ANTARCTIC TREATY

Report of the Norwegian Antarctic inspection under Article VII of the Antarctic Treaty and Article 14 of the Protocol on Environmental Protection to the Antarctic Treaty

JANUARY 2001

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1 Introduction

The right to conduct inspections is a fundamental feature of the openness and transparency of the Antarctic Treaty system.

Article VII of the Antarctic Treaty entitles each Consultative Party to designate observers who shall have the right to carry out unannounced on-spot inspections. The purpose of these inspections is to promote the objectives of and ensure compliance with the provisions of the Antarctic Treaty and the measures adopted under it. The observers shall be accorded complete freedom of access at any time to all areas of Antarctica, including all stations within those areas, as well as vessels and aircraft at points of embarkation and disembarkation.

Article 14 of the 1991 Protocol on Environmental Protection to the Antarctic Treaty (Madrid Protocol) states that in order to promote the protection of the Antarctic environment and dependent and associated ecosystems, and to ensure compliance with the Protocol, the Parties shall arrange, individually or collectively, for inspections by observers to be made in accordance with Article VII of the Antarctic Treaty.

The first and second inspections undertaken by Norway took place in January 1990 and December 1996 respectively. The third inspection, which is described in this report, was carried out in the period 6-8 January 2001. Table 1 and Table 2 give overviews of operative stations and previous inspections in Dronning Maud Land.

The 2001 inspection was conducted in accordance with Article VII of the Antarctic Treaty and Article 14 of the Protocol on Environmental Protection to the Antarctic Treaty.

The 2001 Norwegian inspection team consisted of the following Norwegian nationals designated by the Norwegian Ministry of Justice in accordance with Article VII of the Treaty:

- Ambassador Jan Tore Holvik, Special Adviser for Polar Affairs, Ministry of Foreign Affairs
- Mr. Torodd Veiding, Director General, Polar Department, Ministry of Justice
- Mr. Svein Tore Halvorsen, Adviser, Department for International Cooperation, Ministry of the Environment
- Dr. Olav Orheim, Managing Director, Norwegian Polar Institute
- Ms. Birgit Njåstad, Environmental Officer, Norwegian Polar Institute

The names of the Norwegian observers were communicated to all Contracting Parties to the Treaty by diplomatic note of 13 December 2000.

The logistics supporting the inspections were arranged by the Norwegian Antarctic Research Expedition 2000/01 (NARE). For the first time a Norwegian inspection team used an aircraft between Cape Town and Dronning Maud Land (landing at “Blue 1” by Henriksenskjæra). The intercontinental flight was made in an Ilyushin II-76TB

aircraft and took about six hours each way. A helicopter (MBO 105) was used for transportation between the various stations during the inspection.

The following stations were inspected: Maitri (India), Novolazarevskaya (Russia), SANAE IV (South Africa) and Troll (Norway) (see Figure 1 for location of stations inspected and Table 3 for the itinerary for the inspection programme). The team also visited the site of the former Georg Forster station (East Germany/Germany). One member of the team, Dr. Olav Orheim, visited the EPICA ice core drilling station at the site DML 05 and conducted a limited inspection of the site, assisted by Mr. Tom Maggs (Australia). To avoid the possibility of a conflict of interest, Dr. Orheim and Ms. Njåstad from the Norwegian Polar Institute did not take part in the inspection of the Norwegian summer station Troll. During the inspection of Troll Dr. Dick Hedberg of the Polar Research Committee of the Royal Swedish Academy of Sciences and Dr. Jan H. Stel of the University of Maastricht, the Netherlands, joined the inspection team in their capacity as "special observers". The Norwegian team is most grateful for the valuable professional assistance rendered by colleagues from Sweden, the Netherlands and Australia, although they were not designated as official observers by their respective governments. Unfortunately, due to weather conditions and transportation difficulties, it was not possible to inspect the Japanese station Syowa on East Ongul Island as planned. This is regrettable. The station has expanded in recent years, and has not been subject to an inspection since 1988.

Stations to be inspected were given one or two days advance notice of the observers' visit. On arrival, team members presented their credentials to the station commander. At all stations the team was warmly welcomed and was granted access to all parts of the station.

One journalist from the Norwegian newspaper *Aftenposten* and two journalists from the Norwegian Broadcasting Corporation travelled with the inspection team to the Indian station Maitri. Prior to their arrival, the Indian station commander assured the inspection team that the three journalists were welcome.

The Antarctic Treaty and the Madrid Protocol were used as a basis for the inspection, together with Inspection Checklist A (for permanent Antarctic stations and associated installations) adopted by the Antarctic Treaty Consultative Meeting in 1994 (ATCM XVIII). The inspection had a strong focus on environmental conditions.

The Norwegian team would like to extend its warm thanks to all the personnel at each station visited for their friendliness, hospitality, openness and cooperation. The team would also like to thank helicopter pilot Rob Siegrist for the service he provided and the personnel at Troll and "Blue 1" for providing warm and comfortable accommodation during the nights on the ice.

The following report seeks to summarize the findings of the team. The report builds to a large extent on the 1996 report, as three of the stations inspected at that time were revisited in 2001 (Maitri, Novolazarevskaya and SANAE IV). As far as possible the team has tried to compare conditions at these stations in 1996 and 2001. There is always a possibility that errors and misunderstandings may occur. The observers regret any such errors.

Article 14 of the Madrid Protocol stipulates that Parties whose stations are inspected shall have an opportunity to comment on the report before it is circulated to all Antarctic Treaty Parties and the Committee for Environmental Protection and before it is considered at the Antarctic Treaty Consultative Meeting. This report has been submitted for comment to the Governments of Germany, India, Norway, Russia and South Africa. The Parties were asked to provide comments within one month. No comments were received within this time frame or by the time this report was printed.

Table 1: Active stations in Dronning Maud Land and the date of the most recent inspection

Name of station	Country	Last inspected
Aboa	Finland	1994 (Sweden)
Asuka (field station)	Japan	Has not been inspected
Dome Fuji	Japan	Has not been inspected
EPICA DML 05 (field station)	Germany	2001 (Norway)
Georg Forster[1]	Germany	2001 (Norway)
Maitri	India	2001 (Norway)
Mizuho (field station)	Japan	Has not been inspected
Neumayer	Germany	1996 (Norway)
Novolazarevskaya	Russia	2001 (Norway)
Svea (field station)	Sweden	Has not been inspected
Syowa	Japan	1988 (USSR)
Tor (field station)	Norway	Has not been inspected
Troll	Norway	2001 (Norway)
Wasa	Sweden	Has not been inspected

[1] Station has been removed

Photo 1: The 2001 Inspection Team at Henriksenskjæra ("Blue 1")

From left: Birgit Njåstad, Torodd Veiding, Jan-Tore Holvik, Olav Orheim and Svein Tore Halvorsen

Table 2: Overview of inspections conducted in Dronning Maud Land

Year	Party inspecting	Stations inspected
1967	USA	Syowa
1983	USA	Georg von Neumayer, Syowa, SANAE III, Novolazarevskaya
1988	USSR	Georg Forster, Dakshin Gangotri, Georg von Neumayer, SANAE III, Syowa
1990	Norway	Georg von Neumayer, SANAE III
1994	Sweden	Neumayer, Maitri, Novolazarevskaya, Georg Forster, SANAE III, SANAE IV[1], Sarai Marais, Aboa
1996	Norway	Neumayer, Maitri, Novolazarevskaya, SANAE IV[1]
2001	Norway	Maitri, Novolazarevskaya, Georg Forster[2], SANAE IV, Troll, EPICA DML 05

[1] During construction
[2] After removal of station

Note: Georg von Neumayer, SANAE III, Dakshin Gangotri and Sarai Marais are no longer operative stations.

Table 3: The itinerary for the 2001 inspection programme

Date (2001)	Station	Country	Reference in Figure 1
7 January	Maitri	India	A
7 January	Novolazarevskaya	Russia	B
7 January	Georg Forster (removed)	Germany	C
8 January	SANAE IV	South Africa	D
8 January	Troll	Norway	E
7 January	EPICA DML 05	Germany	F

Figure 1: The location of stations visited during the 2001 inspection

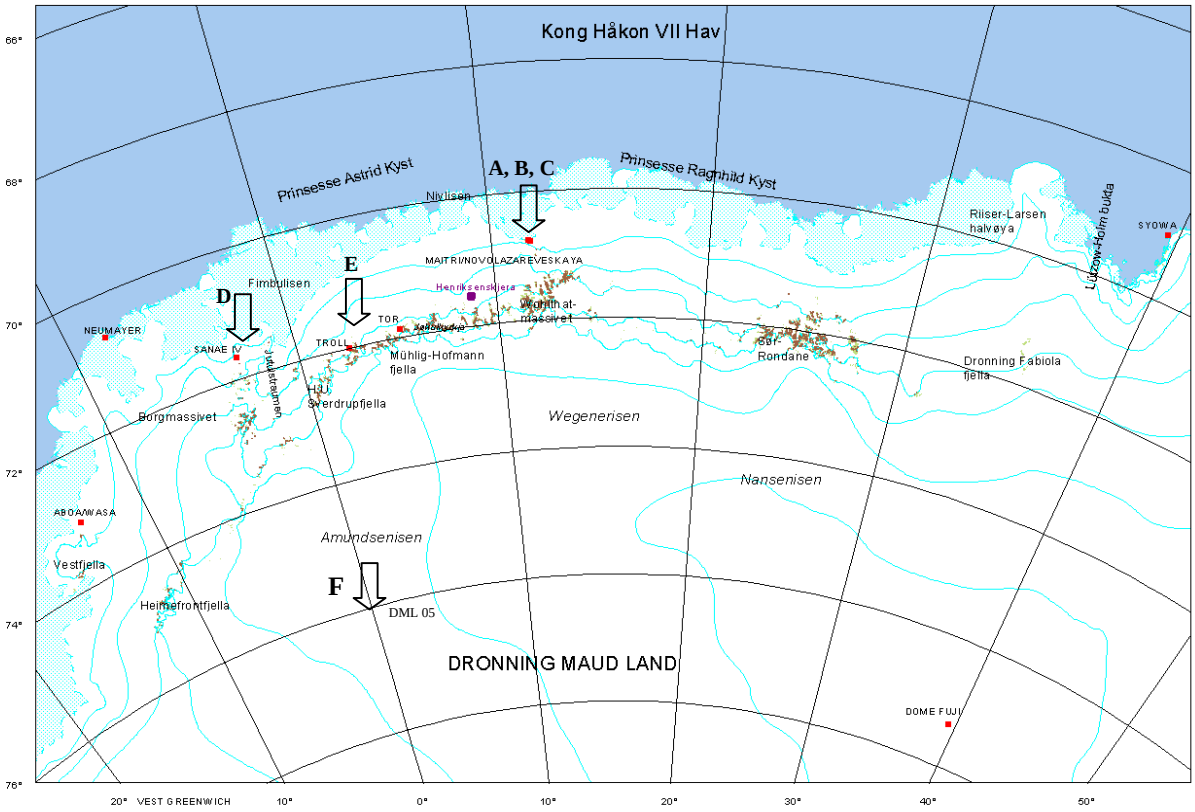


Photo 2: Waste water discharge point at SANAE IV

2 General observations

This section summarizes some issues that arose during the inspection and that in the view of the inspection team could be of general interest to the entire Antarctic community. The issues are not listed in any particular order of priority:

- **Antarctic Treaty provisions**: The Antarctic Treaty provides that Antarctica shall be used for peaceful purposes only. It specifically prohibits any measures of a military nature, such as the establishment of military bases and fortifications, the carrying out of military manoeuvres, and the testing of any type of weapon. Military personnel or equipment, however, may be used for scientific research or any other peaceful purposes. No military activities, armaments, or prohibited nuclear activities were observed, and all scientific programmes were in accordance with previously published plans. The observed activities at each station were in compliance with the provisions and spirit of the Antarctic Treaty.

- **Oil spill contingency plans**: Only one of the all-year stations visited had developed contingency plans for fuel spills (SANAE IV). The inspection team notes that it is important for those stations in Antarctica that have not developed such plans to give priority to this, in accordance with ATCM Resolution 1 (1997) and ATCM Resolution 6 (1998). The inspection team also notes that Article 17 of the Madrid Protocol stipulates that Parties should include information on contingency plans in their annual reports.

- **Discharge of effluent/grey water**: Effluent/grey water was discharged onto ice-free ground at all four stations visited (see e.g. Photo 2), even though the provisions of Annex III of the Madrid Protocol state that such disposal should be avoided. The inspection team notes the need to give further consideration to how inland operations best can be conducted without being in conflict with the Madrid Protocol.

- **Monitoring programmes**: Most of the stations visited carried out analyses of some selected parameters (e.g. waste water quality, drinking water quality, etc.), although comprehensive monitoring programmes seemed to be generally lacking. The inspection team notes the importance of developing comprehensive monitoring programmes for assessing long-term impacts of operations at Antarctic stations, ensuring that environmental monitoring data are collected systematically over time, thus making trend analyses possible.

- **Antarctic Specially Managed Areas**: Two stations (Maitri and Novo-lazarevskaya) are located in a sensitive ice-free area of limited size. It would be useful for the involved Parties and the Treaty system to consider whether the area should be designated as an Antarctic Specially Managed Area (ASMA). This could facilitate the planning and coordination of activities to avoid possible conflicts, improve cooperation and minimize environmental impacts in the area.

- **Waste management**: The inspection team noted that two national programmes had coordinated the waste management systems at their stations with respect for example to colour coding and categories (SANAE IV and Troll). The inspection team saw that this could be useful for the purpose of comparison and evaluation, and practical with respect to logistical cooperation, and suggests further coordination with other programmes and stations where appropriate.

- **Scientific cooperation**: The inspection team observed that scientific cooperation at two neighbouring stations (Maitri and Novolazarevskaya) was rather limited. The inspection team notes the importance of scientific cooperation at stations located near each other in order to avoid redundancy and ensure efficient use of resources.

- **Station operations**: During the inspection the inspection team observed that the level of resources available for station operations varied significantly. The inspection team notes that if basic resources are lacking to run and maintain scientific programmes and to operate a station in accordance with the provisions of the Madrid Protocol, it might be better to close down the station completely rather than prolong its existence without any improvements.

- **Alternative energy**: Experience so far shows that alternative technologies must be better adapted to Antarctic conditions before they can make a significant contribution to energy production. Nevertheless, the inspection team notes the importance of continuing to focus on alternative energy technologies and energy conservation measures with the aim of reducing fossil fuel consumption at the Antarctic stations.

- **Non-indigenous plants**: At two of the stations (Maitri and Novolazarevskaya), the inspection team noted the presence of a wide variety of house plants. Most of these may originally have been brought in for research purposes, but the plants did not seem to serve this purpose any longer. The inspection team noted that there might be a need to further consider issues related to permits for non-indigenous species in Antarctica.

- **Station information:** At one station the inspection team was presented with detailed written documentation on station operations (SANAE IV). This included detailed information on issues raised in the ATCM inspection check list, which was found to facilitate the inspection significantly. The inspection team notes the value of having this kind of documentation available at the stations in Antarctica.

3 Summary of findings

3.1 General

The inspection team visited three all-year stations and one summer station in Dronning Maud Land. All of them were inland stations. Troll was inspected for the first time and SANAE IV for the first time since construction was completed. In addition the team visited the site of the former German station Georg Forster, and one member of the team visited the DML 05 EPICA ice core drilling station. English was used as the means of communication during the inspections.

The inspection team observed no violations of the Antarctic Treaty during the 2001 inspection. As far as the team could discern all equipment at the stations was used for purposes consistent with the provisions of the Treaty. The inspection team was given free access to all areas of the stations. The personnel at the stations visited were frank and open in discussion of the operations carried out at the stations. Station personnel considered inspections generally as a valuable instrument under the Antarctic Treaty. They promote openness and stimulate cooperation and it was seen as an advantage to have “new eyes” to judge ongoing activities. However, attention was also drawn to the fact that inspection teams often pointed out weaknesses and shortcomings without suggesting new procedures.

In general, there was a high level of awareness of the provisions of the Madrid Protocol. It seems clear that most of the stations visited have already significantly altered their practices since the Protocol entered into force in 1998. No one was of the opinion that the provisions of the Madrid Protocol created undue obstacles for scientific activities. It was pointed out, however, that some of the regulations were detailed and difficult to comply with. In this inspection report the observers discuss some issues related to environmental aspects of the operations at the stations. These are intended as suggestions and guidance to the programmes rather than criticism. It is also hoped that by raising some of these issues we will encourage further international cooperation to find solutions suitable for Antarctic conditions.

The inspection team was generally impressed by the scientific and environmental commitment at the stations. It was nevertheless obvious to the team, as it was in 1996, that one of the stations visited did not have sufficient resources and support to carry out adequate scientific activity or operate the station in accordance with the provisions of the Madrid Protocol. Nations operating stations in Antarctica have an obligation to ensure that adequate resources are made available to fulfil the requirements set down in the Antarctic Treaty and the subsequently adopted measures. The inspection team recommends that the national programme in question should seriously consider the viability of continued activity at this station. It might be better to close down the station completely rather than prolong its existence without any improvements.

The inspection team notes with interest that most research stations in Dronning Maud Land are now constructed inland, rather than on the coast as was the norm a few decades ago. The coastal stations have to contend with annual snow accumulation of about 2 metres, and presumably managers have found that avoiding this compensates

for the increased cost of transport. Building inland stations poses new challenges. The inspection team noted in particular that at all four stations inspected, the national programmes had chosen for practical purposes to discharge waste water on to ice-free ground. The Madrid Protocol specifies (Article 4 (1), Annex III) that wastes that are not removed from Antarctica or incinerated shall not be disposed of on to ice-free areas or into freshwater systems. It might be valuable to give further consideration to how inland operations best can be conducted without being incompatible with the intentions of the Madrid Protocol.

The observers were impressed by the spirit of commitment and dedication encountered at all the stations that were visited, and by the openness and friendliness shown by everyone at the bases inspected. Antarctica remains a special place and the scientists and support personnel working there treated it as such. The observers see this as a clear evidence of the spirit of cooperation that prevails within the Antarctic Treaty system and of the transparency of the system.

Use of the Antarctic Treaty inspection checklists is not compulsory under the Antarctic Treaty, but the inspection team found the checklists very useful in making the inspections at the various stations more consistent and easier to compare.

This chapter should be read in conjunction with Chapter 2, which provides an overview of general observations.

3.2 Military activities

The inspection team observed no military or military-related activities, or any evidence of such activities. There were no indications of nuclear explosions or disposal of radioactive wastes or activities linked to these issues. The inspection team observed no breach of the provisions of the Antarctic Treaty reserving Antarctica exclusively for peaceful purposes.

3.3 Scientific research

Scientific research was the basis for the activity at all stations. All stations expressed a desire for international cooperation, and the inspection team was especially impressed by the facilities at SANAE IV, which had been specifically designed with such international exchanges in mind. The inspection noted, however, that cooperation between Novolazarevskaya and Maitri, two stations that are located very close to each other, seems to be restricted to social contacts. The inspection team considers that stations that are located so close to each other should cooperate in order to avoid redundancy and ensure efficient use of resources.

Innovations in communications and computer technology were in use at all stations visited. This allows rapid reporting to national and international data centres and provides a basis for increased international scientific cooperation.

3.4 Personnel

The personnel at the stations visited were mainly civilians. At two stations (Maitri and SANAE IV), military personnel conducted support activities, such as station maintenance, vehicle operations and air operations. The general absence of women

was noticeable. Maitri had for the first time an over-wintering woman (as the station physician). Every all-year station visited had at least one doctor.

The importance of having well-informed and trained personnel in order to reduce environmental impacts and risks was recognized at all the stations inspected. Most programmes conduct extensive training programmes for new personnel prior to going to Antarctica and during service in the region. It was also noted that experienced expedition members ensure that important knowledge and practical experience are transferred to new station personnel when they arrive Antarctica.

3.5 Waste management

Proper waste management and disposal were given high priority at most of the stations. Only at one station (Novolazarevskaya) was waste disposed of into the environment, while the remaining stations had comprehensive schemes for separating, storing and back-loading waste. However, all stations discharged wastewater on to ice-free ground despite the provisions of Annex III of the Madrid Protocol. Although the wastewater at most stations was treated before discharge, it was unclear to the inspection team whether sufficient action had been taken to avoid environmental impact.

Retrograding waste is a costly enterprise and poses challenges. At one of the stations (Novolazarevskaya), there was waste material that had accumulated over several decades. Although most of this was generated before the Madrid Protocol entered into force, the inspection team emphasizes the importance of removing “old” waste from the Antarctic Treaty area. This was done in an exemplary manner during the dismantling of the Georg Forster station.

3.6 Fuel storage and handling

Fuel storage facilities and fuel transfer routines seem to be the station activities with the greatest potential for causing significant environmental impacts. Although no major spills were reported to have occurred since the 1996 inspection, the inspection team noted that contaminated ground from earlier spills still remained visible at most of the stations.

The inspection team noted that basic fuel containment was lacking at some of the stations. Efforts should be made to rectify this as soon as possible.

Only one of the all-year stations (SANAE IV) had developed comprehensive contingency plans for fuel spills. The inspection team urges that priority should be given to the development of such plans, in accordance with ATCM Resolution 1 (1997) and Resolution 6 (1998).

3.7 Energy conservation/alternative energy technologies

Continuous and detailed registration of fuel use is an important factor in controlling and improving power generation and heating efficiency at Antarctic stations. It can also provide data for the assessment of the environmental impact of logistical operations. The inspection team notes the importance of all programmes establishing such routines for the purpose of comparison and trend analyses.

The inspection team noted that all stations visited had either experimented with or considered the use of alternative energy technologies. However, they were not considered to be realistic alternatives at any of the stations at present. Nevertheless, the inspection team does note the importance of maintaining a focus on the issue of alternative energy technologies and energy conservation measures with the aim of reducing fossil fuel consumption at the Antarctic stations.

3.8 Emergency response

All stations inspected were equipped with fire extinguishers and other fire-fighting equipment, as well as emergency accommodation.

All all-year stations had a doctor present, as well as a surgery and equipment for minor surgery. All permanent stations were equipped with stocks of medicine.

The inspection team notes the importance of adequate search and rescue capacity when operating in Antarctica, and commends all the programmes on the SAR capabilities that are part of the operations at their stations.

3.9 Fauna and flora/Protected areas

There was a high level of awareness of the measures established under the Treaty to protect indigenous fauna and flora, as well as the nature and location of areas afforded special protection under the Antarctic Treaty. Houseplants were, however, observed at two of the stations (Maitri and Novolazarevskaya), seemingly without any precautionary measures in place. The inspection team noted that there might be a need to further consider issues related to permits for non-indigenous species in Antarctica.

3.10 Tourism

The stations visited had not been significantly affected by tourism. However, the inspection team noted that the establishment of the seasonal blue ice runway “Blue 1” at Henriksenskjæra introduces new opportunities for tourism and non-governmental activities in Dronning Maud Land. An increased level of activity as a result of better accessibility could have a significant bearing on national programmes and station operations in this area with respect to issues such as transport and storage, accommodation, communications, search and rescue, etc. National programmes will need to consider these issues.

Photo 3: Aircraft landing at Henriksenskjæra (”Blue 1”)

4 MAITRI (India)

4.1 Inspection details

The inspection team arrived by helicopter at Maitri at 9:00 local time (GMT) on 7 January 2001. The team was met by station commander Arun Chaturvedi and several other members of the station personnel. The inspection lasted approximately six hours.

Maitri was also inspected by Norway in 1996. The following report focuses especially on those aspects that have changed since the 1996 inspection and on details that were not properly recorded at that time.

From the station leader the inspection team received a copy of the general guidelines developed for the Indian Scientific Expedition to Antarctica. This document provided useful information for the inspection team and enhanced the observers' understanding of the operations at the station.

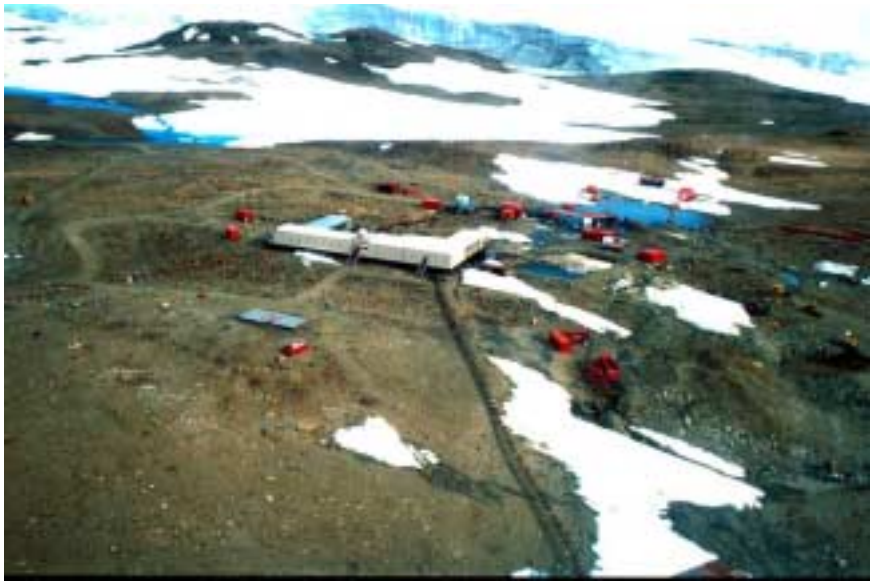
4.2 General information

Maitri is maintained and operated by the National Centre for Antarctic and Ocean Research (NCAOR) on behalf of the Department of Ocean Development, Government of India. Maitri, established in 1989-90, is India's only all-year station in Antarctica. Before the station was established, India used the site for an automatic weather recording programme.

The station, located at 70º45'S, 11º45'E in the Schirmacher Oasis on Vassfjellet in Dronning Maud Land (approximately 80 km from the ice edge), is situated in an area of bare rock, surrounded by a number of small lakes.

The closest station to Maitri is the Russian station Novolazarevskaya, about 4.5 km away. The personnel at the two stations have contact socially, but it was indicated that scientific cooperation is limited.

Photo 4: The main building complex and generator buildings at Maitri



4.3 Personnel and military support activities

During winter 2000, 24 people stayed at Maitri as a part of the XIX Indian Antarctic Expedition. Seven of these were scientists. One of the two medical doctors was the first Indian woman to over-winter in Antarctica.

Station support is provided by Indian Army personnel led by an officer, who was also environmental officer and fire officer. The winter team included 13 army support personnel, five of whom were dedicated to station maintenance and eight to transport.

The 2001 team constituting the XX Indian Antarctic Expedition will consist of 54 members. Eighteen of these will be support personnel and the rest will be scientists. The considerably higher ratio of scientists to support personnel was said to reflect the stronger commitment to the science programme at Maitri in the summer season than in the winter season.

4.4 Scientific research

The station is well equipped with modern scientific facilities with several laboratories, including eight permanent observatories taking measurements in different areas of Antarctic science. Computer technology and communication via the Internet are in use. This permits rapid reporting to national and international data centres.

The main task for the scientists during their stay at Maitri is to collect data for subsequent analysis in India. After each expedition, the Department of Ocean Development publishes a technical report covering logistics and short descriptions of the scientific projects. The scientists then publish their results in Indian and international scientific journals. Scientific activities at Maitri are being pursued in the following areas:

Atmospheric sciences

- Ozone is monitored using radio sondes, which are sent up to 40 km once a week. A Brewer spectrophotometer is employed for ozone/UV-B and trace gas measurements
- Continuous geomagnetic current and pulsation measurements
- Optical auroral studies
- Continuous VLF whistler monitoring.
- Synoptic meteorological data are collected at 3-hourly intervals, and data is transmitted to GTS/WMO via New Delhi every six hours.
- Climatological database

Earth sciences

- Tele-seismic studies (permanent seismic observatory)
- Planetary geodesy (permanent GPS station)
- Geological work, which mainly consists of mapping in the summer
- Albedo and snow drift studies by automatic weather stations
- Ice front monitoring
- Palyno-stratigraphic studies of freshwater lake sediments
- Hydrographic and topographic survey

Human biology and medicine

- Adaptation studies of personnel living under stress due to low temperature and darkness
- Investigations of circadian rhythm changes and immunomodulation.

Biology and environment

- Biodiversity and physiology of terrestrial ecosystems
- Eutrophication analysis of freshwater lakes
- Environmental monitoring of Indian Antarctic activities
- Investigation of bacteria in the lakes

Engineering and communication

- Use of wind as a clean source of energy
- Structural engineering studies
- Long-distance communication studies

The station personnel were in favour of wider international cooperation. At present there are exchanges of scientists during the summer seasons but not in winter. Scientists from several countries have participated in the Indian summer programme. A Peruvian geologist was stationed at Maitri in the 2000 summer season, and two German scientists were expected for the 2001 season. It was indicated that cooperation projects would be a better alternative than physical exchanges for the winter seasons.

4.5 Physical description of station

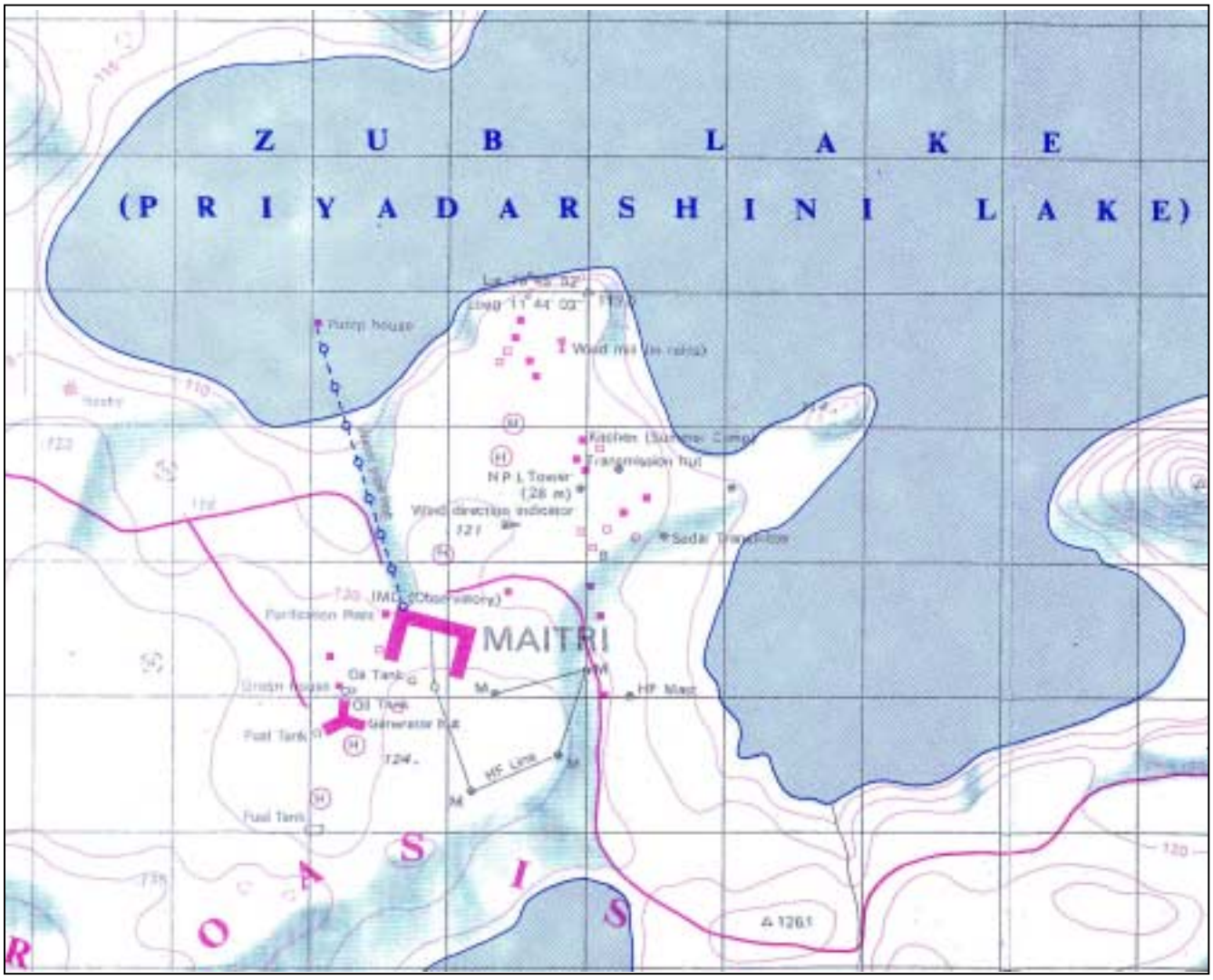
Maitri is a relatively large station complex, spanning an area of approximately 1000 by 500 metres (see Figure 2). The main building of the station is U-shaped with an area of approximately 1200 m^2. This building has two storeys and stands on a steel structure about 2 metres above the ground. It contains the units required for the over-wintering personnel, such as living accommodation (26 single rooms), kitchen, and washing and toilet facilities. West of the main building, and next to the fuel depot, is a separate generator building complex. A summer camp in the northeastern part of the station area contains six residential modules for 50 persons with separate kitchen and toilet facilities and a power generator/communications unit. The summer camp also contains structures for scientific research (including two laboratories), two storerooms, and a lecture hall. The summer camp serves as an emergency camp for the over-wintering personnel.

In the western part of the station area there is a garage complex with a workshop for vehicle maintenance. Maintenance work was earlier carried out in an area closer to the main building, but due to the risk of contamination of the freshwater supply, the whole maintenance complex was moved a few years ago. Containers used for storage are located between the main building and maintenance area. In addition some container units are located in the hills at the edge of the Schirmacher Oasis, which are used as parking facilities for the supply and field vehicles. The whole station is orderly and tidy, and clearly considerable effort has been put into clean-up operations since the 1996 inspection.

Permanent roads have been bulldozed in the station area and to the snow edge, giving easy access to the various installations. Vehicles are restricted to these roads.

The Dakshin Gangotri station (established in 1983) on the ice shelf was the former station of the Indian Antarctic Programme. Dakshin Gangotri was closed when Maitri was opened. The old station has been closed and left on site, but reportedly all hazardous materials have been removed from it.

Figure 2: Layout of Maitri



Source: Special Map Series - Maitri and Environs. Survey of India, Department of Science and Technology.

4.6 Communications

The communications unit in the main complex has telephone, fax and telex. The station is well equipped for long and short distance communication within Antarctica and is readily accessible via INMARSAT. A satellite APT receiver is used for weather information in the region. There is also an INMARSAT terminal in the summer camp in case the terminal in the main building is not working. VHF is used for

communication with mobile units and VHF air radio is used for communication with aircraft. A medium power SSB transceiver is used for communication with the supply ships and for communications with other stations and with India. Two radio operators/scientists maintain the radio station.

4.7 Station facilities and logistics

Transport and resupply
At Maitri Snow Cats, bulldozers, cranes, Pisten Bullies and skidoos are available for station and science operations. At the time of the inspection several of the vehicles were at the shelf awaiting the arrival of the supply vessel. Several of the remaining Pisten Bullies were non-functional, but were to be overhauled by the mechanics, who were due to arrive with the summer crew.

There were no fixed or rotary-wing aircraft at the station at the time of the inspection, and no runway for aircraft was envisaged. Two BEL 407 helicopters were expected to arrive with the summer team and were to be stationed at Maitri during the austral summer.

The station is resupplied by ship. In 2000 the Indian Antarctic Programme for the first time utilized Cape Town as the departure point for its expedition, and it was indicated that Cape Town would probably continue to serve as the regular departure point. The 2001 resupply vessel (MV *Magdalena Oldendorff*) was expected a few days after the inspection. Supplies are transported from the vessel to the station via ground transport and helicopter.

Power generation and fuel storage/usage
The station's power supply system has not been modified significantly since the 1996 inspection. Six 62.5 kW generators operating on Jet A-1 fuel are installed at the station. Normally, only one generator is run at a time. The main power station serving the winter station consists of four generators, while two generators located in a separate building supply the summer station. The main building is heated by one of the four boilers installed in the main building.

The fuel is brought to the ice shelf onboard the supply vessels. At the loading site the fuel is transferred to double-walled steel tanks (10 000 and 20 000 litres) that are transported to the station on sleds. At the station fuel is stored in a separate designated area in double walled steel tanks of various sizes (three tanks of 10 000 litres, three tanks of 20 000 litres and one tank of 60 000 litres). The main fuel depot is located in an area prone to accumulation of melt water, and at the time of the inspection water accumulation was quite extensive. It was unclear whether this had any bearing on the fuel operations. One 10 000-litre tank is next to the garage unit for refuelling of vehicles. At regular intervals, fuel is transferred from the storage tanks to a smaller day tank. The tank is connected to the main power station by fixed piping and the fuel is automatically pumped from the day tank to the generators. In addition to Jet A-1, a small supply of unleaded petrol is available for the snowmobiles. Petrol is stored in 200 litre drums, as are lubricants and antifreeze. The estimated level of consumption of Jet A-1 at Maitri during a year is 230 000 litres, of which an estimated 50-60 000 litres is used for the vehicles.

Since the last inspection, the containment systems around the day tanks and at fuel transfer points have been improved. One area close to the fuel storage area is visibly contaminated by fuel spills, reportedly from operations in the past. The inspection team was informed that the Indian Antarctic Programme is currently considering removal of the contaminated soil. No major spills connected to fuel transfer and storage were reported during the last season.

Solar cell panels and wind generation systems have been tested as alternative energy sources, and testing of such systems will continue in the future. Currently, these are not considered to be practical alternatives to the conventional power supply and are being used in stand-alone mode. Station personnel expressed a desire to learn more about alternative technologies, and also pointed out that there should be more exchange of information on experience of the use of alternative energy sources gained by various national programmes. Currently, information does not always seem to reach those who have the practical responsibility at the stations.

Photo 5: Fuel storage area at Maitri

Water system
Water, which is taken from the freshwater lake below the station, is pumped into storage tanks through a heated piping system. In earlier winter seasons, there were problems with water freezing in the pipes, but this has not happened since the pipes were insulated with heat tape.

Sewage and grey water
The station is equipped with incinerator toilet facilities. Two modules (four toilets) are located in the summer station area, and five single modules are located in the main station building. The incineration temperature is 600ºC. Solid human waste is incinerated once a day. The ashes are collected in drums and transported out of the Antarctic Treaty area once a year.

The grey water is fed into a rotational biological contractor. The treatment involves three stages: a primary settling basin, followed by a bio-digester and a final settlement basin. The settled waste material is incinerated. The treated effluent is temporarily stored in a pond close to the station building. A sealed basin was to be constructed in 1997, but this had apparently not been done, and treated water could still leak out into the ground and contaminate the lake from which the station takes its freshwater. The station personnel indicated that this was not considered a real risk. The treated effluent is sporadically pumped from the settling pond into a tank and subsequently discharged into an ice-free area approximately 1 km from the station. There is no regular analysis of the treated effluent during winter (although it is analysed during the summer season by the environmental team) and no monitoring of potential impacts is conducted at the discharge point. There are plans for the environmental scientists to conduct an EIA during the 2001 season to provide feedback on remedial measures. A new bio-digester already available at the station is to be installed during the current season. There are plans to use only biodegradable soaps and detergents, but so far this has not been done.

Hazardous chemicals
Small amounts of chemicals for laboratory research work, photography and X-rays are stored in appropriate and properly marked containers at the station. Clearly marked drums containing waste chemicals (lubricants, antifreeze, etc.) were stored by the garage unit, although no further containment system for these drums was observed. These are removed from Antarctica once a year.

4.8 Firearms and explosives
No inappropriate military activity was observed during the visit to Maitri station. The inspection team was informed that there was no nuclear material at the station. It was further informed that no representatives of agencies in nuclear fields had ever been present. The station was not equipped with firearms or ammunition. It was reported that explosives (dynamite) left over from the station construction period were stored approximately 500 m from the main building, while the primer caps were stored in a separate location.

4.9 Emergency response capacity
The personnel receive a 10-day training course before departure for Antarctica. This includes training in snow, ice and crevasse conditions, rescue, etc.

Medical
There are two medical doctors at the station. The station is equipped with a surgery, X-ray facilities and stocks of medical drugs. There is no specific SAR capacity at the station. SAR cooperation has been established with the Russian programme at Novolazarevskaya.

Fire
There have been two incidents involving fire at Maitri since the station opened. Since the 1996 inspection, there have been a few minor incidents in connection with the incinerator toilet. Because of this, the Indian programme and the station personnel take fire hazard seriously and have a clear focus on precautionary and preventive measures.

There are dry powder fire extinguishers located in all parts of the station. There is also a separate system for fire contingency purposes installed in the main building (water storage separate from household water systems). A station member is on night watch every night. There are fire drills once a fortnight.

Pollution
Fuel and chemical spills are handled on the spot, although there seem to be no set procedures for the response. No oil spill contingency plan has been prepared for the station, but it was noted that during the 2001 season the environmental team would provide the input for drawing up a contingency plan.

4.10 Environment

Training and information
The personnel go through a one-week information meeting in Goa before departure for Antarctica. At this meeting they are informed about the Antarctic Treaty regulations and the environmental guidelines. They are also given an introduction to the handbook "General Guidelines - Indian Antarctic Programme", which is issued to each team member. Training and information activities also continue throughout the stay at the station. The station personnel indicated to the inspection team that the current expedition leader had a very strong commitment to the environmental aspects of the station operations, and that environmental awareness and education were therefore in focus at the station. Both the Antarctic Treaty and the Environmental Protocol are available on request from the station leader.

Environmental impact assessments and monitoring
All activity that takes place at the station is thoroughly screened by the authorities at the Ministry of Ocean Development as regards environmental issues.

Emissions from generators and incinerators are analysed every summer season, and the composition of the wastewater effluent and drinking water is analysed. A comprehensive environmental impact monitoring programme is being planned, which will involve measurement and monitoring of selected parameters on a continuous basis throughout the year.

Conservation of flora and fauna and management of protected areas
There are no protected areas in the vicinity of Maitri. Flora and fauna are scarce. A few south polar skuas are regularly observed in the station area. The birds have not been observed to be particularly attracted to the food waste storage area. There are also penguin colonies (Adelie penguin) within walking distance of the station. The station personnel indicated that they were informed about the sensitivity of these penguins during hatching and brooding, and had been advised not to visit the colonies. The general guidelines set forth in the handbook "General Guidelines - Indian Antarctic Programme" inform the personnel that they must respect the unique nature of Antarctica and not disturb its flora and fauna.

Non-indigenous plants were noticed in several rooms in the station building, and a greenhouse at the eastern side of the station building was also actively in use. No

indication was given that the plants present were for research purposes, as was the case in 1996. However, the team was informed that scientists visit Maitri on an intermittent basis to conduct experiments on greenhouse horticulture as part of a long-term science plan. It was emphasized, however, that all soils utilized are sterile. There were apparently no procedures or guidelines for precautionary measures relating to non-native plants. The small aquarium that was observed in 1996 is no longer at the station.

Waste management
Thorough written instructions and guidelines concerning waste management are given in the expedition handbook "General Guidelines - Indian Antarctic Programme". The waste separation scheme was clearly marked in appropriate areas at the station.

The waste at Maitri is separated into a number of categories: plastic, paper, glass, tins, used oils and fuels, food scraps. All types of waste with the exception of food scraps and sewage are annually removed from the Antarctic Treaty area and are delivered to reception facilities that have the capacity to recycle various waste categories. Waste that is to be back-loaded to India is no longer stored in empty fuel drums, but is collected and stored in 20' storage containers. The total annual volume of waste to be transported out of Antarctica after the end of the season was estimated to be less than one 20' container. In addition there would be a few drums of ashes and a number of drums of liquid waste, such as old oil and fuel.

All food scraps are collected and temporarily stored in empty fuel drums in a designated area before combustion in the station incinerator (600ºC). The incinerator is operated by an experienced person and is used only when wind velocity and direction will cause the least damage to the environment. The ashes from the incinerator are collected in drums and transported out of the Antarctic Treaty area. During the winter season (and in earlier winter seasons) the incinerator building was inaccessible due to accumulated snow, and consequently a relatively large amount of food waste was stored in the temporary storage area. No problem had been encountered with the stored food waste.

It was obvious that there was a high level of awareness of waste management issues at the station. The area was thoroughly cleaned up in the 1997 summer season. Since then there has been a focus on continuing to maintain a clean and orderly station, both by preventing new waste from dispersing and by collecting old waste. During the past winter season every Saturday had been set aside for clean-up operations at the station. Furthermore, from November onwards one hour every afternoon had been set aside for clean-up operations. These clean-up sessions were mandatory for all members of the winter team. During the six weeks prior to the inspection, an entire 20' container had been filled with scrap and waste collected in the station area.

Radioactive materials
No radioactive isotopes were currently used at the station

4.11 Tourism
No tourists have visited and no NGO activities have taken place at Maitri since the 1996 inspection.

4.12 Conclusion

The inspection team had a very favourable impression of the operations at Maitri. The inspection team was especially impressed by the effort that has been put into clean-up operations at the site since the 1996 inspection. The team effort that is demonstrated during regular clean-up operations at the station is highly commendable. The inspection team was furthermore pleased to see that there has been an emphasis on improving environmental aspects of fuel operations. It was noted that the station still lacks an oil spill contingency plan, but the inspection team was pleased to hear that the Indian programme plans to develop one in the near future.

The inspection team notes that there seems to be little scientific focus at the station during the winter season, and would urge the Indian programme to consider how to make further use of the logistic resources at the station in advancing science in Antarctica.

The inspection team suggests that the station personnel and the Indian programme, in cooperation with other Antarctic programmes, continue to look at issues such as alternative energy technologies, measures related to non-indigenous plants and the discharge of waste water in ice-free areas.

As the neighbouring stations Maitri and Novolazarevskaya are so close to each other in a limited ice-free area, it would be useful for the two Parties involved to consider whether the Schirmacher Oasis should be designated as an Antarctic Specially Managed Area.

The inspection team noted the strong commitment of the expedition leader to environmental aspects of operations. The inspection team would like to emphasize that such commitment at the top level is essential for all operations in Antarctica in order to achieve full compliance with the provisions of the Environmental Protocol.

5 NOVOLAZAREVSKAYA (Russia)

5.1 Inspection details

The inspection team arrived at Novolazarevskaya at 15:30 local time (GMT) on 7 January 2001. The team was met by station commander Yevgeny Pugachyov and several other members of the personnel at the station. The inspection lasted approximately four hours.

It was clear to the inspection team that there had been no major changes at the station (with respect to either installations or operations) since the last inspection in 1996, and in-depth recording of the station installations was therefore not considered necessary. Reference should be made to the inspection reports from the Norwegian inspection conducted in 1996 and the Swedish inspection conducted at the station in 1994.

5.2 General information

Novolazarevskaya was opened as an all-year station in 1961. In 1979 a rebuilding programme was started and the present station complex was erected. The station is operated by the Arctic and Antarctic Research Institute (AARI) in St. Petersburg. Novolazarevskaya is located on ice-free ground in the Schirmacher Oasis on Vassfjellet in Dronning Maud Land at 70º46'S, 11º50'E. The ice shelf edge of Prinsesse Astrid Kyst is approximately 90 km away.

The closest station to Novolazarevskaya is the Indian station Maitri, located 4.5 km west of Novolazarevskaya. Novolazarevskaya was also the closest neighbour to the now dismantled Georg Forster station, which was located 1 km away.

Photo 6: View of Novolazarevskaya station

5.3 Personnel and military support activities

At the time of the inspection a 20-strong all-male over-wintering team was present at Novolazarevskaya station. Approximately half of the personnel were associated directly with scientific activity, although only a few were scientists as such.

There was no indication that a separate summer team would be arriving at the station in the 2001 season (the same was true in 1997). A new over-wintering team was to arrive with the supply ship, which was expected to arrive in March or April.

5.4 Scientific research

Scientific activities at the station are currently at a low level, involving one satellite expert, one meteorologist and one geologist. Activities are now concentrated in the following fields:

Atmospheric sciences

- Meteorological data are collected regularly using radio sonde balloons. Standard parameters such as temperature, pressure, cloudiness, and visibility are measured. Data are transferred on a regular basis to the Hydrometeorology Centre in St. Petersburg.

Earth sciences

- Sea ice mapping is carried out by interpreting satellite images.
- Seismological registrations are made on a continuous basis
- Magnetological observations are made utilizing one analogue and one digital station

Computer technologies and communications via the Internet were in use. This permits rapid data reporting to national and international data centres.

There has been no significant international cooperation on scientific activities in the last decade. At present, there is only unofficial cooperation with the Indian station.

5.5 Physical description of station

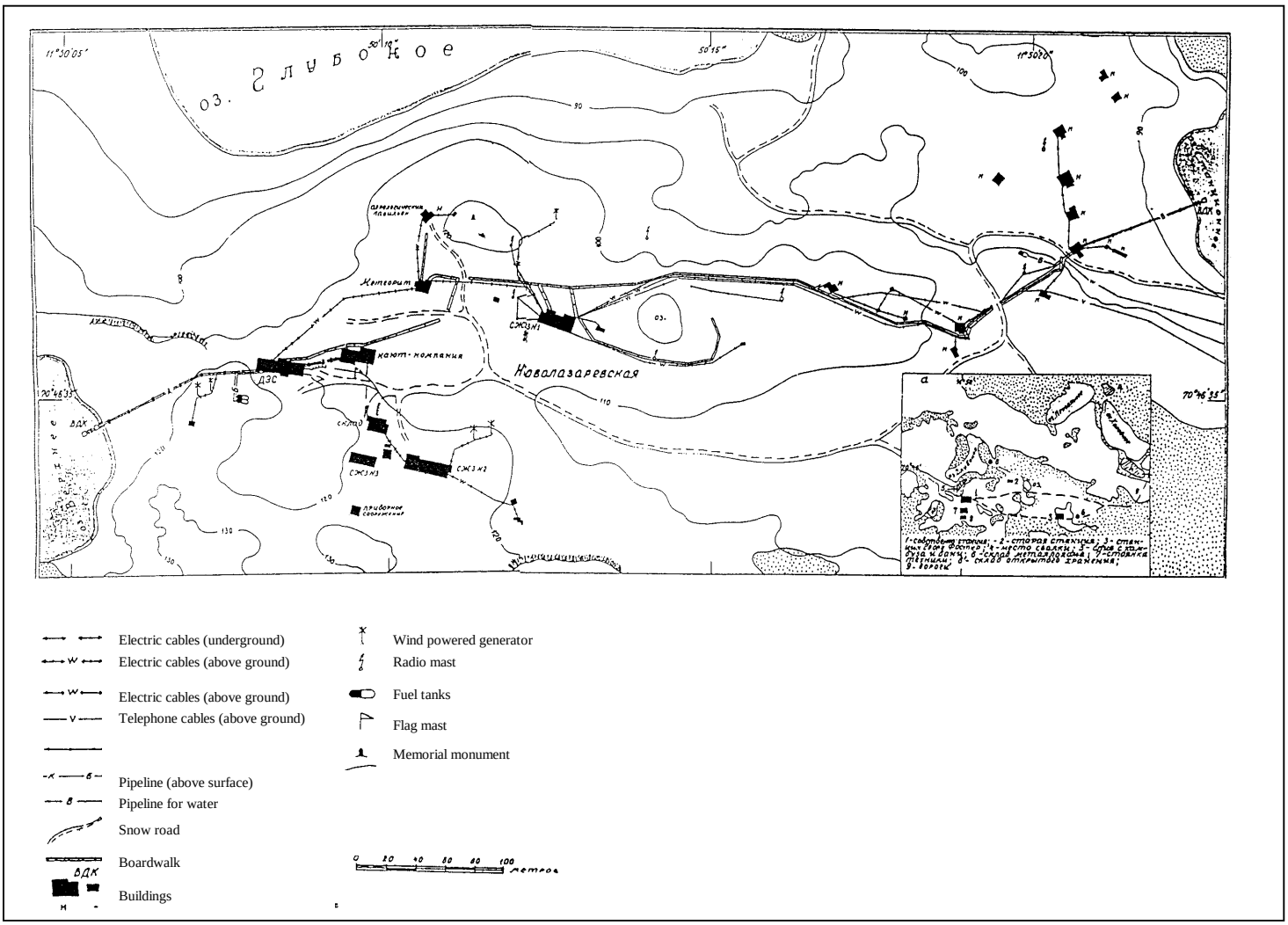
The Novolazarevskaya station complex consists of a relatively large number of buildings of various sizes and varying standard spread over a large area (see Figure 3). Some of the structures are used for storage and temporary summer accommodation. Some buildings and structures are from the earlier Novolazarevskaya station.

The main structures are seven one-storey buildings with an estimated total heated area of 1400 m^2. The buildings, which house offices, common rooms, sleeping quarters, kitchen, mess, etc., are all built on steel structures approximately 1 - 2 metres above the ground. Wooden pathways and hand railings connect the buildings.

The station gives the impression that expansion and development of the station area has not been planned, and some structures appear to be somewhat randomly placed. A large area filled with operational and non-operational vehicles and other equipment visually dominates the station area. This area, reportedly used for parking, storage and maintenance work, seems to be relatively contaminated.

Permanent roads have been bulldozed between the various buildings in the station area, and a road also leads to the point at the ice edge where the transport route to the shelf begins.

Figure 3: Layout of Novolazarevskaya



Source: Arctic and Antarctic Research Institute, St. Petersburg, Russia

5.6 Communications

The station has a medium powered SSB (1 kW) transmitter for communications with supply ships and other stations in Antarctica. VHF radios are used for communications with vehicles and air radio VHF for communication with aircraft. There is also a an INMARSAT B and C station. Telegraphy is used for communication with other Russian stations and radiotelex F1 is used for transmitting meteorological data and for point-to-point traffic. There is one radio operator/radio technician at the station.

Photo 7: Storage area at Novolazarevskaya

5.7 Station facilities and logistics

Transport and resupply
Novolazarevskaya is equipped with a small number of tracked vehicles and tractors, but no lighter vehicles such as snowmobiles.

There were no fixed or rotary-wing aircraft at the station at the time of the inspection, and aircraft are not normally present except during resupply periods. There is a marked helicopter landing area in the station area, although the markings are not clearly visible at present, and the pilot transporting the inspection team was not able to locate the landing area from the air.

The station is resupplied by ship. The 2001 resupply vessel (MV *Akademik Federov*) was expected in March or April. In recent seasons there has been a considerable delay in the arrival of the supply vessel, and in 1997 it did not arrive until June although expected in March. Supplies are transported from the vessel to the station via ground transport and helicopter.

Power generation and fuel storage/usage
The station's power supply system has not been modified since the 1996 inspection. Novolazarevskaya has a total of six generators: three with a capacity of 200 kW (used in the winter period), two of 100 kW and one of 75 kW (used in the summer period). Approximately 7000 litres of fuel is reportedly consumed for power generation each week.

Arctic diesel is used both for power generation and for all vehicles. There are three fuel tanks each holding 50 000 litres located at the station. These tanks are connected to the main power station with fixed piping. A bulk fuel depot is located at the edge of the ice shelf, consisting of sixteen tanks holding 50 000 litres each. The tanks at the ice edge are refilled directly from supply ships. The fuel is transported from the ice edge to the station in smaller tanks and drums, and is then transferred to the station

tanks. There were no reports of containment systems for the bulk fuel depot, and none were observed for the tanks at the station. The inspection team observed contamination of the ground around the fuel tanks at the station. The estimated level of consumption of Arctic diesel at Novolazarevskaya during a year was 300 000 litres, including that which is used for vehicle operations.

No alternative energy is used at the station. The inspection team was told of successful experiments conducted some 20 years ago, but there have not been resources available to continue these experiments.

Photo 8: Fuel storage at Novolazarevskaya

Water system
The station gets its water from a small freshwater lake located nearby the station complex. The water is pumped 150 metres in a heated pipe to the storage tanks at the station. The water quality is reportedly good.

Sewage and grey water
Solid human waste is collected and disposed of into a crevice in the ice shelf. Mobile tanks of 3 m^3 are used for transporting sewage from buildings to disposal site. Grey water from the laundry building and mess building is discharged into the ground a short distance from the main area of the station. No treatment facilities for grey water were reported or observed.

Hazardous chemicals
Chemicals for production of gas to fill the meteorological balloons, for photographic purposes and for development of X-rays are stored at the station. Drums containing waste chemicals (e.g. from gas production) were observed stored in the station area without any marking or further containment system.

5.8 Firearms and explosives
No inappropriate weapons, military related activity or nuclear disposal sites were observed at the station. No firearms or ammunition are kept at the station.

5.9 Emergency response capacity

Reportedly the personnel receive no formal training before departure for Antarctica. However, the personnel at Novolazarevskaya are highly experienced people, and several of the crew had over-wintered at the station a number of times.

Medical

There are two medical doctors at the station which is equipped with a surgery, X-ray facilities and stocks of medical drugs. There are search and rescue plans for the station. A response group consisting of the medical doctor, drivers and radio operator has been established for such operations. SAR cooperation has been established with the Indian programme at Maitri.

Fire

The station is equipped with fire extinguishers and smoke masks. Instructions for use were posted by the equipment. The inspection team obtained no further information on contingency planning for fires.

Pollution

A plan for fuel supply operations is available at the station. This plan includes guidance for clean-up operations in the event of oil spills. It was unclear whether an oil spill contingency plan in accordance with the COMNAP guidelines had been prepared for the station.

5.10 Environment

Training and information

Informal information about the basic principles of the Antarctic Treaty and related documents is given to all expedition members. The station commander has a copy of the Antarctic Treaty and the Environmental Protocol in his office. The personnel are made aware of and provided with a copy of a “Code of Conduct”. These guidelines focus on general matters related to the flora and fauna, waste management, safety and disturbance of ongoing scientific projects.

Environmental impact assessments and monitoring

No information was given regarding these issues.

Conservation of flora and fauna and management of protected areas

There are no protected areas in the vicinity of the station. The inspection team was told that there are few animals in the station area, and only the south polar skua is regularly observed. The “Code of Conduct” gives general guidance with respect to flora and fauna.

Non-indigenous plants were noticed in several rooms in the various station buildings. There was nothing that indicated that the plants were present for research purposes, and there were no other indications that the plants were there pursuant to permit as is now required through the Madrid Protocol. No report was given as to whether soil brought from Russia is sterile. The soil and plants were brought into the station before

1991. The personnel have been informed about precautionary measures related to non-native plants.

Waste management
The inspection team observed no indication that a waste management plan for Novolazarevskaya has been prepared in accordance with Article 8 of Annex III of the Madrid Protocol. No public notices on waste management were observed.

The station personnel indicated that efforts have been made to collect and store waste, but the question of transport has not so far been fully solved, due to lack of resources. Even if waste is transported out to the ice front, there is always uncertainty as to whether the vessel will be able to reach the ice shelf. Presumably open burning of waste still continues at the station although this is no longer permitted under the Madrid Protocol (Article 2, Annex III), and presumably food scraps are still collected separately and disposed of in a crevasse at the inner part of the ice shelf. It is likely that this results in the problem of skuas being attracted to the food waste.

The personnel expressed concern with respect to waste management, and indicated a strong desire to clean up the station area and remove waste. There appeared to be some frustration at the lack of resources to initiate clean-up action at the station — especially taking into account the massive clean-up effort that had taken place at the neighbouring station Georg Forster.

Radioactive materials
No radioactive isotopes were currently used at the station. However, the inspection team was informed that a radioactive isotope generator that has been used for production of electricity to supply an automatic weather station is located (in a lead container) at the station. The generator has been at the station for 30 years, but is now no longer in use, although it is still in good condition. Specialists have checked the installations, and no radioactive radiation has been reported in the vicinity of the generator. The inspection team was told that there are plans to remove the generator from the station.

5.11 Tourism
Small groups of tourists from a number of countries (e.g. Australia, Romania and Switzerland) have visited Novolazarevskaya since the 1996 inspection. In addition, the Russian programme and the personnel at Novolazarevskaya have assisted the tour operator Adventure Network International Inc. (ANI) in transporting fuel to the ANI-operated air strip at Henriksenskjæra (“Blue 1”).

5.12 Conclusions
The inspection team finds it disturbing that there appear to have been few improvements and changes to Novolazarevskaya and the operation of the station since it was last inspected in 1996. The inspection team finds this especially disturbing because the Madrid Protocol has entered into force since the 1996 inspection, and this commits Treaty Parties to a comprehensive environmental framework for Antarctic operations. The inspection team commends the station personnel for attempting to adjust operations accordingly, noting that the support given does not always allow for proper follow-up.

The inspection team furthermore notes that there seems to be a general lack of support and resources, leaving the personnel with limited capacity and resources available for proper operations. The inspection team would, however, commend the station personnel for the positive attitude they showed despite this situation.

The inspection team notes that Novolazarevskaya has had recurrent problems associated with resupply, back-loading of material and exchange of personnel. The programme should carefully consider these matters and attempt to find solutions to rectify the situation.

6 GEORG FORSTER (GERMANY)

6.1 Inspection details

The inspection team arrived at the site of the former East German station Georg Forster at 20:00 local time (GMT) on 7 January 2001. The inspection lasted 15 minutes.

The inspection was the first following the decommissioning of the Georg Forster station.

6.2 General information

Georg Forster was an all-year station established in 1976 and run by the East German Antarctic programme in close cooperation with the Soviet/Russian programme until it established a purely East German identity in 1980. The station normally had a staff of six. When Germany was reunified, the German Antarctic programme took over the operation of the station.

Georg Forster was located on ice-free ground in the Schirmacher Oasis on Vassfjellet in Dronning Maud Land at 70º46'S, 11º50'E, only 1 kilometre from the Russian station Novolazarevskaya. It was an all-year station consisting of three pre-fabricated buildings with an estimated floor area of 110 m^2.

In the period 1994 – 1997 an extensive and ambitious dismantling operation was conducted. The clean-up operations were conducted in cooperation with the personnel at Novolazarevskaya station.

6.3 Observations

The inspection team noted that all structures had been removed from the area and that a plaque commemorating the former station is the only physical installation remaining in the area. The only evidence of past activities the inspection team noted in the immediate area of the site was some indications of ground contamination. The inspection team did not inspect areas other than those in close proximity to where the station buildings had been located.

Photo 9: The site of the former Georg Forster station

6.4 Conclusion

The inspection team was very impressed by the effort that has been put into the dismantling of the Georg Forster station. The German government and Antarctic programme have clearly shown a strong commitment to the Antarctic environment and the provisions and intentions of the Madrid Protocol, especially Article 1 of Annex III which requires the users to clean up abandoned work sites of Antarctic activities.

Photo 10: The plaque commemorating Georg Forster station

7 SANAE IV (SOUTH AFRICA)

7.1 Inspection details

The inspection team arrived at SANAE IV at 9:00 local time (GMT) on January 8 2001. The officer-in-charge, Mr. Adriaan Dreyer, and several other key members of the station personnel met the inspection team. The inspection lasted approximately seven hours.

SANAE IV was officially opened in 1997, a few months after the 1996 inspection. Current operations are therefore very different from the construction activity that was taking place during the last inspection. The inspection team has therefore found it appropriate to include a relatively thorough description of the station and its operations.

On arrival, the inspection team was presented with complete written documentation on the station and its operations, including a document setting out information in accordance with the headings of the Antarctic Treaty system inspection check lists. This information greatly advanced the observers' understanding of the station operations and facilitated the inspection.

7.2 General Information

SANAE IV is an all-year scientific station operated by the South African Department of Environmental Affairs and Tourism. SANAE IV is situated on the edge of the Vesleskarvet nunatak at 71º40'S, 02º51'W about 170 km from the ice shelf. The nunatak area is limited in extent, and the station is generally surrounded by snow-covered ground.

The South African programme operates an emergency base (called the E-Base) at Blaskimen bukta. The nearest neighbouring stations are the Norwegian Troll base some 185 km away, and the German Neumayer base some 250 km away.

Photo 11: SANAE IV

7.3 Personnel and military support activities

At the time of the inspection, there were 65 people, both men and women, from various ethnic groups at the station. The year 2000 over-wintering team consisted of 10 people of whom four were scientists, and a similar team composition was planned for the 2001 over-wintering team. No women were part of the 2000 over-wintering team.

Helicopter service at the station is provided by the South African Air Force. During the 2000-2001 summer season a 14-strong aircrew was present at the station.

7.4 Scientific research

The scientific programme at SANAE IV consists of various year-round upper atmospheric measurements. In addition, the station is the logistical centre for summer research in the field of geology. The programmes are planned and conducted in five-year cycles, the next being due to start in 2001. There were therefore no summer field activities in 2000-2001. A new geological and environmental programme will start in the 2001-2002 season.

The Department of Environmental Affairs and Tourism selects the scientific programmes on the basis of proposals from South African universities and organizations. The institutions responsible for the year-round research were the Universities of Natal (Durban campus) and Potchefstroom, and the South African Weather Bureau. The summer team included a science coordinator in an administrative position. Half the scientific staff were students working on Master or Doctorate degrees, the other half were scientific engineers (technical personnel).

At the time of inspection the previous and new winter teams were both present, as the inspection visit coincided with the six-week training overlap. Both teams showed commendable commitment and enthusiasm for their work. It was clear that the students considered it valuable that the programmes gave an entry directly into the international science community and allowed concentrated efforts on specific issues. There was, however, a wish for even better electronic communication facilities, to allow real-time interaction with other experimenters.

Scientific activities at SANAE IV are being pursued in the following areas:

Atmospheric sciences

- Cosmic radiation is recorded by two neutron monitors, as part of a 40-instrument international chain.
- The energy transfer in the magnetosphere and ionosphere, and the D region of the latter, are studied by numerous means, including magnetometers, low light cameras, goniometer, and a 64-array riometer antenna.
- The convection in the E and F region of the ionosphere is studied by a 16-element antenna array.
- The meteorological programme consists mainly of standard weather observations. No upper air measurements are undertaken.

Earth science

- A seismograph station measures earthquakes, in cooperation with the German programme.
- GPS data are recorded continuously.

The scientific equipment is regularly upgraded. During the 1999-2000 summer season the 64-element antenna was replaced because the old antenna was destroyed by snow build-up, and a new auroral camera was in the process of being installed.

By chance no scientists from outside South Africa were present at the time of inspection. However, the seismic cooperation involves a visit from Alfred Wegener Institute personnel each year, and there were visits from the British Antarctic Survey in connection with the ionosphere programme, which also had close links to US institutions. Swedish scientists had done satellite tracking, and this season a Finnish scientist was using SANAE as a base for snow studies.

The scientists expressed a wish to increase international cooperation, and space is available in the station to accommodate foreign scientists. The inspection team was impressed by the efforts being made to increase scientific cooperation. Another example of cooperation this summer season was the participation by three South African biologists in a joint Norwegian-South African research programme at Bouvetøya.

Reports of the research conducted at SANAE IV are published in national and international scientific journals.

7.5 Physical description of station

The station area is dominated by the main building complex and the fuel bunker, but also contains storage areas and antenna areas (Figure 4).

The main building complex has been constructed to withstand the elements (winds of 250 km/h have been measured in the area) through elaborate anchoring into solid rock and permafrost and through its design. The main building is built on steel frames, four metres above the ground, to prevent accumulation of snow and thereby significant changes to the local environment. Some snow build-up does, however, occur on the lee side of the station. This snow is regularly bulldozed off the cliff side.

The building complex, a steel structure with double walls of orange, white and blue fibreglass (efforts are now under way to make the whole station orange), consists of three interconnected buildings with an area of 2000 m^2. The main part of the complex has two storeys. The walls, roofs and floors are heavily insulated. The building complex contains 28 rooms that can accommodate up to 80 persons during the summer period and up to 18 people in the winter period. There are also meeting rooms, laboratories, hospital, library, dining room, kitchen etc. There is a hangar area with space for two helicopters, which can also be used for maintenance work/parking space for ground vehicles. The main complex is self-contained, and only snow melting and fuel storage take place outside the main building.

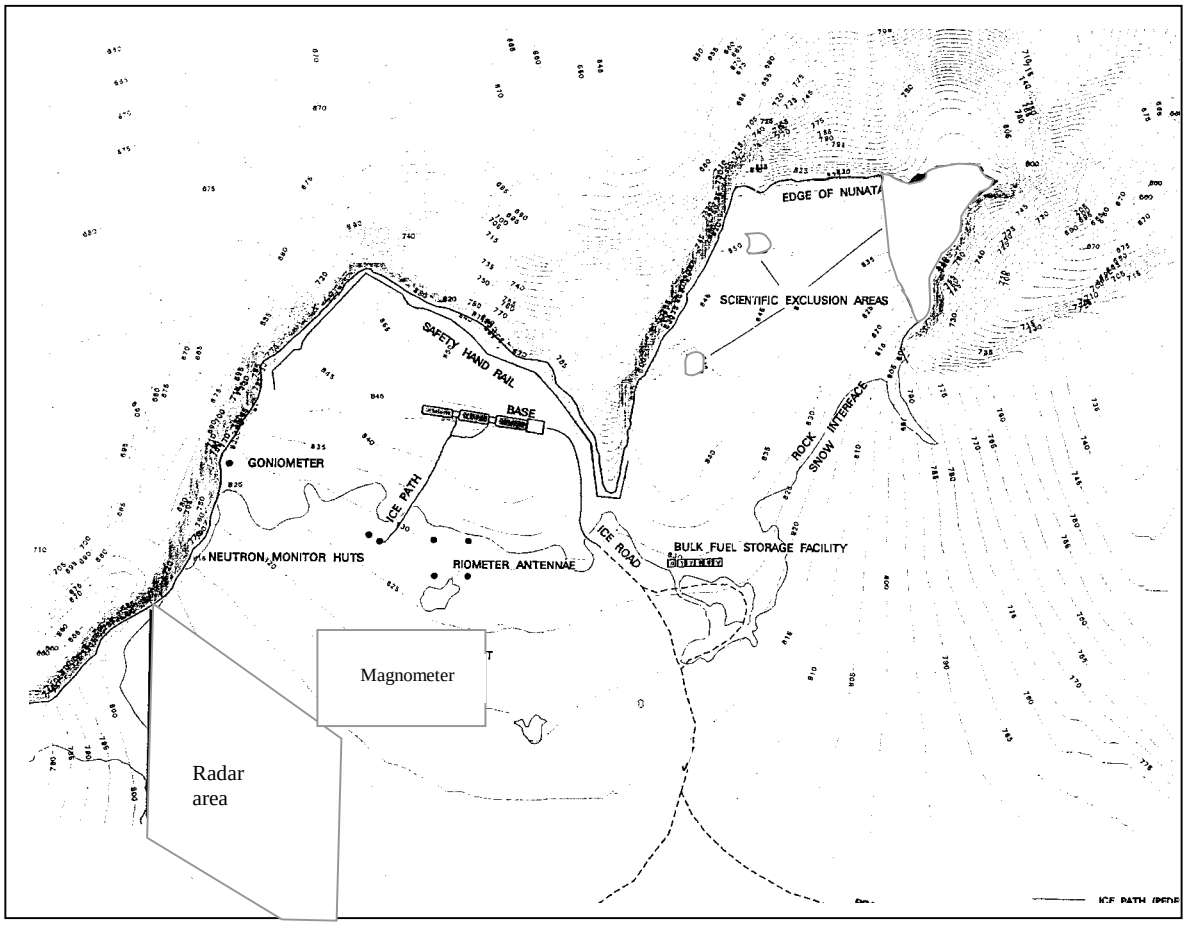
The fuel bunker tanks are located approximately 200 metres from the main complex. The tanks are built on a steel frame several metres above the ground to avoid snow accumulation. A VHF and HF mast is located about 50 metres from the main complex. In addition an array of scientific antennas has been set up in the station area.

SANAE IV does not have a constructed airstrip, but a snow airstrip can be prepared on request. At the time of the inspection an international evaluation team landed at the station using both a Twin Otter and a Basler 67. There are no permanent roads in the station area, with the exception of an ice road constructed on the rock surface leading up to the station complex.

7.6 Communications

The station uses a VHF (with repeater) to the E-base. HF is used for long distance calls and for calls to other stations and ships in Antarctica, as well as back up for satellite communication. SANAE IV is in daily radio contact with Neumayer station. In addition to the VHF and HF radio, the station uses both Intelsat and INMARSAT.

Figure 4: Layout of SANAE IV



Source: South African National Antarctic Programme

7.7 Station facilities and logistics

Transport and resupply
The station is equipped with Caterpillars (D6 and Challengers) and skidoos. Also available were cranes fitted on the D6 Caterpillars and cargo sleds. Personnel were required to adhere to the SANAP vehicle-use policy.

Two Oryx helicopters were stationed at the station for the duration of the summer season. The helicopters were used to transport personnel and sensitive equipment and also served as a Search and Rescue (SAR) facility. Approximately 125 flying hours were anticipated. A Flight Operations Manual has been drawn up.

The station was resupplied by the MV *SA Agulhas*. Supplies were transported to the station via ground transport and helicopter. There is a flagged (and GPS) route from SANAE IV to the ice edge.

Power generation and fuel storage/usage
The station is equipped with three diesel generators, each with a capacity of 268 kW, operating one at a time. The generators operate on polar diesel and consumption has been estimated at approximately 274 000 litres per year. The inspection team was told that measures are being contemplated to reduce fuel consumption further. There were no alternative energy systems installed at the station. Research into alternative energy and energy saving will commence from 1 April 2001. The heating system is built to reclaim heat from the generators; generally speaking too much heat is generated and excess heat has to be vented.

Diesel is transported to the ice shelf onboard the supply vessels. At the time of the 1996 inspection, fuel was temporarily stored in bladder tanks located on the shelf. Reinforced rubber hoses linked together with drip-free quick couplings are now used to pump fuel directly from the vessel into 25 000 litre steel tanks mounted on sleds for transport to the station. This has reduced the number of fuel transfer operations and is thus assumed to have reduced the risk of fuel spills.

Once at the station, the fuel is transferred from the sled tanks to the permanent storage tanks. The permanent storage system consists of a steel-encased bladder system with six sealed steel reservoirs, each containing one 100 000 litre flexible rubber bladder, with a total storage capacity of 600 000 litres. Electronic monitoring systems with sensors have been installed to monitor leaks in the bladders. Fuel is always transferred from the sled tanks to the bunker under strict supervision in accordance with set guidelines. A direct piping system is utilized to transfer fuel from the storage tanks to day tanks located inside the station. Transfers are monitored visually and a daily inspection is made.

No major spills were reported to have occurred during fuel transfer this season. In fact, no major spills have been reported since the 14 000-litre spill that occurred just before the 1996 inspection. Only a limited response was mounted to this spill, and there were still signs of it in the snow surrounding the fuel storage area. There was no other evidence of fuel spillage around the tanks or in any other area of the station.

Photo 12: The bulk fuel storage at SANAE IV

In addition to polar diesel, the station stores unleaded petrol for the snowmobiles (approximately 40-50 drums) and aviation fuel (Jet A-1) for aircraft (approximately 80-100 drums). There were also 2-3 drums of anti-freeze and 2-3 drums of hydraulic oil. There was no containment system for these drums, which were stored in a clearly marked area on the snow-covered ground several hundred metres away from the station complex. All refuelling of vehicles takes place in this area. Small spills from the fuel drums, or those that occur during re-fuelling of vehicles, are dealt with on the spot. A mobile snow melter and oil separator is available to melt polluted snow. Separated fuel is transferred to empty drums, which are then sealed off, treated as hazardous waste, and transported out of Antarctica.

Water system

A snow melter has been installed a few hundred metres from the station buildings. This snow melter, which has the capacity to melt 4000 litres in one operation, supplies the station with water. Water is pumped through a heated piping system up to the hangar, where eleven tanks for water storage (total capacity 44 000 litres) are located. Consumption of water per person per day has been estimated at 90 litres in the winter season and 100-120 litres in the summer season. The station is fully equipped with flush toilets, showers, etc. There was no indication that water conservation policies were in force.

Sewage and grey water

A biological sewage treatment plant has been installed at SANAE IV. Sludge is separated out and is transported out of Antarctica. Effluents and grey water are treated by bio-filters and filtered through a carbon filter, a sand filter and a UV filter before being discharged over the Vesleskarvet cliff. All detergents used at the station are biodegradable to avoid damaging the bio-filter. Effluents must meet South African standards for discharge into freshwater, and regular analysis of effluents is conducted to ensure compliance. No problems had been experienced in achieving these standards, although discoloration of the effluent was sometimes a problem in the

summer season due to the limited load capacity of the system. A large amount of ice is accumulating on the cliffside at the discharge point.

Hazardous chemicals
Besides fuel, anti-freeze, lubricants and medical chemicals, only photographic chemicals and battery acid were present at the station. These chemicals were stored indoors in appropriately marked containers in areas where any leaks could be detected, contained and cleaned. The drainage system in the darkroom was a closed system, ensuring that photographic waste was not mixed and discharged at the site along with the station's grey water. Waste chemicals were stored securely and appropriately marked for transport out of Antarctica.

7.8 Firearms and explosives
No inappropriate weapons, military related activity or nuclear disposal sites were observed at the station. No firearms or ammunition are kept at the station.

7.9 Emergency response capacity

Medical
Two medical doctors are normally present during the summer season and one in winter. SANAE IV is equipped with a hospital room, a small surgery, X-ray equipment and stocks of medical drugs.

SANAE IV has a highly operational SAR capacity. The station has easily available SAR equipment, and the two helicopters based at the station during the summer season are also SAR-equipped. The helicopters have a response time of 15 minutes if the helicopter is on the flight deck and 40 minutes if it is in storage in the hangar. Outside the summer period, when there are no helicopters based at the station, medical evacuation by air is not possible. Written instructions and procedures relating to SAR operations have been prepared and were available at the station.

Fire
The station building is equipped with a fire monitoring system with alarms. Every module in the main complex can be isolated from the rest of the building in the event of fire, and the modules are equipped with spare rations and equipment. Regular fire exercises are held. The old E-Base station is being maintained for emergency purposes, and has food and equipment.

Pollution
An oil spill contingency plan, developed on the basis of the COMNAP Guidelines, has been prepared for the station (and was made available to the inspection team). Personnel using equipment that involves fuel are given training in fuel management. The focus of the present fuel management system at SANAE IV is on prevention of spills, rather than on response actions, as clearly emphasized by the sturdiness of the fuel storage, transport and transfer systems.

7.10 Environment

Training and information
Treaty documentation was available from the officer-in-charge and the over-wintering team leader on request. Personnel go through training before departure for Antarctica. Personnel are informed about the Antarctic Treaty, the Environmental Protocol, the waste management strategy, the code of conduct, and any other pertinent environmental information. At SANAE IV there is also considerable on-the-job training in environmental matters. A code of conduct has been developed, and includes environmental matters. In addition, the "take-over manual", which is issued to every member of the station personnel, gives practical advice on operations and organisation. The handbook, which is in English, is updated annually.

Environmental impact assessments and monitoring
All new activities require preparation of an environmental impact assessment (EIA), including all scientific activities. No major new activity requiring an EIA was to be undertaken during the season of the inspection. Annual monitoring of environmental impact was reportedly conducted, and documentation on this is available from the South African programme on request.

Conservation of flora and fauna and management of protected areas
There are no areas in the vicinity of SANAE IV location that are protected in accordance with the Antarctic Treaty protection system. There are, however, three sites in the station vicinity that have been afforded special protection by the South African programme (cf. Figure 4). At these sites, vegetation (lichens) and microfauna (especially tardigrades) occur, and they are physically demarcated with a string fence. Only scientists and environmental personnel are permitted to enter these areas in accordance with special permits. It was the inspection team's impression that the designated areas were respected.

There are no concentrations of birds in the area, although snow petrels and Antarctic petrels can be observed occasionally. The nearest seabird colony is at Robertskollen, 40 km from the station. According to station personnel the helicopters are not allowed to pass directly over Robertskollen, and landings are not permitted in order to prevent the disturbance of the breeding snow petrel colony on the nunatak. The code of conduct gives general guidelines for behaviour as regards the conservation of fauna and flora. No non-indigenous plants were observed at SANAE IV.

Waste management
SANAE IV has an elaborate waste management system, which is documented in the take-over manual. The following waste categories are separated at SANAE IV:

- Recyclable waste: glass, metals, oil and vehicle batteries.
- Special treatment waste: sewage, kitchen waste, chemicals and medical waste.
- General waste: construction debris and paper, plastic, etc.

Waste is generally stored in 200 litre drums, but larger amounts of construction waste and paper/plastic waste are stored in larger steel containers. All the waste is returned to South Africa, where it is delivered to a company that ensures its proper disposal and recycling. The station leader is in charge of waste management at SANAE IV.

Waste management focuses on minimizing waste generation, for example by measures to prohibit the use of polystyrene beads/chips and shredded paper as packaging material. Cardboard is used instead of plastics and bubble wrap instead of polystyrene. All packaging of waste is done inside the station (in the waste storage room) to minimize loss of waste into the environment. Currently approximately 60 drums and 15 crates of waste are generated at SANAE IV during one annual operational cycle. In addition approximately 6000 litres of solid sewage is transported out from the station every second year.

Radioactive materials
No radioactive materials are currently being used for scientific projects at the station. Permits are required for the use of radioactive materials in the South African Antarctic Programme.

7.11 Tourism
Four members of the private Norwegian over-wintering expedition visited SANAE IV during the 2000 winter. The tour operator Adventure Network International has a fuel depot at SANAE IV and occasionally lands there to re-fuel. With this exception no tourist visits or NGO activities have taken place at SANAE IV since the 1996 inspection.

7.12 Conclusion
The inspection team was very impressed by the operations at SANAE IV. It was particularly impressive to see the extent to which the potential environmental impacts had been taken into account in both the planning and construction phases, and this line is being continued in the operational phase. Clearly the environment had been a concern in deciding on the design of the station and fuel bulk storage, and also in the introduction of a comprehensive waste management system and the restriction of access to sensitive areas near the station site. The inspection team commends these efforts, but nevertheless suggests that the South African programme continue to consider such issues as water conservation measures and alternative energy technologies.

The inspection team notes that physical space to accommodate international cooperation is provided at SANAE IV. International scientific cooperation is a fundamental aspect of the Antarctic Treaty system, and the inspection team is pleased to note that this has been a major underlying factor when commissioning the new station. The inspection team hopes that the use of the facilities at SANAE IV by international scientists will increase in the near future.

Finally, the inspection team would like to compliment the station personnel on the detailed written documentation it provided for the inspection team on their arrival. The documentation, which included detailed information on issues raised in the ATCM inspection check list, facilitated both the inspection itself and production of the subsequent report.

8 TROLL (NORWAY)

8.1 Inspection details

The inspection team started the inspection at Troll at 18:15 local time (GMT +1) on 8 January 2001. The team was accompanied by the station commander John Guldahl. The inspection lasted approximately two hours.

Troll has not previously been inspected.

Since a Norwegian inspection was being carried out at a Norwegian station, the following measures were taken:

- Members of inspection team members who had direct links with the station operations were excluded from the inspection team (i.e. Olav Orheim and Birgit Njåstad from the Norwegian Polar Institute).
- The inspection team was supplemented with two special observers, namely Dr. Dick Hedberg of the Polar Research Committee of the Royal Swedish Academy of Sciences and Dr. Jan Stel of the University of Maastricht, the Netherlands.

8.2 General Information

The Troll station is located at 72º00'S 2º32'E and 1290 m on ice-free ground near an extensive blue ice field in the Jutulsessen area (Mühlig-Hofmanfjella), Dronning Maud Land. The station is located approximately 200 km from the ice edge. Troll was opened in February 1990.

Photo 13: View of Troll station

8.3 Personnel and military support activities

The main building houses up to 10 people, and additional personnel can be accommodated in a fibreglass igloo or in tents. Personnel numbers had varied widely during the current season, with up to twenty-six people present at the station at the

same time. At the time of the inspection only three people were based at the station, while a number of expedition members were out in field camps.

NARE (Norwegian Antarctic Research Expedition) station operations normally take place in the period early December to late February. Although the Troll station has been built to accommodate over-wintering teams, there have been no national over-wintering expeditions so far.

No military personnel are used to support the operations at Troll.

8.4 Scientific research

There are no laboratory facilities at Troll. Most scientific activities are carried out in the field, and Troll functions as the logistics and communication hub.

The scientific activities at Troll include environmental monitoring, geodesy/mapping, glaciology, meteorological observations, geology and terrestrial biology. During NARE 2000-2001, the following scientific projects were carried out with Troll as the logistics base:

Atmospheric science

- Meteorological observations through an Automated Weather System (AWS).

Earth science

- European Project on Ice Coring in Antarctica (EPICA) with field activities on the ice plateau at 75ºS 15ºE.
- Studies on physical processes under the Fimbulisen ice shelf.

Biology and the environment

- Studies on links between variability in the marine ecosystem and the reproductive and feeding success of seabirds in Antarctica — fieldwork based at the field station Tor at Svarthamaren (Site of Special Scientific Interest No. 23).

In addition NARE 00/01 conducted ground work for mapping the area around the Troll station, collected monitoring data for pollution at Troll and initiated monitoring studies of bird colonies near the Troll station.

Computer technology and communication via the Internet were used. This allows rapid data reporting to national and international data centres.

8.5 Physical description of station

Troll consists of one main building (approximately 100 m^2), one garage unit (can accommodate personnel if necessary), two combined generator and workshop buildings, and a fibreglass igloo.

There are no structural installations for helicopter landing, fuel storage or waste storage, although this will be considered in the future.

The station area, and especially the waste storage area, gave a somewhat untidy impression. There was significant outdoor storage of equipment. It was, however, noted that there was an ongoing effort to tidy up the area.

8.6 Communications

The station is well equipped for long- and short-distance communication within Antarctica and is readily accessible via INMARSAT. The station uses a VHF (repeater mounted some seasons) to communicate with the field parties. Regular communication schedules are set up with the individual field parties. In addition to VHF and HF radio, the station is readily accessible via INMARSAT.

8.7 Station facilities and logistics

Transport and resupply

At Troll, three tracked vehicles (BV 206 Hägglunds) and 15 snowmobiles are available for station and scientific operations. Tracked vehicles are mainly used for transport of equipment from the ice edge to the stations, but are also used for some larger research projects. Snowmobiles are mainly used for research activities in the field. The tracked vehicles run on Jet A-1 fuel and the snowmobiles on petrol (95 unleaded).

During NARE 00/01, one helicopter (MBO 105) was periodically stationed at Troll. Helicopters were used to transport equipment from/to the resupply vessel and to transport research parties to the field.

The station is resupplied by ship. In the current season, some resupplies had come with the South African programme's vessel MV SA *Agulhas*, and a second round of resupplies was expected with the Norwegian Polar Institute's own research vessel R/V *Lance* in late January. Supplies were transported to the station mainly via ground transport, but the helicopter was also used.

Since 1991 the Nordic Antarctic operators have cooperated on transport and supplies, so that the responsibility for the logistical arrangements for the Antarctic expeditions rotates between the national operators from Finland, Sweden and Norway. Norway was responsible for transport and supplies for the Nordic expeditions in the 2000-2001 season.

Power generation and fuel storage/usage

The power supply to the station is mainly from generators running on Jet A-1. The station is equipped with a 15 kW and a 46.4 kW generator; the former consumes approximately 50 litres of fuel per day, and the latter approximately 100 litres with a higher energy efficiency. There is also a 4.5 kW back-up generator at the station. Only one generator is run at any time.

All Jet A-1 fuel and petrol is transported to Antarctica in 200 litre drums. Drums are off-loaded from the vessel on to the tracked vehicles and transported to the station. During NARE 00/01 no resupply of fuel had taken place as enough fuel to last several seasons had been brought in during the previous summer expedition.

The fuel depot (both Jet A-1 and petrol) at Troll is currently located on the ice-free ground between the ice and the main building. Some of the fuel drums are stored on specially designed containment mats. The mats retain any small spills that may occur during storage. The mats seem to function satisfactorily. It was, however, noted that most of the drums were standing directly on the ground, with no protection. Spills or leaks from these drums could affect the freshwater source located just below the fuel storage area. It was indicated that further initiatives will be taken to secure the fuel storage depot at Troll. No signs of fuel spills were observed.

Photo 14: Fuel storage area at Troll

No harmful products or substances are deliberately disposed of or emitted during station operations. Guidelines specify that absorbents must be easily available when vehicles or day tanks for generators are refuelled. All helicopter landings, re-fuelling, maintenance, etc. took place on specially designed containment mats to reduce spills and pollution into the environment. Empty fuel drums were compacted to reduce the volume of waste. A containment system has been constructed so that no waste fuel contaminates the environment during such operations.

In addition to traditional fuel, propane is now being used for heating, water heating and for the kitchen stove. Waste heat from the generators can also be utilized to heat water or melt snow if necessary. A heating 'tub' has been installed in the generator buildings for this purpose. Although aware of the success the Swedish programme has had with extensive use of solar energy and propane at its research station Wasa, the Norwegian programme has not yet found satisfactory energy alternatives at Troll. However, the inspection team was informed that solar energy and other alternative energy sources are being contemplated.

Water system

The station takes water from a freshwater reservoir located just below the surface of the blue ice field. The reservoir, which freezes during the winter, has provided the station with sufficient water in past summer seasons. Water is pumped from the

reservoir up to the station. A network of water pipes has been laid from the pump to the generator building, from the generator building to the station unit and from the station unit to discharge point. The pipes are partially covered by gravel and do not cause visual disturbance.

Sewage and grey water
A compost toilet has been installed. The system enables significant reduction of the volume of human, food and paper waste. The system was still being tested at the time of the inspection, but preliminary results seemed to indicate that the compost toilet functions satisfactorily.

A system for purifying/treating waste water has been installed. Treated wastewater is expected to reach near drinking water quality and can in principle be reused for cleaning purposes and such. The system is still being tested, but preliminary results seem to indicate that the treatment system functions satisfactorily.

The wastewater is regularly monitored/analysed to ensure that any water discharged does not contain harmful concentrations of pollutants.

Hazardous chemicals
The inspection team was informed that no significant amounts of hazardous chemicals other than fuel and fuel-related products are kept at the station. Small amounts of paints and glues are kept in the workshops.

8.8 Firearms and explosives
No inappropriate weapons, military-related activity or nuclear disposal sites were observed at the station. No firearms or ammunition are kept at the station.

8.9 Emergency response capacity
New personnel receive training before departure for Antarctica. This includes training in snow, ice and crevasse conditions, rescue, use of communication equipment, use of GPS, first aid, etc.

Medical
There was one medical doctor at the station. There are no specific facilities for medical treatment like X-ray or surgery at the station. The station did, however, seem to be sufficiently stocked with medicines. There were also emergency equipment/medicine bags ready for immediate transport out to the field should any field parties require assistance. The Norwegian programme furthermore indicated that there is an agreement with the South African programme with respect to rescue services from SANAE IV. The inspection team noted, however, that the medical doctor had not been to SANAE IV to inspect the available resources.

Fire
The station is equipped with fire extinguishers and smoke detectors. The inspection team obtained no further information on contingency planning for fires.

Pollution

Troll is equipped with basic spill response equipment (absorbents, etc.). All tracked vehicles and all field parties utilizing snowmobiles are equipped with spill kits with basic spill response equipment. The Norwegian Polar Institute has, in cooperation with its Finnish and Swedish counterparts, developed environmental guidelines that are relevant to station and vehicle operations. Guidelines that are relevant to pollution prevention and response include:

- Oil spill contingency plan.
- Guidelines for storage, handling and transport of fuel
- Guidelines for fuel spill response
- Waste management guidelines.
- Guidelines for operations of small aircraft and helicopters in Antarctica.

8.10 Environment

Training and information
Treaty documentation was available from the station commander on request. Personnel go through training before departure for Antarctica and are informed about the Antarctic Treaty, the Environmental Protocol, the waste management strategy and any other pertinent environmental information contained in the "Nordic Environmental Handbook for Antarctic Operations". The handbook deals with subjects such as the legal framework (the Antarctic Treaty, the Environmental Protocol and national legislation), waste management, oil spill and fuel management and chemical management. Further information is also given at the site. The station commander and each field party have the "Nordic Environmental Handbook for Antarctic Operations".

Environmental impact assessment and monitoring
A multi-year initial environmental evaluation of the operational aspects of Norwegian Antarctic research expeditions, including the operation of the Troll station, has been conducted. This information was made available to the inspection team. All scientific activities have to be evaluated separately.

Conservation of flora and fauna and management of protected areas
The area surrounding the station (radius of approximately 500 m) is considered to be disturbed and pedestrian activity is not restricted here. No rare plants have been registered close to the station, and consequently disturbance is not considered significant. Vehicular traffic on ice-free ground is kept to a minimum and restricted to the immediate area of the station.

The inspection team was informed that visits to the bird colonies close to the station were only permitted in connection with approved research and that expedition members were requested to keep at a distance of at least 200 metres from bird colonies. Care was also taken to minimize disturbance of bird colonies by air traffic.

Waste management
Waste management at the station is in accordance with a strategy set out in *Antarctic Waste Management Handbook for Nordic Antarctic Operations*. All waste, except wastewater, was collected, separated and made ready to be transported out of

Antarctica for appropriate disposal or recycling. A waste compressor has been installed to reduce the volume of the waste (i.e. paper, metal, glass, mixed waste) that has to be transported out. The compressor also makes it possible to compress empty fuel drums to 20 per cent of full size. It was indicated that the compressor had been a good investment for the programme. Arrangements for the disposal and recycling of waste in South Africa were made in advance of the expedition.

All waste generated during resupply and field activities was collected and brought to the station for proper storage or removal.

Radioactive materials
No radioactive materials are used or stored at the station.

8.11 Tourism

People over-wintered at Troll for the first time in 2000-2001 (in agreement with the Norwegian Polar Institute). The group consisted of two skiers, one doctor and one technician. The group used Troll as a base for training and a starting point for skiing across Antarctica. The expedition members did maintenance work in return for the use of the station. There have been no other tourist visits or NGO activities at Troll.

8.12 Conclusion

The inspection team noted that Troll seems to be a well-run summer station, which provides the necessary support for the primarily field-based scientific activity of the Norwegian programme.

The inspection team noted the extensive effort to operate the station within an environmental framework. However, the inspection team nevertheless recommends that the Norwegian programme should consider further measures to tidy up the station area, paying special attention to the issue of fuel storage. Although containment mats had been introduced for some of the drums, the inspection team found it disturbing that most of the drums were unprotected, and urges the programme to consider ways of rectifying this situation as soon as possible. The inspection team also considers it important that the waste water system is carefully evaluated and monitored to ensure minimal disturbance of the natural terrestrial system in the discharge area.

The inspection team furthermore considers that summer stations such as Troll, which are limited in size and intensity of use, are prime candidates for the use of alternative energy systems. The inspection team took note of the fact that the Swedish station, similar in size and type of operation, bases much more of its operations on alternative energy sources. Further consideration of alternative energy systems at Troll is recommended.

The inspection team notes that small summer operations of this type are particularly vulnerable in the event of accidents. In such situations it is important that personnel are familiar with the resources available for medical emergencies and rescue operations and kept up to date. The inspection team notes that it would be useful for the medical personnel to have an opportunity to familiarize themselves with the nearest medical facilities (at SANAE IV).

9 EPICA DRILL SITE (GERMANY)

9.1 Background

One member of the inspection team (Olav Orheim) had the opportunity to visit the EPICA (European Project for Ice Coring in Antarctica) drill site at 75°S 0°E, at an altitude of 2960 m on the inland plateau. The EPICA deep drilling programme was the subject of a CEE (Comprehensive Environmental Evaluation) that was extensively discussed at the Antarctic Treaty Consultative Meeting in September 2000. Because of the magnitude of this operation, and the issues raised in the discussion of it, it was decided to conduct an inspection of this remote field camp, even though practical constraints prevented the whole team from taking part. Dr Orheim was, however, supplemented by Tom Maggs, Australia, as a special observer. Both Dr Orheim and Mr Maggs took part in the discussion of the CEE that took place in the CEP (Committee of Environmental Protection) at the last Treaty Meeting. The observers used the permit issued by the German Environmental Agency (Umweltbundesamt) in October 2000[1] as a basis for the inspection.

9.2 General

The site was visited on 7 January 2001. By then most of the camp installations were in place, and preparations were being made to erect the drill building. Dr. Hans Oerter, who provided Dr Orheim and Mr Maggs with all the information requested, was in charge of operations at the site.

Dr. Oerter explained that there were no major changes to the plans for the operations, as described in the permit issued by the German Environmental Agency on 6 October 2000. This report therefore concentrates on deviations from the previous descriptions, and on new knowledge.

9.3 Overland transport

When the site was visited the six tractors used for overland transport were on site. They were soon to return for the ice shelf edge for another haul. Each such trip transports about 120 tons of equipment to the site. Fuel consumption for the first traverse this season had averaged about 3 l/km/vehicle for the round trip, or altogether about 25 tons for one round trip of the six vehicles. This was less than anticipated, and less than used last year, presumably because snow conditions were better this year.

9.4 The buildings

The main part of the camp consists of elevated buildings, which can be jacked up as required. Most of these came from the original Filchner Station. This was recovered two years previously from a tabular iceberg in the Weddell Sea where it was floating following break-up of the ice shelf where the station had been located.

The buildings were transported to the drill site in the 1999-2000 season and left unattended for the winter. There were concerns that heavy snow drift could develop

[1] "Permit for the implementation of ice core deep drilling in Dronning Maud Land, within the framework of the European Project for Ice Coring in Antarctica (EPICA) from December 2000 to March 2005.

during winter storms, but when the site was reached this summer this turned out not to be a problem.

The site also contains several small buildings for summer use, including buildings used for living quarters during the overland traverses.

Photo 15: Infrastructure at the EPICA DML05 Drilling Site

9.5 Waste

At the time of the inspection the waste management system was in the process of being implemented. Waste was sorted into five categories; food, paper, metal, glass, and miscellaneous. Special drums that can be sealed are brought to the site for retrograding of the waste, and a waste management log is maintained by counting the filled drums of each category.

Human effluent was disposed of in an ice pit, in accordance with the permit. The present facilities were temporary, and there were plans for improving these.

9.6 Fuel

Most of the fuel is stored in 6 ISO steel tanks, each with a capacity of 23 m^3. These are double-walled, but have no additional protection against spills. All the tanks are relatively new, and should therefore be in good condition. All tanks and other related equipment are inspected annually for weaknesses and structural faults. The inspection is done under contract by Germanische Lloyd. The site also contained 10 drums of Jet A1 and 4 drums of petrol, the latter for the snowmobiles. No leaks were observed or reported from either tanks or drums.

Absorbent materials to place around the fuel sites had been brought to the camp, but were not yet in place. However, it was planned to have these in use within a short time.

9.7 Drilling operations

At the time of the visit the camp was still being established. The drill shed was not yet erected, and no drilling had commenced. The drilling operations planned for the 2000-2001 season are relatively minor, being primarily to establish a cased hole through the upper approximately 100 m of permeable snow and firn. Dr. Oerter confirmed that the drilling operations, including use of liquids, were planned to take place exactly in accordance with the permit.

9.8 Conclusion

The site had a very orderly appearance, and the personnel showed dedication and commitment. The overall impression from the presentations was that the field team took environmental concerns very seriously.