3101. cont'd.

b. 3. e. Heat exchangers made of aluminium, copper, nickel or alloy containing more than 60 weight percent (o/w) nickel, or combinations of these metals as clad tubes, designed to operate at pressures of 6×10^5 pascal (6 bar) or less;

4. Chemical exchange separation process:
   a. Fast-exchange liquid-liquid centrifugal contactors or fast exchange liquid-liquid pulse columns made of fluorocarbon lined materials;
   b. Electrochemical reduction cells designed to reduce uranium from one valence state to another;
5. Ion-exchange separation process, including fast reacting ion-exchange resins: pellicular, reticulated resins in which the active chemical exchange groups are limited to a coating on the surface of an inert particle or fibre;
6. Atomic vapour "laser" isotopic separation process:
   a. High power electron beam guns with total power of more than 50 kW and strip or scanning electron beam guns with a delivered power of more than 2.5 kW/cm for use in uranium vaporization systems;
   b. Trough shaped crucible and cooling equipment for molten uranium;
   c. Product and tails collector systems made of or lined with materials resistant to the heat and corrosion of uranium vapour, such as yttria-coated graphite;
7. Molecular "laser" isotopic separation process:
   a. Para-hydrogen Raman shifters designed to operate at 16 µm output wavelength and at a repetition rate of more than 250 Hz;
   b. Supersonic expansion nozzles designed for UF_6 carrier gas;
   c. Uranium fluoride (UF_5) product filter collectors;
   d. Equipment for fluorinating UF_5 to UF_6;
   e. UF_6 carrier gas compressors wholly made of or lined with aluminium, aluminium alloys, nickel or alloy containing 60 weight percent (o/w) or more nickel, including compressor seals;
8. Plasma separation process:
   a. Product and tails collectors made of or lined with materials resistant to the heat and corrosion of uranium vapour such as yttria-coated graphite;
   b. Radio frequency ion excitation coils for frequencies of more than 100 kHz and capable of handling more than 40 kW power;
9. UF_6 mass spectrometers or ion sources specially designed or prepared for taking on-line samples of feed, product or tails from UF_6 gas streams and having all of the following characteristics:
   a. Unit resolution for mass of more than 320;
   b. Ion sources constructed of or lined with nichrome or monel, or nickel plated; **and**
   c. Electron bombardment ionization sources.

Technical Notes:

1. *The following "lasers" and components are important in the atomic vapour "laser" isotopic separation process referred to in 3101.b.6.:*
   a. *"Lasers" to pump dye "lasers":*
      1. *Copper vapour "lasers" of 40 W or more;*
      2. *Argon ion "lasers" of more than 40 W;*
      3. *ND:YAG "lasers" that can be frequency doubled and thereby have an average power of more than 40 W;*
   b. *Other "lasers" and accessories:*
      1. *"Tunable" pulsed dye "laser" amplifiers and oscillators, except single-mode oscillators, with an average power of more than 30 W, a repetition rate of more than 1 kHz and a wavelength between 500 nm and 700 nm;*
      2. *Modulators for controlling and modifying dye "laser" bandwidth;*
      3. *"Tunable" pulsed single-mode dye oscillators capable of an average power of more than 1 W, a repetition rate of more than 1 kHz, a pulse width less than 100 ns, a wavelength between 500 nm and 700 nm and frequency modulation for bandwidth expansion.*
      (For the embargo status of "lasers", see International Industrial List Category 1061.5.)
2. *The following "lasers" are important in the molecular "laser" isotopic separation process referred to in 3101.b.7.:*
   a. *Alexandrite "lasers" with a bandwidth of 0.005 nm (3 GHz) or less, a repetition rate of more than 125 Hz, and an average power of more than 30 W;*
   b. *Pulsed carbon dioxide "lasers" with a repetition rate of more than 250 Hz, an average power of more than 1.2 kW and a pulse length less than 200 ns;*
   c. *Pulsed excimer "lasers" (XeF, XeC1, KrF) with a repetition rate of more than 250 Hz and an average power of more than 250 W;*
   (For the embargo status of "lasers", see Category 1061.5.)
3. *The following microwave power sources and "superconductive" electromagnets are important in the plasma separation process referred to in 3101.b.8.:*
   a. *Microwave power sources of more than 30 GHz and more than 50 kW for ion production;*
   b. *Solenoidal "superconductive" electromagnets of more than 30 cm inner diameter, with a magnetic field of more than 2 T and uniform to better than 1% over the central 80% of the inner volume;*
   (For the embargo status of: Microwave power sources, see Category 1031.1.b.; "Superconductive" electromagnets, see Category 1031.1.e.3.).

3102. Plants for the reprocessing of irradiated nuclear reactor fuel elements, and specially designed or prepared equipment and components therefor, including:

a. Fuel element chopping or shredding machines, i.e. remotely operated equipment to cut, chop, shred or shear irradiated nuclear reactor fuel assemblies, bundles or rods;
b. Criticality safe tanks (e.g. small diameter, annular or slab tanks) specially designed or prepared for the dissolution of irradiated nuclear reactor fuel, which are capable of withstanding hot, highly corrosive liquids, and which can be remotely loaded and maintained;
c. Counter-current solvent extractors and ion-exchange processing equipment specially designed or prepared for use in a plant for the reprocessing of irradiated natural uranium, depleted uranium or "special fissile materials" and other fissile materials;
d. Process control instrumentation specially designed or prepared for monitoring or controlling the reprocessing of irradiated source and "special fissile materials" and other fissile materials.

Technical Note:

A plant for the reprocessing of irradiated nuclear reactor fuel elements includes equipment and components which normally come into direct contact with and directly control the irradiated fuel and the major nuclear material and fission product processing streams.

Statement of Understanding

Counter-current solvent extractors specially designed for use with nuclear propulsion equipment are embargoed by 3202. Certain other counter-current solvent extractors are embargoed by 3101.b.

3103. Nuclear reactors, i.e. reactors capable of operation so as to maintain a controlled, self-sustaining fission chain reaction, and equipment and components specially designed or prepared for use in connection with a nuclear reactor, including:

a. Pressure vessels, i.e. metal vessels as complete units or as major shop-fabricated parts therefor, which are specially designed or prepared to contain the core of a nuclear reactor and are capable of withstanding the operating pressure of the primary coolant, including the top plate for a reactor pressure vessel;
b. Fuel element handling equipment, including reactor fuel charging and discharging machines;
c. Control rods, i.e. rods specially designed or prepared for the control of the reaction rate in a nuclear reactor, including the neutron absorbing part and the support or suspension structures therefor, and control rod guide tubes;
d. Electronic controls for controlling the power levels in nuclear reactors, including reactor control rod drive mechanisms and radiation detection and measuring instruments to determine neutron flux levels;
e. Pressure tubes, i.e. tubes specially designed or prepared to contain fuel elements and the primary coolant in a nuclear reactor at an operating pressure in excess of 50 bars (atmospheres);
f. Coolant pumps, i.e. pumps specially designed or prepared for circulating the primary coolant of nuclear reactors;