

***List of Nuclear –Related Dual –use Equipment, Materials, Software, and Related Technology***

1. Industrial Equipment
2. Materials
3. Uranium isotope separation equipment and components (other than trigger list items)
4. Heavy water production plant related equipment
5. Test and measurement equipment for the development of nuclear explosive devices
6. Components for nuclear explosive devices

***1. Industrial Equipment***

Equipment , Assemblies and components

- High density radiation shielding windows
- Radiation-hardened TV cameras, or lenses
- Robots, end-effectors and control units
- Remoter manipulators

Test and Production Equipment

- Flow-forming machines, spin-forming machines capable of flow forming functions and mandrels
- Machine tools
- Dimensional inspection machines, instruments or systems
- Controlled atmosphere induction furnaces, and power supplies
- Isostatic presses, and related equipment
- Vibration test systems, equipment and components

- Vacuum or other controlled atmosphere metallurgical melting and casting furnaces and related equipment

Materials, software, technology

## ***2.Materials***

Equipment , Assemblies and components

Crucibles made of materials resistant to liquid actinide metals

Platinized catalyst

Composite structures in the forms of tubes

Test and Production Equipment

Titanium facilities or plants, and equipment therefor

Materials,

Aluminium, Beryllium, Bismuth, Boron, Calcium, Chlorine trifluoride, Fibrous or filamentary materials and preregs, Hafnium, Lithium, Magnesium, Maraging steel, Radium -226, Titanium, Tungsten, Zirconium ,Nickel powder and porous nickel metal, Tritium, Helium -3, Alpha-emitting radionuclides

software, technology

## ***3.Uranium isotope separation equipment and components(other than trigger list items)***

Equipment , Assemblies and components

Frequency changers or generators

Lasers, laser amplifiers and oscillators, Valves

Superconducting solenoidal electromagnets

High power direct current power supplies

High voltage direct current power supplies

Pressure transducers

Vacuum pumps

Test and productive equipment

Electrolytic cells for fluorine production

Rotor fabrication or assembly equipment, rotor straightening equipment, bellow-forming mandrel and dies

Centrifugal multiplane balancing machine

Filament winding machines and related equipment

Electromagnetic isotope separation

Materials, software, technology

***4. Heavy Water Production Plant Related Equipment (other than trigger list items)***

Equipment , Assemblies and components

Specialized packings

Pumps

Turboexpanders or turboexpander-compressor sets

Test and productive equipment

Water-hydrogen sulfide exchange tray columns and internal contactors

Hydrogen cryogenic distillation columns

Ammonia synthesis converters or synthesis units

Materials, software, technology

***5. Test and Measurement Equipment for the Development of Nuclear Explosive Devices***

Equipment , Assemblies and components

Photomultiplier tubes

Test and productive equipment

Flash X ray generators or pulsed electron accelerators

Multistage light gas guns or other high velocity gun systems

Mechanical rotating mirror cameras

Electronic streak cameras, electronic framing camera, tubes and devices

Specialized instrumentation for hydrodynamic experiments

High speed pulse generators

Materials, software, technology

### ***6.Components for Nuclear Explosive Devices***

Equipment , Assemblies and components

Photomultiplier tubes Detonators and multipoint initiation systems

Firing sets and equivalent high current pulse generators

Switching devices

Pulse discharge capacitors

Neutron generator systems

Test and productive equipment

Materials

High explosive substances or mixtures

software, technology

| No | Nuclear Material   | Non-Nuclear Material  |
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| 1  | <p><b>Uranium and Thorium</b><br/>Natural Uranium, depleted uranium, thorium</p>   | <p><b>Aluminum alloys</b><br/>-Capable of tensile strength 460MPa or more at 293K (20C)<br/>-In the form of tubes or cylindrical solid forms(including forgings) with an outside diameter of more than 75mm</p>   |
| 2  | <p><b>Low Enriched Uranium (LEU), or plutonium</b><br/>Less than 20% enriched of U-233, U-235 or both,80% exceeding Pu-238</p>   | <p><b>Beryllium</b><br/>Metal, alloys containing more than 50% beryllium by weight, beryllium compounds, manufacturers thereof, and waste or scrap of any of the foregoing. The following do not include in this item<br/>1.Metal windows for X ray machines or for bore-hole logging devices;<br/>2.Oxide shapes in fabricated or semi-fabricated forms especially designed for electronic component parts or substrates for electronic circuits<br/>3.Beryl (silicate of beryllium and aluminium) in the form of emeralds or aquamarines.</p> |
| 3  | <p>Highly Enriched Uranium (LEU), or plutonium 20% and more enriched U-233,235 or both, less than 80% Pu-238<br/>The following items are not prohibited, but are required to be reported;<br/>1.Sub-gram amounts of the special fissionable material in the form of<br/>a).Certified reference material, b).instrument calibration source or<br/>c).sensing component in instruments</p> | <p><b>Bismuth</b><br/>1.A purity of 99.99% or greater in weight and<br/>2.Containing less than 10ppm by weight of silver</p>  |
| 4  | Irradiated nuclear fuel  | <p><b>Boron</b><br/>Boron enriched in the boron-10 (<sup>10</sup>B) isotope to</p>  |

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|    |  | greater than its natural isotopic abundance(~18.5 weight percent)   |
| 5  | Neptunium-237<br>Neptunium Enriched to 20% or more | <b>Calcium</b><br>1.Containing less than 2000 parts per million by weight of metallic impurities other than magnesium; and<br>2.Containing less than 20 parts per million by weight of boron.   |
| 6  |  | <b>Chlorine trifluoride</b>   |
| 7  |  | <b>Fibrous or filamentary materials and preregs</b><br>1.carbon or aramid fibrous or filamentary materials having either of the following characteristics (specific modulus of $12.7 \times 10^6$ m or greater or , specific tensile strength of $23.5 \times 10^4$ m)<br>2. Glass fibrous or filamentary materials having both of the following characteristics (specific modulus of $3.18 \times 10^6$ m or greater, and specific tensile strength of $7.62 \times 10^4$ m or greater)<br>3. thermoset resin impregnated continuous yarns, rovings tows or tapes with a width of 15mm or less.<br>4. composite structures in the form of tubes;<br>-Inside diameter of between 75 and 400mm<br>-made with any of the materials (carbon,glass thermoset.,) |
| 8  |  | <b>Hafnium</b><br>Hafnium metal,alloys containing more than 60% by weights, and hafnium compounds containing more than 60% hafnium by weight<br>Lithium -6( <sup>6</sup> Li) greater than its natural isotopic abundance(~6.5 weight percent)   |
| 9  |  | <b>Magesium</b><br>-Containing less than 2000 parts per million by weight of metallic impurities other than calcium; and<br>-Containing less than 20 parts per million by weight of boron .   |
| 10 |  | <b>Maraging steel</b><br>Capable of an ultimate tensile strength of 2050 MPa at 293K (all linear dimension greater than 75mm)   |
| 11 |  | <b>Radium-226</b> ( <sup>226</sup> Ra) alloys, compounds mixtures and products.<br>Medical applicators and product or device containing less than 0.37 GBq of radium 226 do not include in this item.   |

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| 12 | <p><b>Titanium</b><br/>Alloys capable of having ultimate tensile strength 900MPa or more at 298K.<br/>In the form of tubes or cylindrical solid forms (including forgings) with an outside diameter of more than 75mm.</p>  |
| 13 | <p><b>Tungsten</b><br/>Tungsten, tungsten carbide, and alloys containing more than 90% tungsten by weight having both following characteristics<br/>-in the form with a hollow cylindrical symmetry with an inside between 100 and 300mm and<br/>- a mass greater than 20kg</p>   |
| 14 | <p><b>Zirconium</b><br/>Zirconium with a hafnium contents of less than 1 part hafnium to 500 parts zirconium by weight (does not include 0.1mm or less)</p>   |
| 15 | <p><b>Nickel</b><br/>-Nickel powder (99.0% or greater nickel purity, particle size of less than 10 um measured by ASTM B 330 standard)<br/>-Porous nickel metal product produced from above specified materials</p>   |
| 16 | <p><b>Tritium</b><br/>Compound, mixtures containing tritium (1:1000) tritium to hydrogen ratio</p>  |
| 17 | <p><b>Helium</b><br/>Helium-3 (<sup>3</sup> He) mixtures containing helium 3 and products or devices containing any of foregoing</p>  |
| 18 | <p><b>Alpha sources</b><br/>Alpha emitting radionuclide having an alpha half life of 10 days or greater but less than 200years, in the following forms;<br/>-Elemental, Compounds having a specific alpha activity of 37 GBq per kg or greater, Mixtures having a specific alpha activity of 37GBq per kg or greater, Products or devices containing any of the foregoing</p> |
| 19 | <p><b>Tantalum</b><br/>Tantalum sheets with a thickness of 2.5mm or greater from which a circle of 200mm diameter can be obtained.</p>  |