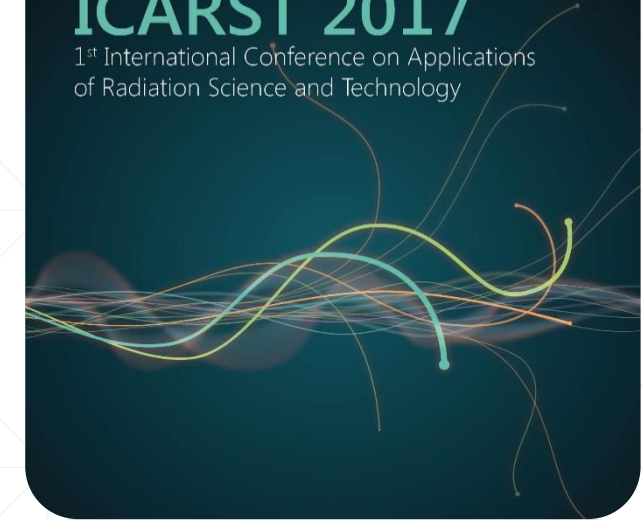




ININ

ICARST 2017
1st International Conference on Applications
of Radiation Science and Technology



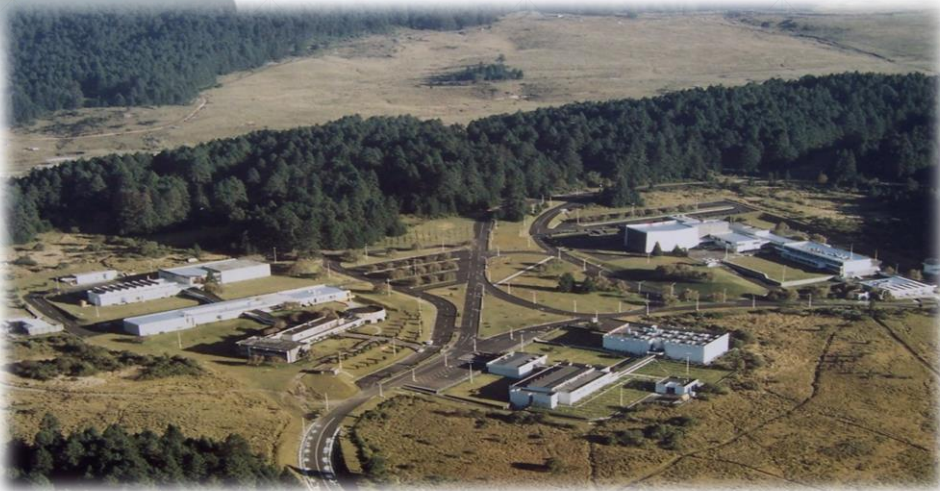
DRAFTING AND PREPARATION PROPOSAL OF IRRADIATION PLANTS

instituto nacional de investigaciones nucleares
Mexico

J. Walter Rangel Urrea

April 28th, 2017

Origin and Evolution through Time

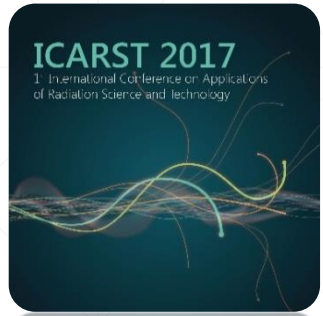


**Comisión
Nacional de
Energía Nuclear
(1956)**

**Instituto
Nacional de
Energía Nuclear
(1972)**

**Instituto
Nacional de
Investigaciones
Nucleares
(1979)**

An answer to United Nations initiative of Atoms for Peace



Legal Framework: Nuclear Law

Article 27:

The **National Institute of Nuclear Research** (inin) shall have the objective to perform research and development in the field of nuclear sciences and technologies, as well as, to promote the peaceful uses of nuclear energy and disseminate the progress accomplished to bond them to the economical, social, scientific and technological development of the country.

Gamma Irradiation Plant at inin



First Demostration Project in Mexico



Other Irradiation Facilities



Inaugurated in: February 1, 2000



Inaugurated in: July 21th, 2011



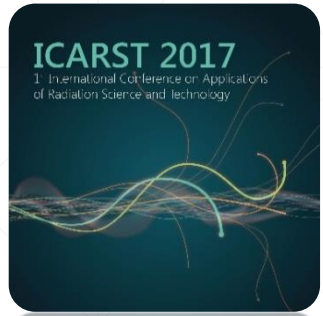
Photos Courtesy of Sterigenics and Benebion





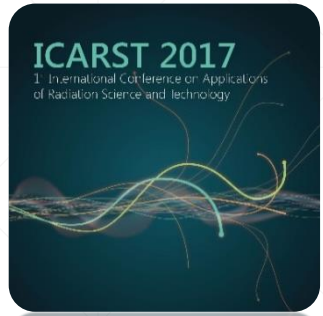
Facilities Location





Irradiation for phytosanitary control

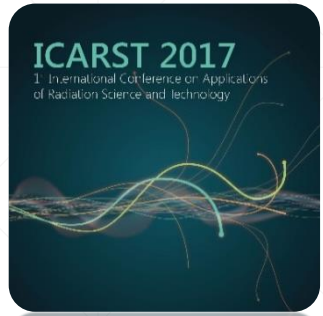
- October 2007:** Irradiation Operational Work Plan USA-Mexico was signed.
 - October 2008:** First Irradiation facility certified (Sterigenics)
 - November 2008:** First shipment of irradiated guava was sent to USA
 - July 2011:** Second Irradiation facility certified (Benebion)
-



Cronology: List of Products

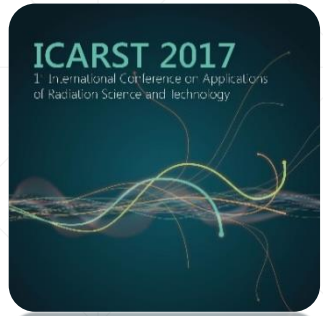
- October 2007:** Mango, Orange, Grapefruit, Tangerine and Sweet Lime.
- Noviembre 2008:** Guava
- April 2009:** Pepper Manzano and Star Fruit (Carambola)
- April 2014:** Pomegranate
- April 2015:** Fig
- May 2015:** Dragon Fruit (Red Pitaya)

Products for import to USA intended for irradiation according Work Plan USA-Mexico



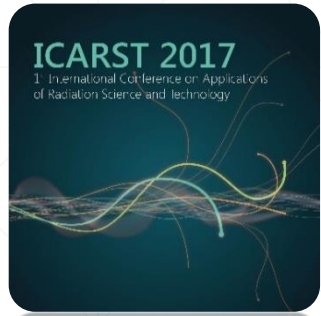
The Market

- The share and the size had grown constantly
 - Some players have included the technology as an in-house option
 - The irradiation is used mainly for sanitization and sterilization
 - Clients understand and assimilate the technology
 - Due its advantages and benefits, it is preferred over other choices
 - This reality has been the valid justification to install other plants
-



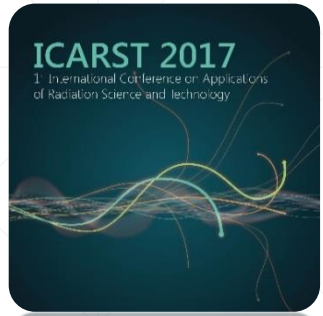
Key Drivers for New Facilities

- **Population Growth:** 123.5 inhabitants in Mexico (2017)
- **Expansion of the Economy:** More capacity to spend
- **Greater Life Expectancy:** 75.3 years in 2017
- **Greater number of people under government programs:** 57 million
- **Productive Chains:** More mature and professional
- **Competitiveness:** Constant search to make improvements
- **Market Segmentation:** products for different niches
- **Export to Other Markets:** South Korea, China, Middle East
- **Gradual obsolescence of chemical treatments:** Due stricter regulation or environmental protection



Technology and Regulation

- **Wide Experience and Knowledge in Mexico: Gamma Ray Irradiation**
- **Irradiation based on e-beam: Still a missing option, only available in-house**
- **First e-beam facility: Located in the City of Tijuana. Inaugurated in march 2017**
- **Optimal Timing to promote by ININ the Installation of a New Facility: A corporate decision has been taken**
- **The E-beam Option considers the Medium Term Strategy 2018-2013 of IAEA: Supports Health and Food safety, contribute to reach the Sustainable Development Goals, avoids radioactive material transportation**
- **IAEA Projects at ININ: Promote the use of irradiation for the benefit of mankind, therefore, all kind of developments of new facilities must be supported**
- **Strong Regulation Knowledge at ININ and a Well-Known Practitioner: As a result of operating an industrial facility for more than 35 years**

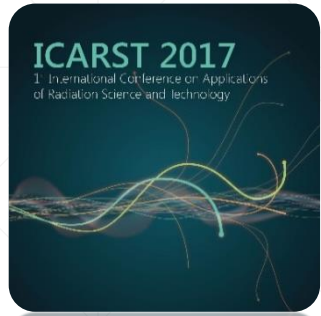


Proposals for New Irradiation Plants

Three Initiatives have been addressed:

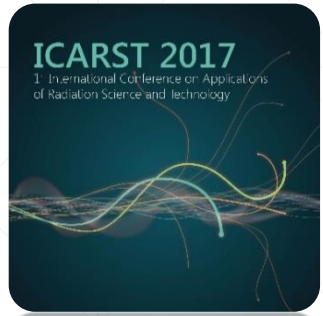
1. A Multipurpose Irradiation Plant at ININ: For sterilization services, research and training
2. An Irradiation Plant for Michoacan State: For Phytosanitary Purposes
3. A Irradiation Plant at ININ: Oriented to process fresh products and medical devices under a Private/Public Scheme

Guidelines for the Development and Presentation of the Cost and Benefit Analysis of Investment Programs and Projects



Initiative 1: Multipurpose Irradiation Plant at ININ

- **Nominal Processing Capacity:** 216,000 m³
- **Design Criteria:** Process demand in excess from the Gamma Irradiation Plan, meet future demand on medical devices, process products from phase out chemical treatments, promote novel industrial applications
- **Some figures:** A period of 27 years (2 for construction and commissioning and 25 for operation). Total Amount **\$19.7 million USD**, Annual Cost: **\$4.4 million USD**
- **Other benefits:** Promote innovation and technology development, specialized training, gain experience and knowledge on e-beam, develop new areas of opportunity
- **Key Indicators:** Net Present Value **\$79.08 million USD**, Internal Rate of Return **47.99%**, Immediate Return Rate 32.7%
- **Other actions performed:** Preinvestment and Legal Study, Environmental, Market and Demand, Costs, Sensitivity Analysis. Info retrieval from third parties.



Initiative 2: An Irradiation Plant for Michoacan State

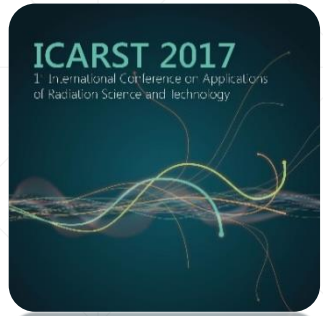
- **Based on e-beam 10 MeV and 10 kW**
- **Design Criteria:** Treatment of agri-food products, mainly, mango, grapefruit and guava, reach a competitive price Vs other treatments available
- **Some figures:** A period of 22 years (2 for construction and commissioning and 20 for operation). Total Amount **\$12 million USD**, Annual Cost: **\$3 million USD**
- **Other benefits:** Promote innovation and technology development for the agrifood sector, get more added value on productive chains, specialized training
- **Key Indicators:** Net Present Value **\$79.08 million USD**, Internal Rate of Return **47.99%**, Immediate Return Rate **32.7%**
- **Other actions performed:** Risk analysis.



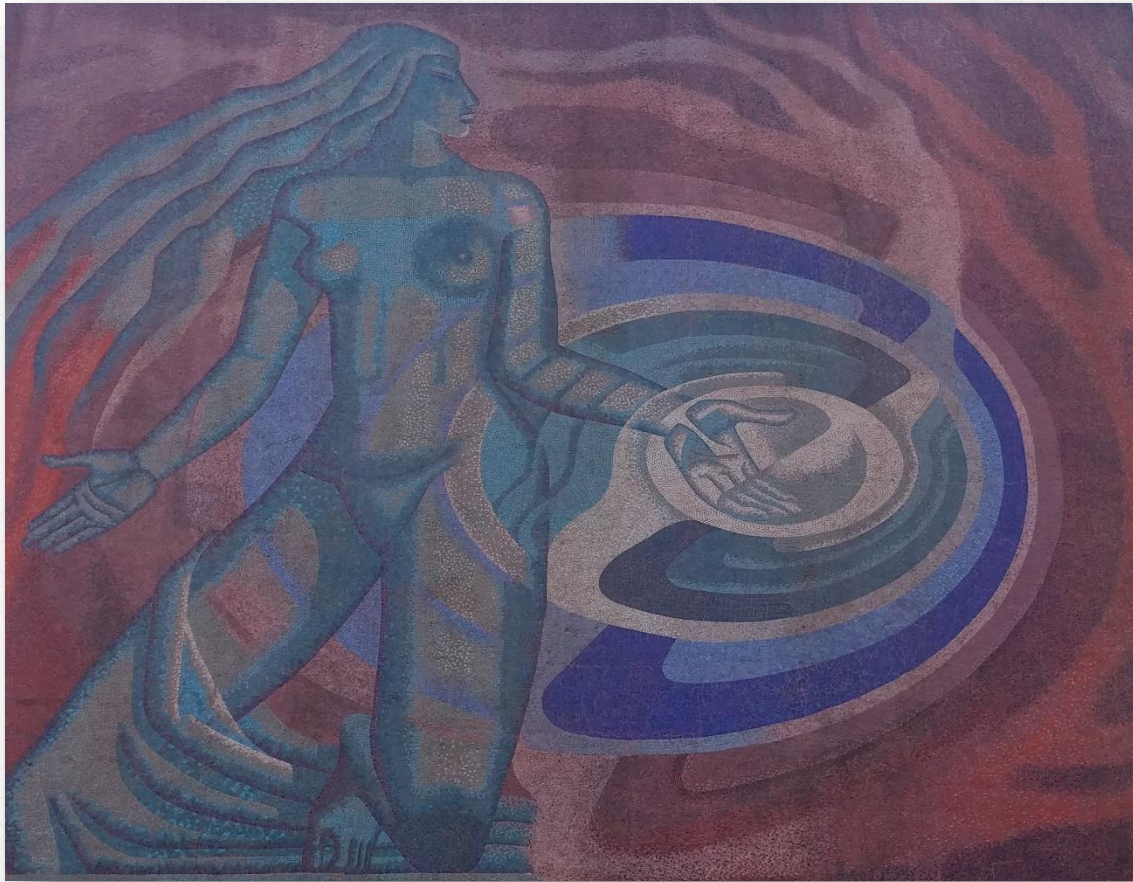
Initiative 3: A Irradiation Plant at ININ

- **Under a private/public model:** With the support of FOCIR and PIAPEM of Inter-American Development Bank
- **Design Criteria:** The development of the project should satisfy what the Mexican Law of Public Private Association establishes.
- **Some figures:** Are not defined yet
- **Other benefits:** Research and technology development, specialized training
- **Other actions performed:** Market study, Risk identification

Conclusions and Final Remarks



- It has been described the long road that ININ has gone through to promote and make feasible the installation of new industrial irradiation plant
- For a research center, is not enough to understand and assimilate the technology in order to be able to develop projects the size of an industrial irradiation plant
- It is very important to emphasize that ININ not only promotes the peaceful uses of nuclear science but also practices a leadership role to disseminate the benefits of irradiation technology in spite of major obstacles
- Many action has been accomplished, on of them is on its way: to have the recognition of IAEA as a Collaborative Training Center in Irradiation Technology



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Thank you



Thank You

