ABSTRACT: Fission molybdenum-99 (Mo) is being produced in Argentina, at the Eneiza Atomic Centre since 1985. The procedure involved the irradiation of HEU targets with an Uranium-Aluminium alloy “meat” cladded with aluminium. At the end of the 1990s, the Atomic Energy National Commission of Argentina (CNEA) started the development of new LEU targets for its Mo production, in order to replace present HEU targets and in the year 2002 began to commercialize Mo from LEU targets. The production process was sold by the company INVAP to Australia, Egypt, Algeria and Coqui Pharma (USA). By 2018 Argentina expects to operate a new reactor to produce radioisotopes (RA-10) and to operate a new Radioisotope Production Plant from Fission. A description of these two facilities will be made. Considering the CTBTO recommended emission levels for Xenon-133 (133Xe) of less than 5 GBq per day, engineering resources and devices to reach these standards in the new plant will be proposed.

PAST

Technetium-99m (99mTc), decay product of 99Mo, is the radionuclide most widely employed in nuclear medicine practices. By this reason, production of fission 99Mo has become a major concern in radioisotope production. Fission 99Mo is being produced in the CNEA of Argentina since 1985, employing highly enriched uranium/aluminium alloy targets (HEU). Chemical processing of the targets is based on the method developed by Dr. Sameh Ali.

OLD Dissolution cell dimensions are: front 2 m, height 1,40 m and depth 1,35 m. It has two motorized master-slave manipulators Central Research model G, US made, motorized movement on coordinator y, with bellows and airtight lock closing the box. It has air tight boxes (alpha, beta, gamma) of stainless steel, 3 mm thickness and are connected to the ventilation system and a shielding of 20 cm of lead.

The Argentine research and production reactor RA-3 (5 MW power – HEU MTR fuel elements) was inaugurate in December 1967 to cover the national demand of radioisotopes for medical use. The experience acquired allowed the design and construction of several other reactors. The reactors built by Argentina in Peru, Algeria, Egypt and Australia show this.

C.N.E.A. is first for having developed 99Mo and I-131 (131I) production methods with LEU, covering at present its own demands and an exportable balance. Bearing in mind commitment of Argentina towards the Treaty on Non-Proliferation of Nuclear Weapons (NPT) and world initiatives for stricter control of nuclear material, C.N.E.A. began in 2002 producing 99Mo with Lowly Enriched Uranium (LEU) and from 2006 131I. In the year 2000 the RA-3 reactor increases power: 5 to 10MW and change HEU to LEU MTR fuel elements.

Targets are irradiated in the RA-3 reactor core during 100 hours with a neutron flux of 1x10^14 n/cm^2.s and ten hours of cooling in reactor pool before of the transport to RPR. Uranium enrichment: 19.7% U – 235: 1.4 grams Total Uranium: 7.0 grams Al in “cladding”: 1.1grams Al in “meat”: 4.6 grams

NEW Dissolution cell dimensions are: front 2 meters(m), height 1,65 m and depth 1,5 m. It has 2 motorized master-slave manipulators HWM, German made, model NBL - A100, motorized movement on coordinators x and y and a shielding of 30 cm of lead. Other characteristics are equal to old cell. The dissolutions of the targets has increased five times.

PRESENT

LEU Aluminide Targets for Fission 99Mo Production

The irradiated targets are dissolved in alkaline solution

Chemical reaction

Al + NaOH + H2O → NaAlO2 + 3/2 H

The Production Process starts with the Filtration of the solution. It involves all Purification steps of 99Mo. It extends 12 hours after completion.

FUTURE

By 2018 the Argentina expects to operate a new Reactor to produce radioisotope (RA-10) and to operate a new Radioisotope Production Plant from Fission.

The RA-10 reactor is conceived as a multipurpose facility suitable for radioisotopes production, materials and fuel irradiation, neutron techniques applications and silicon doping. Operation cycle :26 continuous days.

The design is based on LEU fuel elements and must meet the Argentinian Safety Regulations and International Atomic Energy Agency (IAEA) Standards

Emissions of 133Xe

The percentage of activity corresponds to the moment when was originated. The Production Process coincides the origin and the emission. Air and Hydrogen was originated 4 weeks before of release.

Weekly inventory

CTBTO recommended emission levels: 5 GBq/day

Air-Activity of 133Xe: 0.795 x 4.25 10^6 GBq ;

To emit 5 GBq should be reduced 77500 times 16 periods are needed (T of 133Xe is 5.24 days) ; 12 weeks decaying

Hydrogen- Activity of 133Xe: 0.2 x 4.25 10^6 GBq ; 8.50 10^5 GBq ;

To emit 5 GBq should be reduced 17000 times 14 periods are needed (T of 133Xe is 5.24 days) ; 10 weeks decaying

Production Process: 133Xe: 0.005 x 4.25 10^6 GBq ; 2.12 10^5 GBq ;

To emit 5 GBq should be reduced 400 times Leaks should be minimized during the Production Process