

Educational Applications on Particle Accelerators

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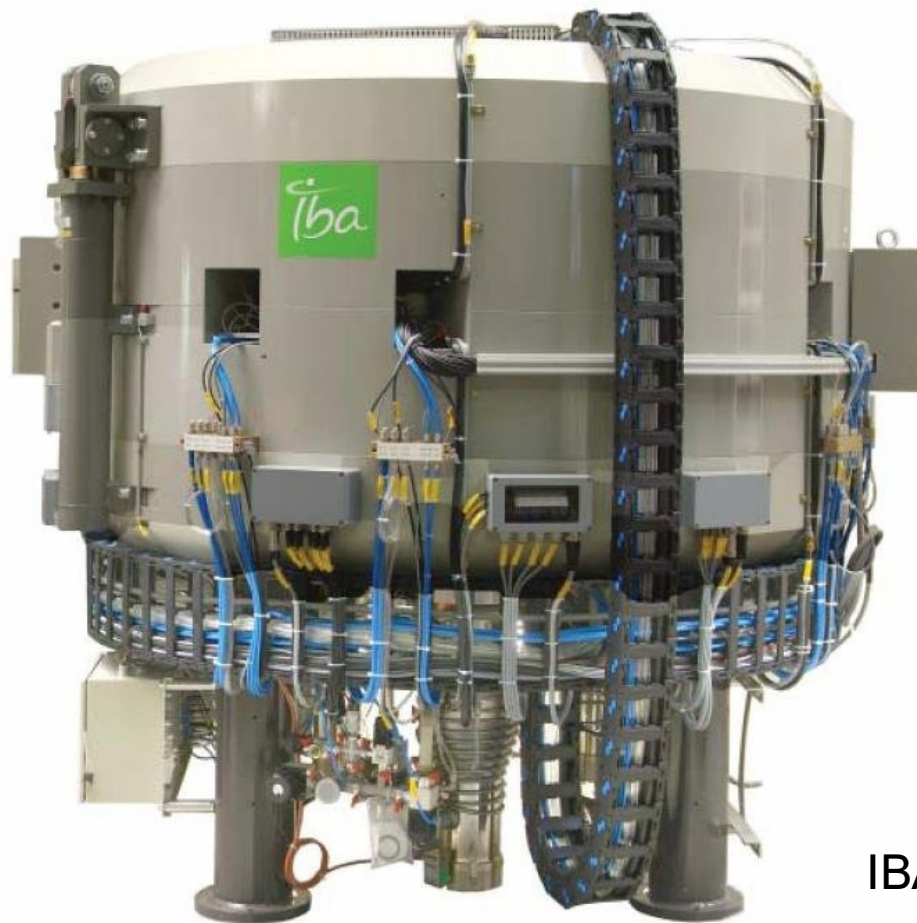
Monopoly

- During the fifty years of the monopoly, all the production and distribution of short half-life radionuclides for medical usage were only possible through the Government Organizations.
- It was impossible for them to keep the supply chain. The development of nuclear technologies was not well updated and the most peripheral places could not access neither the short half life elements nor to improve equipments and techniques in the most different areas. Efficient transport systems, as required for short-lives radioisotopes, also contributed to the deficiency of the distribution.

Monopoly

- Its end for production, distribution and usage of radionuclide for medical, agricultural and industrial purposes, enabled the private enterprise to join this market in regime of concession.
- It became possible to install small accelerators cyclotrons and produce radionuclide with short half lives, having 18-Fluorine as the most relevant one for instance. In less than three years the national scenario changed from 2 cyclotrons operating at full scale to 11 ones.

Cyclotron



IBA Cyclone 18/9

Benefits

- Diagnosis exams as Positron Emission Tomography (PET) combined with Computerized Tomography (CT) or Magnetic Resonance (MR), are now being spread to more territories.
- It became possible to irradiate different targets in cyclotrons and produce ^{11}C , ^{13}N and ^{15}O , which the short half-life with the transit time to get to the patients were restrictive.
- Centralized Radiopharmacies, mainly with Technetium manipulation, became another possibility of the Amendment 49.

Heritage

- The lack of investment in the educational centers to train specialists became a restrictive factor for the whole process.
- National Institutes, had to revise all the norms and statutes during the cyclotrons installation
- There was not any specific health norm for radiopharmaceuticals up to the change of the Constitution.
- Most experienced professionals in these field is retired or in process of retiring. Even the governmental agencies of health and nuclear applications lack of qualified personnel
- The many peculiarities of the project impose training of the technical and administrative staff together.

Culture

- The barriers that the perception of risk due to the nuclear energy usage imposes, allied with the common sense of danger, with the many accidents and military purpose usage wide, are another heritage that the decades of the monopoly left, with no programs of consciousness-raising of its benefits.
- The different levels of the government had to understand and accept what were the benefits of an accelerator facility located in their jurisdiction area. From environmental licenses to population consciousness-raising, it was only the beginning of the hard work.
- With this open of the market it is clear that uranium enrichment will be the next step. Some doubts still remain.

Training

- A comprehensive program on training people from different businesses throughout the country together with universities, companies, hospitals and the government was started.
- Many training programs were written in order to qualify the whole crew, the technical staff went to national and abroad cyclotron facilities, hospitals and nuclear medicine clinics, for practice and theory trainings.

Training (in company)

- The investments on education inside the companies increased significantly the costs and the amount of time spent on the installation of the facility.
- A study, raised and discussed all the aspects that increased the final costs of the project, most of them showed education deficiencies in different levels.
- The constant redesign of projects and delays on the schedule were the most increasing factors.

Training (results)

- The following projects gathered great expertise and from the plant to the staff, the savings were almost 45%.
- The increments of money and time improved the following projects as well as built partnerships for installation and production inside other companies, due to the expertise brought for minimal details. It did not start as a program of knowledge but once the crew faced all the trainings and difficulties this kind of installation could bring, they could start many other projects together with partnerships and teach third ones how to do this job.

Training (universities)

- At universities this program of education started with short presentations followed by question and answer during the year and at regional congresses.
- The university brought specialists to train the private enterprise crew and in exchange the facility could be used for research of the university during the stand-by time of the accelerator.
- At clinics and hospitals the efforts were focused on improving the applications of the radiopharmaceuticals, the products of the accelerator, mainly with the centralized radiopharmacies.

Conclusion

- Breaking down a monopoly is not enough to enable a country to get free from importation of radiopharmaceuticals. It seems to be necessary taking advanced steps to fulfill market with qualified human resources.
- The government, through national agencies, should take the initiative – as recommend by the IAEA – to discharge their responsibilities in contributing for the establishment of a clear regulatory regime and for the formation necessary expertise.
- Industry should be able to start developing its own expertise while pushing/encouraging governmental agencies and educational centers to accomplish their attributed tasks.

Conclusion

- Cooperation at regional and international levels may be a way forward in minimizing the barriers for the establishment of an independence in the field of radioactive material for medical purposes.
- The experience and lessons learned in the field of radiopharmaceuticals production may be used to avoid similar problems in the uranium mining when the state monopoly finally ends.



Thanks!!!

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