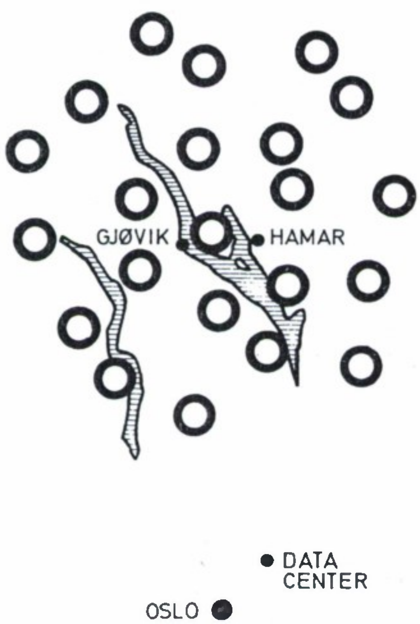
Royal Norwegian Council for Scientific and Industrial Research



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NORWEGIAN SEISMIC ARRAY

NORSAR

P. O. Box 51. 2007 Kjeller – Norway

ESD-TR-73-122

NTNF/NORSAR
Post Box 51
N-2007 Kjeller
NORWAY

NORSAR Technical Report No. 47

SYSTEM OPERATIONS REPORT

1 July - 31 December 1971

15 January 1973

The NORSAR research project has been sponsored by the United States of America under the overall direction of the Advanced Research Projects Agency and the technical management of Electronic Systems Division, Air Force Systems Command, through contract no. F19628-70-C-0283 with the Royal Norwegian Council for Scientific and Industrial Research.

This report has been reviewed and is approved.

Richard A Jedlicka, Capt USAF
Technical Project Officer
Oslo Field Office
ESD Detachment 9 (Europe)

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Date of Contract	:	15 May 1970
Amount of Contract	:	$ 2,051,886
Contract No.	:	F19628-70-C-0283
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Project Supervisor	:	Robert Major, NTNF
Project Manager	:	Nils Marås
Title of Contract	:	Norwegian Seismic Array (NORSAR) Phase 3

CONTENTS

SUMMARY

This report covers the operation of the NORSAR system during the period 1 July - 31 December 1971, except for array monitoring and control and associated field maintenance, which activities are, in accordance with Contract F19628-70-C-0283, covered by a separate report (NORSAR Report No. 40). A chapter on workshop repairs is, however, included here, although the main emphasis is on NDPC operations.

The report covers the first half year period when the regular NORSAR staff had the responsibility for all aspects of operation. Consequently, some areas are treated in somewhat more detail than in earlier reports on the subject.

1. INTRODUCTION

During the first part of this report period, all sides of the NORSAR system were completed and formally accepted by relevant authorities. Full system responsibility was accepted by NTNF as of 1 Sept, when the contract between ESD and IBM/USA terminated, and most IBM/FSD personnel left the project. Three IBM/FSD personnel stayed on at NORSAR,assigned to special tasks, and as consultants to the NORSAR staff.

The transfer of responsbility caused no problems, as project personnel had for a considerable time been working in close cooperation with IBM/FSD towards that end. Furthermore, the system had in the past proved very reliable, when allowed to run without scheduled interruptions. Neverthelees, improvement work continued where and when a pay-off could be envisaged.

2. STATUS OF SYSTEM

2.1 Facilities

The NORSAR facilities at Kjeller consist of the rented permanent building containing computer room, adjacent rooms for air conditioning, card punching, line termination, storage and five offices; a semi-permanent prefabricated office building with 17 offices and auxiliary rooms, part of which is owned by the project, part of it rented; and a small house temporarily borrowed from KCIN at no cost.

The maintenance center, with main workshop facilities, is also located at Kjeller, partly in a rented house, partly in a prefabricated, semi-permanent house similar to the office building, belonging to the project.

NORSAR personnel share a lunchroom with KCIN personnel on the premises.

2.2 Personnel

Except for the Project Manager, all key positions in the project were filled in the period; the Operations Manager temporarily acting as Project Manager. An expected turn-over of personnel was experienced, in particular in the operator group. One programmer left and was replaced by a new man. Three experienced operators were given special tasks and transferred to day shift work: one as EP analyst assistant, one as AM&C analyst assistant, one assumed the position of program and tape librarian. This left 10 operators for regular machine operation shift work, working 2 per shift on a 5-week repeat schedule.

Until the end of September, the field and workshop maintenance was performed under a subcontract with Noratom-Norcontrol A/S. Nine technicians plus a manager were engaged in NORSAR work. The subcontract was terminated at the end of September, the maintenance work from then being conducted directly from NDPC. Eight maintenance personnel were, in understanding with Noratom-Norcontrol A/S and the personnel themselves, transferred to NTNF/NORSAR for the purpose. Practical work continued as before, with six men working in the field and two at the maintenance center, under direction of NDPC.

Part time work for the project is being done by NTNF head office personnel, in particular with payroll, accounting, financial control, etc.

2.3 Equipment, Maintenance

2.3.1 NDPC Equipment

In connection with the expiration of the IBM/FSD contract and the purchase of rented computers and associated equipment, responsibility for maintenance contracting was transferred to NTNF. Consequently, such maintenance was contracted with IBM Norway, starting 29 June 1971. This contract consisted of two parts: a standard contract covering preventive and corrective maintenance on standard equipment 24 hours per day, 7 days per week, and a maintenance agreement on "time and material" basis covering other IBM-delivered equipment (SPS, EOC, Brush Recorder, TOD Unit, etc.). Two 2701 Data Adapters, having become surplus, were removed at the time. A small stock of replacement parts, supplied by IBM/FSD, was inventoried and transferred to NORSAR, for use mainly in special equipment. Spare units are to a certain extent available for the EOC. Figure 2.1 shows the final floor plan of the computer room.

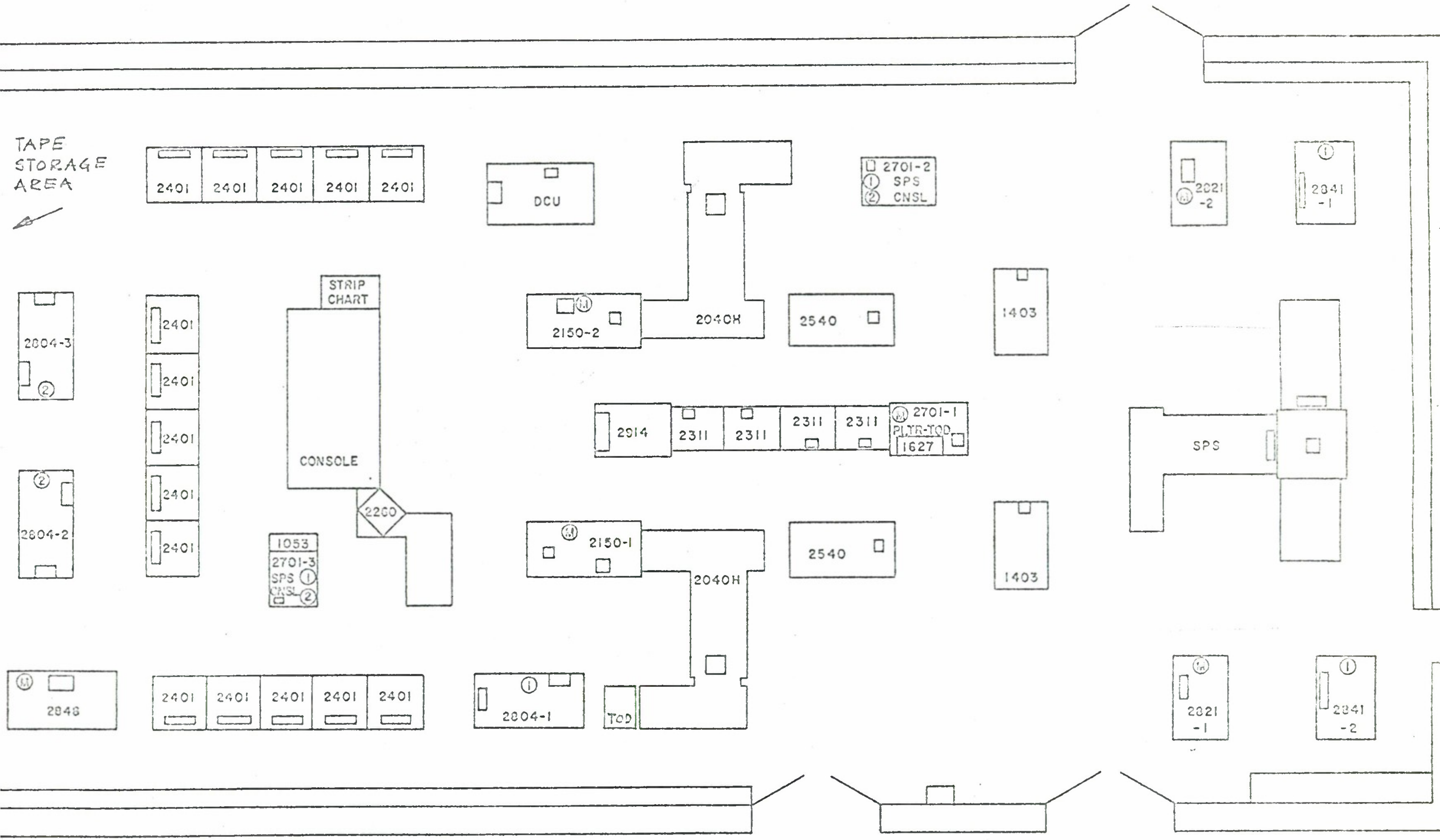


Figure 2.1 NDPC Computer Hall

Table 2.1 gives an indication of maintenance activity in the period.

Month	C.E. Maint.		Power Down		Mach. Error			
	A	B	A	B	A	B	SPS*	EOC
Jul	1	3					1.20	
Aug	7	5	8		9		15.10	
Sep	6	5	1					
Oct	10	8	2	2	4		2.10	
Nov	9	8	5	5	1		4.00	
Dec	5	11			4			2
Total	38	40	16	7	18		22.40	2

* SPS maintenance included in other columns

TABLE 2.1

Maintenance Activity Jul - Dec 1971
(Down Time in Hours)

Air conditioning equipment was maintained under contract with a local firm. No failure of this equipment was registered in the period.

2.3.2 Communications

The communications system consists of 22 dedicated lines (channels), 2400 baud modems, loop check unit for each line, and a call display at NDPC were signalling from the CTV is registered by buzzer and lamp.

Lines, except project-owned local lines at each sub-array, are rented from the Norwegian Telegraph Administration. Also, maintenance of local lines and modems (project-owned) is done by contract with NTA. At NDPC essentially one person is engaged part-time in checking communications performance. This is done by printout scanning, and manual check as necessary. Faults are reported to NTA, where action is taken (in order of priority; NORSAR has, unfortunately, not always top priority). NORSAR's own technicians usually assist in on-the-spot fault locations and repairs of modems and local lines.

Lines from several subarrays are usually routed via a 12-channel carrier system. As a result of this, a carrier outage will cause an outage of a number of subarrays, as there are no facilities for alternative routing. Failure of the communication system between Oslo and Lillestrøm (near Kjeller) may cause an outage of 20 out of the 22 subarrays, whereas a cable fault between Lillestrøm and Kjeller may leave the complete system dead. Input/output level changes occasionally occur along the way, usually caused by the special precautions (equalizers, amplifiers, etc.) taken to make lines comply with the special quality requirements of CCITT M102. Levels are checked by NORSAR personnel, both at NDPC and the CTV, in cooperation with intermediate NTA stations, and adjustments made by NTA as necessary. Table 2.2 shows the line/group of lines outages in the period. An insignificant number of minor modem repairs was performed.

2.3.3 Trans-Atlantic Communication

The Trans-Atlantic Line (TAL) installation at NDPC consists of one 2400 baud modem, and a switch/signal panel. The line is used for alternative data and voice communication between NDPC and SAAC. The line is routed from NDPC via cable to the satellite ground station at Goonhilly Downs in England, hence via satellite to USA.

Sub-Arrays	Oct 1971	Nov 1971	Dec 1971	Jan 1972	Feb 1972	Mar 1972	Apr 1972	May 1972	June 1972	Total Hours Down
01A/01B-04B							11.6	1.1		15.0
02C-06C	0.3					2.0	10.8	1.1		14.2
05B-01C		3.3	0.5		0.5	1.1	7.7	17.0	1.6	44.5
09C-14C		3.3	0.3		0.5	1.1	10.0	20.2	1.6	49.8
01A-14C -7,8C					0.8	0.5	2.2	0.3	0.3	4.1
05B-07B						1.1		3.0		4.1
11C-13C						1.1				1.1

TABLE 2.2

Summary of Communication System Down (Groups of SA's)

NORSAR is not involved in rental or maintenance questions for this system. Discovered failures are reported to the NTA.

2.3.4 Field Equipment

Field equipment status and maintenance for this reporting period is covered by NORSAR Report No. 32, "Field Maintenance Report 1 Jan-30 Sep 1971" and No. 40 "Array Monitoring and Field Maintenance Report 1 Oct 71-30 June 72". Some additional information about workshop activities, relating to the latter half of the period, will be given.

The workshop service is organized with the main workshop (MC) at Kjeller and a field workshop (FMC) in Brumunddal in the array area. Usually "first line" repairs are performed in the field or in the field shop, while more time-consuming jobs and those requiring special tools and equipment are referred to the main workshop. This is the case for most seismometer and SLEM jobs. The MC is equipped with various seismometer test fixtures and SLEM test racks, connected through cable to the computer, to allow realistic tests to be run. This feature is extensively used. The main stock of replacement parts is kept at the MC.

Considerable time was spent at the MC with reconditioning of seismometers both short and long period, initiated in most cases by replacement of out-of-tolerance instruments. In the short period, case investigations indicated that the springs (suspension and cal coil) might be the reason for substandard performance, possibly linked with temperature variations. Extensive temperature tests had been performed earlier (Report No. 32), however, no firm conclusions could be drawn from the seismometer tests apart from a confirmation of instability with changing temperatures. Several seismometers were fitted with new springs; this improved the performance and most units could then be adjusted to an apparently stable state within specifications. Final adjustments had to be performed under normal working conditions; the seismometers were brought out to an LPV and adjusted there before going into storage as OK for replacement. Again, in many cases, whenever one of these reconditioned seismometers after some time was installed in a borehole, its characteristics were way out of specification and the procedure had to be repeated. Further studies of seismometer characteristics and behavior are in progress.

In long period seismometers rusty magnets and filings had earlier been observed. Seismometer reconditioning continued on a small scale, as the short period instruments were given higher priority.

Reconditioning and repair of Ithaco and RA-5 amplifiers continued.

A summary of maintenance center activity in the period is given below. (This may in some cases overlap information given in other reports.)

Summary of maintenance center activities
1 July - 31 December 1971

1) SP Seismometer
   19 seismometers reconditioned (repaired or checked/adjusted). Recurring reasons for seismometer

failure: suspension and adjusting springs, loose set-screws, broken coil wires, loose pigtails, mechanical misalignment, low magnets, 24 cables of different lengths prepared.

2) RA-5 Amplifiers
15 amplifiers reconditioned. Dominant malfunctions: low battery voltage, balance capacitor out of adjustment or defect, defect transistors, various characteristic values outside of tolerance limits. A special test rig for RA-5, with detailed procedures for testing, is being prepared.

3) LP Seismometer
2 horizontal seismometers reconditioned and adjusted.
3 remote centering devices repaired.

4) SLEM
10 ADC's came in for check, of which 8 were sent back to factory. Reasons: missing numbers, wrong or unstable DC offset, gain, clock or reference voltage.

5 SP LTA's checked/repaired for excessive ripple (faulty filter) and/or DC offset.

2 test generators checked/repaired.

1 EPU treated for excessive noise.

5) Various
4 BE cards repaired. Burned resistors caused by lightning.

Various single cards and other units treated for minor deficiencies.

A test set-up was made for testing of SP natural frequency and damping, and several tests performed using subarray 4B LPV as "test station".

Measurements performed with 8 Hz filters for possible introduction in the system.

Various noise measurements performed (e.g., data channel noise at 4B in Sept) with no conclusive results.

MC personnel took part in the establishment of new routines for equipment testing, status recording, spare parts control, etc.

3. NDPC ACTIVITY

3.1 Detection Processor Operation

3.1.1 General Considerations

In July and August of 1971, the final modifications and extensions of the DP software were performed by IBM. Among other things, these included the final checkout of the on-line array monitoring software and an option to provide a fast determination of arrival times and epicenters of large events. A new set of scaling parameters for the on-line DP was introduced 26 July.

During the above two months, the mode of DP operation was semi-continuous, in the sense that DP was taken down whenever needed for program debugging purposes, but otherwise was dedicated to continuous data recording.

From 1 Sept 1971 NTNF/NORSAR took over the formal responsibility for operating the NORSAR system. From this date top priority was given to maintaining a continuous data recording and detection processing, with minimum system intervention. However, whenever DP was subject to error stop for unknown reasons, an SPS and S/360 core dump was taken to provide a possibility for the responsible programmers to locate and correct the cause of malfunctioning. Also, the on-line DP was taken down when software changes or new parameter sets were introduced, as well as for hardware maintenance purposes. In the latter case, however, the secondary S/360 computer was used for backup recording, so as to minimize the data loss.

3.1.2 Data Recording and DP Down Time

Figure 3.1.1 shows Detection Processor down time on a day-to-day basis for July-December 1971. The total monthly recording time is given in Tables 3.1.1 and 3.1.2.

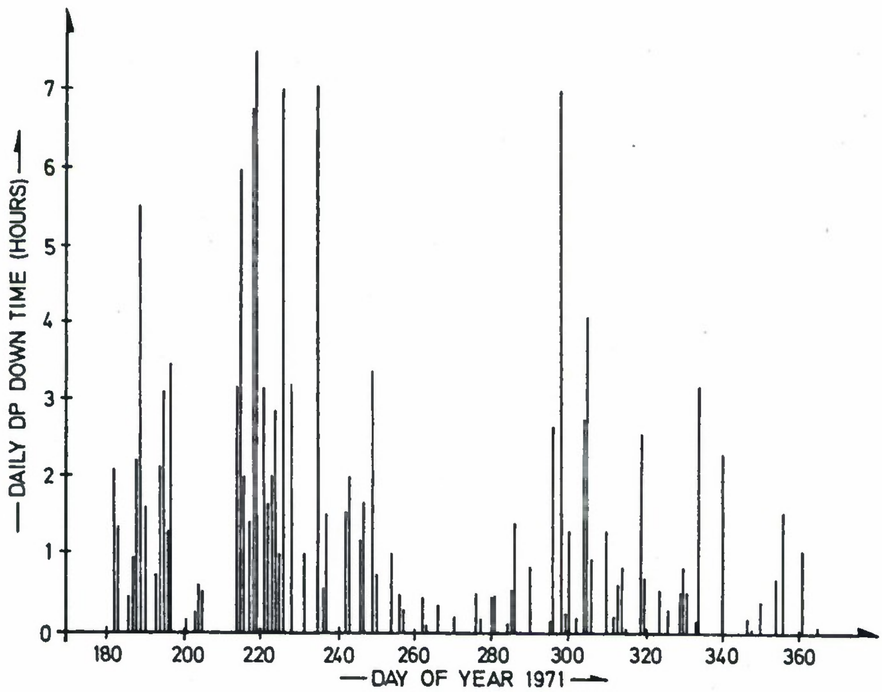


Figure 3.1.1 Daily detection processor down time
July - December 1971

In spite of significant system development during July and August, the Detection Processor was still operational for more than 90% of real time in these two months. The figures improved as could be expected for September-December, with generally less than 3% down time. Most of the down time in the latter period is attributable to a few outages of relatively long duration (up to 7 hours), mainly caused by power breaks or hardware failures.

	DP	EP	Job Shop	Array Mon.	DP Test	C.E. Maint.	Power Down	Idle	Mach. Error	No. of Jobs run in Job Shop
Jul	708		6		29	1				15
Aug	689				29	7	8	2	9	
Sep	704		5		4	6	1			21
Oct	605	38	65	2	5	10	2	13	4	186
Nov	690		2		13	9	5		1	6
Dec	728		4		3	5			4	10
Total hours	4124	38	82	2	83	38	16	15	18	238

COMPUTER A

	DP	EP	Job Shop	Array Mon.	DP Test	C.E. Maint.	Power Down	Idle	Mach. Error	No. of Jobs run in Job Shop
Jul		294	318	111	18	3				1020
Aug		281	344	110		5		4		969
Sep	6	384	300	25		5				1010
Oct	120	249	313	25		8	2	27		1114
Nov	11	197	383	110	4	8	5	2		1047
Dec	11	230	287	205		11				876
Total hours	148	1635	1945	586	22	40	7	33		6036

COMPUTER B

DP up time: $\frac{(4124+148)\cdot 100}{4416}\,\% = 96.7\%$

EP up time: $\frac{(38+1635)\cdot 100}{4416}\,\% = 37.9\%$

TABLE 3.1.1

Computer Usage 1 July - 31 December 1971

	DP UPTIME (hours)	DP UP %	EP UPTIME (hours)	EP UP %	NO. OF DP ERROR STOPS	DP MTBF (days)
Jul	708	95.2	294	39.5		
Aug	689	92.6	281	37.8		
Sep	710	98.6	384	53.3	10	3.0
Oct	725	97.4	287	38.6	12	2.6
Nov	701	97.4	197	27.4	7	4.3
Dec	739	99.3	230	30.9	5	6.2
TOTAL	4272	96.7	1673	37.9	34	3.6

TABLE 3.1.2

DP and EP Computer Usage

A significant parameter is the number of DP error stops and the associated mean time between failures (MTBF), as seen in Table 3.1.1. System stops when DP was taken down deliberately have not been included here.

Of the 34 error stops in the period September-December, tape drive problems account for approximately half. TAL operation, operator actions, EOC, software, SPS, other hardware are the other causes of Detection Processor error stops.

The average MTBF for the last four months was 3.6 days, with the longest continuous interval of error-free DP operation being 10 days.

3.1.3 DP Operational Problems

The main DP problems related to software are summarized in the following, together with the associated Discrepancy Report No. (DR).

Trans-Atlantic data communication from NDPC to SAAC showed a generally good performance except for a tendency for the NORSAR DP to fall behind compared to real time when transmitting the data blocks. The loss of data due to this was, however, minimal (typically a few seconds during a week), and the problem was deferred (DR 324).

Errors in time delays for roughly half of the array beams were discovered on 5 October. These errors had been in the system since the creation of a core image tape on 2 August, and were due to an operator mistake. A new and correct core image tape was created immediately, and steps were taken to provide more extensive checks on the procedure in the future (DR 375).

The beam display of the Experimental Operations Console (EOC) caused several error stops due to data chaining in August and September, and the EOC task was recoded to prevent this (DR 406).

Status indicators on the EOC used for Array Monitoring were blanked out on several occasions after DP error stops. This problem was solved early in 1972 (DR 427).

3.1.4 DP Algorithms and Parameters

When NTNF/NORSAR took over the operational DP system from IBM on 1 Sept 71, most basic routines were working satisfactorily, and only a few software changes were made during the last part of 1971. The most significant program changes were as follows.

Detection Processor task priorities were reordered 20 Sept (Change Request 353) to allow for less probability of losing messages and detections to printer and shared disk during heavy S/360 processing load conditions.

A method for reducing the possibility of false detections caused by reactivation of transmission lines after communication outages was developed and implemented on-line 16 November (Change Request 368).

A continuous recording of all Long Period data on a "Low Rate Tape" was implemented on-line 16 November. This was done in order to make LP data more readily accessible for analysis, and to simplify retention of this type of data. Also all data sent to and received from the Trans-Atlantic Link (TAL) was initially recorded on this tape (Change Request 398).

A summary of DP parameter changes during 1971 is shown in Table 3.1.3. Note that from 22-26 July a parameter error caused an effective DP detection threshold of 16 dB instead of 10 dB. After continuous operation of the NORSAR system started 1 Sept, the following parameter changes were made.

DP detection threshold was increased from 10 dB to 10.5 dB on 16 November. The reason for this was the large number of small detections during the fall months, which caused overflow on the shared disk at several occasions and subsequent operational EP problems (Change Request 436).

A new array beam deployment (Selected Surveillance) was introduced in the NORSAR DP 14 December. (Change Request 454.) The number of beams was reduced from 331 to 318, mainly because of DP overload conditions experienced with the previous beam deployment. Essentially, the new deployment (AB set 401) consisted

Deployment Interval (Day-Hours)	Subarray Beam Deployment	Array Beam Deployment	A-Filter (Hz)	Limiting Level (nm)	STA Scaling 1 nm =	LTA/STA Scale factor	Turn on Threshold (dB)	Q/Q'	Stability Parameters (SS)	Voting M/N (GS)	Others
1971 $10^d\ 21^h$ to $36^d\ 07^h$	114 (SS) 115 (GS)	306 (300AB)	0.9-3.5	17 nm	128 qu (SS) 100 qu (GS)	16 (SS) 16 (GS)	8dB (SS) 7dB (GS)	3/3 (SS) 3/3 (GS)	T-4 samples U-2 rings	3/8	STA rate - 0.6 Int. window - 1.8
$36^d\ 16^h$ to $39^d\ 08^h$							9dB (SS) 7dB (GS)	1/1 (SS) 3/3 (GS)			
$39^d\ 16^h$ to $40^d\ 18^h$									T-3 samples ΔU-2 rings		
$40^d\ 18^h$ to $42^d\ 20^h$				8.5nm							
$42^d\ 20^h$ to $69^d\ 16^h$							10dB (SS) 7dB (GS)		T-4 samples ΔU-1 ring		
$69^d\ 16^h$ to $83^d\ 16^h$				34 nm	549 qu (SS) 400 qu (GS)	2 (SS) 2 (GS)			T-3 samples ΔU-2 rings		
$83^d\ 16^h$ to $92^d\ 15^h$											
$92^d\ 15^h$ to $111^d\ 19^h$											
$111^d\ 19^h$ to $207^d\ 12^h$	123 (SS) 124 (GS)	310 (331AB)			608 qu (SS) 444 qu (GS)						STA rate - 0.5 Int. window - 2.0
$207^d\ 12^h$ to $320^d\ 13^h$				20 nm	917 qu (SS) 671 qu (GS)	8 (SS) 8 (GS)					STA rate - 0.5 Int. window - 1.5
$320^d\ 13^h$ to $348^d\ 13^h$							10.5dB (SS) 7dB (GS)				
$348^d\ 13^h$ to $006^d\ 13^h$		401 (318AB)									
$006^d\ 13^h$ 1972			1.2-3.2		1000 qu (SS) 181 qu (GS)						

TABLE 3.1.3

Detection Processor Deployment in 1971, Selected Surveillance (SS) and General Surveillance (GS) A-filter of retaining the previous beams no 1-259, deleting a number of packed beams in the Alaska-Aleutian-Japan region and adding a few beams to the USSR-China, Mediterranean and East Africa regions. See Table 3.1.4 for a list of the new array beam set.

Detection Processor scaling parameters remained unchanged from 26 July to the end of the year, the Selected Surveillance filter being a 0.9-3.5 Hz Butterworth bandpass filter. The most important scaling parameters are listed in Tables 3.1.5 and 3.1.6.

3.1.5 Detection Processor Performance

Statistics showing the number of on-line Selected Surveillance detections as a function of signal-to-noise ratio are shown in Figure 3.1.2. The four time periods shown cover the months of August-December 1971. In these figures individual detections closer together than 30 seconds have been grouped, since in most cases they would come from the same event.

It is instructive to note the apparent "break point" on all the curves around an SNR of approximately 12 dB. Below this point noise detections start to dominate the picture, with the number of detections increasing very rapidly when SNR decreases. A "noise slope" $(\Delta \log N)/(\Delta \log SNR) = -15$ may be fitted to the curves below 12 dB.

Similarly, a "signal slope" $(\Delta \log N)/(\Delta \log SNR) = -1.1$ seems to provide an adequate approximation for the behavior of the curves above 12 dB, except for high SNR values, where Detection Processor clipping of signals and also the small expected number of detections affect the picture.

BEAM NO	UX (S/KM)	UY (S/KM)	PHASE	LAT	LON	REGION NUMBER AND NAME	
1	-0.0542707	-0.0787291	P	74N	57E	648	NOVAYA ZEMLYA
2	-0.0571833	-0.0787291	P	74N	56E	648	NOVAYA ZEMLYA
3	-0.0601158	-0.0787291	P	73N	55E	648	NOVAYA ZEMLYA
4	-0.0557170	-0.0761895	P	74N	59E	648	NOVAYA ZEMLYA
5	-0.0586495	-0.0761895	P	73N	58E	648	NOVAYA ZEMLYA
6	0.0117313	-0.0660309	P	66N	148W	676	ALASKA
7	0.0131976	-0.0634912	P	62N	146W	1	CENTRAL ALASKA
8	0.0102651	-0.0634912	P	62N	151W	1	CENTRAL ALASKA
9	0.0175964	-0.0609516	P	59N	140W	19	SOUTHEASTERN ALASKA
10	0.0146638	-0.0609516	P	59N	144W	15	GULF OF ALASKA
11	0.0117313	-0.0609516	P	58N	149W	15	GULF OF ALASKA
12	0.0087988	-0.0609516	P	58N	154W	12	ALASKA PENINSULA
13	0.0058662	-0.0609516	P	58N	159W	11	BRISTOL BAY
14	0.0102651	-0.0584119	P	55N	152W	17	SOUTH OF ALASKA
15	0.0073325	-0.0584119	P	55N	156W	17	SOUTH OF ALASKA
16	0.0044000	-0.0584119	P	55N	161W	12	ALASKA PENINSULA
17	0.0014674	-0.0584119	P	55N	166W	9	FOX ISLANDS, ALEUTIANS
18	-0.0014651	-0.0584119	P	55N	170W	3	BERING SEA
19	-0.0073302	-0.0584119	P	56N	179W	3	BERING SEA
20	0.0000012	-0.0558723	P	51N	168W	9	FOX ISLANDS, ALEUTIANS
21	-0.0029314	-0.0558723	P	51N	172W	7	ANDREANOF IS., ALEUTIANS
22	-0.0058639	-0.0558723	P	52N	177W	7	ANDREANOF IS., ALEUTIANS
23	-0.0087965	-0.0558723	P	53N	179E	6	RAT ISLANDS, ALEUTIANS
24	-0.0117290	-0.0558723	P	54N	175E	3	BERING SEA
25	-0.0146615	-0.0558723	P	55N	171E	3	BERING SEA
26	-0.0175940	-0.0558723	P	56N	166E	4	KOMANDORSKY ISLANDS REG.
27	-0.0205266	-0.0558723	P	57N	162E	216	NEAR EAST COAST KAMCHATKA
28	-0.0073302	-0.0533326	P	49N	178W	16	ALEUTIAN ISLANDS REGION
29	-0.0102627	-0.0533326	P	49N	177E	16	ALEUTIAN ISLANDS REGION
30	-0.0131952	-0.0533326	P	50N	173E	16	ALEUTIAN ISLANDS REGION
31	-0.0161278	-0.0533326	P	51N	169E	16	ALEUTIAN ISLANDS REGION
32	-0.0190603	-0.0533326	P	52N	164E	16	ALEUTIAN ISLANDS REGION
33	-0.0219929	-0.0533326	P	53N	160E	216	NEAR EAST COAST KAMCHATKA
34	-0.0234591	-0.0507930	P	50N	159E	222	KURILE ISLANDS REGION
35	-0.0263916	-0.0507930	P	47N	154E	221	KURILE ISLANDS
36	-0.0293242	-0.0507930	P	52N	150E	663	SEA OF OKHOTSK
37	-0.0278579	-0.0482533	P	47N	153E	221	KURILE ISLANDS
38	-0.0337230	-0.0482533	P	47N	147E	220	NORTHWEST OF KURILE IS.
39	-0.0366555	-0.0482533	P	47N	144E	663	SEA OF OKHOTSK
40	-0.0293242	-0.0457137	P	45N	151E	221	KURILE ISLANDS
41	-0.0322567	-0.0457137	P	44N	149E	221	KURILE ISLANDS
42	-0.0351893	-0.0457137	P	43N	147E	221	KURILE ISLANDS
43	-0.0381218	-0.0457137	P	46N	142E	662	SAKHALIN ISLAND
44	-0.0307904	-0.0431740	P	43N	149E	222	KURILE ISLANDS REGION
45	-0.0337230	-0.0431740	P	42N	147E	225	OFF COAST HOKKAIDO, JAPAN
46	-0.0366555	-0.0431740	P	42N	144E	224	HOKKAIDO, JAPAN, REGION
47	-0.0395880	-0.0431740	P	45N	139E	223	EASTERN SEA OF JAPAN
48	-0.0351893	-0.0406344	P	40N	144E	229	OFF E COAST HONSHU,JAPAN
49	-0.0381218	-0.0406344	P	41N	141E	224	HOKKAIDO, JAPAN, REGION
50	-0.0410543	-0.0406344	P	42N	137E	223	EASTERN SEA OF JAPAN
51	-0.0366555	-0.0380947	P	37N	143E	229	OFF E COAST HONSHU,JAPAN
52	-0.0395880	-0.0380947	P	39N	139E	226	NEAR W COAST HONSHU,JAPAN
53	-0.0351893	-0.0355551	P	32N	145E	611	NORTH PACIFIC OCEAN
54	-0.0381218	-0.0355551	P	34N	141E	229	OFF E COAST HONSHU,JAPAN
55	-0.0410543	-0.0355551	P	36N	136E	226	NEAR W COAST HONSHU,JAPAN
56	-0.0366555	-0.0330154	P	27N	143E	212	BONIN ISLANDS REGION
57	-0.0395880	-0.0330154	P	32N	137E	211	SOUTH OF HONSHU, JAPAN
58	-0.0425206	-0.0330154	P	34N	133E	233	NEAR S COAST OF S. HONSHU
59	-0.0322567	-0.0304758		0	0	0	
60	-0.0351893	-0.0304758	P	20N	145E	216	MARIANA ISLANDS
61	-0.0381218	-0.0304758	P	25N	140E	213	VOLCANO ISLANDS REGION
62	-0.0439869	-0.0304758	P	32N	130E	235	KYUSHU, JAPAN
63	-0.0366555	-0.0279361	P	17N	144E	215	MARIANA ISLANDS REGION
64	-0.0425206	-0.0279361	P	28N	131E	239	RYUKYU ISLANDS REGION
65	-0.0454531	-0.0279361	P	30N	127E	234	EAST CHINA SEA
66	-0.0381218	-0.0253965		0	0	0	
67	-0.0439869	-0.0253965	P	26N	128E	238	RYUKYU ISLANDS
68	-0.0469194	-0.0253965	P	29N	123E	666	OFF COAST OF E. CHINA
69	-0.0454531	-0.0228568	P	22N	125E	247	SOUTHEAST OF TAIWAN
70	-0.0483857	-0.0228568	P	25N	120E	243	TAIWAN REGION
71	-0.0469194	-0.0203172	P	20N	122E	248	PHILIPPINE ISLANDS REGION
72	-0.0425206	-0.0177776		0	0	0	
73	-0.0454531	-0.0177776	P	14N	123E	249	LUZON, PHILIPPINE ISLANDS
74	-0.0483857	-0.0177776	P	17N	119E	248	PHILIPPINE ISLANDS REGION
75	-0.0439869	-0.0152379		0	0	0	
76	-0.0469194	-0.0152379	P	11N	120E	252	PALAWAN, PHILIPPINE IS.
77	-0.0601158	-0.0330154	P	49N	104E	334	MONGOLIA
78	-0.0542507	-0.0279361	P	39N	112E	658	NORTHEASTERN CHINA
79	-0.0630484	-0.0177776	P	39N	96E	322	KANSU PROVINCE, CHINA
80	-0.0923737	-0.0177776	P	58N	55E	335	URAL MOUNTAINS REGION

TABLE 3.1.4

NORSAR Array Beam Set 401 (14 December 1972)

Part I

BEAM NO	UX (S/KM)	UY (S/KM)	PHASE	LAT	LON	REGION NUMBER AND NAME	
81	-0.0586495	-0.0152379	P	29N	103E	307	SZECHWAN PROVINCE, CHINA
82	-0.0615821	-0.0152379	P	34N	98E	325	TSINGHAI PROVINCE, CHINA
83	-0.0674471	-0.0152379	P	44N	87E	332	NORTHERN SINKIANG PROV.
84	-0.0703797	-0.0152379	P	48N	81E	329	EASTERN KAZAKH SSR
85	-0.0571833	-0.0126983	P	24N	104E	318	YUNAN PROVINCE, CHINA
86	-0.0601158	-0.0126983	P	29N	100E	307	SZECHWAN PROVINCE, CHINA
87	-0.0630484	-0.0126983	P	34N	95E	325	TSINGHAI PROVINCE, CHINA
88	-0.0659809	-0.0126983	P	39N	90E	321	SOUTHERN SINKIANG PROV.
89	-0.0689133	-0.0126983	P	44N	84E	332	NORTHERN SINKIANG PROV.
90	-0.0586495	-0.0101586	P	23N	100E	318	YUNAN PROVINCE, CHINA
91	-0.0615821	-0.0101586	P	29N	96E	313	INDIA-CHINA BORDER REGION
92	-0.0645146	-0.0101586	P	34N	92E	325	TSINGHAI PROVINCE, CHINA
93	-0.0674471	-0.0101586	P	39N	87E	321	SOUTHERN SINKIANG PROV.
94	-0.0703797	-0.0101586	P	44N	81E	332	NORTHERN SINKIANG PROV.
95	-0.0601158	-0.0076190	P	23N	97E	297	BURMA-CHINA BORDER REGION
96	-0.0630484	-0.0076190	P	29N	93E	306	TIBET
97	-0.0659809	-0.0076190	P	34N	89E	306	TIBET
98	-0.0718459	-0.0076190	P	44N	78E	329	EASTERN KAZAKH SSR
99	-0.0615821	-0.0050793	P	24N	93E	294	BURMA-INDIA BORDER REGION
100	-0.0645146	-0.0050793	P	29N	90E	306	TIBET
101	-0.0703797	-0.0050793	P	40N	81E	321	SOUTHERN SINKIANG PROV.
102	-0.0630484	-0.0025397	P	26N	90E	317	EASTERN INDIA
103	-0.0659809	-0.0025397	P	29N	87E	306	TIBET
104	-0.0689133	-0.0025397	P	35N	82E	306	TIBET
105	-0.0718459	-0.0025397	P	40N	78E	321	SOUTHERN SINKIANG PROV.
106	-0.0645146	0.0	P	27N	87E	310	NEPAL
107	-0.0733122	0.0	P	40N	75E	320	KIRGIZ-SINKIANG BORDER
108	-0.0689133	0.0025396	P	31N	81E	306	TIBET
109	-0.0718459	0.0025396	P	36N	77E	324	KASHMIR-SINKIANG BORDER
110	-0.0747785	0.0025396	P	40N	73E	716	KIRGIZ SSR
111	-0.0777110	0.0025396	P	42N	70E	713	CENTRAL KAZAKH SSR
112	-0.0703797	0.0050793	P	32N	78E	304	KASHMIR-TIBET BORDER REG.
113	-0.0733122	0.0050793	P	37N	74E	719	TADZHIK-SINKIANG BORDER
114	-0.0762448	0.0050793	P	39N	71E	715	TADZHIK SSR
115	-0.0718459	0.0076189	P	32N	75E	303	KASHMIR-INDIA BORDER REG.
116	-0.0747785	0.0076189	P	37N	71E	717	AFGHANISTAN-USSR BORDER
117	-0.0762448	0.0101586	P	38N	68E	715	TADZHIK SSR
118	-0.0747785	0.0126982	P	37N	68E	717	AFGHANISTAN-USSR BORDER
119	-0.0777110	0.0126982	P	40N	64E	339	UZBEK SSR
120	-0.0674471	0.0152379	P	19N	74E	314	INDIA
121	-0.0762448	0.0152379	P	39N	64E	339	UZBEK SSR
122	-0.0718459	0.0177775	P	25N	68E	710	PAKISTAN
123	-0.0733122	0.0203172	P	28N	65E	710	PAKISTAN
124	-0.0777110	0.0228568	P	35N	59E	348	IRAN
125	-0.0703797	0.0253965	P	25N	62E	354	WESTERN PAKISTAN
126	-0.0703797	0.0304758	P	26N	58E	353	SOUTHERN IRAN
127	-0.0733122	0.0304758	P	31N	56E	348	IRAN
128	-0.0689133	0.0330154	P	26N	56E	353	SOUTHERN IRAN
129	-0.0718459	0.0330154	P	30N	54E	348	IRAN
130	-0.0674471	0.0355551	P	25N	54E	352	PERSIAN GULF
131	-0.0703797	0.0355551	P	29N	53E	353	SOUTHERN IRAN
132	-0.0689133	0.0380948	P	28N	51E	353	SOUTHERN IRAN
133	-0.0718459	0.0380948	P	33N	50E	348	IRAN
134	-0.0777110	0.0330154	P	39N	49E	338	CASPIAN SEA
135	-0.0733122	0.0406344	P	37N	46E	345	NORTHWESTERN IRAN
136	-0.0659809	-0.0177776	P	44N	90E	332	NORTHERN SINKIANG PROV.
137	-0.0689133	-0.0177776	P	48N	84E	329	EASTERN KAZAKH SSR
138	-0.0718459	-0.0177776	P	52N	77E	329	EASTERN KAZAKH SSR
139	-0.0645146	-0.0152379	P	39N	93E	321	SOUTHERN SINKIANG PROV.
140	-0.0733122	-0.0152379	P	51N	75E	329	EASTERN KAZAKH SSR
141	-0.0718459	-0.0126983	P	48N	78E	329	EASTERN KAZAKH SSR
142	-0.0483857	0.0228568	P	6S	72E	426	CHAGOS ARCHIPELAGO REGION
143	-0.0410543	0.0253965	P	16S	69E	429	MID-INDIAN RISE
144	-0.0469194	0.0253965	P	8S	69E	426	CHAGOS ARCHIPELAGO REGION
145	-0.0527844	0.0253965	P	0N	69E	421	CARLSBERG RIDGE
146	-0.0395880	0.0279362	P	17S	65E	427	MASCARENE ISLANDS REGION
147	-0.0454531	0.0279362	P	9S	66E	429	MID-INDIAN RISE
148	-0.0542507	0.0330154	P	5N	60E	421	CARLSBERG RIDGE
149	-0.0601158	0.0330154	P	14N	59E	417	ARABIAN SEA
150	-0.0557170	0.0355551	P	9N	57E	421	CARLSBERG RIDGE
151	-0.0586495	0.0355551	P	13N	57E	417	ARABIAN SEA
152	-0.0571833	0.0380948	P	13N	54E	416	SOCOTRA REGION
153	-0.0557170	0.0406344	P	13N	52E	416	SOCOTRA REGION
154	-0.0527844	0.0457137	P	13N	47E	555	WESTERN ARABIAN PENINSULA
155	-0.0469194	0.0507930	P	12N	42E	558	ETHIOPIA
156	-0.0498520	0.0558723	P	20N	39E	555	WESTERN ARABIAN PENINSULA
157	-0.0498520	0.0253965	P	4S	69E	426	CHAGOS ARCHIPELAGO REGION
158	-0.0425206	0.0279362	P	12S	65E	429	MID-INDIAN RISE
159	-0.0571833	0.0330154	P	9N	60E	421	CARLSBERG RIDGE
160	-0.0483857	-0.0025397		0	0	0	

TABLE 3.1.4

Part II

BEAM NU	UX (S/KM)	UY (S/KM)	PHASE	LAT	LON	REGION NUMBER	AND NAME
161	-0.0513182	-0.0025397	P	0N	102E	706	NORTHERN SUMATRA
162	-0.0542507	-0.0025397	P	6N	99E	707	MALAY PENINSULA
163	-0.0601158	-0.0025397	P	19N	94E	296	BURMA
164	-0.0498520	0.0	P	6S	101E	273	SOUTHWEST OF SUMATRA
165	-0.0527844	0.0	P	1N	97E	706	NORTHERN SUMATRA
166	-0.0557170	0.0	P	5N	95E	706	NORTHERN SUMATRA
167	-0.0586495	0.0	P	13N	93E	703	ANDAMAN ISLANDS REGION
168	-0.0615821	0.0	P	20N	91E	319	BAY OF BENGAL
169	-0.0542507	0.0025396	P	3N	93E	705	OFF W.COAST OF N. SUMATRA
170	0.0263940	-0.0558723	P	51N	128W	25	VANCOUVER ISLAND REGION
171	0.0381241	-0.0507930	P	47N	112W	456	MONTANA
172	0.0351916	-0.0507930	P	45N	116W	33	WESTERN IDAHO
173	0.0322590	-0.0507930	P	44N	120W	32	OREGON
174	0.0293265	-0.0507930	P	43N	125W	30	OFF COAST OF OREGON
175	0.0263940	-0.0507930	P	43N	129W	30	OFF COAST OF OREGON
176	0.0395904	-0.0482533	P	44N	110W	459	YELLOWSTONE PARK, WYO.
177	0.0366578	-0.0482533	P	42N	114W	33	WESTERN IDAHO
178	0.0337253	-0.0482533	P	41N	118W	37	NEVADA
179	0.0307928	-0.0482533	P	40N	122W	36	NORTHERN CALIFORNIA
180	0.0278602	-0.0482533	P	40N	126W	34	OFF COAST OF NORTH CALIF.
181	0.0381241	-0.0457137	P	40N	112W	478	UTAH
182	0.0351916	-0.0457137	P	38N	115W	37	NEVADA
183	0.0322590	-0.0457137	P	37N	119W	39	CENTRAL CALIFORNIA
184	0.0293265	-0.0457137	P	36N	124W	38	OFF COAST OF CALIFORNIA
185	0.0425229	-0.0431740	P	41N	105W	460	WYOMING
186	0.0366578	-0.0431740	P	36N	113W	42	WESTERN ARIZONA
187	0.0337253	-0.0431740	P	34N	117W	43	SOUTHERN CALIFORNIA
188	0.0307928	-0.0431740	P	33N	120W	38	OFF COAST OF CALIFORNIA
189	0.0351916	-0.0406344	P	32N	114W	46	W. ARIZ-MEXICO BORDER
190	0.0337253	-0.0380947	P	29N	114W	48	BAJA CALIFORNIA
191	0.0351916	-0.0355551	P	27N	111W	49	GULF OF CALIFORNIA
192	0.0366578	-0.0330154	P	25N	108W	49	GULF OF CALIFORNIA
193	0.0351916	-0.0304758	P	22N	108W	51	OFF COAST OF CENT. MEXICO
194	0.0337253	-0.0279361	P	19N	108W	53	REVILLA GIGEDO ISLANDS
195	0.0381241	-0.0253965	P	19N	101W	57	MICHOACAN, MEXICO
196	0.0351916	-0.0253965	P	17N	104W	64	OFF COAST MICHOACAN, MEX.
197	0.0366578	-0.0228568	P	16N	100W	58	NEAR COAST GUERRERO, MEX.
198	0.0410566	-0.0203172	P	17N	94W	61	CHIAPAS, MEXICO
199	0.0381241	-0.0203172	P	15N	97W	66	NEAR COAST OF OAXACA, MEX
200	0.0425229	-0.0177776	P	16N	91W	62	MEXICO-GUATEMALA BORDER
201	0.0395904	-0.0177776	P	14N	93W	69	NEAR COAST OF CHIAPAS,MEX
202	0.0439892	-0.0152379	P	16N	88W	93	BRITISH HONDURAS
203	0.0410566	-0.0152379	P	13N	90W	71	NEAR COAST OF GUATEMALA
204	0.0425229	-0.0126983	P	12N	88W	76	OFF COAST OF CENT.AMERICA
205	0.0439892	-0.0101586	P	12N	85W	75	NICARAGUA
206	0.0410566	-0.0101586	P	10N	87W	77	OFF COAST OF COSTA RICA
207	0.0425229	-0.0076190	P	9N	84W	78	COSTA RICA
208	0.0366578	-0.0076190		0	0	0	
209	0.0410566	-0.0050793	P	7N	83W	77	OFF COAST OF COSTA RICA
210	0.0381241	-0.0050793	P	0N	86W	696	GALAPAGOS ISLANDS REGION
211	0.0395904	-0.0025397	P	3N	82W	83	SOUTH OF PANAMA
212	0.0439892	0.0	P	6N	76W	99	NORTHERN COLOMBIA
213	0.0410566	0.0	P	3N	78W	83	SOUTH OF PANAMA
214	0.0381241	0.0	P	4S	82W	108	OFF COAST OF N. PERU
215	0.0483880	0.0025396	P	10N	71W	100	LAKE MARACAIBO
216	0.0454554	0.0025396	P	6N	73W	99	NORTHERN COLOMBIA
217	0.0425229	0.0025396	P	3N	74W	103	COLOMBIA
218	0.0395904	0.0025396	P	1S	77W	107	ECUADOR
219	0.0381241	0.0050793	P	7S	77W	111	NORTHERN PERU
220	0.0366578	0.0076189	P	12S	76W	115	NEAR COAST OF PERU
221	0.0542530	-0.0025397	P	20N	71W	88	DOMINICAN REPUBLIC REGION
222	0.0557193	0.0	P	20N	68W	402	NORTH ATLANTIC OCEAN
223	0.0571856	0.0025396	P	21N	64W	402	NORTH ATLANTIC OCEAN
224	0.0557193	0.0050793	P	18N	63W	92	LEEWARD ISLANDS
225	0.0571856	0.0076189	P	19N	60W	92	LEEWARD ISLANDS
226	0.0542530	0.0076189	P	15N	62W	92	LEEWARD ISLANDS
227	0.0557193	0.0101586	P	17N	59W	92	LEEWARD ISLANDS
228	0.0527868	0.0101586	P	13N	61W	95	WINDWARD ISLANDS
229	0.0498542	0.0101586	P	9N	62W	97	NEAR COAST OF VENEZUELA
230	0.0674494	0.0203172	P	32N	42W	403	NORTH ATLANTIC RIDGE
231	0.0645168	0.0203172	P	28N	44W	403	NORTH ATLANTIC RIDGE
232	0.0615844	0.0203172	P	24N	46W	403	NORTH ATLANTIC RIDGE
233	0.0659832	0.0228568	P	30N	41W	403	NORTH ATLANTIC RIDGE
234	0.0601181	0.0228568	P	23N	44W	403	NORTH ATLANTIC RIDGE
235	0.0571856	0.0228568	P	19N	46W	403	NORTH ATLANTIC RIDGE
236	0.0542530	0.0228568	P	15N	47W	403	NORTH ATLANTIC RIDGE
237	0.0733145	0.0253965	P	41N	31W	404	AZORES ISLANDS REGION
238	0.0703819	0.0253965	P	36N	35W	403	NORTH ATLANTIC RIDGE
239	0.0527868	0.0253965	P	13N	46W	403	NORTH ATLANTIC RIDGE
240	0.0718482	0.0279362	P	39N	31W	405	AZORES ISLANDS

TABLE 3.1.4

Part III

BEAM NO	UX (S/KM)	UY (S/KM)	PHASE	LAT	LON	REGION NUMBER	AND NAME
241	0.0513205	0.0279362	P	11N	43W	403	NORTH ATLANTIC RIDGE
242	0.0498542	0.0304758	P	10N	41W	403	NORTH ATLANTIC RIDGE
243	0.0483880	0.0330154	P	9N	39W	406	C. MID-ATLANTIC RIDGE
244	0.0469217	0.0355551	P	8N	36W	406	C. MID-ATLANTIC RIDGE
245	0.0454554	0.0380948	P	8N	34W	406	C. MID-ATLANTIC RIDGE
246	0.0410566	0.0406344	P	4N	33W	406	C. MID-ATLANTIC RIDGE
247	0.0366578	0.0431740	P	1N	30W	406	C. MID-ATLANTIC RIDGE
248	0.0351916	0.0457137	P	1N	27W	406	C. MID-ATLANTIC RIDGE
249	0.0322590	0.0457137	P	2S	26W	409	SOUTH ATLANTIC OCEAN
250	0.0146638	0.0457137	P	18S	13W	410	SOUTH ATLANTIC RIDGE
251	0.0307928	0.0482534	P	1S	22W	406	C. MID-ATLANTIC RIDGE
252	0.0190626	0.0482534	P	12S	15W	410	SOUTH ATLANTIC RIDGE
253	0.0161301	0.0482534	P	14S	12W	410	SOUTH ATLANTIC RIDGE
254	0.0293265	0.0507930	P	0N	19W	406	C. MID-ATLANTIC RIDGE
255	0.0205289	0.0507930	P	8S	14W	408	ASCENSION ISLAND REGION
256	0.0278602	0.0533326	P	2N	17W	561	OFF S. COAST OF NW AFRICA
257	0.0249277	0.0533326	P	1S	15W	407	NORTH OF ASCENSION ISLAND
258	0.0219952	0.0533326	P	4S	13W	407	NORTH OF ASCENSION ISLAND
259	0.0190626	0.0533326	P	6S	11W	408	ASCENSION ISLAND REGION
260	-0.0439869	-0.0457137	P	51N	131E	656	EASTERN RUSSIA
261	-0.0513183	-0.0431740	P	52N	114E	328	EAST OF LAKE BAIKAL
262	-0.0586496	-0.0406344	P	54N	102E	327	LAKE BAIKAL REGION
263	-0.0454532	-0.0380947	P	42N	124E	658	NORTHEASTERN CHINA
264	-0.0527845	-0.0355551	P	45N	112E	334	MONGOLIA
265	-0.0483857	-0.0330154	P	38N	119E	658	NORTHEASTERN CHINA
266	-0.0615821	-0.0253965	P	43N	98E	334	MONGOLIA
267	-0.0557171	-0.0203172	P	32N	105E	307	SZECHWAN PROVINCE, CHINA
268	-0.0527845	-0.0152379	P	25N	105E	664	EASTERN CHINA
269	-0.0073302	-0.0380947	SKP	15S	174W	173	TONGA ISLANDS
270	0.0029336	-0.0355551		0	0	0	
271	-0.0131952	-0.0330154	PKP	29S	179W	177	KERMADEC ISLANDS REGION
272	-0.0117290	-0.0304758	PKP	26S	178W	171	SOUTH OF FIJI ISLANDS
273	-0.0234591	-0.0304758	PCP	51N	146E	663	SEA OF OKHOTSK
274	-0.0337230	-0.0279361	PCP	31N	141E	211	SOUTH OF HONSHU, JAPAN
275	-0.0117290	-0.0253965	PKP	30S	179W	177	KERMADEC ISLANDS REGION
276	-0.0190603	-0.0228568		0	0	0	
277	-0.0087965	-0.0152379	PKP	30S	176W	177	KERMADEC ISLANDS REGION
278	-0.0146615	-0.0152379	PKP	18S	169W	174	TONGA ISLANDS REGION
279	-0.0410544	-0.0152379		0	0	0	
280	-0.0190603	-0.0126983	PKP	16S	154E	595	CORAL SEA
281	-0.0322568	-0.0050793		0	0	0	
282	-0.0395881	-0.0025397		0	0	0	
283	0.0205289	0.0		0	0	0	
284	0.0146636	0.0		0	0	0	
285	-0.0469194	0.0		0	0	0	
286	-0.0190604	0.0025396		0	0	0	
287	0.0351915	0.0050793		0	0	0	
288	0.0102651	0.0076189	PKP	52S	90W	692	SOUTHERN PACIFIC OCEAN
289	0.0190626	0.0126982		0	0	0	
290	-0.0322567	0.0152379	PCP	31N	53E	348	IRAN
291	0.0337252	0.0177775		0	0	0	
292	0.0014674	0.0177775	PKP	74S	52W	157	WEDDELL SEA
293	0.0029336	0.0203172		0	0	0	
294	-0.0161278	0.0228568		0	0	0	
295	-0.0029314	0.0253965		0	0	0	
296	0.0190626	0.0279362		0	0	0	
297	0.0058662	0.0355551		0	0	0	
298	0.0000011	0.0355551		0	0	0	
299	-0.0161278	0.0431740	P	25S	28E	584	REPUBLIC OF SOUTH AFRICA
300	-0.0190603	0.0482534	P	17S	28E	580	RHODESIA
301	-0.0293242	0.0507930	P	6S	35E	573	TANZANIA
302	-0.0263916	0.0558723	P	1S	30E	572	LAKE TANGANYIKA REGION
303	-0.0293242	0.0558723	P	1N	32E	568	UGANDA
304	-0.0718459	0.0431740	P	37N	44E	343	TURKEY-IRAN BORDER REGION
305	-0.0689133	0.0482534	P	37N	41E	366	TURKEY
306	-0.0483857	0.0634912	P	28N	33E	553	UNITED ARAB REPUBLIC
307	-0.0498520	0.0660309	P	35N	30E	371	EASTERN MEDITERRANEAN SEA
308	-0.0527844	0.0660309	P	37N	30E	366	TURKEY
309	-0.0483857	0.0685706	P	37N	28E	366	TURKEY
310	-0.0513182	0.0685706	P	38N	28E	366	TURKEY
311	-0.0542507	0.0685706	P	39N	29E	366	TURKEY
312	-0.0410543	0.0711102	P	34N	26E	370	CRETE
313	-0.0439869	0.0711102	P	36N	26E	369	DODECANESE ISLANDS
314	-0.0366555	0.0736498	P	35N	24E	370	CRETE
315	-0.0322567	0.0761895	P	35N	22E	400	MEDITERRANEAN SEA
316	-0.0351893	0.0761895	P	36N	22E	368	SOUTHERN GREECE
317	-0.0381218	0.0761895	P	37N	23E	368	SOUTHERN GREECE
318	-0.0337230	0.0787292	P	37N	21E	368	SOUTHERN GREECE

TABLE 3.1.4

Part IV

Table 3.1.5 Detection Processor Scaling (26 July 1971 - 6 Jan 1972)

SEIM = 6 SA = 22 U-BP 0.9-3.5 HZ SEL. SURV. 07/26/71

FILTER PARAMETERS

	THEORETICAL	IMPLEMENTED	DP INPUT	FILTER PROC INPUT
K	0.18207	5946	0.18146	
A(0)	1	1	1	0.1814575E 00
A(1)	0	0	0	0.0
A(2)	-3	-3	-3	-0.5443726E 00
A(3)	0	0	0	0.0
A(4)	3	3	3	0.5443726E 00
A(5)	0	0	0	0.0
A(6)	-1	-1	-1	-0.1814575E 00
B(1)	-0.78964	-25875	-0.78964	-0.7896423E 00
B(2)	0.11755	3852	0.11755	0.1175537E 00
B(3)	-0.14618	-4790	-0.14618	-0.1461792E 00
B(4)	0.37631	12331	0.37631	0.3763123E 00
B(5)	-0.08356	-2738	-0.08356	-0.8355713E-01
B(6)	-0.01050	-344	-0.01050	-0.1049805E-01

DSUM = 0.2155192E 01
D2SUM = 0.2245389E 01
CSUM = -0.4268514E-06
C2SUM = 0.5149446E 00
CABSUM= 0.2006375E 01
CEVEN = 0.1057458E 01

SCALING FACTORS

ALPHA =	1	MU =	0
DELTA =	0	R =	3
BETA(SA) =	-1	NU =	-2
RHO =	-1	SIGMA =	-5
BETA(LA) =	-4	NFU =	6

GAINS

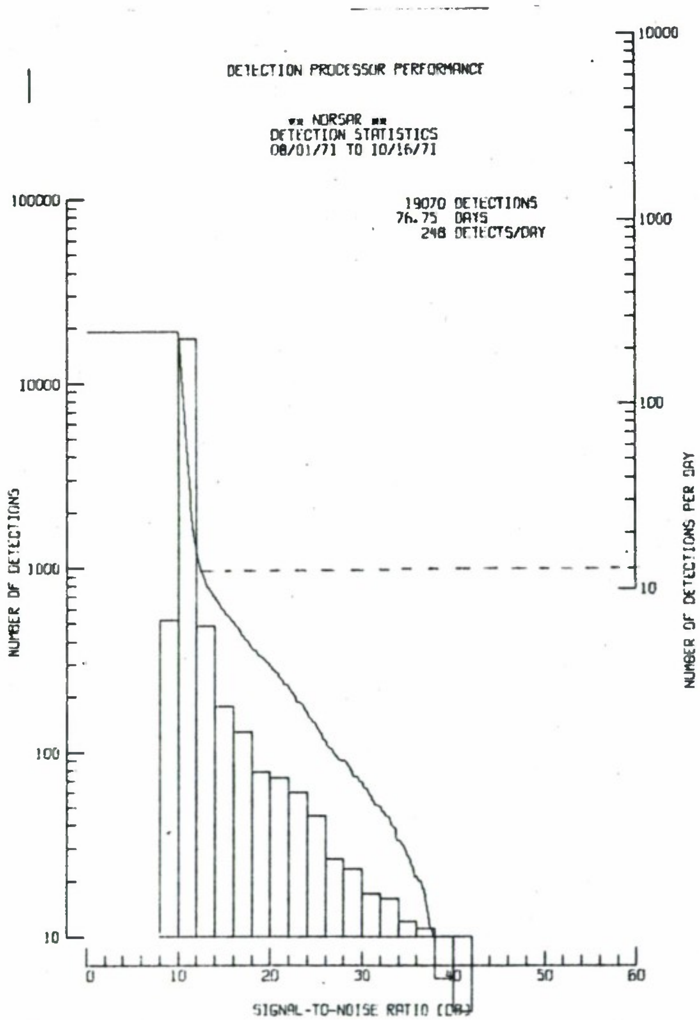
G(SA) = 0.245E 01
G(F) = 0.370E 01
G(LA) = 0.469E 01

GAMMA = - 15

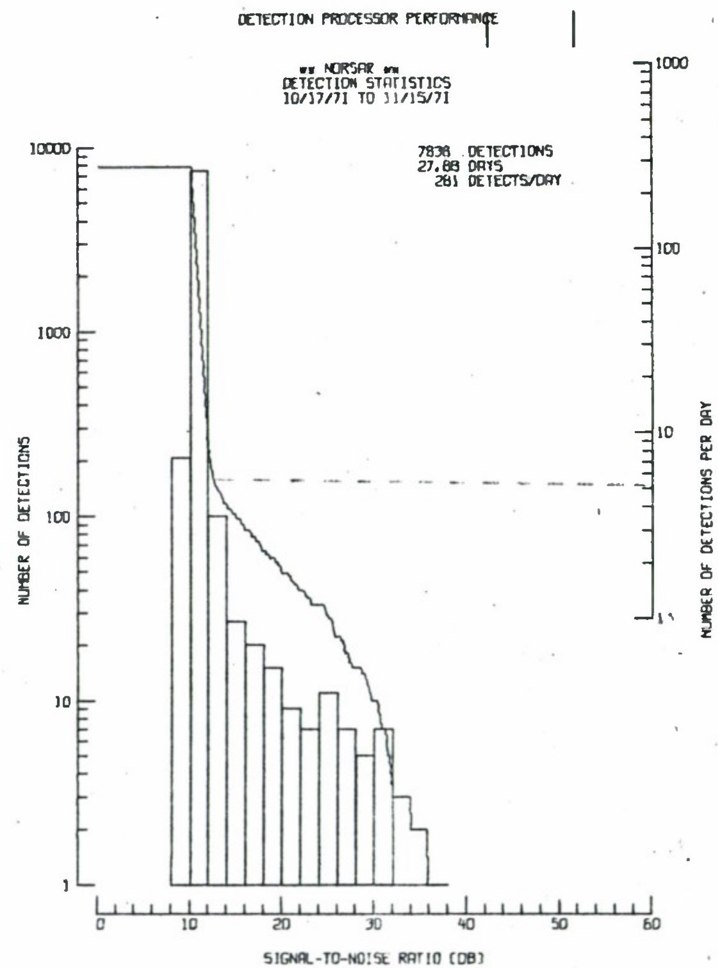
	Multiplier	Value 0.9-3.5 Hz Filter	Corresponding noise scaling
1. Input single seismometer values			23.4 qu/nm
2. Filter input shift (ALPHA)	2**ALPHA	1	46.8 "
3. Filter noise suppression (GF)	1/GF	3.7	12.6 "
4. Filter arithmetic scaling (FSCALE)	1/FSCALE	1.00	12.6 "
5. Filter output shift (DELTA)	2**DELTA	0	12.6 "
6. Subarray beamforming (GSA)	GSA=$\sqrt{6}$	$\sqrt{6}$	30.2 "
7. Subarray output shift (BETASA)	2**BETASA	-1	15.1 "
8. Array beam preshift (RHO)	2**RHO	-1	7.5 "
9. Array beamforming (GLA)	GLA=$\sqrt{22}$	$\sqrt{22}$	35.4 "
10. Array beam output shift (BETALA)	2**BETALA	-4	2.2 "
11. Rectification $\| \|$ $\sqrt{2/\pi}$	$\sqrt{2/\pi}$		1.8 "
12. Rectification shift (MU)	2**MU	0	1.8 "
13. STA integration (STAW)=(R*S)	STAW	15	26.4 "
14. LTA scaling shift (ZETA)=(NU-SIGMA)	2**ZETA	3	211 "

TABLE 3.1.6

Detection Processor Scaling
26 July 1971 - 6 Jan 1972

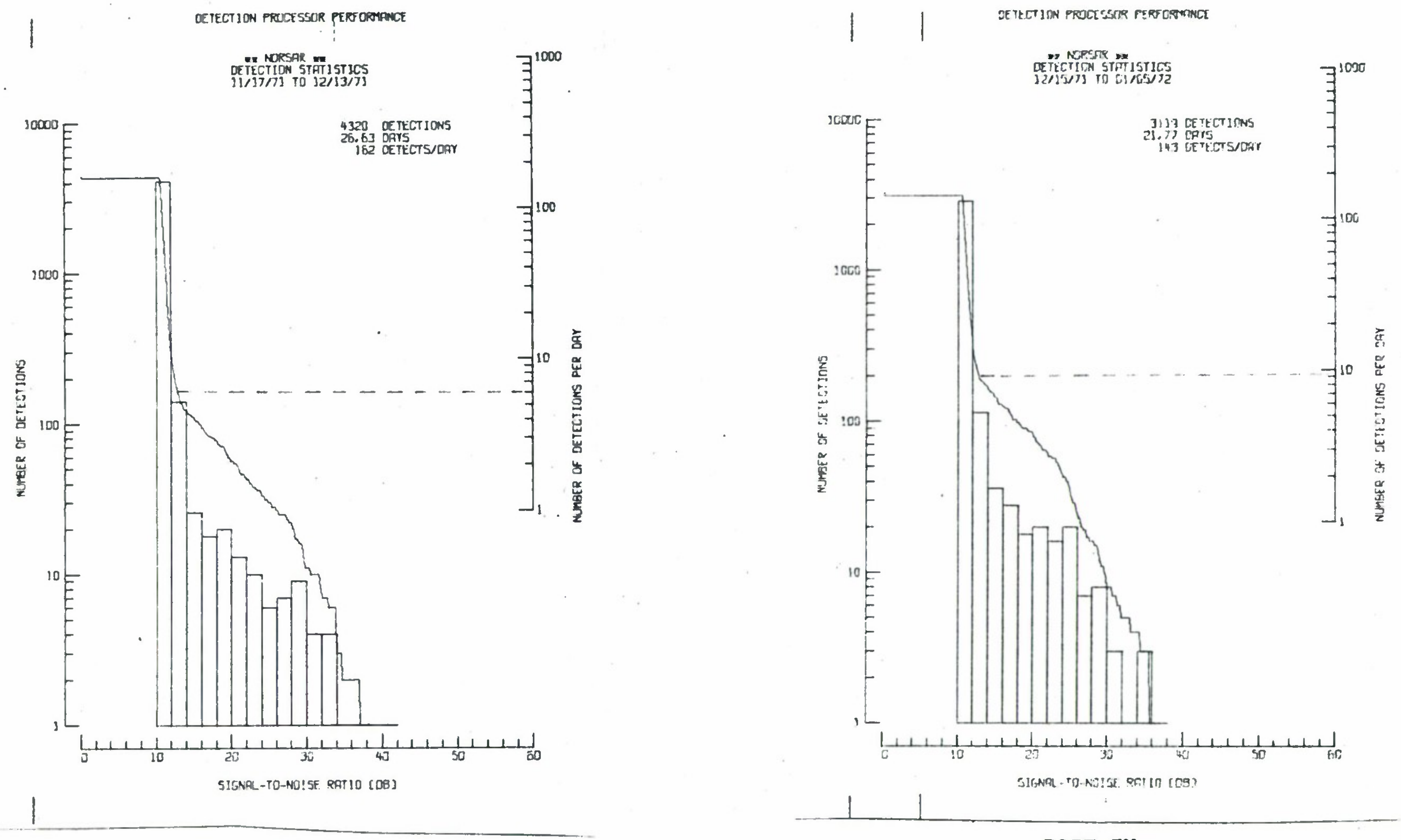


PART I



PART II

Figure 3.1.2 NORSAR Detection Statistics 1971



PART III

PART IV

Figure 3.1.2 NORSAR Detection Statistics 1971

The intersection (12 dB) between the noise and signal slopes is remarkably stable for all time periods selected. This represents the SNR above which only a negligible number of false alarms (i.e., noise detections) may be expected. Looking at the corresponding number of detections above 12 dB, however, one discovers an average number of 12, 5, 6 and 9 for the four time period respectively. This drop in the detection rate during the fall months is without doubt caused by increased background seismic noise. Note that a major earthquake swarm from Kamchatka has somewhat biased the detection rate for the fourth time period.

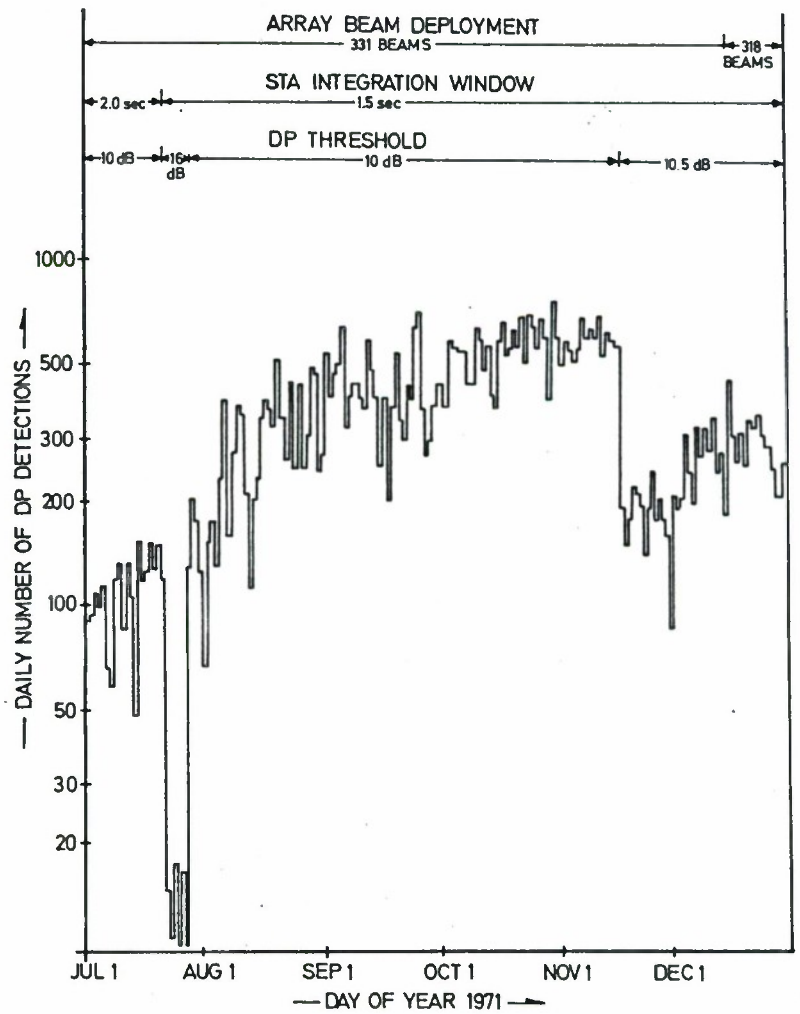


Figure 3.1.3 Daily number of DP detections July - December 1971

The number of detections declared by the DP shows significant day-to-day variation as shown in Figure 3.1.3. This figure gives the combined daily number of detections for Selected and General Surveillance, with no grouping of detections close in time. It is seen from this picture that while an average number of 100 detections per day was seen in July, this number increased to 500 in October, with the same DP threshold. In contrast to this, the number of reported seismic events declined substantially from July to October. Obviously, the false alarm rate was much higher in October, and it has later been verified that the variability of the seismic noise (and thus the probability of false alarms) is very much dependent on the shape of the noise power spectrum. Thus the fall and winter weather conditions seem to both increase the noise level and increase the false alarm rate, both factors contributing to a degrading of the NORSAR DP performance.

3.1.6 Data Retention

Procedures and software for retention of short and long period data beyond the mandatory 9 month period were developed in August and September. From 1 October, the data retention program was run on a regular basis, with 1 March 1971 being the start time for regular event retention.

The criteria for data saving were the following: All LP data was to be retained indefinitely on Low Rate tapes.

For SP data, time intervals of variable length for selected events were to be retained indefinitely on specially created "stacked" data tapes.

For the purpose of event selection, the world was divided into 3 regions: Seismic, Aseismic and Special Interest areas.

The special interest areas were initially defined to encompass known nuclear test sites; and the following boundaries were selected:

Between	$45^{\circ}N-77^{\circ}N$	and	$45^{\circ}E-69^{\circ}E$
"	$47^{\circ}N-54^{\circ}N$	and	$72^{\circ}E-83^{\circ}E$
"	$49^{\circ}N-55^{\circ}N$	and	$1173^{\circ}E-177^{\circ}W$
"	$35^{\circ}N-39^{\circ}N$	and	$114^{\circ}W-120^{\circ}W$

Event selection was to be performed using event data from NOAA and NORSAR bulletins, with the option to include events manually selected by an analyst.

For each bulletin event, the NORSAR or NOAA epicenter information was used in conjunction with a "seismicity map" developed by IBM to decide whether or not the event occurred in an area of significant seismic activity. Possible location errors of 100 km (NOAA) and 500 km (NORSAR) were allowed for in this process.

On this basis, the time interval to be saved for each event was determined by epicentral distance from NORSAR and body wave magnitude as shown in Table 3.1.7. If an event satisfied more than one criterion, the one implying the longest time interval to save was to be chosen.

In October, an option was provided to run the routine data retention in a foreground partition of the Event Processor. This allowed for very efficient operation from a computer time viewpoint from this date.

Source Region	Distance (Δ)	Magnitude (m_b)	Retention Interval
Seismic	$0^{\circ}\leq\Delta\leq15^{\circ}$	$m_b>3.5$	1
	$25^{\circ}\leq\Delta\leq105^{\circ}$	$m_b>4.6$	1
	$0^{\circ}\leq\Delta\leq180^{\circ}$	$m_b>5.8$	2
	$0^{\circ}\leq\Delta\leq180^{\circ}$	$m_b>6.5$	3
Aseismic	$0^{\circ}\leq\Delta\leq15^{\circ}$	$m_b>3.5$	1
	$25^{\circ}\leq\Delta\leq105^{\circ}$	$m_b<4.2$	1
	$25^{\circ}\leq\Delta\leq105^{\circ}$	$m_b\geq4.2$	2
	$0^{\circ}\leq\Delta\leq180^{\circ}$	$m_b>6.5$	3
Special Interest	$0^{\circ}\leq\Delta\leq105^{\circ}$	$m_b<4.2$	1
	$0^{\circ}\leq\Delta\leq105^{\circ}$	$m_b\geq4.2$	2
	$0^{\circ}\leq\Delta\leq180^{\circ}$	$m_b>5.0$	2
	$0^{\circ}\leq\Delta\leq180^{\circ}$	$m_b>6.5$	3
Events Selected by Analyst			3

Retention Intervals:

1 - (P-2 min) to (P+10 min)
2 - (P-2 min) to (P'P'+10 min)
3 - (P-2 min) to (P'P'+40 min)

TABLE 3.1.7

Rules for retaining SP data at NDPC

3.2 Event Processor Operations

3.2.1 General Considerations, Mode of Operation

The Event Processor (EP) is a software package which performs a detailed study of selected detections from the Detection Processor (DP), in order to refine the location and compute various signal parameters.

Implementation of the EP at NORSAR started in the beginning of 1971, and from the end of April the system was run on a regular basis. That involved a necessary and important daily review by analysts, a process which led to a gradual improvement of both EP's and the analysts' performance.

During this reporting period, the EP was more or less continuously in a state of change, and most so in the first two months. This applies to algorithms, parameters, output and review procedures. Completely new algorithms were implemented, others were heavily modified, and much work was also invested in pure debugging, in order to get the software in line with the intentions. The EP is heavily parametrized, and much work was put down in the optimization of these parameters.

On 1 Sept 1971 the formal responsibility for the operation switched from IBM/FSD to NTNF/NORSAR, and from the same date a weekly seismic bulletin was produced and distributed externally to about 50 institutions throughout the world.

In the daily analysis work, the first question to be answered by the analyst is whether a processed detection is a seismic event (including later phases) or not. Table 3.2.1 shows that for the time period 15 Sept - 31 Dec 1971, 56.9% of the processed detections were accepted. On the other side, 19.6% were rejected because there were other processings of the same event,

Analyst Classification	Number of Processings	Percentage
Accepted as events	971	56.9
Rejected as being:		
- Noise detections	280	16.4
- Local events	54	3.2
- Double processings	335	19.6
- Communication errors	66	3.9
Sum Processed	1706	100

TABLE 3.2.1

Analyst Decisions for EP Processings
during the Time Period 15 Sept - 31 Dec 1971

while 16.4% were rejected as being noise detections. This last decision is a difficult one; there is just no objective criterion which the analyst can use in deciding whether a particular detection is caused by noise or a real event. In practice, the requirement would be that the beam should show a clear cycle, and very few events were accepted where not also at least a few subarrays showed the signal. Figure 3.1.2 in chapter 3.1.5 shows that the "breaking point" between signals and noise detections was around 12 dB, and this was also used as the EP-threshold until 15 Nov 71, when the EP-threshold was raised to 13 dB. Before this change, there were an average of 67.7% noise detections, and this was more than one could afford during a time period when there was lack of computer time. Also, as demonstrated in Section 3.1.5 (Figure 3.1.3) the number of noise detections increased throughout the autumn, in proportion to the increase in the noise level (Figure 3.2.1a). After the EP-threshold was raised to 13 dB, the noise detections dropped to 2.9%, meaning of course that many real events never came to EP.

3.2.2 Computer Utilization

According to Table 3.1.2, EP was up 37.9% of the time on the B-computer. Since there is always available background partition(s) during EP operation, this means that less than 37.9% of the capacity of the B-computer was used on EP.

A detailed study (Bungum and Berteussen 1971) of the computer time required by EP showed that 9 min 2.9 sec were used per event, excluding the time used for tape handling. As much as 53% of this time was spent in the Time Delay Correction Package, while the Depth Estimator took 12%.

As Table 3.2.1 shows, there were processed a total of 971 detections during the 3½ last months of 1971, 57% of which were accepted as real events. Taking also into consideration that some of these accepted ones were later phases, the time per accepted event was therefore closer to 20 minutes. This was not considered satisfactory, and the above cited computer time analysis was part of an effort to find out where one could possibly cut down the required computer time.

3.2.3 Special EP Operational Problems

Since the Event Processor in this period has been in a transition phase, with debugging and implementation of new algorithms going on continuously, most of the operational problems have been terminations or hangups caused by modifications of the system. Apart from these self-inflicted bugs, which were found and corrected, errors inherent in the system turned up and caused problems. For instance, in the middle of the period the procedure of re-cycling of the assigned EPX numbers caused a temporary hangup of EP operation until the error was located and the algorithm corrected. A small problem of Event Tape use was corrected by modifying the tape monitoring routine in the Event Processor, such that the operator is left with the decision of whether a Job Step 3 may use the same Event Tape as Job Step 4. The standard configuration of operation for the Event Processor was changed to 2 regions (A & B), as the 3 regions' operational mode (A,B & C) are never used. However, the output editing step (Job Step 4) was allowed to execute in one region only (A), thus freeing enough core space to Background to allow jobs of normal size to execute concurrently. An additional bonus is the free space obtained in the Core Image Library when removing the B and C phases of the different packages.

To allow the data retention program to run concurrently with the Event Processor on the B-computer, a special background version of the Event Processor was implemented. The data retention program has a high I/O rate and makes little use of the CPU. It should therefore be run in foreground 2. In the new EP background version, the EP monitor was linked into the third unused region (C), thereby freeing 40K for a foreground 2 region.

3.2.4 EP Parameters and Algorithms

Of the more significant changes in parameter values in this period, the following should be mentioned.

July 16

Changes in the parameters for the correlation package:

- The constants used for computing prior probabilities (HPPRB2) were changed from 0.5 to 1.0.
- The variance estimate for region corrections (VSUBR2) was reduced from 0.16 to 0.04.

Changes in the parameters for the event parameter extraction package:

- The number of samples between the start sample and the first peak (NAL4), when determining the arrival time by threshold pick, was doubled from 50 to 100.
- The number of samples between the start sample and the arrival time (NAA4), when determining the first motion direction, was decreased from 30 to 10.
- The correlation function threshold (FB4) in the first motion direction calculation was increased from 0.75 to 0.90.

October 27

The EW coordinates of the instruments relative to the center seismometer for subarray 03C were corrected.

November 15

The EP prethreshold level (PSTHRSH) was raised from 12 to 13 dB.

December 7 to 22

During this period the filter base was changed and new filters were tested as processing filters for EP. The final results were:

- The same filter, a 1.0-3.0 Hz Butterworth bandpass filter, was used in the correlation procedure, the array beamforming and during plotting. (Earlier, different filters had been used for different jobs.)
- The filter base was rearranged to comprise the following bandpass filters:

1)	1.0 - 3.0 Hz (EP-processing filter)
2)	1.4 - 3.4 "
3)	All Pass
4)	0.8 - 2.5 "
5)	0.75- 4.0 "
6)	1.6 - 3.2 "
7)	1.2 - 3.0 "

December 22

The parameters determining the length of the plotted output (TBFRP & TAFTP) were changed so that the smallest plot had an Array Beam Panel 80 seconds long (whereas the earlier value was 40 seconds).

New algorithms have been added to the EP system, and changes have been made in the already existing. To the already mentioned implementations (see 3.2.3), one should add:

July

The test mode package was implemented. This addition simplifies the problem of testing out new algorithms in an EP context.

The event family grouping package was implemented as a part of the Event Processor Controller. Many of the hangups of the Event Processor during this period were caused by the event family grouping package, and so far it has not given any results (that is, in relating different EPXes). However, since this package performs some important functions in the control of the detections received, it was decided that it was better to leave it in its non-productive state within the system, rather than to take it out.

The supergrouping algorithm was also implemented as a part of the Event Processor Controller. This routine merges detections which are related in time and from the same partition, into supergroups. Apart from minor bugs that have been corrected, this routine performs as expected.

December

Coding was inserted in the calibration and interpolation package to compute standard deviations for the computed velocity, inverse velocity, azimuth and range, on the basis of the standard deviations computed for the inverse velocity components by the correlation procedure.

Algorithms for automatic parameter change in Detection Bulletin File line editing were inserted. (An edited change in the arrival time, dominant period or amplitude gives automatically a corresponding change in the origin time, amplitude and magnitude, or magnitude only.)

The logic for choice of plot length in Job Step 3 was improved and some obvious errors were corrected.

3.2.5 EP Performance Statistics

A special report (Bungum and Berteussen, 1972) has been prepared which partly covers this reporting period. However, some results will still be given here.

Table 3.2.2 shows, on a monthly basis, the number of events reported by NORSAR, totally and in the teleseismic zone. On a daily basis, this is also displayed in Figure 3.2.1b, where one dominating feature is the swarm from Kamchatka on day 349, also mentioned in chapter 3.1.5. Figure 3.2.1a shows for the same time period the average noise level within the processing frequency band, computed as the beam average of the Long Term Average (LTA) in Selected Surveillance.

The gradual increase in the background noise level throughout the autumn, and the simultaneous decrease in the number of reported events, is very clear from Figures 3.2.1a and 3.2.1b. Also, the reader can easily from the same figures assure himself of the good day-to-day correlation between noise and signals, swarms excepted.

Another way of studying the number of reported events is to look at the distribution of the daily number of events as presented in Figure 3.2.2. The empirical curve is smoothed but still shows considerable deviations from the theoretical Poisson distribution for this process. The main reasons for the deviation is swarms and variations in detectability caused by noise variations.

Month	NORSAR Number of Events		NORSAR/NOAA Comparison $0^{\circ}<\Delta<180^{\circ}$			NORSAR/NOAA Location Difference $30^{\circ}<\Delta<90^{\circ}$		
	$0^{\circ}<\Delta<180^{\circ}$	$30^{\circ}<\Delta<90^{\circ}$	NORSAR only	NOAA only	NORSAR & NOAA	Events	50%	90%
Jul 71	415	277	200	407	184	78	190	500
Aug 71	320	264	172	251	136	75	210	1150
Sep 71	334	272	161	198	161	94	210	700
Oct 71	244	205	89	231	150	71	170	400
Nov 71	154	125	67	199	90	59	210	550
Dec 71	280	252	105	193	175	132	220	550
Jul-Dec	1747	1395	794	1479	896	509	200	560

TABLE 3.2.2

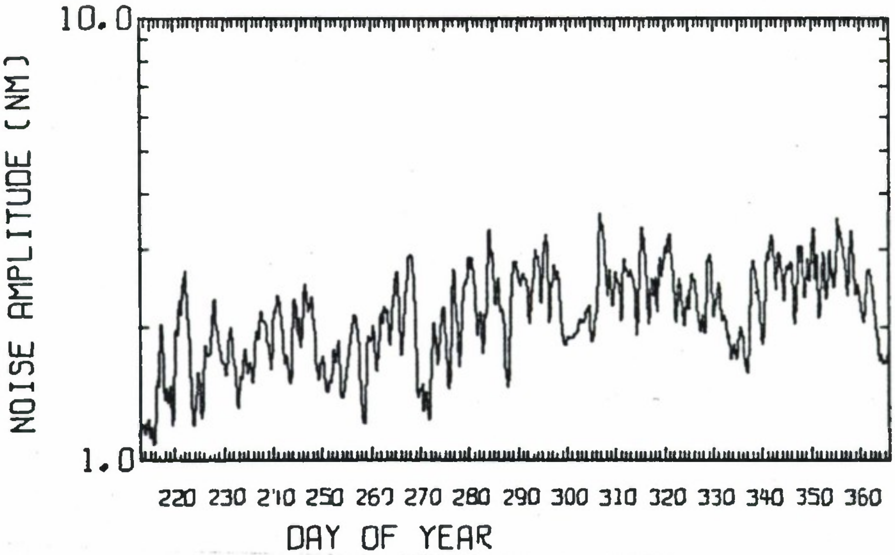


Figure 3.2.1a Average noise level at NORSAR within the processing frequency band 0.9-3.5 Hz, for the time period 1 Aug - 31 Dec 1971.

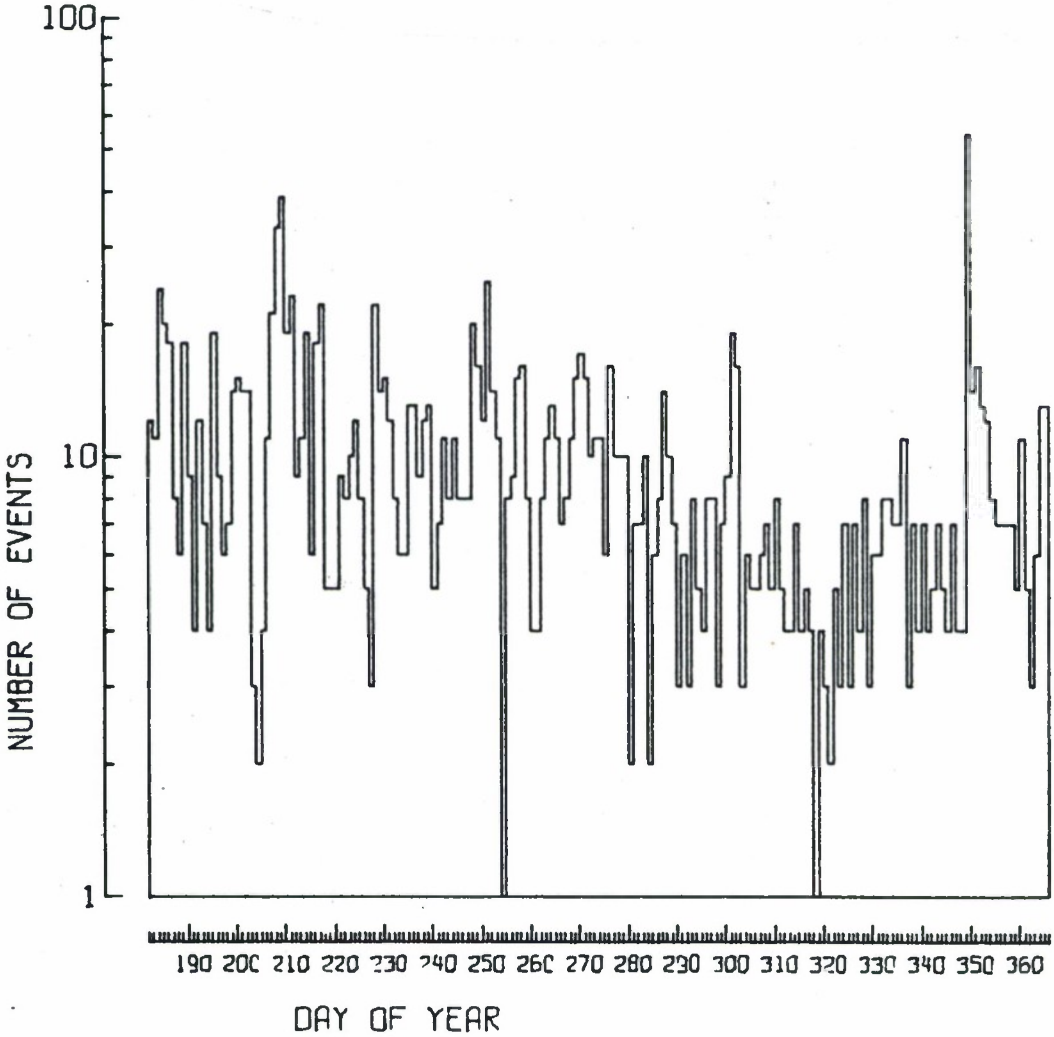


Figure 3.2.1b Daily number of events reported by NORSAR as a function of day of year for the time period 1 July - 31 December 1971.

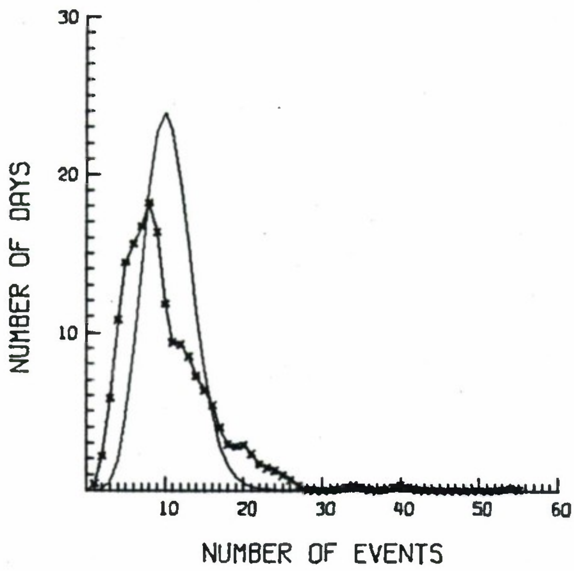


Figure 3.2.2 Number of days when N events are reported by NORSAR, as a function of N, for the time period 1 July - 31 December 1971. The smooth curve is the theoretical Poisson distribution, based on the same total number of events.

A comparison with NOAA is also presented in Table 3.2.2, which shows that roughly 50% of the events reported by NORSAR are confirmed by NOAA. The world-wide coverage by NOAA of course accounts for the large number of NOAA events not reported by NORSAR.

Some results from a location study are also presented in Table 3.2.2. For events located by both NOAA and NORSAR the distribution of the difference has been computed on the monthly basis. The 50% level varies between 170 and 210 km, while for the complete reporting period (Figure 3.2.3) the 50% level is at 200 km and the 90% at 560 km.

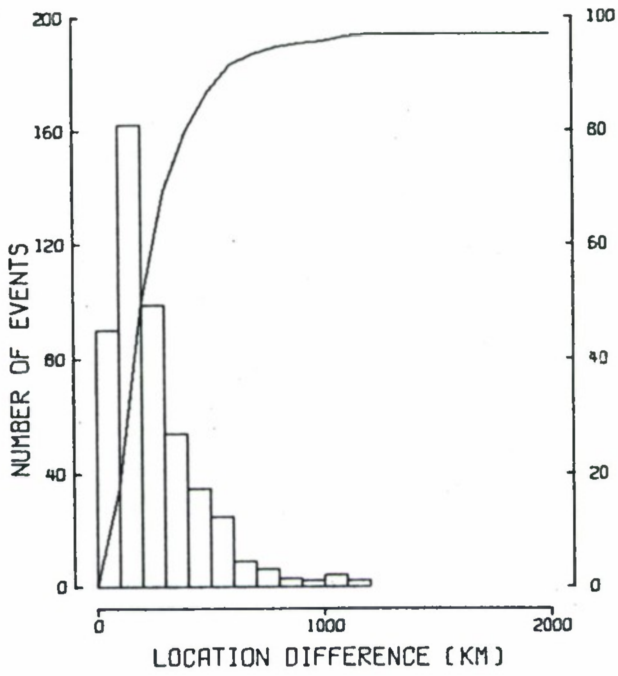


Figure 3.2.3 Incremental and cumulative distribution of location differences between NOAA and NORSAR for all events reported by both institutions in the time period 1 July - 31 December 1971, located by NOAA within 30^{o}-90^{o} from NORSAR.

Finally, it should be noted that during the reporting period time delay and location corrections were used which were computed from preliminary data, based on only 18 single seismometers (Plan D). Therefore, after the implementation of better corrections and a tuning of the filters, one should expect significant improvements as compared to the above results.

3.3 Array Monitoring and Control

The array monitoring and control activities at NDPC, being closely related to the field maintenance work, are extensively covered in NORSAR Report No. 40.

3.4 Change Control Board (CCB)

A Change Control Board (CCB) was formally established 1 Sept 1971, as a succession to the IBM CCB. Protocols were transferred from IBM to the new CCB. The board is organized with 3 permanent members (of which 1 IBM) and a secretary. In addition, other personnel take part in meetings (which are held weekly) for presenting and explaining discrepancies or change requests, or reporting results of requests. Requests are assigned to a person working in the relevant field, and results are reported to the board in due course. All changes to, or discrepancies in, the NORSAR system, whether hardware or software, are handled by the CCB. The request form is shown in Figure 3.4.1. Table 3.4.2 indicates the CCB activity in the period 1 Sept - 31 Dec 1971. Table 3.4.1 explains the codes used in weekly printouts. Table 3.4.3 shows a typical printout page.

NORSAR CHANGE CONTROL BOARD

Discrepancy Report ☐ Change Request ☐

PORT NO: ________ ORIGINATOR: ________ DATE: ________ GMT TIME: ________

CEIVED BY CCB: ____ ________ REFERENCE (REPORT NO): ______________

STEM AFFECTED

☐ EP - Event Processor	☐ NH - NDPC Hardware
☐ DP - Detection Processor	☐ CH - Communication Hardware
☐ AM - Array Mon. & Control	☐ FE - Field Equipment
☐ LP - LP Processing	☐ OP - Operational Procedures
☐ OS - Other Software	☐ PC - Parameter Change

SCRIPTION OF TOPIC

TIONS PROPOSED

TIONS PERFORMED ASSIGNED TO: ______________

MENTS

UMENTATION/OP.PROC. IS UPDATED ☐ IMPLEMENTATION DATE: ________

	1	2	3	4	5	6
/STATUS CODE						
DATE						
SIGNATURE						

MENTS

Figure 3.4.1 NORSAR CCB Discrepancy Report

ATTACHMENT ☐

NTNF/NORSAR CHANGE CONTROL BOARD
DISCREPANCY REPORT (DR) AND CHANGE REQUEST (CR) DATA FILE
THIS FILE WAS UPDATED LAST TIME 10/26/71

THE FOLLOWING CODES DESIGNATE
THE SYSTEM AFFECTED IN EACH CASE

EP - EVENT PROCESSOR	NH - NORSAR DATA CENTER HARDWARE
DP - DETECTION PROCESSOR (AND SPS)	CH - COMMUNICATION SYSTEM HARDWARE
AM - ARRAY MONITORING PROGRAMS	FE - FIELD EQUIPMENT
LP - LONG PERIOD SIGNAL PROCESSING	OP - OPERATIONAL PROCEDURES
OS - OTHER SOFTWARE	PC - PARAMETER CHANGE (DP AND/OR EP)

THE FOLLOWING CODES REFLECT THE
CURRENT STATUS OF EACH REQUEST

A - HAS BEEN ACCOMPLISHED
B - IS BEING IMPLEMENTED
C - HAS BEEN CANCELLED
D - HAS BEEN DEFERRED, BUT WILL BE RECONSIDERED
E - HAS BEEN ADEQUATELY EXPLAINED OR ANSWERED
I - IS BEING INVESTIGATED
L - LOW PRIORITY ITEM, TO BE SUSPENDED INDEFINITELY
R - HAS BEEN REJECTED
U - IS PRESENTLY UNRESOLVED
W - IS WAITING FOR IMPLEMENTATION

STATUS CODES CHANGED SINCE PREVIOUS DISTRIBUTION ARE MARKED *
NEW REPORTS SUBMITTED SINCE PREVIOUS DISTRIBUTION ARE MARKED **

TABLE 3.4.1

Status 1 Sep 1971 (transferred from IBM)	Status 31 Dec 1971

NUMBER OF REQUESTS FOR EACH STATUS CODE

A	N/A	84
B	0	9
C	N/A	9
D	9	13
E	N/A	20
I	11	14
L	4	5
R	N/A	1
U	0	6
W	0	3

TABLE 3.4.2

CCB Activity 1 Sept - 31 Dec 1971

REPORT NO	REFER NO	TYPE DR/CR	SYSTEMS AFFECTED	ORIGIN DATE	LOGGED DATE	CLOSED DATE	SUBJECT	PRESENT STATUS
0429		CR	DP	11/09/71	11/10/71	11/16/71	CHANGE TNDEPR TO MAKE POSSIBLE USE OF ONLY ONE LTA BUFFER	A
0430		DR	DP	11/06/71	11/10/71		EOC WAVEFORM STOPPED DURING DISPLAYING AMCHITKA EXPLOSION	I
0431		DR	DP	11/06/71	11/10/71	11/10/71	POWER BREAKE AT 2790 15H 37M (POWER BACK AT 16H 40M)	E
0432		DR	DP	11/10/71	11/10/71	11/12/71	ONLINE DP DID NOT ACCEPT HEADER CHECKED TAPES	E
0433		CR	DP	11/10/71	11/10/71		MAKE ONLINE DP PUNCH DATACARDS FOR TAPE LIBRARY PROGRAM	I
0434		DR	FE	11/05/71	11/10/71	11/10/71	AM/C STATUS 10/17 - 10/30 1971	A
0435		CR	EP,PC	11/10/71	11/10/71	11/11/71	CHANGE EP THRESHOLD FROM 12 TO 13 DB	A
0436		CR	DP,PC	11/10/71	11/10/71	11/16/71	RAISE DP THRESHOLD FROM 10 TO 10.5 DB	A
0437		CR	EP,PC	11/10/71	11/10/71	12/07/71	INTRODUCE A PARAMETER WHICH CONTROLS THE NUMBER OF BEAMPACKINGS	A *
0438		CR	DP	11/16/71	11/17/71	11/16/71	SKIP READING TO 360 FROM SPS OF B-FILTER DATA IF THE B-FILTER IS NOT USED	A
0439		CR	EP	11/16/71	11/17/71		OLD RECOMMENDATIONS FOR CHANGES IN ARRIVAL TIME DETER-MINATION PARAMETERS TO BE RECONSIDERED	W
0440		DR	DP	11/25/71	12/01/71	11/26/71	'AC' RECORDS ON HIGH RATE TAPES WERE NOT PROPERLY WRITTEN	A
0441		DR	DP	11/25/71	12/01/71	12/08/71	ONLINE DP STOPPED THREE TIMES DUE TO NO HR BLOCK AVAILABLE	A *
0442		DR	FE	11/18/71	12/01/71	12/01/71	AM/C STATUS 31 OCT - 13 NOV 1971	A
0443		DR	DP	11/23/71	12/01/71	12/06/71	HIGH RATE TAPE NO6613 MISSING TAPEMARK BETWEEN HDR1-RECORD AND DATA	C *

TABLE 3.4.3

3.5 Seismic Data Exchange

3.5.1 NORSAR Weekly Seismic Bulletin

Regular distribution of weekly seismic bulletins started in September 1971. The bulletin is sent to fifty institutions in seventeen different countries.

Country	No. of Institutions
Australia	1
Canada	1
Denmark	1
Federal Republic of Germany	6
Finland	2
France	3
German Democratic Republic	2
India	3
Israel	1
Japan	1
Netherlands	1
Norway	2
Sweden	3
Switzerland	1
USSR	1
United Kingdom	4
United States of America	17

3.5.2 Bulletins Received

NORSAR received bulletins regularly, starting before or during the report period, from stations/institutions at the following locations:

- Bergen, Norway (including Kongsberg, Tromsø and Kings Bay stations) - weekly
- Hagfors, Sweden - daily detector readings, array
- Uppsala, Sweden - weekly
- Helsinki, Finland - weekly, four stations
- Copenhagen, Denmark - weekly, network

- Gauribidanur, India - weekly
- Moscow, USSR - monthly
- LASA - weekly
- NOAA - monthly

3.5.3 Tape Distribution

NORSAR data tapes were supplied to the following during the period:

- University of Copenhagen, Denmark (3)
- University of Helsinki, Finland (3)
- University of Utrecht, Netherlands (2)
- University of Karlsruhe, Federal Republic of Germany (1)
- Lincoln Laboratory, U.S.A. (2)
- SAAC (169)

REFERENCES

The following reports and documents have been issued in the report period and have a bearing on the relevant subjects.

1) Suppression of Noise in LP-channels, A/S Teleplan Report, 12 July 1972.

2) SP Seismometer Instrument Chain, A/S Teleplan Report, 5 November 1971.

3) Progress Report, 2nd Quarter 1971, NORSAR Report No. 17.

4) Progress Report, 3rd Quarter 1971, NORSAR Report No. 18.

5) Progress Report, 4th Quarter 1971, NORSAR Report No. 20.

6) Bungum, H., and K-A. Berteussen: NORSAR Event Processor Computer Time Requirement, NORSAR Technical Report No. 21, December 1971.

7) Ringdal, F.: Discussions with SAAC personnel on Trans-Atlantic Data Transmission from SAAC to NDPC, NORSAR Travel Report No. 22.

8) Bungum, H., and K-A. Berteussen: An Evaluation of the Routine Processing of Events at NORSAR during the Time Period May-October 1971, NORSAR Report No. 24, March 1972.

9) Field Maintenance Report, 1 Jan - 30 Sept 1971, NORSAR Technical Report No. 32.

10) Steinert, O., and A. Kr. Nilsen: Array Monitoring and Field Maintenance Report, 1 Oct 71 - 30 June 72, NORSAR Technical Report No. 40.

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13. ABSTRACT

This report covers the operation of the NORSAR system during the period 1 July - 31 December 1971, except for array monitoring and control and associated field maintenance, which activities are, in accordance with Contract F19628-70-C-0283, covered by a separate report (NORSAR Report No. 40). A chapter on workshop repairs is, however, included here, although the main emphasis is on NDPC operations.

The report covers the first half year period when the regular NORSAR staff had the responsibility for all aspects of operation. Consequently, some areas are treated in somewhat more detail than in earlier reports on the subject.

DD FORM 1 NOV 65 1473

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT