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INTRODUCTION TO NORSAR SP ANALOG STATION

44

by

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NORWEGIAN SEISMIC ARRAY

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SUMMARY

A brief description of signal path and maintenance routines for the NORSAR SP analog station is given. The station magnification as function of frequencies is included

1 CONFIGURATION

The output from a conventional NORSAR SP seismometer (HS-10-1/ARPA) and seismograph amplifier (TI RA-5) located in LPV/05C is being transmitted to NDPC without digitization. NORSAR Plan D telemetry equipment, Geotech AS-330 and XS-410, is used for the transmission. At NDPC a recording station, Helicorder RV-301 and AR-311, with a LABTEKNIKK time mark unit is installed.

2 FREQUENCY RESPONSE

The characteristics of the seismic instrumentation are given in Table 2. This part of the seismograph is identical to other SP instrumentation in the array.

Figure 1 shows the magnification of the seismograph and Table 1 the measured values of the channel as of date 22 November 1972. The seismograph magnification, M, as function of frequency, f, is calculated from equation (1),

$$M = a/y$$

$$y = \frac{G \cdot I \cdot 10^3}{4\pi^2 f^2 m} \qquad (1)$$

a - peak-to-peak deflection in mm on the seismogram caused by the calibration current, I, in the cal. coil.

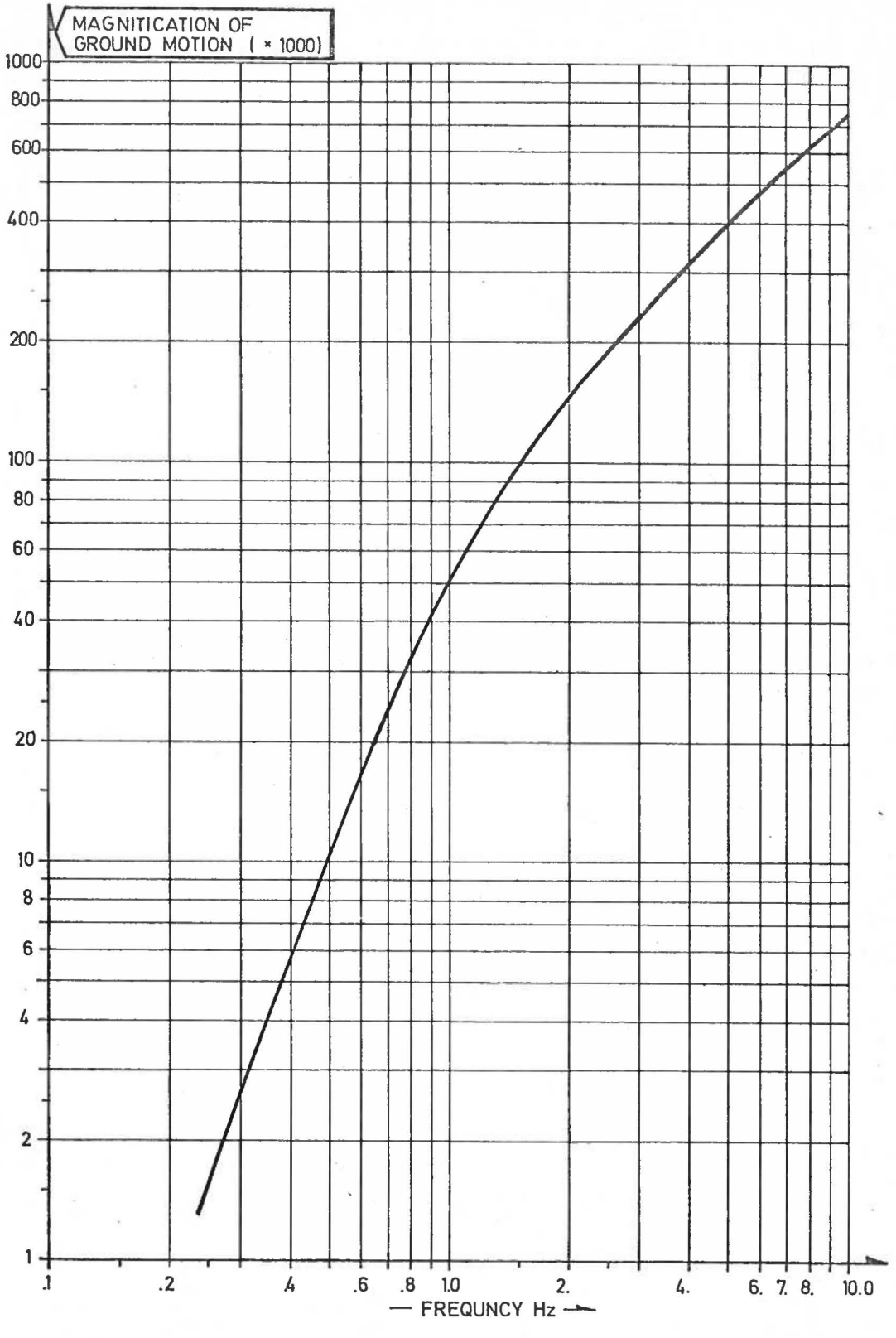

Fig 1. Frequency response of NORSAR analog SP station.
Calculated characteristics of seismic instrumentation:
λ=0.74, F_o=0.95Hz, RA-5 gain=75.3 dB

(Date: 22 November 1972)

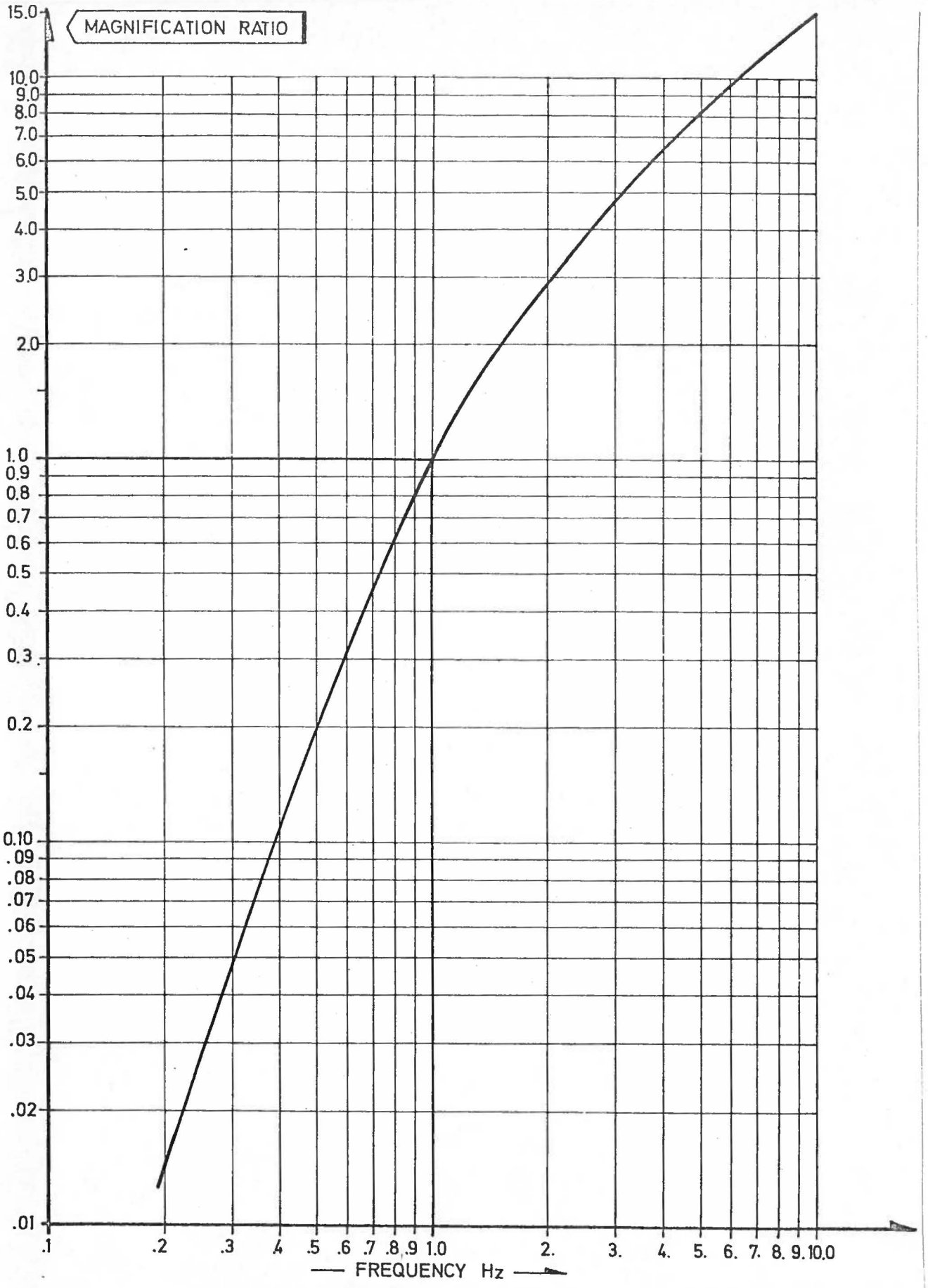

Fig 2. Magnification of ground motion relative to magnification at 1.0 Hz.

y - equivalent ground motion in microns
G - cal. coil motor constant
m - seismometer mass

Frequency	Recorder Deflection mm	Magnification
0.143	4.5	230
0.2	7.0	705
0.33	11.5	3 190
0.5	15.7	9 810
0.625	18.1	17 840
0.80	19.3	30 830
0.95	20.2	46 000
1.0	20.0	50 000
1.25	19.0	76 000
1.6	16.45	108 600
2.0	14.0	140 000
3.0	10.0	225 000
4.0	7.9	316 000
5.0	6.5	407 000
7.0	4.5	552 000
10.0	3.0	750 000
Coil	RA-5	Cal. Coil
Damping 0.74 Nat. Freq. 0.95 Hz	Gain 75.3 dB	Current 400 μA Motor Const. 0.033 N/A

TABLE 1

Magnification of NORSAR Analog Station
(Numerical base for Figure 1.)

The station magnification may be altered by the AM analyst if the background noise level changes significantly. Knowing the station magnification at 1.0 Hz, the user can at any time calculate ground motion using Figure 2 and recorder deflection.

Part	Parameter	Dim.	Nominal	Tolerance
Seism.*	Moving mass	g	825	1.5%
	Nat. freq.	Hz	1.00	15 %
	Damping ratio	-	0.70	15 %
	Cal. coil motor constant	N/A	0.0326	5 %
	Cal. coil sensitivity	nm/μA	1.00	
Seismograph Amplifier	Distortion			max 5%
	Gain	dB	74.7	3 dB
Calibration Signal (sine)	Frequency	Hz	1.0	4 %
	Amplitude (peak-to-peak)	V	20.0	5 %
* The linear operating range is ± 600 nm of ground motion.				

TABLE 2

Characteristics of Seismic Instrumentation

3 TIME MARKING

Time marks will be written on the seismogram every minute, hour and 24 hours. A time mark panel is installed in the station rack for easy comparison between station and NDPC/TOD timing. The clock can be controlled within 0.1 sec. The drift of the clock is expected to be insignificant.

4 MAGNIFICATION

A label fixed to the drum rack will at any time give the last value of magnification and other characteristics of the station.

Input calibration voltage: E_l = — 20 V

Line impedance : R_L = 55 ohm/km loop

C_L = 52 nF/km loop

Calibration network resistance: R_N = 50 kΩ

Calibration coil resistance : R_c = 20 Ω

Calibration coil current : Ic = Ei/ΣR — 400 μA

Calibration coil motor constant: G_c = 0.0326 N/A

Applied force : $F = G_c \cdot I_c$ — 13.04 μN

Mass : m = 0,825 kg

Force to (Relative to seismometer)

Acceleration: $al = \frac{F}{m} \cdot \frac{s^2}{s^2+2\delta w_o s+w_o^2}$ — 11.3 μm/s²

Velocity : $Vl = \frac{F}{m} \cdot \frac{s}{s^2+2\delta w_o s+w_o^2}$ — 1.8 μm/s

Distance : $Xl = \frac{F}{m} \cdot \frac{1}{s^2+2\delta w_o s+w_o^2}$ — .287 μm

$s=j\omega_o$ $\delta=0.7$ $f=1.0$

Equivalent earth motion

Acceleration: $a = \frac{F}{m}$ — 15.9 μm/s²

Velocity : $V = \frac{F}{m} \cdot \frac{1}{s}$ — 2.54 μm/s

Distance : $X = \frac{F}{m} \cdot \frac{1}{s^2}$ — .400 μm

Data coil generator constant: G_m = 1020 V/m/s

Data coil output at 1 Hz : $E_m = G_m \cdot Vl$ — 1.83 mV

Attenuation (Damping resistance): D_m = 240/290 — 1.52 mV

Amplifier gain (74.6 dB) : A = 5400

Amplifier output : $E_o = A \cdot E_m \cdot D_m$ — 8.2 V

Amplifier output impedance : R_o = 1200 ohm

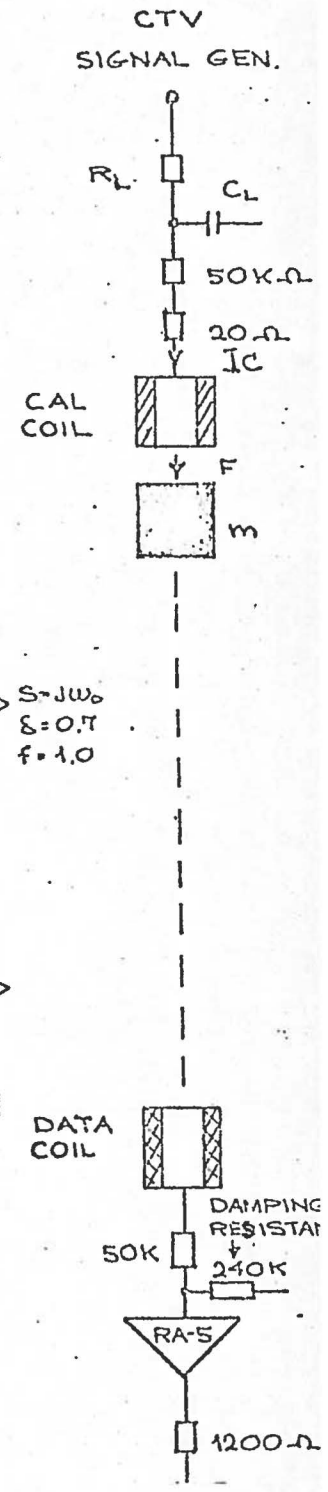

Fig. 3. SP Calibration flow chart

5 POLARITY CONVENTION

Vertical ground motion upwards gives an amplitude upwards on the seismogram.

This is consistent with the convention that a positive calibration sine signal monitored through the SLEM MUX channel shall produce an indication of a positive ground motion deflection.

6 STATION MONITORING

The seismic instrumentation of the station will be monitored regularly, approximately once a month, using NDPC's AM off-line capabilities. Fig. 3 shows the calibration flow chart of the seismic instrumentation (Excerpts from (2)). The transmission instrumentation will be controlled bimonthly (refer (1)). The station timing will be controlled daily.

7 INQUIRIES

All inquiries should be directed to the AM analysts who will maintain and keep a historic file for the station.

REFERENCES

(1) NORSAR Technical Report (in print): Test Procedures for Transmission Line of NORSAR Analog Station.

(2) Dalland, L.J.: NORSAR SP Seismometer Instrumentation Chain, Teleplan A/S, 15 November 1971.