



IPEN/CNEN's mobile electron beam irradiation unit. Source: IPEN/CNEN

EBA MOBILE UNIT HIGHLIGHTS

Why it Matters

Water quality is one of the defining challenges of this century. CNEN/IPEN developed a mobile electron beam accelerator to treat industrial effluents and enable reuse, reducing environmental and health risks.

Technology

- Capacity: up to 1,000 m³/day of effluents
- Technology Readiness Level (TRL): 7 – demonstrated in industrial environments
- Applications: sanitation (SABESP), oil & gas (PETROBRAS), chemicals (CLARIANT)
- Also used for professional training (SENAI)

Partnerships & International Cooperation

- International Atomic Energy Agency (IAEA) – TC Projects BRA8025 & BRA1035
- TRUCKVAN – mobile unit manufacturer
- NUCLEP – radiological shielding & engineering
- Brazilian Innovation Agency (FINEP) & National Research Council (CNPq) – funding support
- EB-Tech (South Korea) – industrial electron accelerator supplier

Impact & Future

The mobile unit provides an alternative and complementary technology to conventional wastewater treatment. It has demonstrated environmental, economic, and industrial benefits. The team is currently developing a business model for providing technological services to industries.

MOBILE UNIT WITH ELECTRON BEAM ACCELERATOR (EBA)

*“Treating Industrial Effluents for Reuse Purposes”
“Advancing water reuse and sustainability”*

Nuclear Science and Applications for Environmental Protection

Water quality is one of the defining challenges of this century, directly affecting human health, food production, ecosystems, and economic growth. Pollution of freshwater resources is increasing due to untreated or poorly treated wastewater, industrial effluents, agricultural runoff, pharmaceuticals, pesticides, and personal care products. Climate change further aggravates these risks, while the long-term consequences remain uncertain.

Conventional wastewater treatment plants often show limited efficiency in removing refractory and toxic pollutants, such as organochlorine compounds, persistent organic contaminants, and odour-causing substances. These gaps highlight the urgent need for alternative and complementary technologies that can improve treatment efficiency, reduce toxicity, and enable water reuse.

The Mobile Unit with Electron Beam Accelerator (EBA)

In response to this challenge, the Nuclear and Energy Research Institute (IPEN/CNEN), with support from the International Atomic Energy Agency (IAEA), developed a mobile irradiation unit equipped with an industrial electron beam accelerator.

Technical features

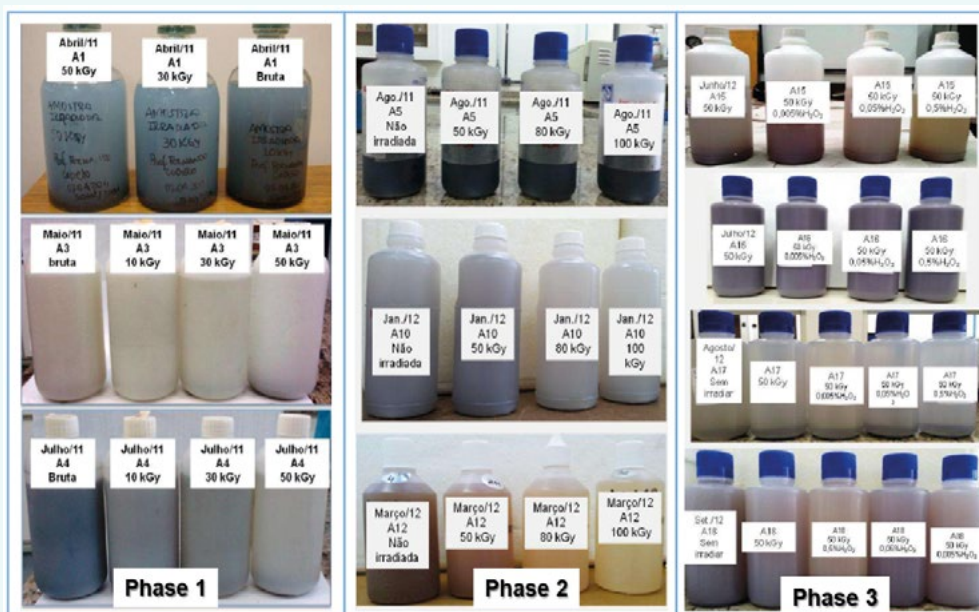
- 700 keV, 28 mA, 20 kW accelerator
- Treatment capacity: up to 1,000 m³/day
- Positioned between a laboratory-scale facility and full industrial operation (TRL 8)

The mobile unit was designed to demonstrate and validate the electron beam technology in real operational environments across diverse sectors, bridging the gap between R&D and industrial application

Applications and Demonstrations

The unit has been tested in partnership with major Brazilian companies and institutions:

- **Sanitation:** São Paulo Sanitation Company (SABESP)
- **Oil & Gas:** Petrobras (offshore platforms and effluent treatment)
- **Chemicals:** Clariant
- **Training:** National Industrial Apprenticeship Service (SENAI), for professional capacity building



Treated wastewater samples subjected to different irradiation doses. Source: IPEN/CNEN

Major sustainability challenges addressed:

- Removal of odour-causing compounds (geosmin, MIB) in drinking water
- Degradation of toxic and refractory organic pollutants in sewage and industrial wastewater
- Sewage and sludge disinfection
- Reduction of toxicity by decomposition of surfactants and persistent contaminants

Partnerships and Open Innovation

The project reflects Brazil's commitment to innovation through strong public–private and international collaboration:

- International Atomic Energy Agency (IAEA): investment, training, and provision of advanced analytical instruments – Gas Chromatograph Mass Spectrometer (GC-MS), Ultraviolet Visible Spectrophotometer (UV-Vis), Total Organic Carbon Analyser (TOC), radiation monitoring devices).
- TRUCKVAN: Brazil's largest mobile unit manufacturer, responsible for chassis design and adaptation to national transport standards.
- NUCLEP (Brazilian Heavy Equipment Company): developed and installed the radiological shielding.
- FINEP (Brazilian Innovation Agency): funded the acquisition of the industrial accelerator from EB-Tech (South Korea).
- CNPq (National Council for Scientific and Technological Development): supported research grants for equipment operation.
- SENAI (National Industrial Apprenticeship Service): partnered in professional training, integrating the mobile unit into its educational and industrial innovation programs.



Advanced analytical instruments – a lab inside the mobile unit. Source: IPEN/CNEN.

Impact and Results

The mobile unit demonstrates that electron beam technology can:

- Complement conventional wastewater treatment, offering advanced solutions for difficult-to-remove pollutants
- Improve water reuse practices, contributing to sustainability and circular economy goals
- Enhance industrial safety and efficiency while reducing environmental impacts
- Provide a flexible, mobile, and scalable solution adaptable to different industries and effluent types

The project also strengthened Brazil's innovation ecosystem by combining the expertise of research institutions, private industry, and international organizations.

Future Outlook

The Mobile Unit stands as a strategic pathway for technology transfer, bridging research and market application. Its demonstrated results in multiple sectors highlight its potential to be scaled and integrated into industrial operations, fostering innovation and sustainability in Brazil and beyond.

The team is currently discussing the technology business model and validating different types of effluents to estimate operating costs and market prices. The future scenario envisions a partnership with TRUCKVAN to provide technological services to potential industries and explore innovation opportunities.

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Discover more:

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