IAEA
International Atomic Energy Agency
Atoms for Peace and Development

IAEA Activities in support of Mo-99 Production with LEU

WOSMIP 2023

December 7, 2023

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International Atomic Energy Agency

IAEA Support for Mo-99/Tc-99m Technology

Department of Nuclear Sciences and Applications

- Radioisotope Products and Radiation Technology Section
- Focuses on Technology Development, Application

Department of Nuclear Energy

- Research Reactor Section
- Focuses on HEU Minimization

Radioisotope Products and Radiation Technology Section: Activities Relevant to Mo-99

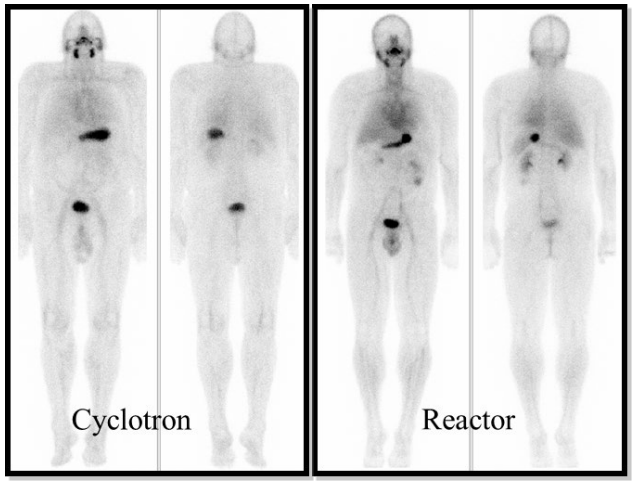
- Research and Development
- Implementation of Technologies
- Education / Training / Qualification

Areas:

- Production of radioisotopes and radiopharmaceuticals
- Accelerator-based radiation technologies for industry, environment, and cultural heritage
- Sealed radiation sources for NDT and other application

CRP: Accelerator-based Alternatives to Non-HEU production of Mo-99/Tc-99m

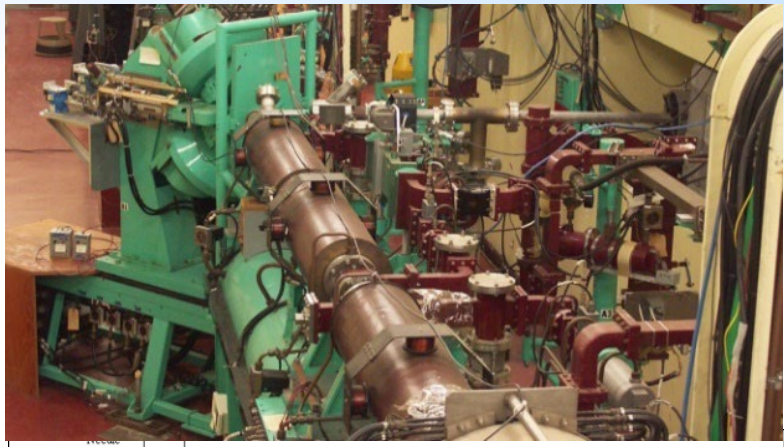
- 2011-2015
- 18 participants from 16 Member States
- Production of Tc-99m in cyclotron - very successful
- Technology to produce several (>30) Ci Tc-99m per run in medical cyclotrons of energies below 24 MeV proven; clinical trials under way; regulatory approvals sought
- Monograph approved in Europe
- Self-sufficiency in hospitals/towns/country
- Good option for hospital or radiopharmacy; local productions
- Target specifications; reuse of targets etc. need consideration
- Published 2017

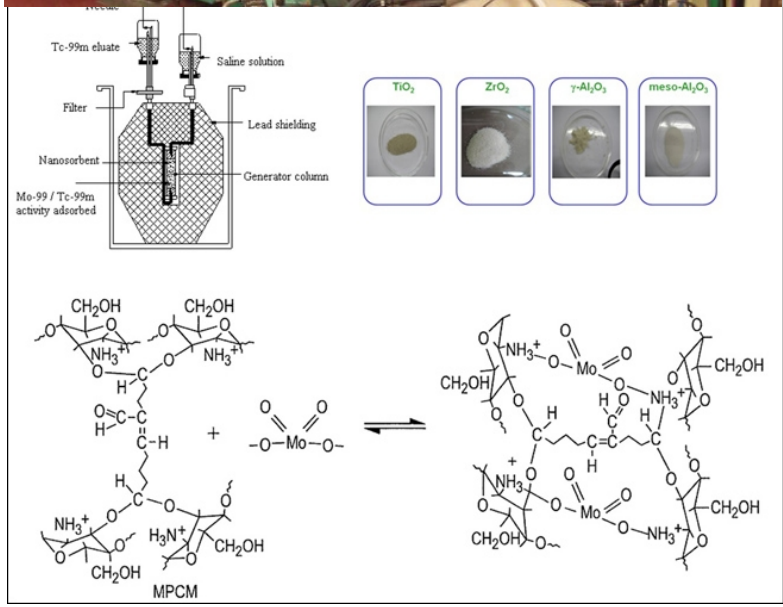


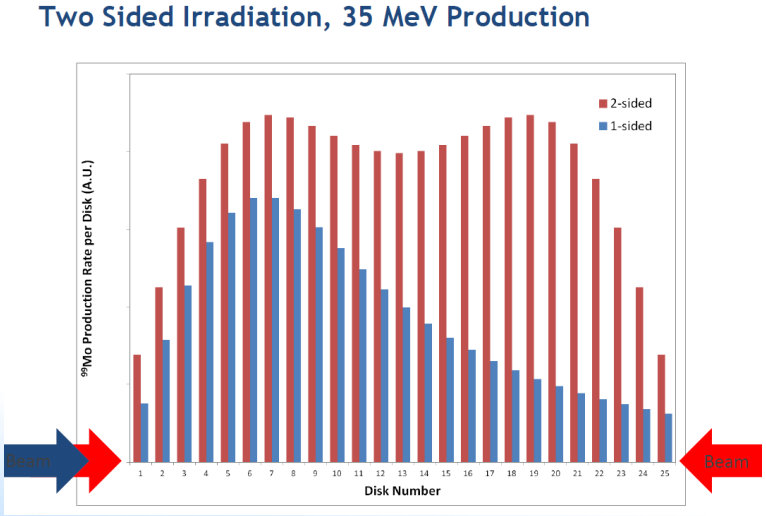
Comparison of cyclotron- and reactor-based Tc-99m pertechnetate for the Univ. of Alberta Clinical Trial (cancer thyroid patients imaged post-thyroidectomy)

CRP: Photonuclear Route for Producing Tc-99m and Tc-99m Generators

- First Meeting: December 2017
- 18 Approved Proposals
- Aimed as use of low specific activity Mo-99 for generator preparation and accelerator production of Mo-99 (Mo-100 (γ,n) reaction)
- Third RCM November 2021
- Publication anticipated in 2024







https://www.iaea.org/newscenter/news/new-crp-new-ways-of-producing-tc-99m-and-tc-99m-generators

CRP: Sharing and Developing Protocols to Further Minimize Radioactive Gaseous Releases to the Environment in the Manufacture of Medical Radioisotopes, as Good Manufacturing Practice

- Request received from Australia, Belgium, the Netherlands, Republic of Korea, and the USA in May 2014
- Request proposed the IAEA initiate a CRP on the topic of technologies to reduce emissions from medical isotope production facilities
- Separate Presentation of Results at WOSMIP 2023

New CRP: Development of a New Generation of Tc-99m Kits

- Announced in October 2023
- 2024-2028
- The main objective CRP is to transfer the knowledge acquired to produce a series of technetium-99m (99mTc) radiopharmaceuticals for imaging various biological substrates of relevant clinical interest (especially new targets in cancer diagnosis) using the most efficient methods of Tc-99m labelling. Several 99mTc radiopharmaceuticals will be produced for imaging the following biological substrates

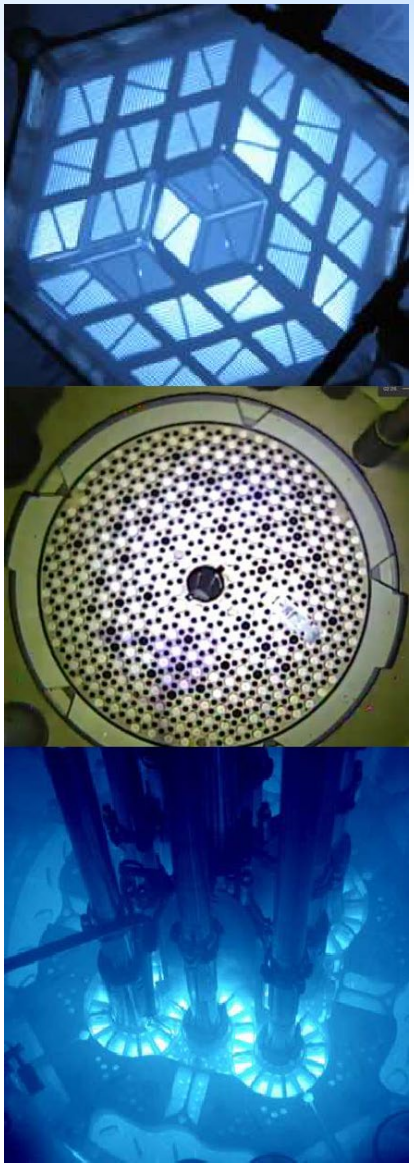
Development of new generation of Tc-99m kits | IAEA

Research Reactor Section Support for HEU Minimization

30+ years of IAEA support on international efforts to reduce HEU in international civilian activities

We assist countries, upon request with

- Conversion to LEU
- New Fuel Specification and Procurement
- HEU Removals
- Non-HEU Mo-99 Production



Non-HEU Mo-99/Tc-99m Production

IAEA supports Member States to ensure sustainability of production of Mo-99/Tc-99m and other radioisotopes

Technologies:

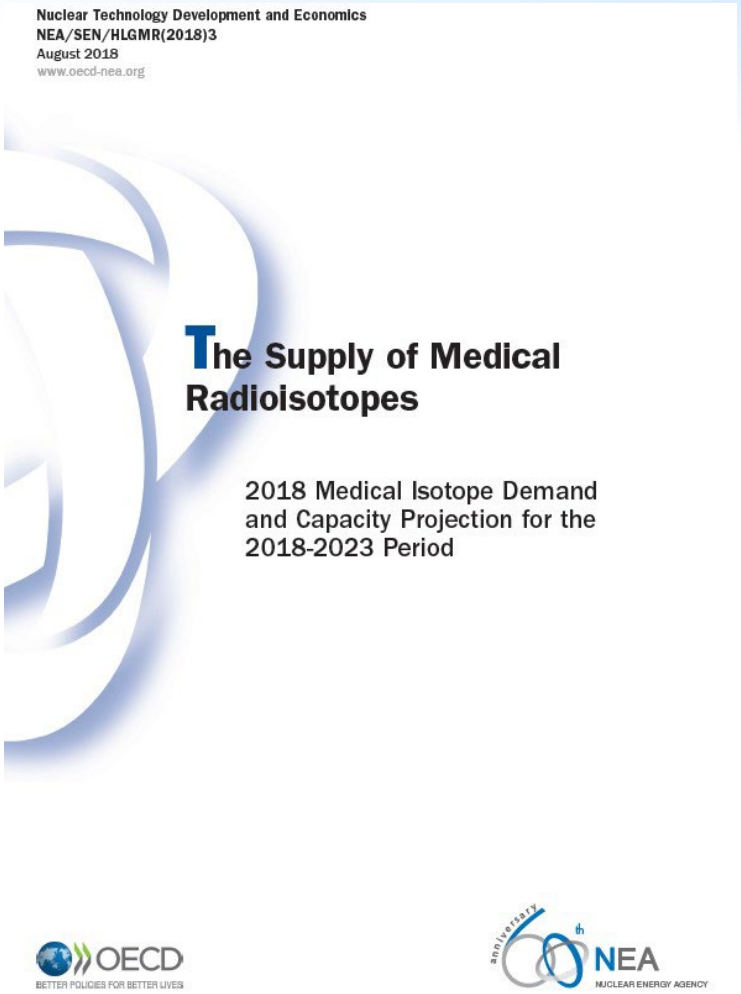
- Conversion of Major Mo-99/Tc-99m Producers – HEU to LEU targets
- Non-HEU Production of Mo-99 (Mo-98 activation)
- Accelerator-based alternatives to Non-HEU Production of Mo-99/Tc-99m

Production Support:

- 2018 OECD Isotope Supply Review
- 2018 and 2020 Technical Meetings on Global Capabilities for Production and Manufacture of Non-HEU Mo-99 Targets
- 2022 Technical Meeting on Management of Wastes / Residuals from Mo-99 Production
- October 2022 Mo-99 International Symposium
- US Molybdenum-99 Program Support

OECD: 2018 Medical Isotope Supply Review

- Spurred by Unplanned Shutdowns of Irradiation Capacity
- Assessed Global Demand, Irradiation Capacity, Processing Capacity
- Illustrated Weaknesess in Supply of Radioisotopes
- Resulted in Increased Collaboration Amongst Producers to Stabilize Supply



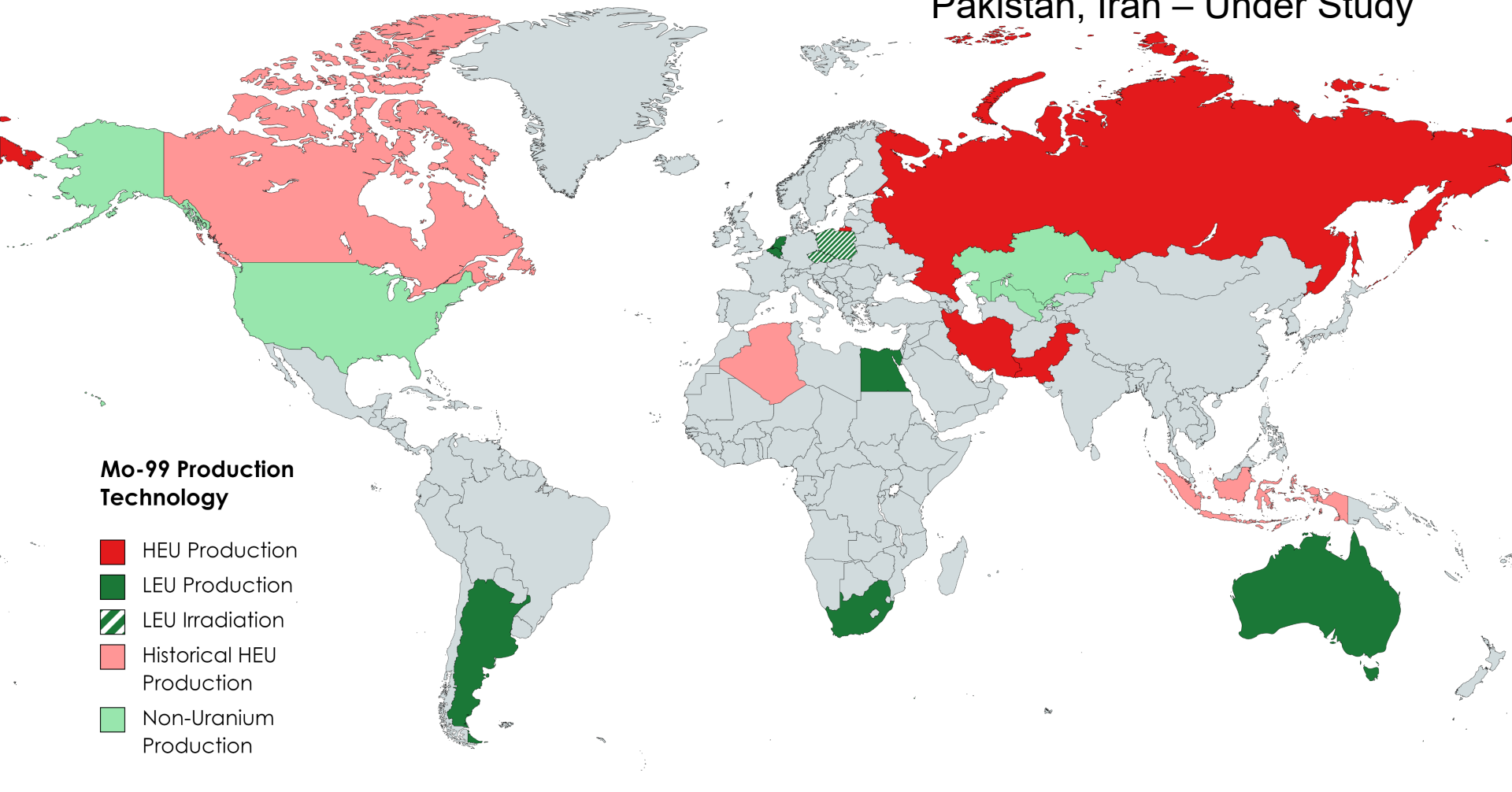
US Molybdenum 99 Program

- Established by US Congress in Response to Shutdown of Maple Reactors in Canada
- Designed to Establish Commercial Supply of Non-HEU Based Mo-99/Tc-99m Production in the USA
- Cooperative Agreements Made with Three Companies
- Led to January 2022 End of US Exports of HEU for MIP

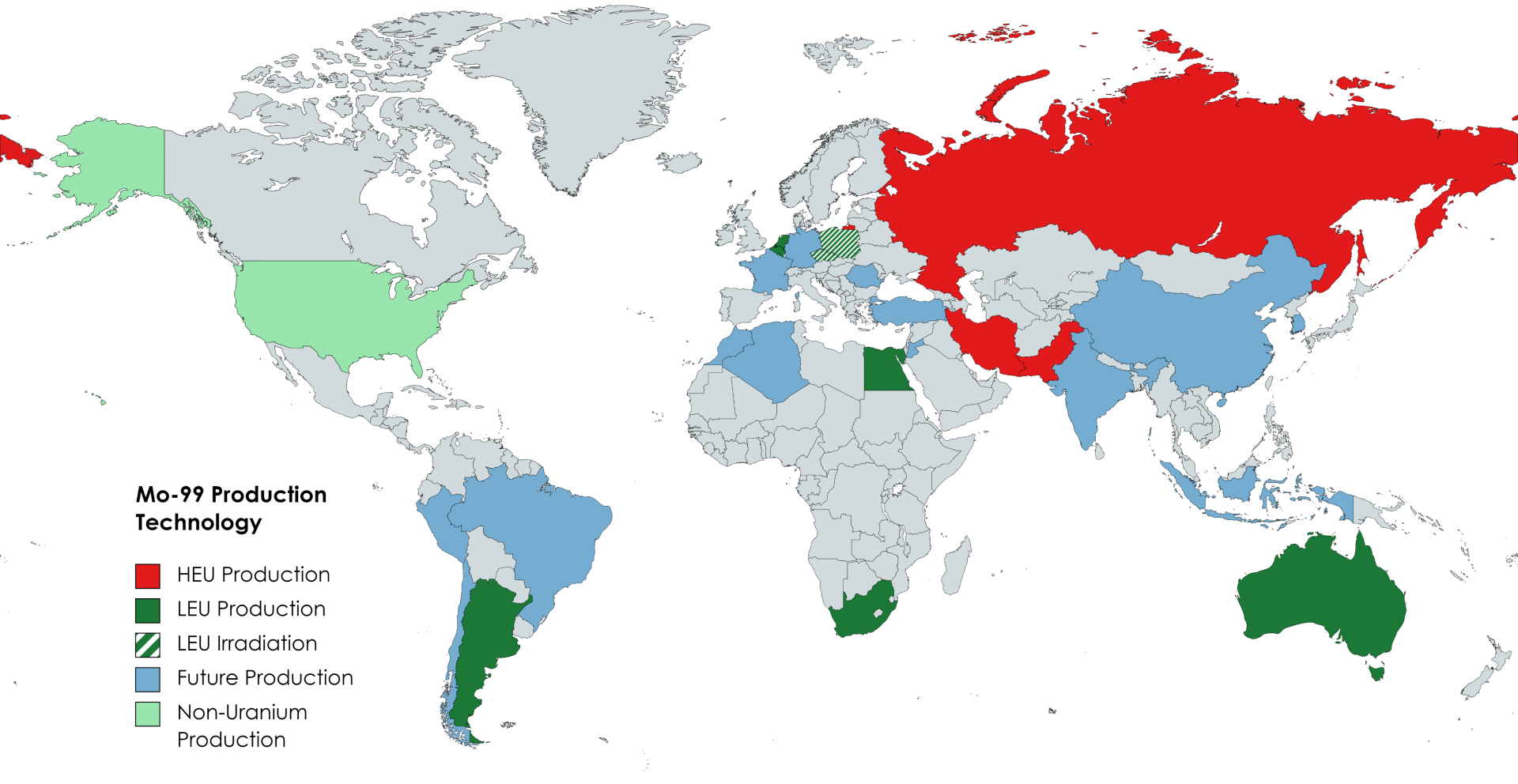
NIOWAVE	NorthStar MEDICAL RADIOISOTOPES, LLC	SHINE
Accelerator with LEU fission	Two technologies: ➢ Neutron capture with enriched Mo-98 targets ➢ Accelerator with Mo-100 targets	Accelerator with LEU fission

Most World Mo-99 Process Capacity Now non-HEU

LEU Production Anticipated:
Russia 2024
Pakistan, Iran – Under Study



Many Countries Looking to Develop Mo-99 Production Capabilities



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QUESTIONS?

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Thank you!