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Improvement of the aircraft noise monitoring and information disclosure system at Narita International Airport in response to the revised guideline for aircraft noise

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ABSTRACT

This paper makes a report on an updated aircraft noise monitoring and information disclosure system at Narita International Airport. At Narita international airport, monitoring of aircraft noise has been continuously performed since the airport was opened in 1978. The purpose of monitoring is to survey the noise exposure situation around the airport, to confirm the conformity of acoustical environment at residential areas around the airport to the Environmental Quality Standards of Aircraft Noise, and to process noise complaints. Results of noise monitoring by prefecture and city governments and the airport company at 104 points around the airport are continuously collected by the Narita Airport Regional Symbiosis Promotion Foundation and are processed by an united manner using a data processing system, which has been renewed last year, because the method of evaluating aircraft noise in the Environmental Quality Standards has been revised from WECPNL to L_{den} in 2007[1]. In this paper, we make a report on improvements to the way to automatically identify sound sources, to identify aircraft events, to take account of aircraft ground operation noises and to make periodical data reporting more efficient and effective. We also discuss problem caused after the renewal of the system.

Keywords: Aircraft Noise, Monitoring

1. INTRODUCTION

At Narita international airport, monitoring of aircraft noise has been continuously performed since the airport was opened in 1978[2]. There are 104 monitoring stations which prefectures, city authorities and the airport company (NAA) maintain around the airport (Figure 1). All measurements collected at these stations are automatically sent online to an aircraft noise monitoring and information disclosure system, which consists of a data logger, data processing and editing terminals, a radar data reception unit and a server that delivers information to related authorities and the public, installed in Narita Airport Regional Symbiosis Promotion Foundation (NSF). The System analyzes all measurements in a united manner to identify aircraft sound events using flight log information, calculates WECPNL and L_{den}, and automatically distributes daily flash reports of noise monitoring to local governments and NAA by e-mail. Later, data are re-checked by manual inspection for exclusion of non-aircraft events and extraordinary aircraft events. Afterwards, the result is filed to make up monthly and annual reports, and NSF distributes those reports after an examination at the Aircraft Noise Evaluation Committee established in the NSF. The reports are also opened to the public on the NSF Web pages (http://www.nrt.or.jp). This paper makes a report on the improvement of the system in response to the revised guideline of Environmental Quality Standard for Aircraft Noise.

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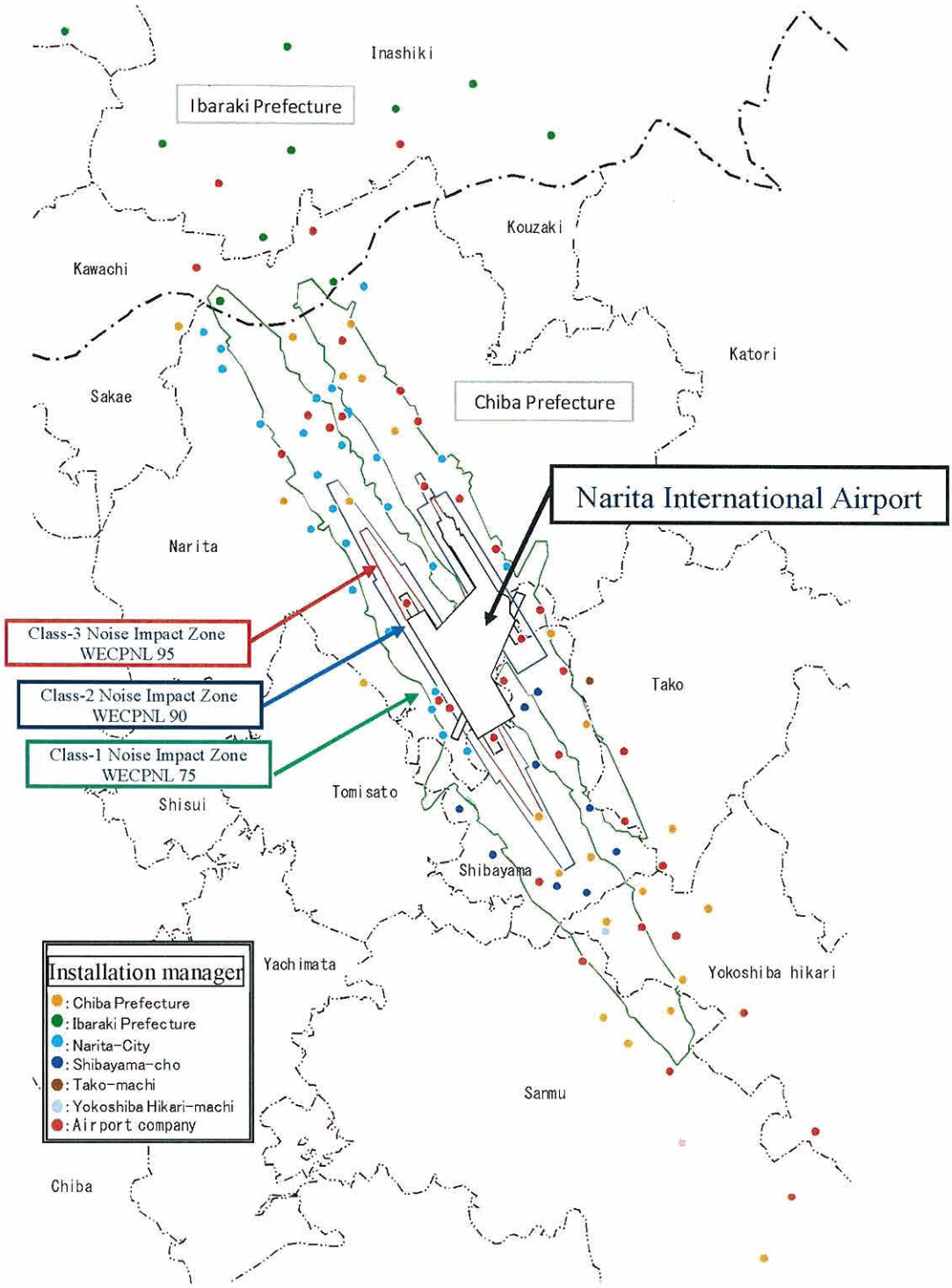

Figure 1 – This is aircraft noise Monitoring Point at around Narita airport

2. OUTLINE OF THE RENEWED SYSTEM

The system was renewed after careful consideration on specifications of the renewal consistent with the requirements of Environmental Quality Standard for Aircraft Noise and Manual for Measurement and Evaluation of Aircraft Noise, necessary improvement on data processing flow, a roadmap toward regular operation, etc. The main features of the new system are as follows;

1) Unified collection and data management of measurements from 104 noise monitoring stations.
2) Secondary check of noise events by comparing the time between noise observation and aircraft flyover close to monitoring points, using radar data
3) Check of noise events by comparing those with a database of past observations.
4) Manual inspection and data correction of aircraft noise events by comparing level fluctuation patterns among monitoring stations on the PC display and by listening to sound recordings of relevant aircraft noise events.
5) Identification of noise events due to reversal over-flight and noise contributions of aircraft ground activities such as taxi, APU and engine run-up in addition to flyover noise events.
6) Renewed function of data reduction, calculation of L_{den} and WECPNL, tabulation and graphic representation, and information disclosure to the public.

The renewed system started its operation as test run, last year, parallel to the conventional system. It is planned to check the reliability of the system and its new functions, which the conventional system could not deal with, such as identification of reversal over-flight noise events, as well as to improve the system if needed before fiscal 2013, when the new Environmental Quality Standard will be enforced.

3. FLOW OF DATA PROCESSING AND INFORMATION DISCLOSURE

Figure-2 shows a flow chart of data processing and information disclosure to the public in the renewed system. The flow consists of data collection, two stages of automatic data check, three steps of manual data inspection and correction, final data reduction and preparing reports, and information disclosure.

Initial automatic data check and flash report: Measurements collected from 104 monitoring points are automatically related to flight information by checking one-to one correspondence if the time of occurrence of a noise event matches that of an aircraft either landing or takeoff within a margin of time difference between points, specified appropriately dependent on the relationship of location with the airport and runways. The result is sent as a daily flash report to all related organizations early morning the next day after necessary data reduction and calculation.

Secondary automatic data check: Results of the initial check are automatically checked using flight path observations from radar tracking data for flight control. We estimate the time when an aircraft passes most closely by individual monitoring points.

The next stage is manual inspection and data correction of aircraft noise events by the operator: Uncertain and/or doubtful data which considerably differ in magnitude and level pattern from usual aircraft noise events are extracted using database of past observations, and are checked by manual inspection on the display. We judge whether this noise event is aircraft noise or not by comparing sound level between monitoring points (see Figure-3) and by listening to the actual sound. Finally, we compare data with the final flight log information, and afterwards carry out data reduction and make reports to check the situation of aircraft noise exposure around the airport.

The final monthly and annual reports of noise monitoring are requested to be approved by the Committee of Aircraft Noise Evaluation, which consists of members from academic arena, local and national governments and NAA, organized by the Narita Airport Regional Symbiosis Promotion Foundation.

Then, the approved reports are sent to all organizations involved in the management of aircraft noise issues at Narita International Airport, including prefectures, city authorities and NAA maintaining monitoring points around the airport. The results are also uploaded on the WEB pages of the Foundation for information disclosure open to the public.

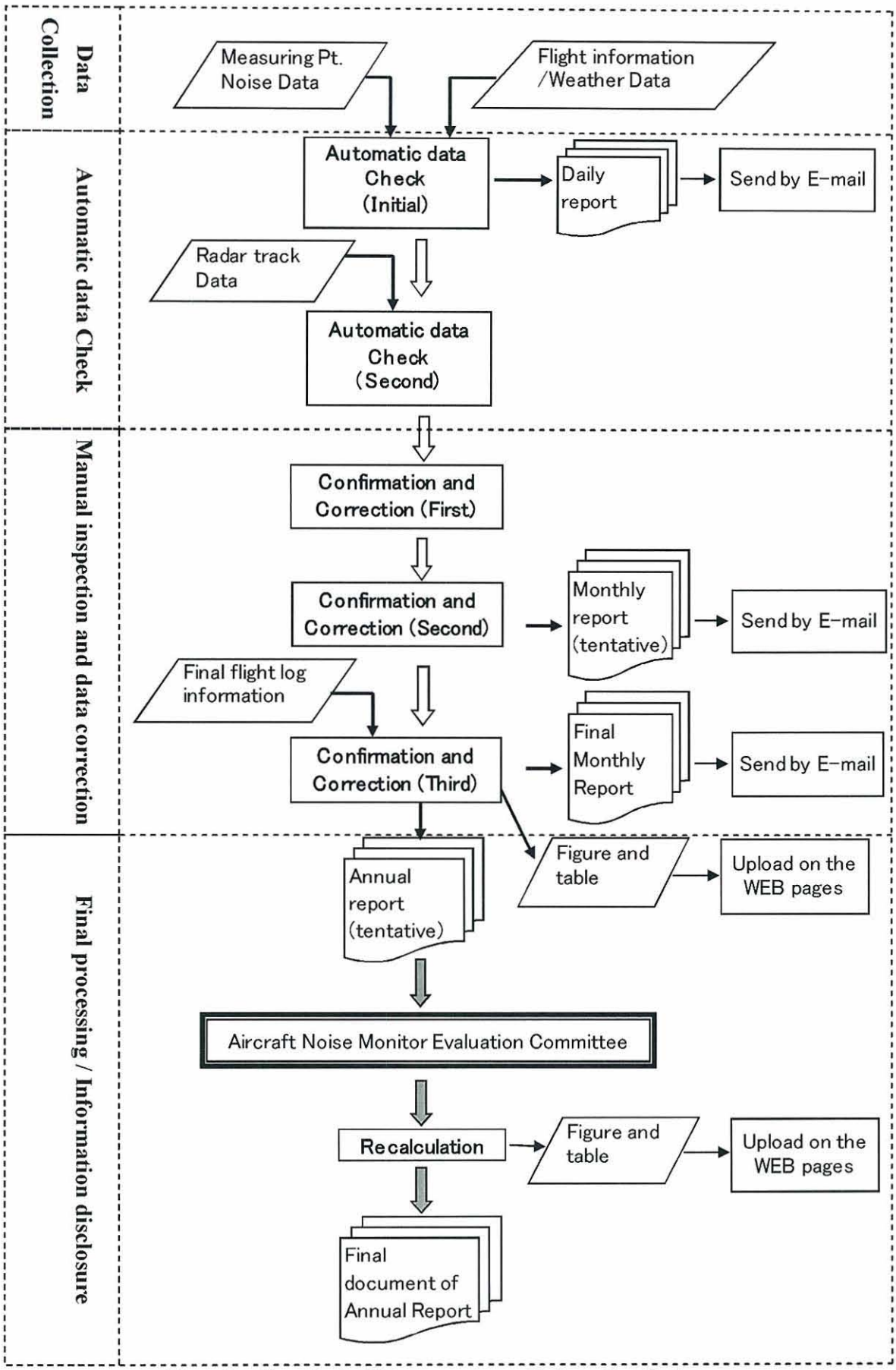

Figure 2 – Flow chart of data processing and information disclosure

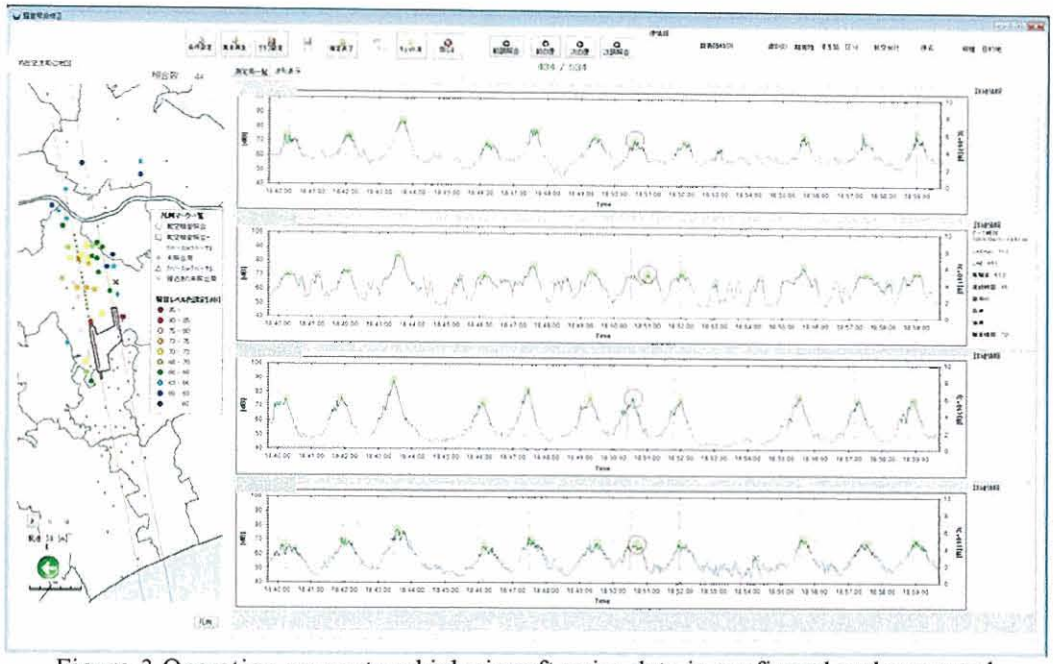

Figure-3 Operation screen to which aircraft noise data is confirmed and corrected

4. DATA PROCESSING OF THE RENEWED SYSTEM

4.1 Check of Noise Events by Comparing Those with a Database of Past Observations

In the conventional system, a lot of labor costs were spent on manual data inspection and correction works. The cause was that a lot of noise disturbances such as road traffic noise, cricket chirping, dog barking, and wind noise were measured wrongly as aircraft noise events at the stage of automatic data check at each noise monitoring points, because noise events were judged as aircraft noise if the time of noise observation coincided with that of aircraft passing most closely by the noise monitoring stations.

In the renewed system, the procedure was improved to compare results of automatic data check with a database of past observations and classify uncertain or doubtful data as data requiring manual check at each point in order to reduce the possibility of wrong identification of aircraft noise events. Note that the database of past observations consists of average and standard deviation of L_{ASmax}, L_{AE} and duration time for each aircraft type and flight mode at each noise monitoring point.

4.2 Check of Noise Events by Comparing Level Fluctuation among Points

In the renewed system, a function to compare level fluctuation observed simultaneously at multiple monitoring points (see Figure 3) is prepared as an important tool for judging whether a noise event is ascribed to aircraft movement. It helps us to distinguish noise disturbances from aircraft noise, because many noise disturbances are different in maximum sound level or duration time length from aircraft noise. This function has proved to be useful at least in checking noise events due to thrust reversal after landing, because this noise is usually observed almost at the same time at many monitoring points located in the surrounding of the runway.

4.3 Check of the status of noise monitoring at each point

Rise-up of background sound level or malfunction of devices may sometimes cause doubtful results of noise monitoring over a certain time period at a specific point. The renewed system was improved to be able to check the situation of background sound level at each point as well as examine the log of operations of sound level meters so as to solve such problems quickly. Daily check of the log makes it possible to find such problems quickly

5. NOISE CONTRIBUTIONS DUE TO ADDITIONAL AIRCRAFT ACTIVITIES

The renewed system takes account of noise contributions due to aircraft ground activities, noise reversal flight and helicopter in response to the requirements of the revised guideline of Environmental Quality Standard for Aircraft Noise. This section briefly describes the method of examining these noise sources in order to calculate from the all measured data.

5.1 Noise due to Aircraft Ground Operations

One of new targets of noise monitoring is ground noise due to aircraft ground operations and maintenance such as taxiing, use of APU (Auxiliary Power Unit) and engine run-up test. Sound source identification of ground noise is very difficult because available information on the situation of such operations and maintenance activities is limited, radar and transponder signal are ineffective in the identification of sound sources and listening to sound of noise events are not also useful. The only available means is to use daily reports on ground noise generation issued by Narita Airport Cooperation. The detection of ground noise is carried out using the function of detecting sound arrival direction (i.e., elevation and azimuth angles) every moment [3], installed in the instrument set up at several noise monitoring points in and around the airport.

5.2 Noise of Reversal flight

Aircraft sometimes turn around after take-off, return and fly over the airport, which is called reversal flight. Sound level of reversal flight noise events is low compared with that of usual take-off and landing, but reversal flight noise is sometimes important because it happens to be frequently observed at several noise monitoring points. Each noise event of reversal flight observed at a noise monitoring point is automatically judged whether it is aircraft noise or not, both by comparing the occurrence time of the noise event with the time at which an aircraft is estimated to fly over the point using flight path tracking data by Radar and ADS-B and by checking elevation angle of sound arrival data, which are estimated using cross correlation techniques at the point.

5.3 Noise of helicopter

Most helicopter operations at Narita are visual flights aimed at special purposes such as patrol and pilot training. Thus, it is difficult to get sufficient information on flight paths and operational details except the time of take-off and landing. Therefore, noise events caused by helicopter are identified by using the time of take-off and/or landing and measurements of sound arrival direction (elevation and azimuth angles) observed at several noise monitoring points.

6. CONCLUDING REMARKS

This paper explained a brief summary of an aircraft noise monitoring and information disclosure system, which was renewed to meet requirements of the revised guideline of Environmental Quality Standards for Aircraft Noise and Manual for Measurement and Evaluation of Aircraft Noise, at Narita International Airport. In the renewed system, the function of data check and correction for identification of aircraft noise events was reinforced and improved in accuracy. The renewed system has started its regular operation since April, 2011. It is planned to examine the validity of the system including calculation of noise contributions of ground noise and reversal flights till the enforcement of the revised guideline in April, 2013.

ACKNOWLEDGEMENTS

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