

AVIATION OPERATIONAL MEASURES FOR FUEL AND EMISSIONS REDUCTION WORKSHOP



HOW TO SAVE FUEL BY LOSING TIME?

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Air Traffic Management Panel
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➔ IN ABSORBING ARRIVAL
DELAYS LINEARY DURING
DESCENT INSTEAD OF
HOLDING STACK TECHNIQUE

ARRIVAL TRAFFIC IS GENERALLY ORGANIZED THROUGH SUCCESSIVE LAYERS:

→ STEP 1

→ ARRIVAL SLOTS (AIRLINES SCHEDULES) ARE DETERMINED ACCORDING TO RUNWAY CAPACITY (TYPICAL VALUE 44 a/c PER HOUR FOR SPECIALIZED RUNWAY)





→ STEP 2

→ DEPARTURE SLOTS
(including
overbooking) ARE
ALLOCATED
ACCORDINGLY BY
ATFM (pretactical)





→ STEP 3

→ ATC CONTROLLERS
REFINE TRAFFIC
SEQUENCES AS
APPROPRIATE
(tactical)





✈ NOTE:

✈ OVERBOOKING IS
REQUIRED TO
COMPENSATE
UNPREDICTABLE,
UNEXPECTED AND
INACCURATE
ELEMENTS such as:

- ✧ AIRLINES DELAYS
- ✧ FLIGHT
CANCELLATIONS
- ✧ BAD WEATHER

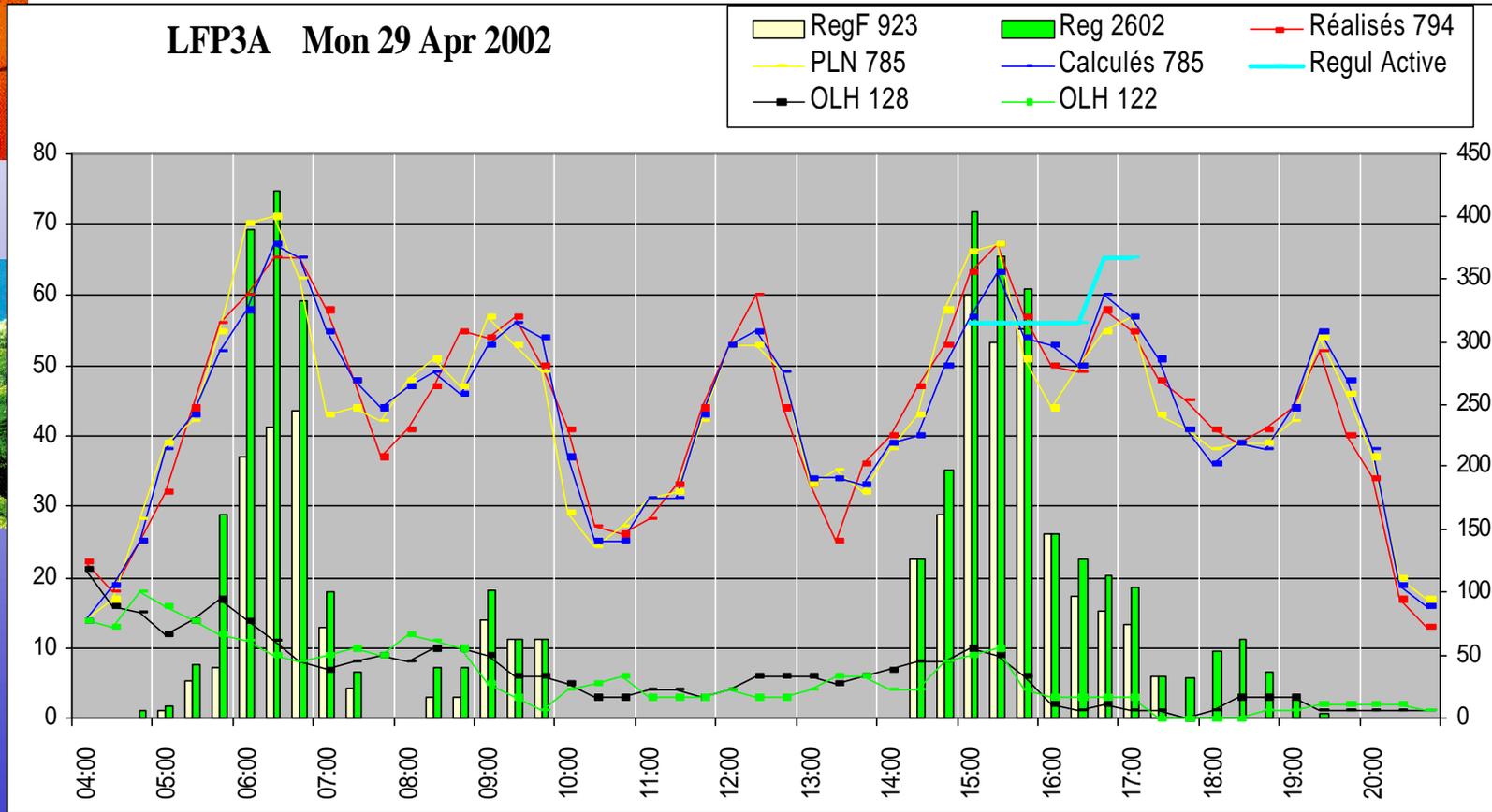
HOWEVER OVERBOOKING AND INACCURACY CAN INDUCE HOLDING BEFORE LANDING

THOSE DELAYS COULD BE
ABSORBED EITHER :

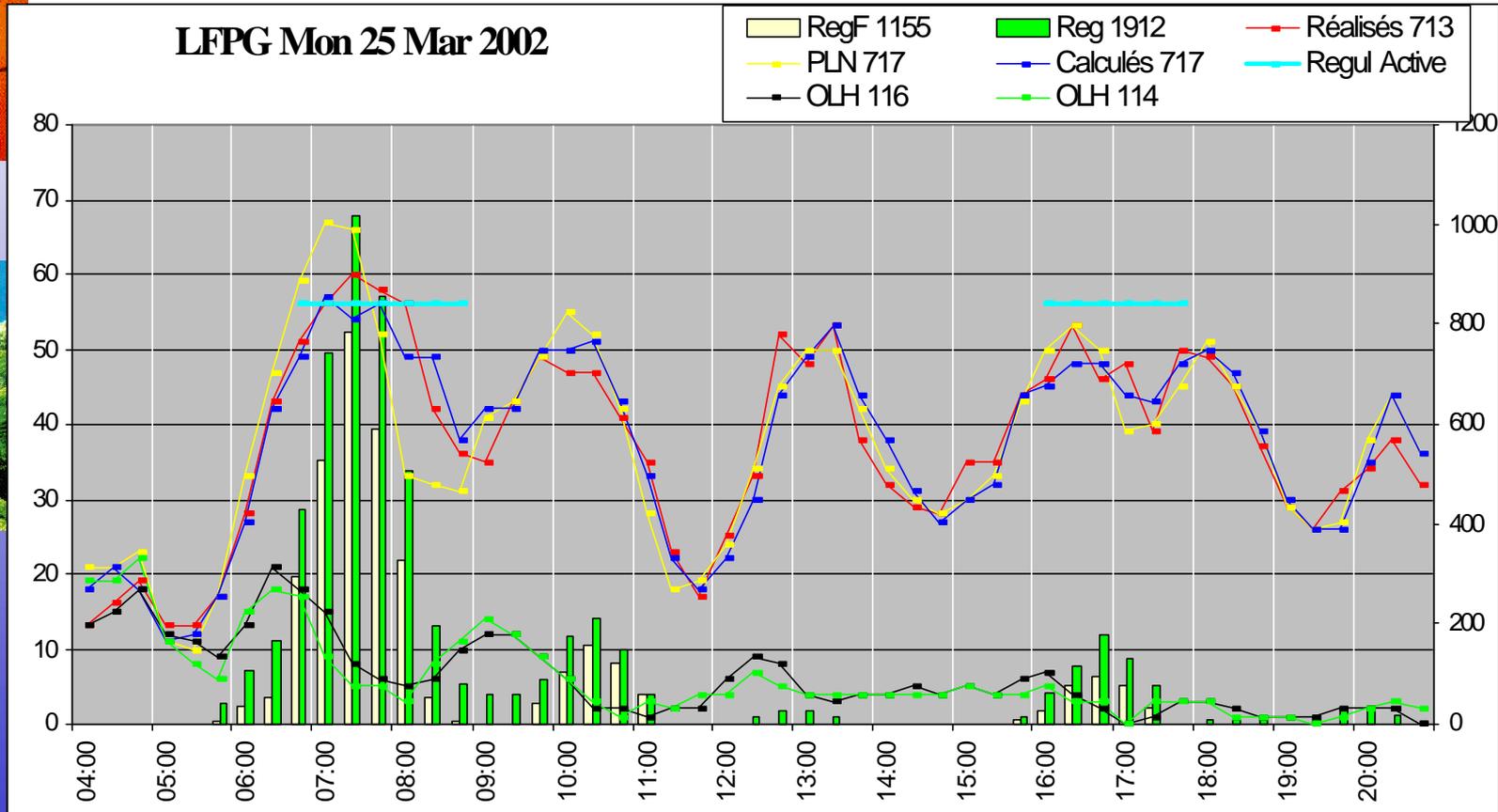
- IN HOLDING STACK (e.g. London)
- LINEARY (e.g. Paris CDG)



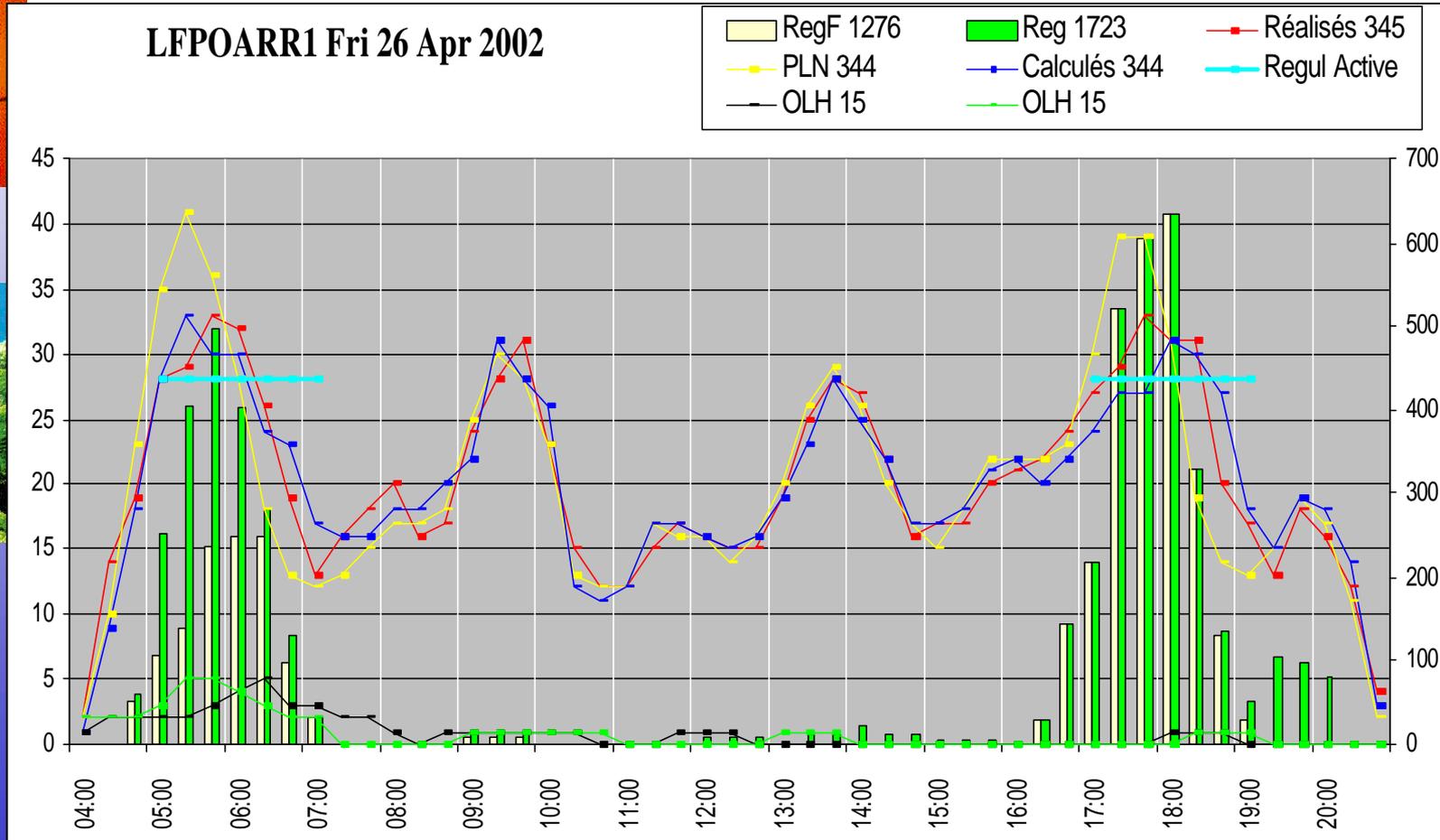
ARRIVING TRAFFIC TO PARIS CDG + LE BOURGET



ARRIVING TRAFFIC TO PARIS CDG



ARRIVING TRAFFIC TO PARIS ONLY



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- HOLDING STACK TECHNIQUE IS BEING USED AS AN AIRCRAFT TANK CLOSE TO RUNWAY FOR PREVENTING GAPS TO HAPPEN INTO LANDING SEQUENCES.
- IT CAN BE USED EASILY WITHOUT ANY COMPUTER ASSISTANCE



- HOLDING STACK INDUCES SIGNIFICANT EXTRA FUEL BURN
- IT ENABLES LONG DELAYS ABSORPTION CAPABILITY



- LINEAR HOLDING CAN ONLY ABSORB 'REASONABLE' DELAYS (5/7 minutes)
- IT HAS TO BE COMPLEMENTED BY HOLDING STACK FOR LONGER DELAYS
- IT IS VERY SUITABLE TO HUB SEQUENCES



- IT IS SAVING FUEL EVEN COMPARED TO NOMINAL TRAJECTORY
- IT REQUIRES COMPUTER ASSISTANCE FOR EFFICIENT SEQUENCING AND SPACING

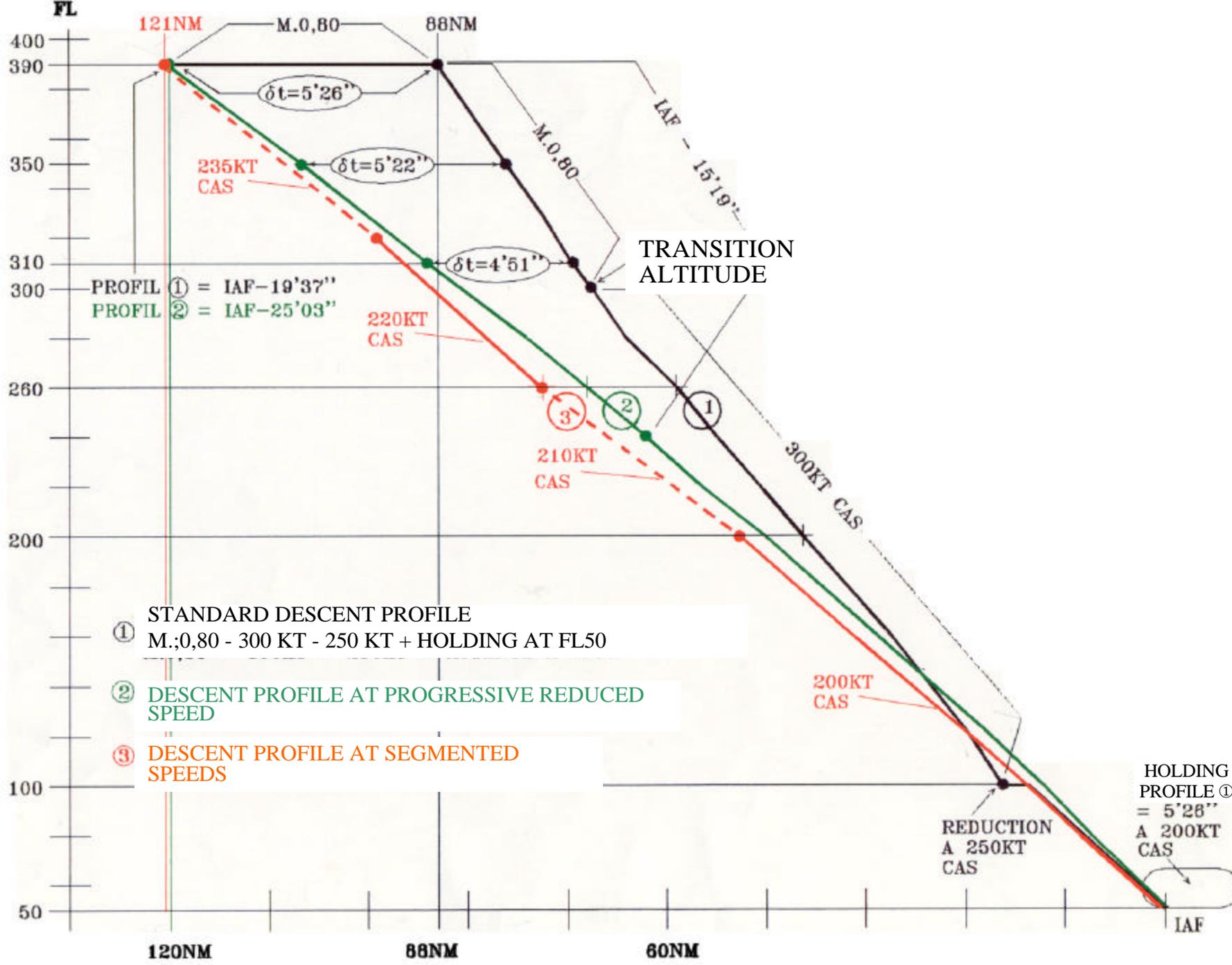
SAVED FUEL BURN/ ABSORBED DELAYS



EXAMPLE OF AIRBUS A310
DESCENDING AT MINIMUM
DRAG SPEED ACCORDING
TO :

- PROGRESSIVE SPEED
REDUCTION PROFILE
- SEGMENTED SPEED PROFILE





- ① STANDARD DESCENT PROFILE
M.:0,80 - 300 KT - 250 KT + HOLDING AT FL50
- ② DESCENT PROFILE AT PROGRESSIVE REDUCED SPEED
- ③ DESCENT PROFILE AT SEGMENTED SPEEDS

TYPICAL SPEED SEGMENTS



FLIGHT LEVELS

CAS

390 – 310

235 Kts

310 – 260

220 Kts

260 – 200

210 Kts

200 – 50

200 Kts

ABSORBABLE DELAYS DURING DESCENT ONLY



FL	ät	
390	+05 ²⁶	FL: Flight level where descent is started ät: Time interval between both (standard-progressive reduction) descent profiles
350	+05 ²²	
310	+04 ⁵¹	
280	+04 ⁴⁰	
240	+03 ⁴⁵	
200	+02 ⁵⁵	

FUEL BENEFITS COMPARISON/STACK VERSUS LINEAR



	Absorbed delay	Saved fuel compared to nominal	Extra fuel holding stack at FL 200	Total fuel benefits
FL	Ät	ÄcL	ÄcA (Hippo at FL 200)	
390	05'47"	-366 kg	+348 kg	-714 kg
350	07'26"	-358 kg	+449 kg	-807 kg
310	09'13"	-290 kg	+555 kg	-845 kg
280	10'38"	-230 kg	+640 kg	-870 kg
260	11'31"	-190 kg	+694 kg	-884 kg
240	12'40"	-138 kg	+766 kg	-904 kg



EXAMPLE OF COMPUTER ASSISTANCE

INFORMATION GIVEN BY MAESTRO - ARRIVAL MANAGER



MAESTRO V9

PG_W/PO_W ROULAGE_MINI 09:50:30 [ACTIF] [FORMATION]

PISTE INIT INI2 VOLS EN ATTENTE 0

Time	Flight	Status	Aircraft	Priority	Runway
10:15	DLH4172	L 09	A319	2	27
10:15	BRY82A	M 05	DH8C	-	27
10:15	AFR1319	L 06	A320	-	27
10:15	AFR1411	L 04	B735	-	27
10:10	SAS1579	L 01	B736	3	27
10:10	JKK151	M 54	MD80	3	27
10:10	AFR1881	M 53	SB20	2	27
10:05	BAW16MP	M 51	B733	1	27
10:05	AF655JE	S 54	F70	-1	27
10:00	AFL251	L 51	B734	-	27
10:00	AFK112U	S 10	B732	-	26
10:00	AFR113Y	S 07	A320	3	26
10:00	AFR1217	S 06	BA46	3	26
10:00	AFR271N	M 00	A320	3	26
10:00	SWR722	S 03	A320	1	26
10:00	AF689VC	S 01	B732	5	26
10:00	AF701BR	S 00	A320	6	26
10:00	CSA764	L 58	B735	4	26
10:00	EWG2616	L 57	BA46	4	26
10:00	AFR1205	S 55	A321	4	26
10:00	AFR130X	L 54	A320	2	26
10:00	AFR1229	S 52	B733	2	26
10:00	AFR2125	M 47	A320	1	26
10:00	AFR1049	S 50	A321	-	26
10:00	BZH846	S 49	CRJ1	-	26
10:00	AFR1643	S 47	A320	1	26
09:55	AEA1021	M 44	B734	1	26
09:55	DAH1002	S 46	B743	-	26
09:55	AAL120	M 41	B763	1	26
09:55	MAH550	L 44	B733	-	26
09:55	AFR1241	L 42	A320	-	26
09:55	BAW62AB	M 39	A319	-	26

7R: 120s NS / 82 26L: 90s NS / -35 25: 120s NS / NS

Time Scale

Current Time

Runway 27 (North)

Runway 26 left

Runway 25 (Le Bourget)

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SEQUENCE DETAILS



MAESTRO V9				
09:50:30				
	AFR112U	S 10	B732	-
	AFR113Y	S 07	A320	3
	AFR1217	S 06	BA46	3
10:15	AFR271N	M 00	A320	3
	SWR722	S 03	A320	1
	AF689VC	S 01	B732	5
10:10	AF701BR	S 00	A320	6
	CSA764	L 58	B735	4

IAF (origin)
(S = Susin, M = Merue,
L = Lorta)

Time at IAF

Current Delay

Callsign

Aircraft Type

WHAT MAGNITUDE OF BENEFITS COULD BE PROVIDED BY LINEAR HOLDING ?



- THIS IS DEPENDING UPON AIRPORT AND DEMAND COMBINATION
- HOWEVER SOME TYPICAL VALUES ARE ALREADY AVAILABLE



IN NORMAL CONDITIONS

LINEAR HOLDING
ALLOWS FUEL SAVING OF

2x60'x85kg = 10,200 kg
PER DAY AT PARIS ORLY
AND

3x110'x85kg = 28,050kg
PER DAY AT PARIS CDG

IN HEAVY SITUATION AT PARIS ORLY (100' min Delay)

60' OF LINEAR HOLDING
ARE SAVING

60'X85kg = 5,100kg

WHILE 40' OF HOLDING
STACK ARE INCREASING
FUEL BURN BY 2,400kg

AT PARIS CDG (225' min Delay)

60'x85kg = 5,100kg ARE
SAVED WHILE 165'x60kg
= 9,900kg ARE LOST



CONCLUSIONS



→ LINEAR HOLDING REDUCES
FUEL BURN

→ IT WORKS IN REAL LIFE

→ ADDITIONAL BENEFITS CAN
BE OBTAINED BY LINEAR
HOLDING:





✧ REDUCTION OF FLIGHT TIME AT
LOW ALTITUDE → LOWERING
NOISE

✧ REDUCTION OF FLIGHT TIME IN
THE HOLDING STACK
→ REDUCING RISK

✧ LINEAR HOLDING ⇒ THE WAY
AHEAD

AVIATION OPERATIONAL MEASURES FOR
FUEL AND EMISSIONS REDUCTION
WORKSHOP



Thank you !



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