

IMS stations specifications

Introduction

The IMS stations specifications are based on the Treaty Text and on reports by the Expert Groups of the Ad Hoc Committee in 1995 (e.g. CD/NTB/WP.283, CD/NTB/WP.269 and CD/NTB/WP.224).

These specifications are defined for the four required technologies : seismics (primary and auxiliary), infrasound, hydroacoustics (T-phase and hydrophones) and radionuclide (particulate and noble gas).

I. General requirements

1. Environmental specifications such as temperature range of operation, or down time are standard values. They might be adapted for specific sites where conditions are extreme (the Arctic region or Antarctica for example).
2. Data availability or timely data availability is computed over a period of one year. It is highly dependant on power failure, lightning and communication reliability.
3. To reach the required availability and limit future maintenance costs it is essential that stations be as autonomous and low consuming as possible. This will limit power backing equipment. Solar power should be preferred when possible. Stations should be hardened against lightning.
4. When indoors, systems requiring no or limited ambient room temperature control should be preferred.
5. Field communication equipment is part of the station. It should also comply with the above requirements.
6. Surveys should be conducted to ensure that siting does not alter station operational characteristics.
7. There should be some level of protection against physical damage to the field equipment.
8. New stations should comply with specifications. Existing stations should be upgraded to meet specifications. Planning of upgrading should be adapted to budget.
9. Certification procedures for compliance of station with requirements will have to be defined.

II. Minimum requirements for station specifications

Table 3. Specifications for primary and auxiliary seismic stations

<i>Characteristics</i>	Minimum Requirements
<i>Sensor type</i>	seismometer
<i>Station type</i>	3C or array
<i>Position (with respect to ground level)</i>	Borehole or vault
<i>3 C Pass Band ¹</i>	SP: 0.5 - 16 Hz + LP : 0.02 - 1 Hz or BB : 0.02 - 16 Hz
<i>Sensor response</i>	flat to velocity or acceleration over the pass band
<i>Array Pass Band</i>	(SP : 0.5 - 16 Hz LP : 0.02 - 1Hz) ²
<i>Number of sensors for new arrays³</i>	9 SP (1C) + (1 SP (3C) + 1 LP (3C)) ⁴
<i>Seismometer noise</i>	≤ 10 dB below minimum-earth noise at the site over the pass band
<i>Calibration</i>	within 5 % in amplitude and 5° in phase over the pass band
<i>Sampling rate ¹</i>	≥ 40 samples/s ⁵ LP : ≥ 4 samples/s
<i>Resolution</i>	18 dB below the minimum local seismic noise
<i>System Noise</i>	≤ 10 dB below the noise of the seismometer over the pass band
<i>Dynamic range</i>	≥120 dB
<i>Absolute timing accuracy</i>	≤ 10 ms
<i>Relative timing accuracy</i>	≤ 1ms between array elements
<i>Operation temperature (° C)</i>	-10° C to 45 °C ⁶
<i>State of health</i>	Status to be transmitted to the IDC : clock, calibration, vault and/or borehole status, telemetry
<i>Delay in transmission to IDC</i>	≤ 5 min
<i>Data frame length</i>	SP : ≤ 10 s ; LP ≤:30s
<i>Buffer at station or at NDC ⁷</i>	≥ 7 days
<i>Data availability</i>	≥ 98 %
<i>Timely data availability</i>	≥ 97 %
<i>Mission capable arrays</i>	≥ 80 % of the elements should be operational

¹ For existing GTSN stations upgrading will need further consideration.

² For 1C element of teleseismic arrays, the upper limit is 8 Hz.

³ In case of noisy sites or when increased capability is required number of sensors could be increased.

⁴ Can be achieved by a single Broad Band instrument.

⁵ This applies to 3C and regional arrays. For existing teleseismic arrays, 40 samples/s are necessary for 3C but 20 samples/s are suitable for other sensors

⁶ Temperature range to be adapted for some specific sites

⁷ Procedure for buffering to ensure minimum loss of data and single point failure should be addressed in the IMS Operation Manual.

<i>Precision on station location</i>	≤ 100 m absolute for stations (WGS84) ≤ 1 m relative for arrays elevation above sea level ≤ 20 m
<i>Seismometer orientation</i>	$\leq 3^\circ$
<i>Data format</i>	GSE format
<i>Data transmission</i>	primary : continuous auxiliary : segmented

Data from auxiliary stations are essential for the IDC to achieve the required location precision for seismic events.

For existing auxiliary stations the minimum requirement for certification as an IMS facility is a 90 % data availability. Existing auxiliary stations will be upgraded over some period of time. When not otherwise specified in the above table upgraded or new auxiliary stations should comply with technical requirements adopted for primary stations in terms of operational characteristics. Overall auxiliary station reliability should match as closely as possible those of the primary stations.

When auxiliary stations have a dual use, priority access to data, status monitoring and command of the station should be given to CTBTO / IDC. This should be firmly established by National Authorities and accounted for in terms of communication field equipment.