



## 19<sup>th</sup> COMNAP Symposium (2020)

### “Antarctic Station Modernization: Future-proofing Infrastructure to Support Research and to Reduce Environmental Impact”

The 19<sup>th</sup> COMNAP Symposium (2020) “Antarctic Station Modernization: Future-proofing Infrastructure to Support Research and to Reduce Environmental Impact” includes presentations covering eight subjects and themes:

- a. Construction methods and management
- b. Incorporating life safety systems
- c. Maintaining, upgrading and scaling data collection, storage and transfer systems
- d. Energy-efficiency and renewable technologies
- e. Stakeholder engagement/supporting science during modernization projects
- f. Managing a “construction site” rather than a “scientific research site”
- g. Health, safety and well-being during modernization and in design, planning and transition stages.

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## Abstract Book

### How future-focused logistics and infrastructure will enhance Antarctic science

Stuart Gibson and Adrian Young

*Australian Antarctic Division (Australia)*

The Australian Antarctic Division (AAD) will deliver future-focused logistics and infrastructure to enhance the ability of scientists to answer questions of global significance.

The AAD has identified six key principles which will be reflected through its modernisation activities. These are:

- Health, safety and well-being
- Support for world-leading science
- Future flexibility
- Environmental stewardship
- Sustainability
- Representing Australia in Antarctica

The AAD is in the early stages of designing a state-of-the-art Davis research station that will rely on new and emerging technologies to reduce water consumption, energy needs and waste generation, minimising the station's environmental footprint and operating costs.

The AAD is also continuing to progress plans for a new aerodrome near Davis research station, subject to environmental approvals.

Davis Aerodrome would be East Antarctica's premier aviation hub, with year-round flights to the continent departing from the Antarctic Gateway city of Hobart, Australia.

It is envisaged that expeditioners landing at the aerodrome would be taken to Davis research station, or transported to field camps and stations further afield through a network of intracontinental flights operated by Australia and other nations.

The infrastructures delivered by the Davis Aerodrome project would include:

- A 2,700m paved Code 4E runway suitable to accommodate all existing and foreseen future large aircraft capable of return flights from Australia without refuelling at the aerodrome.
- Aviation infrastructures, including a taxiway, aircraft apron, runway lighting, intracontinental aircraft hangars, expeditioner processing facility, storage shed, fuel storage and Aerodrome Rescue and Fire Fighting Services station and Air Traffic Services centre.
- A 4.5km access road from the station to the aerodrome.

## The Belarusian Antarctic station: The complex approach to creation, construction and renovation

Aleksei Gaidashov, Igor Pilshikov

*Republican Centre of Polar Research (Republic of Belarus)*

The Republic of Belarus has been building the Belarusian Antarctic research station in East Antarctica, Enderby Land, Tala Hills, since December 2015.

The planning and construction of the research station include the renovation and modernization of buildings used by the Soviet Antarctic expedition in the period 1980–1991 alongside the installation of new infrastructure. The use of prefabricated modular sections was chosen as the most appropriate approach to build the station due to their versatility. Making future improvements, or allowing for their removal from the Antarctic Treaty area at any time.

Using support provided by helicopters, the modules were disembarked from a vessel and positioned on height-adjustable installation platforms. Each structural unit of the research station can be integrated and attached to similar units, allowing for a multi-functional complex, including a hospital. The use of innovative design solutions, alternative energy sources and systems to efficiently control electricity, heat and water, support the creation of a state-of-the-art facility simplifying the construction process and reducing the costs. The research station can accommodate up to 11 people in winter and up to 15 during the summer months.

The construction of the research station strictly adheres with the rules for the treatment of waste and oil and, thanks to the installation of automated scientific instruments, supports environmental protection through remote sensing capabilities.

## Architecture and construction of the new main building of the Arctowski station

Ewa Kurylowicz<sup>1</sup>, Piotr Kuczyński<sup>1</sup>, Karolina Czumaj<sup>1</sup>, Aleksander Krauze<sup>1</sup>, Bartosz Świniarski<sup>1</sup>, Bartosz Marciniak<sup>1</sup>, Hubert Maciejewski<sup>1</sup> and Dariusz Puczko<sup>2</sup>

<sup>1</sup>*Kurylowicz & Associate (Poland)*, <sup>2</sup>*Institute of Biochemistry and Biophysics Polish Academy of Science (Poland)*

The aim of this presentation is to provide insights on the construction of a new residential building and the conversion of the Henryk Arctowski Polish Antarctic Station. The scope of work includes:

- The construction of the main residential building.
- The construction of two new warehouses: garage for land and marine vehicles, with an evacuation shelter.
- The modernisation of all existing features on the premise, such as: power plant, main fuel deposit, two warehouses, several residential buildings, lighthouse and all the network services (power, water and sewage).

This presentation will focus on the main building that, with a usable area of ca. 1500m<sup>2</sup>, is designed to meet safety and well-being standards for crew and researchers during the Antarctic summer.

The building shape was designed to mitigate the wind load on structural elements and prevent snow accumulation at the entryway. The building will be situated in consideration of the main wind direction (southwest). In order to prevent snow accumulation at the entrance, the main building is to be elevated on a steel truss, which will be set on a precast concrete foundation. The main building structure consists of a precast timber frame with “sandwich” panels as cladding. The outer layer will be made of special aluminium with copper. This material provides sufficient stiffness and is resistant to mechanical grinding caused by particles carried by wind.

With environmental sustainability in mind, the building was designed to utilize as much natural light as possible. Necessary power will be partially provided by renewable energy sources (photovoltaics).

Structural components (including prefabricated foundations) and other required materials will be transported by sea in standard shipping containers after pre-assembly and disassembly at the manufacturing site.

The modular, prefabricated design allows for off-site preparatory works to be carried out any time of year, while construction works on site will be carried out during Antarctic summer seasons.

## Chilean Antarctic Infrastructure to 2030

Marcelo Leppe, Osmar Gippert Albarrán, Felipe De la Lastra Dreckmann and Marcela Andrades Soto  
*Instituto Antartico Chileno*

The program to modernize three Chilean Antarctic stations began in 2019. The three Chilean Antarctic stations are:

- Professor Julio Escudero, Fildes Bay, King George Island
- Yelcho Station, Doumer Island, South Bay
- Carvajal Station, Adelaida Island, Margarite Bay

It is estimated an investment of 70 million US dollars will be needed to complete this project in a period not less than eight years. This project requires coordinated work with other public and Antarctic actors, for the development of the project and logistical support.

During 2019 and 2020, studies on soil mechanics and topo-bathymetry, associated with port facilities, have been conducted to define the type of foundations and constructive modalities, stages of construction and initial models for their operation, with a time-span of 30 years. These will be our inputs to obtain the definitive preliminary project to tender the detailed design and construction of each of these stations.

With all the aforementioned input, we are in the process for bidding for the preliminary projects for Yelcho and Carvajal stations.

In this poster we will present the conceptual design models for these two stations, which are taking into account the scientific research conducted in the Antarctic Peninsula and the infrastructure's logistical requirements that are specific to each area.

## The New Brazilian Antarctic Station Comandante Ferraz: prospects for the Antarctic constructions technological innovations

Newton Fagundes de Carvalho<sup>1</sup>, José Costa dos Santos<sup>1</sup>, Zhang Yi<sup>2</sup> and Jiao Yang<sup>3</sup>

<sup>1</sup>Brazilian Antarctic Program (Brazil), <sup>2</sup>Tsinghua University (China), <sup>3</sup>China Electronics Imp. & Export. Coop (China)

After the geological and geotechnical studies carried out by the Brazilian Navy in the Antarctic summer 2014, the construction work for the new Brazilian Antarctic station began. This civil work was designed to support the research and development of several scientific areas such as geosciences, engineering, biology, chemistry and medicine.

The construction was completed in 2020 and has a built area of 4,500m<sup>2</sup> that includes 17 scientific laboratories. The station has an energy cogeneration system, comprising diesel generators integrated with renewable wind and solar energy modules.

Adverse environmental conditions, such as winds up to 200km/h, soils subject to freezing and thawing cycles, the occurrence of ice sheets in the subsoil, as well as earthquakes, have made the construction in Antarctica an engineering challenge. The safety of the building and of the personnel was paramount hence, both in the design phase and construction, the soil geotechnical characteristics and the site environmental conditions were observed in order to conduct technical adjustments.

During the construction process, sensors to monitor the soil were implemented into the structure. These sensors and a laboratory for soil research will help understanding the foundations' behaviour in the extreme Antarctic environment.

## New fire extinguishing system in Juan Carlos I station

Joan Riba, Miguel Angel Ojeda

*Marine Technology Unit – Spanish National Research Council (Spain)*

One of the main characteristics of Juan Carlos I station is its modular design. This design implies some special characteristics regarding general services, such as energy, communications, and protection systems to mention a few.

One of the innovative systems at the station is its fire extinguishing system, closely related to the fire detection system. The combination of both makes the base safer and better protected against one of the greatest dangers an Antarctic base can face, a fire. A water mist system is installed: this converts water into a fine mist at a pressure of 120 bar when it is activated and remains pressurized to 18 bar the rest of the time. These systems are not only 100% environmentally friendly, but are also often more effective than conventional gas or water firefighting equipment.

One of the added advantages is that the system is kept charged year-round with a liquid called "temper", a saline solution that does not freeze to -40°C, with minimal maintenance.

In addition, the protection is increased with the additional fixed hose reels and extinguishers that allow access to places where the sprinklers of the nebulized system can not reach. Fire detection is carried out in all the modules by means of a wide range of detectors (smoke, temperature, flame) that are installed depending on the uses of the rooms. Fire containment is also important during the base design stage. At Juan Carlos I, containment features include doors with different radio frequency (RF) alarms and specially protected areas where all walls have a RF120 rating: the kitchen, the pump room and the control room for the extinguishing system.

Finally, not only the systems, but also the personnel, who must have the appropriate training, can guarantee the quality of a system so important to the life of the base.



## Designing and validating a sustainable Antarctic station: Antarctica New Zealand's Scott Base Redevelopment project and the custom sustainability accreditation scheme

Peter Taylor<sup>1</sup>, P. Sitter<sup>1</sup>, S. Shelton<sup>1</sup>, V. Singleton<sup>1</sup>, H. Broughton<sup>2</sup>, S. Middleton<sup>3</sup>, J. Partington<sup>3</sup>, M. Craig<sup>4</sup>, M. Fearnley<sup>4</sup>, T. Taylor<sup>4</sup>, A. Davidson<sup>5</sup>, S. Archer<sup>5</sup> and J. Chapa<sup>6</sup>

<sup>1</sup>*Antarctica New Zealand (New Zealand)*, <sup>2</sup>*Hugh Broughton Architects (United Kingdom)*, <sup>3</sup>*Jasmax (New Zealand)*, <sup>4</sup>*Steensen Varming (Australia)*, <sup>5</sup>*New Zealand Green Building Council (New Zealand)*, <sup>6</sup>*Green Building Council Australia (Australia)*

Antarctica New Zealand is currently designing a new Antarctic station to replace the current aging station, Scott Base. The Scott Base Redevelopment project has key environmental and sustainability requirements, one of which is an independent accreditation of sustainable design.

The project will integrate innovative architectural elements, energy efficiency, occupant health and well-being, and demonstrate leadership in sustainability. Antarctica New Zealand is currently working through the developed design and analysing options for logistics and construction methodologies ranging from traditional build on site, to a full build off continent and a 'big lift' ship carrying the pre-assembled station to Antarctica.

To demonstrate leadership in sustainability, a sustainability accreditation program that is both robust and specific for the Antarctic built environment is required. As no such program existed in New Zealand, one was developed in collaboration with the New Zealand Green Building Council. A bespoke Green Star Custom Tool for the design and as-built accreditation scheme was the result.

The Green Star Custom Tool encourages practices that reduce the project's contribution to climate change, enhance the health and well-being of inhabitants, ensure high performance of buildings, and contribute to market transformation (being an innovator of new sustainable technology to support market exposure).

This presentation will provide an insight into the development of this tool, and discuss the strategies Antarctica New Zealand is developing to minimise its environmental impact throughout the Scott Base Redevelopment. The potential for the collaborative development of Antarctic sustainable rating systems will be introduced.

## Energies supply strategies for Spanish Antarctic stations: Looking for sustainability

Joaquim Rabada, Joel Sans, Miguel Angel Ojeda and Joan Riba  
*Marine Technology Unit – Spanish National Research Council (Spain)*

Despite the fact that the Spanish Antarctic stations Gabriel de Castilla and Juan Carlos I are summer only, both maintain scientific equipment acquiring data year-round. This fact and the will of minimizing the ecological footprint of both stations, have required different strategies to provide the energy supply needs both in summer, when the stations are open and fully operational, and in winter without supervision. The continuity in the data acquisition is crucial for long-term monitoring and Spain is operating several of those long-term projects.

Power generation during the summer operating phase is based on diesel generators, however, over time, a cogeneration system has been added to these generators. The heat generated by the diesel generators is used for the air conditioning system and domestic hot water.

During the rebuilding of the Juan Carlos I station, the cogeneration system was fully developed, becoming a pivotal element in the daily energy management of the base. This system has also allowed a substantial saving in fuel consumption. It is also important to note that the modular configuration of the Spanish stations adds a higher level of complexity to the cogeneration system, requiring special pipes and conductions. However, we have found that with the appropriate design this does not represent significant heat losses.

An autonomous cogeneration generator project has been developed at the Gabriel de Castilla station, allowing a relatively small generator to operate with an integrated cogeneration system to support station energy needs.

The winter energy supply strategy is entirely based on the use of renewable energy, both wind and solar. In the 2000s, wind turbines and some photovoltaic panels were installed to power specific equipment during the winter season. At present, Juan Carlos I station has a wind farm consisting of three wind turbines, to which another wind turbine will be added during the 2020/21 season, and two photovoltaic fields, for a total power of around 6000W. The energy is accumulated in large batteries and it is completed with a communication system that, during winter, allows to remotely control the state and quality of the energy supplied, as well as possible problems in the powered equipment.

Innovative way to support energy needs during winter are carried out at Gabriel de Castilla station where a prototype of a methanol battery is supplying energy to equipment. This energy source is based on two 125W methanol cells working in parallel charging a bank of batteries at 24V. Along with this system, a diesel generator has been installed to prevent possible batteries malfunctions and it is located in an isolated container. The use of this technology has three main aspects: demonstrate feasibility for small requirements in the base, confirm the use of an unattended energy source for 270 days and, finally, a possible transition towards distributed generation at the base to minimize the difficulties of its modular configuration providing each building with its own renewable generator equipment based on this technology.

Despite having different approaches, both strategies pursue the same final objective, which is to reduce and optimize the use of fossil fuels. Moreover, we intend to maximize the use of alternative energies and provide a reliable energy source for the automatic instruments during winter.

## Testing Methodology to quantify carbon footprint and first results

Patrice Bretel and Jérôme Chappellaz  
*Institute Polaire Français Paul-Émile Victor (France)*

The French Polar Institute proposed at the COMNAP AGMXXXI (2019), held in Plovdiv, Bulgaria, to be a «beta tester» for carbon footprint quantification and to present its methodology, preliminary results and give feedbacks on encountered difficulties.

A French method/tool, developed mainly for corporations, called Bilan Carbone® has been used to conduct this research. Sources of carbon are divided in categories (i.e. transport energy, purchases, services, etc.) and the data collected are organised in databases. The database is published by the French energy agency (Agence De l'Environnement et de la Maîtrise de l'Energie). The CO2 emission factors from the Bilan Carbone® databases are automatically calculated per unit; however, direct measurement of petrol consumption, for example, can be introduced.

Few primary results are presented:

- There is a huge amount of work to collect the data. Looking for information that can be translated into carbon impact means getting all the dimensions of the activities from transportation, to freight, to all the purchases of equipment, invoices of services, types of material use for infrastructure and buildings, fixed assets depreciation.
- When the management of a site is shared with other programs or implies private companies' services, the information on carbon footprint becomes really complicated to get as the partner should also have the same methodology. Sometimes, the only way is to consider the financial component (i.e. rent costs) and to associate it with approximate carbon footprint quantitative appreciation.
- One main result, is the identification of the areas that have the greatest impact and those where even big efforts won't give big results. Transport is the main impacting emission factor.
- The carbon footprint is a very relevant method to analyse an activity as it concerns every dimension (even waste management).

One of the results is that we should improve the data collection relevant for carbon emissions from the beginning of every process and doing that on a yearly and regular basis. It would give more accurate results and save a lot of time to produce a carbon footprint report.

Transport and freight are the major carbon footprint sources. Optimizing transport by saturating the capacities of the vectors (ship, planes) is a first step. Season organisation should include buffer time to guarantee the success of operation and to avoid any carbon emission with a low success rate. When possible, adding scientific projects to logistics activities is a good way to optimise the carbon footprint.

## Improving insulation capabilities at Gabriel de Castilla station for a better energy efficiency

Joaquín Núñez Regodón<sup>1</sup> and Antonio Quesada<sup>2</sup>

<sup>1</sup>*Ejército de Tierra - Ministerio de Defensa (Spain)*, <sup>2</sup>*Comité Polar Español (Spain)*

Energy efficiency and renewable energy are pivotal to reduce energy consumption and to achieve greater energy independence. Proper identification and the evaluation of design parameters for living zones will contribute to more energy efficient stations, leading to obvious economic savings, and, even more importantly, will guarantee less environmental impact in the area.

This presentation aims to carry out an analysis of the optimal parameters to comply with the NZEB concept. We will focus on three factors:

- Current status of the insulation of the Spanish Antarctic station Gabriel de Castilla and the influence of thermal bridges on energy behaviour
- Infrastructure's thermal transmission coefficients
- Thermal behaviour influence on the soil under the Gabriel de Castilla station.

This study then proposes improvements to reduce energy consumption by up to 85% and to increase environmental comfort, implementing clean energies to supply the station. These components must be transportable to Deception Island and built without auxiliary elements that are not available in the Antarctic. Additionally, they must require minimum maintenance and withstand the climatic characteristics of the area, with such characteristics affecting their durability. Our proposal suggests the use of materials that favour an adequate life-cycle, reducing the ecological footprint.

## From Logistical Hub to Key Science & Observing Station: Upscaling science and environmental performance at the Norwegian research station Troll

Birgit Njaastad<sup>1</sup>, John Guldahl<sup>1</sup>, Nalan Koc<sup>1</sup>, Ole Arve Misund<sup>1</sup> and Frode Vik Bredesen<sup>2</sup>

<sup>1</sup>Norwegian Polar Institute (Norway), <sup>2</sup>Statsbygg (Norway)

The Norwegian Troll station was established as a small seasonal field facility in 1989, mainly to support remote fieldwork in an extensive area of Dronning Maud Land. The upgrading to a permanent station in 2005 included efforts to increase the science capabilities, but Troll's role has continued to be to primarily support and provide service to remote and large-scale fieldwork. Troll and the operations at the station comply with the legal environmental framework for activities in Antarctica, but over the years there has been little room to move from good environmental compliance to more extensive environmental innovation.

Developments over the last decades, and an increased willingness and interest in providing for more science activities at the station itself, has led to a continuous need to expand facilities, adding new elements on to the existing structures. The core structure at Troll is now no longer able to support and facilitate further energy efficient, environmentally sensitive expansion. Now the Norwegian national Antarctic programme finds itself at a crossroad with regard to decisions about the future status of, and capabilities at, Troll station. Whether the next step entails upgrading and modernization of existing infrastructure or building new facilities remains to be decided.

We will highlight early steps being taken in progress aiming to ensure a robust planning process for the modernization of Troll, involving relevant stakeholders and competence from the very start. We will consider the following:

- Engaging Statsbygg, the Norwegian government's key advisor in construction and property affairs, building commissioner, property manager and property developer
- Scaling new capacity and capabilities for an unknown future growth/need
- Identifying and prioritizing key science facilities
- Identifying and assessing risks and pitfalls
- Stepping up with regard to innovative energy production
- Life cycle thinking.

## Scott Base Redevelopment Project

Simon Shelton<sup>1</sup> and Hugh Broughton<sup>2</sup>

<sup>1</sup>*Antarctica New Zealand (New Zealand)*, <sup>2</sup>*Hugh Broughton Architects (United Kingdom)*

The Scott Base Redevelopment project aims to provide a fit-for-purpose facility that meets the project objectives to:

- Protect the Antarctic environment
- Provide a facility that keeps people safe and healthy
- Enable logistics to support high-quality science
- Maintain New Zealand's credibility amongst Antarctic Treaty Parties.

The Scott Base Redevelopment project is in the third of four stages of design before construction is due to commence in the 2022/23 season.

In this presentation, we touch upon the design evolution to date showing some high-level schematics and architectural renders, discuss managing and engaging large numbers of stakeholders, the challenges experienced through the design process as well as significant investigations undertaken as part of the design process e.g. snow and wind modelling, geotechnical drilling, ground penetrating radar and a topographical drone survey that have influenced the design. We will also introduce the construction methodology that has been considered.

## Science must go on: Running research while Juan Carlos I station was rebuilt

Joan Riba, Miguel Angel Ojeda, Jordi Sorribas and Jordi Felipe  
*Marine Technology Unit – Spanish National Research Council (Spain)*

The Spanish Antarctic station Juan Carlos I, located on the Hurd Peninsula, Livingston Island (62°39'46" S, 60°23'20" W), has been in operation, with interrupted periods, since its establishment in January 1988. Even though it is a summer only station, personned from mid-November to early March, automated instruments are maintained year-round.

A rebuilding process started in 2004 when there was official acceptance that the station's original facilities and services needed a refurbishment. In 2008, the tender winner started the work for manufacturing the new modules. The 2017–18 Antarctic campaign was the first in which the renewed base has operated at its full capacity. In February 2019, the renovated facilities were officially inaugurated.

During the renovation years, a large population of workers and technicians, dedicated to the refurbishment, coexisted with a reduced number of researchers conducting scientific projects in order not to paralyze scientific activities. One of the main scientific goals during the rebuild period was to continue to maintain the historical data series, which had been recorded since the establishment of the station.

The combination of both activities represented a challenge for planning, logistics and coordination of field activities because the refurbishment affected all the station spaces and vital systems-obliging people to work and live, for a long time, in provisional facilities with a high occupancy density.

This presentation shows the timeline from the start of the refurbishment activities, with its milestones and construction phases, the scientific activities carried out, and steps implemented to coordinate and enable both activities simultaneously.

## Rothera redevelopment and the challenges of managing a 'construction site'

Simon Garrod

*British Antarctic Survey (United Kingdom)*

The British Antarctic Survey (BAS) is undergoing extensive redevelopment at Rothera research station as part of its modernization programme. The first phase involved replacing the existing wharf with a deeper version to allow the new BAS research vessel, the RRS *Sir David Attenborough*, to resupply the station. This construction project brought significant challenges due to the scale of activities and the relatively limited space available for machinery operations, quarrying and stock-piling of rock, building the new steel frames, and workshops. Additionally in the second season of the two-year wharf project, we started groundworks for the new science and operations building.

During this period, we sought to minimise the impact to science, both on station and in the field, since Rothera is the hub for BAS air operations. This is a long-term programme of construction so we had to find ways to facilitate construction needs, whilst maintaining scientific outputs. Construction will last for several years and therefore we could not put science on hold. Accommodating the numbers of people on station has been a challenge and has required changes to both station infrastructure and station routines.

The wharf project has now been completed successfully and perhaps most importantly of all, safely. As major construction activity was undertaken, whilst maintaining normal station operations, safety and risk management was an overarching theme and required a joined up approach between construction partners and BAS.

From the outset, the project philosophy was to deliver the modernization programme as a partnership, rather than as a separate construction team working independently of BAS. Achieving this level of integration began well before construction started on site. This joined up approach has been integral to the overall success of the project delivered and was a key element in managing a construction site at an Antarctic research station.



## Environmental impact related to the modernization of the Arctowski Station (legal basis, assessment methodology, mitigation actions guideline)

Bartosz Marciniak<sup>1</sup>, Monika Piątkiewicz<sup>1</sup> and Dariusz Puczko<sup>2</sup>

<sup>1</sup>*Project Management (Poland)*, <sup>2</sup>*Institute of Biochemistry and Biophysics Polish Academy of Science (Poland)*

The aim of this presentation is to assess the environmental impact in relation to the modernization of the Henryk Arctowski Polish Antarctic station.

In order to assess the modernization's environmental impact, Bartosz Marciniak and Monika Piątkiewicz touch upon the legal basis for the environmental impact assessments (EIAs), including also the Polish regulations - Act of 3rd October 2008 on the Provision of Information on the Environment and its Protection, Public Participation in Environmental Protection and Environmental Impact Assessments consolidated text Journal of Laws of 2020, item 283 as amended.

We will discuss the environmental impact assessment, the methodology used to identify the zones of direct and indirect impact, and the identification of environmental threats. We will also present the results of the environmental impact assessment.

The proposed mitigation actions, including rules for conducting construction works in areas with special environmental conditions, and cumulative impact, both in the context of other activities implemented in the region and in the context of subsequent stages of the station modernization will be presented. The station modernization has been divided into stages to mitigate the cumulative impact and monitoring guidelines have been followed and implemented.

## Creating an optimal work/living space for researchers: Designing interiors focusing on people's needs in extreme Antarctic isolation

Hubert Maciejewski<sup>1</sup>, Julita Mańczak<sup>2</sup>, Maciej Bidermann<sup>2</sup> and Agnieszka Kruszewska<sup>3</sup>

<sup>1</sup>*Demiurg Project (Poland)*, <sup>2</sup>*Vox Capital Group (Poland)*, <sup>3</sup>*Institute of Biochemistry and Biophysics Polish Academy of Science (Poland)*

Demiurg Project is tasked to design the new Polish Antarctic station. Previous strategies for designing spaces located in extreme environments hardly ever took into account the needs of their inhabitants. The main focus was on their functional and technical purpose.

Marginalization of the psychological needs of people living and working in isolation for months is surprising since the effects of the scientific research, to a large degree, depend on the psychological condition of the researchers.

The idea behind the designing of the new Henryk Arctowski station's interiors is based on the identification of the needs of people who will work and live in long-term isolation. In our presentation, we will explain why it is important and pragmatic to adopt this particular approach in designing Antarctic stations' interiors.