International Civil Aviation Organization

THE NINTH MEETING OF PERFORMANCE BASED NAVIGATION

IMPLEMENTATION COORDINATION GROUP (PBNICG/9)

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Agenda Item 5: CDO/CCO Implementation

Continuous Descent Operations (CDO) Performance Monitoring at Incheon International Airport (RKSI)

(Presented by Republic of Korea)

SUMMARY

This paper presents information on the progress of Continuous Descent Operations (CDO) at Incheon International Airport (RKSI), Republic of Korea (ROK) which has been implemented at RKSI since 2012. Due to the limited airspace with two neighboring airports (Incheon (RKSI) and Gimpo (RKSS) International Airports) and heavy traffic, implementing CDO over 24 hours remains difficult. CDO achievement was measured and compared, after the analysis on ADS-B data, flight trajectories for flights arriving at RKSI for the two years (2018 and 2019) before the COVID-19 pandemic.

1. INTRODUCTION

1.1 In accordance with the guidance from ICAO DOC 9931 CDO manual, ROK has stipulated four CDOs for runway 33L/R of RKSI airport.

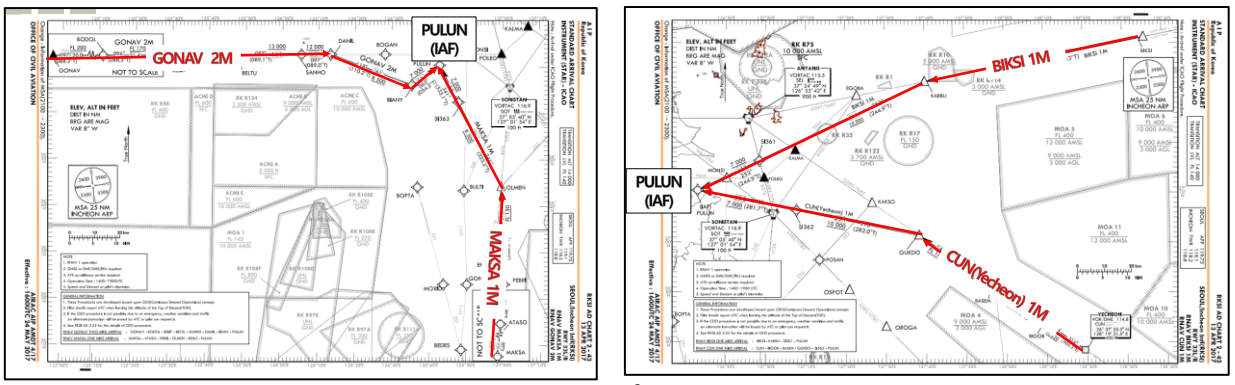

Figure 1: Four CDOs for RKSI

1.2 The concept of CDO primarily intends to reduce fuel burn and thus CO2 emissions as well as noise. Despite its environmental benefit, the CDO STARs are restrictedly implemented during low traffic density situation. Another reason for the restriction is the limited airspace, Terminal Maneuvering Area (TMA) encompassing two congested neighboring airports (RKSI and RKSS). Figure 2 shows the locations and STARs/SIDs of the two airports. As seen in the Figure 2, prohibited area is established in the north of the airports and thus the STARS and SIDs are densely set in the southern airspace of the airports.

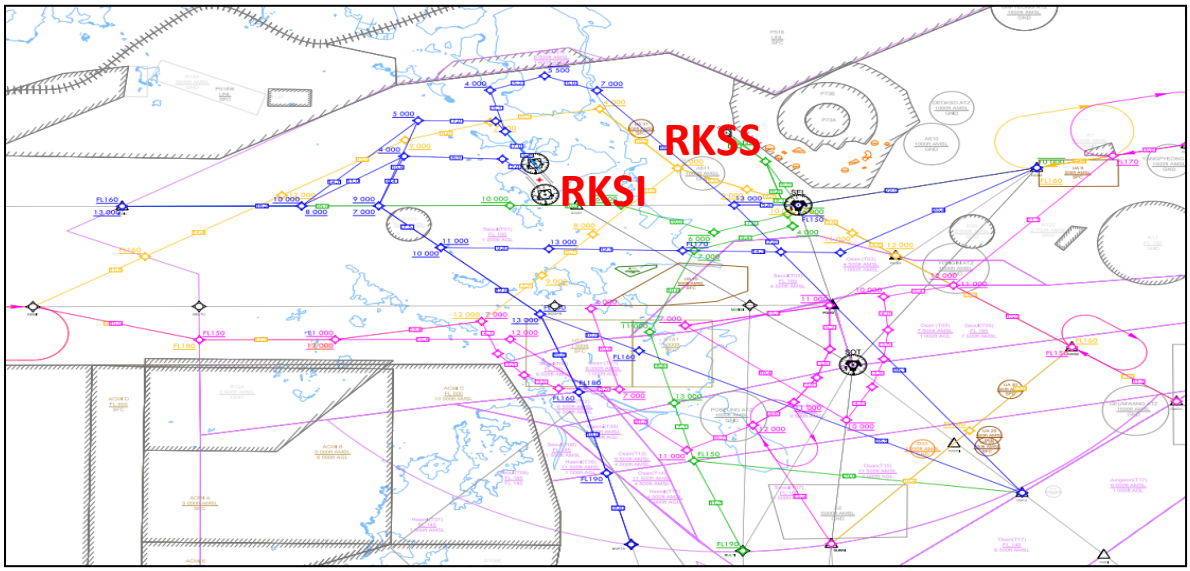

Figure 2: STARs and SIDs for RKSI and RKSS

1.3 This paper presents CDO performance measured at RKSI airport. For the measurement, ADS-B data was collected and processed to remove irregular tracks (e.g., holding aircraft, missed approaches, and erroneous tracks).

2. DISCUSSION

2.1 In order to monitor the CDO performance at RKSI, the ADS-B track data was analyzed for the two years (2018 and 2019) before COVID-19. Due to the incompleteness of the flight track data, however, the analysis on all flight could not be conducted. Table 1 is the summary of the analyzed total number of arrivals and the published number of arrivals. For this performance monitoring, about 93.7% and 94.7% of arrivals were included in the analysis for year 2018 and 2019 respectively.

	Arrival (Analyzed)	Arrival(Published)
	RWY33 L/R	
2018	100,875	107,645
2019	105,825	111,727

Table 1: Number of Arrivals

2.2 The performance monitoring process adopted a harmonized metric proposed by European CCO/CDO Task Force. Flight track of each flight was measured by its time (seconds) spent in level flight from the top of decent (TOD) to final approach fix (FAF). A descent is considered to be continuous if segment of level flight occurs no longer than 20 seconds, and level flight incorporates any segment of flight having a vertical speed less than 300 feet per minutes.

2.3 Figure 3 shows the light track of two arrivals (KE012, KE252) together with vertical profiles and ground speeds over distance from runway threshold. In the aforementioned figure, KE012 is considered to be making a continuous descent after passing the starting point of STAR named BIKSI till FAF. On the other hand, KE252 is deemed to be in level flight during certain segment as marked with thick black line in Figure 3. In this case, KE252 is analyzed to have spent total 202 seconds in level flight.

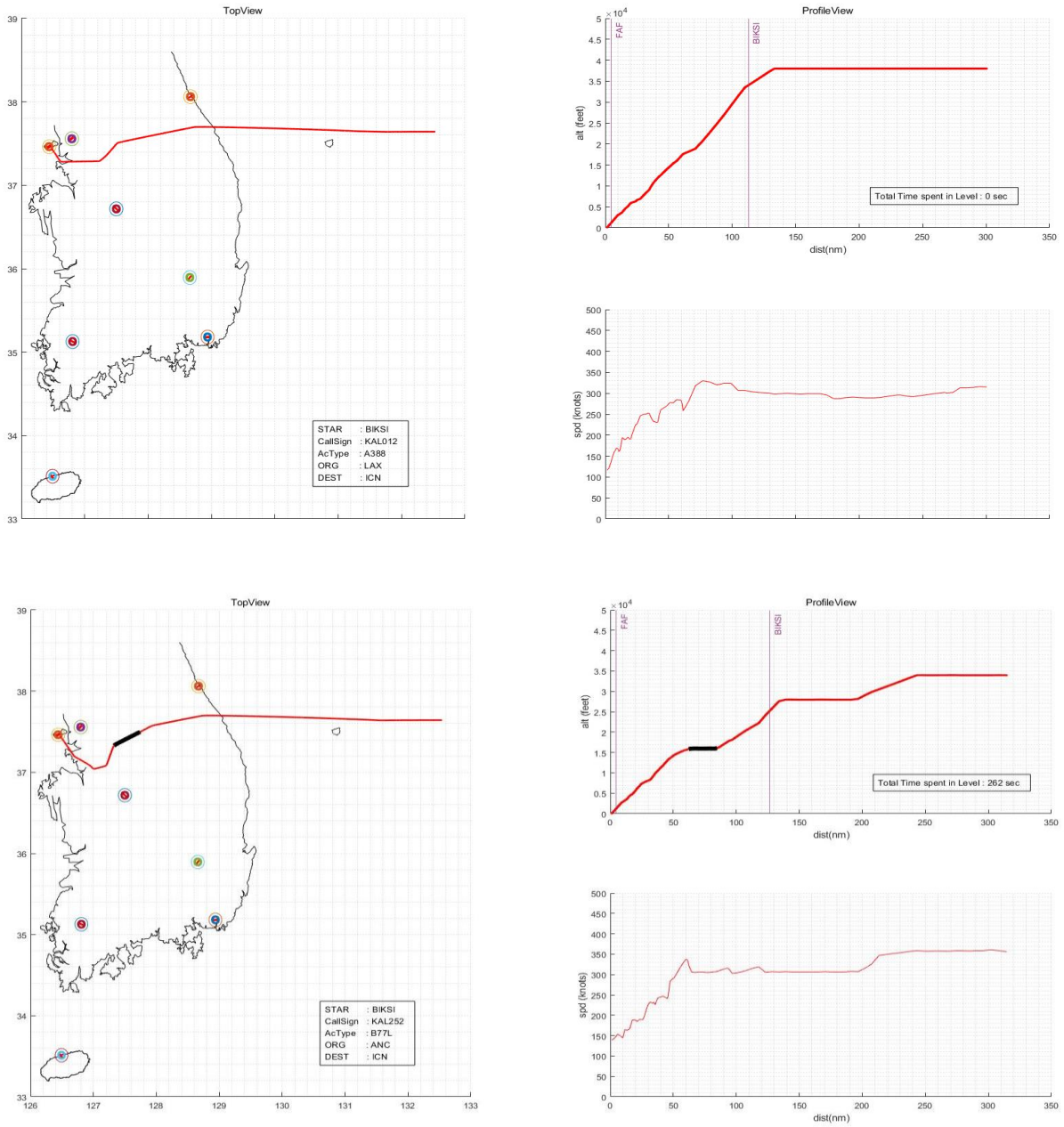

Figure 3: Examples of CDO Performance Analysis

< Above: Continuous Descent (KE012), Below: Step-down Approach (KE252) >

2.4 Compared with level flight, the CDO of KE012 achieved 439.6kg fuel reduction which is equivalent to 1,389kg CO2 emissions in the segment between the starting point of STAR and FAF.

2.5 The Appendix of this Paper summarizes overall CDO performance of arrivals using runway 33 L/R at RKSI by time period in 2018 and 2019. In 2018, 9.3% of total arrivals took the advantages of CDO and achieved 2,070,303 kg fuel reduction which is equivalent to 6,542,157 kg CO2 emissions. In 2019, 8.3% of total arrivals took the advantages of CDO and achieved 2,067,208 kg fuel reduction which is equivalent to 6,532,377 kg CO2 emissions.

2.6 Given the global priority to support airlines' recovery from the unprecedented economic fallouts of the COVID19 pandemic, the ROK is planning to introduce CDOs at Jeju International Airport (RKPC) this year.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper; and

b) discuss any relevant matters as appropriate.

Appendix

CDO Performance Monitoring at RKSI: RWY 33 L/R

(2018)

Number of Flights

	0~1	1~2	2~3	3~4	4~5	5~6	6~7	7~8	8~9	9~10	10~11	11~12	12~13	13~14	14~15	15~16	16~17	17~18	18~19	19~20	20~21	21~22	22~23	23~24	Total
BIKSI	24	12	63	376	403	201	35	24	5	10	99	284	75	181	265	111	265	165	103	87	200	53	47	164	3,252
CUN	143	33	106	880	594	586	628	571	356	426	1,682	1,314	1,842	2,675	1,657	2,129	2,386	2,041	2,077	3,630	2,381	2,830	1,018	590	32,575
MAKSA	269	153	251	1,445	4,858	5,059	5,140	3,964	2,161	2,354	881	708	588	1,769	1,438	1,583	1,811	1,628	2,367	2,465	2,275	2,162	1,087	691	47,107
GONAV	315	103	279	612	917	212	309	519	447	1,191	1,260	350	1,372	2,454	1,285	351	198	400	885	1,449	1,517	840	432	244	17,941
Total	751	301	699	3,313	6,772	6,058	6,112	5,078	2,969	3,981	3,922	2,656	3,877	7,079	4,645	4,174	4,660	4,234	5,432	7,631	6,373	5,885	2,584	1,689	100,875

Percentage of CDO flights

	0~1	1~2	2~3	3~4	4~5	5~6	6~7	7~8	8~9	9~10	10~11	11~12	12~13	13~14	14~15	15~16	16~17	17~18	18~19	19~20	20~21	21~22	22~23	23~24	Total
BIKSI	8.3%	33.3%	31.7%	22.1%	17.1%	10.4%	11%	4%	0%	10%	1%	0%	1%	4%	2%	6%	8%	5%	9%	6%	5%	2%	17%	13.4%	9.7%
CUN	37.8%	24.2%	36.8%	23.3%	21.2%	17.1%	21%	14%	15%	12%	11%	11%	11%	8%	7%	14%	12%	12%	13%	11%	14%	9%	12%	32.2%	12.6%
MAKSA	14.9%	12.4%	17.5%	15.8%	8.0%	7.9%	6%	6%	9%	12%	8%	9%	9%	5%	6%	10%	8%	10%	8%	7%	7%	8%	11%	13.2%	8.2%
GONAV	18.7%	15.5%	17.6%	12.4%	9.2%	7.1%	8%	5%	9%	5%	4%	15%	6%	4%	7%	11%	7%	8%	6%	3%	2%	3%	6%	11.5%	6.3%
Total	21%	16%	22%	18%	10%	9%	8%	7%	9%	10%	8%	10%	9%	6%	7%	12%	10%	11%	10%	8%	8%	8%	11%	20%	9.3%

Time spent in level flight (Seconds per Flight)

	0~1	1~2	2~3	3~4	4~5	5~6	6~7	7~8	8~9	9~10	10~11	11~12	12~13	13~14	14~15	15~16	16~17	17~18	18~19	19~20	20~21	21~22	22~23	23~24	Total
BIKSI	154	86	113	131	204	268	222	253	260	229	342	292	309	307	334	218	236	205	219	295	319	346	211	188	248
CUN	117	98	98	137	189	170	156	179	192	174	154	168	173	235	233	161	172	167	176	219	215	197	167	118	188
MAKSA	116	130	84	125	234	186	176	247	184	151	163	166	186	312	277	158	166	147	185	307	258	210	144	120	204
GONAV	130	147	137	163	236	288	227	263	204	205	234	186	216	287	284	187	189	174	228	335	370	277	210	149	254
Total	124	131	110	136	230	191	177	241	188	171	188	184	193	275	267	164	174	161	189	272	273	215	165	131	209

(2019)

Number of Flights

	0~1	1~2	2~3	3~4	4~5	5~6	6~7	7~8	8~9	9~10	10~11	11~12	12~13	13~14	14~15	15~16	16~17	17~18	18~19	19~20	20~21	21~22	22~23	23~24	Total
BIKSI	57	21	100	516	401	114	32	8	1	20	115	318	60	129	272	147	302	118	149	104	254	113	131	132	3,614
CUN	240	35	127	864	562	669	588	551	360	384	1,720	1,418	2,139	1,954	1,833	2,257	2,439	1,987	2,035	3,555	2,414	2,871	1,056	787	32,845
MAKSA	164	184	329	2,070	4,972	5,135	5,135	3,956	2,422	2,524	1,145	887	885	1,169	1,791	1,621	2,070	1,630	2,409	2,531	2,609	2,176	1,496	716	50,026
GONAV	373	176	371	767	933	238	229	524	486	1,178	1,730	588	2,658	1,238	1,513	286	149	210	1,048	1,159	1,200	1,054	765	467	19,340
Total	834	416	927	4,217	6,868	6,156	5,984	5,039	3,269	4,106	4,710	3,211	5,742	4,490	5,409	4,311	4,960	3,945	5,641	7,349	6,477	6,214	3,448	2,102	105,825

Percentage of CDO flights

	0~1	1~2	2~3	3~4	4~5	5~6	6~7	7~8	8~9	9~10	10~11	11~12	12~13	13~14	14~15	15~16	16~17	17~18	18~19	19~20	20~21	21~22	22~23	23~24	Total
BIKSI	0.0%	28.6%	21.0%	19.8%	15.2%	6.1%	9%	0%	0%	0%	1%	1%	0%	4%	6%	6%	3%	10%	5%	7%	4%	3%	3%	12.9%	8.4%
CUN	18.3%	54.3%	50.4%	19.0%	17.6%	19.4%	19%	13%	15%	10%	12%	10%	9%	10%	9%	12%	11%	12%	11%	11%	11%	8%	13%	31.0%	12.1%
MAKSA	9.8%	9.8%	15.8%	12.9%	7.8%	7.0%	6%	5%	5%	10%	4%	7%	7%	6%	5%	8%	6%	9%	7%	6%	6%	8%	11%	11.2%	7.2%
GONAV	8.6%	8.5%	9.7%	8.7%	5.3%	4.6%	5%	8%	6%	5%	3%	5%	3%	5%	5%	4%	4%	6%	5%	2%	2%	3%	4%	7.3%	4.5%
Total	11%	14%	19%	14%	9%	8%	7%	6%	7%	9%	7%	7%	6%	8%	6%	9%	8%	10%	8%	8%	7%	7%	10%	18%	8.3%

Time spent in level flight (Seconds per Flight)

	0~1	1~2	2~3	3~4	4~5	5~6	6~7	7~8	8~9	9~10	10~11	11~12	12~13	13~14	14~15	15~16	16~17	17~18	18~19	19~20	20~21	21~22	22~23	23~24	Total
BIKSI	169	155	131	141	194	190	194	268	220	202	328	291	307	229	269	244	238	248	217	271	275	289	243	159	229
CUN	130	88	125	137	168	146	151	176	166	160	163	164	208	173	202	173	177	160	162	189	180	180	171	120	174
MAKSA	106	113	93	142	181	154	166	229	180	148	185	164	231	186	222	160	183	145	191	249	215	198	151	126	182
GONAV	141	124	156	177	229	238	246	237	218	210	237	217	253	211	207	199	222	158	200	283	321	277	224	158	230
Total	133	119	128	147	188	157	168	225	184	168	201	187	234	189	214	172	185	156	183	227	226	206	178	134	190