Radioisotopes production technology -EGYPT experience

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ETRR2 Research Reactor

Opportunities and Approaches for Supplying Molybdenum-99 and Associated Medical Isotopes to Global Markets, symposium.

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Contents

Summary

- **The ETRR-2 complex consists of the ETRR-2 research Reactor, the Fuel Manufacturing pilot plant (FMPP), and the Radioisotope Production plant (RPF).**

- **The ETRR-2 is a 22 MW multipurpose reactor, while the FMPP plant produces the fuel elements for the reactor, and the RPF plant makes use of the irradiation capabilities of ETRR-2 reactor to produce radioisotopes for medicinal and industrial use. The three facilities are located in the Inshas site- EAEA – Egypt.**

- **The RPF was designed for the production of Mo-99, I-131, I-125, Cr-51,Ir-192,and Mo-99/Tc-99m generators.**

ETRR2 complex

ETRR2 - FMPP - RPF Complex

Milestones of RPF

• Construction and Civil Works	2004
• Pre-commissioning Tests	2007
• Commissioning (Cold and Hot tests)	2008
• Preliminary acceptance	2011
• final acceptance	2013

• Licensing and certification
  • Radiological plant & operator licenses (ENRRA – prime Ministry cabinet)
  • Radiopharmaceutical plant & product licenses (CAPA - Ministry of Healthy)
	2014

• Start regularly production	2015

RPF Facility description

The Plant has 12 hot cells to produce the following radioisotopes:

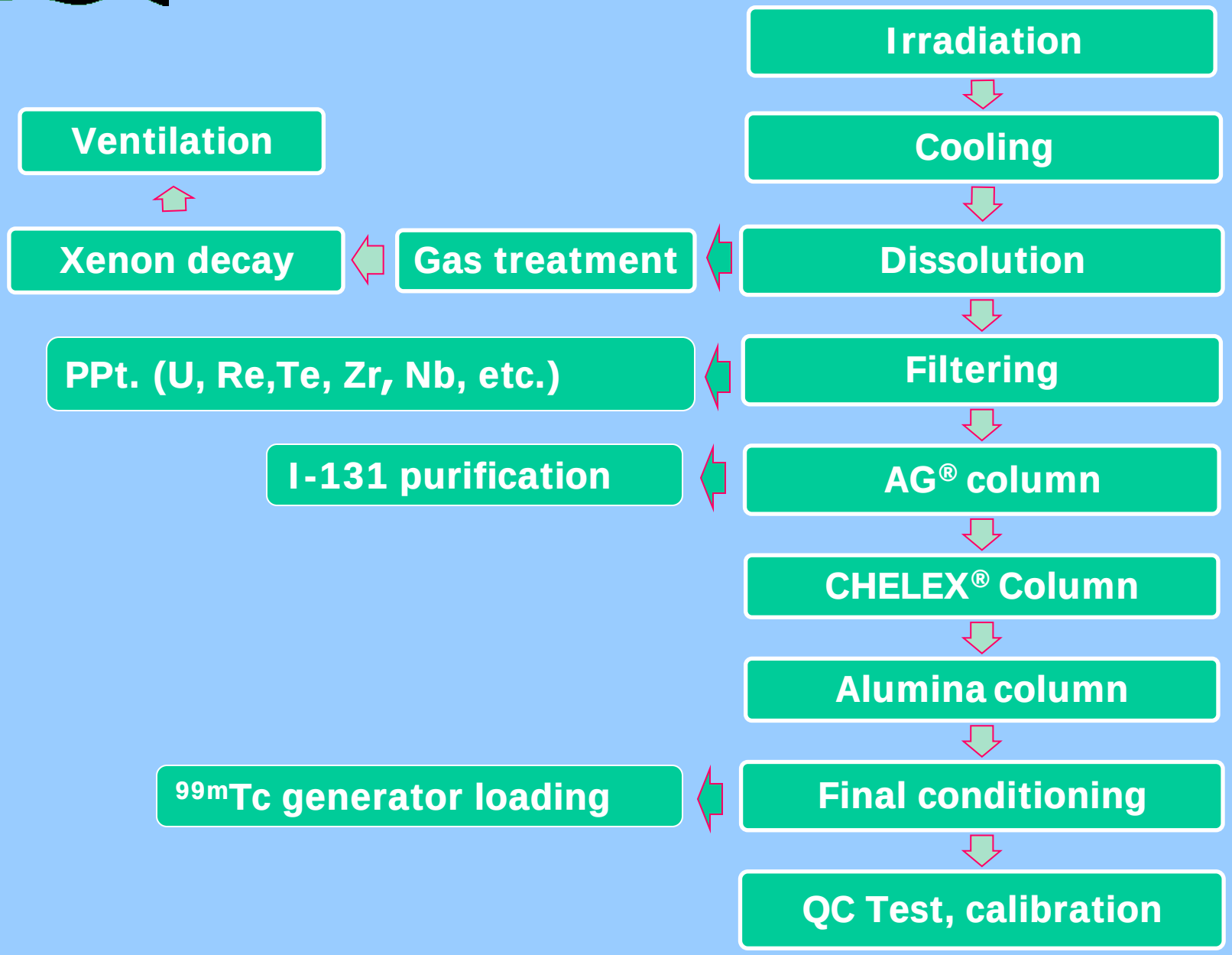
Radio isotope	description
Molybdenum- 99	(produced through the fission of LEU). The weekly production of Mo-99 will reach 200 Ci (6 days precal.)
Iodine -131	(produced through the fission of LEU): This radioisotope is used in nuclear medicine as therapeutic or diagnosis agent. The weekly production of I-131 will reach 30 Ci.
Iodine -125	(produced through the irradiation of Xenon gas): This radioisotope is used in nuclear medicine as therapeutic or diagnosis agent. The weekly production of I-125 will reach 5 Ci.
Chromium -51	(produced through the irradiation of potassium chromate targets): This radioisotope is used as injectable medical product. The weekly production will reach 500 mCi.
Iridium -192	(wire produced through the irradiation of iridium-platinum-alloy targets): This radioisotope is used in brachytherapy. The weekly production will reach 280 mCi.
Iridium -192	(produced through the irradiation of natural Iridium sheets): This radioisotope is used in sealed sources for industrial gamma radiography. The plant can produce sources of up to 100 Ci.

Facility description

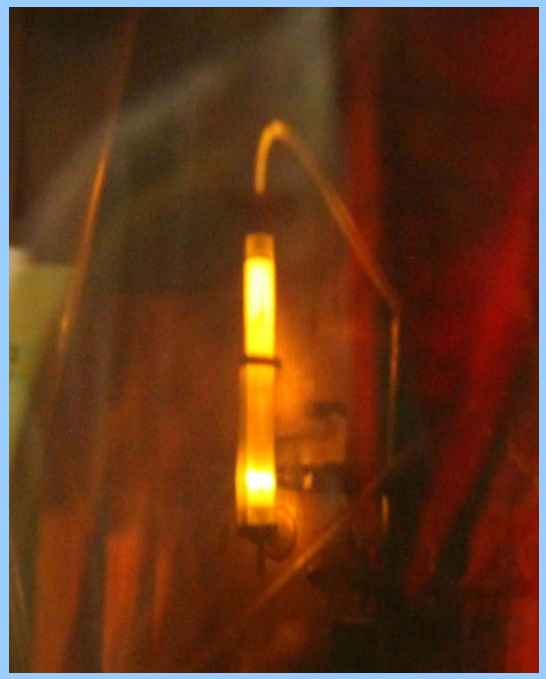
Hot cells operation side

Hot corridor view

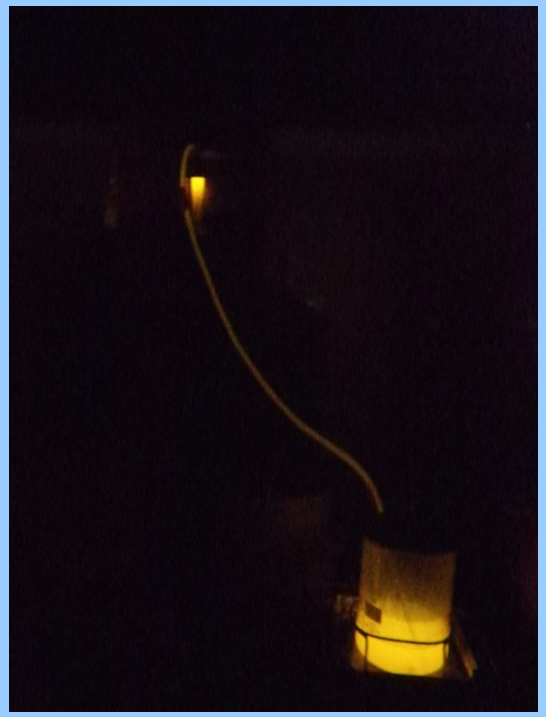
Molybdenum Production stages



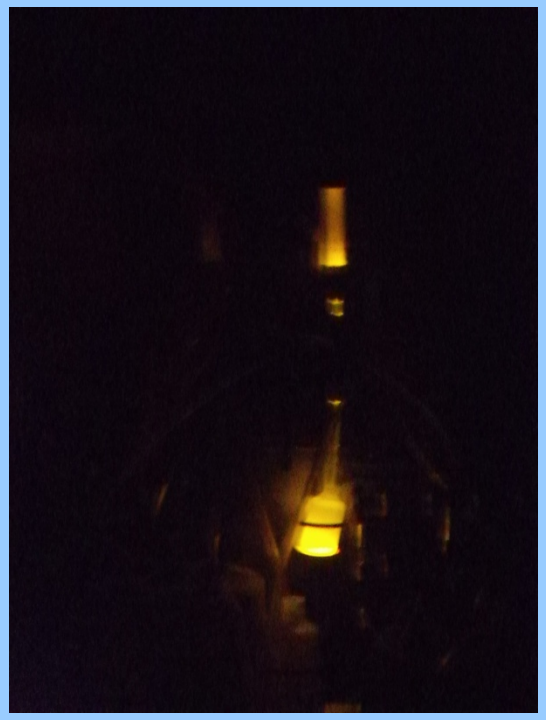
Molybdenum Production stages



AG® column



Alumina loading



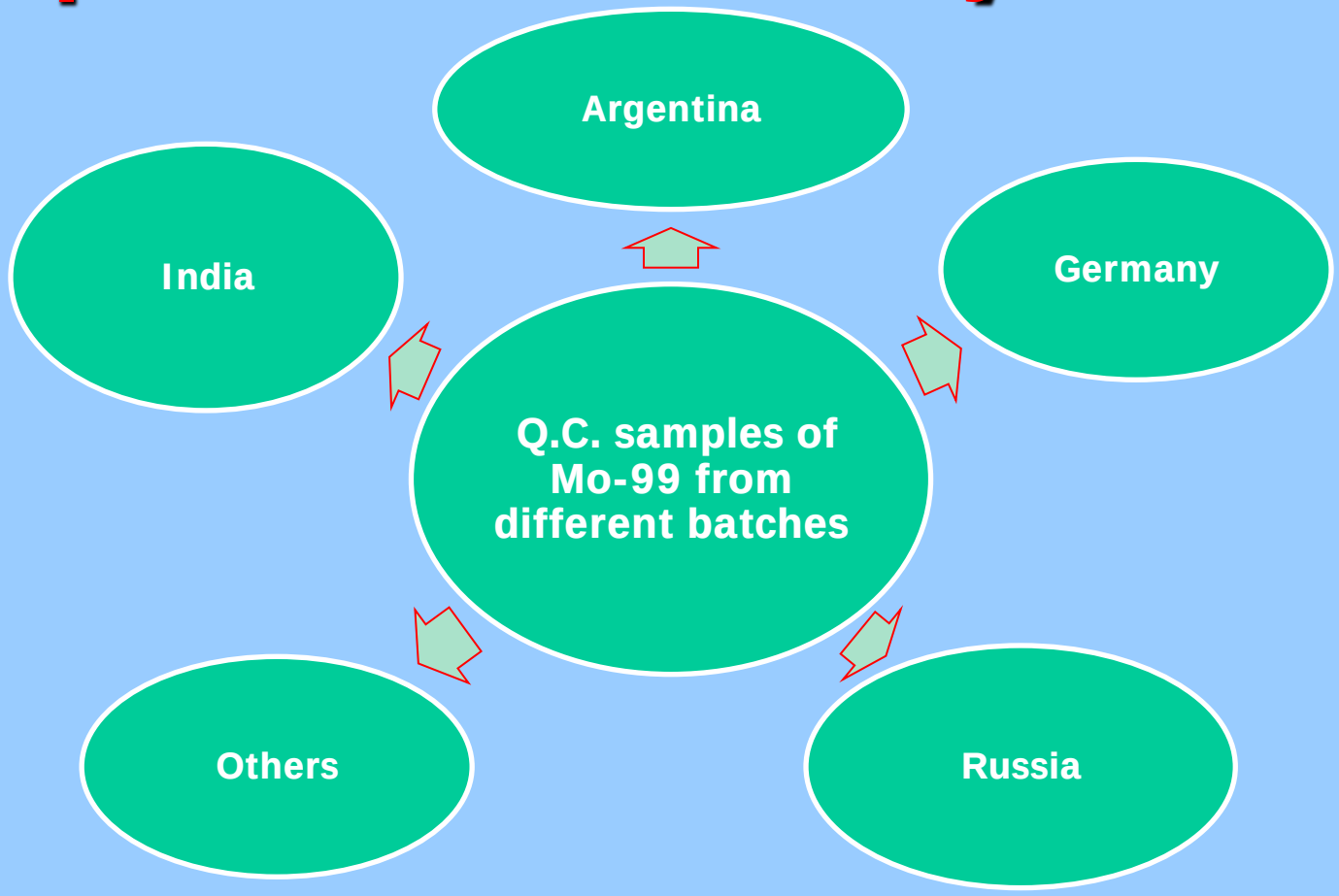
Alumina elution

Specifications of Molybdenum

The end product is a sodium molybdate ^{99}Mo solution with the following technical characteristics:

	Specification
Activity concentration	> 10 Ci / ml
Specific activity	> 27 KCi / g Mo
pH	7-10
Radiochemical purity	> 95 % as $^{99}MoO_4^{2-}$
Radionuclide purity	^{131}I < 5×10^{-3} %
	^{103}Ru < 5×10^{-3} %
	$\Sigma\beta$ < 5×10^{-3} %
	$\Sigma\alpha$ < 6×10^{-6} %

Specifications of Molybdenum



- **The results ^{99m}Tc eluted from the loaded generator were found to be accepted according to European and US Pharmacopeia.**

Specifications of Tc-99m generator

The generator allows a reliable and efficient production of sodium pertechnetate (Tc-99m) solution with high activity concentration, of the following characteristics:

	Specification
pH	5-7
Biological quality	pyrogen-free and sterile
Aluminum	< 5 micrograms/ml
Mo-99/Tc-99m concentration	< 0.1 %

Specifications of Iodine-131

carrier-free Iodine-131 solution allows its further fractionation and capsulation for use in nuclear medicine

	Specification
Activity concentration	200-1000 mCi/ml
Activity (capsules for therapy)	50 mCi/capsule
Activity (capsules for diagnosis)	10 mCi/capsule
Specific activity	Carrier free
pH	7-9
Radiochemical purity	> 95 % as Iodide
Radionuclidic purity	^{95}Nb < 1 x 10^{-1} %
	^{95}Zr < 1 x 10^{-1} %
	^{103}Ru < 1 x 10^{-1} %
	^{132}I < 1 x 10^{-1} %
	^{133}I < 1 x 10^{-1} %

Scope of current supply

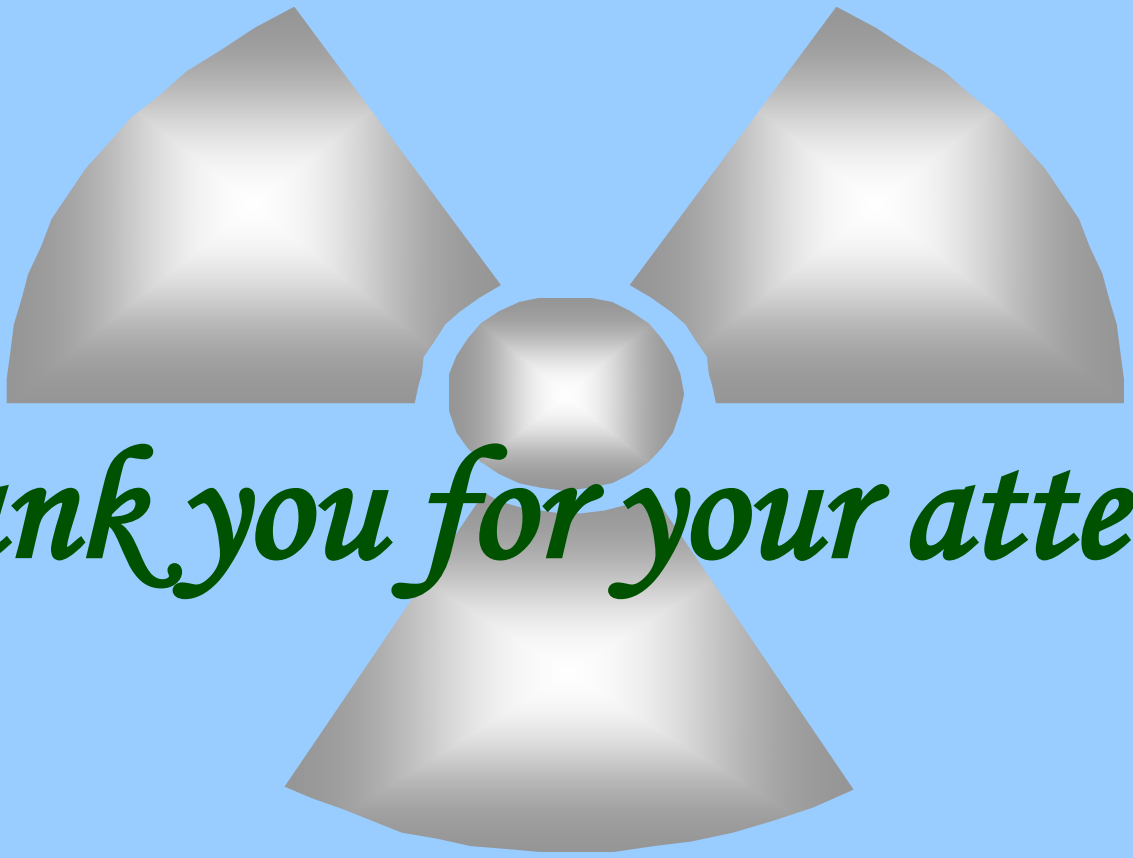
- Egyptian demand weekly from 30 - 40 ^{99m}Tc- generator as an average.
- Now we cover a part of our local market demand of Tc-99m generator and I-131.
- Our scope now is to cover all of our local market demand of Tc-99m and I-131.
- Our currently production from Mo-99:
  - 70 - 75 Ci /week (6-days calibration)
  - 2 batches / month
  - 10 month / year

Future plan

- **Short Term Objectives (1-3 years):**
  - **We are looking to increase our Mo-99 production gradually to reach the maximum capacity**
  - **180-200 Ci /week (6-days calibration)**
  - **4 batches / month**
  - **10 month / year**

Future plan

- **Long Term Objectives (more than 3 years).**
  - **Our reactor have two irradiation position each can contain 12 LEU plates.**
  - **We are looking to increase our Mo-99 production to reach:**
    - **400 Ci /week (6-days calibration)**
    - **4 batches / month**
    - **10 month / year**
  - **This can be done by modification the Mo-99 production hot cell equipment, verification of the corresponding shielding, transportation, gas releases, liquid waste management, etc., as well as issuing the necessary licensing documents. This will be done with IAEA support**



Thank you for your attention!

EGYPT

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