COMPLEX TECHNOLOGICAL PROJECTS THAT IMPROVE OUR DAILY LIFE

2021

INVAP

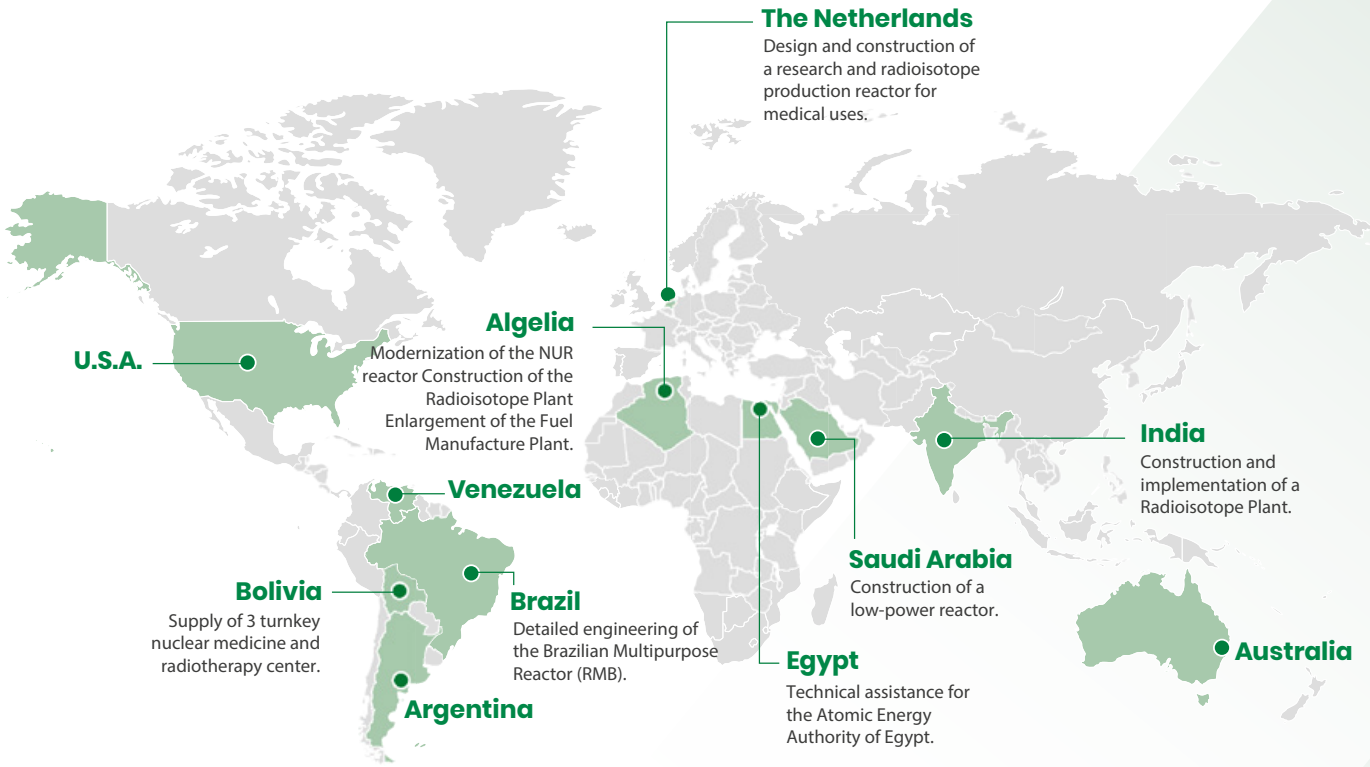
INVAP S.E. is a self-sufficient company of the province of Río Negro that has been developing advanced technological projects in different fields of the nuclear, space, defense, communication, energy, security, environment and nuclear medicine industries for more than four decades. Thanks to its experience in conceiving, implementing and managing multidisciplinary and highly complex projects, INVAP is able to provide products and services complying with its customers' requirements and to go through all the stages that a project involves, from the technical advice prior to the construction agreement to the turnkey delivery of plants. These projects have as its ultimate goal

to improve people's quality of life and contribute to the sustainable development.

Its mission is to develop and carry out technological projects providing its customers with strategic value, in the context of a self-sustaining company. To create genuine sources of employment, encouraging the development of the staff and the communities where it operates, while protecting the natural environment.

WE ARE AN ARGENTINE GLOBALLY ACTING COMPANY

INVAP's headquarters are located in San Carlos de Bariloche. The company has facilities in several Argentine cities (Córdoba, Neuquén, Buenos Aires, Campana and Rosario) as well as subsidiaries, partnerships and representatives in those countries to which it has made large exports. Here are our current projects, partnerships and representative offices in the world:



WE UPHOLD INTEGRITY AND TRANSPARENCY IN OUR CONDUCT.

+INFO
For more information, visit our website

INVAP's reputation is based not only on its technological capability but also on a tradition of ethical conduct. Business integrity is constitutive of the organization and is recognized in Argentina and the world.

The company's Code of Ethics and its associated Integrity Program ensure an ethical standard of behavior with clear rules for all the people involved in the organization, regardless of their position or function.

Besides, INVAP intends to enforce the Code of Ethics before third parties, and is ready to accept similar codes if they meet the same integrity standards.

The company has zero tolerance for corruption of any kind, whether public or private, active or passive.

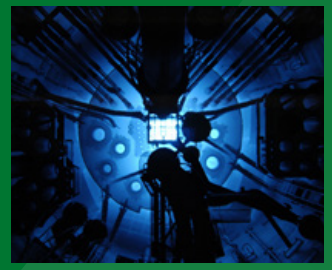
INVAP is committed to comply with local and national laws, international treaties and other applicable regulations of the countries where it operates. Regulatory compliance is the basis of its operations, proactively aiming at achieving the best practices, with a socially responsible management approach.

BUSINESS AREAS

INVAP is organized in different strategic business units offering innovation and creativity to the market through technological solutions tailored to each project by multidisciplinary teams that work in close relation with our value-chain.

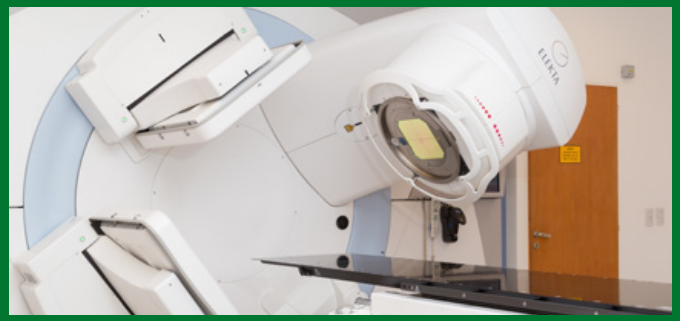
NUCLEAR TECHNOLOGY

- Research and radioisotope production multipurpose reactors.
- Radioisotope production plants.
- Products, services and maintenance for nuclear facilities.



SPACE TECHNOLOGY

- Low orbit satellites.
- Geostationary satellites.
- Optical, radar (SAR) and communication payloads.
- Ground stations.
- Subsystems/Sensors and Actuators.
- Consultancy and training services.
- Services based on satellite images.



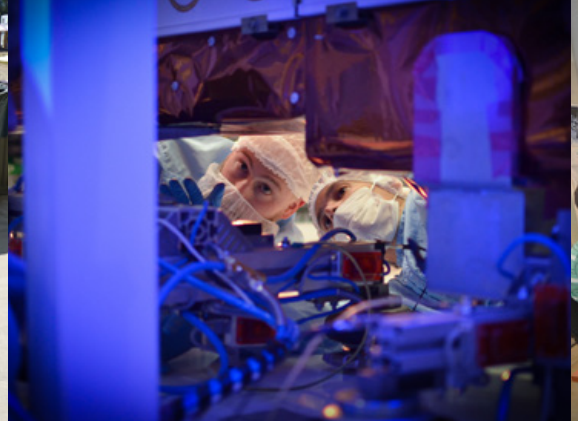
TECHNOLOGY FOR DEFENSE, SECURITY AND THE ENVIRONMENT

- Intelligence, Surveillance and Reconnaissance (ISR) Solutions.
- Military air traffic surveillance and control 3D radars.
- Electro-optical gyro-stabilized sensors.
- Command and control centers.
- Extension of systems' lifetime and upgrade.
- Primary (PSR) and secondary (MSSR) Air Traffic Control (ATC) radars.
- Doppler Meteorological Radars, dual polarization.
- Unmanned Aerial Systems with rotating wings.

TECHNOLOGY FOR HEALTH AND INTEGRAL PROJECTS

- Plants for radioisotope production.
- Medical equipment for radiotherapy.
- Turnkey radiotherapy centers.
- Several complex technological projects.

INVAP has carried out **more than 1,000 project** on topics as diverse as the design and construction of nuclear research facilities and radioisotope production plants for medical uses; the development of Earth observation satellites for environmental risk management; telecommunication satellites; the design and construction of radars to control air traffic and safety and monitor climate change; the turnkey provision of specialized nuclear medicine centers; and many engineering services for different industries.

STAFF ORGANIZATION AND PROFIT SHARING

More than **1000 persons** work at INVAP, 85% of whom are highly qualified professionals and technicians.

The company is developing some of the most interesting technological projects of the region, and many of our team members are internationally recognized for their contribution to science, technology and productive innovation.

85% HIGHLY QUALIFIED PROFESSIONALS AND TECHNICIANS.


NUCLEAR TECHNOLOGY

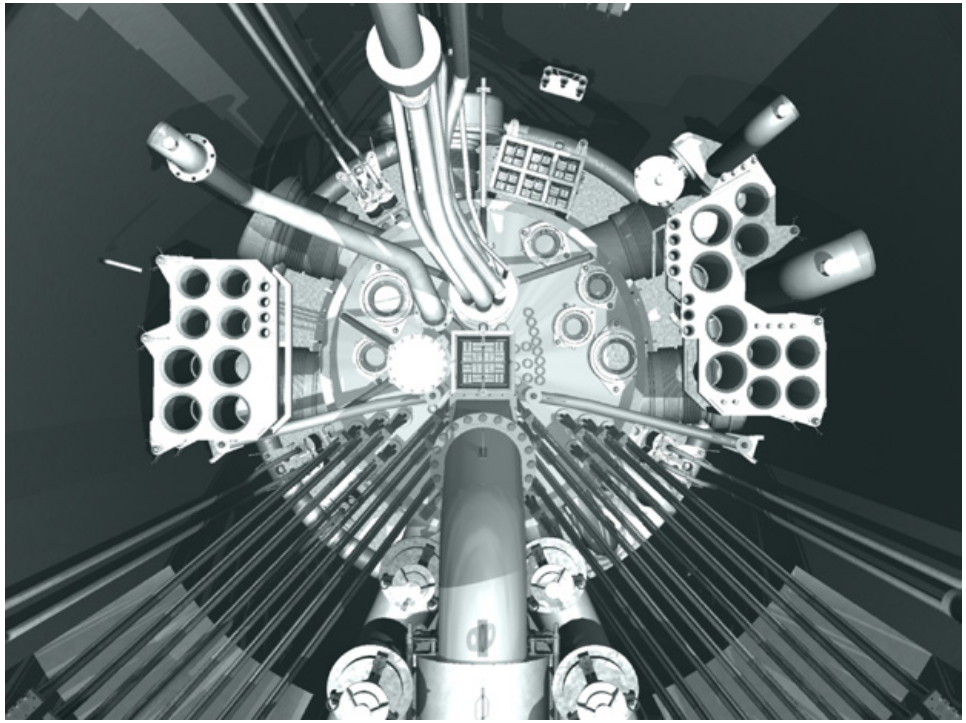
OPAL REACTOR
AUSTRALIA

WORLD LEADER IN NUCLEAR TECHNOLOGY

The company is internationally recognized for its nuclear technology and, today, it has become a member of the leading group in building nuclear reactors used for scientific and technological research, radioisotope production for health uses and highly complex nuclear facilities.

INVAP provides nuclear plants and other nuclear facilities with services, and offers tailor-made solutions to meet specific operational and maintenance needs. These capabilities are also implemented to optimize existing nuclear systems and to replace components manufactured by other suppliers.

Nuclear projects developed all over the world.



Render: reflector tank,
PALLAS reactor.

INVAP is currently working in the engineering development of the **PALLAS** (the Netherlands) and RMB (Brazil) reactors. The former is aimed at radioisotope production, whereas the latter, a multipurpose reactor, is aimed both at research and at radioisotope production.

In Argentina, together with the National Commission of Atomic Energy (CNEA, in Spanish), the company is building the Argentine multipurpose reactor RA-10.

INVAP is also building two radioisotope production plants, the first one to India and the other to Algeria.

Moreover, the company is now making progress on the construction of a low-power research reactor (LPRR) for the organization King Abdulaziz City for Science and Technology, in Saudi Arabia.

Besides, INVAP's services were hired again by the Centre de Recherche Nucléaire de Draria, Algeria, to increase from 1 MW to 3.5 MW the power of the NUR reactor designed and built by the company 25 years ago.

SPACE TECHNOLOGY

SAOCOM

SPACE AS A STRATEGIC RESOURCE

The eight satellites designed, built and put into orbit by INVAP have earned the company prestigious recognition in the international scenario of the satellite technology. Today, it is the only Latin American company able to carry out complete satellite projects, from developing the mission concept to putting the satellite into orbit and its operation with the exception of the launching.

SAOCOM 1A satellite.

SAOCOM 1B in the Integration Building (CEATSA).

In relation to the LEO satellite development (Low Earth Orbit), the company reached its latest milestone for the launching of the Earth observation satellite **SAOCOM 1B**, on August 30, 2020, from the US Cape Canaveral Air Force Base, in Florida, and the launching of its predecessor SAOCOM 1A, on October 7, 2018, from the US Vandenberg Air Force Base, in California.

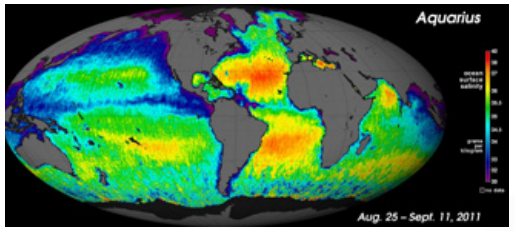
This mission is now adding radar instruments that will permit to obtain images of Argentina and the rest of the world no matter the light (daytime or nighttime) or weather conditions. The constellation is comprised by both SAOCOM 1 satellites that have the same requirements concerning design, functionality and effectiveness. INVAP participates in this program as supplier of the Service Platform and the central spare parts of the Synthetic Aperture Radar for the Argentine National Space Activities Commission (CONAE, in Spanish) and the Italian Space Agency (ASI, in Italian.)

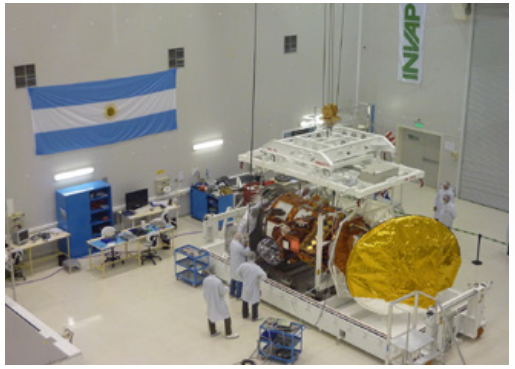
Likewise, INVAP is working in the SABIA-Mar mission (an Argentine-Brazilian satellite designed to provide information on the sea environment). The project has been conceived as part of a space cooperation agreement between Argentina and Brazil, and is carried out by the CONAE and the Brazilian Space Agency (AEB, in Spanish), together with several companies and organizations of both countries. This is the first joint mission aimed at the observation of the sea and coastal areas that will provide valuable information to study the marine ecosystem, carbon cycles, fishing activities and the weather, among other applications.

The Earth observation satellite program, in which the company participated, has successfully completed the SAC-D/Aquarius project thanks to the establishment of a joint mission between the Argentine National Space Activities Commission (CONAE) and the U.S. National Aeronautics and Space Administration (NASA) together with Brazil, Canada, France and Italy. It proved to be an important milestone in INVAP contribution to the space career. In the context of this project, the NASA Jet Propulsion Laboratory (JPL) —which manufactures the most complex space-qualified vehicles and equipment— designed and produced the Aquarius, valued then at 280 million U.S. dollars, whose main goal is to measure the surface seawater salinity on a global scale, thus contributing to better understand the climate change phenomenon.

This sophisticated instrument was integrated by Argentine professionals into the Scientific Applications Satellite SAC-D, fully developed at INVAP's headquarters. On June 10, 2011, the satellite SAC-D/Aquarius was successfully launched from the Vandenberg Air Force Base, U.S.A.

Seawater salinity map with information provided by the SAC-D/Aquarius.





SAC-D/Aquarius in Clean Room.

ARSAT-1 satellite.

As regards the development of geostationary satellites, INVAP was the main contractor of ARSAT S.A. to design, build, assemble and test the Argentine telecommunication satellites **ARSAT 1 y 2** (geostationary models that orbit at 36,000 km from the Earth) developed for the Argentine Geostationary Telecommunications Satellite System. They are in orbits 81° and 72° West, allocated to the Argentine Republic by the International Telecommunication Union (ITU) dependent on the United Nations.

The ARSAT-1, whose assemblage at INVAP's headquarters concluded in 2013, was successfully put into orbit on October 16, 2014. The ARSAT-2 was launched on September 30 a year later. With these projects, INVAP took up and fulfilled a great challenge: to develop and manufacture geostationary satellites that orbit 36,000 km away from the Earth, with an expected 15-year lifetime, a communication service availability of 99.9% and a pointing accuracy of the antennas higher than 0.5°.

In its permanent pursuit of new markets and business opportunities, INVAP in a strategic partnership with the company Turkish Aerospace created **GSATCOM *Space Technologies***. The new partnership initiates the first program to develop, produce and commercialize small geostationary satellites to provide telecommunication services and get into the international geo-satellite market in a competitive way. This new family of satellites will offer a variety of telecommunication solutions implemented on a fully electric platform based on the concept of small satellites of high performance.

TECHNOLOGY FOR DEFENSE, SECURITY AND THE ENVIRONMENT

RPA-170M

PROTECT TO LIVE BETTER

INVAP works together as a team with governments and private actors to provide innovative technologies to the defense, security and environmental areas. For an effective air traffic control the company manufactures Monopulse Secondary Radars **(RSMA, in Spanish)** and surveillance and control radars for air and land spaces with civic and military aims, wholly designed by professionals and technicians in Argentina.

RSMA
San Carlos de Bariloche Airport.

RPA-240T at INVAP's headquarters,
San Carlos de Bariloche.

The National Ministry of Defense, through the Argentine Air Force (FAA, in Spanish) hired INVAP's services to build twelve 3D long-range radars for air traffic surveillance and control **(RPA-240T)** which are installed and put into service in the north of the country. The RPA can be transported by land or air, and is designed to operate in permanent or semipermanent facilities for air space surveillance and for the defense and security of the Argentine territory.

RPA-170M,
Merlo FAA base.

In this respect, INVAP designed and manufactured for the FAA a mobile version of a Primary Radar. The radar, called **RPA-170M**, is a state-of-the-art medium-range 3D radar for strategic air defense that operates in L-band. It is a high mobile system designed to be deployed swiftly with minimum staff.

In 2018, due to a contract signed with the FAA, the AN/TPS-43 radars were updated increasing the national airspace surveillance and control, which added to the primary radars (RPA) played a strategic role during the G-20 Summit in Argentina, in November that same year.

As regards the security area, INVAP has an optical gyro-stabilized system for aircrafts, called EVT-035A, **Electro-optical Gyro-stabilized Multi-sensor System.**

In relation to the environmental area, INVAP has designed and provided the National System of **Meteorological Radars** (SINARAME, in Spanish) for the National Secretariat Office of Water Resources (Argentina.) The integrated system of eleven meteorological radars and the operation and process center provide information for meteorology, hydrology and research. Together with other systems, they are used as a key element in the improvement of forecasts in the short term and warning systems for serious meteorological events.

The RMA-C320 is a dual polarization Doppler radar operating in C-band. It can be configured to observe the atmosphere from a distance of up to 480 km and 360º in azimuth, sweeping in elevation from below the horizon up to over 90 grades.

RMA-C320.

Render: RUAS-160A fumigating.

RUAS – 160A PROJECT

The **RUAS-160** is a compact, modular unmanned aerial system with rotating wings, counter-rotating coaxial rotors, and great autonomy.

The system consists of three main components: the aerial segment (the unmanned aerial vehicle itself, with rotating wings), the ground segment (ground monitoring and control console) and a set of transported equipment (called "payloads") that are tailored to accomplish the required mission.

The different modular payloads allow the system to be adapted for use in defense and security activities; agricultural, oil & gas, forest and mining industries; firefighting support; search and rescue on land or at sea; sanitary operations; etc.

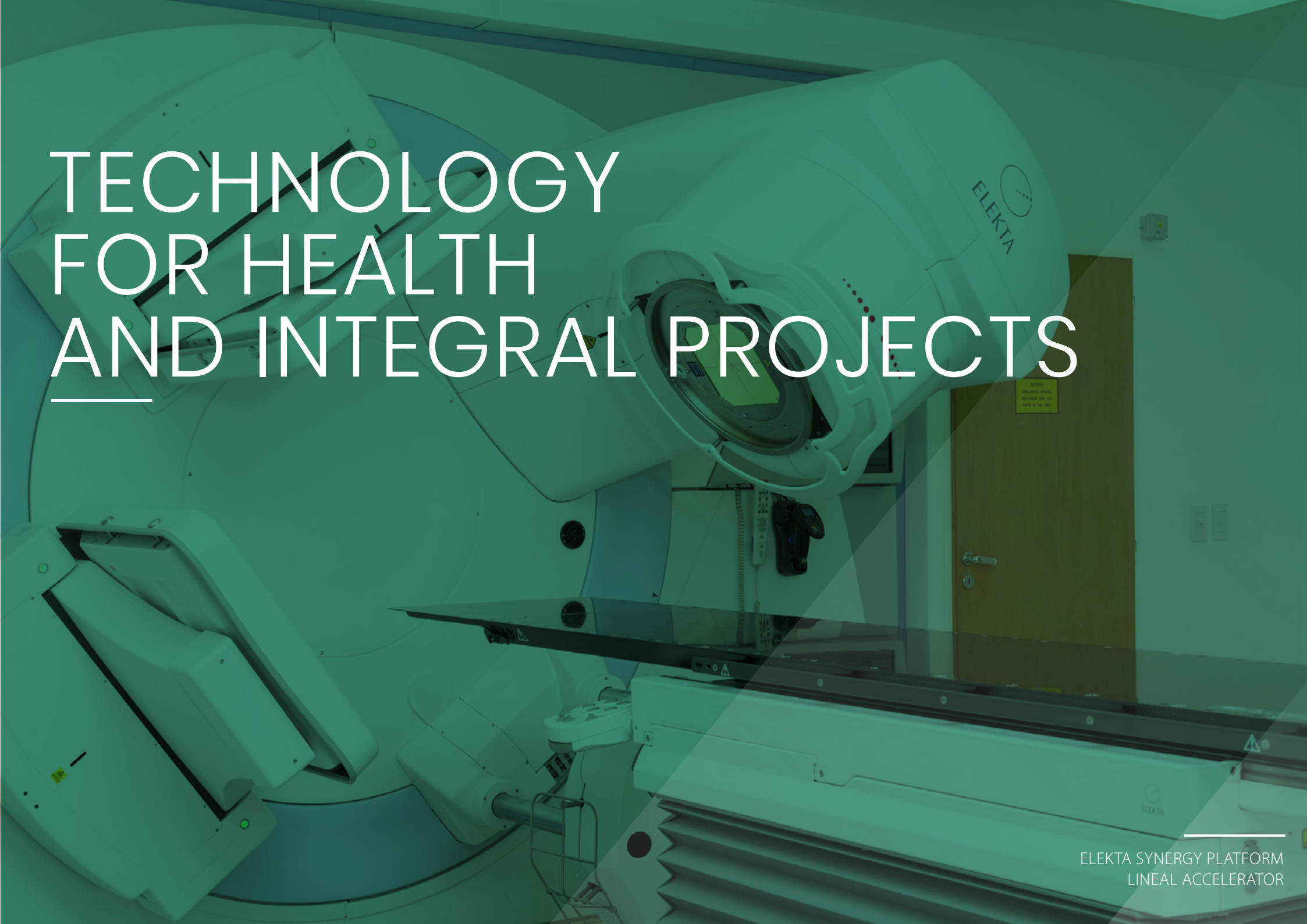
Thanks to its compact and lightweight design, it can be easily transported, and deployed from any terrain or ship, and operate in adverse weather conditions.

Payloads:

- Gyro-stabilized platform with electro-optical/infrared sensors.
- LIDAR (Light Detection and Ranging).
- X-band SAR radar.
- Equipment for highly-selective crop-dusting and image capture to determine the health state of the soil and crops.

RUAS-160.

TECHNOLOGY FOR HEALTH AND INTEGRAL PROJECTS



ELEKTA SYNERGY PLATFORM
LINEAL ACCELERATOR

NUCLEAR TECHNOLOGY AT THE SERVICE OF HEALTH

INVAP develops highly complex medical projects for domestic and international customers. These projects include the construction of turnkey radiotherapy centers; the design and shielding assessment of bunkers, as well as their construction and monitoring of the civil works complying with local regulations; the supply and implementation of equipment for brachytherapy, radiotherapy, proton therapy and radiopharmacy, and of their respective validation and start-up processes; preventive and corrective maintenance programs, guarantees and spare parts for all the equipment; and training programs in clinical workflow, operation and maintenance for medical professionals.

INTECNUS Foundation
in San Carlos de Bariloche.

Cyclotron for radioactive tracers production, INTECNUS Foundation, San Carlos de Bariloche.

In Bolivia, the **first** of three nuclear medicine centers built by INVAP —with similar characteristics to those developed in Argentina— was inaugurated in 2019. In Venezuela, the company refurbished and upgraded, from 2009 to 2012, 19 medicine centers to provide radiotherapy and nuclear medicine services.

Nuclear Medicine and Cancer Treatment Institute, El Alto.

Elekta Flexitron®

In Argentina, the company has developed for the CNEA nuclear medicine centers providing radiation oncology treatments through linear accelerators used for clinical purposes and high-doses brachytherapy equipment, integrated with treatment simulation and planning systems. Many of these centers are able to produce radioisotopes for drug processing. Besides, a **Proton Therapy Center** with unique facilities in Latin America is under construction for the treatment of cancer.

TECHNOLOGICAL INTEGRATION

INVAP's technological integration projects include all those innovative challenges that the company is able to face and that are beyond the scope of projects in the nuclear, space or defense, security and environment fields.

One of the most important technological integration projects developed is Open Digital Television. Between 2009 and 2015, it involved the construction of 90 digital transmission stations in different places of Argentina. They included the engineering design and the application of technological innovations such as Mobile Relay Stations.

This project was also exported to Venezuela, where INVAP built over 20 relay stations between 2013 and 2015.

Facilities of an Open Digital Television transmission shelter.

Diigital Transmission Station for Open Digital Television (TDA, in Spanish).

Open Digital Television Control Center at ARSAT's headquarters in Benavídez.

FUNDACIÓN INVAP

INVAP Foundation was created in 2004 with the purpose of promoting social changes through technological development in projects with a social impact.

The organization connects and articulates public and private actors at the national and international levels, putting INVAP's wide experience and knowledge at the service of the community.

Its strategic axes are: social and productive development, communication and awareness, and institutional strengthening. Today, its most emblematic projects are "*Emprendé Con Ciencia*" (Enterprising With Science) and *"Bioenergía Andina*" (Andean Bioenergy).

+INFO

www.fundacioninvap.org.ar

info@fundacioninvap.org.ar

ESC2

BIOENERGÍA ANDINA

TRANSFORMANDO RESIDUOS EN RECURSOS

+INFO

www.invap.com.ar

info@invap.com.ar