Case Study: A university is conducting research into laser isotopic separation of Si and decides to try separation of uranium isotopes.

In the burgeoning area of quantum computing research, one idea holds that nuclear spins of $^{29}\text{Si}$ in a nuclear spin-free matrix of $^{28}\text{Si}$ and $^{29}\text{Si}$ can be used as a quantum bits (qubits). Natural silicon is only 4.7% $^{29}\text{Si}$, so producing isotopically enriched high quality bulk single crystals is difficult. To support this research, a university develops a program of atomic vapour laser isotopic separation (AVLIS) of silicon. As a side project, the group also tests feeding vapourised uranium into the system to determine if uranium enrichment is possible.

This type of experiment would require a permit from ASNO. If this research was not made known to ASNO then not only would it be in breach of the Safeguards Act, but this would be considered by the IAEA as undeclared uranium enrichment, in breach of Australia’s safeguards agreement.

- The researchers should seek early advice from ASNO. With upcoming changes to the declarations of associated equipment, equipment in this example may require a permit under the Safeguards Act even in the absence of any uranium experimentation. Furthermore, if the research results are to be shared with a foreign national the researchers should seek guidance from the Department of Defence in accordance with the WMD Act.

Case Study: A university research group has a novel idea for uranium enrichment and is running computer simulations.

AVLIS separates isotopes of a given element by selective photo-ionisation. High-resolution, tunable lasers are used to exploit the hyperfine splitting of atomic levels due to neutron number differences between isotopes. This hyperfine splitting is in the range of GHz (~μeV). The photo-ionisation usually proceeds via a “pathway” of multi-step excitation transitions, with a great deal of importance placed on selection of the optimum “pathway”. A research group has an idea on a novel ionisation “pathway” for uranium photo-ionisation and runs computer simulations to quantify and test the process, with the ultimate aim of patenting the technique.

- As this is a novel enrichment idea, this clearly fits under the definitions of associated technology under the Safeguards Act, irrespective of whether any equipment is used or experimentation carried out. A permit for possession of associated technology and an authority to communicate information will be required. If in any doubt the researchers should contact ASNO immediately for a determination. Furthermore, if the research results are to be shared with a foreign national the researchers should seek guidance from the Department of Defence in accordance with the WMD Act.
The Nuclear Non-Proliferation Treaty (NPT) entered into force in Australia in 1973. Article III of the NPT requires signatory nations to conclude a comprehensive safeguards agreement with the International Atomic Energy Agency (IAEA), the template agreement for which is known as INFCIRC/153. Australia finalised its agreement with the IAEA in 1974*. The NPT enshrines the basic political commitments and is the principle treaty. The safeguards agreements however set out the mechanics of the verification system needed to facilitate the “trust but verify” mantra of international safeguards. To address weaknesses in INFCIRC/153 a model integrated safeguards agreement was finalised in 1997 — known as the Additional Protocol (INFCIRC/540). Australia was the first country to sign and ratify the Additional Protocol** — stamping its international safeguards credentials.

To give legislative strength to the provisions in the comprehensive safeguards agreement, the Nuclear Non-Proliferation (Safeguards) Act (“Safeguards Act”) was promulgated in 1987. This Act is the enabling legislation specifying the Australian Safeguards and Non-Proliferation Office (ASNO) as the regulatory authority for nuclear safeguards in Australia. One of ASNO’s major safeguards roles is compiling declarations and reports to the IAEA’s nuclear materials and activities, as specified in the safeguards agreements.

* Agreement between Australia and the IAEA for the application of safeguards in connection with the Treaty on the Non-Proliferation of Nuclear Weapons.
** Protocol Additional to the Agreement between Australia and the IAEA for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons.

The Safeguards Act specifies four “items” for regulatory control, being:

- **Nuclear materials:** uranium, plutonium and thorium.
- **Associated materials:** nuclear-grade graphite, high purity heavy water.
- **Associated equipment:** equipment or plant that is specially designed, manufactured or built for use, or is specially suited for use, in nuclear activities — and is declared as such by the Minister*. Examples being:
  - nuclear reactors and related specialist equipment;
  - plants for reprocessing or fabrication of nuclear fuel elements;
  - equipment designed or prepared for the separation of isotopes of uranium.
- **Associated Technology:** any document that contains information (other than that which is lawfully available) that is applicable primarily to the design, production, operation, testing or use of equipment such as that which can be used for enrichment, reprocessing or irradiation of nuclear material.

* Declaration in Commonwealth of Australia Gazette No. G15, 21 April 1987