Polarforschung 76 (1-2), 47 – 57, 2006 (erschienen 2007)

Georg von Neumayer Station (GvN) and Neumayer Station II (NM-II) German Research Stations on Ekström Ice Shelf, Antarctica

by Eberhard Kohlberg[1] and Jürgen Janneck[2]

Abstract: Construction, technology and living conditions on the two German Antarctic research stations Georg von Neumayer Station (GvN, operational 1981/82 to 1992) and Neumayer Station II (NM-II, operational since 1992), which is going to be replaced by a new station in 2007/2008 are briefly described and compared.

Zusammenfassung: Bau, Technik und Lebensbedingungen auf den beiden deutschen Forschungsstationen in der Antarktis, der Georg-von-Neumayer-Station (GvN, in Betrieb von 1981-1992) und Neumayer-Station II (NM-II, in Betrieb seit 1992), die in 2007/2008 durch eine neue Station ersetzt werden wird, werden kurz beschrieben und verglichen.

INTRODUCTION

Planning of the construction of a new German research station – Neumayer Station III – in Antarctica has already been started several years ago. It will be the third station in series on the Ekström Ice Shelf near Atka Bay and it will replace the present Neumayer Station II (NM-II) constructed in 1992, the successor of the first station, the Georg von Neumayer Station (GvN) which was constructed in 1981/82. On occasion of the 25th anniversary of research stations NM-II and GvN on the Ekström Ice shelf it appears timely to reflect on the development and history of the two previous comparative assessment.

In January 1978 the government of the Federal Republic of Germany decided to accede to the Antarctic Treaty and doing so established the first official step of a German comeback to Antarctic research. In May 1978 a further step was taken when the German Research Council (DFG) was admitted as the German representative to the Scientific Committee of Antarctic Research (SCAR). To obtain consultative status within the Antarctic Treaty system the accomplishment of a comprehensive research program and the commitment to long-term scientific activity in the Antarctic were important prerequisites. Finally, with the construction and operation of a permanently occupied research station in Antarctica – the Georg von Neumayer Station (GvN) on the Ekström Ice shelf – which was commissioned at the beginning of March 1981, Germany received full member status with the Antarctic Treaty Consultative Party (ATCP). Only shortly before – on 15 July 1980 – the Alfred Wegener Institute, the national German institution for polar research, was established as a foundation under public law.

[1] Reederei F. Laeisz (Bremerhaven) GmbH, Brückenstraße 25, 27568 Bremerhaven
[2] Stiftung Alfred-Wegener-Institut für Polar- und Meeresforschung (AWI) in der Helmholtz-Gemeinschaft, Postfach 120161, 27515 Bremerhaven.

RECONNAISSANCE AND LOCALISATION OF THE BUILDING SITE

In austral summer 1979/1980 a scientific expedition under the leadership of Heinz Kohnen on the Norwegian MS "Polarsirkel" took place in the Weddell Sea. One major issue was the site survey for the selection of a suitable location to build the German research station. A location on the Filchner-Ronne Ice Shelf at 77°36'S and 50° 40'W was selected as a first choice. An alternative building site was identified on the Ekström Ice Shelf in the area of Atka Bay in the NE Weddell Sea at 70°36'S, 8°20'W in the event that access to the Filchner-Ronne Ice Shelf in the southernmost Weddell Sea was not possible because of the generally difficult ice conditions there.

During austral summer 1980/81 the ships "Gotland II", "Polarsirkel" and "Titan" with the construction team of the research base on board met extremely difficult ice conditions on their way to the Filchner-Ronne Ice Shelf and were finally stopped in late December by heavy pack ice at 77°28'S, 43°39'W. On 15 January 1981 a decision was reached to save time for construction and not to further follow the original plans (Filchner-Ronne Ice Shelf) but to use the alternate construction site on the Ekström Ice Shelf. After all, between both locations a commonality existed as they were both located on an ice shelf. This decision was made in accordance with the general research concept developed by the Alfred Wegener Institute (AWI) and within the German Research Council (DFG).

To find a construction site for the German research base apart from the Antarctic Peninsula with its many research stations and as far south in the Weddell Sea as needed to conduct glaciological, geophysical and meteorological investigations was gaining high scientific importance. Ice Shelves have an important impact to the ocean. In order to run a research station at such a location it should be possible to combine oceanic data collected with the new RV "Polarstern" on one hand with data gathered at the observatories on the station on the other hand. Furthermore, Atka Bay and Ekström Ice Shelf provided a favourable logistic base and access for expeditions to the Antarctic Plateau and the Kottas and Heimefront mountains.

DESIGN AND CONSTRUCTION OF THE GEORG VON NEUMAYER STATION

Since it was decided to build the station on an ice shelf, two construction concepts had to be considered in order to manage the yearly growth of snow cover of about 80-100 cm as well as the snow-drift.

Two concepts were conceived. The first possibility was a construction under the snow cover in the ice. Here, the construction would have disappeared over the years in the increasing snow and ice masses. The second possibility consisted of a platform above the snow/ice surface on which the quarters and workspaces were to be mounted. Along with this concept would have come a yearly elongation of the platform pillars, which would have resulted in tremendous personnel costs. South Africa and Great Britain had already built a tube construction under the snow cover. Hence this design was chosen despite of the restricted lifetime of the station due to deformations resulting from creeping ice and the increasing pressure from the growing snow cover. The lifetime of the first station was estimated to be ten years, which could be approved.

For the German station the buildings were designed in container form. They were placed in large tubes made of wavy steel plates and therefore protected against the influence of the atmospheric conditions. The steel tubes compensated the resulting forces from the snow pressure. The air gap between the buildings und the tube walls resulted in a certain insulation of the buildings. The real insulation was situated on the outer faces of the buildings. As mentioned, this concept had already passed the test of the British and South African stations.

At the time of the order the Federal Ministry of Research assumed that the station would be shut down for the first Antarctic winter after finishing its installation phase. Following the final installation the station was to be occupied with a crew of scientists and technical personnel during the second season 1981/82. But in the later process the decision was made to complete the station to perform a safe wintering of a basic crew in the very first winter season. The safety inspection of the whole building was carried out in due form by the Germanische Lloyd in Hamburg.

In January 1980 the company Christiani & Nielsen AG received an award for their 14.6 million D-Mark proposal. During the succeeding phase of construction many material test were carried out in order to investigate the strength of different materials at very low temperatures and their insulation capabilities. Vehicles, hydraulic cranes and radio communication plants were investigated in hired refrigerating chambers. For reasons of economy a full test in the assembly of the station did not take place (Fig. 1). Only thirteen containers of construction stage 1 were mounted. Test runs of the power units, heating, air conditioning, heat transmission, snow melting, water production and purifying, pressure increase and fire protection were performed.

Independently, parts of the large steel tubes were also mounted for test purposes. This test mounting also acted as an indicator for possible planning and construction failures as well as finding an optimal configuration of the assembly personnel.

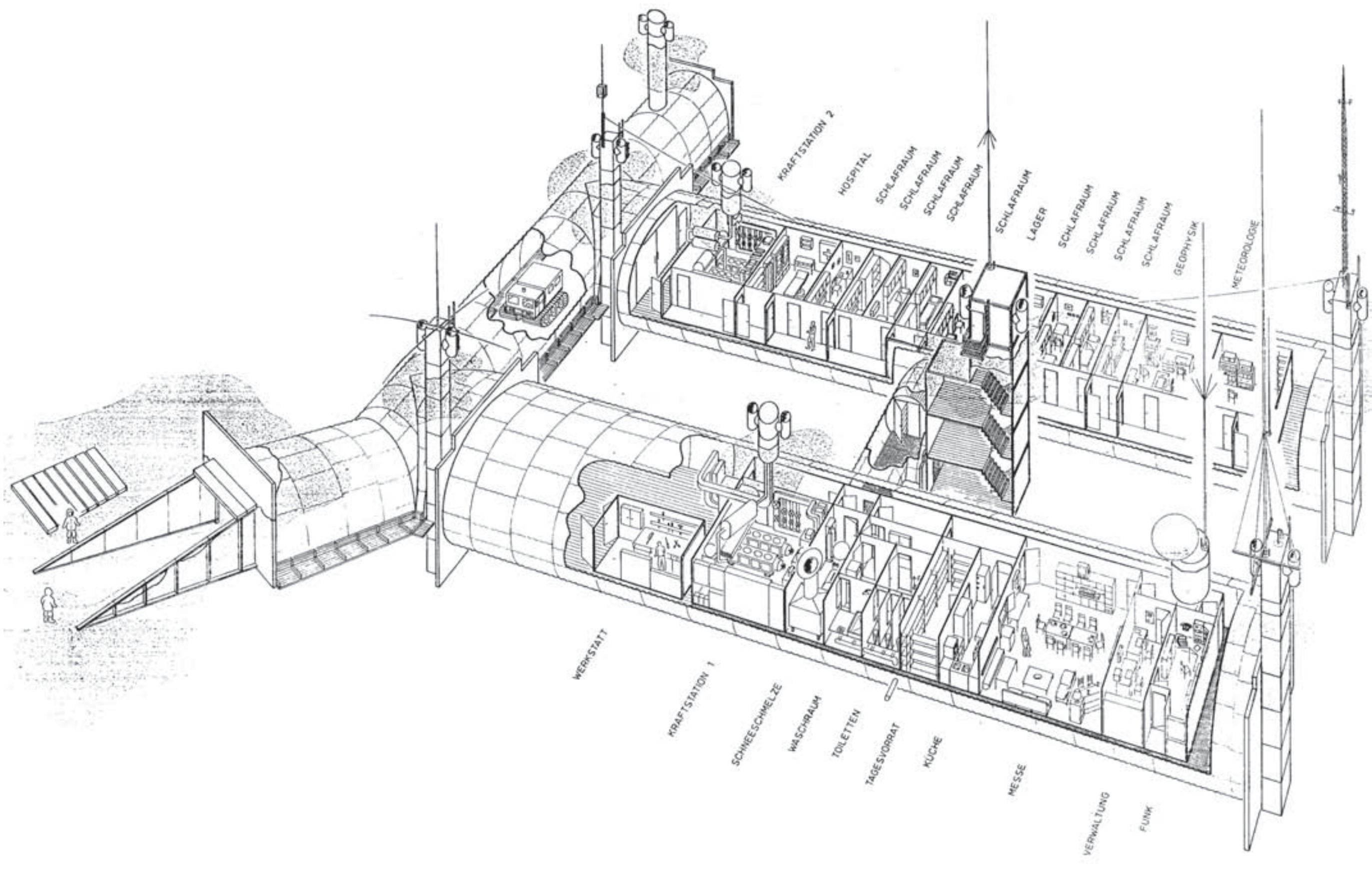

Fig. 1: Georg von Neumayer Station (GvN). Schematic diagram of the tube construction situated beneath the snow surface (Figure D. Enss / Polarmar).

Abb. 1: Georg-von-Neumayer-Station (GvN). Schema der unter dem Eis liegenden Röhrenkonstruktion (Abbildung D. Enss / Polarmar).

JOURNEY AND ASSEMBLY OF THE STATION

In total 1103 t, equalling 3986 m^3 of freight were necessary for the assembly and the subsequent wintering. All cargo went onboard the "Gotland II". A few accommodation cabins and collapsible container had to be left behind because the "Gotland II" had reached her loading capacity.

MS "Gotland II" was equipped with ice class E3. The main dimensions were: BRT 999, overall length 91.2 m, beam 12.8 m and draught 4.5 m. The ship sailed at 12.5 knots powered with a 1965 kW Deutz engine. Equipped with a continuous hatch the ship was very suitable for unloading via helicopter. The existing crane capacities had to be expanded especially for this application. The forecastle was equipped with a 20 t cargo gear. The single load for cargo was 18 t. Additional accommodation modules on the aft raised the ship's capacity to 45 berths.

Beside the transport ship "Gotland II" two more ships participated in the expedition to the Weddell Sea. The Norwegian MV "Polarsirkel" was used as a basis for the accompanying research work of scientists. In addition two helicopters owned by the company "Helicopter Service Wasserthal GmbH" had to be stored on this ship. Scientist used these helicopters for reconnaissance missions as well as for transportation purposes to the building site. The third ship in the trio was the salvage tug BMS "Titan" owned by the shipping company Bugsier located in Hamburg. With its enormous engine power it was chartered to support the other ships with breaking the ice and blazing the trail.

The journey started in Bremerhaven and took course via Montevideo and Grytviken to the Antarctic continent at Kapp Norvegia. Soon, the subsequent path to the Filchner-Ronne Ice Shelf, the desired location of the new station, was blocked by solid sea-ice. On the 14th of January 1981 at position 77.5°S, 44°W the ice situation made the desired location inaccessible. After consulting with the Alfred Wegener Institute the Federal Minister of Science and Technology (BMFT) instructed to call the alternative location in the Atka Bay. At this stage remaining time was already running short. Finally on the 23rd of January the ships could be unloaded after the "Gotland II" berthed at the sea ice.

The unloading action had to be interrupted again and again because of breaking sea ice and the resulting danger for men and materials. The unloading was done in a 24-hour duty. The real position of the construction site was specified on 70°36'40"S, 008°21'55"W, 7.5 km away from the shelf-ice edge. The determined movement of the ice at that location was 160 m $year^{-1}$ in NNE direction. The shelf ice with a thickness of approximately 200 m at this location was floating instead of being fixed to the ground. It took the vehicles to travel 75 minutes from the ice edge to the construction site. In total 850 t were transported on sledges. The transportation went on until the middle of February. Most of it was done during nighttimes, when the vehicles were not in use for assembly. At first, a camp for the assembly crew was set up. It comprised accommodations for 42 people as well as the power unit, snow melting unit, kitchen, mess room, sanitary containers, and supply-containers, in totalling 700 m^2 of interior space.

Station installation started with the excavation of a trench for the steel tubes. At a depth of 1.1 m the required strength against shear and the required density was reached. After the assembly of the base-plates a small snow blower was used to blow snow under the plates of the basement. Blown snow can reach a much higher strength than natural snow after just a short time. The assembly of the first tube took ten days. After installing the substructure hoisting of the up to 9 t heavy container modules onto the structure took place. Afterwards it was possible to mount the walls on the southern face site. On the northern end huge steel gates were installed. Together with the assembly of the first tube a wastewater disposal line with heating facilities of 80 m in length was laid. Afterwards it was possible to start up the power unit, the water treatment unit and the wastewater disposal. Simultaneously the test of the radio communication plant proceeded.

With the end of the polar day the assembly of the second tube started. On the 24th of February after the assembly of the last steel plate the topping-out ceremony was celebrated. At that time the station was baptized and named in honour of "Georg von Neumayer". Three days later the second tube was closed with bulkheads and the assembly was finished on 3rd March 1981 (Fig. 2). For all technical and safety systems the service engineer from Germanische Lloyd Hamburg successfully performed an acceptance test. The camp of the assembly crew was not removed due to the short construction time. The next day the crew already went onboard the "Titan" and "Gotland II". Within 40 days of construction time including disembarkation and transportation 20,000 hours of labour had been accumulated. In total the building outlay amounted to 14,998,112 DM.

TECHNICAL DESCRIPITION

The steel tubes, having a length of 50 m for the protection of the building modules consisted of cambered and zinc coated wavy steel plates. In each case 14 plates were mounted to a circle about 5 m in diameter; each plate had a weight up to 370 kg. Due to their smaller diameter the steel plates of the connection tube between the main tubes I and II had a reduced thickness. In total 165 t of steel plates for the tubes had been used.

The building modules were restricted in size to 20 feet ISO containers, mainly for transport reasons The inner length was 5.81 m, the inner width 2.19 m and clearance 2.28 m. The installations for the air conditioning system were being set up on top of the containers. In each case 2 to 4 containers were grouped into one block. Each block was positioned on a steel pallet the weight of which was transferred via spindles to the sub construction in order to adjust possible movements of the ice after assembly.

One power unit was installed in both tubes. Each unit consisted of two diesel powered generators producing a three-phase alternating current of 75 kVA by 3 x 220 V at 50 Hz including the auxiliary attachment like day tank, starter, battery and chargers. Special importance was given to the economic consumption of energy. For this reason the diesel engines were equipped with heat exchangers for the utilization of energy from cooling water and exhaust fumes. This regenerated heat

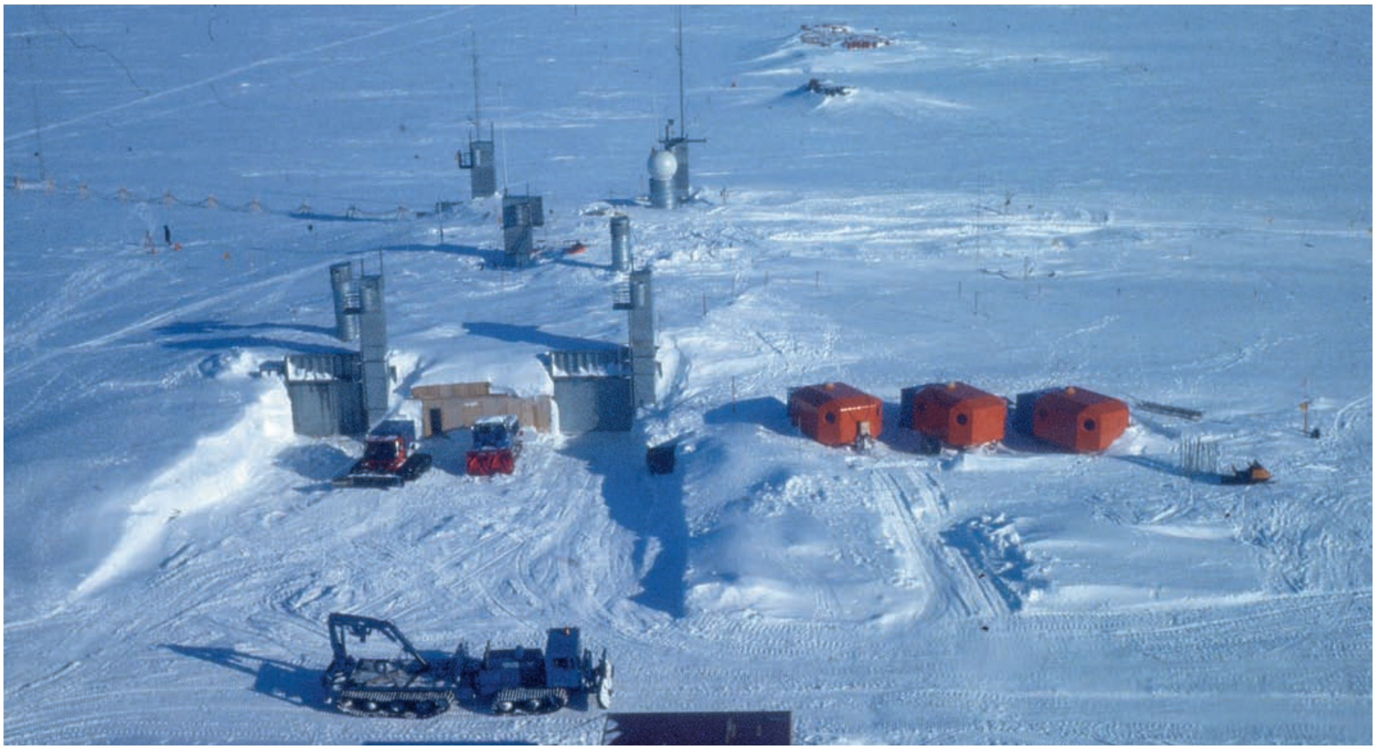

Fig. 2: Situation of Georg von Neumayer Station in its first season 1981. The first phase of construction at the station is completed. The steel tubes are completely covered by snow. During the second construction phase during austral summer 1981/1982 the cross tube serving as a vehicle garage will be annexed (D. Enss / Polarmar).

Abb. 2: Die Georg-von-Neumayer-Station im Jahre 1981. Die erste Bauphase der Station ist abgeschlossen. Die Röhren sind bereits vollständig mit Schnee bedeckt. In der zweiten Bauphase wird 1981/1982 die Querröhre für die Fahrzeugunterbringung angefügt (G. König-Langlo).

could be used for the production of warm water, heating of the station and for operating the snow-melting unit.

Required freshwater was going to be produced by melting snow. Therefore, the snow was dropped through a feeding funnel onto hot-plates in a tank with a capacity of 2000 l. The performance of the snow-melting unit was 100 l h^{-1}. In-house disposal of water and sewage from the containers took place via waste pipes and finally a disposal pipe with heating facilities of 80 m in length dumped it into an ice cavern.

The communication unit of the station was equipped for:
- Satellite communication with ships and via ground stations into the international telecommunication network;
- Medium wave communication in the form of telegraphic connections with ships;
- Short wave communication in the form of telegraphy, telephony and telex via radio stations with ships or within the Antarctic to foreign stations or German operations at sea;
- VHF radio for communication with helicopters, aircrafts and vehicles operating on ice within close range.

An extensive safety concept was arranged for the protection of station and personnel the main components of which were:
- Passive fire protection with extensive use of inflammable material and the separation into five fire-zones;
- Active fire protection via fire- and smoke detectors; an automatic halon-gas extinction unit for power plants, and numerous mobile fire extinguishers at strategic locations;
- Dual power unit installed separately in the two main tubes;
- In total four emergency exits in addition to the two main exits;
- Separate storage of fuel and provisions;
- Battery-driven emergency radio transmitter;
- Medicinal and instrumental equipment for medical treatment including small surgeries;
- Weatherproof lodges functioning as emergency huts so called “islands of survival” in the outer regions of the station with fully equipped survival kits.

Originally it was planned to shut down the station after finishing the first stage of construction (March 1981) for about one year until final assembly during austral summer 1981/82. However, in the course of summer 1980 it was decided to have to start the first wintering earlier. Therefore a number of installations planned for the second construction stage had to be put in first in order to achieve technical and safety approval from the Germanische Lloyd.

The first wintering crew consisted of only five persons. Selection was made with respect to scientific and technical qualifications needed for the wintering-over as well as a detailed medical check-up. The wintering crew was carefully advised and trained by contractors and manufacturers in the various technical installations, gears and duties of daily life. Technicians participated in the test assembly of the station in Germany. All participants attended various safety trainings, especially training by a mountain guide on alpine glaciers, in order to train their behaviour on ice. Just like today, the first wintering crew was away from home for 15 month and during this period the crew was on its own for nine month.

To a modest extent recreational equipment was available at the station at the start up. A home trainer and table tennis were

Fig. 3: General hospital of Georg von Neumayer Station (GvN) in 1989.

Abb. 3: Allgemeines Hospital der Station Georg-von-Neumayer-Station (GvN) im Jahr 1989.

Fig. 4: Meteorological laboratory of the Georg von Neumayer Station (GvN) in 1989.

Abb. 4: Blick in das meteorologische Labor der Georg-von-Neumayer-Station (GvN) im Jahr 1989.

Fig. 5: Mess room and lounge of Georg von Neumayer Station in 1989.

Abb. 5: Messe und Aufenthaltsraum der Georg-von-Neumayer-Station (GvN) im Jahre 1989.

available for physical training. For entertainment purposes, a video type cassette system with 50 hours of film material, 50 books and a hi-fi system were installed (Figs. 3, 4, 5). Telecommunication via short wave radio with the family and friends at home was subject to charge and expensive. A daily connection via short wave radio communication to other wintering stations in Antarctica was established. However, due to distances and general dangers of Antarctic winter visits of the neighbouring stations and crews were strictly forbidden.

CONSTRUCTION OF NEUMAYER STATION II (NM-II)

It was clear from the beginning that the lifespan of the Georg von Neumayer Station (GvN) was limited. As predicted, due to the snow accumulation of 80-100 cm a^{-1} it "sunk" deeper and deeper into the ice (Fig. 6, 7, 8). The first major damages – dents, twisted beams and cracks – occurred in 1989. Due to lateral pressure of the moving ice and the increasing load of accumulating snow the two main tubes deformed to the shape of a banana. Oftentimes the crew woke up when a single bolt sheared off a beam with a loud bang (Fig. 9). By the end of 1990 the upper edge of the main tubes laid under a 9 m thick firn/ice cover. Glaciologists had calculated – and forecasted –everything quite accurately. In its ten years of existence, the station had moved over a distance of 1500 m into northern direction.

Hence the decision for a new construction had to be made. In the meantime the UK had decided to build a new station – the "Halley V" – mounted on a platform. The Alfred Wegener Institute favoured an aboveground construction as well. Therefore, the Polarmar GmbH in Bremerhaven was commissioned in 1989 to start a case study in order to compare advantages and disadvantages of aboveground and underground constructions and to evaluate both solutions with respect to technical and economical aspects. Polarmar introduced several solutions: rigid platforms, jointed platforms and a novel solution, which became patented later on. The constructions of the Polarmar design were located under one roof, which was levelled on the top of the snow cover. With frequent adjustments the roof should be kept on the level of the snow cover.

However, instead of the Polarmar design favoured initially, a conventional underground tube-construction was eventually selected for the construction of NM-II. Partially due to the lack of sufficient experience with the technically new concept of the Polarmar design the decision was also made based on economic reasons.

In any case, the Polarmar design was basically very interesting and therefore, this concept was used to build the garage and storage facilities of NM-II in order to gain experience with this new construction design. The great benefit of a tube design for NM-II derived from the ten years operational experience with GvN as well as the detailed glaciological and technical measurements and documentations of the deformation behaviour in the area. Several potential construction sites were investigated and surveyed within this time until ideal location was found not far from the GvN site. In 1990 Polarmar took over the leadership of detailed planning for building Neumayer Station II on behalf of AWI. It supervised the production of station components, the test assembly and the

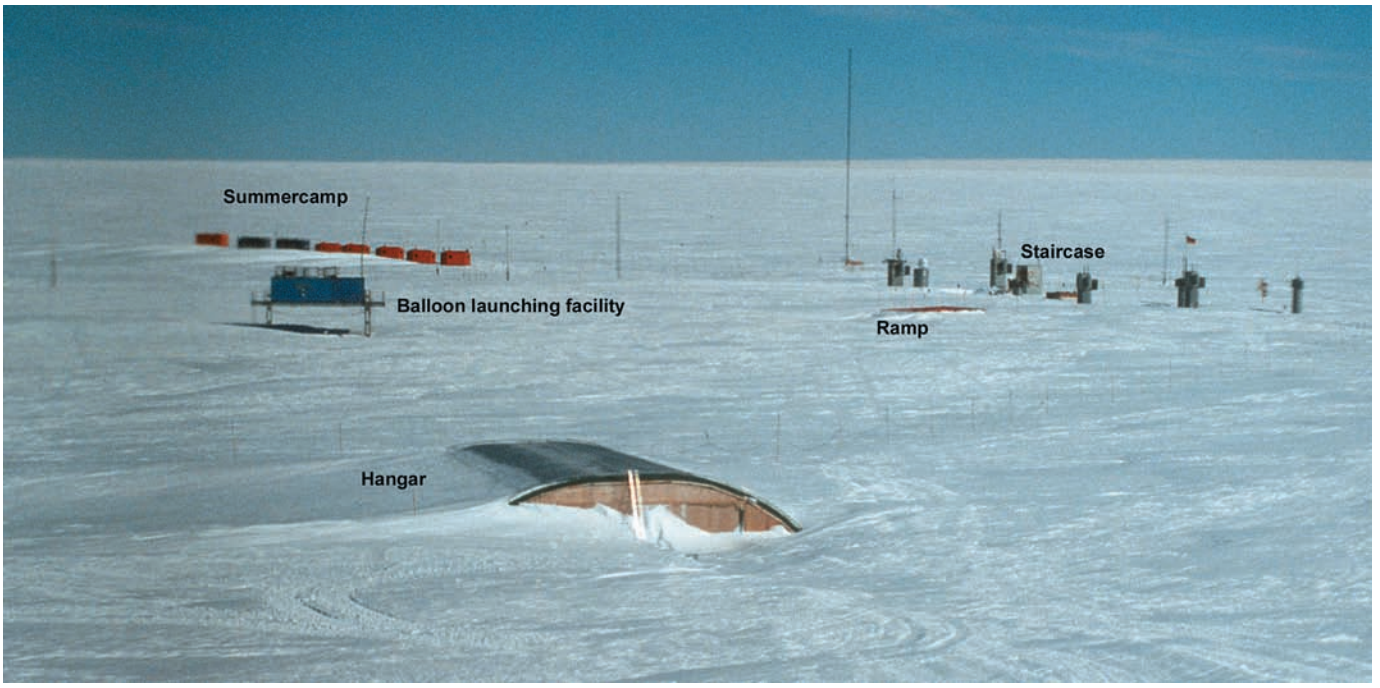

Fig. 6: Area view of Georg von Neumayer Station (GvN) in 1989. In front the aircraft hangar almost completely covered by snow. Entrance towers, exhaust pipes and antenna domes in the right centre mark the position of the GvN structure beneath the snow. Behind the balloon-launching container (centre left) of the meteorological observatory the red emergency huts are visible in the background (AWI).

Abb. 6: Übersicht über das Stationsgelände der Georg-von-Neumayer-Station (GvN) im Jahre 1989. Im Vordergrund die Flugzeughalle fast vollständig unter dem Schnee begraben. Lüftungs- und Ausstiegsschächte sowie Antennendome in der Bildmitte rechts lassen die Lage der Station unter dem Schnee erkennen. Hinter der Ballonfüllhalle des meteorologischen Observatoriums (Bildmitte links) sind die roten Hütten der Rettungsstation zu erkennen (AWI).

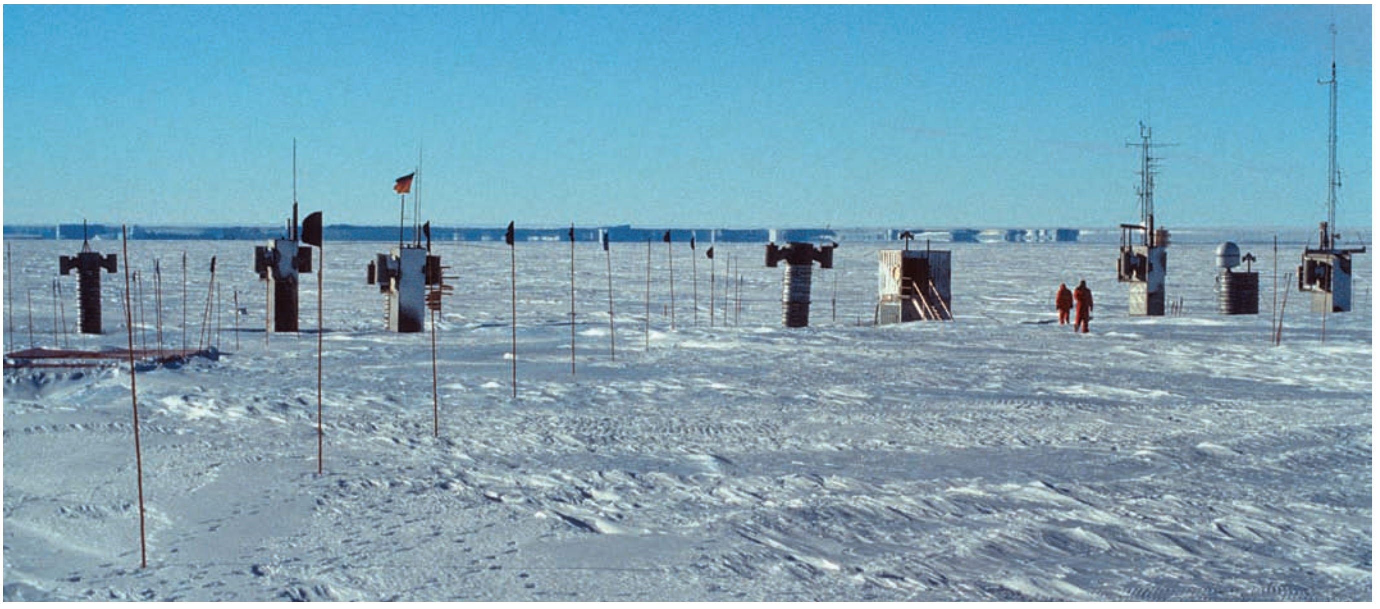

Fig. 7: Georg von Neumayer Station (GVN) in 1989. Staircases, ventilation shafts and antennas roughly mark the position of the station beneath the snow surface. The four emergency exit towers indicate the ends of the tubes.

Abb. 7: Die Georg-von-Neumayer-Station (GvN) im Jahr 1989. Treppenhäuser, Lüftungsschächte und Antennen markieren die Lage der Station unter der Schneeoberfläche; die vier Notausstiege kennzeichnen das Ende der Röhren.

Fig. 8: Ramp of the Georg von Neumayer Station (GvN) as the entrance for vehicles into the cross tube and workshop (AWI).

Abb. 8: Einfahrtsrampe der Georg-von-Neumayer-Station (GvN) zur Einfahrt für Fahrzeuge in die Querröhre und Werkstatt (AWI).

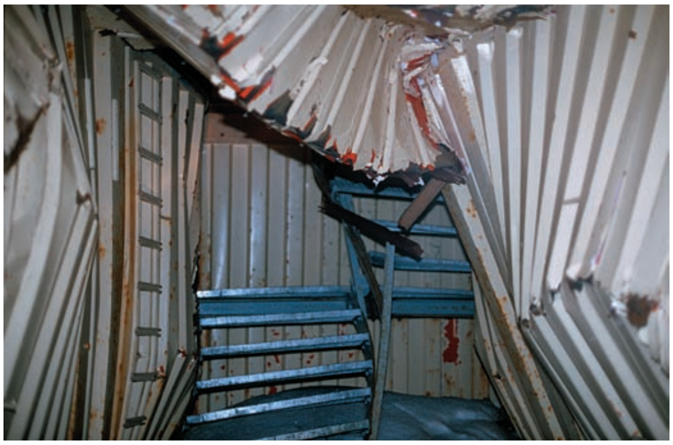

Fig. 9: Georg von Neumayer Station (GvN) in 2000. Eight years after abandonment of the station the staircase shows strong demolition by ice pressure.

Abb. 9: Georg-von-Neumayer-Station (GvN) im Jahr 2000. Zunehmende Zerquetschung des Treppenhauses durch Eispressung acht Jahre nach Aufgabe der Station.

final assembly on-site. The Germanische Lloyd in Hamburg was commissioned again to perform the safety inspections.

The preassembly of the technical facilities was done mostly ready-for-use in order to keep the time for the assembly in the Antarctic as short as possible. Diesel generators, air condition units, the fresh- and wastewater treatments were inspected while being installed, just before the equipment was loaded in Bremerhaven onto the Dutch SPS "Icecrystal", in total 2200 t or 7500 m^3 of cargo respectively. In the beginning of December 1991 the ship left Cape Town heading for the Atka Bay. At first, the journey went well. But only 45 nm before reaching Atka Bay the "Icecrystal" hit heavy pack ice with a thickness of up to 4 m on the 19th of December 1991. On the January 3rd the open water of the coastal polynia in front of the shelf ice edge was reached and two days later the ship moored at the sea ice of Atka Bay. The unloading started already at night. Close to the building site a camp for the workers was established. It consisted of 27 containers providing accommodations to 52 persons. Almost all cargo was unloaded within just ten days. The assembly was performed temporarily around the clock in a two-shift operation. As soon as one tube was mounted in its whole length, the sub construction was assembled in order to accommodate the interior equipment modules of the station. Only then was it possible to close the tubes and protect the structure from drifting snow. The final assembly became a race against time due to periods of bad weather. But on the 12th of March the new Neumayer Station was handed over to the Alfred Wegener Institute officials.

According to international agreements identical names for logistic stations were not accepted. Hence the simple name "Neumayer II" was chosen, having in mind that this name is easier to use in international contacts. In agreement with the protocol for environmental protection one year later the interior of the old GvN Station was completely removed. Merely the steel pipes remained in the ice.

TECHNICAL DESCRIPTION OF NEUMAYER II

The new Neumayer Station II (NM-II) has according to the old GvN's tube concept basically the same partitioning, but it had been extensively increased in size (Fig. 10, 11). The H-shaped arrangement of the tubes and bulkheads enabled to subdivide the station in different areas as requested for safety reasons. Ten years of experience in operating of the GvN Station enabled the AWI to make very precise specifications for the new station. Although the number of wintering crew members did not change, more space should be provided for the scientists and their labour. Five additional laboratories for biological, chemical and electronic investigations had been added. 125 % of additional space compared to GvN was available for the scientists. But also in other areas more space was created than before. The kitchen, mess rooms, administration and the hospital had been extended with the help of additional containers. Due to the integration of a sauna in the sanitary area addi-

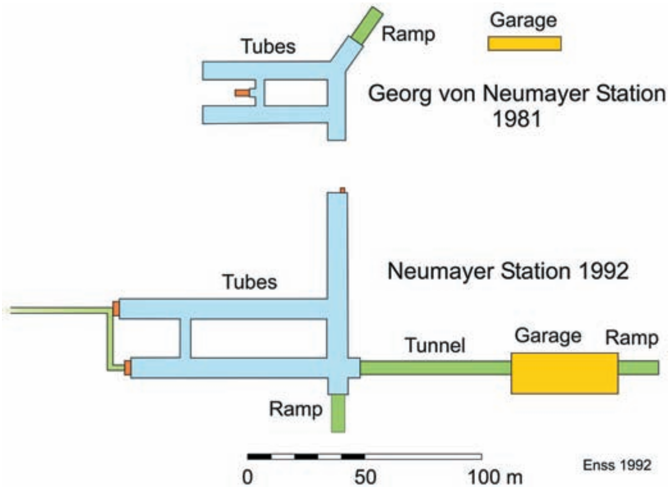

Fig. 10: Schematic diagram showing proportions of the two stations Georg von Neumayer (GvN) constructed in 1981 and its successor Neumayer Station II (NM-II) constructed in 1992 (D. Enss / Polarmar).

Abb. 10: Schematische Darstellung und Größenvergleich der beiden Stationen Georg-von-Neumayer (GvN) gebaut 1981 und Neumayer-Station II (NM-II) gebaut 1992); schematische Darstellung (D. Enss / Polarmar).

tional room was needed. Additional containers for battery charging, storage of provisions and drying of work clothes had been installed. The technical and spacial configuration should be sufficient for a summer crew of 40 persons (Fig. 12). This amount of personnel had already been reached during the summer seasons at GvN. It is easily imaginable how narrow the old station was under these circumstances. At both stations the dimensions of the rooms were related with the size of 20 feet ISO containers. Hence it is easy to compare both sizes with the following values. 35 containers were available for all purposes at the old station. However, at the new station 53 containers were available.

Operational and technical aspects influenced the division into compartments. The total length of >90 m resulted from the wish to have next to all rooms as well provision containers, fuel tanks (Fig. 13), workshops and parking space for at least three vehicles in the protected area sheltering them independently from specific weather situations. The old station had made it clear that big efforts concerning transport and maintenance for the outer compartments were necessary. A few numbers shall give an impression on the growth of size from GvN to NM-II (Tab. 1).

	GvN (old station)	Neumayer II
Protected area	1.160 m^2	2250 m^2
Air-conditioned area	416 m^2	816 m^2

Tab.1: Space at Georg von Neumayer Station (GvN) and Neumayer Station II (NM-II).

Tab. 1: Platzangebot auf der Georg-von-Neumayer-Station (GvN) und der Neumayer-Station II (NM-II).

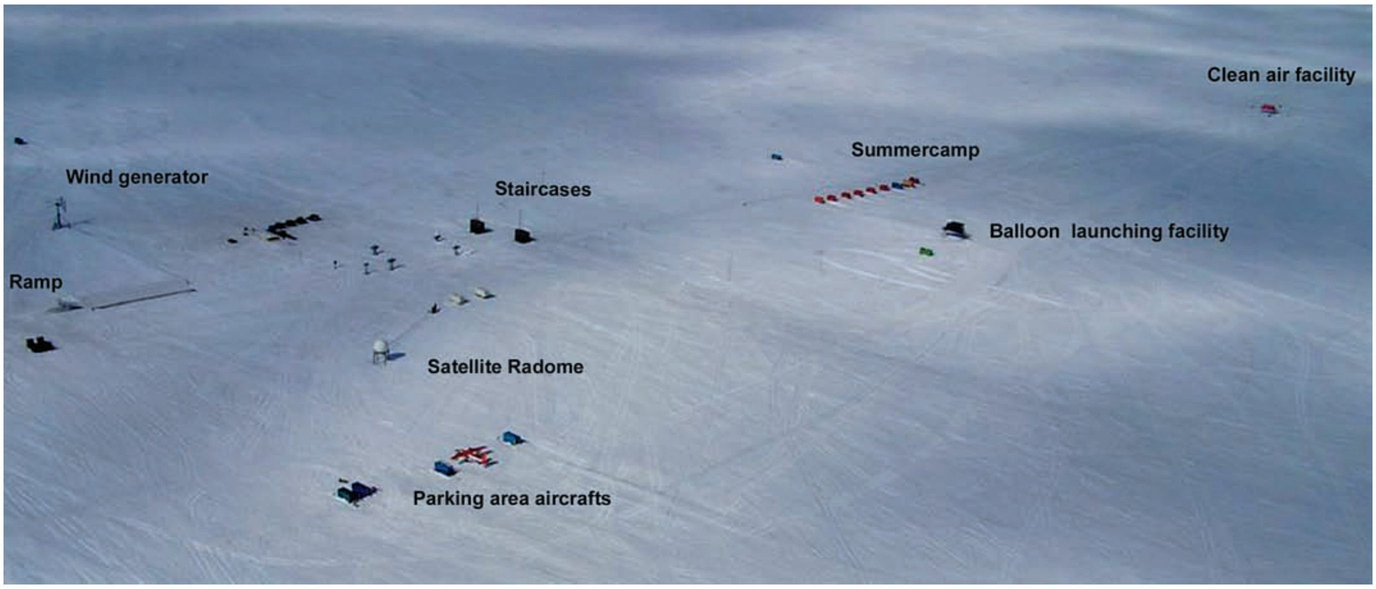

Fig. 11: Research station Neumayer II (NM-II) in 1999. Aerial view of the station in total including the remote clean air observatory. The ramp and the staircases mark the outline of the station beneath the snow surface (D. Steinhage).

Abb. 11: Neumayer-Station II (NM-II) im Jahr 1999. Luftaufnahme der Station in ihrer gesamten Ausdehnung einschließlich des luftchemischen Observatoriums. Rampe und Treppenhäuser markieren die Grenzen der unter dem Eis liegenden Stationsanlagen (D. Steinhage).

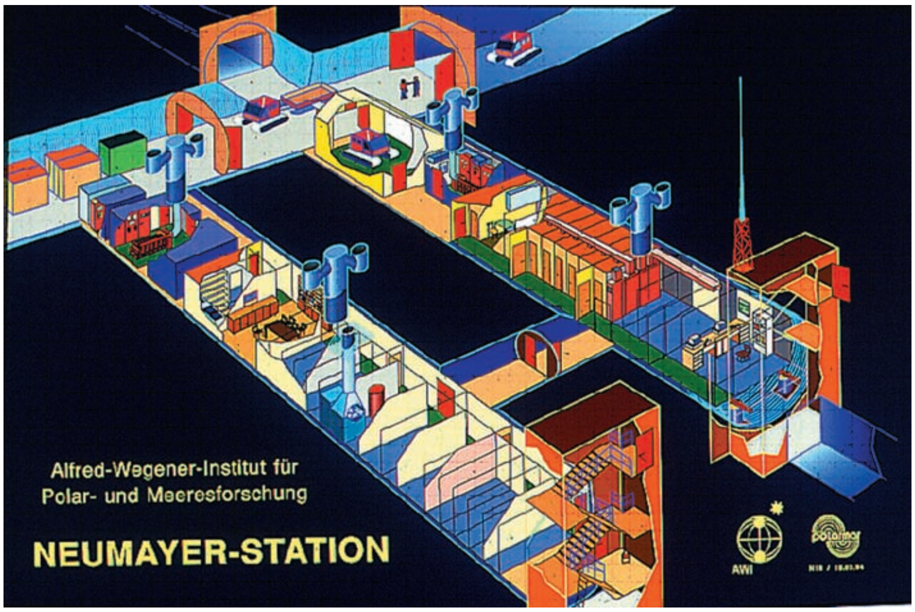

Fig. 12: Schematic diagram of Neumayer Station II (NM-II) showing the station design below the ice (not showing the vehicle garage), (D. Enss / Polarmar)

Abb. 12: Schematische Darstellung der Neumayer-Station II (NM-II) mit den unter der Schneeoberfläche im Firn/Eis befindlichen Stationsanlagen (ohne Fahrzeughalle), (D. Enss / Polarmar).

Fig. 13: View into the fuel storage of Neumayer Station II (NM-II) in 1999 showing six inter-connected diesel tanks with a total capacity of 130,000 l.

Abb. 13: Blick in das Tanklager der Neumayer-Station II (NM-II) im Jahre 1999, in dem sechs miteinander verbundene Dieseltanks mit einer Gesamtkapazität von 130.000 l untergebracht sind.

A garage for the vehicles was installed, which had not been included in the original plans (Fig. 14, 15, 16). The hall was situated in the ice with a roof levelled almost at the top of the snow cover. It had to be raised frequently according to the growing snow cover. Flexible joints in the construction allowed such a movement. After the lifting of the roof the ground needed to be filled with new snow from the outside. The level of the garage with respect to the tubes changed within the years and therefore the tunnel between tubes and garage needed adjusting as well.

Electricity and heat was supplied to NM-II via a combined heat and power system from diesel generators. This system offered an optimal efficiency in the combustion of fossil fuel. In total three generators were installed separately from each other. Each of the two main engines was able to provide enough power to supply the energy demand of the whole station. They were put to use alternately. The third generator was smaller and should have been used in case of emergency, for instance such as malfunctioning main engines. To make use of the process heat the engines were equipped with heat exchangers for cooling water and exhaust gas.

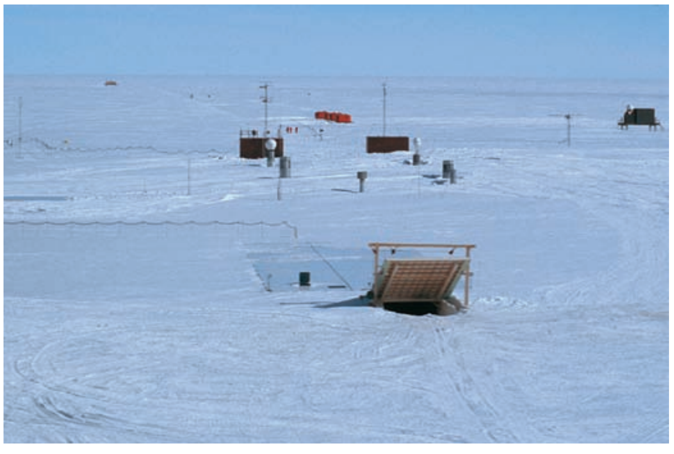

Fig. 14: Overall area view Neumayer Station II (NM-II) in 1999 (view to the north) showing in front the northern ramp, the entrance to the vehicle garage.

Abb. 14: Übersicht über das Stationsgelände der Neumayer-Station II (NM-II) im Jahre 1999 (Blick nach Süden). Im Vordergrund die Nordrampe mit der Einfahrt in die Fahrzeughalle. Die Lage der beiden Röhren wird durch die Treppenhäuser, Antennen und Lüftungsschächte nachgezeichnet. Im Hintergrund (mittig) die roten Hütten der Rettungsstation.

As outline of the Madrid environmental protocol large attention was given to environmentally friendly construction material in order to reduce any danger for the environment. Environmentally harmful emissions were reduced by installing a 20 kW wind energy plant. The rooms were heated solely with warm air. Contrary to the old GvN station, the tubes were also air conditioned, or actually cooled due to the experience gathered on GvN that melting processes occurred by warming up the steel tubes with warmer air from the outside and heat emissions from the station facilities.

Fig. 15: View into the vehicle garage of Neumayer Station II (NM-II) in 1999. The garage is built into the firn with a new type of roof construction, which is regularly corrected according to the snow accumulation and surface.

Abb. 15: Blick in die Fahrzeughalle der Neumayer-Station II (NM-II) im Jahr 1999. Die Garage ist als Graben in den Firn eingefräst; die neuartige, von hydraulischen Stelzen getragene Dachkonstruktion wird regelmäßig (jährlich) dem Niveau der Schneeoberfläche angepasst und der Garagenboden entsprechend aufgefüllt.

Fig. 16: View from the cross tube through the ice tunnel between the vehicle garage and the cross tube of Neumayer Station II (NM-II) in 2005. The original roof construction can be recognized in the walls of the ice tunnel indicating the roof level of the tunnel at the time of construction (AWI).

Abb. 16: Neumayer-Station II (NM-II) im Jahr 2005. Blick aus der Querröhre in den Verbindungstunnel zwischen Fahrzeughalle und Querröhre. In den Wänden erkennt man die ehemaligen Deckenträger, die das Deckenniveau (bzw. die Schneeoberfläche) des Verbindungstunnels zur Zeit des Neubaus darstellen (AWI).

Fresh water was produced by melting snow using the waste heat from diesel generators. The melting unit had a capacity of 4000 l. Next to it two additional holding tanks with a capacity of 2000 l were available. During the wintering over the water supply was sufficient. During summer seasons the capacity of fresh water was often exhausted depending on the varying number of summer personnel. The supply of cold and warm water in the buildings and the increase of water pressure did not vary from the system used on GvN station. A remarkable technical innovation was the operation of a biological wastewater treatment as outlined in the Antarctic contract. The grey and black water was pumped after its biological treatment via pipe a 100 m to a soak-away.

The telecommunication technology from the GvN station had proved itself and therefore the new construction was equipped with the same variety of communication. But the technical progress in telecommunication was so fast that the station needed improvement in modern technology. A remarkable progress was the installation of a permanent satellite connection for data exchange in 1999. This dedicated line led to less expensive telephone charges for private calls and to permanent availability of internet and e-mail.

The safety installations in particular for fire fighting had been adjusted to the current technological standard and to the larger size of the station. As previously used on GvN station for fire fighting purposes, powder and CO_2 extinguishers were available. The kitchen, the radio room and the power station were all equipped with a Halon-gas extinguishing system

CHANGES IN LIVING CONDITIONS ON GVN AND NM-II RESPECTIVELY

The new construction of the station was a technical and spacious improvement. In the end the question of how the living conditions had changed with the improvement in comfort remains open. To speak from my own experience as director and doctor of GvN and on NM-II stations in 1989 and 1999 over a span of two wintering seasons respectively, the author can reflect on his own experiences.

No changes occurred with respect to the number and the composition of personnel. Nine people still stay during winter season, but with the new station more space was made available for each them, e.g. in the important general social rooms like mess room and hospital (Figs. 17, 18). For the time of the wintering over the personnel could take advantage of the bigger size of the station with respect to their hobbies. A fitness room, which was unavailable at the old station, was installed. However, during the summer season the devices had to be removed due to the shortage of space. The installation of the satellite connection was also a major progress. Now the station was permanently connected to the internet enabling the personnel to stay informed about current world affairs without any delay.

At the GvN station news and information about current world affairs were only available via the “Deutsche Welle” radio program at 18:00 UTC. Private correspondence was only possible via telefax and telex at very high costs. So everybody minded exactly the words he/she wanted to send. Nowadays, a tremendous number of e-mails are being send. Sometimes, (natural) restrictions in communication such as it was the case at GvN might have an educational and/or social influence on the sender of such letters. Hence, it cannot be seen generally as old-fashioned and negative. Perhaps the pleasure receiving a fax which was sent every four weeks was much more intense and important than a daily short e-mail.

Fig. 17: Neumayer Station II (NM-II) in 1999. View of mess room and lounge which is significantly enlarged in comparison to the predecessor Georg von Neumayer Station (GvN; see Fig. 8).

Abb. 17: Neumayer-Station II (NM-II) im Jahr 1999. Auch der Messe- und Aufenthaltsraum zeigen eine deutliche Vergrößerung im Vergleich zur Vorgängerstation, der GvN.

Fig. 18: Hospital and operating theater of the new station Neumayer II (NM-II) in 1999.

Abb. 18: Hospital- und Operations-Raum der Station Neumayer II (NM-II) im Jahr 1999.

Still, the wintering over follows the same rules today as it was in the past independent from the size of the station.

The administrative effort has grown as well with the increased size of the station. The safety equipment has been expanded for instance. Its functionality is only guaranteed with professional treatment. Service and maintenance of plants and safety equipment have to be exactly documented by the technical personnel. During the summer months the administrative effort becomes bigger due to the higher number of lingering persons. The director of the station then becomes partly a manager, who has to take care of the contentment of the personnel as well as providing the best working conditions.

With the increase in size – from GvN to NM-II – the station had to be serviced more often. Hence a crew has been coming frequently in order to do the required service, such as the heightening of buildings for example. The most obvious differences between both become visible during the summer period observable in the varying amount of supplies via ship, arrivals and departures, and, last but not least, the time of residence.

At the times of the GvN station the supply ship, mostly the FS "Polarstern", landed at the beginning of the summer season in the Atka Bay to drop off provision and exchange personnel. At the end of the season, the ship returned a second time to take care of the disposal. In the meantime, all summer guests and the wintering crew stayed on the station. Arrivals and departures to Cape Town or South America occurred only in emergency situations. During this time people got to know each other pretty well.

The possibility of air transportation from South Africa to the Antarctic and the use of other supply vessels like the South African "S.A. Agulhas" led to a higher fluctuation in personnel. It was possible to reduce the time of residence for many persons so they could leave the station directly after the end of their scientific field program and did not have to wait several weeks for transportation by ship at the very end of the season. This "evolution" led to a much higher turnover in personnel during the summer campaign and to therefore to a higher organisational effort. While in the past only one arrival and one departure for all participants had to be organized, nowadays detailed and exact planning is necessary nowadays to have the right people at their assumed positions at a specific time to do their scientific or logistic work. Another side effect of the fast connection via plane has been the growing number of short visits of VIPs. The numeral occupancy of the station at a certain date grew only slightly but the total number of persons on the station during one summer campaign had grown by one third.

Despite all these changes the enlargement of the station has demonstrated the necessary step forward. Hence it should be kept in mind for all future plans.

References

Enss, D. (1981): Schlussbericht Christiani & Nielsen.- 1-46

Enss, D. (1992): Der Neubau der Neumayer-Station in der Antarktis.- Hansa 9: 3-15

Lange, G. (2001): Die Neuma¥er-Station auf dem Ekström-Schelfeis.- In: G. Lange (ed), Eiskalte Entdeckungen - Forschungsreisen zwischen Nord- und Südpol. Delius-Klasing, Bielefeld, 74-80.