T2.4-P7

Radioisotopes Production in Argentina. Change of HEU to LEU and improvements to reduce the emissions of Radioxenon

E.C. Carranza, P. Cristini, A. Novello, M. Bronca, R. Bavaro, D. Cestau , R. Centurión, P. Bronca, E. Gualda, H. Spinelli, C. Bravo, L. Ivaldi, G. Meyer, D. Villalba, F. Nieli, L. Santarén

ABSTRACT: Argentina was the first country in the world to change the Molybdenum-99 production process from HEU (high enrichment Uranium) to LEU (low enrichment Uranium) bearing in mind commitment towards the Treaty on Non-Proliferation of Nuclear Weapons (NPT) and world initiatives for stricter control of nuclear materials. In 1985 the Fission Radioisotope Production Plant from (FRPP) began to produce commercially Molybdenum-99 with HEU targets and in 2002 they were changed to LEU. The production process starts with the dissolution of the uranium / aluminum compound targets in an alkaline medium and continues with 4 purification steps. In this type of process three main ways of emission of radioxenon to the environment can be distinguished. These ways are air, hydrogen and production process, they are analyzed and quantified. The FRPP taking into account the recommendations of CTBTO and IAEA is developing and implementing actions to reduce emissions of radioxenon. For this purpose, the volume of the decaying tanks will be increased, the separation of the hydrogen from the noble gases will be carried out and improvements have been made to the production process.

Change of HEU to LEU

1989, RA-3 Reactor Core was converted to LEU Fuel.

1985-2002, ^{99}Mo Commercial Production from HEU targets.

2002-present, ^{99}Mo Commercial Production Conversion from HEU to LEU.

2005, Commercial Production of Fission ^{131}I as a by-product of the ^{99}Mo Production

CNEA was the first producer to develop ^{99}Mo and ^{131}I production methods with LEU, covering at present its own demands and exports to Brazil.

Transportation from RA-3 reactor is accomplished through an internal corridor. Motorized shielding of 23 cm of lead. Capacity for carrying up to four targets.

Uranium aluminide targets are irradiated in the RA-3 reactor core during 108-120 hours with a neutron flux of 1x10^{14} n/cm2x sec. and nine hours of cooling in reactor pool.

Production Process

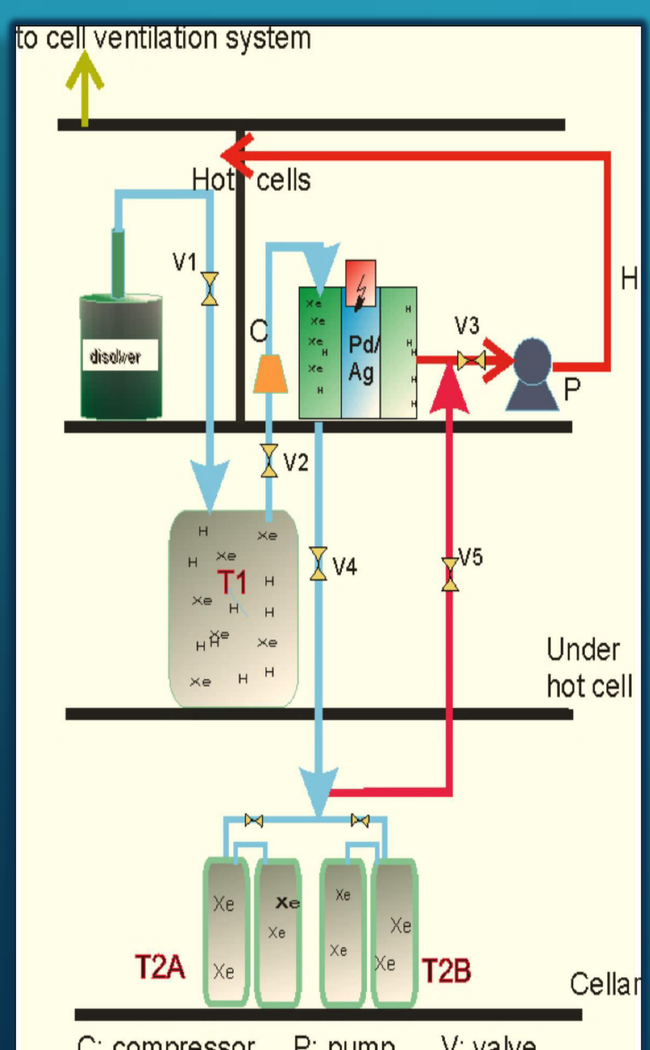
Mo-99 RADIOCHEMICAL PROCESS FEATURES
Dissolution of LEU targets.
Filtration.
Ion Exchange Purification.

DISSOLUTION OF LEU TARGETS
Alkaline digestion.
Solution: ^{99}Mo, ^{131}I, ^{137}Cs and other F.P. soluble in alkaline medium.
Precipitate: UO_2 and insoluble F.P. (actinides, etc.).

FILTRATION
Sintered stainless steel plate. Non-fissioned Uranium remains in the precipitate.

MOLYBDENUM PURIFICATION
Molybdenum solution is loaded and stripped in four different columns of ion exchangers for purification and conditioning.
Finally, the ^{99}Mo is delivered for quality control and dispatch.

Improvements to Reduce the Emissions of Radioxenon



Palladium membrane system

***Hydrogen**-Is produced by Al during targets dissolution.*

Chemical reaction:

Al + NaOH + H2O → NaAlO2 + 3/2H$_2$

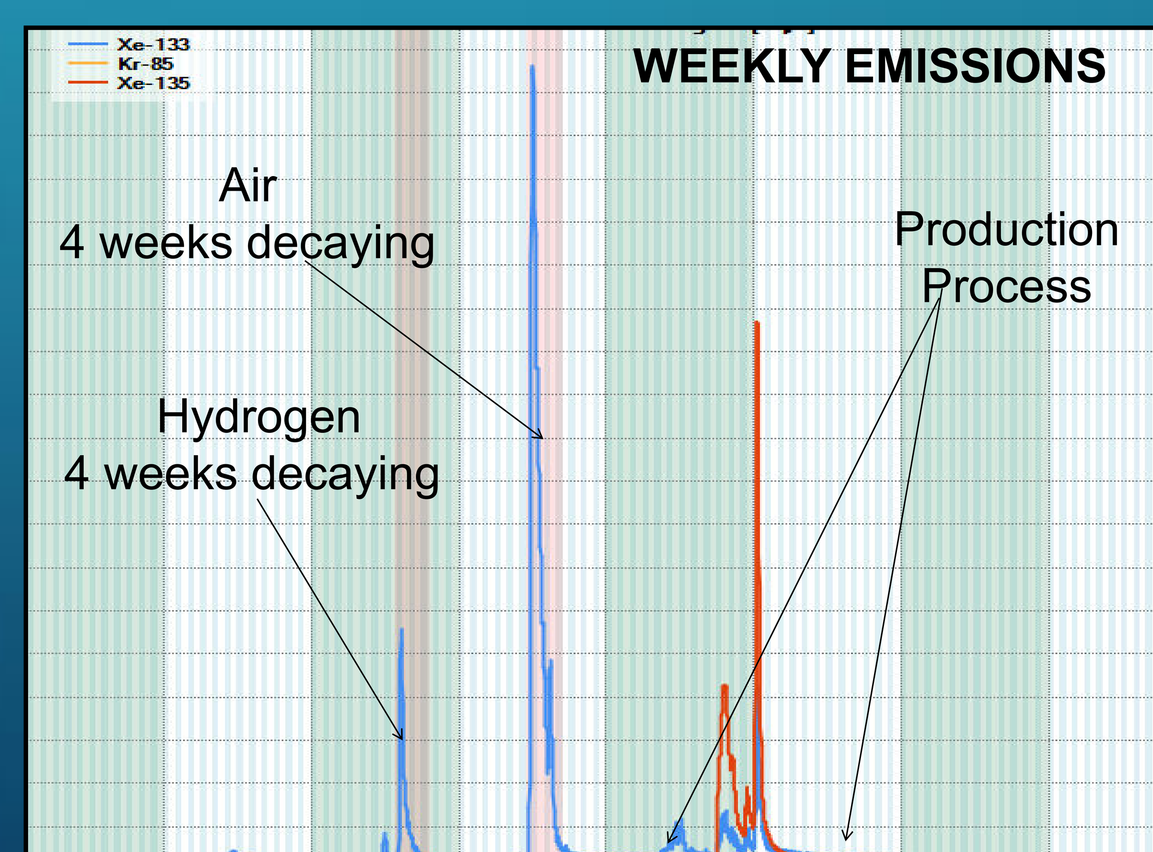
The hydrogen occupies more than 95% of the gases stored in this way.
The solution is based on the separation or capture of hydrogen.
In this manner the impurities can be stored, as the ^{133}Xe, in a smaller volume longer.
For hydrogen separation a palladium membrane will be used and for its capture hydrides forming materials will be used.
The minimum decay time for both cases is 13 weeks.
If we take into account emission reductions due to decay:
4 weeks: reduction factor: 35 times
13 weeks: reduction factor165000 times.

Therefore the emission will be reduced 4570 times

Three main ways of emission of ^{133}Xe

A. Air
B. Hydrogen
C. Production Process

All weekly emission is attributable to one of this three ways



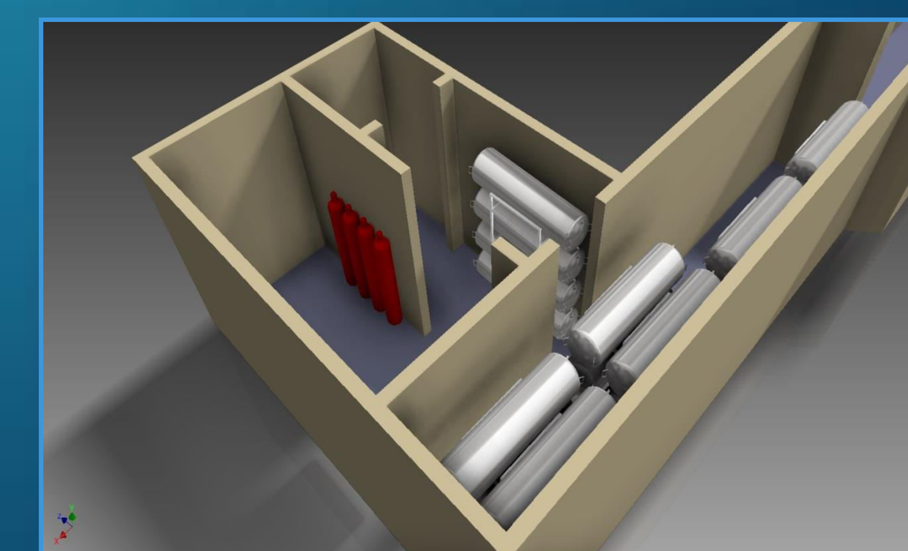
Air	Hydrogen	Production Process
40%	25%	35%

Percentage of weekly emissions

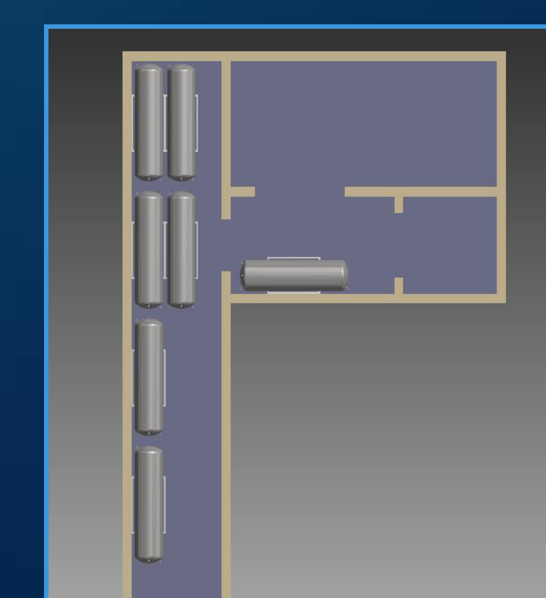
***Air**-Is used to move liquids in columns and vessels. The gases like ^{133}Xe are retained in tanks where vacuum has been made previously*

Air: Some of the existing tanks will be replaced.
The volume will increase by 80%.
The time of permanence in the tanks will increase from 4 to 8 weeks.
If we take into account emission reductions due to decay:
4 weeks: reduction factor: 35 times
8 weeks: reduction factor 1623 times.

Therefore the emission will be reduced 46 times



Future distribution of tanks in the cellar



The production process begins during the filtration of the solution, after dissolution. It involves all purification steps of Mo and iodine. The approximate time is 12 hours.

The production team in the last two years has planned the operations to reduce emissions during the production process.

The emission has decreased 20%. In addition, due to the increase of production the relation emission over production is even lower, nearly 40%.