i. Molecular pumps comprised of cylinders having internally machined or extruded helical grooves and internally machined bores;

j. Ring-shaped motor stators for multiphase AC hysteresis (or reluctance) motors for synchronous operation within a vacuum in the frequency range of 600 to 2,000 Hz and a power range of 50 to 1,000 Volt-Amps;

k. Frequency changers (converters or inverters) specially designed or prepared to supply motor stators for gas centrifuge enrichment, having all of the following characteristics, and specially designed components therefor:

1. Multiphase output of 600 Hz to 2 kHz;
2. Frequency control better than 0.1%;
3. Harmonic distortion of less than 2%; and
4. An efficiency greater than 80%;

NOTE:
The high strength-to-density ratio materials used for centrifuge rotating components are:

a. Maraging steel capable of an ultimate tensile strength of 2.05×10^9 N/m2 or more;

b. Aluminium alloys capable of an ultimate tensile strength of 0.46×10^9 N/m2 or more; or

c. "Fibrous and filamentary materials" with a "specific modulus" of more than 3.18×10^6 m and a "specific tensile strength" greater than 7.62×10^4 m.

3. Aerodynamic separation process:
   a. Separation nozzles consisting of slit-shaped, curved channels having a radius of curvature less than 1 mm. Contained within the nozzle is a knife-edge which separates gas flowing through the nozzle into two streams;
   b. Tangential inlet flow-driven cylindrical or conical tubes, specially designed for uranium isotope separation;
   c. UF6-hydrogen helium compressors wholly made of or lined with aluminium, aluminium alloys, nickel or alloy containing 60% or more nickel, including compressor seals;
   d. Aerodynamic separation element housing, designed to contain vortex tubes or separation nozzles;
   e. Heat exchangers made of aluminium, copper, nickel, or alloys containing more than 60% 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;

   N.B.:
   The "lasers" and components, specified as follows, are important in atomic vapour "laser" isotopic separation:
   (For the embargo status of "lasers", see Category 1061.5.)
   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.
7. Molecular "laser" isotopic separation process:
   a. Para-hydrogen Raman shifters designed to operate at 16 micrometres 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% or more nickel, including compressor seals;

   N.B.:
   The "lasers", specified as follows, are important in molecular "laser" isotopic separation:
   (For the embargo status of "lasers", see Category 1061.5.)
   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;
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;

   N.B.:
   Microwave power sources and superconductive electromagnets, specified as follows, are important in the plasma separation process:
   (For the embargo status of microwave power sources, see Category 1031.1.b.)
   (For the embargo status of "superconductive" electromagnets, see Category 1031.1.e.3.)
   a. Microwave power sources of more than 30 GHz and greater 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;
9. UF_6 mass spectrometers/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;
   c. Electron bombardment ionization sources; and
   d. Collector systems suitable for isotopic analysis.

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

3102. 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