \_\_\_\_\_ Signature: (sign): \_\_\_\_\_

Date: \_\_\_\_\_

**Return Completed and Signed Agreement to:**

UT-Battelle, LLC/RSICC  
Oak Ridge National Laboratory  
P.O. Box 2008  
1 Bethel Valley Road  
Oak Ridge, TN 37831-6003  
Phone: 865-574-6176 Fax: 865-241-4046  
Email: [pdcc@ornl.gov](mailto:pdcc@ornl.gov)

## Treasury OFAC compliance guidelines

FISCHER & ASSOCIATES

### 6. OFAC Regulations: Purpose, Scope, and Enforcement

#### What Are the OFAC Regulations? What Are They Intended to Accomplish?

- Office of Foreign Assets Control (OFAC) falls under the Department of the Treasury.
- Regulations are found in Title 31 CFR, Parts 500-599.
  - Broadly regulate and restrict transactions with embargoed countries plus certain nongovernmental organizations to implement strategic foreign policy.
  - Restrict transfer and exchange of items and services.
  - Restrict commercial, industrial, and financial relationships benefitting countries
  - Restrict travel (Cuba) subject to certain exceptions.
  - Prohibit transactions with certain end users – OFAC’s Specially Designated Nationals List (present in the U.S. or abroad).
- Approximately twenty-five embargoed countries plus certain non-governmental organizations: most comprehensive controls apply to the following:
  - Cuba, Iran, Syria, N. Korea and Sudan
  - Regulations are country-specific
  - OFAC regulations operate independently of other export control regulations (dual-use/EAR, military defense/ITAR)
    - An activity that might not be controlled under EAR or ITAR may be controlled under OFAC
  - OFAC Sanctions Programs: Terrorism
    - Regulations include Executive Order and several sanctions (31 CFR 594-597)
    - Sanctions apply to certain listed entities



## Treasury OFAC compliance guidelines (continued)

FISCHER & ASSOCIATES

### > 6. OFAC REGULATIONS: PURPOSE, SCOPE, AND ENFORCEMENT

#### How Are OFAC Regulations Enforced?

- All regulated activity requires prior authorization in the form of an OFAC license issued by the Department of Treasury.
- While OFAC publishes some country-specific guidance on regulatory interpretation, such guidance is not comprehensive; in general, questions in doubt are handled through requests for Advisory Opinions or License Applications.
  - Data provided in advisory opinions is treated as proprietary and confidential upon request.
- Treasury deploys its own investigative enforcement team, and operates jointly with the FBI and the Commerce Department's Office of Export Enforcement (OEE).
- Sanctions include civil and criminal monetary penalties which can be assessed against the individual violator and/or the institution. Cases can be referred to the Department of Justice for criminal investigation.
  - Monetary penalties can range up to the greater of \$250,000 or twice the value of the transaction, per violation.
- The most common violations in the academic and research community involve the following:
  - Cuba-based research and independent travel.
  - Outbound and collaborative Iranian transactions (see below for further detail).
  - Access to restricted research tools in the U.S. by OFAC-restricted foreign nationals.
  - Failure to screen OFAC-restricted end-users.

## University compliance guidelines Common Scenarios

FISCHER & ASSOCIATES

### > 6. OFAC REGULATIONS: PURPOSE, SCOPE, AND ENFORCEMENT

#### How Specific Research Activities Trigger Requirements: Common Scenarios

- Travel to an OFAC-restricted country.
  - Note: Only Cuba requires licenses for personal and certain professional travel; for all other countries, no license is required for personal travel.
- Providing a restricted "service." This concept is common to the regulations across the five most heavily sanctioned nations, as excerpted below from the Iran sanctions:  
"§560.204 Except as otherwise authorized pursuant to this part, including §560.511, and notwithstanding any contract entered into or any license or permit granted prior to May 7, 1995, the exportation, re-exportation, sale, or supply, directly or indirectly, from the United States, or by a United States person, wherever located, of any goods, technology, or services to Iran or the Government of Iran is prohibited, including the exportation, re-exportation, sale, or supply of any goods, technology, or services to a person in a third country undertaken with knowledge or reason to know that:  
(a) Such goods, technology, or services are intended specifically for supply, transshipment, or re-exportation, directly or indirectly, to Iran or the Government of Iran; or  
(b) Such goods, technology, or services are intended specifically for use in the production of, for commingling with, or for incorporation into goods, technology, or services to be directly or indirectly supplied, transshipped, or reexported exclusively or predominantly to Iran or the Government of Iran."
- Common scenarios involving restricted services include the following:
  - Exporting research data which is not publicly available.
    - "Export" is defined as a transfer: electronic, conversational or hard copy media
    - "Publicly available" means published on a website or through scholarly publication, etc.
    - Iranian download of a Website publication containing research results is allowable; however, providing technical assistance upon request from an Iranian individual or institution in Iran triggers license requirement.
  - Importing samples or materials for analysis/provision of data results.
    - Even where the samples or materials are strictly for research purposes and results are intended for publication, importation without a license is prohibited.
    - Note: Importing any item from Iran requires license authorization; other countries have item-specific requirements.
  - Data exchange with OFAC foreign national researchers and scholars based in OFAC countries.
    - Note export prohibition above: issuing data or research results that is unrelated to publication may constitute a restricted export.
    - Serving on collaborative research committees or boards: No issue, unless "service" is being provided: common sense standard – discussions should be limited to what has been published or general discussions pertaining to collaboration.
- Be aware of new Ukraine-related Russia sanctions affecting energy sector and expanding SDN List/Sectoral Sanctions



## University compliance guidelines Training Resource

FISCHER & ASSOCIATES

### Fischer & Associates

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## **Guidance from NA-22 for University research related to SNM Office of Defense Nonproliferation Research and Development**

### **Selected information that may be helpful as a comparison**

#### **General Rules:**

Information and software useful for designing or developing nuclear weapons are classified to prevent or delay availability of confirmed nuclear weapon information.

#### **Special Nuclear Materials (SNM) - Types and Quantities**

#### **Isotopes of interest**

$^{235}\text{U}$  and  $^{239}\text{Pu}$  are the fissile materials used in nuclear weapons and are referred to as Special Nuclear Material (SNM). Other isotopes and elements have been suggested including  $^{233}\text{U}$  (from the Th fuel cycle) and  $^{237}\text{Np}$  and  $^{241}\text{Am}$  (from spent fuel reprocessing). Our office would like to be informed of any work on isotopes other than  $^{235}\text{U}$  and  $^{239}\text{Pu}$  or work on any non-bomb grade Pu ( $^{239}\text{Pu}$  content less than 90%) or U ( $^{235}\text{U}$  content less than 90%).

## **Guidance from NA-22 for University research related to SNM Office of Defense Nonproliferation Research and Development**

### **Special Nuclear Materials (SNM) - Types and Quantities (continued)**

#### **Quantities of Interest**

Here is the official IAEA definition of significant quantity:

- **SIGNIFICANT QUANTITY** -- The approximate quantity of nuclear material in respect of which, taking into account any conversion process involved, the possibility of manufacturing a nuclear explosive device cannot be excluded.

## **Guidance from NA-22 for University research related to SNM Office of Defense Nonproliferation Research and Development**

### **Nuclear Safeguards and Security:**

The following SNM production activities are of concern:

- Essentially all uranium isotope enrichment activities are classified.

### **Unclassified Research Areas**

- The following subject areas are generally considered unclassified:
- Electronics and data handling when not tied to specific application
- Basic chemistry and physics of uranium and plutonium
- Processing of uranium ore
- Uranium hexafluoride production
- Geology of uranium and thorium deposits
- Theoretical and experimental physics

Thank you!





## TFG/Office of Science/Fusion Energy Panel Discussion Questions

1. What are the best practices and roles for university research and export control for tritium technology, since published general scientific research is generally excluded from export control?
2. Should there be more guidelines and controls of research and publications and export control language since 10 CFR 810 is silent on tritium as a special nuclear material (SNM)?
3. Should tritium be specifically identified as a SNM?
4. Should the TFG play an active role in drafting guidelines related to what is or is not export controlled or classified, particularly for fusion energy research with tritium, which encompasses neutron multiplication, tritium breeding, processing, storage, isotope purification, isotope separation, water detritiation, and tritium barrier and permeator materials development, particularly as the US fusion program is collaborating at the university (UCLA) and lab (INL) sites with ITER member domestic agencies from China, EU, India, Japan, South Korea, and the Russian Federation.
5. What are the lessons learned from past TFG activities in the public domain?
6. Which activities are the TFG able to provide data that will eliminate duplication?
7. Which new activities are the TFG interested in collaboration?
8. Which activities will answer questions needed for safe successful ITER operation?
9. What collaborations should take place on JET to maximize the knowledge capture during the last D-T volumetric fusion neutron source operations between now and ITER (2030+)?