NUCLEAR MEDICINE EUROPE
the industry association

The nuclear medicine sector has an intricate system for ensuring essential medical isotopes are produced when they are needed. It involves carefully managed production schedules that take account of supply, demand and many logistical considerations around just six nuclear reactors. So, how does the system work?

HOW THE NUCLEAR MEDICINE SECTOR **COORDINATES ISOTOPE SUPPLY**

Europe is the leading world supplier of medical radioisotopes and a leader in developing nuclear medicine diagnostics and treatments. The process for using this technology starts with the production of medical radioisotopes. These are isotopes produced artificially, mainly in research reactors and accelerators.

The production process involves several activities, including the fabrication of targets; their irradiation; transportation of the irradiated targets to processing facilities; radiochemical processing or encapsulation in sealed sources; quality control; and transportation to end users.

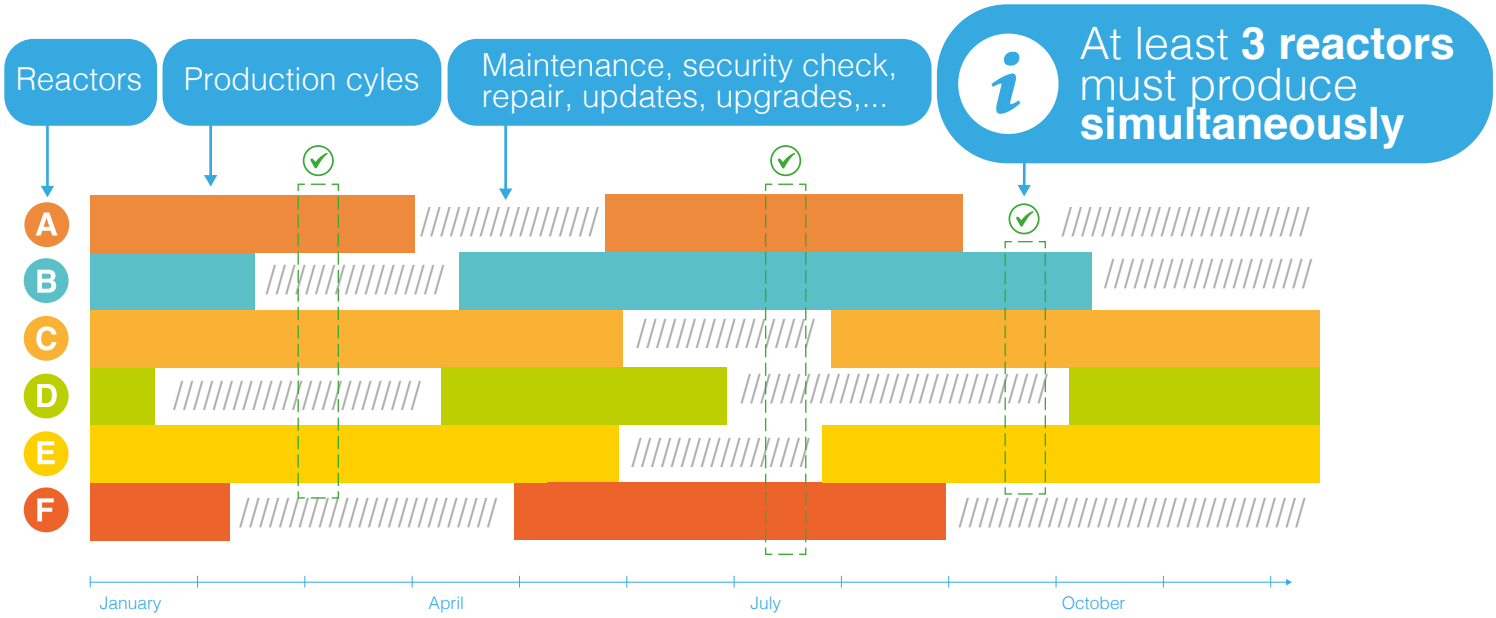
Some radiopharmaceuticals are extracted from radioisotope generators and contain a radioisotope.

Some **85 per cent** of all diagnostic medical scans worldwide rely on the availability of the radioisotope **Molybdenum-99 (^{99}Mo)** and its daughter product, **Technetium-99m (^{99m}Tc)**, to produce around 17 million diagnostic procedures a year globally. **Lutetium-177 (^{177}Lu)** and **Iodine-131 (^{131}I)** are used in therapeutic treatments (^{131}I has been used for over 50 years, mainly for thyroid cancer).

The production of radioisotopes needs to be managed carefully, with separate sequences for each stage. It starts with the cyclotron or reactor, followed by the nuclear reaction or radioisotope production.

^{99}Mo is only produced in six research reactors: four in Europe, while the other two are in South Africa and Australia. The product is then shipped from the reactor to the production facility where it is turned into a radiochemical grade product or an active pharmaceutical ingredient (API). The final stage is when it is a radiopharmaceutical product.

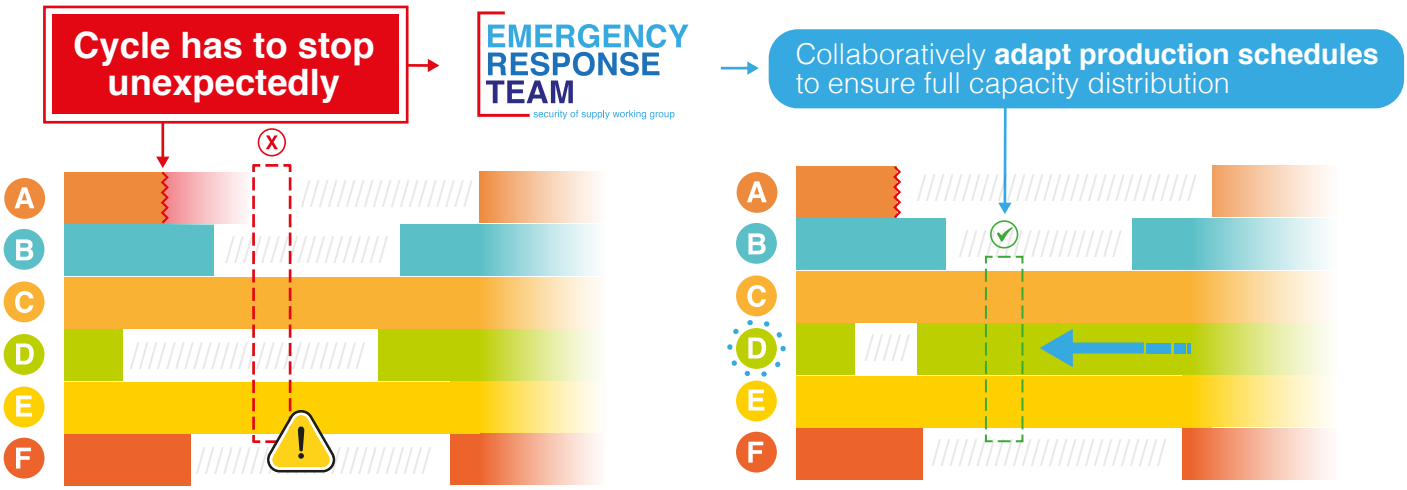
However, the six reactors do not operate on a non-stop basis. Production cycles may be interrupted because of refuelling, maintenance, security checks, repairs, updates and upgrades. To ensure that enough radioisotopes are produced at all times, there is an informal arrangement that **at least three reactors must produce simultaneously**.



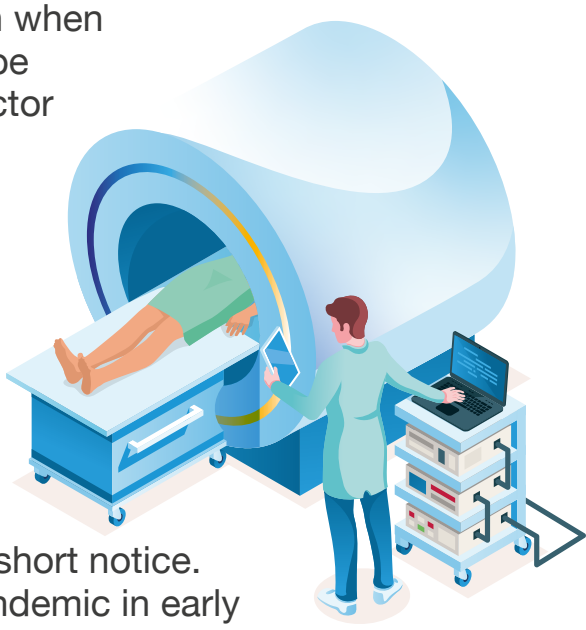
Since the different production stages are intricately linked, **the schedules must be adapted dynamically** every time there is an interruption due to an unexpected stoppage.

This is where NMEU comes in.

With members and associates that include virtually all the major medical isotope producing reactors and production facilities, we have an overview of the different schedules, and can liaise between facilities to ensure that at least three reactors are operating at any time. When there is an issue, **NMEU's Emergency Response Team** gets on the phone: they realign schedules where feasible to ensure full capacity of production, so slack in one area can be met elsewhere.



This process requires planning and foresight.
There is a lag time – often up to a week - between when a reactor returns to operation and when the isotope targets have been exposed to neutrons in the reactor for a sufficient period to produce the desired isotopes. These targets must be removed from the reactor, cooled, transported, and then processed in separate isotope production facilities. Only then, can the targets be transported to radiopharmaceutical product manufacturers who produce the final products which are then shipped to medical institutions for administration in patients.



Sometimes, new arrangements must be made at short notice. That was the case at the start of the Covid-19 pandemic in early 2020. **It was also the case in January 2022**, when there was a risk of shortages of Molybdenum-99 (^{99}Mo) and Iodine-131 (^{131}I): a water leak was identified in the High Flux Reactor (HFR) reactor in Petten, Netherlands which prevented the start of the regular irradiation cycle leading to a shortage of several medical isotopes.

However, they could be partially offset by the quick restart of Poland's research reactor, Maria, and an earlier than planned restart of the BR2 research reactor at the Belgian Nuclear Research Centre in Mol. In addition, other reactors have stepped up medical isotope production. The result was that supply was able to continue with only a limited disruption.

This article is an initiative from the NMEU Communications Working Group and the Security of Supply Working Group.

The **NMEU Communications Working Group**'s mission is to communicate in the most efficient way all relevant information regarding Nuclear Medicine and Molecular Imaging industry to all stakeholders and influencers, such as the European Union Parliament, the European Union Commission, EU governments, national and international pharmaceutical agencies, physicians, patient groups and the public in general.

The **Security of Supply Working Group** is committed to global coordination of Reactors and Radiopharmaceutical producers of critical medical isotopes to ensure continuity of global supply with a minimum risk of disruption.

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