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NEW AIRPORT NOISE MONITORING SYSTEM AT OSLO AIRPORT - GARDERMOEN

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1. INTRODUCTION

When the Norwegian Parliament decided to establish the new Oslo Airport at Gardermoen, a part of this decision was requirement to include an advanced airport noise and track monitoring system.

Stationary and mobile noise monitoring terminals will continuously give information on both total noise as well as aircraft related noise exposure at each measurement position. This system shall also monitor actual runway and flight track usage, in order to control conformance to regulations. This will be made possible through interface to radar and traffic information systems..

The complete and fully operating Airport Noise and Track Monitoring System must be delivered, tested and accepted no later than on the opening of the new airport, October 8, 1998.

2. SYSTEM REQUIREMENTS

The Aircraft Noise and Track Monitoring System consists of the following elements:

- A Central Data Unit including hardware and software to receive, process and store information from connected units.
- A number of stationary and mobile Noise Monitoring Terminals
- Data transfer system from the NMTs to the CDU
- Interface to external systems (Radar, Traffic and Meteorology)

The Central Data Unit in the Noise and Track Monitoring System shall take care of all data exchange, interface to external systems, data management and -storing, calculations and data presentation.

It was recommended that the CDU preferably should be a modern high-performance PC, using MS Windows-NT version 4.0 or higher.

As a minimum, the CDU must have capacity to handle 25 stationary and 5 mobile noise monitoring terminals, and 5 independently operated user terminals. The CDU shall, without complete reconfiguration, be able to handle future expansion and upgrading of the system both with respect to quantity and quality of data.

Each of the user terminals shall be a high performance PC using MS Windows NT, a monitor and a full colour printer.

A kind of logic detection of aircraft noise events must be included, in order to separate single noise events into aircraft and non aircraft . In addition, the CDU must perform a correlation analysis between radar detected flights and noise events.

Both stationary and mobile NMTs shall have equal acoustical performance. The mobile NMTs are mainly intended to run for short time monitoring powered by batteries. However, if main power is available, there is no limitation in endurance. A-weighting network, and 1/3-octave analysis in the frequency range of 50 Hz to 10 KHz is a minimum. The filters shall be configured for full parallel operation. Sampling rate shall be sufficient for presentation of 1 sec slow values. Some data reduction may take place locally at the measurement cite, before digitally transmitted to the CDU.

Calibration of the NMT must be made automatic and regularly, at a minimum once per 24 hour. It is recommended to be a multi frequency test, and requested also for several levels. Alternatively, a more complex calibration procedure is accepted to take place annually, using special auxiliary equipment.

All aircraft noise related metric calculated, shall be based on true aircraft noise single events only. In addition a total noise exposure must be presented, including either all single events detected by the NMTs, or based on a continuous 1 sec sampling of sound level.

The report generator must be able to produce any user defined report of all requested noise metric that can be calculated by the CDU. Any logical combination of different parameters, defined by the user, must also be accessible for any period of time. An example of such a combination may be: All B737-400 ILS landings to runway 19R for a given day.

3. PERFORMANCE

Aircraft noise events will be correlated by radar detected objects identified as aircraft that can be individually defined by flight number and aircraft type. The operation will be detected by radar, presenting the actual flight track, assigned runway and procedure for the movement. In addition, actual flight profile can be presented.

Each noise event that exceeds a dynamic trigger threshold, will create a recorded sound file, long enough to clarify the event as an aircraft or not. These sound files will be stored in a ring buffer large enough for 3-5 days of recording. In addition, on-line listening to the microphone signal is another feature intended for quality control.

A sliding time window of user defined with, will be used in order to establish a locally continuously varying background noise level at each measurement cite. To form the dynamic

trigger threshold, a locally defined offset will be added to the measured background level. By using such a defined trigger threshold, we expect to be able to make a much more correct aircraft noise measurement, specially during the quietest periods of the day.

New for this system is that we will include 1/3-octave measurement of average noise spectra at each monitoring position. Separate spectra will be available for total noise exposure, and for aircraft noise. Both sets of spectres will be presented for normal percentage values as 1%, 5%, 10% etc.; down to 90%, 95% and 99%, as well as for Leq. These values can be calculated for any user defined time period.

4. INSTRUMENTATION

The microphone system is based on Norsonic Outdoor Microphone System NOR-1210A. The microphone system is the only unit left outside the weather-protected and temperature controlled enclosure. The system is constructed for outdoor operation within a temperature range of -40°C to +50°C. The microphone system has a windscreen with four anti-bird spikes on the top. Integrated in a raincap is a electrostatic actuator for calibration of the ½" air-condenser microphone, with an externally supplied 200 volt polarisation voltage.

The sound level analyser is the Norsonic NOR-121 Environmental Sound Analyser. The instrument makes level measurements according to IEC 651 type 1 and IEC 804 type 1 as well as 1/3-octave analysis according to IEC 1260 type 1. The instrument is also compatible with the type 1 requirement in the recently proposed IEC 1672 standard for sound level meter.

The Environmental Sound Analyser NOR-121 is mainly a digital instrument. The analogue input signal from the microphone system is optionally HP-filtered (16 Hz, 3. order Butterworth filter) to reduce low-frequency noise components from wind, amplified in a low-noise input amplifier and thereafter digitised.

Included in the outdoor NMT part of the Airport Noise and Track Monitoring System is also a PC that controls the system, store data and transfer data to the CDU. The PC also transmit messages to the CDU like «loss of microphone signal», «loss of main power», «low battery power» etc.

Data transmission between NMT and CDU is made by ISDN communication. For stationary NMTs by leased lines, for mobile NMTs by GSM phones.

5. REPORTS

As common available database systems are used to store most of the parameters registered, most user defined report formats can be easily selected for publication. At the moment we are in the phase of defining a set of standard reports.

Typical monthly reports must include the Norwegian parameters EFN and MFN together with a total noise exposure metric as LAeq. It may also be possible to include other aircraft noise metric as LDN or LDEN. Other reporting items must be runway statistics, night-time exposure, possible procedure violence etc. Statistics on track- and profile dispersion may be of interest. As single events are identified by aircraft type and carrier, the system can produce the «best of the month» airliner or aircraft type with respect to noise exposure, procedure adherence etc.

The 1/3-octave measurements will be used mainly for generation of an outdoor average aircraft noise spectra. This results will, together with a sound insulation spectra for nearby living houses, be used for calculation of indoor noise exposure. Such a process is found necessary as the Airport Authority has given a grantee on maximum indoor aircraft noise level, and indoor noise measurements in occupied living houses are found impractical and very difficult to make.

In addition, 1/3-octave measurement facility can on demand be used for complete sampling of spectral information through a total flight event. The intention of this feature is to collect information for validation of the aircraft noise databases used for calculation of noise zones around airports. When long time data will be available, average statistical information on takeoff profile for selected aircraft types can be compared to profiles used in airport noise models. As meteorological information also are collected, we will be able to normalise measured values to any standard reference atmosphere.

6. REFERENCES

IEC 60651 (1979-01) Sound Level Meters
IEC 60804 (1985-01) Integrating - avering sound level meters
IEC 61260 (1995-08) Electroacoustics Octave-band and fractional-octave-band filters
IEC 1672 (Proposal withdrawn)
ISO 3891 (1978) Acoustics - Procedure for describing aircraft noise heard on the ground.