Princess Elisabeth Antarctica

The First “Zero Emission” Polar Research Station

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International Polar Foundation and the Princess Elisabeth Station

The International Polar Foundation (IPF) was set up in 2002 with the vision of bridging the gap between science of society through education, action and demonstration.

With a particular focus on polar science and its ability to help us better understand climate change, the IPF, through a range of communications and outreach tools and projects, aims to show how the energy challenges of today can be tackled for a sustainable future.

It was with this goal in mind that the Princess Elisabeth station concept was born during the International Polar Year 2007-2008, the world's first "zero emission" scientific research station in Antarctica.

Commissioned by the Belgian federal government, the IPF managed the development of the Princess Elisabeth station from design phase to completion, including financing and building the station onsite. The IPF today has the mandate of Antarctic Operator for the Belgian Polar Secretariat.

www.polarfoundation.org
www.antarcticstation.org

Technology & Ingenuity

Energy Production

12%	22 m² thermal solar panels
40%	380 m² photovoltaic solar panels
48%	9 wind turbines

The genius of this new structure lies in the truly innovative way in which known building technologies, renewable energy and water treatment technologies have been seamlessly integrated into a structure and an operating system that is reminiscent of a living organism.

Several internationally renowned companies have joined the project to create real and vibrant partnerships which have advanced in a fruitful collaboration and knowledge sharing exercise. The role of the private sector in supporting this project and the public enthusiasm which has accompanied every phase in the process has greatly motivated the team to make a real difference.

This project takes us in the right direction with regard to the need for rethinking the future in the face of climate change. Princess Elisabeth is the first "zero emission" facility in Antarctica, at the beginning of an era in which the rising cost of fuel has begun to seriously endanger future research activities. The Princess Elisabeth station shows that the climate challenge is not insurmountable where there is goodwill and collaboration between peoples, sectors and countries.

Ambitious

Subjected to extreme conditions, and faced with monumental logistical challenges related to transporting building materials to the Antarctic interior, the Princess Elisabeth station achieves high standards for functionality, safety and minimum environmental impact.

Pioneering

The Princess Elisabeth station is a first in many respects. The advanced design methodology, including analysing the day-to-day requirements and needs of the research teams, the balance of new and proven technologies installed in the station, the intelligent integration to achieve the "zero emission" target, the private sector involvement in the financing, and the private/public partnership for future operations, are all innovative aspects which open up new possibilities for designing polar research stations of the future.

Zero Emission

Unique in its design and construction, the Princess Elisabeth station is the only polar research facility to be designed and built to operate entirely on renewable energies.

Water Treatment Unit

In line with the requirements of the Antarctic Treaty to minimise environmental impact, the Princess Elisabeth station is equipped with a specially designed water treatment unit. Inspired by technology developed for the space sector, the two bioreactors and two filtration units will allow the station to treat 100% of its grey and black waters. Most of the recycled water, although fit for human consumption, will be reused for other functions.

Renewable Energy

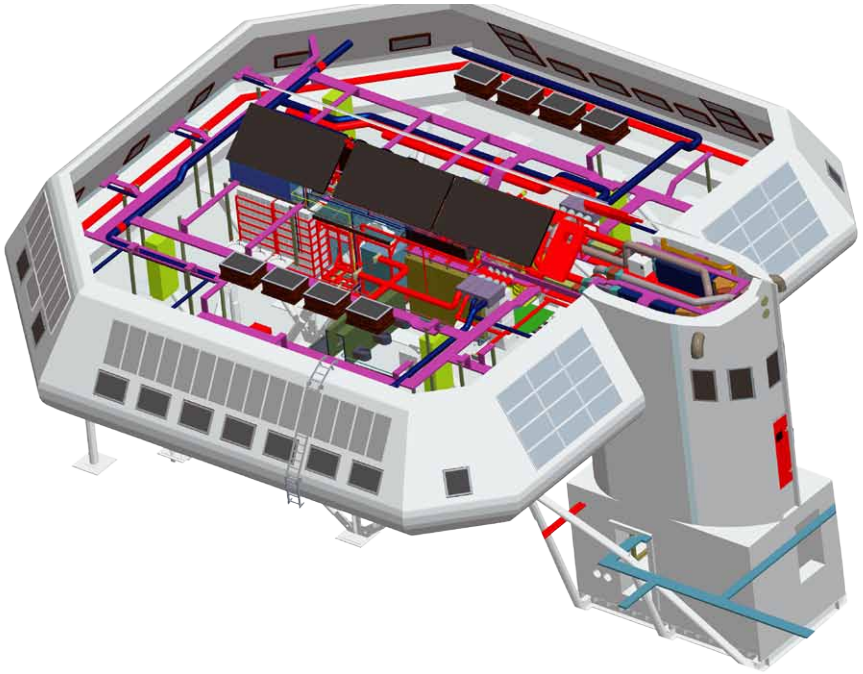
The station is designed to be powered by a combination of two renewable and carbon-neutral technologies for producing electricity: wind and solar power. While wind power will be used to supply the station with electricity all year long, solar power will provide both electricity (photovoltaic panels) and hot water (solar thermal panels) during the austral summer.

A Passive Building

The station's skin, insulation, shape, orientation and window disposition allow a comfortable ambient temperature to be maintained inside the building with little energy input. Sophisticated ventilation and air circulation systems are an integral part of temperature management. The Princess Elisabeth station was conceived to take full advantage of currently available passive building techniques.

Intelligent Systems

All station systems are integrated and piloted by a programmable logic controller. This configuration ensures that working and living conditions inside the station are optimised allowing for the most energy efficient system in the world. The smart grid performance is 3 times better than with any conventional system. This centralised control also allows for remote monitoring during the winter.



General information

Station

- Austral summer station : open from November to February
- Capacity: 25 to 40 people
- Expected lifespan: 25 years minimum
- Total usable space: 400 m² main building + 1500 m² technical areas

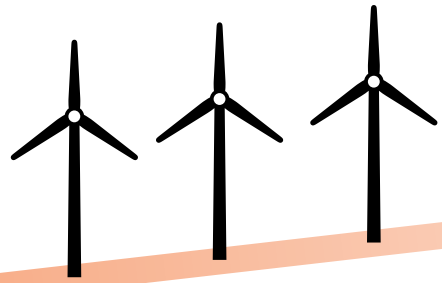
Meteorological Conditions

- Air temperature: -50°C to -5°C
- Dominant katabatic winds
- Prevailing wind direction: East
- Monthly average wind speed: 20 km/h
- Monthly maximum wind speed: 125 km/h
- Monthly maximum gust speed: 250 km/h
- Average atmospheric pressure: 830 hPa
- Precipitation: accumulation depending on snowdrift
- 24-Hour daylight: 100 days out of 120 during austral summer season

Location

- Position: 71°57'S 23°20'E, on the Utsteinen Ridge, north of the Utsteinen Nunatak, Dronning Maud Land, East Antarctica.
- Altitude: 1382 m
- Distance to Coast: 220 km
- Distance to Japanese Syowa station: 684 km
- Distance to Russian Novolazarevskaya station: 431 km
- Research areas: Sør Rondane Mountains, glaciers, coast and the Antarctic Plateau

Smart Grid: a World First



The Princess Elisabeth's major feature, which allows to be a "zero emission" station, is its Micro Smart Grid – a unique system based on a Demand Power Management System. This advanced autonomous energy network was developed in partnership with GDF Suez (Laborelec) and Schneider Electric.

Energy production technologies selected for the Princess Elisabeth – solar photovoltaic, wind turbines, solar thermal– have all been commercially available for some time, but they had never before been interconnected as a stand-alone energy efficient network. The key hurdle to overcome in designing an operational system was to manage and control all electrical loads, with a permanent large disparity between available energy produced and cumulative potential usage from installed equipment.

This led to Laborelec – GDF Suez developing a proprietary Demand Power Management System. The smart grid is controlled by a redundant Programmable Logic Controller (PLC), the "brain" of the station, itself managed through a human interface Schneider Electric developed.
The PLC simultaneously supervises more than 2,000 points of energy production or consumption. Such a set of innovative solutions guarantees delivery of the required power within a logical pattern of dynamic priorities. It makes it possible to manage an installed power ten times larger than the energy production, which is about three times more efficient than any existing network.

To date, the Princess Elisabeth Micro Smart Grid is the most efficient energy network in the world. A satellite link grants remote access to the station via the PLC. The Princess Elisabeth station can thus be monitored and all its energy-related systems managed and adjusted remotely throughout the winter.

People living at Princess Elisabeth had to adapt their individual behaviour and re-think their relationship with energy, always keeping in mind that the global energy budget had to be shared carefully rather than used thoughtlessly.

① Backup generator to be replaced by hydrogen fuel cell

Energy Production

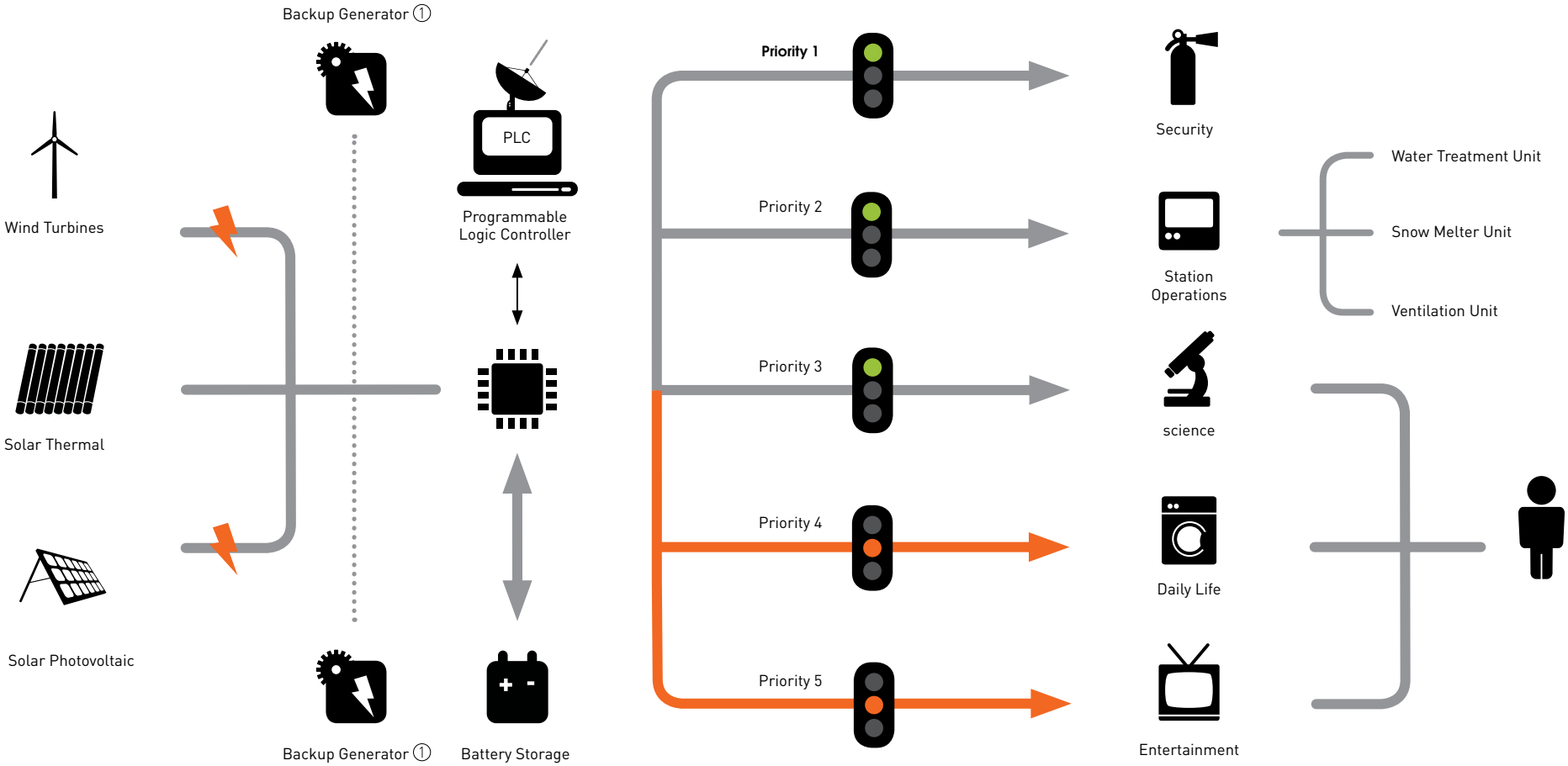
Limited Production Capacity

Control & Supply

Balance Available Energy & Cumulated Request
Dynamic Prioritization

Variable Demand

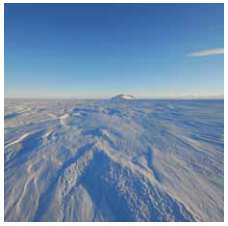
Energy Request



Region and Location

Princess Elisabeth Antarctica is a dedicated research station built with the aim of supporting the scientific work of both Belgian and international scientists in East Antarctica. Because of its location and facilities, the station not only provides state of the art logistical support and equipment for visiting scientists, but also access to a wide variety of interesting environments for study.

The station is uniquely situated at the foot of the Sør Rondane mountain range and at the edge of the polar plateau. Within a radius of 200 km, scientists can easily access a wide range of potentially interesting Antarctic environments.






In logistics terms the new station can act as a hub for field exploration in the 20°- 30° E sector of Antarctica.

Science at Princess Elisabeth Station

Since beginning operations, the PEA has welcomed international scientists working on a range of polar related science.

BELATMOS

Monitoring of Ozone and Related Trace Gases, UV Radiation and Aerosol Particles in support of Atmospheric Chemistry and Climate Research.

Observation of composition and chemistry of the atmosphere to monitor ozone and other airborne particles.

BELDIVA

Belgian Microbial Diversity Project in Antarctica.

Exploration of the microbial diversity within a 200km radius of the station.

BELISSIMA

Belgian Ice Sheet - Shelf Ice Measurements in Antarctica.

Study of the glacial flow towards the ocean, which could accelerate as a result of climate change and contribute to the sea level rise.

BGR

Bundesanstalt für Geowissenschaften und Rohstoffe.

German geological investigation of the area to signs of the Gondwana formation over 500 million years ago, and of its break up around 180 million years ago.

CAML

Census of Antarctic Marine Life.

Assessing the nature, distribution and abundance of all living creatures in the Southern Ocean to establish a baseline of Antarctic marine biodiversity.

DELAQUA

Deglaciation, Ice Sheet Thickness and Climate Change in Dronning Maud Land during the Late Quaternary.

Assess the impact of climate change and environmental changes on Antarctic organisms by using biological indicators.

GIANT

Geodesy for Ice in Antarctica.

Combining GPS data, gravimetry and seismology techniques to trace horizontal and vertical deformations of the Earth's surface to study their relationship with the ice mass variations.

HYDRANT

Hydrologic System of Antarctica.

Investigating the atmospheric part of the Antarctic hydrologic cycle from moisture evaporation and cloud formation to snowfall.

LGGE

Laboratoire de Glaciologie et Geophysique de l'Environment / Glacioclim.

Tracing snow accumulation and ice sheet movements from year to year.

MICROMETA

Micrometeorites from Antarctica.

Worldwide collaboration combining recent developments in micrometeorite analysis with Belgian know-how in cosmochemistry.

SAMBA

Search for Antarctica Meteorites: Belgium Activities.

In collaboration with Japan's NIPR.

Ice preserved meteorites allow to better understand the evolution of the solar system and the planets.

Equipment and Facilities

Mandated as Belgian Antarctic Operator, the International Polar Foundation (IPF) sets out to provide all scientific projects with state of the art support, logistics and equipment.
Available at Princess Elisabeth:

The satellite link allows for efficient communication with remote members of the team and enables high speed transfer of data collected on the field.

Aside from the main building, 2 scientific shelters on the ridge provide dedicated locations for installing scientific instruments and collecting data in the immediate vicinity of the station.

The 1500m^2 technical spaces offer all the facilities needed to store and repair all but the most heavy equipment. Various scientific equipment is available for research activities in the field from small ice drill to deep ice drilling system.

The 3 Prinoth tractors, the Hammar side-loader, sledge-equipped trailers and numerous skidoos available at the station ensure that heavy equipment and scientific crews can easily be transported anywhere in the vicinity of the station.

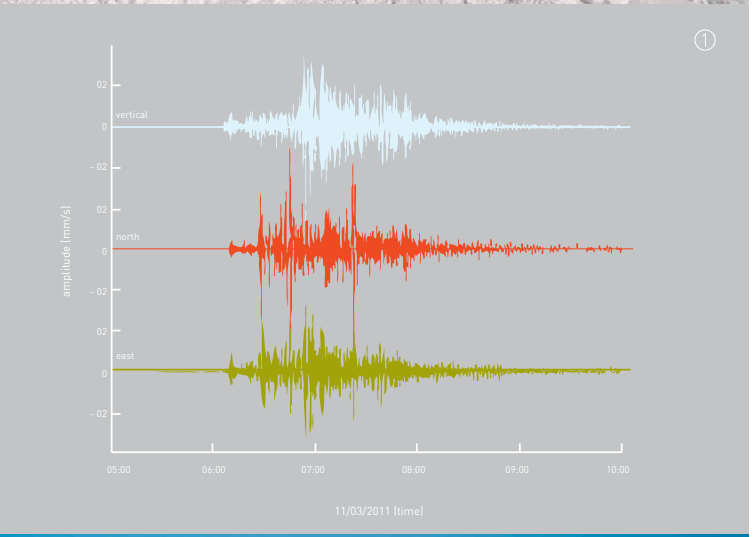
Mobile labs and fully equipped accommodation containers can be deployed to ensure that field research can be carried out in the best possible conditions, even for long periods.

Mobile Facilities

Equipment available at Princess Elisabeth for field campaigns and traverses:

For all field research conducted in the coastal area North of the Princess Elisabeth station as well as for activities in the Sor Rondane mountain range and on the Antarctic plateau, the IPF has developed a dozen mobile units. Mounted on standard 20ft Lehmann sledges, they can be used for either short or long traverses, or as mobile field stations.

Several types of mobile units are available: sleeping units with five beds, kitchen and dining room, office units and technical facilities units (workshop, energy production, combined solar & diesel snow melter, toilet, sink, storage, etc). For shorter campaigns, two 10ft units mounted on 20ft sledges permit small teams to operate with a minimum of sleeping and cooking facilities combined with storage for 20 fuel drums. If required, there are also two mobile laboratories (wet and dry labs), a glaciology workshop with possible storage at -28°C as well as a reefer container in case there is a need to transport ice cores by sea. The mobile units are conveyed to their area of operation by Prinoth snow tractors.



Rationale

Research

Study of deep ice cores in Antarctica has enabled scientists to demonstrate the connection between temperature and atmospheric carbon dioxide levels, as well as the anthropogenic origin of current growing concentrations of CO_2. Not only do observations in Antarctica contribute to a better understanding of Earth's climate system, they also provide key information concerning the state of the planet and serve to develop better climate models to help decision-makers.

The Princess Elisabeth station provides the necessary services and facilities to efficiently support international scientific research in the Sør Rondane area. The operational and scientific management of the station is the responsibility of the Belgian Polar Secretariat, a private/public partnership between the IPF and the Belgian government including the Belgian Federal Science Policy Office (BELSPO).

Historical Imperatives

The International Polar Year 2007-09 was a joint effort of the international polar science community to highlight the important contribution of polar research. Built during the IPY, the Princess Elisabeth station is in the long lineage of historical stations constructed during the International Geophysical Year (IGY) 1957-58. A fitting successor to the King Baudouin station which was built by Belgium in 1958 and closed in the 1960's, the station aims to make its historical contribution to scientific research in the Polar Regions, leading to a greater understanding of our World and the way it functions.

Inform & Educate

The International Polar Foundation will use the station for education and outreach purposes, to raise awareness about the importance of polar research and its contribution to understanding climate change. Through a range of outreach tools including websites, CD-ROMs, school talks and programs, plus interviews and live updates from the station, polar science is being taken to a broader audience.

①

Earthquake in Honshu offshore (11/03 05:46:23, Mw=8.9)
recorded at ELIB seismometer, Princess Elisabeth Antarctica.
SOURCE: Royal Observatory of Belgium

Key Dates

February 2004:
Belgian government commissions the IPF to design and build an Antarctic research station, as a private/public partnership

First BELARE - Nov 2004:
Find a construction site

BELARE 2 - Nov 2005:
Logistics planning

BELARE 3 - Jan 2007:
Prepare site for construction

September 2007:
Pre-construction and inauguration ceremony in Brussels
Station open to public (35,000 visitors in 4 days)

BELARE 4 (2007-2008):
Construction of building

BELARE 5 (2008-2009):
Installing active systems

February 2009:
Official inauguration of station in Antarctica
End of IPY 2007-08

BELARE 6 (2009-2010):
Systems integration
Station operates in "zero emission"

April 2010:
Station donated to Belgian state by IPF
Belgian Polar Secretariat launched
IPF mandated Antarctic Operator










SES



Sponsors

that have made the Princess Elisabeth Station possible:

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