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Export Control Requirements for Tritium Processing Design and R&D

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2017 update

Export control documents, last modified on 12-31-2016, were reviewed in February 2017 to identify any changes to the original assessment in the following 2015 report. All ECCNs were reviewed to ensure new sections have not been added and current identified references were not modified or removed. Results are noted following the ECCN specific section below. In addition, a review of newly identified 10 CFR requirements have been added to the *Other Requirements* section.

Introduction

This document will address requirements of export control associated with tritium plant design and processes. Los Alamos National Laboratory has been working in the area of tritium plant system design and research and development (R&D) since the early 1970's at the Tritium Systems Test Assembly (TSTA). This work has continued to the current date with projects associated with the ITER project and other Office of Science Fusion Energy Science (OS-FES) funded programs. ITER is currently the highest funding area for the DOE OS-FES. Although export control issues have been integrated into these projects in the past a general guidance document has not been available for reference in this area. To address concerns with currently funded tritium plant programs and assist future projects for FES, this document will identify the key reference documents and specific sections within related to tritium research. Guidance as to the application of these sections will be discussed with specific detail to publications and work with foreign nationals.

Tritium plant systems that have been or are currently being planned to be studied include; vacuum pumping of tritium gas, tritium separation from tritium containing compounds and other gas compounds, hydrogen isotope separation (hydrogen, deuterium, and tritium), tritium storage on metal hydride beds and quantitative tritium analysis. All aspects of research and development (R&D) associated with these sub-systems of a tritium plant will be analyzed in respect to export control requirements.

Export Control Requirements

The overall guidance for export control is governed by the Bureau of Industry and Security within the US Department of Commerce. To determine if an export license is needed from the Department of Commerce the associated items (research areas) need to be linked with an Export Control Classification Number (ECCN). ECCNs are five character alpha-numeric designations used on the Commerce Control List (CCL) to identify dual-use items for export control. *An ECCN categorizes items based on the nature of the product, i.e. type of commodity, software, or technology and its respective technical parameters.*ⁱ ECCNs are divided into 5 groups:

- A-Equipment, Assemblies and Components
- B-Test, Inspection and Production Equipment
- C-Materials
- D-Software
- E-Technology

EAR99 is a "catch-all" category for items under Commerce jurisdiction for export that are not on the Commerce Control List. US specific work with ITER is covered under this category.

Determination as to whether or not authorization is required to export is determined by the following steps;

1. What is the ECCN of the item?
2. Where is the item going?
3. Who are the end users?
4. What is the end use?

Work identified within an ECCN may need a license if a foreign nexus is involved, questions 2-4.

Examples:

You want to publish in open literature.

You want to work with a foreign national.

You want to send controlled technical data, controlled software or equipment to a foreign national.

Assessment

Definitions

In order to assess ECCNs for applicability to tritium plants processes there is a need to review the definitions of the text quotations used in the ECCN. Below are the relevant definitions from Part 772 Definition of Terms of the Export Administration Regulationsⁱⁱ used in the ECCNs.

Development - (General Technology Note)--“Development” is related to all stages prior to serial production, such as: design, design research, design analyses, design concepts, assembly and testing of prototypes, pilot production schemes, design data, process of transforming design data into a product, configuration design, integration design, layouts.

Nuclear reactor - (Cat 0 and 2) includes the items within or attached directly to the reactor vessel, the equipment which controls the level of power in the core, and the components which normally contain, come into direct contact with or control the primary coolant of the reactor core.

Production - (General Technology Note) (All Categories) -- Means all production stages, such as: product engineering, manufacture, integration, assembly (mounting), inspection, testing, quality assurance.

Specially designed - When applying this definition, follow this sequential analysis set forth below. (For additional guidance on the order of review of “specially designed,” including how the review of the term relates to the larger CCL, see Supplement No. 4 to Part 774 of the EAR – Commerce Control List Order of Review.)

Software - (Cat: all)--A collection of one or more “programs” or “microprograms” fixed in any tangible medium of expression

Technology - (General Technology Note, throughout EAR) Specific information necessary for the “development”, “production”, or “use” of a product. The information takes the form of ‘technical data’ or ‘technical assistance’.

Use - (All categories and General Technology Note)--Operation, installation (including on-site installation), maintenance (checking), repair, overhaul and refurbishing.

ECCN Review

To assess the applicable ECCNs for tritium processes the following discussion is separated into individual categories and the relevant ECCNs. Reference to the official ECCN documents can be found in Appendix 1.

CCI Category 0 – Nuclear Materials Facilities & Equipment [Miscellaneous Items]ⁱⁱⁱ

Category-0 identified three primary (#P) ECCN (0B004.b.3a, 0B999, and 0C004) and 2 what this document will term secondary (#S) ECCN (0D001 and 0E001) that relate to the primary ECCN numbers related to either software or technology terms.

1P: 0B004.b.3a Hydrogen cryogenic distillation towers and cold boxes designed for operations below 35K (-238°C), *(deleted in 2013)*

ECCN, 0B004.b.3a deals with the export of equipment for cryogenic distillation columns that could be an area of focus for many tritium plant system dealing with isotope separation. The temperatures used in TSTA work were capable of temperature less than the 35K reference. The boiling point for hydrogen isotopes range from 20.4k to 25K. However, unless the equipment is to be shipped this would not be applicable to the focus of this paper.

2P: 0B999 Specific Processing Equipment as Follows (Gloveboxes and Hot Cells) *(no update 2016)*

ECCN 0B999 deals with the export of gloveboxes or hot cells. Again, although work with these types of equipment may be used in the focus of this document it is not reasonable to believe that any output would be the actual shipment of them and this ECCN would not be appropriate.

3P: 0C004 Deuterium, heavy water, deuterated paraffins and other compounds of deuterium, and mixtures and solutions containing deuterium, in which the isotopic ratio of deuterium to hydrogen exceeds 1:5000. *(related to tritium facilities), (deleted in 2013)*

The specific reference to 0C004 deals with deuterium compounds. The experimental focus in tritium plant would potentially associate these subject areas through isotope separation or detritiation clean-up systems. However the focus of this ECCN is the material itself and not technology so this ECCN would not be applicable for this work.

1S: 0D001 “Software” specially designed or modified for the “development”, “production”, or “use” of items described ~~0B~~ (except for 0B968 and 0B999), or ~~0C~~ *(related to software for tritium facilities)* in 0A002. *(Reference to 0B004 and 0C004 deleted in 2013)*

In most cases the tritium plant research and development activities focus of this document will not deal with software development and are more directed to the engineering and chemical processes. As such the reference to 0D001/0B and 0C are not identified as appropriate ECCNs.

2S: 0E001 “Technology” according to the Nuclear Technology Note, for the “development”, “production”, or “use” of items described in ~~0B (except 0B986 and 0B999), 0C, 0A002 or 0D001~~ (related to tritium facilities), (Reference to 0B004 and 0C004 deleted in 2013)

ECCN 0E001 “technology” and “development” would cover any work described in this document. The question is the scale of such work. The text is referenced to “distillation towers and cold boxes” and implies large scale, actual production, applications. The implication is that research and development of distillation technologies would not be covered by this ECCN.

The initial assessment of these ECCNs was completed in 2012. When reviewing the 2015 revision of the Category 0 document on the Commerce web site, the following ECCN were not referenced; 0B004 and 0C004. LANL’s export control group was contacted for an explanation of the missing numbers. The following guidance was given;

On October 4, 2013, the Bureau of Industry and Security (BIS) published the Federal Register Notice “Revisions to the Export Administration Regulations (EAR) to Make the Commerce Control List (CCL) Clearer.” Among the revisions implemented by this final rule is the removal from the CCL of 14 Export Control Classification Numbers (ECCNs) subject to the exclusive jurisdiction of the Nuclear Regulatory Commission (NRC) under 10 CFR part 10.

Please note that the ECCNs shown below have been removed from the CCL, effective October 15, 2013.

0A001	0B001	0B002	0B003	0B004
0B005	0B006	0C001	0C002	0C004
0C005	0C006	0C201	1C012	

All exports of nuclear items previously classified under these 14 ECCNs are subject to NRC licensing regulations

Due to this elimination of the above identified ECCNs, in addition to the assessment above for 0B004 and 0C004, they can be eliminated from export control requirements. These elimination would also affect 0E001 and remove it as an applicable requirement in addition to work at larger scale. The NRC regulation reference for this change are found in appendix J - Illustrative List of Uranium Conversion Plant Equipment and Plutonium Conversion Plant Equipment Under NRC Export Licensing Authority and K -Illustrative List of Equipment and Components Under NRC Export Licensing Authority for Use in a Plant for the Production of Heavy Water, Deuterium and Deuterium Compounds of the Part 110 document. A review of these documents do not identify any tritium plant system R&D that would affect work covered under this regulation.

CCL Category 1 – Materials, Chemicals, Microorganisms and Toxins^{iv}

Category 1 is the most applicable to Tritium Plant systems. Four primary (1A225, 1B228, 1B231 and 1C235) and three secondary (1E001, 1E201 and 1E202) ECCNs have been identified for this category

1P: 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. **(No update 2016)**

The first ECCN deals with tritium extraction from Heavy water, 1A225. Current scope of experiments and research are not planned with heavy water extraction and recovery of tritium. Although there may be an overlap with highly tritiated water from detritiation systems and other byproduct effluences, current technologies are focused on electrolytic separation of water to T2 and O2 and no catalysis are being used, thus eliminating this ECCN.

2P:1B228 Hydrogen cryogenic distillation columns having all of the characteristics described in this ECCN (see List of Items Controlled), below. **(No update 2016)**

As with Category 0 issues dealing with hydrogen distillation, ECCN 1B228 could have application. The characteristics described in this ECCN are as follows;

- a. Designed to operate with internal temperatures of 35 K (-238 °C) or less;
- b. Designed to operate at an internal pressure of 0.5 to 5 MPa (5 to 50 atmospheres);
- c. Constructed of “fine-grain stainless steels” of the 300 series with low sulphur content or equivalent cryogenic and H2-compatible materials; and
- d. With internal diameters of 30 cm or greater and “effective lengths” of 4 m or greater.

From the description of the List of Controls the application of this ECCN requires that all cases be applied and is related to the export of equipment. As in Category 0, it is not foreseen that R&D activities will result in the export of equipment and thus this ECCN can be eliminated.

3P:1B231 Tritium facilities or plants, and equipment therefor, as follows (see List of Items Controlled). **(No update 2016)**

ECCN 1B231 characterizes the following areas;

- 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.

The characteristics for this ECCN could have application to tritium processing and export control requirements for all areas listed. The b. Equipment subcategories having the most defined application. However, this ECCN is related to shipment of equipment and R&D activities will not be directly affected.

4P: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. (**No update 2016**)

1C235 is another ECCN that does not appear to affect current work scope. This ECCN deals with tritium compounds in excess of 0.1% and the shipment of the material. Projected experimental work is not focused on material transfers outside of the US and should not affect export control requirements.

1S:1E001 “Technology” according to the General Technology Note for the “development” or “production” of items controlled by 1A002, 1A003, 1A004, 1A005, 1A006.b, 1A007, 1A008, 1A101, **1B** (except 1B608, 1B613 or 1B999), or **1C** (except 1C355, 1C608, 1C980 to 1C984, 1C988, 1C990, 1C991, 1C995 to 1C999). (**Addition of all references, 2016**)

ECCN 1E001 does raise an issue as it is applied to the identified primary ECCNs with the exception of “development” and “production” specifically to 1B228 and 1B231. As a result of this ECCN LANL has a license with ITER, D451817, to cover development activities of b. categories technologies listed in 1B231 above.

2S:1E201 “Technology” according to the General Technology Note for the “use” of items controlled by 1A002, 1A007, 1A202, **1A225** to 1A227, 1B201, 1B225, 1B226, **1B228 to 1B232**, 1B233.b, 1B234, 1C002.b.3 and b.4, 1C010.a, 1C010.b, 1C010.e.1, 1C202, 1C210, 1C216, **1C225 to 1C237**, 1C239 to 1C241 or 1D201. **1A225 1B228, 1B231.** (**Addition of all references, 2016**)

1A225, 1B228 and 1B231-b1 have been eliminated in the above assessment and due the term of “use” can be excluded. 1B231-a Facilities or plants for the production, recovery, extraction, concentration, or handling of tritium has been identified as having possible application. LANL currently has a license with ITER, D440757, to address issues dealing with Tritium Plant hazard analysis that are applied to the plant as a whole.

3S:1E202 “Technology” according to the General Technology Note for the “development” or “production” of goods controlled by 1A202 or **1A225** to 1A227. (**Addition of all references, 2016**)

As stated with 1A255 above this applies to heavy water technology and is out of scope of tritium plant processing.

CCL Category 2 – Materials Processing^v

The final review is Category 2 – Material processing. There are three primary ECCNs (2A226, 2A291 and 2B225) and four secondary ECCNs (2D290, 2E001, 2E201 and 2E290).

1P:2A226 Valves having all of the following characteristics (see List of Items Controlled). (**No update 2016**)

The first ECCN is 2A226 with a focus on valves having the follow criteria;

- a. A “nominal size” of 5 mm or greater;
- b. Having a bellows seal; and
- c. Wholly made of or lined with aluminum, aluminum alloy, nickel, or nickel alloy containing more than 60% nickel by weight.

The size limitation (a.) is in reference to the inlet or outlet diameter of the valve. A conversion to standard engineering lengths used in the US would relate to valves of diameters greater than 1/8” and are of potential use in tritium research. Many valves currently used in experimental set-ups are of a bellow type (b.). However the material of use is generally a stainless steel or similar alloy and do not match the criteria of c. As in the discussion above all three criteria need to match and c. will eliminate this ECCN to tritium research.

2P:2A291 Equipment, except items controlled by 2A290, related to nuclear material handling and processing and to nuclear reactors, and “parts” and “components” and “accessories” therefor. (**No update 2016**)

ECCN 2A291 address equipment related to nuclear material handling and processing and to nuclear reactors. This would include parts, components and accessories. The review of the List of Items Controls include the following;

- a. Process control systems intended for use with nuclear reactors.
- b. Simulators “specially designed” for “nuclear reactors”.
- c. Casks that are “specially designed” for transportation of high-level radioactive material and that weigh more than 1,000 kg.
- d. Commodities, “parts,” “components” and “accessories” “specially designed” or prepared for use with nuclear plants (e.g., snubbers, airlocks, pumps, reactor fuel charging and discharging equipment, containment equipment such as hydrogen recombiner and penetration seals, and reactor and fuel inspection equipment, including ultrasonic or eddy current test equipment).
- e. Radiation detectors and monitors “specially designed” for detecting or measuring “special nuclear material” (as defined in 10 CFR Part 110) or for nuclear reactors.

As a tritium plant does not meet the definition of “nuclear reactor”, a, b, and d. can be eliminated. Item c is concerned with casks and e radiation detectors, again areas of research not related to tritium plant work addressed in this document. This ECCN can be eliminated.

3P:2B225 Remote manipulators that can be used to provide remote actions in radiochemical separation operations or hot cells, having either of the following characteristics (see List of Items Controlled). (**No update 2016**)

ECCN 2B225 address concerns with remote manipulators in hot cell activities. It is not foreseen that any work for tritium plants would fall within this scope.

1S:2D290 “Software” “specially designed” or modified for the “development”, “production” or “use” of items controlled by 2A290 or **2A291**. . (**Addition of all references, 2016**)

ECCN, 2D290 is concerned with “software” development related to 2A291 and based on the assessment above in Category 0 no work in this area will be associated with tritium plant research, limited to nuclear reactors.

2S:2E001 “Technology” according to the General Technology Note for the “development” of equipment or “software” controlled by **2A** (except 2A983, 2A984, 2A991, or 2A994), **2B** (except 2B991, 2B993, 2B996, 2B997, 2B998, or 2B999), or **2D** (except 2D983, 2D984, 2D991, 2D992, or 2D994). (**Addition of all references, 2016**)

2E001 does include the “development” aspect of tritium plant research. However all primary ECCN have been excluded from this assessment.

3S:2E201 “Technology” according to the General Technology Note for the “use” of equipment or “software” controlled by 2A225, **2A226**, 2B001, 2B006, 2B007.b, 2B007.c, 2B201, 2B204, 2B206, 2B207, 2B209, **2B225** to 2B233, 2D002, 2D201 or 2D202 for NP reasons. (**Addition of all references, 2016**)

As with the above assessments in this CCL category “use” and “software” will exclude this ECCN.

4S:2E290 “Technology” according to the General Technology Note for the “use” of equipment controlled by, **2A291**. (**No update 2016**)

As with the above assessment of 2A291 this ECCN will excluded.

Summary

The following table summarizes the assessment of the identified ECCNs.

ECCN Number	Primary / Secondary ECCN	Summary Description	Assessment outcome	ECCN Appropriate (Y/N)
OB004.b.3a	Primary	Hydrogen Cryogenic Distillation	Scale too large, deleted in 2013	N
OB999	Primary	Glovebox and Hot Cells	Equipment only	N
OC004	Primary	Deuterium Compounds	Material only, deleted in 2013	N

ECCN Number	Primary / Secondary ECCN	Summary Description	Assessment outcome	ECCN Appropriate (Y/N)
0D001	Secondary (All except 0B999)	Software Development, Production and Use	No software development	N
0E001	Secondary (All except 0B999)	Technology Development, Production and Use	Deleted in 2013 for 0B004 and 0C004	N
1A225	Primary	Catalysts hydrogen isotope exchange	Heavy water, out of scope	N
1B228	Primary	Hydrogen Cryogenic Distillation	All characteristics not met	N
1B231	Primary	Tritium Facilities or plants	Equipment only	N
1C235	Primary	Tritium Compounds	Material only	N
1E001	Secondary (1B and 1C)	Technology Development and Production	License with ITER to cover b. descriptions as applied to hydrogen distillation and use of metal hydrides for storage	Y
1E201	Secondary (All 1A and 1B)	Technology Use	License with ITER to cover a. descriptions as applied to entire fuel cycle. Does not apply to b. specific technologies for use (b)	Y
1E202	Secondary (All 1A)	Technology Development and Production	Heavy water, out of scope	N
2A226	Primary	Valves	Equipment only, all characteristics not met	N
2A291	Primary	Equipment Nuclear Reactors	Excluded, not a Nuclear Reactor	N
2B225	Primary	Remote Manipulators	Equipment only	N
2D290	Primary	Software Development, Production and Use	No software development	N
2E001	Secondary (All)	Technology Development	No Match for Controlled Items Listed	N
2E201	Secondary (2A226, 2B225)	Technology Use	Use only, allows for R&D	N
2E290	Secondary (2A291)	Technology Use	Use only, allows for R&D	N

Table 1 – ECCN Assessments Summary

From the review of the current ECCNs from the Commerce Department most cannot be associated with work currently planned for tritium plant R&D. The ECCNs that have been identified as having potential impact on tritium processing work are discussed in more detail below. Appendix 2 has been developed

to identify subjects and research directions that may move work into ECCN requirements that were deemed not appropriate above. It should be noted that regulation can change and workers in these areas should contact their companies export control experts to ensure this assessment is current and accurate.

ITER Collaborations

LANL currently has the following license with ITER to address the ECCNs in Category 1 that can have application and they are listed below, Table 2. The EAR99 reference was identified from work LANL has completed on the conceptual design work on the Tokamak Exhaust Process (TEP), for ITER.

ECCN Number	Technology	Current Licenses
EAR99	Production, Development & Use Technology for the Tokamak Off-Gas Exhaust Processing System (TEP) for ITER Fusion Device	License D408201 to ITER Organization, its duly ratified member nations and their technical representatives. Valid 2/24/2009 – 2/28/2019
1E201	Production, Development & Use Technology of a Hazard & Operability (HAZOP) Methodology for the ITER Tritium Plant Systems	License D440757 to ITER Organization, its duly ratified member nations and their technical representatives. Valid 1/20/2011 – 1/31/2021
1E001	Production, Development & Use Technology of the ITER Fuel Cycle	License D451817 to ITER Organization, its duly ratified member nations and their technical representatives. Valid 3/8/2011 – 3/31/2021

Table 2 – Current LANL License to address identified ECCNs

Requirements with the ITER organization in respect to export control is outline in the governing documents that developed the international agreement.

In accordance with Article 20 of the ITER Agreement, the ITER Organization and the Members shall use any material, equipment or technology generated or received pursuant to the ITER Agreement solely for peaceful purposes and no transfer of material, equipment or technology shall take place that is contrary to national export control or related laws and regulations.

The provisions of the ITER Agreement set out the obligations and roles of the ITER Organization and the Members as concerns export control, peaceful uses and non-proliferation.

Article 20 – Peaceful Uses and Non-Proliferation – provides that:

- 1. The ITER Organization and the Members shall use any material, equipment or technology generated or received pursuant to this Agreement solely for peaceful purposes. Nothing in this paragraph shall be interpreted as affecting the rights of the Members to use material, equipment or technology acquired or developed by them independent of this Agreement for their own purposes..*
- 2. Material, equipment or technology received or generated pursuant to this Agreement by the ITER Organization and the Members shall not be transferred to any*

third party to be used to manufacture or otherwise to acquire nuclear weapons or other nuclear explosive devices or for any non-peaceful purposes.

3. *The ITER Organization and the Members shall take appropriate measures to implement this Article in an efficient and transparent manner. To this end, the Council shall interface with appropriate international fora and establish a policy supporting peaceful uses and non-proliferation.*
4. *In order to support the success of the ITER Project and its non-proliferation policy, the Parties agree to consult on any issues associated with the implementation of this Article.*
5. *Nothing in this Agreement shall require the Members to transfer material, equipment or technology contrary to national export control or related laws and regulations.*
6. *Nothing in the Agreement shall affect the rights and obligations of the Parties that arise from other international agreements concerning non-proliferation of nuclear weapons or other nuclear explosive devices.*

Article 6 paragraph 7 (x) provides that the Council shall “decide whether to propose material, equipment and technology for consideration by international export control fora for inclusion on their control lists, and establish a policy supporting peaceful uses and non-proliferation in accordance with Article 20”.

These provisions confirm the primacy of national export control or related laws and regulations for the Members and the ITER Organization, and their duty to implement Article 20 in an efficient manner by inter alia consulting on any issue associated with the implementation. It is therefore useful to distinguish two different dimensions of export control, peaceful uses and non-proliferation: namely, that which pertains to internal ITER Organization management, and that which involves interparty relations and relations between the ITER Organization and the Parties.^{vi}

To implement these requirements ITER has issued multiple documents outlining export control reviews to ensure this guidance is followed. If work in the area of tritium processing is being funded directly by ITER or the US-IPO the program should work to these directives to ensure authorization of open publication of research and development activities and interactions with foreign nationals. Review of this process has shown that many R&D activities have been allowed to be published without restriction.

Other Requirements

In order for work in the areas of tritium fuel processing to be in open publications the identified ECCNs, 1E001 and 1E201 will pose an issue. However, the National Security Decision Directive (NSDD) will allow for open publication if the following decision is made and documented by the government funding agency.

The research to be performed under this (contract/agreement/project – include reference #, if applicable) shall be considered "fundamental research" as defined in National Security Decision Directive (NSDD) 189 and (funding agency/sponsor) hereby approves the information and technical data resulting from the research for public release.

NSDD 189 defines fundamental research as "basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons." Work in the area of tritium processing research may fall within this guidance as it is not reduced to practice during the R&D stage.

It should also be noted that work in tritium processing may require assessments in terms of intellectual property rights. New technology development in reference to tritium processing should be review for application and the program should contact the appropriate company organization that supports this field.

In addition to the Department of Commerce assessment in the original document in 2016 a review of 10 CFR 810, Department of Energy Assistance to Foreign Atomic Energy Activities (in affect 3/25/15) and 10-CFR 110, Nuclear Regulatory Commission were reviewed to application to tritium processing design and R&D. The table below outlines identified areas.

CFR Reference	Scope Reference	Summary Description	Assessment outcome	Appropriate (Y/N)
810	810.2 (c)(4)	Does not apply to, Nuclear fusion reactors, per se, except for supporting systems involving hydrogen isotope separation technologies with the scope defined in paragraph (b)(7) of this section and 810.7 (c)(3)	(b)(7) and (c)(3) References Heavy water production and hydrogen isotope separation, when the technology or process has reasonable potential for large-scale separation of deuterium (2H) from protium (1H), not applicable to tritium R&D activities	N
110	Appendix L	Byproduct Material, Tritium	Material only	N

Conclusion

It is the recommendation of this paper that if work is being done in an area of potential technology identified in the above assessment that the program work directly with the funding agency to determine if the NSDD 189 or ITER export review is applicable to the tritium processing research. If following reviews the technology can be applied to NSDD or is given approval by ITER for public release the work can be presented in the open domain and work with foreign nationals is permitted. The program should work with their export control group to document these conclusions for the release of published work to avoid questions concerning export control requirements. If the funding agency does not feel the work will fall within the scope of the NSDD or if ITER export control is required then a proper license should be implemented. The experimental results and designs should be controlled in a manners that restricts the exchange of information and equipment to approved entities as directed by the license.

Appendix 1

A review of the CCLs in 2012 identified the following ECCN that are relevant to tritium processes:

CCI Category 0 – Nuclear Materials Facilities & Equipment [Miscellaneous Items]

0B004.b.3 Hydrogen Distillation process

b.3a Hydrogen cryogenic distillation towers and cold boxes designed for operations below 35K (-238°C)

0B999 Specific Processing Equipment as Follows (Gloveboxes and Hot Cells)

0C004 Deuterium, heavy water, deuterated paraffins and other compounds of deuterium, and mixtures and solutions containing deuterium, in which the isotopic ratio of deuterium to hydrogen exceeds 1:5000. (*related to tritium facilities*)

0D001 “Software” specially designed or modified for the “development”, “production”, or “use” of items described in 0A001, 0A002, **0B** (except for 0B968 and 0B999), or **0C** (*related to software for tritium facilities*)

0E001 “Technology” according to the Nuclear Technology Note, for the “development”, “production”, or “use” of items described in 0A001, 0A002, **0B** (except 0B986 and 0B999), **0C**, or **0D001** (*related to tritium facilities*)

CCL Category 1 – Materials, Chemicals, Microorganisms and Toxins

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.

1B228 Hydrogen cryogenic distillation columns having all of the characteristics described in this ECCN (see List of Items Controlled).

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

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.

1E001 “Technology” according to the General Technology Note for the “development” or “production” of items controlled by 1A001.b, 1A001.c, 1A002, 1A003, 1A004, 1A005, 1A006.b, 1A007, 1A008 1A101, **1B** (except 1B608, 1B613 or 1B999), or **1C** (except 1C355, 1C608, 1C980 to 1C984, 1C988, 1C990, 1C991, 1C995 to 1C999).

1E201 “Technology” according to the General Technology Note for the “use” of items controlled by 1A002, 1A007, 1A202, **1A225** to 1A227, 1B201, 1B225, 1B226, **1B228 to 1B232**, 1B233.b, 1B234, 1C002.b.3 and b.4, 1C010.a, 1C010.b, 1C010.e.1, 1C202, 1C210, 1C216, 1C225 to 1C237, 1C239 to 1C241 or 1D201.

1E202 “Technology” according to the General Technology Note for the “development” or “production” of goods controlled by 1A202 or **1A225** to 1A227.

CCL Category 2 – Materials Processing

2A226 Valves having all of the following characteristics (see List of Items Controlled).

2A291 Equipment, except items controlled by 2A290, related to nuclear material handling and processing and to nuclear reactors, and “parts” and “components” and “accessories” therefor.

2B225 Remote manipulators that can be used to provide remote actions in radiochemical separation operations or hot cells, having either of the following characteristics (see List of Items Controlled).

2D290 “Software” “specially designed” or modified for the “development”, “production” or “use” of items controlled by 2A290, **2A291**, 2A292, 2A293, or 2B290.

2E001 “Technology” according to the General Technology Note for the “development” of equipment or “software” controlled by **2A** (except 2A983, 2A984, 2A991, or 2A994), **2B** (except 2B991, 2B993, 2B996, 2B997, 2B998, or 2B999), or **2D** (except 2D983, 2D984, 2D991, 2D992, or 2D994).

2E201 “Technology” according to the General Technology Note for the “use” of equipment or “software” controlled by 2A225, **2A226**, 2B001, 2B006, 2B007.b, 2B007.c, 2B201, 2B204, 2B206, 2B207, 2B209, **2B225** to 2B233, 2D002, 2D201 or 2D202 for NP reasons.

2E290 “Technology” according to the General Technology Note for the “use” of equipment controlled by 2A290, **2A291**, 2A292, 2A293, or 2B290.

Appendix 2

Examples of changes to scope of research that may affect ECCN assessment.

ECCN or Other Jurisdiction	Description	Assessment Per Paper	License Required if Foreign Nexus?
0B999	Specific processing equipment, as follows: a. Hot cells; b. Glove boxes suitable for use with radioactive materials.	Equipment only	Maybe if equipment is sent -Low concern - only controlled to countries under embargo or sanction and denied parties
ECCN or Other Jurisdiction	Description	Assessment Per Paper	License Required if Foreign Nexus?
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.	Out of scope of current FES work	If in scope due to catalyst work in combination with heavy water for tritium recovery – Controlled for Nuclear Nonproliferation and Anti-Terrorism – Depends on country
1B228	Hydrogen cryogenic distillation columns having all of the characteristics described in this ECCN a. Designed to operate with internal temperatures of 35 K (-238 °C) or less; b. Designed to operate at an internal pressure of 0.5 to 5 MPa (5 to 50 atmospheres); c. Constructed of “fine-grain stainless steels” of the 300 series with low sulphur content or equivalent cryogenic and H ₂ -compatible materials; <i>and</i> d. With internal diameters of 30 cm or greater and “effective lengths” of 4 m or greater.	All characteristics not met	If characteristics met: Primary concern is d. and diameter and length requirements. Other criteria will most likely be met. Need to address if equipment is shipped. – Controlled for Nuclear Nonproliferation and Anti-Terrorism – Depends on country
1B231	Tritium facilities or plants, and equipment therefor, as follows: 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; <i>or</i> b.2. Hydrogen isotope storage and purification systems using metal hydrides as the storage, or purification medium.	Equipment only	Need to address if equipment is shipped – Controlled for Nuclear Nonproliferation and Anti-Terrorism – Depends on country
1C235	Tritium, tritium compounds, mixtures containing tritium in which the ratio of tritium to hydrogen atoms exceeds 1 part in 1,000,	Material only	Need to address if material is shipped

ECCN or Other Jurisdiction	Description	Assessment Per Paper	License Required if Foreign Nexus?
	and products or devices containing any of the foregoing.		– Controlled for Nuclear Nonproliferation and Anti-Terrorism – Depends on country
1E001	“Technology” according to the General Technology Note for the “development” or “production” of items controlled by... 1B (except 1B608, 1B613 or 1B999), 1C (except 1C355, 1C608, 1C980 to 1C984, 1C988, 1C990, 1C991, 1C995 to 1C999))...		If not covered under NSDD 189 requirements may need to be addressed dependent on country – Controlled for Nuclear Nonproliferation and Anti-Terrorism
1E201	“Technology” according to the General Technology Note for the “use” of items controlled by... 1B228 to 1B232... 1C225 to 1C237...	Use only, allows for R&D	If complete tritium system is being defined in work this may need to be addressed. – Controlled for Nuclear Nonproliferation and Anti-Terrorism – Depends on country
ECCN or Other Jurisdiction	Description	Assessment Per Paper	License Required if Foreign Nexus?
2A226	Valves having all of the following characteristics (see List of Items Controlled). a. A “nominal size” of 5 mm or greater; b. Having a bellows seal; <i>and</i> c. Wholly made of or lined with aluminum, aluminum alloy, nickel, or nickel alloy containing more than 60% nickel by weight.	Equipment only, all characteristics not met, (c.)	Need to address if equipment is shipped – Controlled for Nuclear Nonproliferation and Anti-Terrorism – Depends on country
2A291	Equipment, except items controlled by 2A290, related to nuclear material handling and processing and to nuclear reactors, and “parts” and “components” and “accessories” therefor.	Excluded, not a Nuclear Reactor	?
2B225	Remote manipulators that can be used to provide remote actions in radiochemical separation operations or hot cells, having either of the following characteristics (see List of Items Controlled).	Equipment only	Need to address if equipment is shipped – Controlled for Nuclear Nonproliferation and Anti-Terrorism – Depends on country
2D290	“Software” “specially designed” or modified for the “development”, “production” or “use” of items controlled by 2A290, 2A291 , 2A292, 2A293, or 2B290.	No software development	If software development is being done then assessment should be addressed – Controlled for Nuclear Nonproliferation, and Anti-Terrorism – Depends on country
2E001	“Technology” according to the General Technology Note for the “development” of equipment or “software” controlled by 2A (except 2A983, 2A984, 2A991, or 2A994), 2B (except 2B991, 2B993, 2B996, 2B997, 2B998,	No Match for Controlled Items Listed	When research direction becomes more specific to industrial processes as opposed to fundamental research for identified

ECCN or Other Jurisdiction	Description	Assessment Per Paper	License Required if Foreign Nexus?
	or 2B999), or 2D (except 2D983, 2D984, 2D991, 2D992, or 2D994).		areas assessment should be reviewed. – Controlled for National Security, Missile Technology, Nuclear Nonproliferation, Chemical & Biological Weapons, and Anti-Terrorism – Depends on country
2E201	“Technology” according to the General Technology Note for the “use” of equipment or “software” controlled by 2A225, 2A226 , 2B001, 2B006, 2B007.b, 2B007.c, 2B201, 2B204, 2B206, 2B207, 2B209, 2B225 to 2B233, 2D002, 2D201 or 2D202 for NP reasons.	Use only, allows for R&D	When research direction becomes more specific to use as opposed to fundamental research for identified areas assessment should be reviewed. – Controlled for Nuclear Nonproliferation, Chemical & Biological Weapons, and Anti-Terrorism – Depends on country
2E290	“Technology” according to the General Technology Note for the “use” of equipment controlled by 2A290, 2A291 , 2A292, 2A293, or 2B290.	Use only, allows for R&D	When research direction becomes more specific to use as opposed to fundamental research for identified areas assessment should be reviewed. – Controlled for Nuclear Nonproliferation, Chemical & Biological Weapons, and Anti-Terrorism – Depends on country
ECCN or Other Jurisdiction	Description	Assessment Per Paper	License Required if Foreign Nexus?
NRC 10 CFR 110 Appendix L	Tritium, tritium compounds, and mixtures containing tritium that are byproduct material (e.g., produced in a nuclear reactor)	Material only	General License may be applicable – See 10 CFR 110.23
NRC 10 CFR 110.24	Deuterium	Material only	General License may be applicable – Depends on quantity and country
DOE 10 CFR 810.2 (c)(4)	This part does not apply to nuclear fusion reactors per se, except for supporting systems involving hydrogen isotope separation technologies within the scope of (b)(7) and 810.7(c)(3) (b)(7) Heavy water production and hydrogen isotope separation when the technology or process has reasonable potential for large-scale separation of deuterium from protium	Technology only Not heavy water production Not large scale	If large scale separation – DOE doesn’t license itself when program already approved by the Secretary of Energy

ECCN or Other Jurisdiction	Description	Assessment Per Paper	License Required if Foreign Nexus?
	810.7(c)(3) Engaging in or providing technology (including assistance) for any of the following activities with respect to any foreign country or entity (or a citizen or national of that country other than U.S. lawful permanent residents or protected individuals under the Immigration and Naturalization Act: Heavy water production and hydrogen isotope separation when the technology or process has reasonable potential for large-scale separation of deuterium from protium.		

ⁱ <http://www.bis.doc.gov/index.php/licensing/commerce-control-list-classification/export-control-classification-number-eccn>

ⁱⁱ Part 772 – Definitions of Terms, 2015-05-21

ⁱⁱⁱ Part 774, Supplement 1, 15 CFR Ch. VII (1-1-12 Edition)

^{iv} Commerce Control List, Supplement No.1 to Part 774 Category 1, 2015-07-22

^v Commerce Control List, Supplement No.1 to Part 774 Category 2, 2015-07-22

^{vi} ITER Intranet, Techweb, Export Control