International Civil Aviation Organization

Tenth Meeting of the Air Traffic Management Sub-Group (ATM/SG/10) of APANPIRG

Video Teleconference, 17 – 21 October 2022

Agenda Item 5: ATM Systems (Modernization, Seamless ATM, CNS, ATFM)

ENHANCED WAKE TURBULENCE SEPARATION IN JAPAN

(Presented by Japan)

SUMMARY

This paper presents the implementation process and current status of the enhanced Wake Turbulence Separation (eWTS) at Tokyo/Haneda International Airport (RJTT) and Tokyo/Narita International Airport (RJAA) in Japan to support the ATM/SG action item 9/6.

1. INTRODUCTION

1.1 At the ninth meeting of ATM Sub-Group (ATM/SG/9), Hong Kong China presented the implementation process of the enhanced Wake Turbulence Separation (eWTS) scheme at Hong Kong International Airport (HKIA) on 5 November 2020. It was agreed at the meeting to consider sharing experiences and lessons learned in the implementation of eWTS as action item 9/6.

1.2 Since being a member of the Wake Turbulence Specific Working Group (WTSWG) hosted by ICAO headquarters (ICAO HQ), having implemented eWTS at Tokyo/Haneda International Airport (RJTT) and Tokyo/Narita International Airport (RJAA) and having shared experience by using **Attachment A** at the Re-categorization of wake turbulence categories (RECAT) webinar hosted by the Beijing Sub-Regional office on 22 September 2021, Japan offered to contribute action item 9/6 at the ATM/SG/9 meeting.

2. DISCUSSION

<u>Background of eWTS implementation in Japan</u>

2.1 Before the COVID-19 pandemic, air traffic demand in Japan was expected to grow 2 to 3 percent per year, and it drove the need for expansion of the airport and terminal airspace capacity, particularly at the Tokyo metropolitan airports, RJTT and RJAA.

2.2 In the long-term vision for the future air traffic systems of Japan, which was called "Collaborative Actions for Renovation of Air Traffic Systems (CARATS)", the Japan Civil Aviation Bureau (JCAB) established the implementation plan of RECAT in accordance with the Global Air Navigation Plan (GANP) of the International Civil Aviation Organization (ICAO), in 2013.

2.3 The implementation for the reduced wake turbulence separation with RECAT (seven wake turbulence groups) in Japan was named RECAT-Japan. The introduction of RECAT-Japan at RJTT and RJAA by early 2020 was determined in 2018, it was also considered one of the reasons to prepare for the Tokyo 2020 Olympic and Paralympic Games which were originally planned to hold in 2020.

Implementation process of RECAT-Japan as trial operation

2.4 JCAB planned to implement RECAT-Japan with a phased approach since the RECAT would be standardized in the Procedures as the enhanced Wake Turbulence Separation (eWTS) for Air Navigation Services - Air Traffic Management (PANS-ATM), ICAO Doc 4444, on 5 November 2020.

2.5 The implementation of a trial operation until 5 November 2020 was conducted based on the result of conducting safety assessments by JCAB with close support from the Japanese research organizations, the Electronic Navigation Research Institute (ENRI) and the Japan Aerospace Exploration Agency (JAXA). The materials of RECAT-EU provided by EUROCONTROL and RECAT-US provided by the Federal Aviation Administration (FAA) also contributed to the trial operation.

2.6 The working group for the implementation of RECAT-Japan was established by the Air Traffic Control (ATC) Division of JCAB Headquarters (JCAB HQ). Members of the working group were above two research organizations, some Japanese airline operators, ATC units of RJTT and RJAA, the Tokyo Regional Civil Aviation Bureau (TCAB) and the Air Navigation Services Safety Office which was one of the regulatory divisions of JCAB.

2.7 To implement RECAT-Japan at RJTT, three specific analyses and assessments were needed. First, evaluation of the decay characteristics over the sea surface was required because most of the flight procedures for departure/approach were established over the sea. **Figure 1** shows an example of RJTT runway operation and the observing direction of the Light Detection and Ranging (LIDAR). **Figure 2** shows LIDARs installed by ENRI and JAXA.

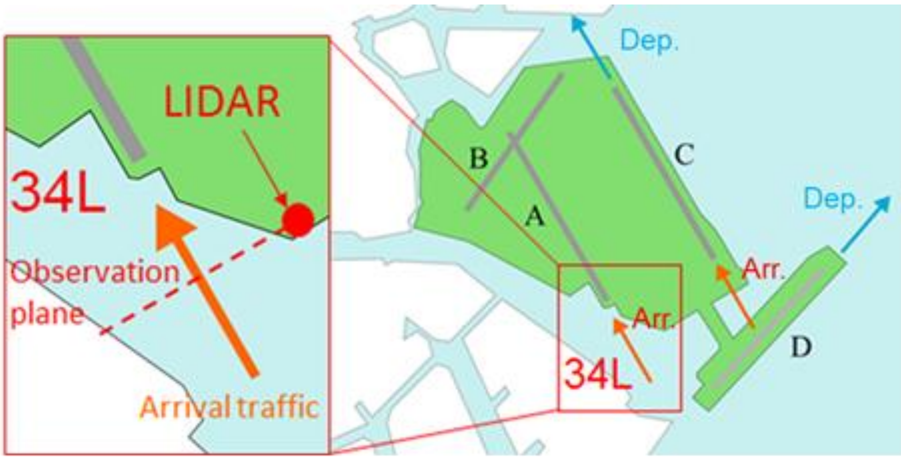

Figure 1: Example of RJTT runway operation and observing direction of LIDARs

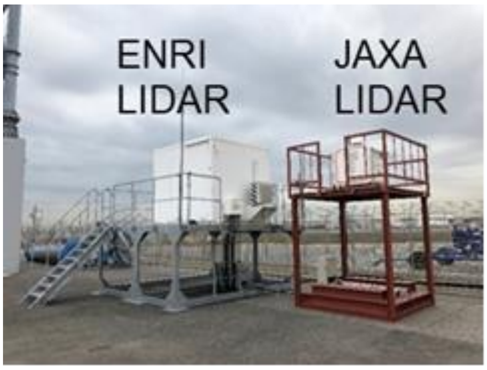

Figure 2: LIDARs installed by ENRI and JAXA

2.8 It was verified by JAXA that wake decay over the sea would be within an acceptable safety level for implementation of the reduced wake turbulence separation with RECAT although it was slightly observed slower than over the land. Figure 3 shows the observed wake decay characteristics over the sea surface around RJTT.

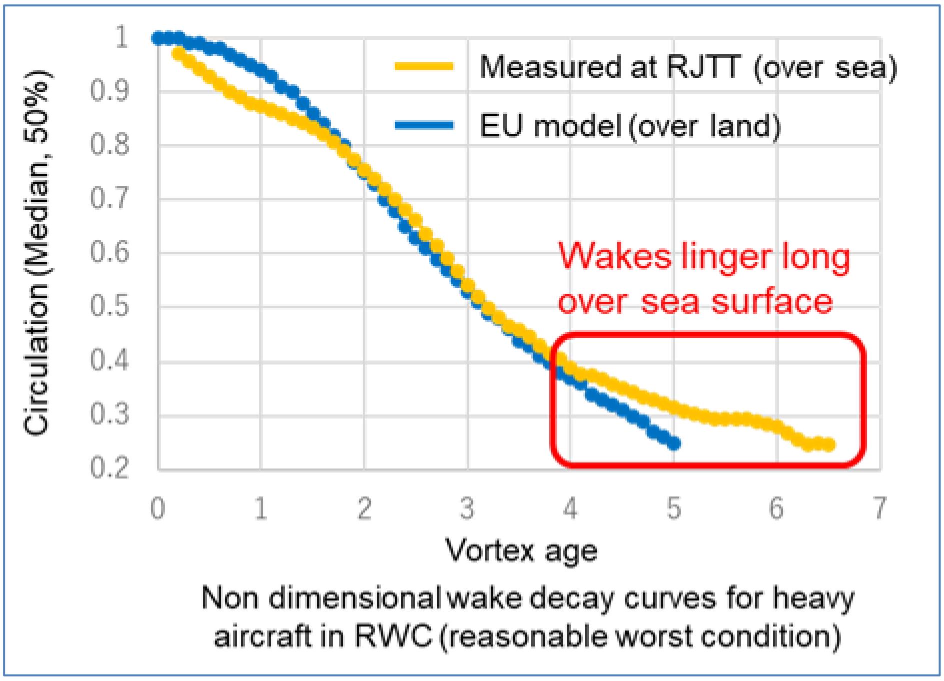

Figure 3: Observed wake decay characteristics over the sea

2.9 Second, the benefit of RECAT-Japan in runway throughput needed to consider the realistic ATC operation for arrival aircraft at RJTT, where the Point Marge System was introduced in 2019. Another aspect was an improvement of runway throughput considering airport surface operations. ENRI developed two types of simulators to evaluate each terminal airspace and airport surface operation.

2.10 Third, two PBN approach procedures for RJTT runway 16L and 16R have 3.45 degrees vertical pass, slightly steeper than usual the 3 degrees vertical pass, on the final approach segment, so that JAXA also verified that the safety level of the RECAT-Japan operation at two these procedures would be acceptable because the duration time under wake influence would be shorter on the steeper vertical pass and the RECAT-US operation had been already introduced into the similar approach procedures with steeper vertical pass such as KSAN runway 27 approach.

2.11 Nine hazards were identified, and five mitigation measures were established by the working group. **Table 1** shows a summary of hazards and mitigation measures. The format and submission procedure for the Wake Turbulence Encounter Report (WTER) were also discussed in the working group.

ID No	Identified Hazard	Precondition	Result of Analysis	Mitigation Measure
RCT-01	Difference of final approach speed between approaching aircraft	Procedural speed on final approach by AIP	Acceptable with mitigation	a. Instruction of final approach speed by ATC
RCT-02	Encounter of wake turbulence from other aircraft	Encounter of wake turbulence from other aircraft	Acceptable without mitigation	Not necessary

ID No	Identified Hazard	Precondition	Result of Analysis	Mitigation Measure
RCT-11	Long runway occupation of preceding arrival aircraft	Procedure of speedy turn off or crossing runway by AIP	Acceptable with mitigation	b. Remind of Procedure of speedy turn off or crossing runway
RCT-12	Crossing traffic on runway between arrival aircraft	Procedure of speedy turn off or crossing runway by AIP	Acceptable with mitigation	b. Remind of Procedure of speedy turn off or crossing runway
RCT-13	Appling wrong wake turbulence minimum	Using ATC support system	Acceptable with mitigation	c. Training for ATC
RCT-14	Delay of flight crew's response for ATC instruction	Awareness and intervention by ATC	Acceptable with mitigation	c. Training for ATC
RCT-15	Starting roll of departure aircraft without ATC clearance	Awareness and intervention by ATC	Acceptable without mitigation	Not necessary
RCT-21	Failure of ATC support system	Awareness and coping by ATC	Acceptable with mitigation	d. Operational procedure without ATC support tool e. Preparation of alternative tool
RCT-22	Wrong setting of ATC support system	Awareness and coping by ATC	Acceptable with mitigation	d. Operational procedure without ATC support tool e. Preparation of alternative tool

Table 1: Summary of hazards and mitigation measures

2.12 The working group was consideration on the human factor due to complicated seven grouping of RECAT-Japan led to the upgrade of the Trajectorized Airport Traffic Data Processing System (TAPS), which is a system for Tower ATC and Terminal Radar ATC, to indicate specific wake turbulence group on data blocks of a radar target.

2.13 The plan, tool and procedure for the training of ATC personnel were considered and established by JCAB HQ and TCAB. The best way of ATC personnel training, applying the upgraded program to the TAPS simulator, had difficulty due to technical issues. The ATC personnel took classroom learning based on the teaching material which was prepared by JCAB HQ.

2.14 After the 6 runs of the working group, the working group agreed to implement RECAT-Japan at RJTT and RJAA as a trial operation from 26 March 2020. It was noticed and published by the Aeronautical Information Publication (AIP) Supplement.

2.15 Although JCAB planned to hold explanatory meetings for aircraft operators at RJTT and RJAA, the meetings were forced to be canceled due to COVID-19. JCAB distributed material for the meeting to the Aircraft Operators, instead. **Attachment B** is the material.

<u>Transition process to official operation based on eTWS</u>

2.16 The transition from trial operation to official operation was considered based on the draft of the Manual on Implementation of Wake Turbulence Separation Minima, ICAO Doc 10122, which had been considered and discussed by the ICAO WTSWG meetings until May 2020.

2.17 Besides, the draft amendment of the PANS-ATM and the Aircraft Type Designators (ICAO Doc 8643), review for the safety assessment of the trial operation, and analysis of WTERs reported and submitted from aircraft operators to JCAB were of great contribution to the transition.

2.18 Seven WTERs were reported to JCAB during the trial period from 25 March 2020 to 30 September 2020. **Table 2** shows a summary of WTER which was analyzed and assessed with the support of ENRI and JAXA. **Figure 3** and **Figure 4** show the encounter location maps of the reported WTERs.

2.19 It was analyzed and assessed by ENRI, JAXA and JCAB that case 2 was not due to wake turbulence from preceding aircraft. There were two reasons, one was that the vertical climbing pass of the reporter aircraft was higher than the generator aircraft. The other was that the average wind strength was 21knots and the maximum was 32knots at that time.

	Airport	**Reporter**	**Generator**	**DEP/ ARR**	**Flight Phase**	**Encounter Location**	**Altitude**	**Severity**	**Pilots' Operation**	**Sec ***
1	RJTT	B738	B763	DEP	Climb	3NM from RWY	2,500FT	Moderate	Controlled manually	111
2	RJTT	B738	A359	DEP	Initial climb	Between RWY END and 1NM from RWY	500FT-1,600FT	Moderate	Controlled manually	-
3	RJTT	A320	A359	ARR	Approach	8NM from RWY	2,500FT	Weak	Remained engaged	109
4	RJTT	B738	B763	DEP	Climb	3NM from RWY	3,000FT	Weak	Remained engaged	87
5	RJTT	B738	B763	ARR	Approach	Between 15NM and 10NM from RWY	2,000FT-3,000FT	Moderate	Disengaged manually	97
6	RJAA	A320	B763	DEP	Climb	7-10NM from	3,500FT-4,000FT	Weak	Remained engaged	97
7	RJTT	B738	B788	ARR	Landing	Before touch down	20FT	Moderate	Controlled manually	106
* Time separation at encounter location from generator aircraft to reporter aircraft analyzed by ENR										

Table 2: Summary of WTER during trial phase

Figure 3: Encounter locations around RJTT

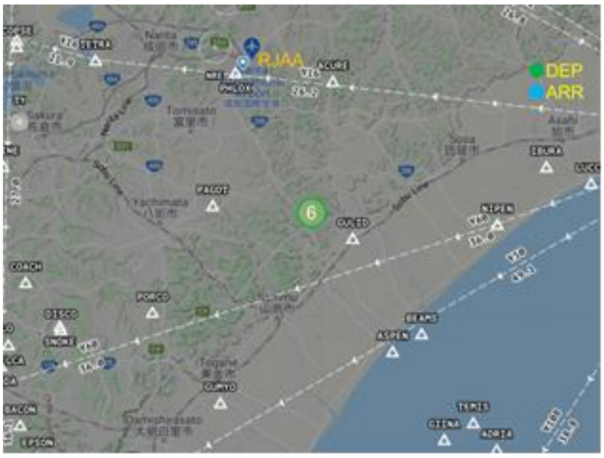

Figure 4: Encounter location around RJAA

2.20 The working group was held 3 times during the period from June 2020 to October 2020 to review the trial operation. Nine hazards and five mitigation measures were reviewed by the working group. **Table 3** shows a summary of the review. The working group confirmed and determined that additional hazards were not identified and mitigation measures were not needed to add and change

ID No	Identified Hazard	Occurrence of Operational Impact	Result of Review	Mitigation Measure
RCT-01	Difference of final approach speed between approaching aircraft	Not occurred	Acceptable	No change
RCT-02	Encounter of wake turbulence from other aircraft	Occurred (7 events)	Acceptable	No change (Not necessary)
RCT-11	Long runway occupation of preceding arrival aircraft	Occurred (1 event)	Acceptable	No change
RCT-12	Crossing traffic on runway between arrival aircraft	Not occurred	Acceptable	No change
RCT-13	Appling wrong wake turbulence minimum	Not occurred	Acceptable	No change
RCT-14	Delay of flight crew's response to ATC instruction	Not occurred	Acceptable	No change
RCT-15	Starting roll of departure aircraft without ATC clearance	Not occurred	Acceptable	No change (Not necessary)

ID No	Identified Hazard	Occurrence of Operational Impact	Result of Review	Mitigation Measure
RCT-21	Failure of ATC support system	Not occurred	Acceptable	No change
RCT-22	Wrong setting of ATC support system	Not occurred	Acceptable	No change

Table 3: Summary of review for hazards and mitigation measures

2.21 As the result of the review by the working group, it was agreed to implement eWTS officially based on the PANS-ATM, ICAO Doc 10122 and Doc 8643 from 5 November 2020, and noticed and published by the AIP.

Current and future work for eTWS in Japan

2.22 Obtaining and analyzing WTERs at airports and airspace where eWTS is implemented is required by ICAO HQ. **Table 4** shows the number of WTERs at RJTT and RJAA submitted by aircraft operators. A total of 25 WTERs have been reported from aircraft operators as of September 2022.

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
2020				1			2	4	1		2	1	11
2021						1					3		4
2022	1	1				1	2	3	2	-	-	-	10
SUM	1	1	0	1	0	2	4	7	3	0	5	1	25

Table 4: Number of submitted WTERs

2.23 According to **Table 4**, the number of WTERs seems to be in proportion with the traffic volume since the traffic volume in Fukuoka FIR in 2021 decreased from it in 2020 and the traffic volume in 2022 continues to be in a recovery trend.

2.24 Additionally, it is identified that the summer season, from July to September, seems to be reported more WTERs than other months except for November. One of the reasons would be that the wind strength in the summer season is weaker than in other seasons in Japan.

2.25 JCAB has the implementation plan of eWTS at other airports in Japan such as Osaka/Kansai International Airport. Besides, the implementation of advanced eWTS including time-based wake turbulence separation for arrival aircraft has been considered and discussed in CARATS.

2.26 Japan is willing to contribute to the ATM/SG action item 9/6 and support States and ATS providers in the Asia Pacific region that are considering to implement eWTS.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper;

b) discuss how to achieve the action item 9/6, and

c) discuss any relevant matters as appropriate.

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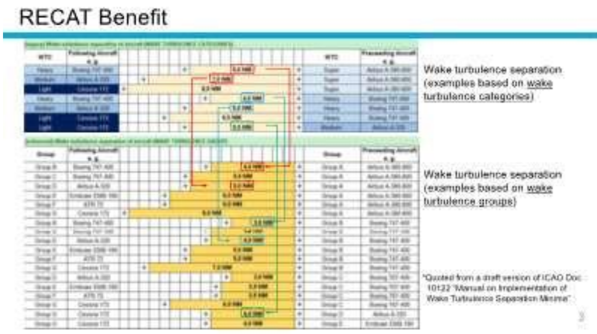
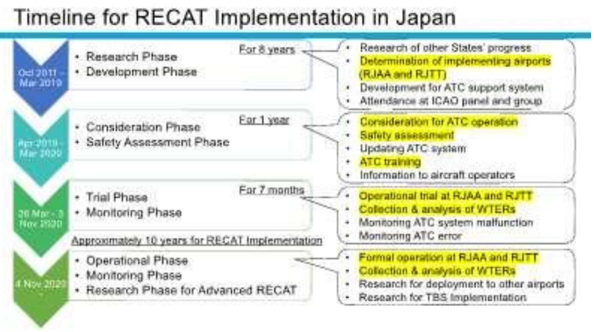
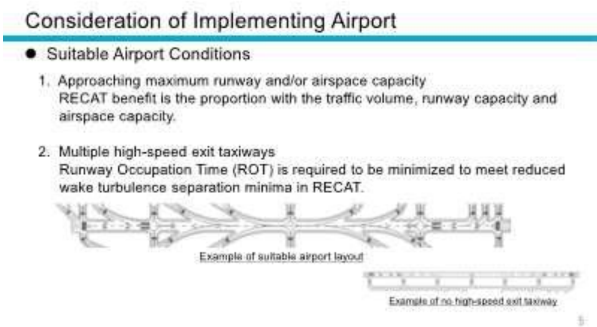
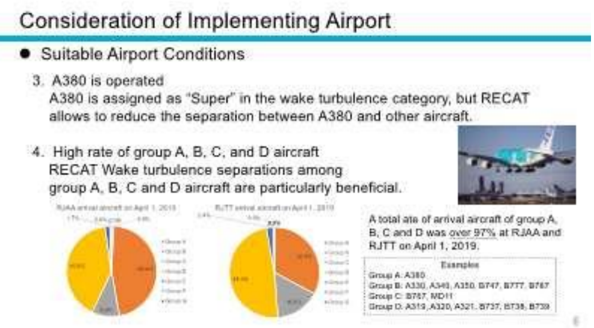
Attachment A: Material of RECAT webinar in September 2021









Determination of Implementing Airport

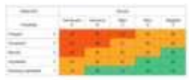
- Determination of reasons
  - Runway and airspace capacities of RJAA and RJTT were approaching full.
  - RJAA and RJTT have multiple high-speed exit taxiways.
  - RJAA handles A380, and RJTT has the ability to handle A380[*2].
  - Many group A, B, C, and D aircraft were operated at RJAA and RJTT.
  - RJAA and RJTT were expected to be a gateway airport for Tokyo 2020.

	1. Runway and/or airspace Capacity	2. Multiple high-speed exit taxiways	3. A380 is operated	4. High rate of group A, B, C, and D aircraft	Gateway for Tokyo 2020
RJAA	Approaching full (in peak hours)	Yes	Operated	Total 97% or more	Yes
RJTT	Approaching full	Yes	Not regularly operated[*2]	Total 97% or more	Yes

*2: RJTT has the ability to handle A380, but there are some operational restrictions.

Consideration for ATC Operation and Safety Assessment

- Purpose
  - Consideration to mitigate increasing ATC workload
  - Identification of expected hazards after implementing RECAT
  - Consideration for mitigation measures to reduce the risks



- Method
  - ICAO Doc 10122
    "Manual on Implementation of Wake Turbulence Separation"[*3]
- Members for Working Group
  - ANSP (JCAB HQ)
  - Regulator (JCAB HQ)
  - ATC facilities (TWR & TERMINAL)
  - Aircraft operators (ANA & JAL)
  - Research institutions (ENRI[*4] & JAXA[*5])

*3: JCAB has a draft version as a member of WTSWG.
*4: Electronic Navigation Research Institute
*5: Japan Aerospace Exploration Agency

ATC Support System/Tool

- Purpose
  - RACAT wake turbulence groups are not filled in a flight plan.
  - ATC needs a support system/tool to identify a correct RECAT wake turbulence group of aircraft and applying separation.
- JCAB ATC Support System (One example of ATC support systems/tools)

ATC Training

- Purpose
  - To avoid applying incorrect wake turbulence separation
  - To understand how to use ATC support system/tool
  - To deal in case of failure of ATC support system/tool
- Method
  - ATC simulator
  - Classroom learning

- Period
  - Depending on the ATC facility

Wake Turbulence Encounter Report (WTER)

- Purpose
  - Collection and analysis of WTERs are required to monitor safety issues after implementing RECAT.
- Format and Items
  - The format of WTER is not standardized.
  - The items for WTER have been considered and discussed at the Wake Turbulence Specific Working Group (WTSWG) hosted by ICAO HQ.
- Submission
  - The collected and analyzed WTER is required to submit to ICAO HQ through the ICAO secure portal website.

WTER format in Japan

Wake Turbulence Encounter Report (WTER) in Japan

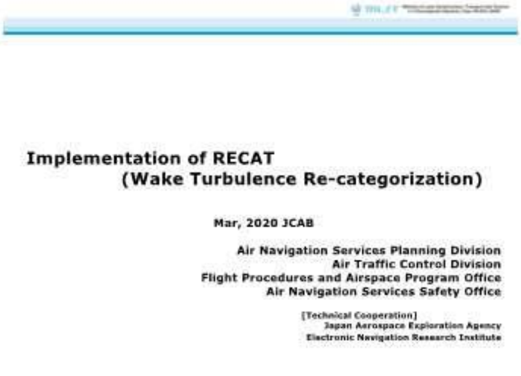
- Pilots should report wake turbulence encounter events around RJTT and RJAA to JCAB. (It is informed in AIP.)
- JCAB analyzes the reported events with ENRI.
- JCAB submits the report to ICAO through the ICAO secure portal website.

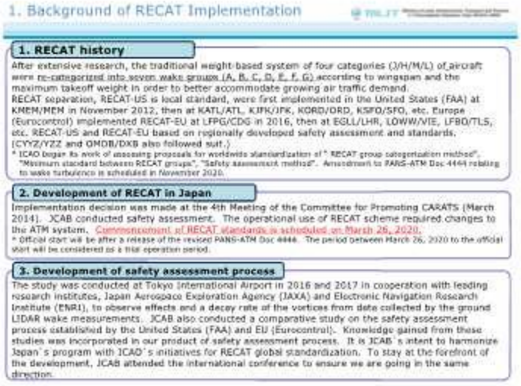
Seven wake turbulence encounter events, one event around RJAA and six events around RJTT, were reported and analyzed during the period from 25 March 2020 to September 2020.

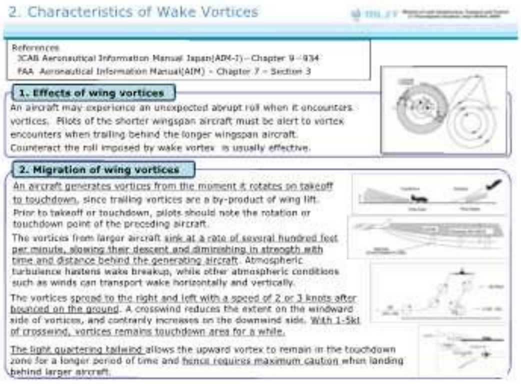
Encounter Locations around RJTT

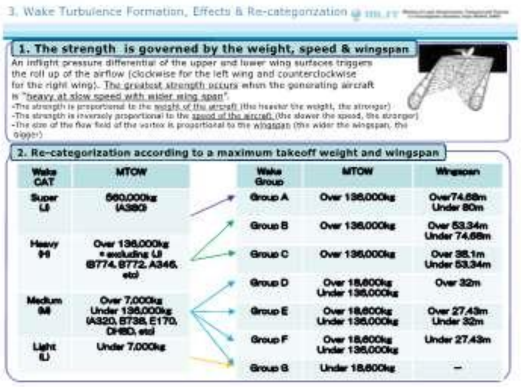
Encounter Location around RJAA

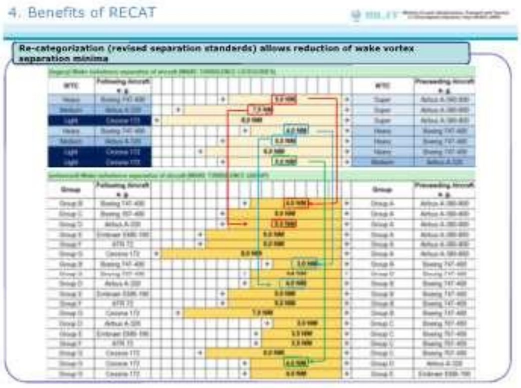
Attachment B: Material for ATC units and aircraft operators before RECAT implementation

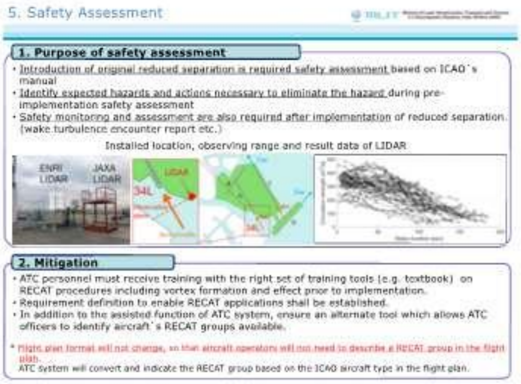


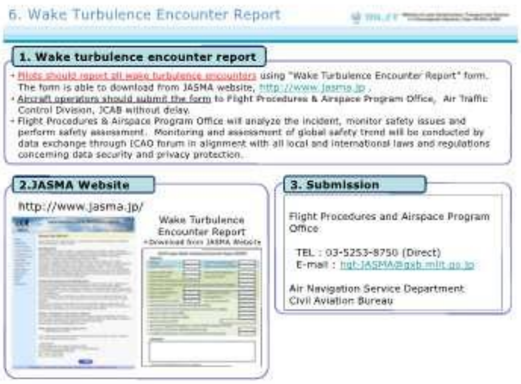


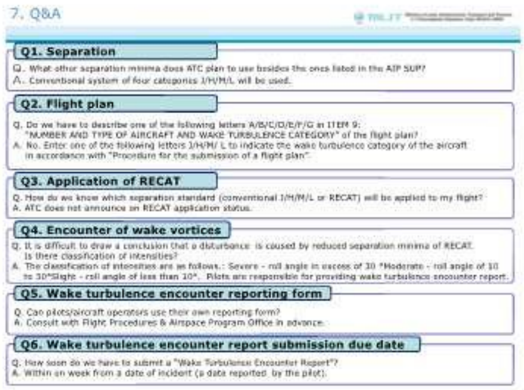


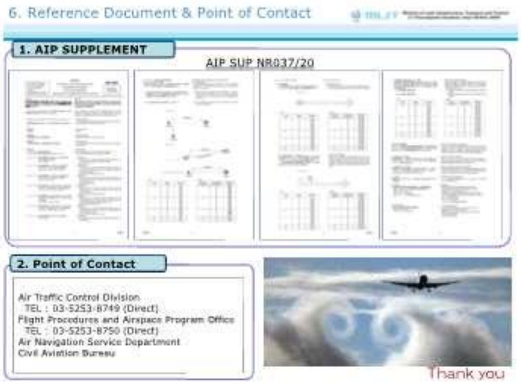







6. Wake Turbulence Encounter Report
1. Wake turbulence encounter report
• Pilots should report all wake turbulence encounters using "Wake Turbulence Encounter Report" form. The form is able to download from JASMA website, http://www.jasma.jp .
• Aircraft operators should submit the form to Flight Procedures & Airspace Program Office, Air Traffic Control Division, JCAB without delay.
• Flight Procedures & Airspace Program Office will analyze the incident, monitor safety issues and perform safety assessment. Monitoring and assessment of global safety trend will be conducted by data exchange through ICAO forum in alignment with all local and international laws and regulations concerning data security and privacy protection.
2.JASMA Website
http://www.jasma.jp/
Wake Turbulence Encounter Report
•Download from JASMA Website
3. Submission
Flight Procedures and Airspace Program Office
TEL : 03-5253-8750 (Direct)
E-mail : hqt-JASMA@gxb.mlit.go.jp
Air Navigation Service Department
Civil Aviation Bureau


7. Q&A
Q1. Separation
Q. What other separation minima does ATC plan to use besides the ones listed in the AIP SUP?
A. Conventional system of four categories J/H/M/L will be used.
Q2. Flight plan
Q. Do we have to describe one of the following letters A/B/C/D/E/F/G in ITEM 9: "NUMBER AND TYPE OF AIRCRAFT AND WAKE TURBULENCE CATEGORY" of the flight plan?
A. No. Enter one of the following letters J/H/M/ L to indicate the wake turbulence category of the aircraft in accordance with "Procedure for the submission of a flight plan".
Q3. Application of RECAT
Q. How do we know which separation standard (conventional J/H/M/L or RECAT) will be applied to my flight?
A. ATC does not announce on RECAT application status.
Q4. Encounter of wake vortices
Q. It is difficult to draw a conclusion that a disturbance is caused by reduced separation minima of RECAT. Is there classification of intensities?
A. The classification of intensities are as follows.: Severe - roll angle in excess of 30 °Moderate - roll angle of 10 to 30°Slight - roll angle of less than 10°. Pilots are responsible for providing wake turbulence encounter report.
Q5. Wake turbulence encounter reporting form
Q. Can pilots/aircraft operators use their own reporting form?
A. Consult with Flight Procedures & Airspace Program Office in advance.
Q6. Wake turbulence encounter report submission due date
Q. How soon do we have to submit a "Wake Turbulence Encounter Report"?
A. Within on week from a date of incident (a date reported by the pilot).


6. Reference Document & Point of Contact
1. AIP SUPPLEMENT
AIP SUP NR037/20
2. Point of Contact
Air Traffic Control Division
TEL : 03-5253-8749 (Direct)
Flight Procedures and Airspace Program Office
TEL : 03-5253-8750 (Direct)
Air Navigation Service Department
Civil Aviation Bureau
Thank you