EISCAT

EUROPEAN INCOHERENT SCATTER SCIENTIFIC ASSOCIATION

ANNUAL REPORT 1978

S-981 01 KIRUNA, SWEDEN, PHONE (0980) 18740

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HEADQUARTERS SENIOR STAFF AT 31 DECEMBER 1978

T HAGFORS	–	DIRECTOR
K FOLKESTAD	–	ASSOCIATE DIRECTOR
S WESTERLUND	–	ASSOCIATE DIRECTOR
L TOPO	–	BUSINESS MANAGER

INTRODUCTION

The observational facilities of the EISCAT Scientific Association, now in the third year of construction, are designed to make use of the scattering of electromagnetic waves from thermally excited plasma waves (incoherent scattering) to derive a variety of ionospheric physical parameters. Among these parameters are the plasma density, the electron and ion temperatures, the ionic composition, the neutral gas density, the neutral gas velocity, the applied large scale electric field and the intensity of the precipitation of suprathermal charged particles.

No other ground-based technique can yield such a wealth of physical information about the ionized part of the atmosphere. In many cases the information provided by incoherent scatter experiments is more reliable than that obtained by in situ measurements in satellites and rockets. This is so because the perturbations introduced by the scattering are usually negligible, whereas perturbations caused by the passage of a space vehicle may be severe. Scattering experiments of this type have been carried out extensively at low and middle latitudes, and in one facility (Chatanika, Alaska) at high latitudes. There is great interest in expanding and improving on such high latitude studies in the scientific community, because the high latitude ionosphere is much more irregular and unpredictable than that at low and middle latitudes.

The irregular ionospheric behaviour at high latitudes stems from the coupling of the ionosphere, via the near vertical open geomagnetic field lines, to the magnetosphere. In many respects the convection of the high latitude ionosphere provides an image of magnetospheric processes. The high latitude ionosphere often carries substantial electric currents (auroral electrojets) which supply energy to the atmosphere either directly through heating or indirectly through the generation of gravity waves which dissipate at great distances from the position of the currents. The currents are also responsible for magnetic disturbances. The high latitude ionosphere displays one of the most spectacular natural phenomena, that of the aurora. It is known that the aurora is caused by precipitating energetic charged articles, but the acceleration mechanism is not known.

The EISCAT facilities are intended to contribute information on a number of problems relating to the high latitude ionosphere and the magnetosphere, such as the convection of the ionosphere and its relation to magnetospheric properties, the acceleration mechanisms of auroral particles, the behaviour of the auroral current systems and their relation to magnetic pulsations, the origin of gravity waves and the heating of the neutral atmosphere through the «polar wind».

In addition to being able to supply physical data on its own the EISCAT facility will be called upon to provide supplementary data in a number of other studies. These studies may be ground-based, such as coherent radar backscatter observations of electric fields, magnetometer observations of electric currents or observations of ionospheric absorption caused by particle precipitation; or they may be studies carried out in rockets and satellites to derive composition, temperatures or electric and magnetic fields and the spectrum of energetic precipitating particles.

In some cases the EISCAT facility will also be expected to supply diagnostic data during experiments designed to actively modify the naturally occurring ionosphere, either by powerful electromagnetic radiation (heating), by chemical releases (Ba-release) or by particle beams (gun experiments).

In order to satisfy the diverse requirements for observational data, EISCAT is in the process of implementing a dual frequency high power radar system, monostatic at 224 MHz (VHF) and tristatic at 933 MHz (UHF). The actual system was largely defined in the previous two annual reports. During 1978 the UHF antennas have been built and delivered, the transmitter building completed and much of the receiving and data analysis equipment tested in prototype form. A contract for a cylindrical VHF antenna has been let and work has since then advanced rapidly.

The delay in the construction of the UHF transmitter referred to as a possibility in the previous annual report has, unfortunately, materialised. At present there appears to be no chance that the first test transmissions can take place before November 1979. It is frustrating to have to report that the continual slippage in the transmitter manufacturer's schedules has made predictions about the eventual turn-on of the complete facility uncertain.

Apart from the serious time delay encountered with the transmitter, the progress with the procurement and programming of the equipment has been satisfactory.

Tor Hagfors
Director

INSTRUMENTATION

The major events in the instrumentation area were the completion and the acceptance of the UHF antennas and the awarding of a contract for the construction of a cylindrical, steerable VHF antenna. The build-up of the facility is progressing according to plans except in one major area, that of the transmitters. The transmitter construction is lagging seriously behind because of technical difficulties encountered by the klystron manufacturer and will almost certainly cause a delay in the start of the operation by one year. Delays have also been encountered in the production of the digital equipment, but are not expected to become a controlling factor in determining the turn-on of the equipment.

Figure 1: The UHF antenna in Kiruna.

UHF Antenna Acceptance

The three UHF antennas, designed by TIW Systems Inc. of Palo Alto, California and manufactured by TIW Systems Ltd. of Toronto, Canada, are identical 32,5 m parabolic reflector antennas, see Figure 1. The antennas represent the first three of a design which is intended for satellite communication at 4 and 6 GHz. The rigidity and the accuracy of the antennas therefore in several respects exceed what is needed by EISCAT at UHF.

The acceptance tests were designed to verify that the contract specifications have been met. The most important specifications, reproduced in Table 1, pertain to the radio frequency (RF) performance.

The complete acceptance tests involved four different categories.

Structural and mechanical tests
Control system tests
De-icing system tests
RF performance tests

The structure and mechanical tests revealed that some bolts and nuts had not been tightened to the prescribed torques. This was not considered serious and will be corrected during the 1979 regular overhaul and maintenance programme.

Table 1. UHF antenna.

	Specification	Test result
Frequency range		
reception:	933.5 ± 12.5 MHz	achieved
transmission	933.5 ± 2.5 MHz	not tested
Gain	48.0 dB	48.0 ± 0.5 dB
Sidelobes		
nearest	< - 13 dB	- 14 ± 1.0 dB
> 10° off axis	< - 30 dB	< - 36 dB
> 60° off axis	< - 50 dB	< - 50 dB except 3 tripod lobes at - 46 dB
Polarization	Arbitrary	confirmed
Pointing accuracy	± 0.065 deg	0.02 deg
Elevation range	0-100 deg	0-100 deg
Azimuth range	± 270 deg	± 270 deg
Slewing rates	> 80 deg/min	80 deg/min (tracking rate)

The control system exceeds the specifications in that it allows motion at rates of 80 degrees per minute even under computer control. The angular encoders in elevation and azimuth give 22 bits. Only 17 bits are used in the servo loops and only 14 bits are required to meet the specifications on pointing accuracy.

The de-icing system consists of electrical heaters built into the antenna reflector panels. A total of 465 kW can be applied. The surface is divided into eight separate sectors and each sector into an inner and an outer part. Each of the 16 parts can be controlled separately. The tests showed the system to work satisfactorily.

The RF tests involved the whole of the EISCAT staff and took about six weeks to complete. In the testing the low noise receivers were used for the first time. The measurements of gain, pointing direction and main lobe width between half power points were made by observations of the radio sources Cassiopeia A, Taurus A and Cygnus A. All these sources are suitable as standards because their properties have been recorded in great detail for this purpose. The scanning of the beam past the source was done by pointing the antenna ahead of the source and then letting the source drift through the beam as a result of the earth's rotation.

An example of a scan through Cassiopeia A is shown in Figure 2. The diagram shows the output power recorded (logarithmically) against Universal Time (UT). Two kinds of calibration pulses are recognized in the diagram. The pulse marked «2 dB» is a calibration of the recorder scale. The other pulse marked «86°K» is a calibrated noise signal of power $P = kTB$ injected at the input of the parametric amplifier (k is Boltzmann's constant, T is 86°K and B is the bandwidth). Since the power in the noise pulse is known it can be used to determine the signal power. The scale to the left in the diagram gives the power expressed in degrees Kelvin.

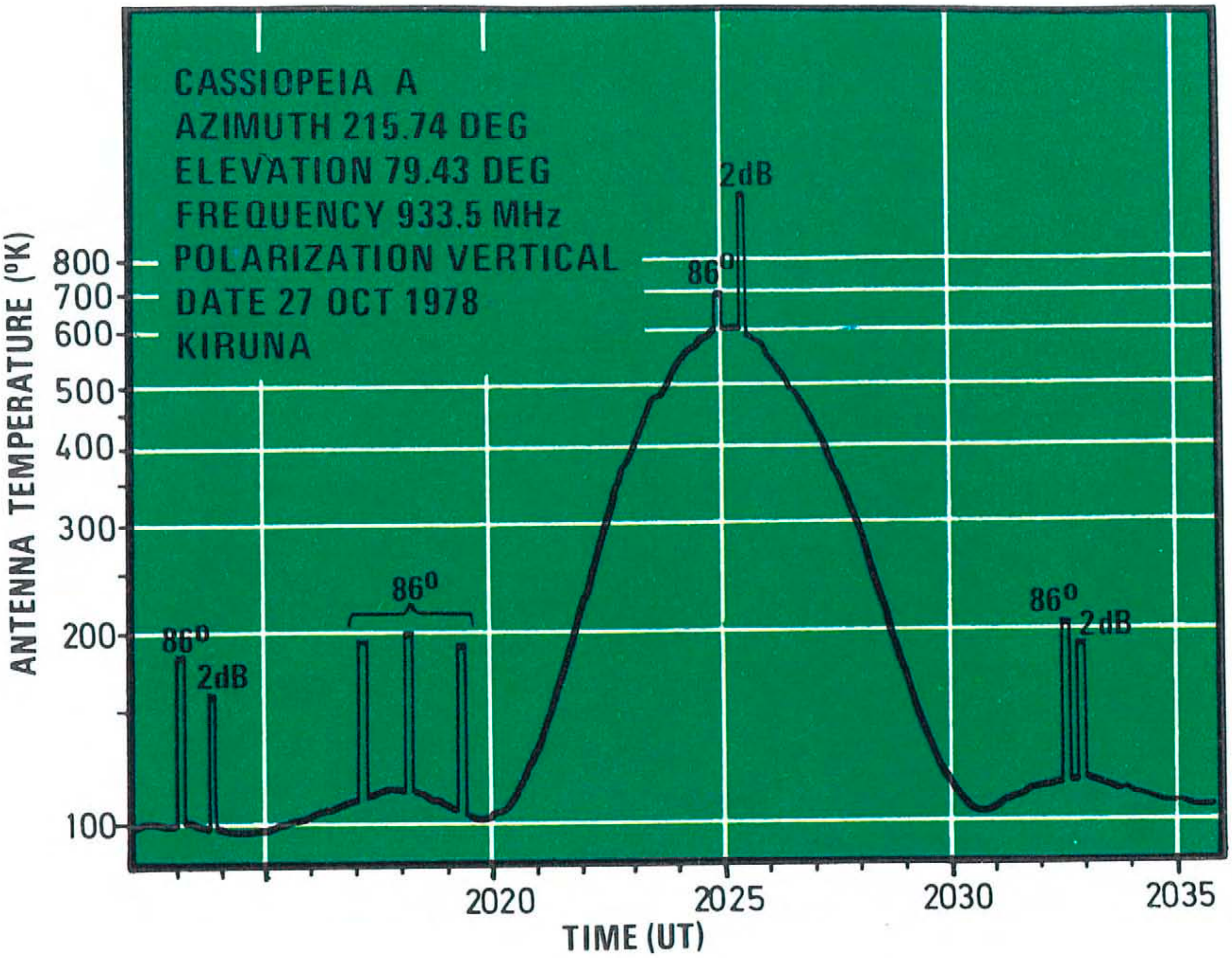


Figure 2: Drift scan through Cassiopeia A.

The weak natural radio sources do not allow the sidelobes to be measured. In the Tromsø area a test transmitter was therefore installed on a mountain top and used as a source for sidelobe and polarization studies, see Figure 3. A scan in azimuth through ± 108 degrees with respect to the test transmitter is shown in Figure 4. The sidelobe level was found to be satisfactory except for three -45 dB lobes removed 82.4 degrees from the main beam direction. These are associated with reflection from the legs of the tripod supporting the subreflector and were deemed unavoidable.

High power testing of the feed system was also to have been included but could not be completed because no transmitter was available.

Figure 3: View from test transmitter toward the Tromsø station at Ramfjordmoen.

VHF Antenna construction

As a result of tendering at the end of 1977 a consortium consisting of MAN, KRUPP and MBB was selected to manufacture the VHF antenna. The contract was signed in March 1978.

For reasons of economy the 10^4 m^2 antenna aperture originally desired had to be reduced by a factor of two. The design will now consist of a set of 4 identical sections, capable of moving independently in the magnetic meridian plane. The axial and transverse dimensions of each section are 30 and 40 m respectively. The total physical area of the antenna reflector is therefore 4800 m^2. An end view of the antenna structure is shown in Figure 5.

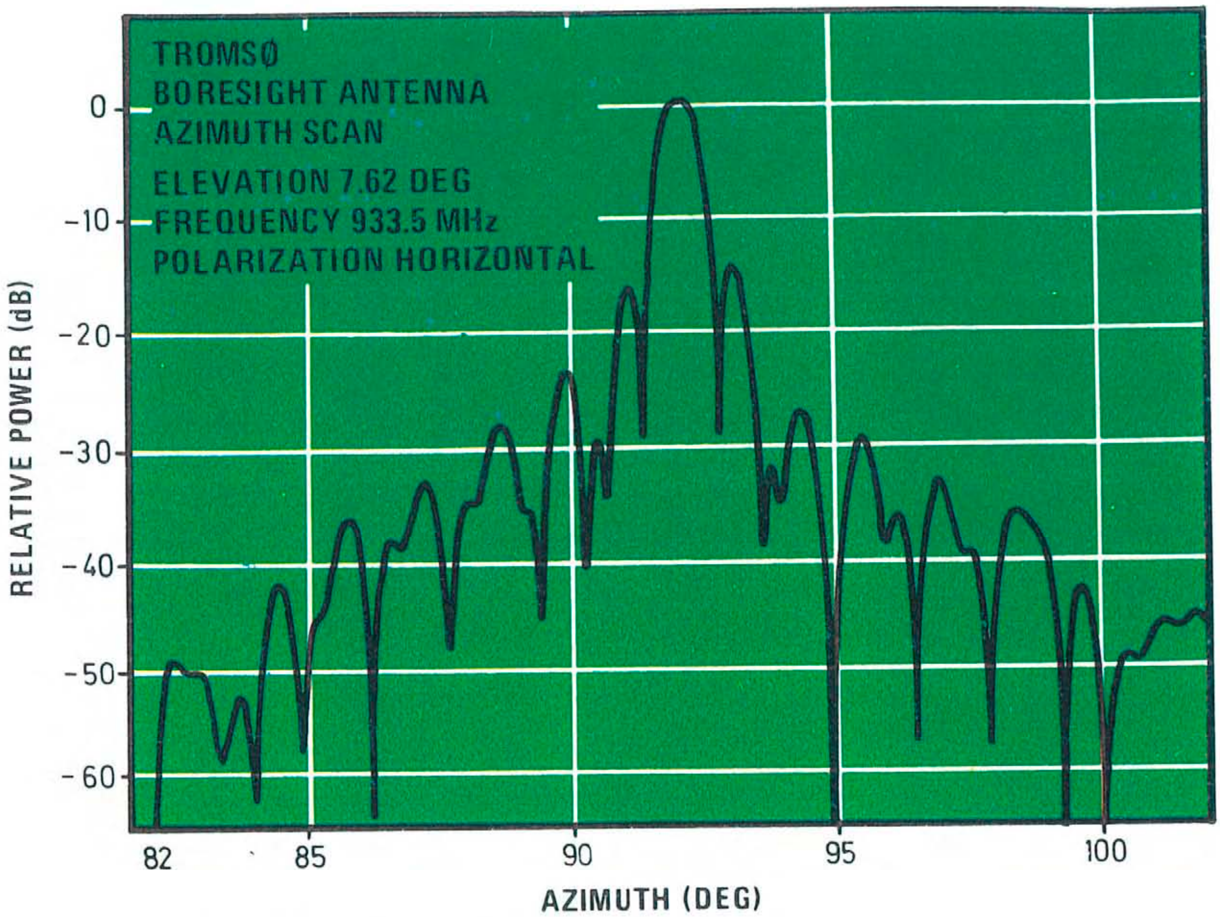


Figure 4: Scan of sidelobes with test transmitter as source.

By synchronizing the movements of pairs of neighbouring elements the antenna may be operated in a split beam mode, an attractive possibility in many scientific investigations of spatial variations of ionospheric parameters. The polarization of the outgoing wave may be selected as right- or left-handed circular, or certain types of linears. When working in the single beam mode, the possibility exists of switching between orthogonal circular polarizations from pulse to pulse. An automatic switchyard has also been included for easy handling of the split beam operation.

The feed system is realized as an array of crossed dipoles mounted over a reflecting plane. In order to obtain near identical illumination of the reflector in the two polarizations longitudinal reflecting rods are placed on either side of the row of dipoles, see Figure 6. This novel design is due to Mr. Kildal of the University of Trondheim.

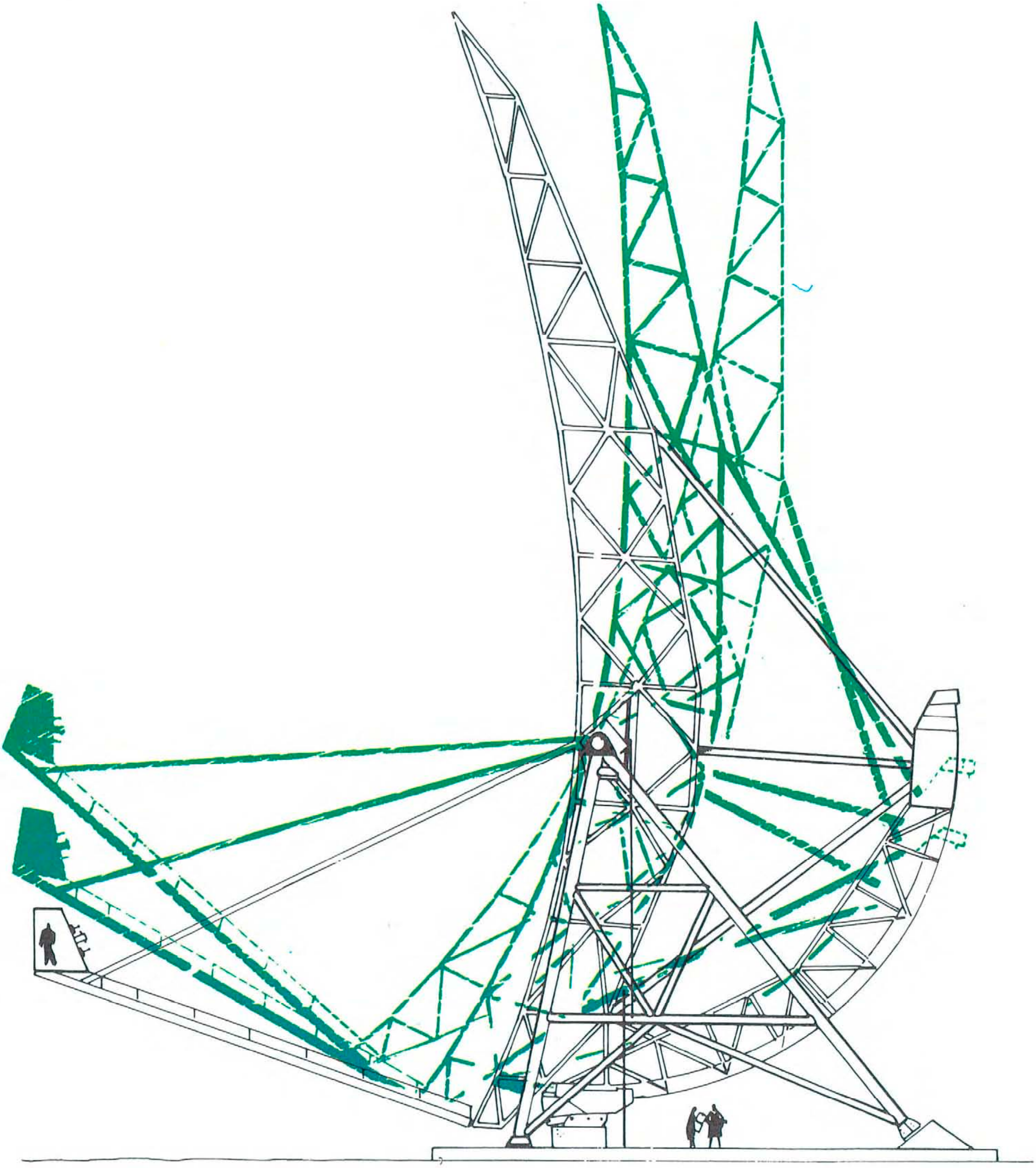


Figure 5: The VHF parabolic cylinder antenna design.

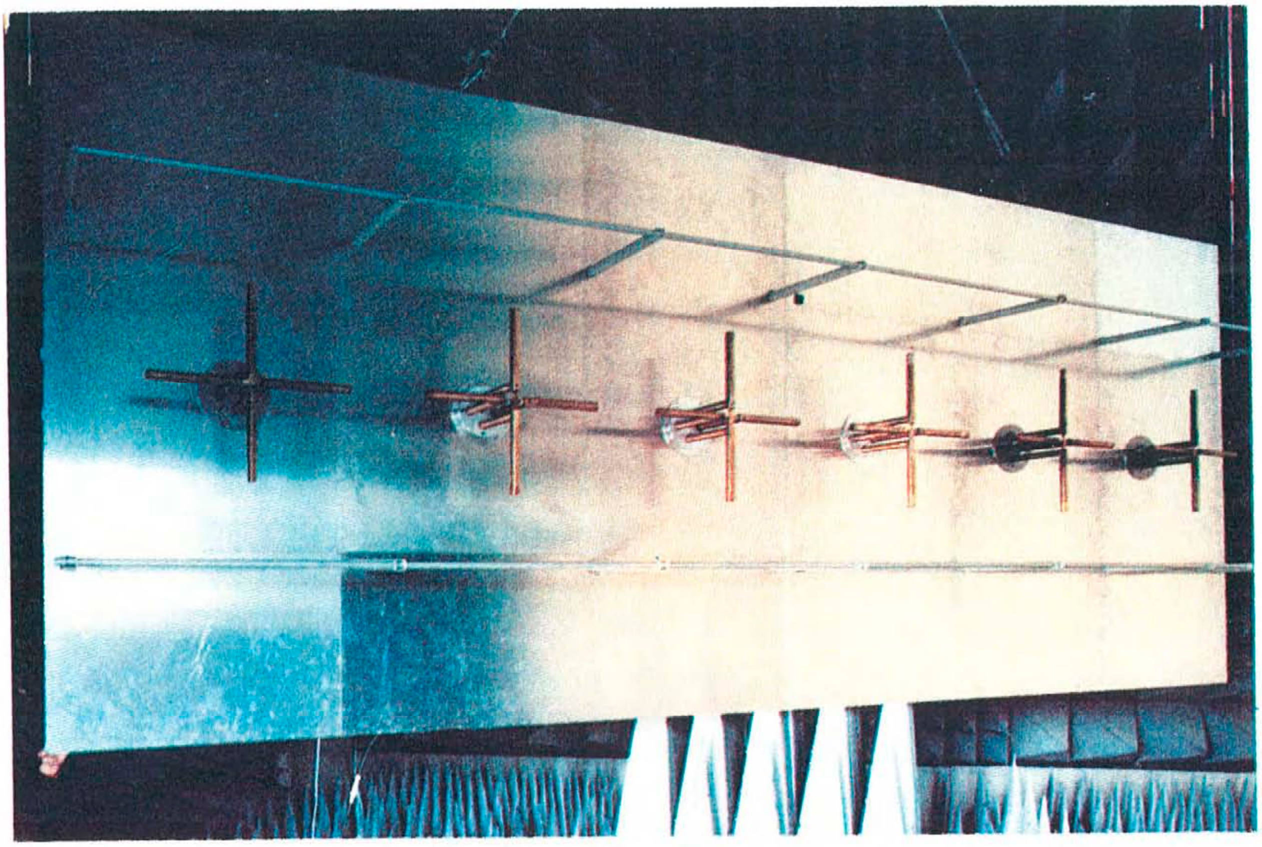


Figure 6: Prototype VHF feed section under test in anechoic chamber.

By incrementing the lengths of the feed paths in a systematic manner along the dipole array the antenna beam may be swung by as much as 25° from the «normal» direction which is in the magnetic meridian. The required modification of the phase paths is effected by manually changing the connecting cables to the feeder elements.

By introducing different increments in the two halves of the antenna the split beams can be made to squint. The phasing will allow the beam to be directed toward a region immediately above the magnetic pole.

Computers and Control Systems

Since 1977 each site has had a NORD 10 computer with 64 K of memory (16 bit words). These computers will be used for the on-line control of EISCAT experiments. The three machines will be connected to each other via permanent leased telecommunication lines to be installed in 1979.

All real-time communication with the peripheral devices controlled through the computers will take place through standard CAMAC interfaces. Many of the hardware interfaces will not be available before late 1979. During the current year the computers were successfully interconnected with the UHF antenna steering control units and computer controlled steering of the antennas achieved. Since November 1978 pointing calibration routines have been run at Sodankylä with the antenna steering under automatic computer control. Since mid-1978 the computers have been used in conjuction with the calibration of the time and frequency standards at the three sites.

At the Sodankylä site modifications have been made to the computer internal clock to enable the computer to be directly synchronized with the Cesium frequency standard. These modifications will also be made to the Tromsø and Kiruna site computers to enable all machines to be kept precisely in phase with each other.

At the Tromsø site the prototype radar controller has been connected via CAMAC to the computer and programs for the radar controller have been transferred successfully from the computer. The prototype correlator has also been successfully interfaced with the computer in a test system.

It is expected that the production of all the radar controllers will be complete by midsummer 1979. The production of the correlators is scheduled for completion in September 1979.

Development of software has been proceeding in the following areas:

Radar Controller
Correlator
Computer control of antennas
Computer calibration of antenna patterns
Computer control and calibration of time and frequency

A prototype real-time operating system has been developed. This system has been used to evaluate several important features of the system. The critical data paths within the computer have been examined. In particular, tests have been made to investigate the transfer of data from the correlator output memory to the final data tapes.

An on-line data analysis program has been implemented which has the capability of carrying out on-line analysis of the incoherent scatter spectra. Preliminary tests indicate that a single spectrum can be analysed in about two seconds. When run in conjunction with an experiment the ability to perform on-line data analysis provides an important check on the quality of the data and will permit changes to be made in the data-taking procedure when ionospheric conditions so require.

Receivers

The UHF parametric amplifiers were acceptance tested in the manufacturer's (AIL) plant during April 1978. One amplifier failed to pass. The amplifier that failed was repaired, tested and shipped later. Table 2 lists performance data for the preamplifiers. The principle of operation was described in the 1977 Annual report.

The parametric amplifiers were used in the UHF antenna tests. In these the system noise was near 100°K, see Figure 2. In the final configuration the system noise will be near 50°K. The higher antenna temperatures during the tests were caused by the temporary method of connection.

In most respects other than in the noise performance the parametric amplifiers have caused considerable difficulties. Some failures have occurred in the electronic system, but most of the problems stem from the vacuum and the cryogenic systems. Oil and impurities inside the vessel have had a detrimental effect on the cooling, and the marginal cooling has in turn caused the performance to suffer. Advice has been sought from cryogenics and vacuum techniques specialists and the situation has improved. We are now convinced that the parametric amplifiers will work reliably but with greater effort in labour than originally anticipated. In view of the problems with the parametric amplifiers, low noise transistor amplifiers have been ordered as backup for certain applications.

The prototype of the UHF receiver following the parametric amplifiers has been tested and the functions which are controlled by the computer have been exercised. All the receiver channels are due to be acceptance tested during May 1979.

Table 2: UHF dual channel preamplifier performance

Frequency range	933.5 ± 15 MHz
	(1 dB down)
Gain	> 65 dB
Gain stability over 1 min	± 0.1 dB
over 24 h	± 0.5 dB
Phase stability	< 0.1 rad per 24 h
Noise temperature	< 15°K

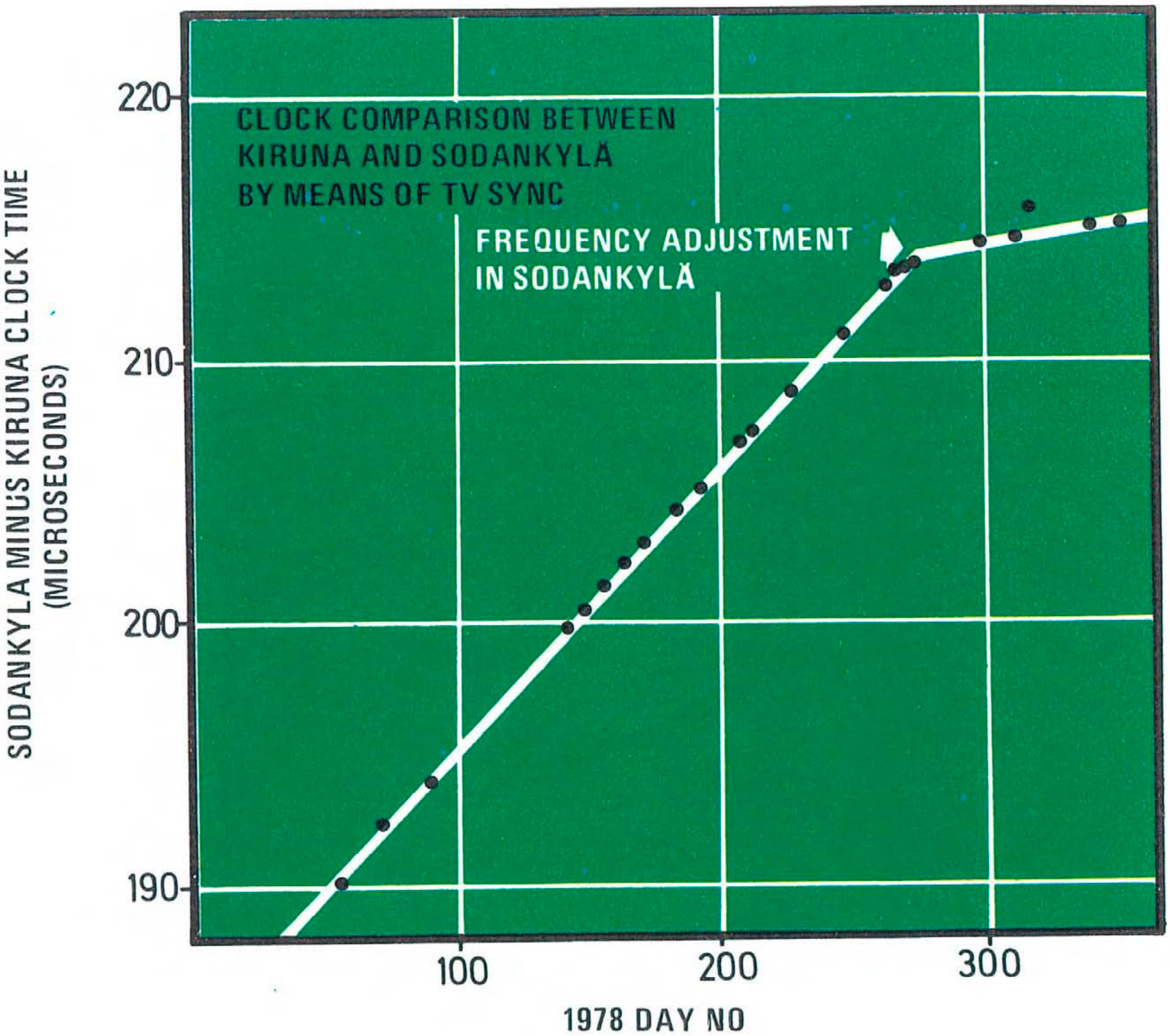


Figure 7: Results of a comparison of the rates of the clocks in Kiruna and Sodankylä.

Time and Frequency Control

The time must be accurately synchronized between the three sites in order to allow the receivers to keep in step in the bistatic mode. A one microsecond maximum offset is the desired goal.

The heart of the time and frequency system at each site is the Cesium frequency standard. It produces a pure reference frequency with a maximum offset from a world standard frequency of a few parts in 10^{12}. When using the standard to drive a clock one part in 10^{12} corresponds to a time drift of 0.1 microsecond per 24 hours.

One clock driven from the Cesium standard supplies time to the radar controller with a resolution of one microsecond. Another clock provides the computer with time with millisecond resolution. Every frequency used in the system is derived from the Cesium standard frequency.

There are several means of keeping the clocks at the three sites on the same time within less than one microsecond. The most direct is to use a fourth Cesium clock that is transported to all sites and used to set the local clocks. This is the best but also the most expensive method. If the performance of the clocks is well known it is usually possible to rely on the time to be within the prescribed accuracy for many weeks.

An indirect means of comparing the clocks is to use a radio wave received simultaneously at several sites. The time of arrival of a pulse or some other recognizable feature in the signal is different at the three sites due to different distances from the signal source. Once these distances are measured or the delays calibrated the radio wave can be used to compare the clocks. The accuracy thereby obtained depends on the stability of the propagation path.

Two radiowave methods have been implemented.

The first uses 100 kHz pulses from the LORAN-C transmitter situated in Bø, Vesterålen, Norway. One site receiver phase locks an oscillator to the received frequency. The influence of the ionosphere is avoided by using only the ground wave mode. The phase locked oscillator is allowed to drive a clock which may be used as back-up if the Cesium clock fails. Left on its own, the LORAN-C clock has an accuracy of a few microseconds due to changes in atmospheric propagation parameters.

TV signals are also used for clock comparisons. In this case the sync pulses for vertical scans are used. Vertical sync pulses are generated at at rate of 50 per second. In our receivers, the seconds pulse from the local clock starts a 10 MHz counter. This counter is then stopped by the synchronizing pulse that follows between 0. and 20,000. milliseconds later. This is done at two remote places simultaneously using the same synchronizing pulse. The result of such a comparison of the clocks in Kiruna and Sodankylä is shown in Figure 7.

Figure 8: The transmitter building at Ramfjordmoen (near Tromsø) under construction.

The Transmitters

The projected delivery date of the transmitter has kept slipping during 1978. The cause of the delay has been the difficulties encountered by the klystron manufacturer in producing the two klystrons which were ordered. The two UHF klystrons, operating at 933 MHz were supposed to represent slight modifications of a series of 70 klystrons previously manufactured by the same manufacturer. The only difference from the previous klystrons was a slightly higher output power. This increased requirement caused the klystrons to break into oscillations. It turned out to be extremely difficult to identify the origin of these oscillations. The klystrons were disassembled, modified and reassembled several times before the problems were finally solved, the first klystron was delivered to the transmitter manufacturer during September and the second tube shortly thereafter.

The tubes appeared to meet all the specifications and to perform well in tests during their acceptance. A considerable amount of work remains for the transmitter manufacturer to integrate the klystrons into the transmitter and to test the klystron in place before the in-plant preliminary acceptance tests can take place These tests are due to occur during April or May of 1979 which means that the transmitter cannot be expected to be fully operational much before the end of 1979.

The VHF klystrons have been assembled and will be tested during the early part of 1979. Most of the VHF transmitter parts are in the same stage of completion as those of the UHF transmitter. However, due to the uncertainty in the delivery of the VHF klystrons it is very unlikely that the VHF transmitter will be operational before the second half of 1980.

The Sites

The main change in the premises of the three sites occurred at Tromsø (Ramfjordmoen) where the transmitter building was completed in the early summer. The site computer and the EISCAT equipment was moved from the Tromsø University buildings to the Ramfjordmoen site in August, and the EISCAT technical staff now work in the laboratories and offices of the transmitter building. A photograph of the building in the final stages of construction is shown in Figure 8.

The activity at all three sites has been very hectic with the erection of the UHF antennas. The roads, which were a concern, held up well to the heavy transports of antenna materials, except at Kiruna, where road improvements had to be improvised during the spring thaw.

At Ramfjordmoen the pouring of the concrete for the VHF antenna foundation was well under way by the end of 1978. This work will be completed by early 1979 in preparation for the erection of the VHF antenna during the spring.

PLANNING OF SCIENTIFIC PROGRAMMES

Common Programmes

The first round of proposals for particular programmes has been invited from the associates. A discussion of these proposals will take place at the first SAC meeting of 1979. Although some of the proposals have been received a discussion of the particular programme will be deferred until next year's annual report.

In the common programme three experiments have been agreed upon by SAC. Some work has been completed to implement these experiments in terms of radar controller, correlator and antenna pointing instructions.

In the first of these experiments the transmitter antenna beam will point along the direction of the geomagnetic field line at about 250 km height. The transmitter will emit pulses suitable for the measurement of the autocorrelation function at all three receivers in the E-region and the F1- and F2-regions. The height resolution at E-region heights (105 km) will be 5 km, in the F1- region ($\approx$ 180 km) 10 km and in the F2-region ($\approx$ 280 km) 20 km. The desired parameters derived from the ionic fluctuation spectrum are electron density (N_e), electron and ion temperatures (T_e and T_i), the ionic mass (M^+) and three components of the plasma velocity. In addition it is desirable to observe the plasma line fluctuation and the frequency shift in order to deduce directly the electric current. Unfortunately it will not immediately be possible to observe the plasma lines in a routine experiment due to equipment limitations and electric current measurements will require special observational procedures. (EISCAT may initially borrow French correlators for plasma line observations). The EISCAT system will allow E- and F-region observations at the same time by simultaneous observations with single pulses at high altitudes and multiple pulses at lower altitudes and in addition provide the long pulses necessary for the bistatic observations. Such a scheme is made possible by the multiple frequency operation of the transmitter and by the flexibility built into the radar controllers and the data analysis equipment.

A wide variety of scientific investigations may be based on such observations. It will be possible to monitor the electric fields originating in the magnetosphere and their variation with time and geomagnetic conditions. From the details of the electron density profiles conclusions may be drawn as to the nature of the particle precipitation. The variation of electric current with altitude will give the electric conductivity and some indication of the neutral density variation. Measurements of temperatures and their dependence on particle precipitation will provide information on the energy input to the ionosphere. The observation of the plasma drift velocity will allow the electric fields to be deduced, and since these fields map along the geomagnetic field lines to magnetospheric heights an image of the magnetospheric convection phenomena will be obtained. The plasma drifts can also, under some circumstances be used to deduce neutral gas motion which is controlled by atmospheric convection and by the presence of gravity waves.

The second common programme experiment is planned in such a way that the best possible coordination can be made between EISCAT observations and observations which are made at each of the three sites with the considerable complement of other observing instruments existing there. These include optical instruments, magnetic recording instruments and other types of radio wave measuring devices. In order to achieve such coordination the point of intersection of the three antenna beams will be moved cyclically between the three sites. Measurements will be made of the same quantities as in the previous experiment and with about the same height resolution. This experiment will be particularly well suited for studies of phenomena which in some way travel across the three sites, such as gravity waves, electric field reversals, auroral arcs etc.

A third experiment planned within the common programme involves a scanning in the magnetic meridian plane through Tromsø. All heights - or ranges - which give useful signals will be observed from

Tromsø whereas the Kiruna and the Sodankylä sites will monitor the F-region at a fixed height. The parameters measured will be the same as in the previous two experiments. This experiment is well suited to study the variation of ionospheric properties with magnetic latitude. Such variations can be quite pronounced and abrupt and reflect the coupling of the observed magnetic field lines to magnetospheric regions of vastly different properties. This experiment will at first be carried out at UHF. When the VHF system comes into operation it may prove interesting to use this system because the greater sensitivity will enable greater ranges of magnetic latitudes to be observed, although three-dimensional plasma motion will not be obtained.

There is considerable interest in the inclusion of an observing programme designed to study the lower part of the atmosphere, the stratosphere and the mesosphere. So far the planning of such observations has not been made firm.

Cooperative Activities

Several particular programmes have been proposed in conjunction with other types of observations. It will lead too far afield in an annual report to describe all the details of the proposed cooperative experiments and only a summary will be presented. Cooperation with EISCAT is required in a range of rocket experiments launched either from Kiruna or from Andøya. EISCAT cooperation is required to establish the desirable launch conditions and to perform observations of identical or closely related quantities to those observed in the rocket.

Examples of such quantities are DC and AC electric fields, electron temperature and densities, composition, ionospheric currents and energetic particle precipitation. In some rocket launches chemical releases will be made and EISCAT will be called upon to track the ionized clouds and to observe the electric fields which drive the ionized part of the cloud, and to detect modifications in ionization caused by possible triggered particle precipitation.

Cooperative experiments with satellites will involve the comparison of the physical state at a geostationary orbit position and the corresponding ionospheric footprint of the magnetic field which in some cases will be within the EISCAT operating range. In the case of low-flying satellites direct comparison of EISCAT observations and in situ measurements will often be possible. EISCAT will extend in time the measurements made by the satellite as it passes near the antenna beam and the satellite will extend the EISCAT observations in space. Plans have even been made to study the feasibility of a special satellite (EISCAT-Sat) for cooperative research with EISCAT.

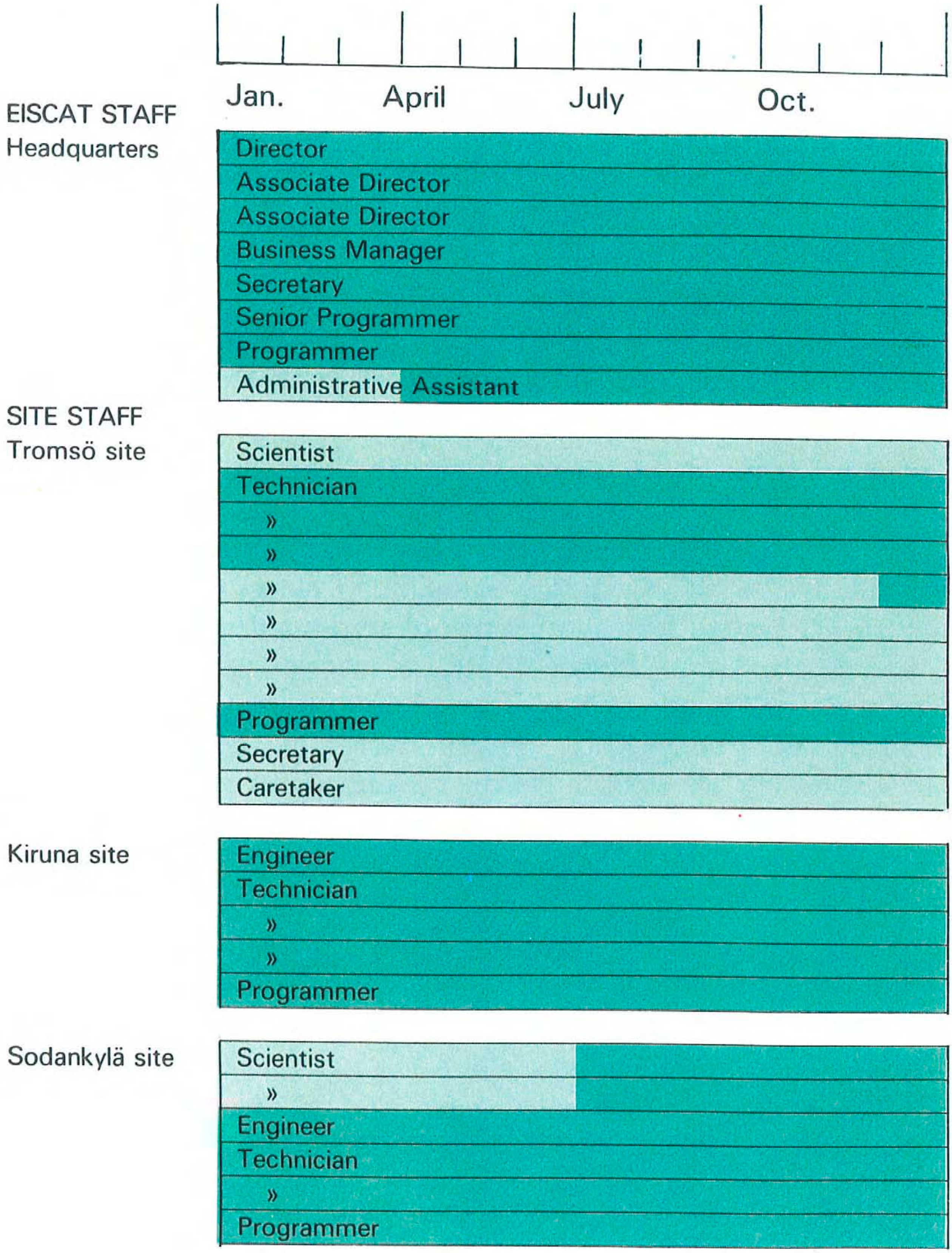
A number of ground-based observations will be made in cooperation with EISCAT. Some observations will be made in Northern Scandinavia rather than elsewhere because of the existence of EISCAT.

A radar system designed to measure the electric field distribution at E-region height over a large geographic area surrounding EISCAT, the so-called STARE system, will be operated simultaneously with EISCAT and will supplement the data with morphological information which is impossible to establish with EISCAT alone. An extension of the STARE system with another pair of similar radars operating between Scotland and Sweden (SABRE) is under discussion and could be interesting from an EISCAT point of view. A partial reflection experiment near Tromsø will supplement the height range which can be studied. Results from ground based magnetometer chains will aid in the interpretation of EISCAT-measured ionospheric currents. Optical interferometer experiments planned will directly measure the motion of the neutral constituents of the ionosphere and the simultaneous measurement of the plasma drift may be used in studies of the interaction of the neutral and the ionized components of the region.

A high power HF transmitter feeding large broadside antenna arrays will modify the ionosphere over Tromsø by heating and by the excitation of parametric plasma instabilities and EISCAT will serve as the most important diagnostic tool.

The cooperative endeavours listed above only cover a few examples of what is envisaged, but nevertheless show that EISCAT will be of benefit to — and will profit from — a multitude of other observations.

STAFFING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Business Manager
Secretary
Senior Programmer
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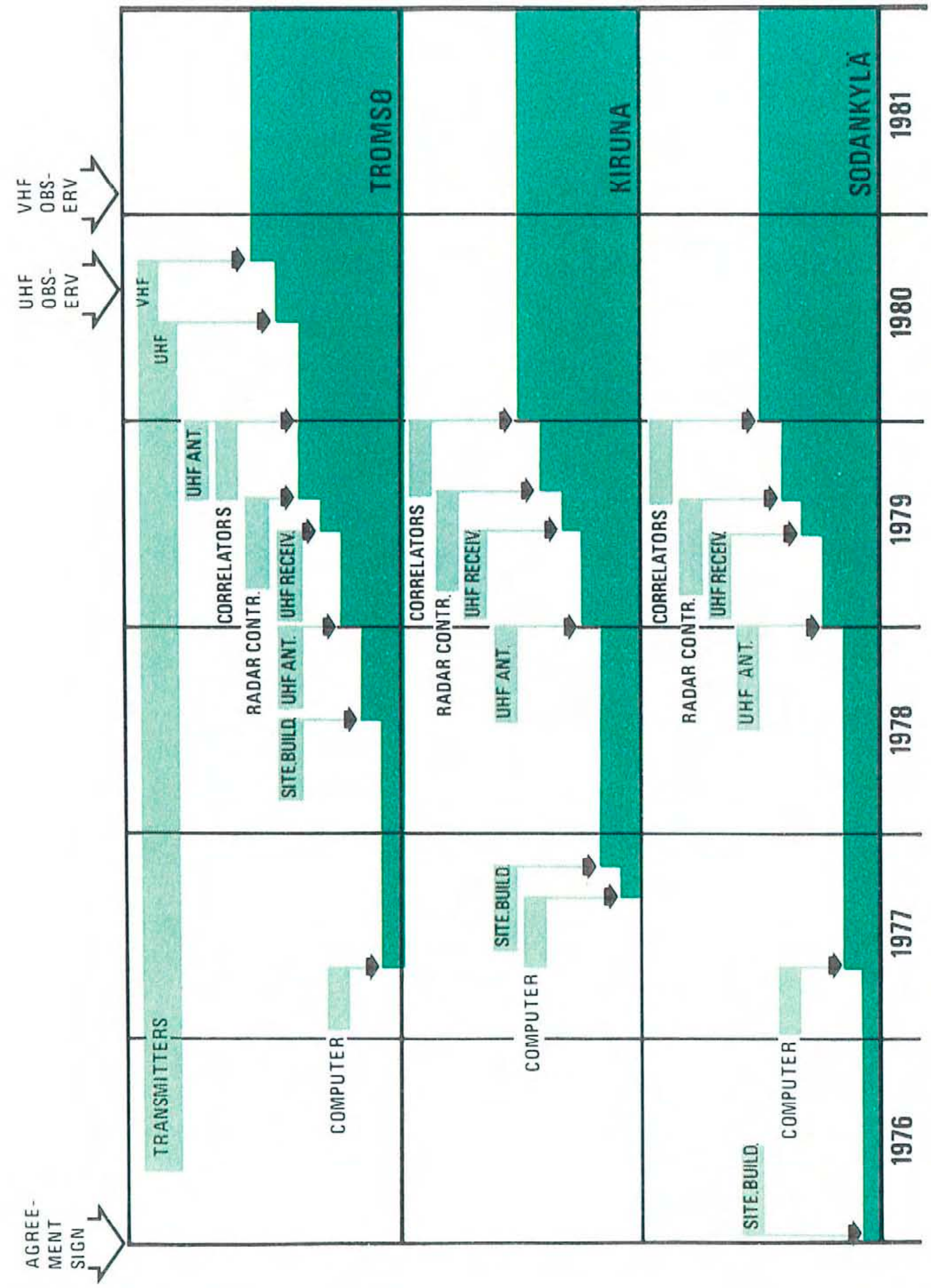
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MEETINGS OF COUNCIL AND COMMITTEES

Council

The 9th meeting (special meeting), Slough, 24 February 1978.

The 10th meeting, Helsinki, 11-12 May 1978.

The 11th meeting, Paris, 9-10 November 1978.
Sir Granville Beynon was elected new chairman to replace Monsieur Creyssel who held the chair for three years.

Scientific advisory committee

The 9th meeting, Slough, 10 February 1978
The 10th meeting, Paris, 9-10 May 1978
The 11th meeting, Helsinki, 5 August 1978
The 12th meeting, Paris, 7-8 November 1978

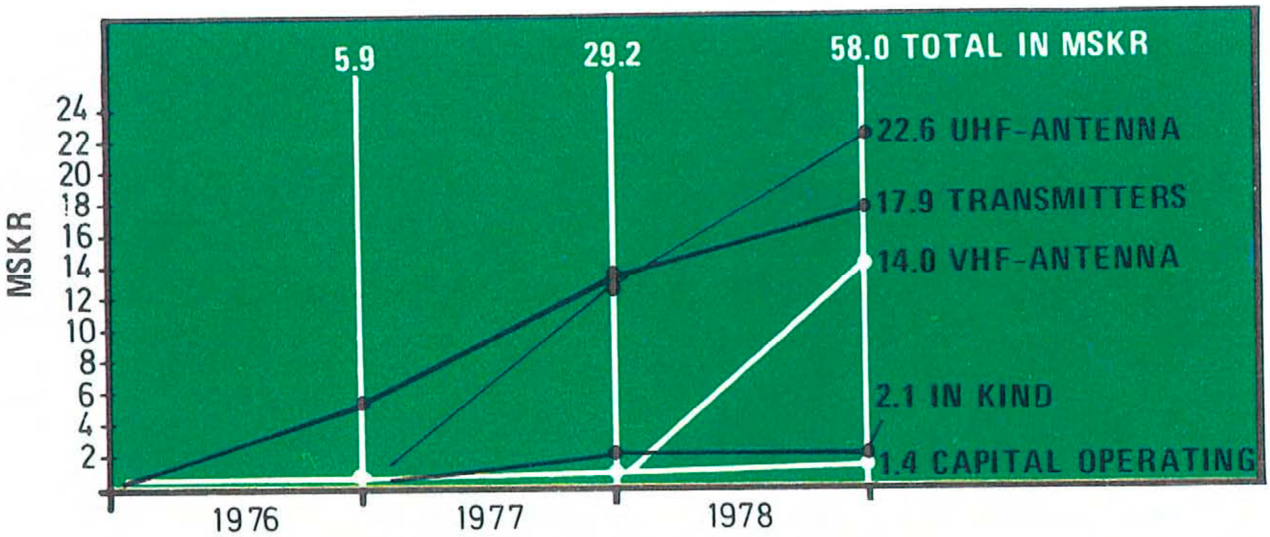
Administrative and finance committee

The special meeting, Slough, 24 February 1978
The 10th meeting, Munich, 12-13 April 1978
The 11th meeting, Munich, 3-4 October 1978

FINANCE AND ACCOUNTS

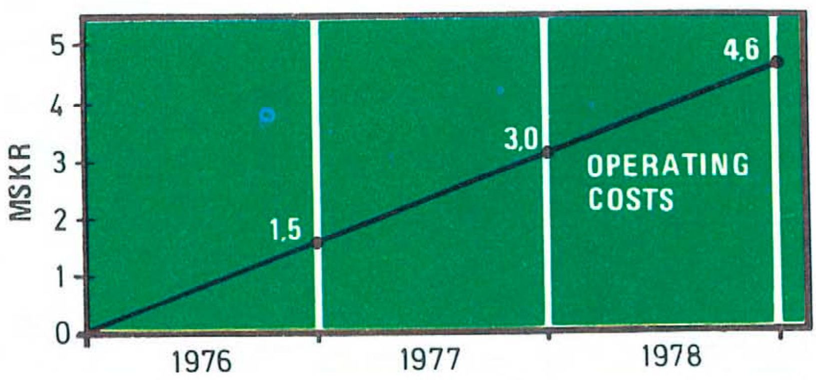
Capital investments

The capital investments amouted to 58 MSkr at the end of 1978. The cumulative cash flow of the capital investments has been as follows:



Operating costs

The operating costs increased by 1,6 MSkr to over 4,5 MSkr in 1978, but are not yet up to the level for full operations. The annual costs have had the following annual progress:



Provisional balance sheet

(unit: kSkr)

Assets

	At Jan. 1, 1978	Add.	Transf.	Depr.	At Dec. 31, 1978	At Dec. 31, 1977
FIXED ASSETS						
Pool/In Kind						
Premises	1,505			30	1,475	1,505
Equipm. under construction						
Transmitters	13,449	4,419			17,868	13,449
UHF-Antennas	12,796	10,110	-340		22,566	12,796
VHF-Antenna	—	14,063			14,063	—
Receivers	423				423	423
Time/freqvency system	194				194	194
	28,367	28,592	-340	30 0	56,589	28,367
Capital Operating						
Housing	19			1	18	19
Data processing system	638	28			666	638
Ancillary equipment and furniture	71	389	+ 170	23	607	71
Motor vehicles	99	57		36	120	99
	827	474		60	1,411	827
	29,194	29,066	- 170	90	58,000	29,194
CONTRIBUTIONS						
Pool - uncalled					5,200	-
CURRENT ASSETS						
Debtors					804	1,598
Cash					10,430	6,600
Special account					2,151	9,468
					13,385	17,666
					76,585	46,860

Notes on the Balance Sheet:

1. Remaining commitment due to main contracts; Transmitters, U.S. $ 1,738,000
   UHF-Antennas, U.S. $ 762,000
   VHF-Antenna, DM 6,600,000
2. In Kind expenditure by Nordic Associates is only included to the extent that fixed assets have been formally handed over as contributions to EISCAT.

at 31 December, 1978.

Liabilities

	At Dec 31, 1978	At. Dec. 31, 1977
CAPITAL		
Contributions		
Pool	63,100	31,400
Capital Operating	1,548	1,310
In Kind	2,122	2,122
	66,770	34,832
Un-called contributions	5,200	-
Depreciations	- 90	-
	71,880	34,832
RESERVES		
General reserve	903	1,413
Special reserve	2,151	9,468
Advance contributions	-	410
	3,298	11,291
PROVISIONS		
Contingency provisions	351	737
Liability for reimbursement	1,298	-
	1,649	737
	76,585	46,860

Provisional operating account For the period ending 31. December 1978 (unit: kSkr)

	1978	1977
INCOME		
Contributions from Associates	4,200	3,428
plus Cash Surplus (Recurrent)	752	-
	4,952	3,428
Other income: Operating	215	411
Investment Pool	939	721
Liability for re-imbursement to Balance Sheet	- 1,298	-
	4,808	4,560
EXPENDITURE		
Personnel	2,246	1;237
Travel	721	563
Administration and finance	942	453
Operation	362	133
Consultant's fee	295	148
Provision for accounts payable	-	453
	4,566	2,987
Surplus to Balance Sheet: Recurrent	- 697	852
Pool	939	721
	4,808	4,560

Note on the operating account

Council decided at its meeting on November 9-10, 1979 that «in accordance with Financial Rules 9, 5 and 10 the Recurrent Surplus for 1977 (752,339.09 Skr) should be offset against 1978 contributions from the Associates.»

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OF THE UNITED KINGDOM
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