

# **Progress on further enhancement of Narita International Airport and its noise countermeasures**

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# ABSTRACT

This paper describes the progress on further enhancement of Narita International Airport, which is promoted by the airport company (NAA) and the Government, and its effectiveness of noise countermeasures. This enhancement aims for airport capacity expansion up to a maximum of 500,000 movements per year in future by means of extension of the existing parallel runway, construction of a new third runway and relaxation of night-time flight restrictions, in order to enhance international competitiveness of Narita International Airport in East Asia and to improve convenience for airport customers. Especially at night, the number of flight movements will increase greatly, so sleeping effects are concerned. A confirmation letters was exchanged at the Four-party Council, which is decision-making body for the enhancement, held in March 2018. Based on the confirmation letter, NAA is now promoting the construction of the inner windows in order to minimize the influence at night as a measure for relaxation of night-time restriction on Runway A operation. Furthermore, NAA plans to introduce the slide operation that changes take-off and landing time for each runway to ensure quiet time at night. This paper also describe the current noise countermeasures at Narita and reports the future issues of the enhancement.

**Keywords:** Enhancement, Airport, Countermeasure **I-INCE Classification of Subject Number:** 30

# **1. INTRODUCTION**

According to the IATA estimate announced last October, the number of air passengers in the world will be doubled to 8.2 billion people in 2037 after 20 years. In particular, Asia Pacific is said to have the highest annual growth rate of 4.8%, accounting for nearly half of the worldwide passenger numbers. Extended construction is underway at the main airport in East Asia. In China, for example, the construction of new airports

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with 880 thousand annual operations and 100 million passengers handling in place of the current Beijing airport is proceeding. A further functional enhancement plan is being promoted even at Narita Airport located in the same East Asia. We need to prepare a thorough system, including supporting the Olympic and Paralympic Games to be held in Tokyo in 2020 and 40 million foreign visitors to Japan. Furthermore, in response to future air demand, we will further enhance the functions to improve competitiveness between airports.

In this functional enhancement, there is concern about the influence of noise such as sleep disturbance to residents around the airport due to the significant increase in departure and arrival at late night and early morning. NAA is proceeding with the construction of the inner window in the bedroom of the residence as one of measures to relax night-time flight restrictions on Runway A scheduled to be ahead of the plan, to reduce the effect of sleep. After the functional enhancement, in addition to the construction of the inner windows, we are planning so-called "slide operation" to secure quiet time by shifting the operation time of each runway.

In this paper, we introduce the outline of noise countermeasures to date at Narita airport, and describe the measures and the effectiveness of the measures to mitigate the influence of noises especially at late night and early morning due to further functional enhancement.

### 2. OVERVIEW OF FUNCTIONAL ENHANCEMENT

#### 2.1 Further functional enhancement

As shown in Fig. 1, further functional enhancement is to increase the number of annual flight movement up to 500,000 by extending the current 2,500 m Runway B to the north by 1,000 m, constructing a new 3,500 m Runway C and relaxing night-time restrictions.



Fig.1-Airport layout for the enhancement

As for the flight time, we will remove the restriction of up to 10 departures and arrivals of each runway between 22:00 and 23:00 and set operation time from 6:00-23:00 to 5:00 - 0:30( see Fig.2). In Fig. 2, the term "Flexible application" refers to an operation in the event of an emergency not depending on the responsibility of the airline. In the north wind, Runway B is used for takeoff, Runway C is used for landing, while in the south wind, Runway B is used for landing, Runway C is used for takeoff. In addition, the

slide operation is assumed, which shifts the operation time of the three runways in order to secure the quiet time under the flight path.



Fig.2- Operating hours for the enhancement

### 2.2 Preceding of relaxation of night-time restriction on Runway A

As for further functional enhancement, construction will begin after environmental assessment and legal procedures, and official operation is expected to be about 10 years later. In order to respond to the demand of the Olympic Games, as shown in Fig. 3, it was decided by the Four-party Council in March 2018 that the night-time operation of the Runway A up to the present 23 o'clock will be extended by 1 hour. This full-scale operation time expansion is the first time since the opening of the airport. We confirmed that the relaxation of night-time flight restriction on only Runway A implement from the winter schedule of 2019 at the Four-party Council held in Februaly this year.



Fig.3- Operating hours for relaxation of Runway A

However, in order to reduce the noise influence of residents in the surrounding area at night, we are proceeding with installation of inner windows in the bedroom. Aircraft operating after 23:00 are to be limited to low noise aircraft of categories A to C of Narita Aircraft Noise Rating Index. Aircraft Noise Rating Index was invented at ACI (Airports Council International) and is an index classified based on the noise margin described in ICAO Annex16 Chapter 3 Reference value as shown in Table 1.

Table 1 Narita Aircraft Noise Rating Index

Criteria to be met	Categories					
concurrently	А	В	С	D	E	F
Cumulative EPNdB reduction from ICAO Chapter 3 standard of at least:	20 or more	15 or more	10 or more	5 or more	0 or more	Aircraft not classified
Individual EPNdB reduction from ICAO Chapter 3 Standard at each noise measurement point of at least:	4 or more	3 or more	2 or more	1 or more	0 or more	in any of categories A through E

# 3. NOISE SITUATION AT NARITA AIRPORT

In this chapter, we describe the legal system of Environmental Quality Standards for Aircraft Noise in Japan, Aircraft Noise Prevention Law and Special Act for Aircraft Noise prevention, the operation restrictions of Narita Airport and the current situation of night-time noise.

# 3.1 Environmental Quality Standard for Aircraft Noise

In Environmental Quality Standards for Aircraft Noise in Japan, standard values are set for each category area as shown in Table 2. In addition, the achievement period and the improvement goals are set for each airport, and in the case of Narita Airport are set as shown in Table 3. However, in areas where it is deemed difficult to attain the Environmental Quality Standards by the target dates in spite of the comprehensive measures to be taken to control aircraft noise, measures shall be taken, including soundproofing the houses of people wishing to remain in the area with a view to obtaining the indoor conditions equivalent to the ones where the Environmental Quality Standards are being met. At the same time, maximum endeavours shall be made to attain the environmental standards as soon as possible.

Tuble2 Environmental Quanty Standards for Threndy House					
Category of area	Standard value in Lden				
Ι	57dB or less				
П	62dB or less				
Note: Area category I refers to area exclusively for residential purpose and Area					
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Table2 Environmental Quality Standards for Aircraft Noise

Note: Area category I refers to area exclusively for residential purpose and Area category II refers to other areas where the normal living conditions shall be preserved.

Table 3 Target dates and Improvement Goals

	Target dates	Improvement Goals
Narita International Airport	Within ten years	Within five years to attain less than 70dB (or 50dB or less indoors in areas exceeding 70dB)

### **3.2 Laws concerning noise control**

NAA has carried out noise measures under the two laws of ANPL (Aircraft Noise Prevention Law) and SAANP (Special Act for Aircraft Noise Prevention). The former is mainly for subsidy of soundproof construction of houses, and dwellings that live before the notification of the noise area (Class1) specified based on *L*den 62 dB can receive subsidies for soundproof construction. The latter is mainly for restrictions on the building construction around the airport, and resident compensation is available for residents who live prior to setting the countermeasure area (*L*den 66 dB or more). As of the end of September 2018, the cumulative total of environmental measures cost was 414.8 billion yen. Apart from these measures, as a measure beyond the legal framework, the Symbiosis Foundation implements additional measures for adjacent to the ANPL Class1 area, and local governments are implementing noise measures for the Tanima area.

# **3.3 Operating restrictions and their relaxation**

At Narita Airport, in order to prevent the spread of noise, it is obliged that the aircraft climbs straight and descent straight ahead in a section of about 35 km. In addition, flight altitude other than departure and arrival in Chiba Prefecture where the airport is located is set to be over 6,000 feet. Specifically, we have established a monitoring area and disclose the airline name and flight number of the aircraft when deviating the area without reasons. Regarding night-time operation, except for bad weather and emergencies, we restrict the flight between 23:00 and 06:00. Furthermore, the number of flights between 22:00 and 23:00 at each runway is limited to 10 or less. In the past, the Japanese government and NAA have relaxed the following flight restrictions in order to cope with the increase demand in air (See Table 4).

Table 4 Operating restrictions and their relaxations

Operating Restrictions(OR)			
OR1: Above 6,000 feet flight altitude other than take-off and landing			
OR2: Flight route restriction			
Straight climb and descent between Tone River and Kujukuri Coastline			
OR3: Ten times flight movement between 22:00 and 23:00 for each runway			
OR4: Nighttime curfew			
23:00-06:00 except emergency			
Relaxation of Operating Restrictions			
ROR1: Flight altitude reduction for landing aircraft			
ROR2: Relaxation of flight route restrictions			
ROR3: Relaxation of nighttime curfew (23:00-24:00)			
limitation of low noise aircraft			

a. Altitude reduction of landing aircraft

In order to ensure smooth operation of aircraft landing from the north side of the airport, from July 2006, we have lowered the altitude from 6,000 feet to 4,000 feet at a fix "Lakes Point" located in the northeast of the airport where the approaching aircraft from each direction converged. We conducted noise measurements before and after altitude reduction, but we could not confirm a significant change in the noise value (ROR1).

b. Measures for mitigation of traffic congestion

The southward departure aircraft had taken the flight procedure which goes straight to the Kujukuri Coastline, but since March 2011, as a part of congestion mitigation measures, aircraft can turn left or right from corridors if it passed from the south end of ANPL Class1 and reaches altitude 6,000feet or more. The target is a departing aircraft for Europe and Hokkaido (ROR2).

c. Relaxation of nighttime flight restriction

Since opening of Narita Airport, except for emergency, we have restricted flights from 23:00 in the evening to 6:00 in the early morning. About five years ago, in order to respond to the increase in flight operations of LCC in particular, we permitted aircraft operation until 24:00 when unavoidable situation such as bad weather condition not

dependent on airline's responsibility. However, the aircraft is limited to low noise aircraft, NAA collects landing charges as much as usual, and distributes landing charge equivalent (penalty) to the surrounding area. In fiscal year 2017, the number of applications was 268, the number of flight movements was 98, and the total penalty was approximately 26 million yen (ROR3).

#### 3.4 Current noise situation at night

In this section, we show the trend of the noise exposure situation during the 16 years from FY 2002, when the second parallel runway came to operation, to FY 2017.



*Fig. 4-Trends in noise exposure in night-time (23-7)* 

We evaluated using six noise metrics, i.e., *L*den, "night-time-average sound level (*L*Aeq,night)" and "Night-time Number Above (N65,night, N70,night, N75,night and N80,night)" at four levels from 65 dB to 80 dB at an interval of 5 dB and at four unattended noise monitoring stations owned by NAA: NMS01 and NMS02 (Runway A) and NMS03 and NMS04 (Runway B). NMS02 and NMS04 are located under the flight path at around 8 km away from the end of each runway respectively, whereas NMS01 and NMS03 are located at around 1 km to the side from flight path. Note that the night-time is defined as the eight hour time period from 23:00 to 07:00. As is shown in Fig. 4, both the average sound level and the number of noise occurrences show a decreasing trend in the runway A. Noise exposure at the two sites NMS01 and NMS02 (Runway A), tends to decline due to the replacement of older aircraft with newer low-noise aircraft year by year. However, N65,night is increasing at NMS02, located under the flight path of Runway A, after FY2011. The cause is guessed to be the increase in low-noise aircraft of up to 65-70dB in *L*A,Smax. On the other, at NMS03 and NMS04, *L*Aeq,night remains

unchanged. At NMS 04, N65, night and N70, night are rapidly increasing in FY 2016 and FY2017. It is assumed that many single noise events of 65 dB to 75 dB is generated.

# 4. PROGRESS ON THE FUNCTIONAL ENHANCEMENT

We reported on further enhancement of Narita Airport at this Congress two years ago and last year<sup>1,2</sup>. In this chapter, we describe the progress of the enhancement. In March last year, we reached an agreement on a further functional enhancement plan at the Four-party Council, and we exchanged a confirmation letter. We also describe the progress of the inner windows installation in the bedroom and the survey on health effects of aircraft noise, both are specified in the confirmation letter, and environmental assessment concerning the enhancement.

# 4.1 Inner windows installation

With the precedent implementation of relaxation of night-time flight restriction on Runway A, from October last year, NAA began to install inner windows in the bedroom of the residence in the noise mitigation area (SAANP\_Zone1) shown in Fig.5 to reduce the influence of noises such as sleep disturbance at night. In Fig. 5, the target of the inner window installation this time is the area hatched with pink colour, and the target number is about 900 houses. In the future, with extension of Runway B and construction of runway C, inner windows installation project will be expanded also in those Lden 62 dB contours and the Tanima areas (Area hatched with blue).



Fig.5- Target area for inner window installation



Fig.-6 Sound insulation effect experience house and inner window(right picture)

We assumed that this inner window installation work has sound insulation effect of about 35 dB to 40 dB together with existing sound insulation work. Because there are many farm-type houses around Narita Airport, it is assumed that construction of the expected sound insulation effect is difficult. NAA bought an old private house, and improved the facilities that installed the inner window installation so that the surrounding residents can easily experience the sound insulation effect. Fig. 6 shows an external view of the sound insulation effect experience house for the inner window. NAA opened this facility to the public, and operated a free tour bus in order to allow as many residents as possible to experience this facility.

This facility is located about 7.4 km from the north end of the current Runway B and about 150 m to the west from the flight path of Runway B. Fig.7 shows a floor plan of the house. Noise measurement was carried out simultaneously with the ROOM 3 shown in this figure and outdoors. As a result, a sound insulation effect of 37.7 dB on average was confirmed. The number of noise events was 210 (only landing airclaft) and the sound insulation amount at the octave band center frequency 500 Hz.

There is a possibility that the sound insulation effect as shown in this figure may not be obtained depending on the situation of the house to be constructed. However, it is considered that the Environmental Quality Standards of *L*den 50 dB or less mentioned above is satisfied in the inner window construction target area shown in Fig. 5. In the slide operation after the functional enhancement described in Section 2.1, the residents living in the Tanima areas between two runways are influenced by both runways, so it is the target area for inner window installation. Therefore, installing the inner window in the bedroom is expected to be effective in reducing noise. However, installation of the inner window in the bedroom is an effective measure for reducing the influence of noise at night-time.



Fig.7 Floor plan for sound insulation effect experience house

### 4.2 Survey on health effects of aircraft noise

As reported in this meeting in 2016, NAA conducted a survey<sup>3,4</sup> on health effects of aircraft noise for the 10,000 residents around the airport due to the flexible operation of the curfew currently being implemented. In the relaxation of night-time flight restriction on runway A, the number of flights late at night and early in the morning will increase, so there are concerns about health effects such as sleep disturbance. Therefore, the confirmation letter at the Four-party Council promises to carry out the same health impact survey as the previous one. In the previous survey, we conducted a survey mainly using self-written questionnaires for surrounding residents. Based on the answer to the questionnaire, the relation between annoyance, life disturbance, sleeping influence and mental / physical influence and exposure amount of aircraft noise was analysed by a statistical method. In this survey, we will establish a third-party committee consisting of academic experts and others as we did last time and we will consider the investigation method etc. at an early date.

#### 4.3 Environmental Impact Assessment

In Japan, there is a law stipulating an environmental assessment called the Environmental Impact Assessment Law, for projects that may have a major impact on the environment, such as large-scale public works projects. Under the law, the proponent will publish the results of forecast evaluation, hear opinions from the general public, local public entities, etc., and based on those opinions, the business is considered to make the contents of the project more environmentally friendly. In the case of aerodromes longer than 2,500 m in runway length as in this further enhancement, they are classified as subjects of Class 1 projects. And the general evaluation items are air quality, noise, low frequency noise, vibration, water quality, animals and plants, landscape etc. Fig.8 shows a rough flow of Environmental Impact Assessment in Japan.



# Fig.-8 Procedure of Environmental Impact Assessment

After preparing Document on Primary Environmental Impact Consideration in June 2016, we have continued to prepare Draft of Assessment method and Draft EIS, and in February 2019 we prepared EIS. Ultimately, we will prepare an Impact Mitigation report and announce it to the public. And in order to start construction work, it is necessary to obtain permission to install under the aeronautical law. Therefore, it is a requirement to obtain a consent form concerning land acquisition from land owners and to finalize the EIS in this Environmental Impact Assessment. At each stage from the Document on Primary Environmental Impact Consideration to the Draft EIS, we heard opinions from the people (including the surrounding residents) and the prefectural governor / municipal mayor. Main opinions on noise are as follows.

✓ NAA should properly grasp the influence of noise accompanying the increase in flight number of aircraft, such as increasing the noise monitoring point as the function is strengthened, and announce the result.

- ✓ In addition to the effect on aircraft noise due to sleeping, psychological sense of pressure such as anxiety and tension for the local residents will increase, so NAA should conduct a health impact survey from before the enhancement to the future. Based on the results, NAA should take measures to consider health maintenance. In carrying out the health impact survey, NAA should consider new investigations such as blood pressure monitoring in addition to conventional methods.
- ✓ As the runway is extended and newly constructed and the number of flights increases, the area affected by noise exceeding environmental standards will expand. Therefore, in order to achieve environmental standards related to aircraft noise, NAA is to maximize measures to reduce noise, such as promoting introduction of low noise type aircraft at all times.

Based on these opinions, NAA prepared and announced a road map that sets the timing of various noise control measures and concrete numerical targets, etc., along with the preparation of the Impact Mitigation Report.

### 5. CONCLUDING REMARKS

In this paper, we outline the operating restrictions and noise countermeasures that we have carried out at Narita airport, which is the inland airport, and also described the progress status of further enhancement. At Narita Airport, as air demand increased, the airport capacity was increased by promoting introduction of low noise aircraft and relaxing flight restrictions. However, in order to enhance the competitiveness among international airports in East Asia, we proposed a further functional enhancement plan with contents of 500,000 annual flights, assuming aviation demand in about 20 years. And, after explanation to the residents around airport in March last year, we reached an agreement on functional enhancement. Noise influences such as sleep disturbance especially at night are regarded as problems in functional enhancement. Measures to install inner windows in the bedroom and slide operation are effective for ensuring the sleep of the surrounding residents, and it is considered that a certain understanding was obtained through the town-hall meetings for the residents. Moreover, it is meaningful for the first time that the operation time has been extended after the opening 40th anniversary.

However, since the concerns of the surrounding residents remain with night-time noises even if the measures mentioned above are taken, it is desirable to set concrete targets like planning a roadmap and systematically reduce night-time noise.

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