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Performance Validation of Version 154.0 ANSER Control Laws for the F-18 HARV

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Overview

A new software release designated version 154.0 was developed and tested for use on the F/A-18 High Angle-of-Attack Research Vehicle (HARV). The software release incorporates all software changes to the Actuated Nose Strakes for Enhanced Rolling (ANSER) control laws through version 153.0 with the following exceptions. The first exception is a modification of the On-Board Excitation System (OBES), which replaces the OBES load in version 153.0 with 17 new maneuvers. The second exception is the modification to change the symmetric strake deployment schedule back to the original schedule in ANSER control law version 151.1. The final modification replaces two instrumentation parameters. The three modifications make up the new software release for use in the Research Flight Control System (RFCS) flight control computer.

Reasons for Change

A brief description of the reasons for changes to the control laws follows:

1. The symmetric strake deployment schedule was changed to make the closed-loop parameter identification results obtained with OBES maneuvers in version 154.0 compatible with previous flight test results.

2. Additional closed loop Parameter Identification (PID) and frequency sweep inputs were included to complete the PID test matrix (OBES maneuver 1-7). OBES maneuvers 8-15 were added specifically for flow visualization flight tests. The impulsive Sine and Schroeder Wave inputs in OBES maneuvers 16 and 17 were implemented for the first time in a RFCS software release. A summary of all OBES maneuvers for version 154.0 can be found in Appendix A.

3. A request was made to add two new instrumentation parameters for post flight analysis. Those parameters are lat_pilot_cmd and dir_pilot_cmd, which are internal lateral and directional control law commands, and replace qcfilter1 and qcfilter2, the filtered-impact-pressure parameters.

Testing Performed

All checkcases were run using the Dryden batch simulation release 15a with FORTRAN-coded control laws corresponding to RFCS version 154.0. See Reference 1 for ANSER control law specification. The Hardware-In-the-Loop (HIL) simulator, version 16, was run using the Ada flight code for RFCS version 154.0.

Table 1 contains the weights and inertia's used for the performance validation testing.

Table 1
Aircraft Configuration for Validation

GW lbs	C.G.,fs in	C.G.,bl in	C.G.,wl in	Ixx slug-ft^2	Iyy slug-ft^2	Izz slug-ft^2	Ixz slug-ft^2
35764.6	456.30	0.0	105.4	22632.6	174246.3	189336.4	-2131.8

A subset of twelve checkcases from the ANSER performance-validation checkcases documented in Reference 2 were run to test version 154.0. These checkcases are listed in Table 2.

Plots containing the comparisons between batch and HIL simulations are contained in Appendix B.

Table 2
Closed-Loop Checkcases for V154.0 Performance Validation

Check case	RFCS Mode	Altitude (ft)	Mach Number	AOA (deg)	Load Factor (g's)	Thrust	Inputs
1	TV	25000	0.35	trim	1.0	trim	+3/-2.5 in. ramped long. stick doublet.
4	TV	35000	trim	30.0	1.0	trim	+3/-2.5 in. ramped long. stick doublet.
7	TV	16000	trim	50.0	trim	MAX A/B	+3/-2.5 in. ramped long. stick doublet.
20	S	25000	0.35	trim	1.0	trim	2 in. ramped lateral stick doublet.
22	S	35000	trim	30.0	1.0	trim	+3/-2.5 in. ramped long. stick doublet.
23	S	35000	trim	30.0	1.0	trim	2 in. ramped lateral stick doublet.
26	S	16000	trim	50.0	trim	MAX A/B	2 in. ramped lateral stick doublet.
27	S	16000	trim	50.0	trim	MAX A/B	50 lb ramped pedal doublet.
30	S	40000	0.68	trim	1.0	trim	PLA ramped input to MAX and IDLE. +5 in. (aft) ramped longitudinal stick pulse. +1.5 in. (rt) ramped lateral stick pulse. -50 lb (lt) ramped pedal pulse.
33	S	25000	0.3	trim	1.0	trim	PLA ramped input to MAX and IDLE. +5 in. (aft) ramped longitudinal stick pulse. -3 in. (lt) ramped lateral stick pulse. 50 lb (rt) ramped pedal pulse.
41	TV/1	25000	0.35	trim	1.0	trim	2 in. ramped long. stick doublet.
46	TV/1	25000	0.35	trim	1.0	trim	2 in. ramped long. stick doublet.

Note: TV - Thrust Vector Only Mode, S - Strake Only Mode, TV/1 - Thrust-Vector Only Mode/Dial-a-Gain Option 1.

OBES Maneuvers

All OBES maneuvers were run in the batch simulation, using flight Ada code to check the OBES generated input signals against the OBES specification (References 4, 5, and 6). Closed-loop dynamics were checked to ensure desired aircraft response characteristics in order to achieve acceptable research data. All OBES maneuvers

coded in this software release matched their specification and are acceptable for flight test.

Dial-A-Gain

The Dial-A-Gain options for version 154.0 have not changed from the options available in version 153.0. A summary table of selectable gain sets for all software loads used during Phase III testing are shown below in Table 3.

Table 3
Dial-A-Gain Options for Version 154.0

RFCS Software Loads	DDI Gain Selection 0	DDI Gain Selection 1	DDI Gain Selection 2
Version 150.0	Feedback Gain set 0 (low)	Feedback Gain set 1 (medium)	Feedback Gain set 2 (high)
Version 151.0	Feedback Gain set 0	Feedback Gain set 1	Feedback Gain set 2
Version 151.1	Feedback Gain set 1	Feedback Gain set 0	Feedback Gain set 2
Version 152.0	Feedback Gain set 1	Feedback Gain set 0	Feedback Gain set 2
Version 153.0	Feedback Gain set 1	Not Selectable	Not Selectable
Version 154.0	Feedback Gain set 1	Not Selectable	Not Selectable

Note: DDI - Digital Display Indicator

Summary and Conclusions

The Ada implementation of the ANSER control laws was tested in the HIL simulation and compared with the FORTRAN control-law implementation in batch simulation. There are differences between the HIL and batch simulation results, but the significant differences can be accounted for by known differences in the simulations. (Reference 2, 3, 7, and 8) When the differences are taken into account, the time-history results between simulations are acceptable. The Ada modifications to the ANSER Control Laws perform satisfactorily and are ready for Phase III flight test.

REFERENCES

1. HARV Control Law Design Team: *Design Specification for a Thrust-Vectoring, Actuated-Nose-Strake Flight Control Law for the High-Alpha Research Vehicle*, NASA TM-110217, May 1996.

2. Messina, M. D.; *Performance Validation of the ANSER Control Laws for the F-18 HARV,* NASA Contractor Report 198196, August 1995.

3. *Performance Validation of the NASA-1A Control Laws for the F/A-18 HARV Final Report,* Internal High-Alpha Technology Program Document, 21 March 1994.

4. Morelli, E. A.; *Parameter Identification Flight Test Maneuvers for Closed Loop Modeling of the F-18 High Alpha Research Vehicle (HARV),* NASA Contractor Report 198269, May 1996.

5. Murphy, P. C.; Gallo, B. D.; *ANSER Control Law Validation Inputs: OBES Sine Sweeps for Closed-Loop Identification,* Internal High-Alpha Technology Program Document, 17 August 95.

6. Murri, D. G.; *OBES Requirements - ANSER Aerodynamic Measurements and Flow Visualization,* Internal High-Alpha Technology Program Document, 24 March 94.

7. Messina, M. D.; *Performance Validation of Version 152.0 ANSER Control Laws for the F-18 HARV,* NASA Contractor Report 198250. January 1996.

8. Connelly, P. J.; *Performance Validation of Version 153.0 ANSER Control Laws for the F-18 HARV Test Plan/Final Report,* SPARTA Inc., January 30, 1996.

APPENDIX A

Version 154.0 OBES Maneuvers

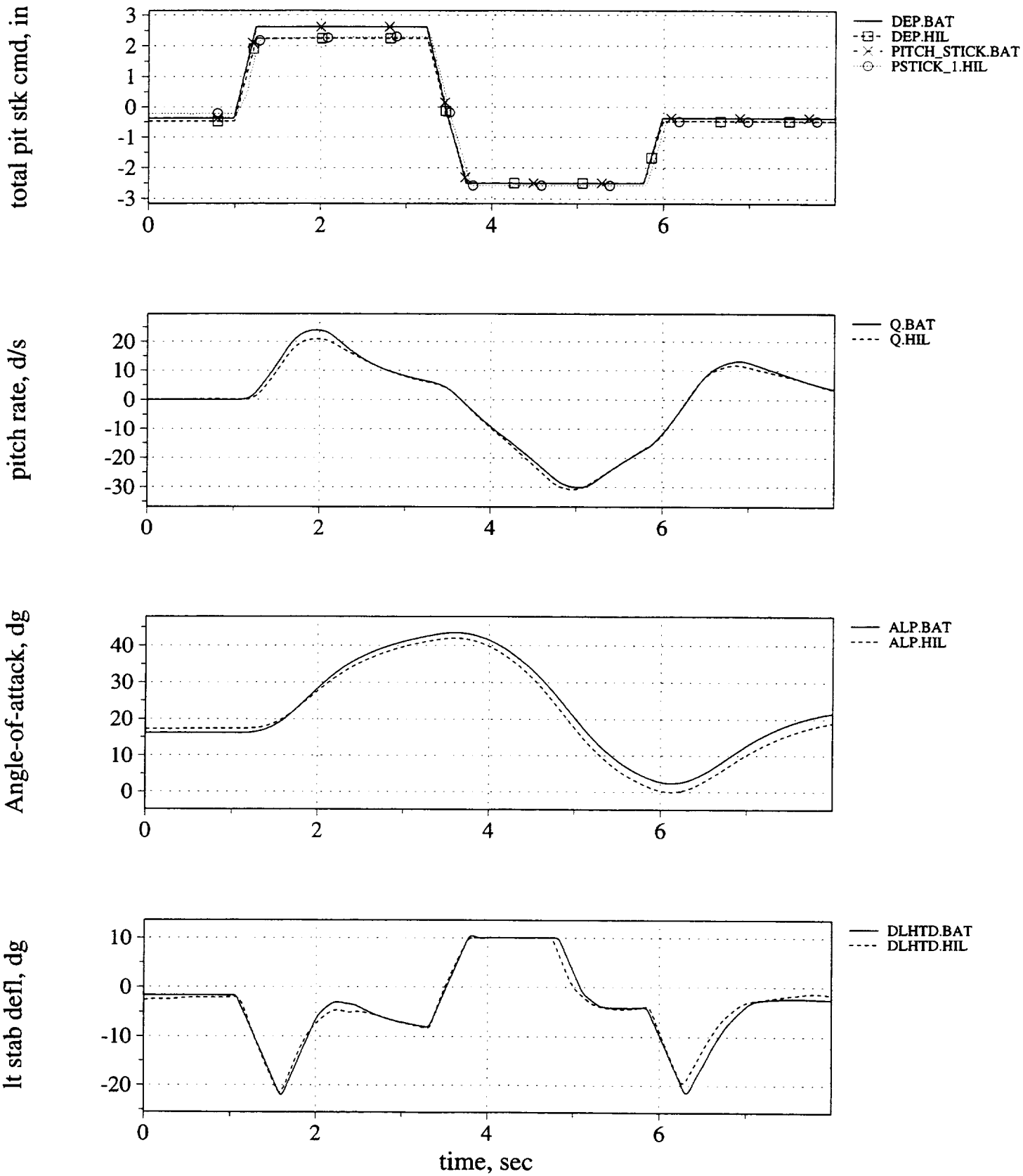
MNVR CODE	OBE_INDEX	Surface/Command Input	Function	Amplitudes	Duration (sec)	Flight Conditions	ANSER Mode
****5	1	Rudder Ped/Lateral Stick	Optimal Input LAT/DIR (CL)	81.227/2.211	24.00	25k/1 g/30° AOA	STV
***4*	2	Rudder Ped/Lateral Stick	Optimal Input LAT/DIR (CL)	79.034/2.211	24.00	25k/1 g/45° AOA	STV
***45	3	Rudder Ped/Lateral Stick	Optimal Input LAT/DIR (CL)	81.227/2.421	24.00	25k/1 g/60° AOA	STV
3	4	Lateral Stick	Frequency Sweep & Bias	1.6-1.25	33.00	25k/1 g/5° AOA	TV
**3*5	5	Lateral Stick	Frequency Sweep & Bias	1.6-1.4	33.00	25k/1 g/20° AOA	TV
**34*	6	Rudder Pedal	Frequency Sweep & Bias	70.0-35.0	33.00	25k/1 g/5° AOA	TV
**345	7	Rudder Pedal	Frequency Sweep,Bias,Ramp	80.0-40.0	33.00	25k/1 g/20° AOA	TV
*2***	8	Strakes	Programma Strake	Sweep	50.00	Varies with Research	TV
*2**5	9	Strakes	Programma Strake	Sweep	50.00	Varies with Research	TV
*2*4*	10	Strakes	Programma Strake	Sweep	50.00	Varies with Research	TV
*2*45	11	Strakes	Programma Strake	Sweep	50.00	Varies with Research	TV
*23**	12	Strakes	Programma Strake	Sweep	50.00	Varies with Research	TV
*23*5	13	Strakes	Programma Strake	Sweep	50.00	Varies with Research	TV
234	14	Strakes	Programma Strake	25.0/15.0	60.00	Varies with Research	TV
*2345	15	Strakes	Programma Strake	15.0/25.0	60.00	Varies with Research	TV
1****	16	S-D Stab/Ail/Rud/Vanes	Schroeder-Phased	.5/.5/1/2/.25/.25	70.00	Varies with Research	TV
1***5	17	S-D Stab/Ail/Rud/Vanes	Impulsive SIne	.5/.5/1/2/.25/.25	80.00	Varies with Research	TV
				Strake Amplitude			
12345	31	Strakes	STRAKE BUILT-IN-TEST	90.00	240.00	WOW Only	TV

APPENDIX B

Batch versus Hardware-In-the-Loop Time Histories

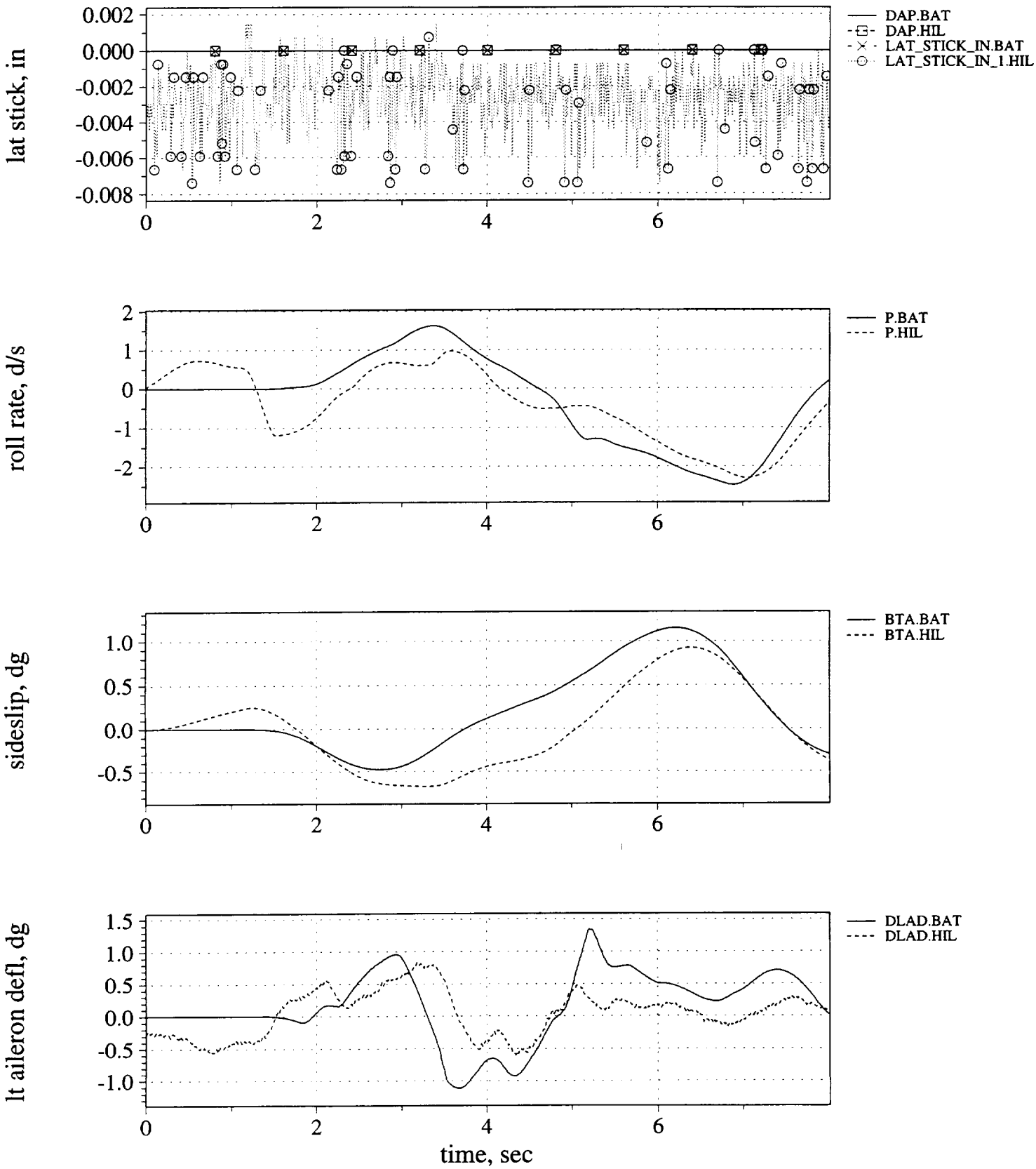
Appendix B - Batch versus HIL Version 154.0

CASE_1__TV_Mode__.35-25k_trim_AOA_3_-2.5_in_ramp_dep page 1/12



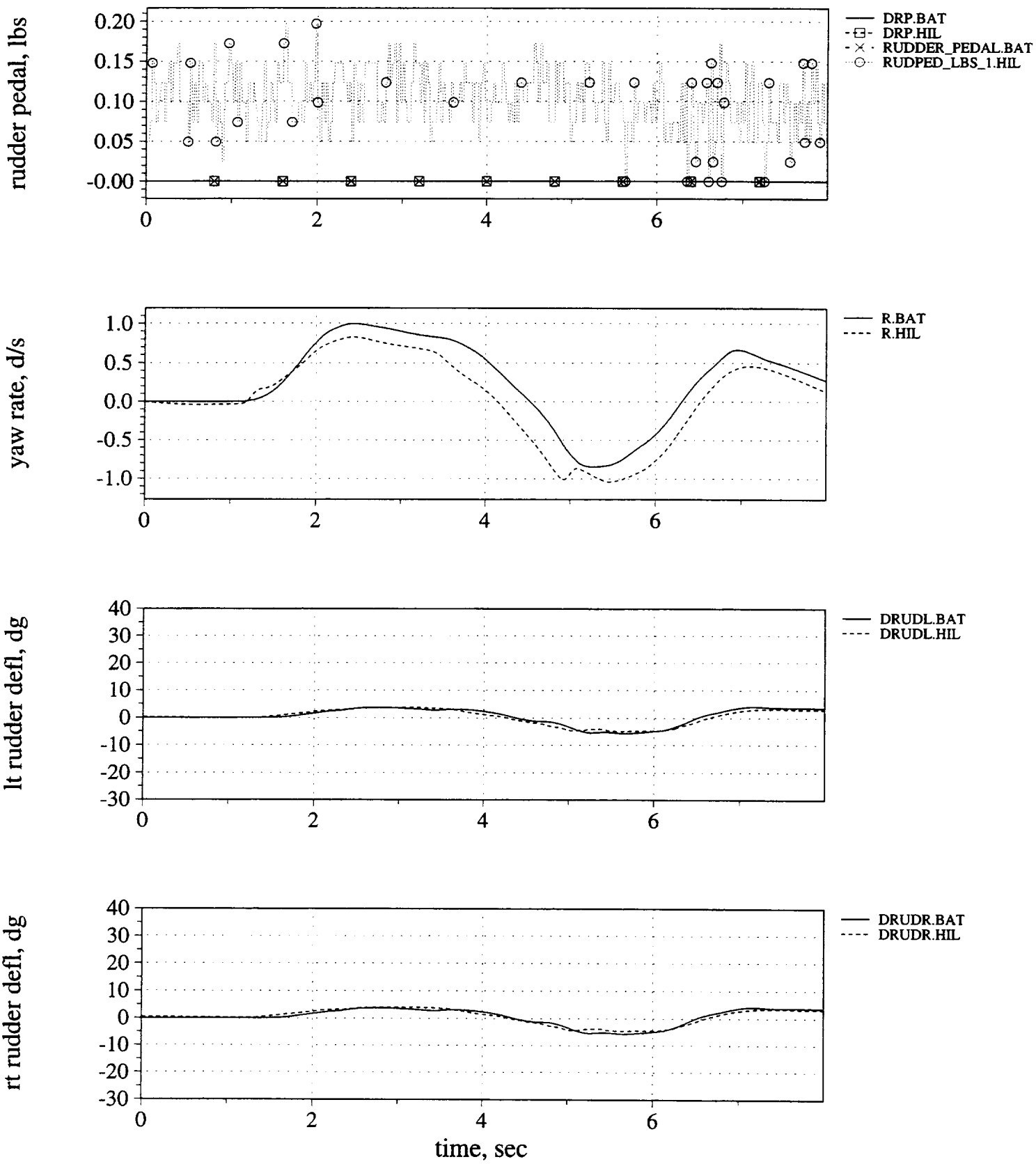
Appendix B - Batch versus HIL Version 154.0

CASE_1__TV_Mode__.35-25k_trim_AOA_3_-2.5_in_ramp_dep page 2/12



Appendix B - Batch versus HIL Version 154.0

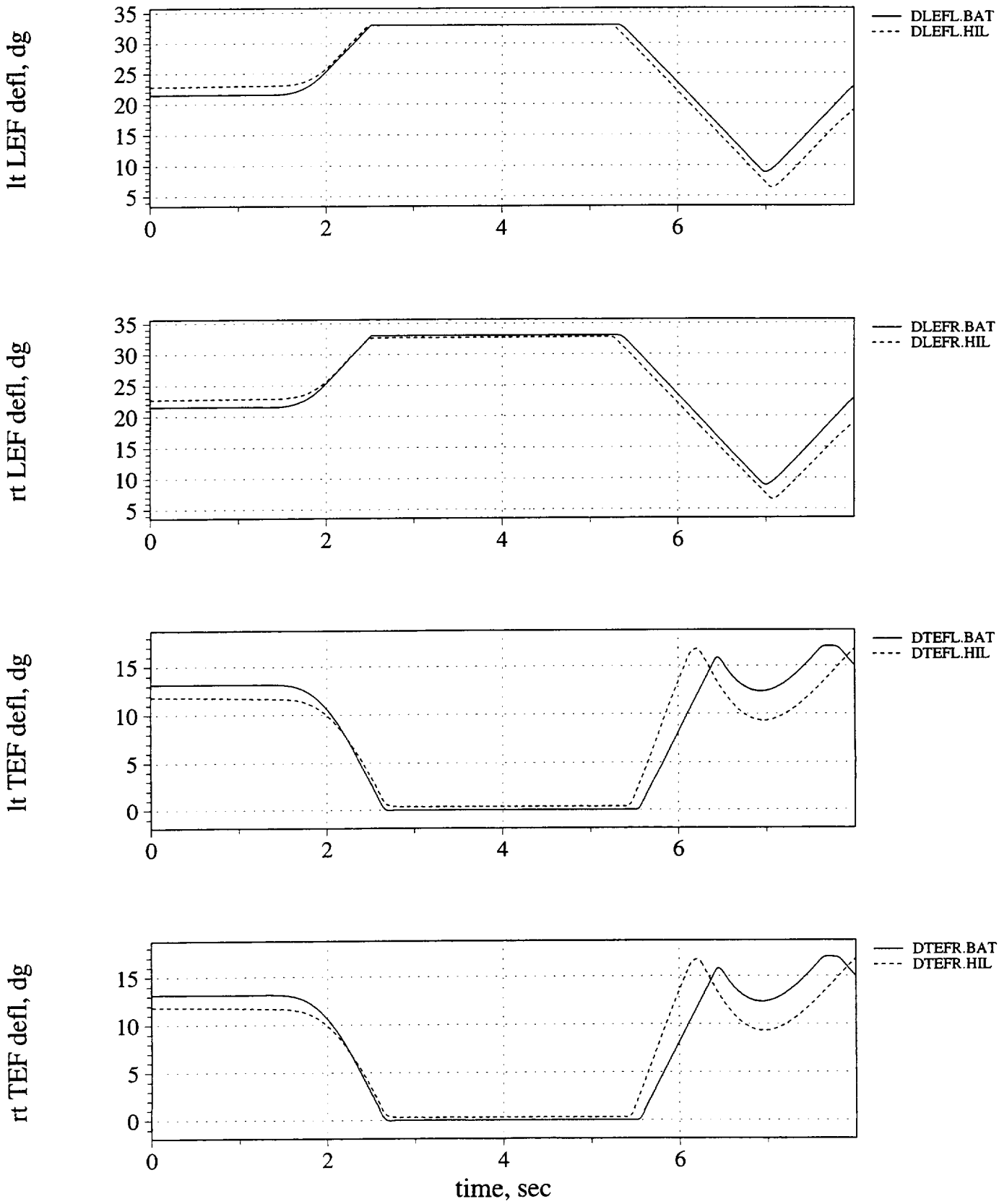
CASE_1__TV_Mode__.35-25k_trim_AOA_3_-2.5_in_ramp_dep page 3/12



Performance Validation Checkcases

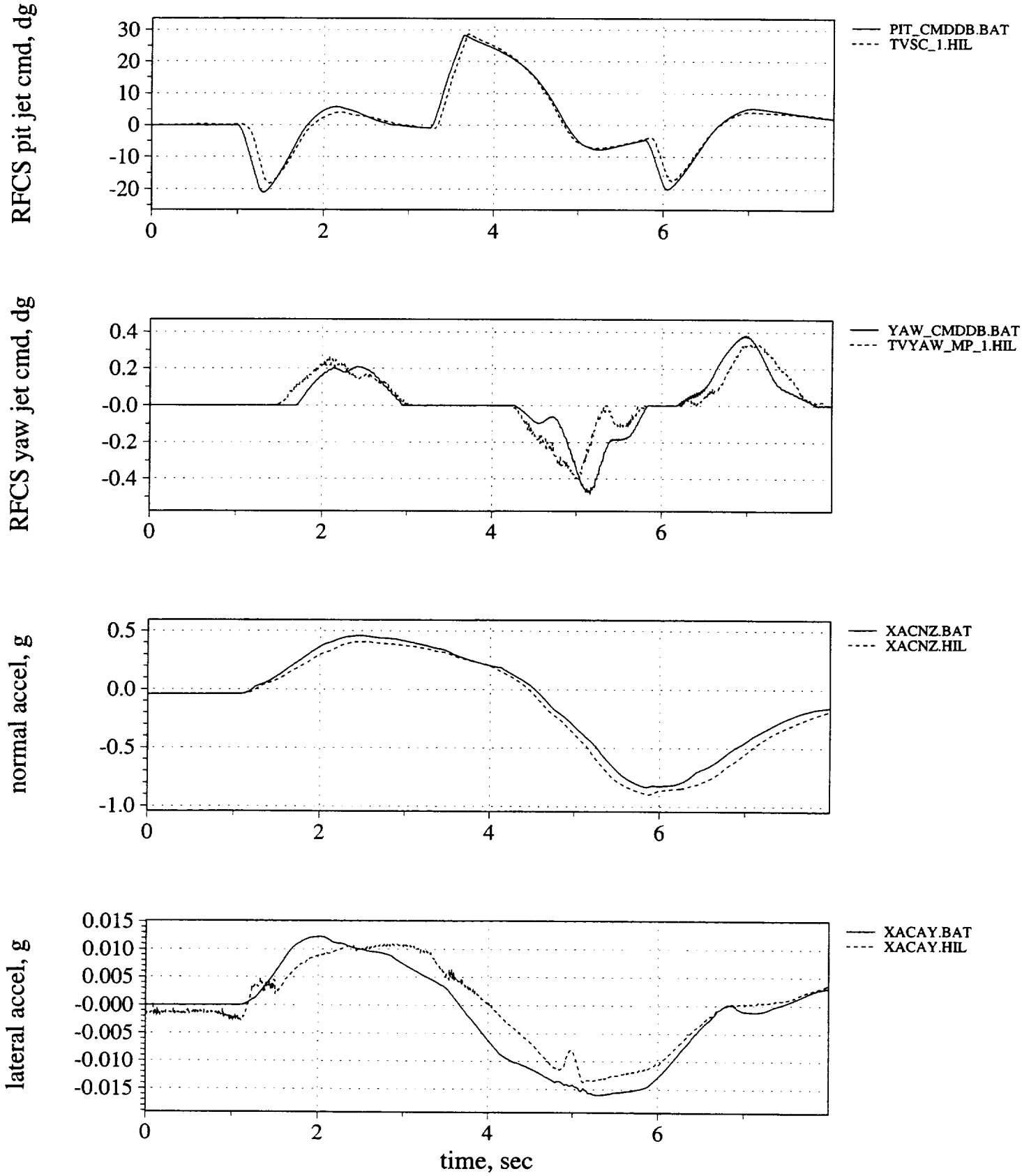
Appendix B - Batch versus HIL Version 154.0

CASE_1__TV_Mode__.35-25k_trim_AOA_3_-2.5_in_ramp_dep page 4/12



Appendix B - Batch versus HIL Version 154.0

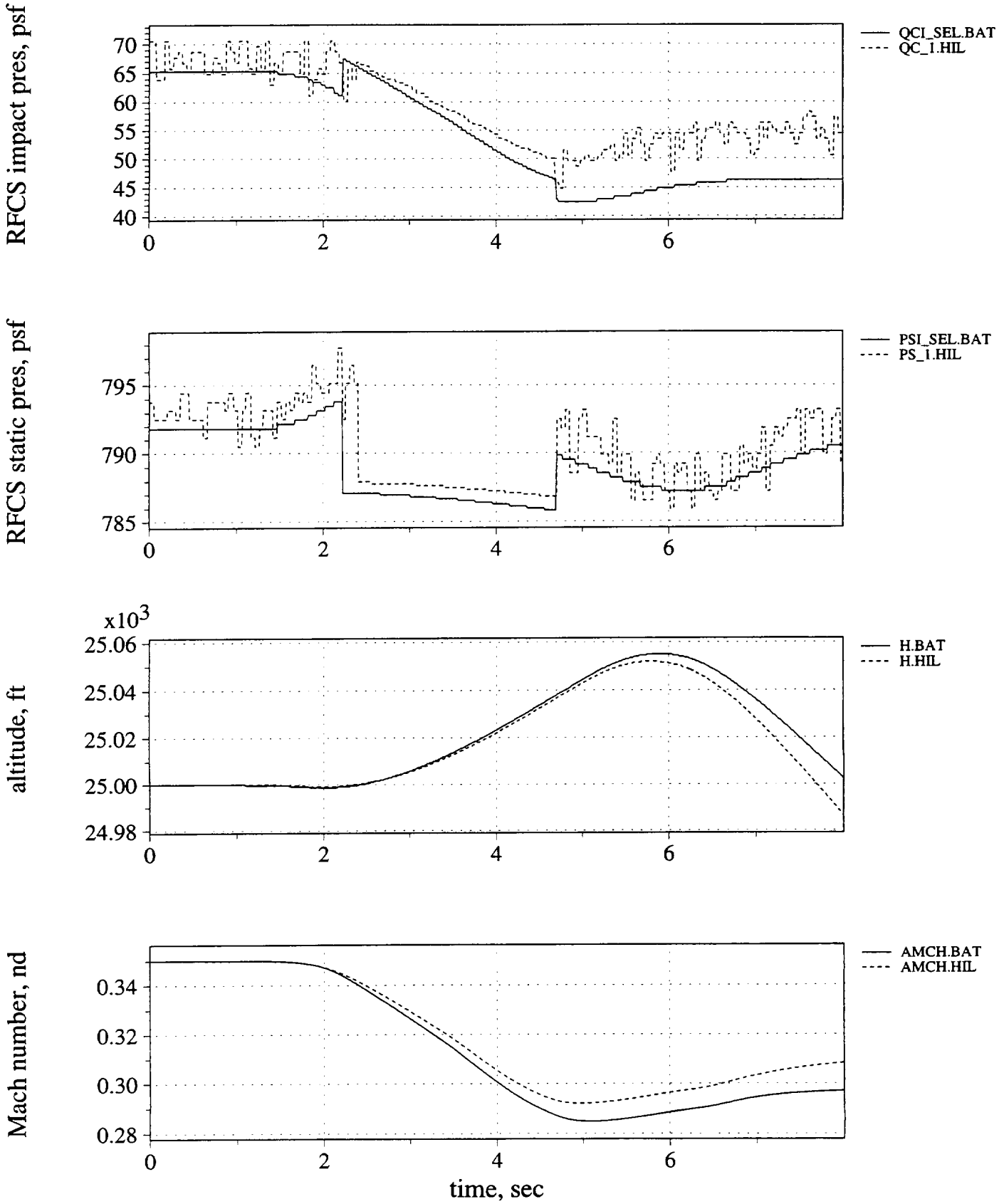
CASE_1__TV_Mode__.35-25k_trim_AOA_3_-2.5_in_ramp_dep page 5/12



Performance Validation Checkcases

Appendix B - Batch versus HIL Version 154.0

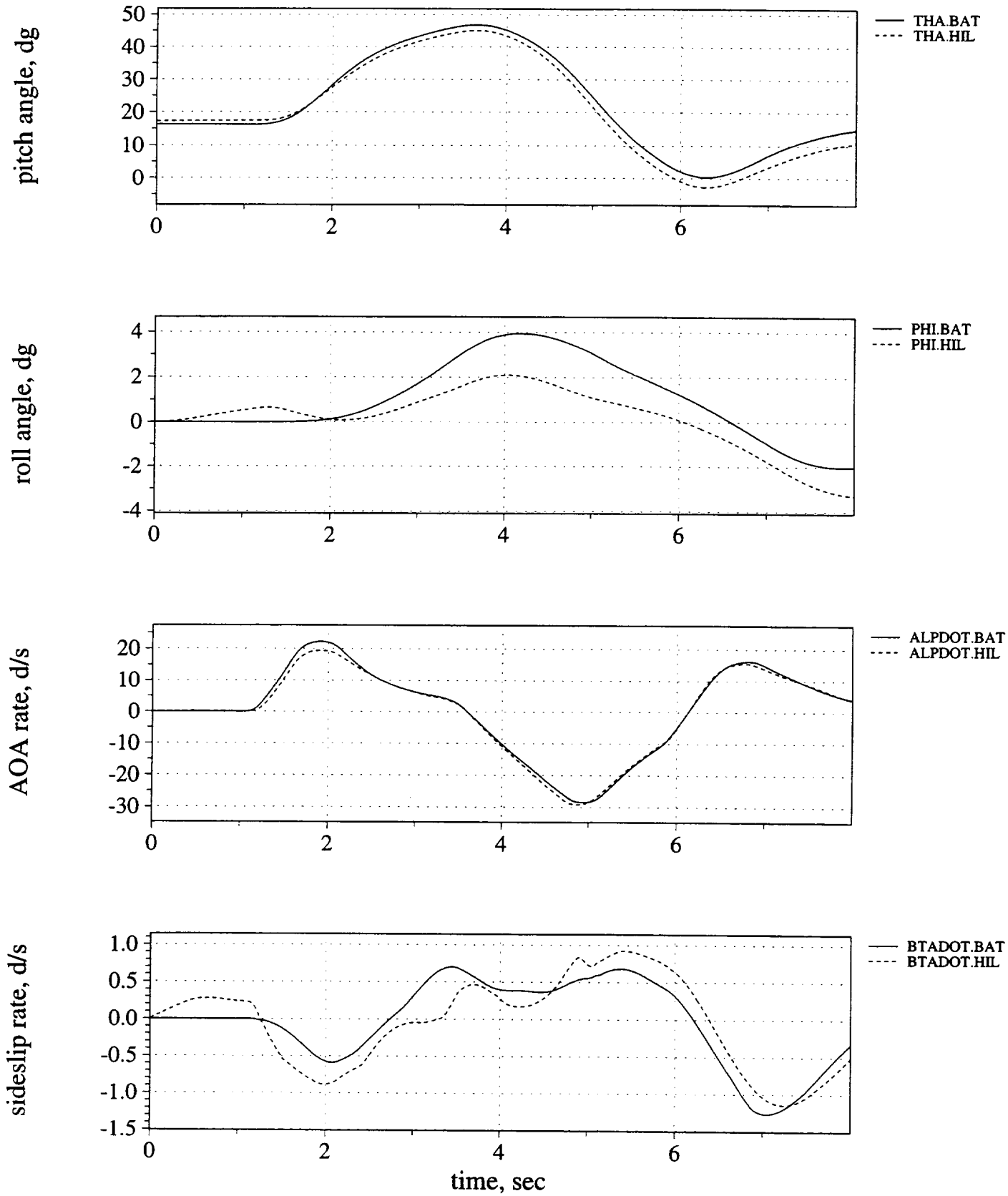
CASE_1__TV_Mode__.35-25k_trim_AOA_3_-2.5_in_ramp_dep page 6/12

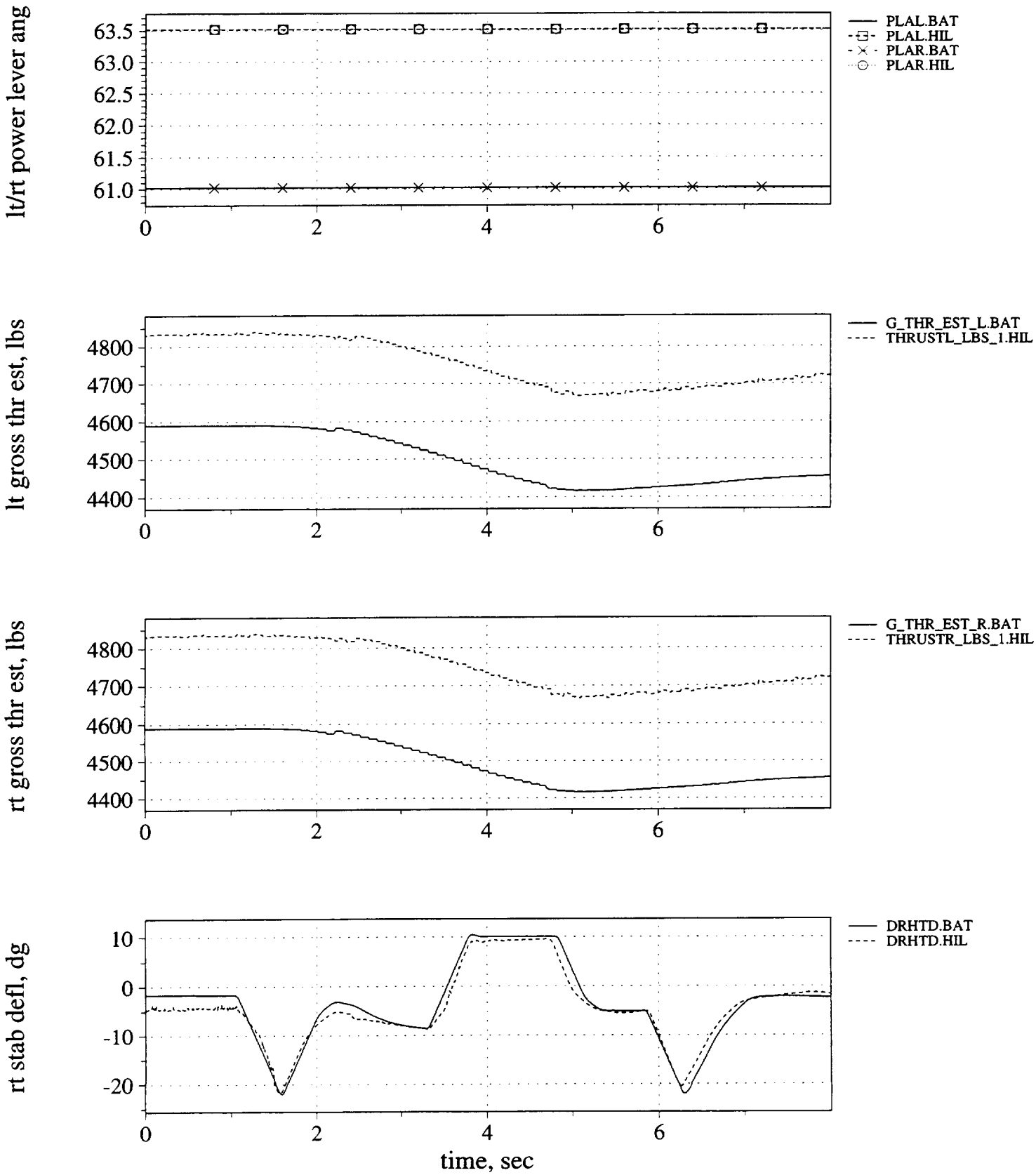


Performance Validation Checkcases

Appendix B - Batch versus HIL Version 154.0

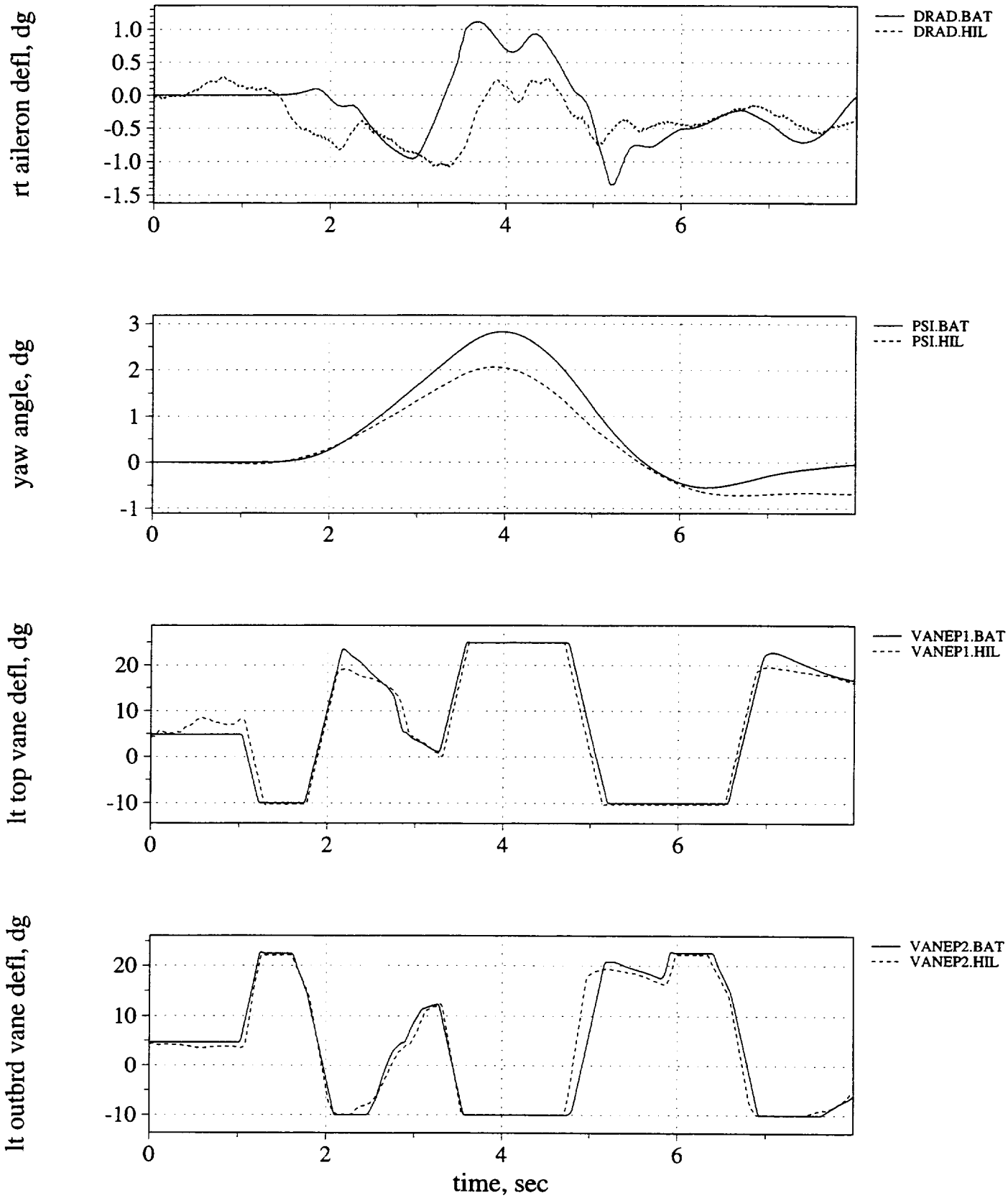
CASE_1__TV_Mode__.35-25k_trim_AOA_3_-2.5_in_ramp_dep page 7/12




lt/rt power lever ang
63.5
63.0
62.5
62.0
61.5
61.0
0
2
4
6
PLAL.BAT
PLAL.HIL
PLAR.BAT
PLAR.HIL
lt gross thr est, lbs
4800
4700
4600
4500
4400
G_THR_EST_L.BAT
THRUSTL_LBS_1.HIL
rt gross thr est, lbs
G_THR_EST_R.BAT
THRUSTR_LBS_1.HIL
rt stab defl, dg
10
0
-10
-20
DRHTD.BAT
DRHTD.HIL
time, sec

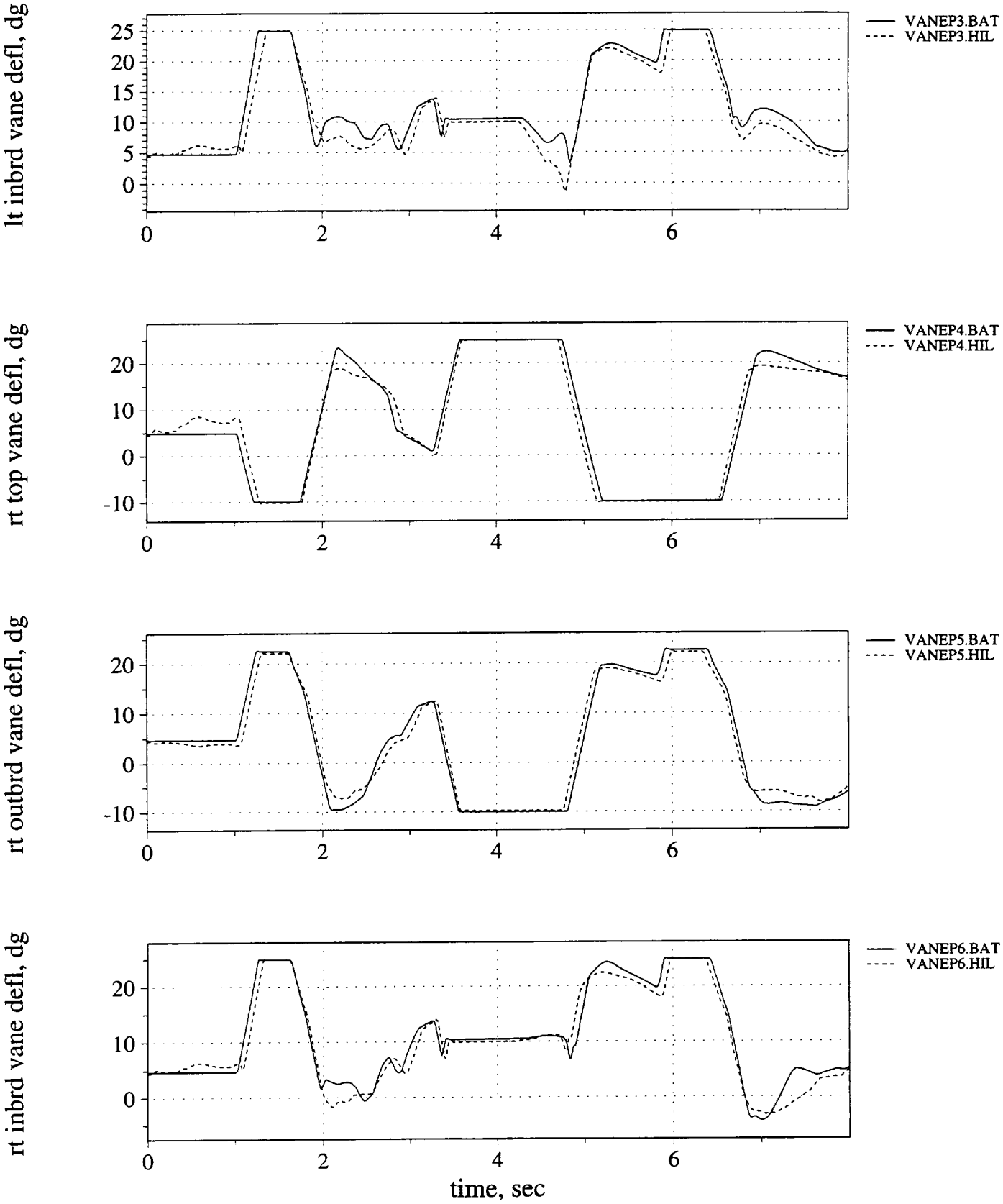
Appendix B - Batch versus HIL Version 154.0

CASE_1__TV_Mode__.35-25k_trim_AOA_3_-2.5_in_ramp_dep page 9/12



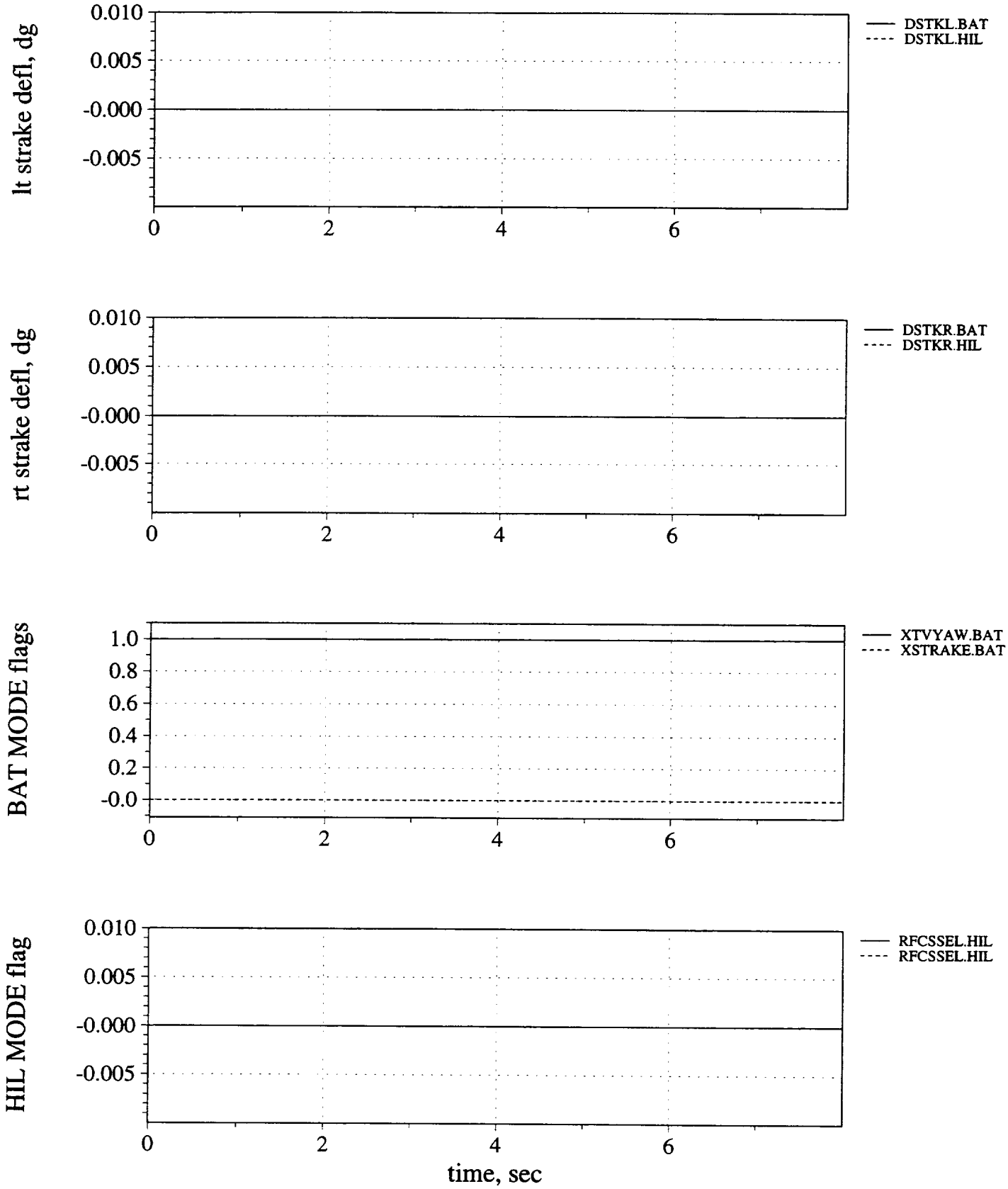
Appendix B - Batch versus HIL Version 154.0

CASE_1__TV_Mode__.35-25k_trim_AOA_3_-2.5_in_ramp_dep page 10/12



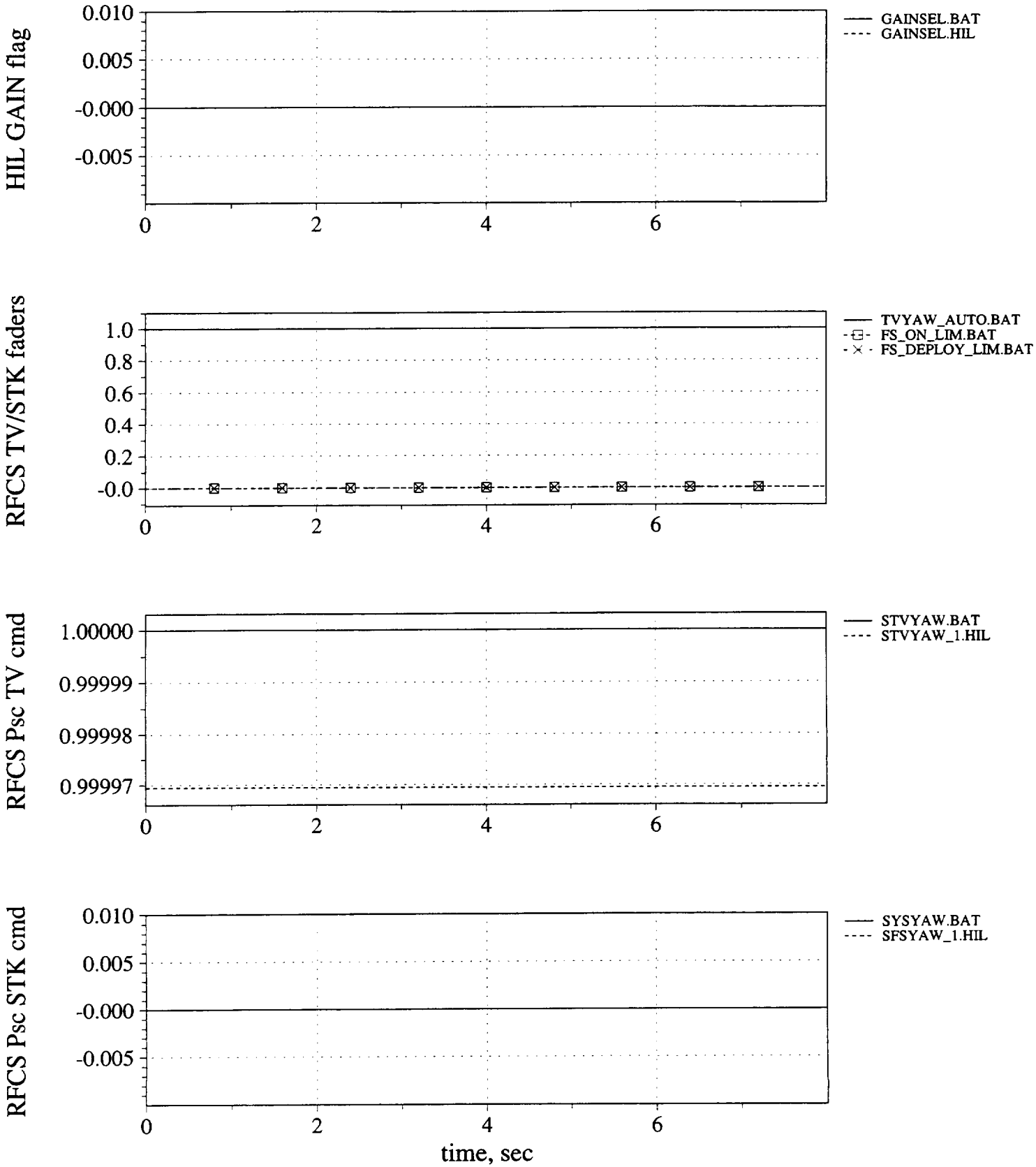
Appendix B - Batch versus HIL Version 154.0

CASE_1__TV_Mode__.35-25k_trim_AOA_3_-2.5_in_ramp_dep page 11/12



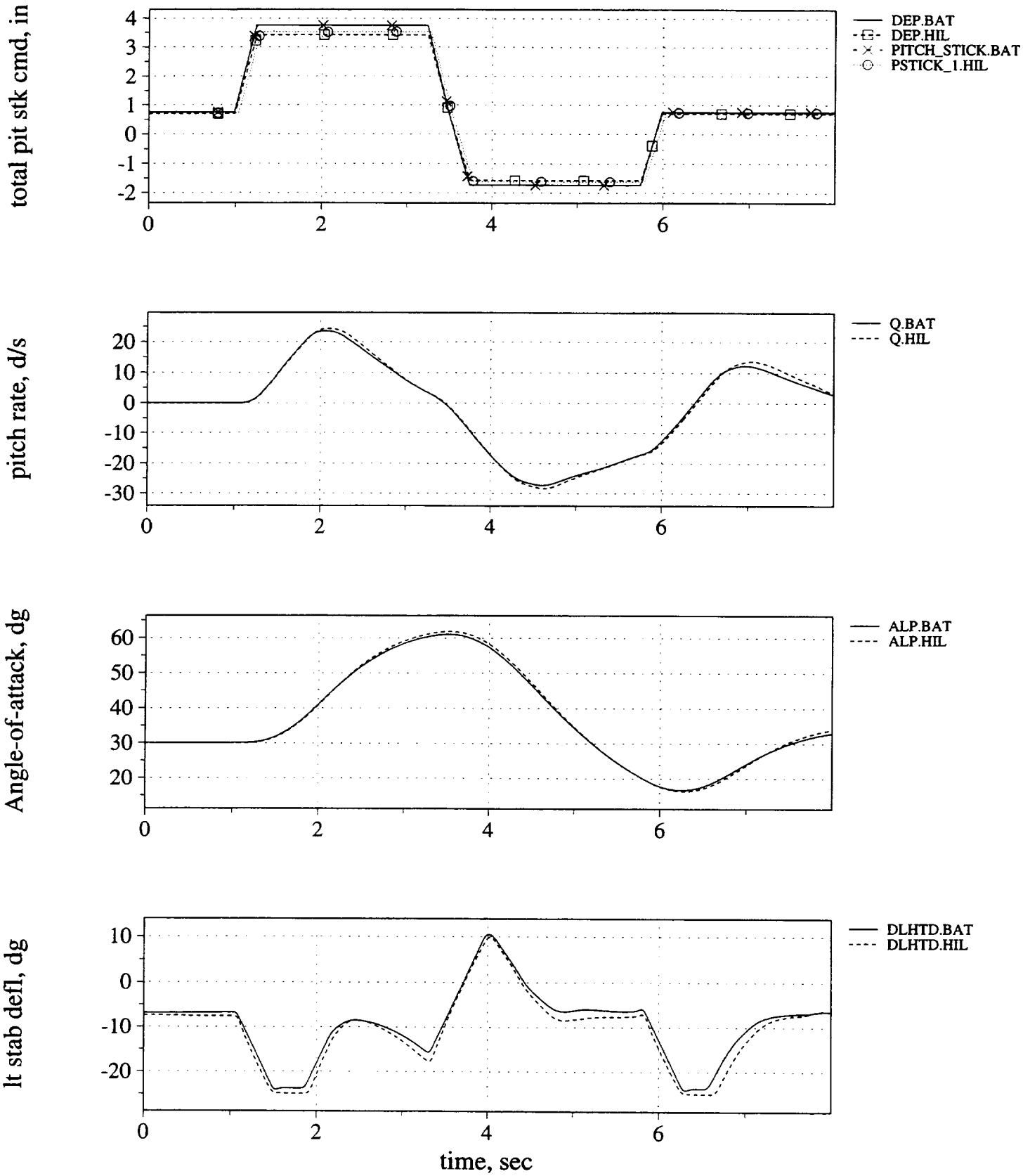
Appendix B - Batch versus HIL Version 154.0

CASE_1__TV_Mode__.35-25k_trim_AOA_3_-2.5_in_ramp_dep page 12/12



Appendix B - Batch versus HIL Version 154.0

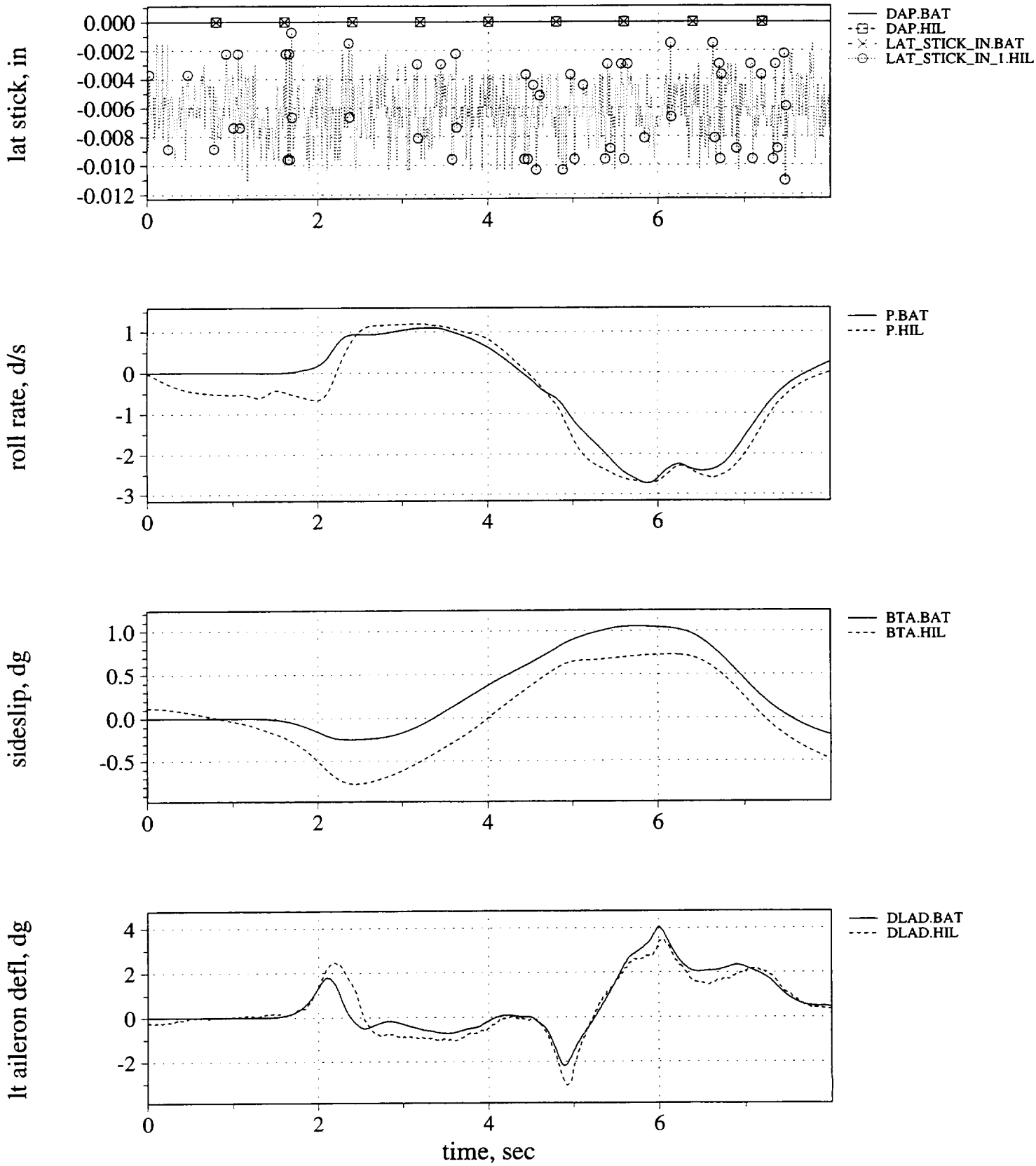
CASE_4__TV_Mode__30alp-35k_Max_AB_3_-2.5_in_ramp_dep



Performance Validation Checkcases

Appendix B - Batch versus HIL Version 154.0

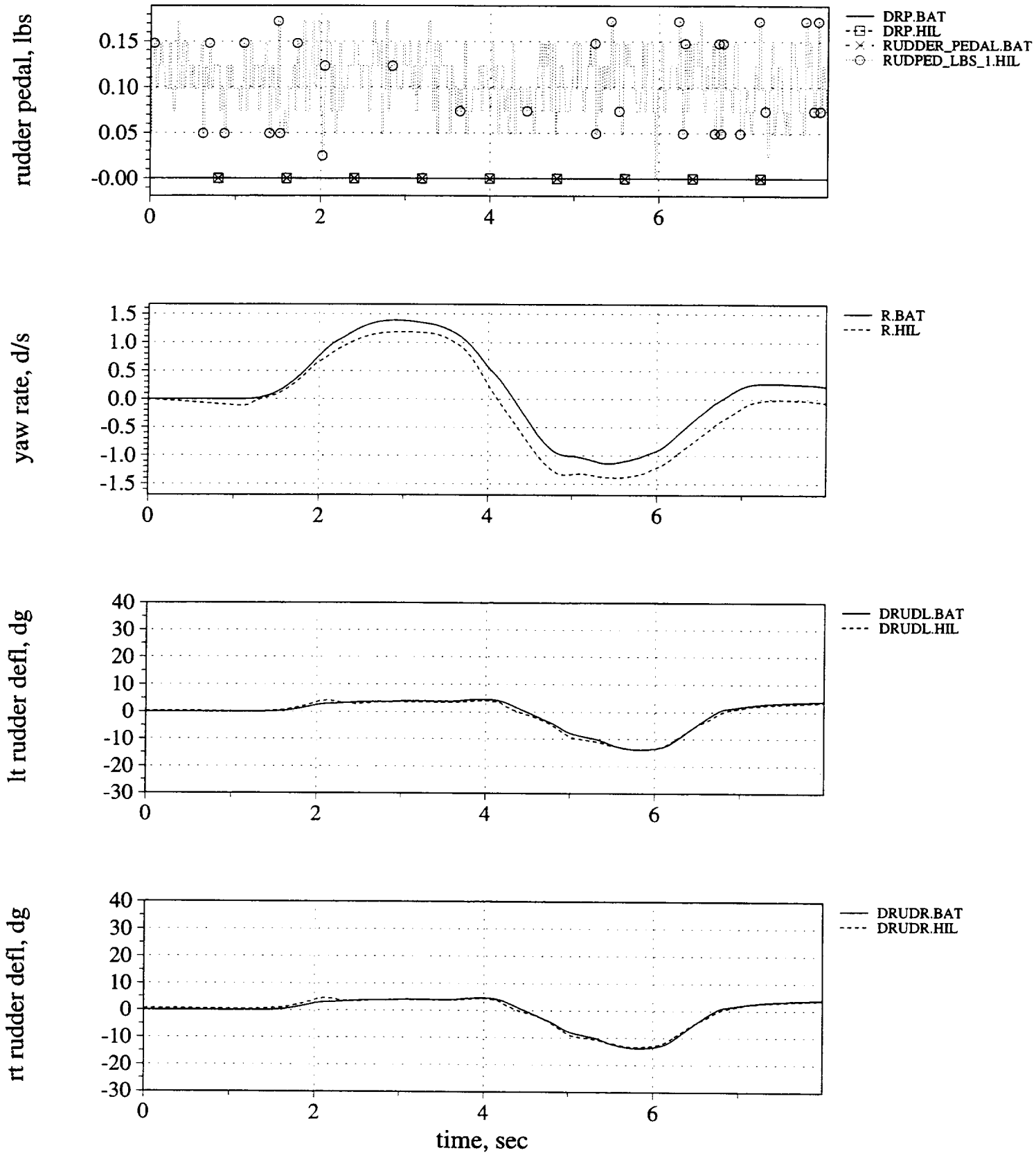
CASE_4__TV_Mode__30alp-35k_Max_AB_3_-2.5_in_ramp_dep page 2/12



Performance Validation Checkcases

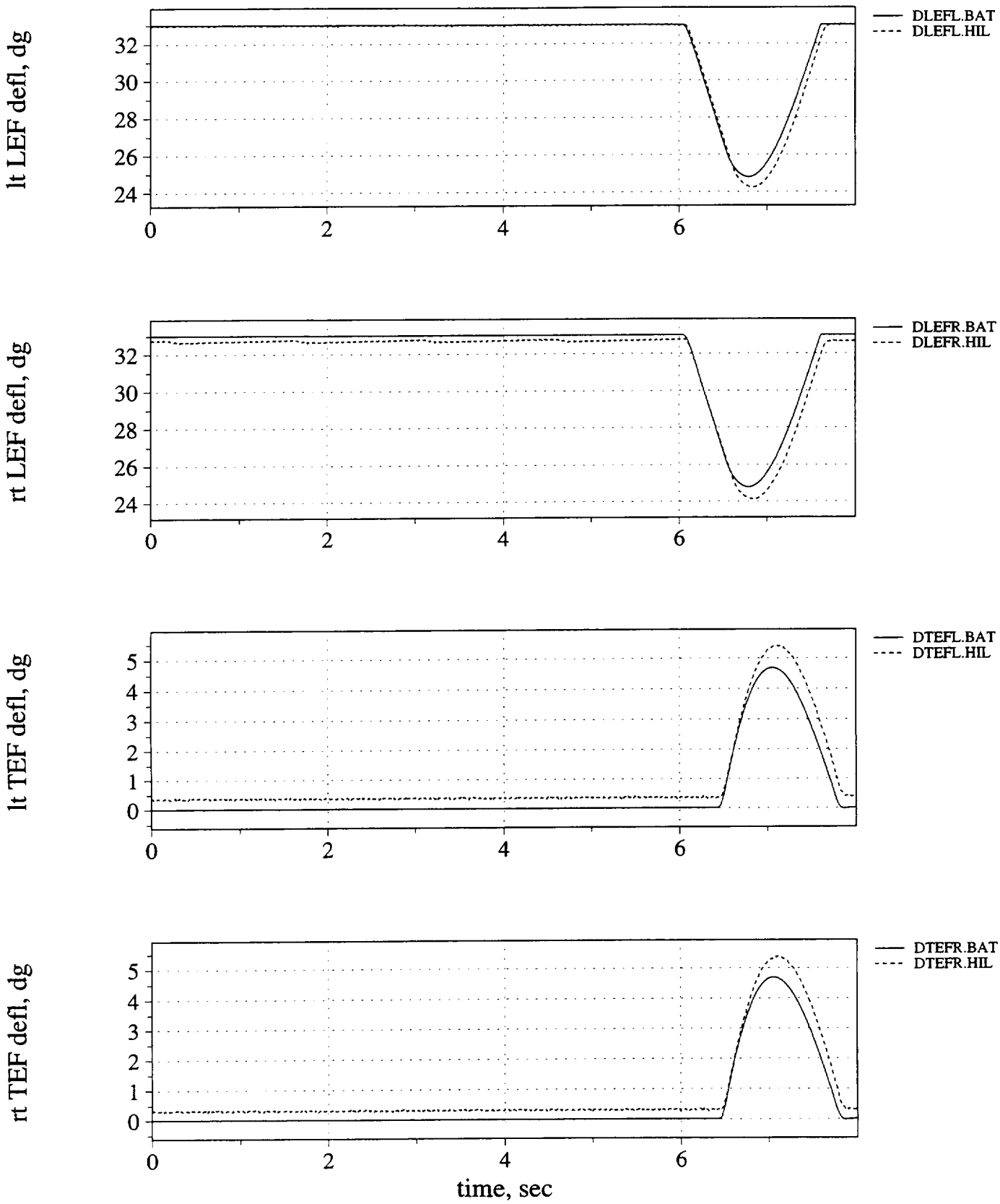
Appendix B - Batch versus HIL Version 154.0

CASE_4__TV_Mode__30alp-35k_Max_AB_3_-2.5_in_ramp_dep page 3/12



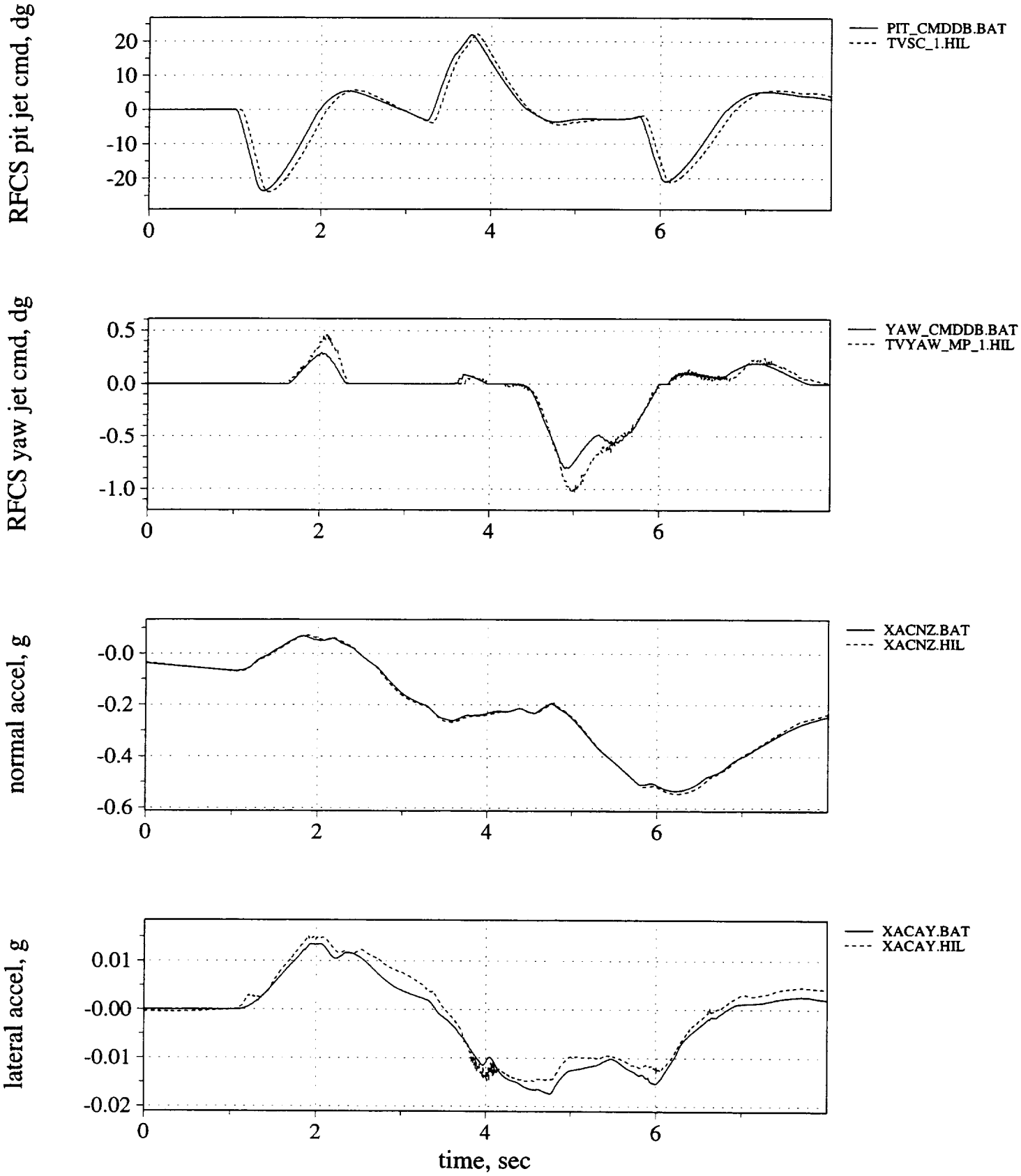
Appendix B - Batch versus HIL Version 154.0

CASE_4__TV_Mode__30alp-35k_Max_AB_3_-2.5_in_ramp_dep page 4/12



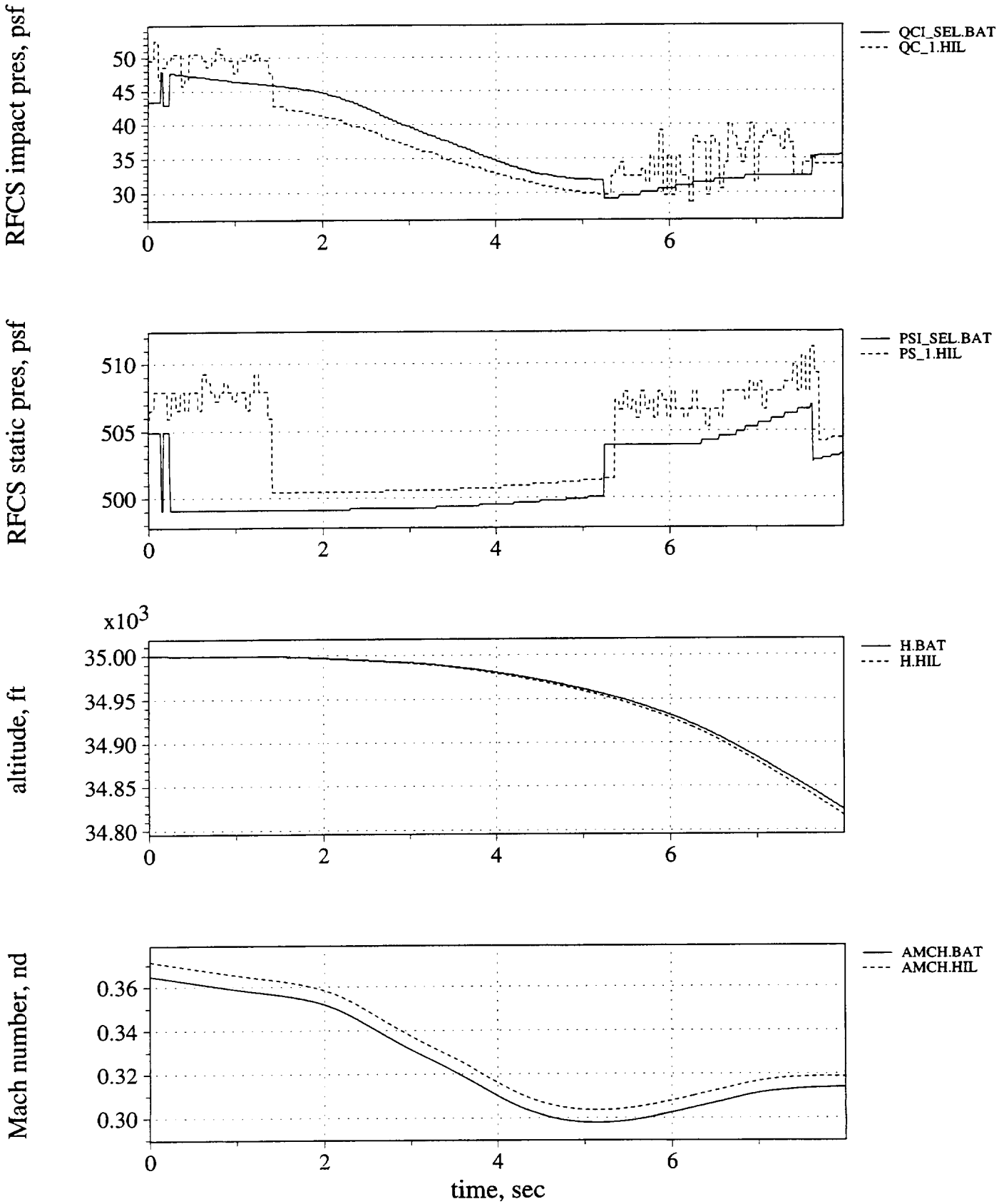
Appendix B - Batch versus HIL Version 154.0

CASE_4__TV_Mode__30alp-35k_Max_AB_3_-2.5_in_ramp_dep page 5/12



Appendix B - Batch versus HIL Version 154.0

CASE_4__TV_Mode__30alp-35k_Max_AB_3_-2.5_in_ramp_dep page 6/12



Appendix B - Batch versus HIL Version 154.0

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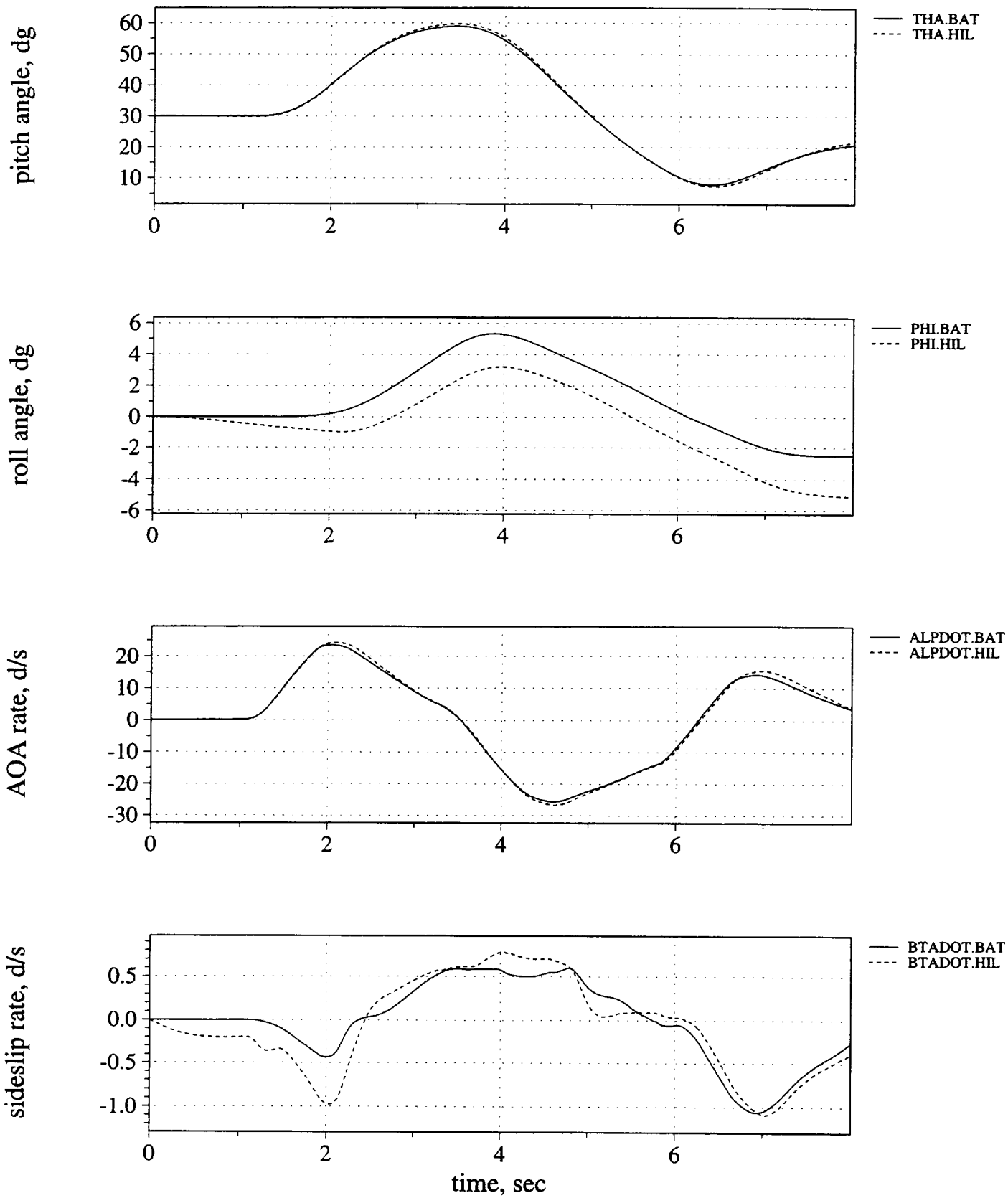

Performance Validation Checkcases

Appendix B - Batch versus HIL Version 154.0

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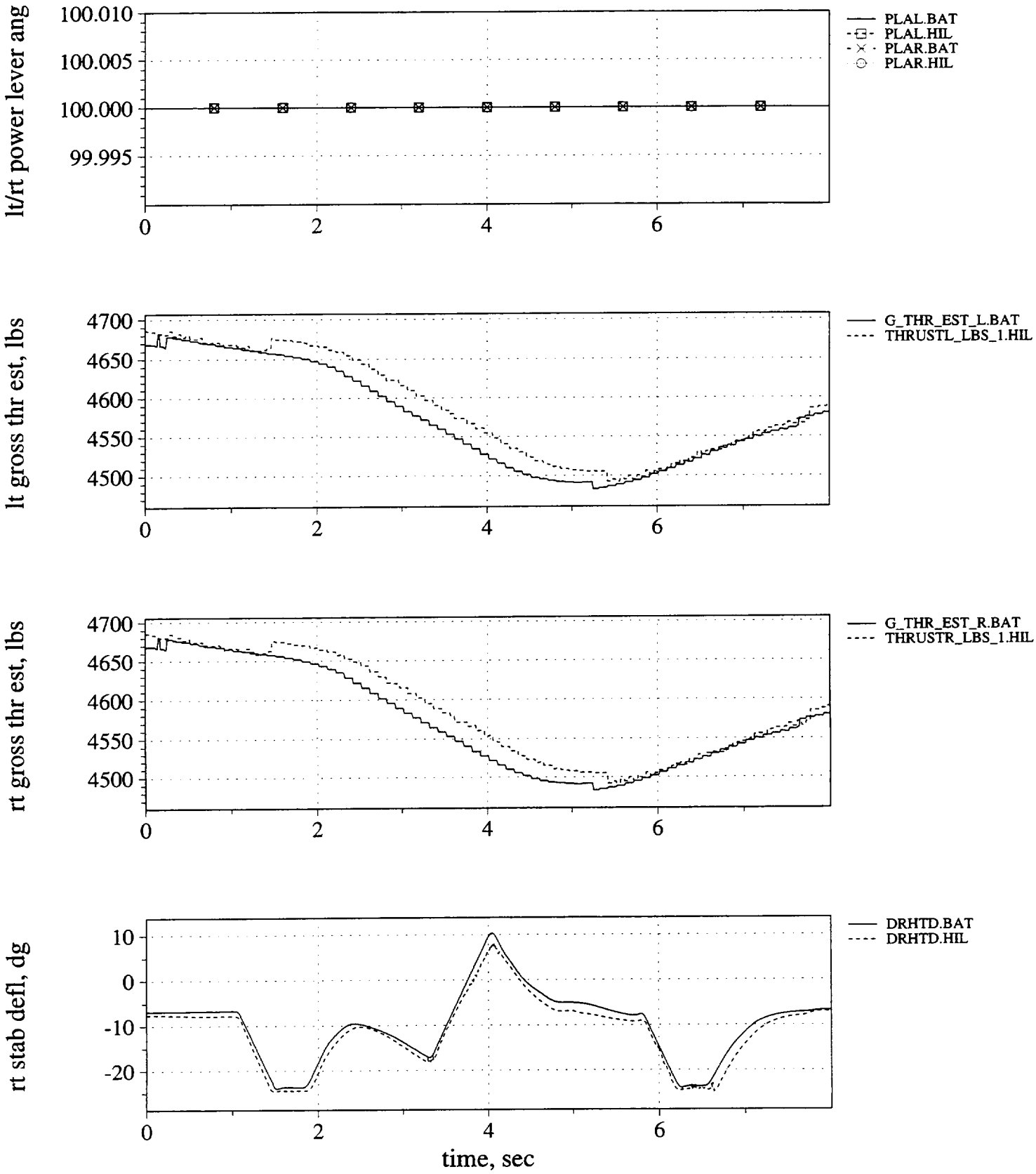
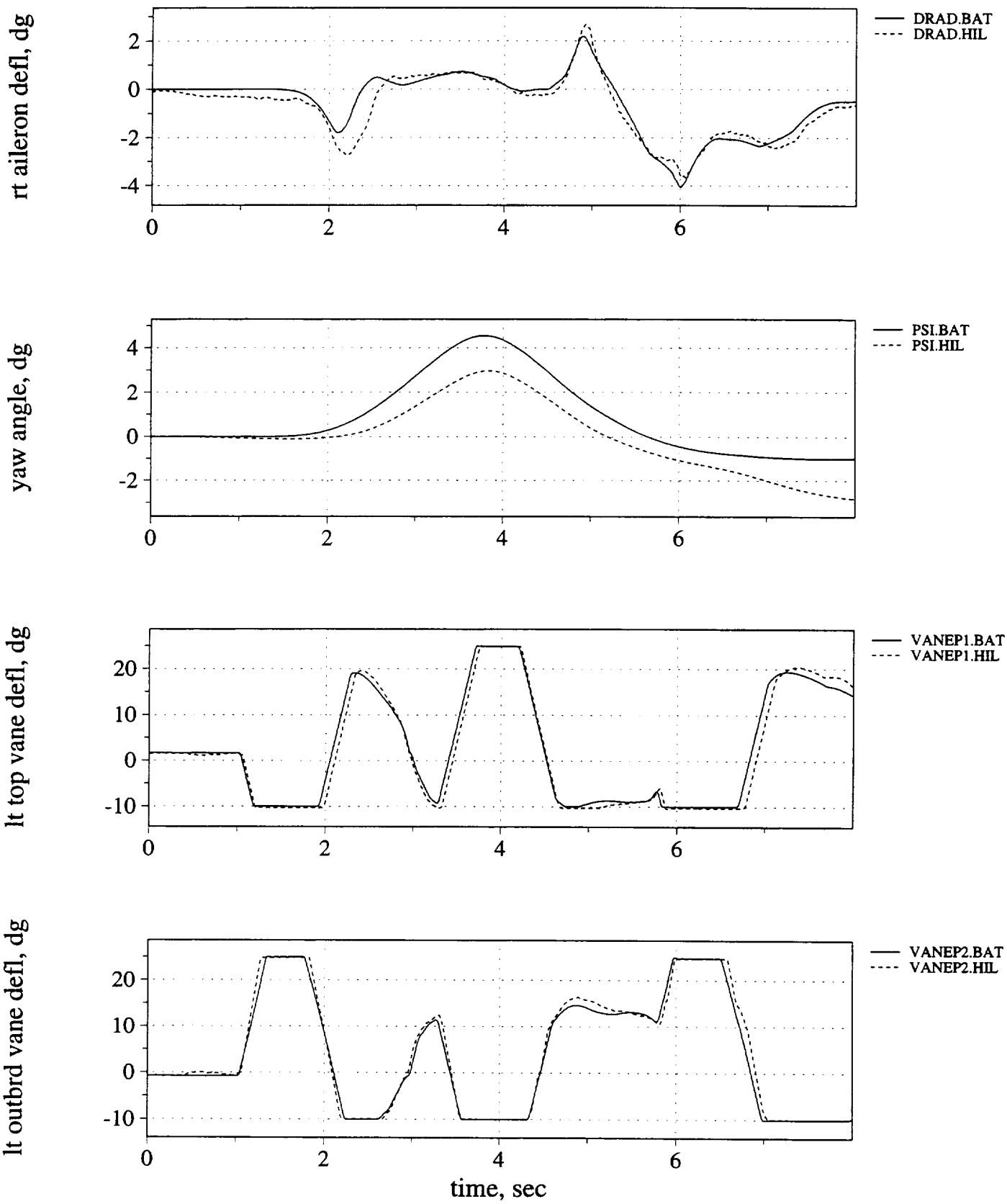
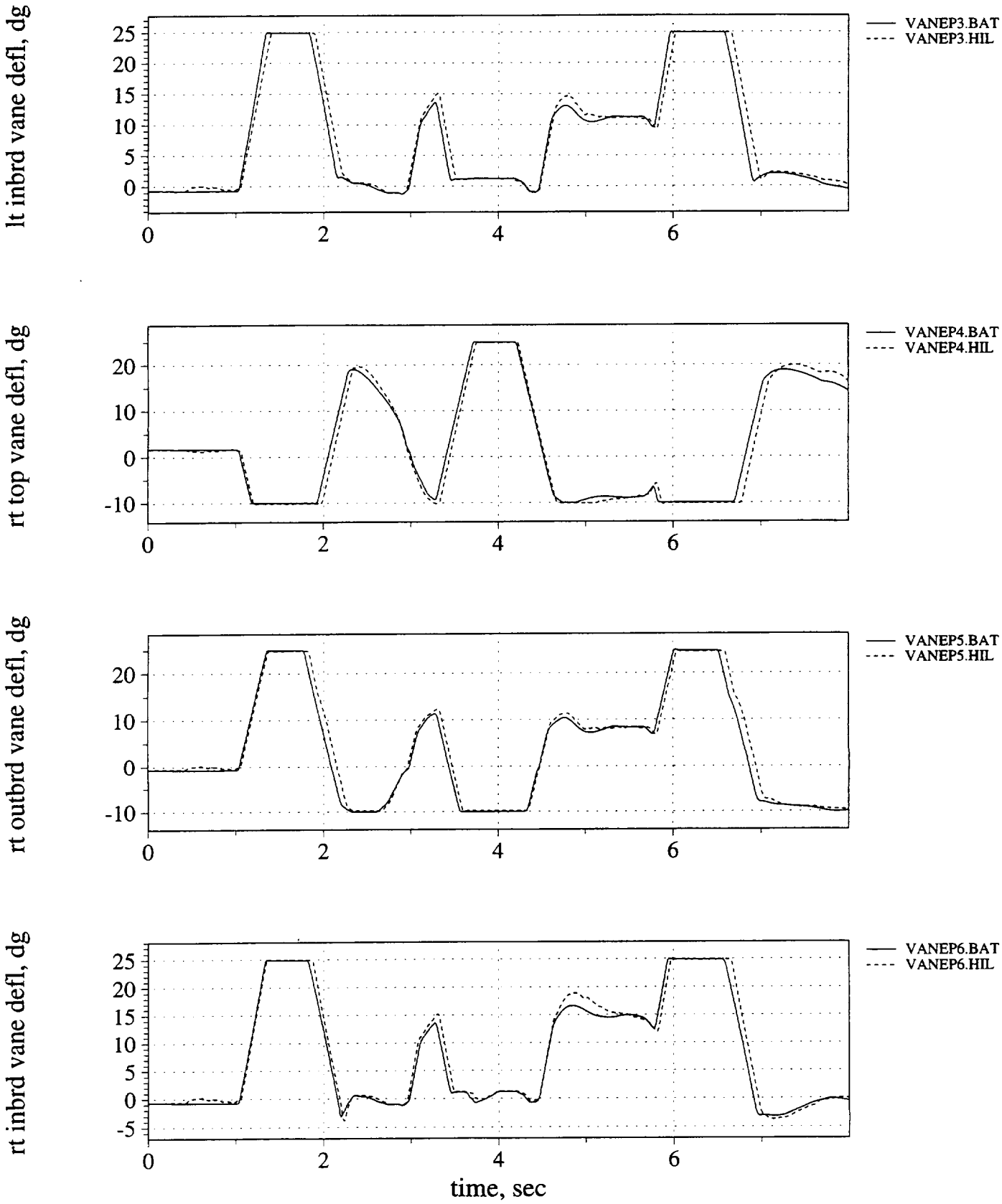
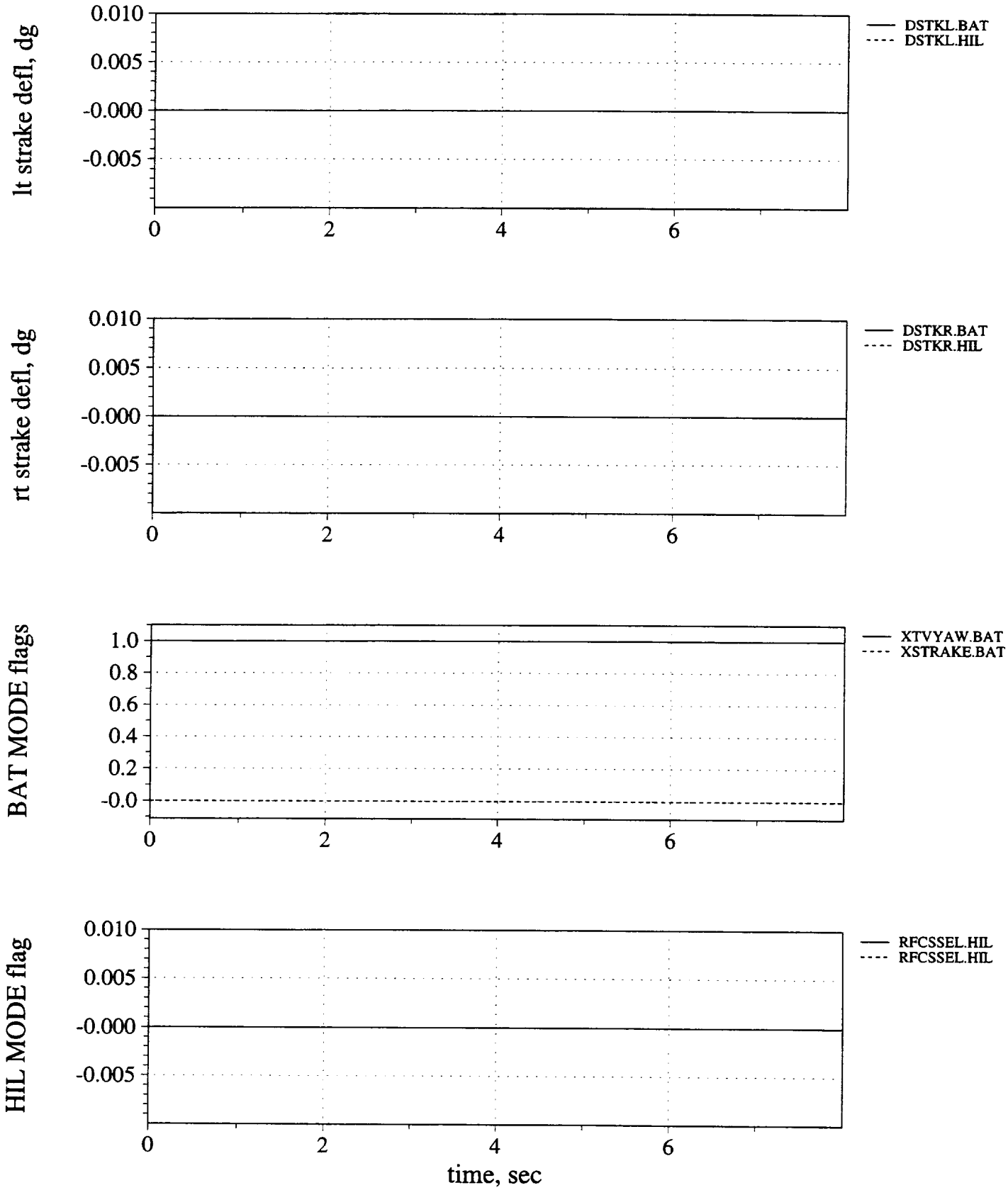


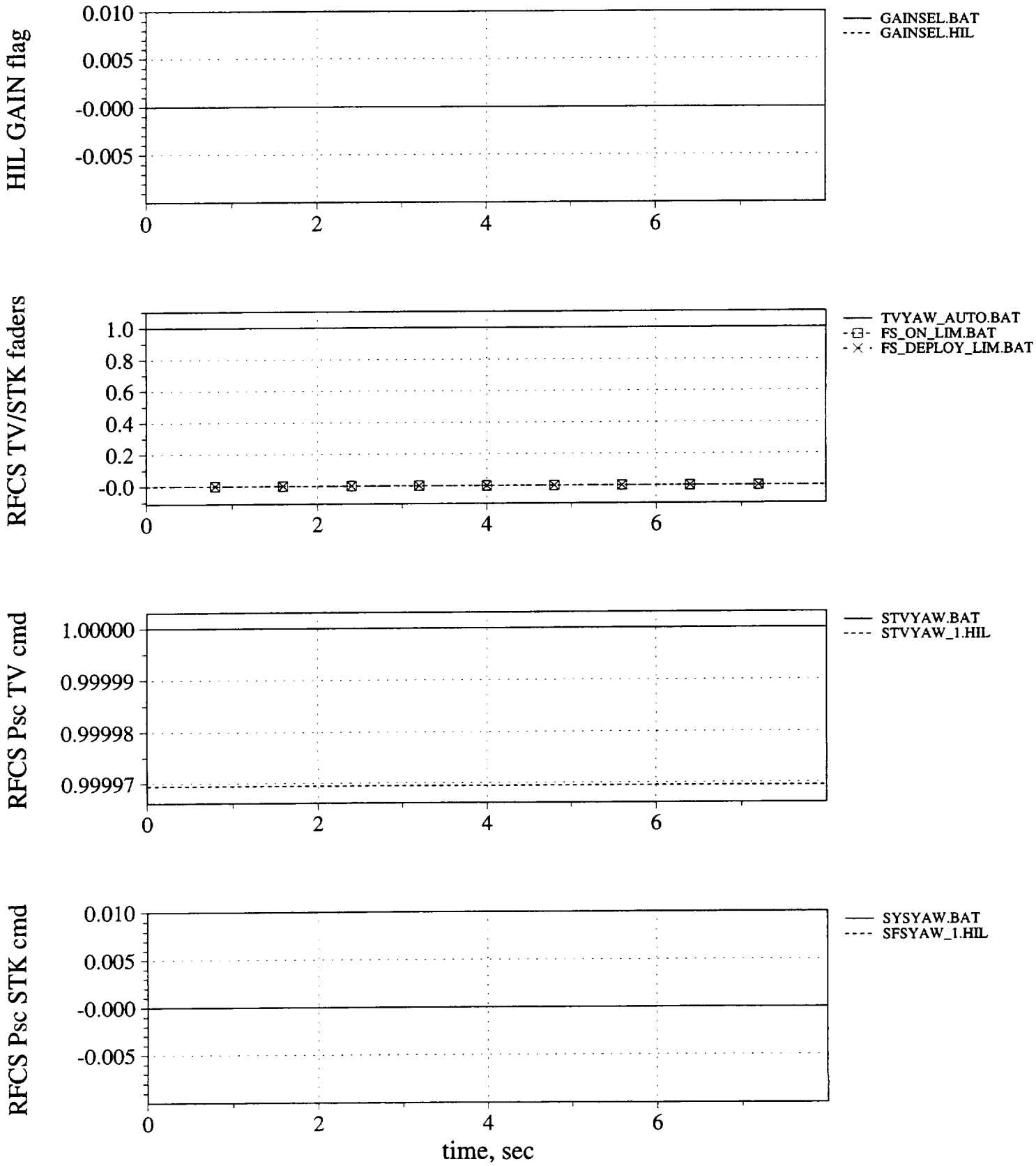

rt aileron defl, dg
DRAD.BAT
DRAD.HIL
yaw angle, dg
PSI.BAT
PSI.HIL
lt top vane defl, dg
VANEP1.BAT
VANEP1.HIL
lt outbrd vane defl, dg
VANEP2.BAT
VANEP2.HIL
time, sec


lt inbrd vane defl, dg
VANEP3.BAT
VANEP3.HIL
rt top vane defl, dg
VANEP4.BAT
VANEP4.HIL
rt outbrd vane defl, dg
VANEP5.BAT
VANEP5.HIL
rt inbrd vane defl, dg
VANEP6.BAT
VANEP6.HIL
time, sec


lt strake defl, dg
0.010
0.005
-0.000
-0.005
0
2
4
6
DSTKL.BAT
DSTKL.HIL
rt strake defl, dg
0.010
0.005
-0.000
-0.005
0
2
4
6
DSTKR.BAT
DSTKR.HIL
BAT MODE flags
1.0
0.8
0.6
0.4
0.2
-0.0
0
2
4
6
XTVYAW.BAT
XSTRAKE.BAT
HIL MODE flag
0.010
0.005
-0.000
-0.005
0
2
4
6
RFCSSEL.HIL
RFCSSEL.HIL
time, sec

Appendix B - Batch versus HIL Version 154.0

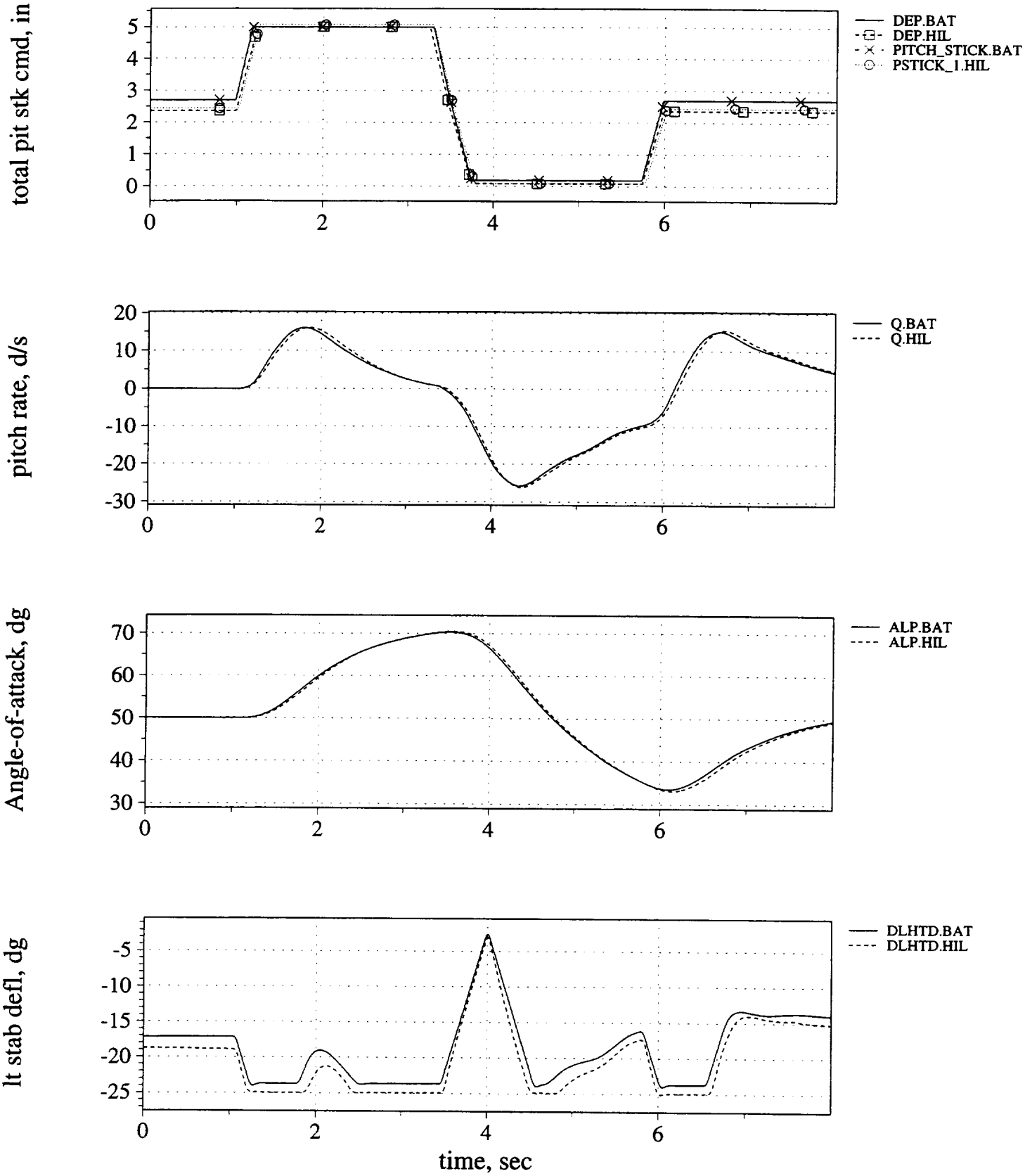
CASE_4__TV_Mode__30alp-35k_Max_AB_3_-2.5_in_ramp_dep page 12/12



Performance Validation Checkcases

Appendix B - Batch versus HIL Version 154.0

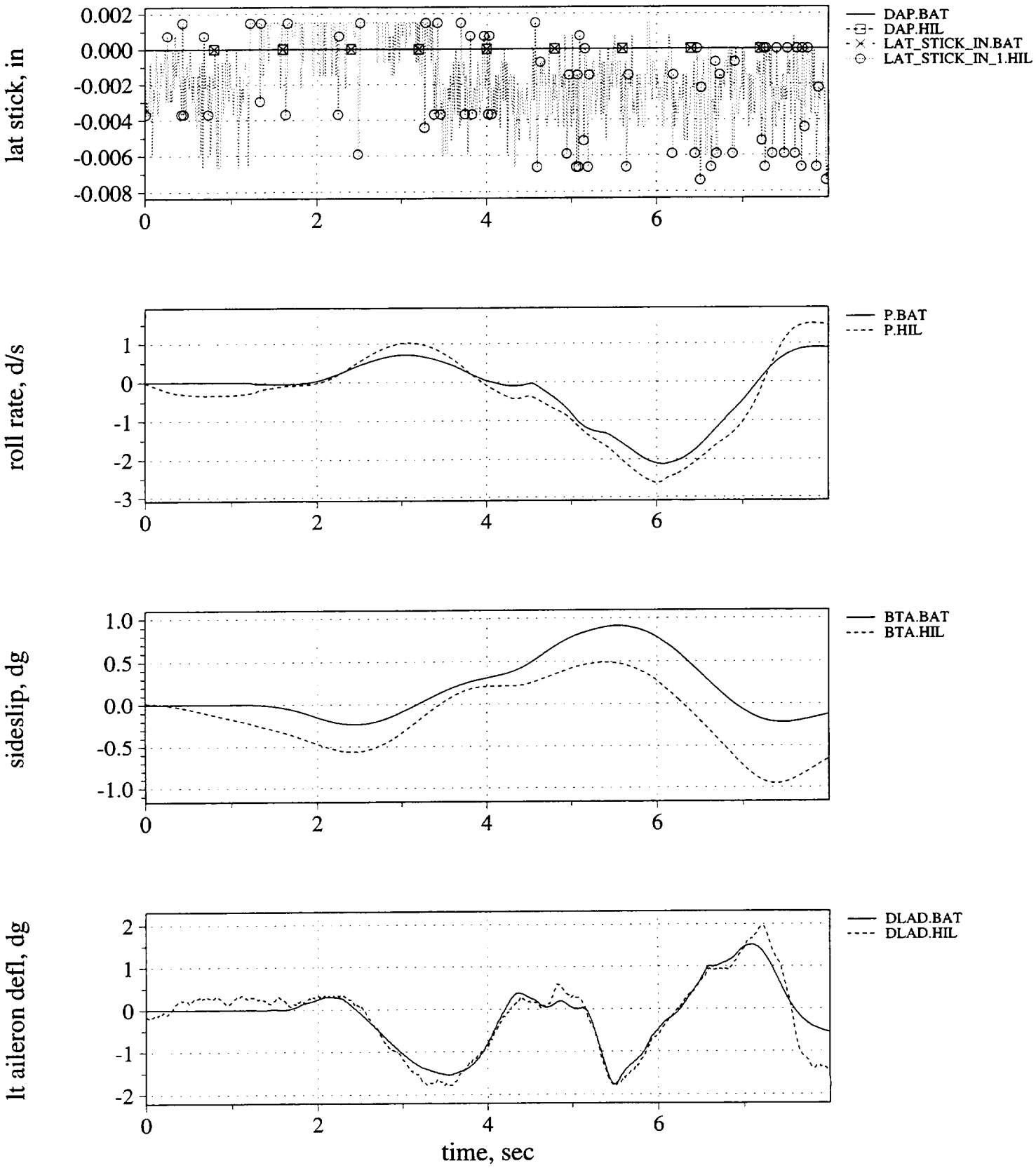
CASE_7__TV_Mode__50alp-16k_Max_AB_3_-2.5_in_ramp_dep

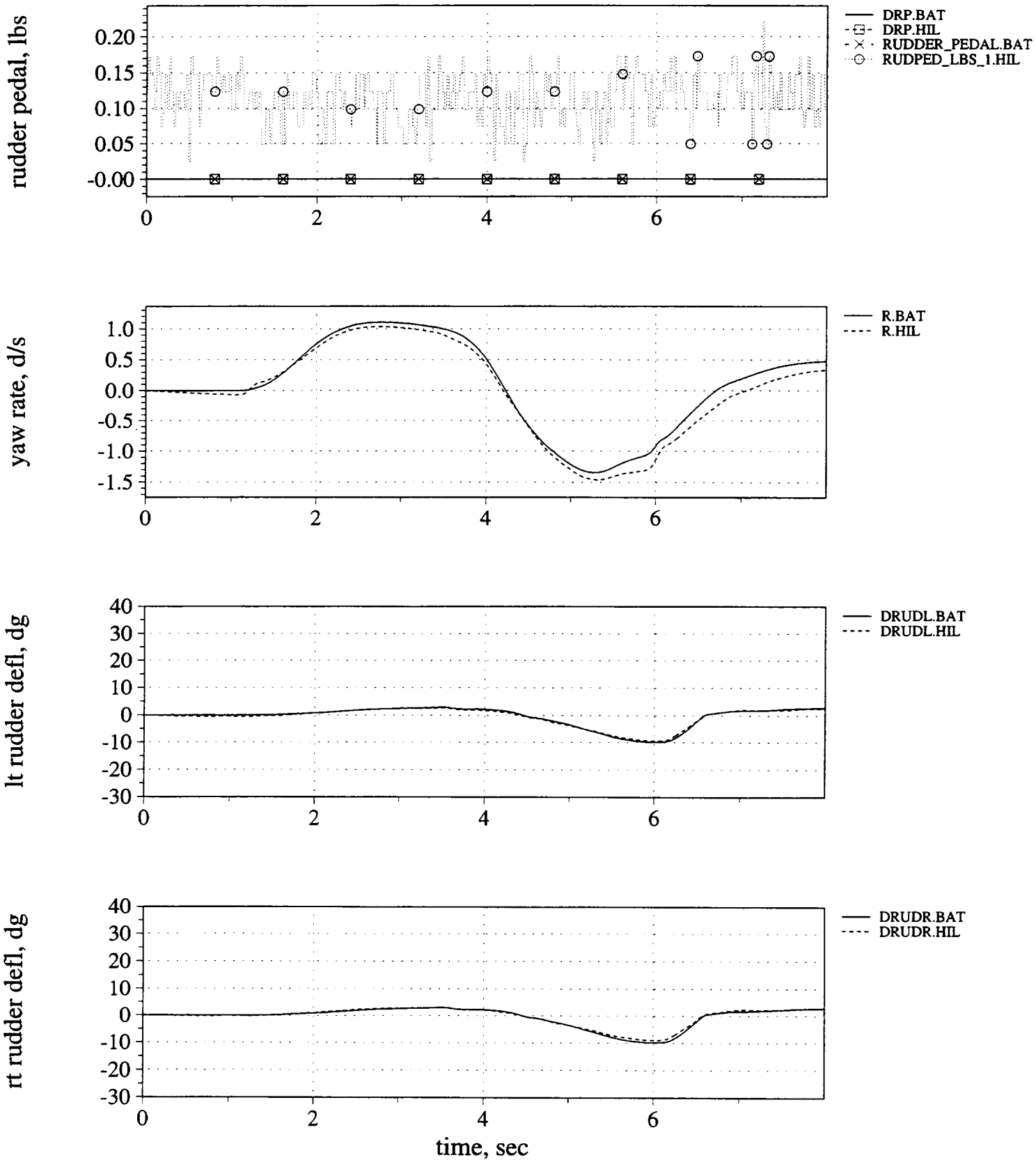


Performance Validation Checkcases

Appendix B - Batch versus HIL Version 154.0

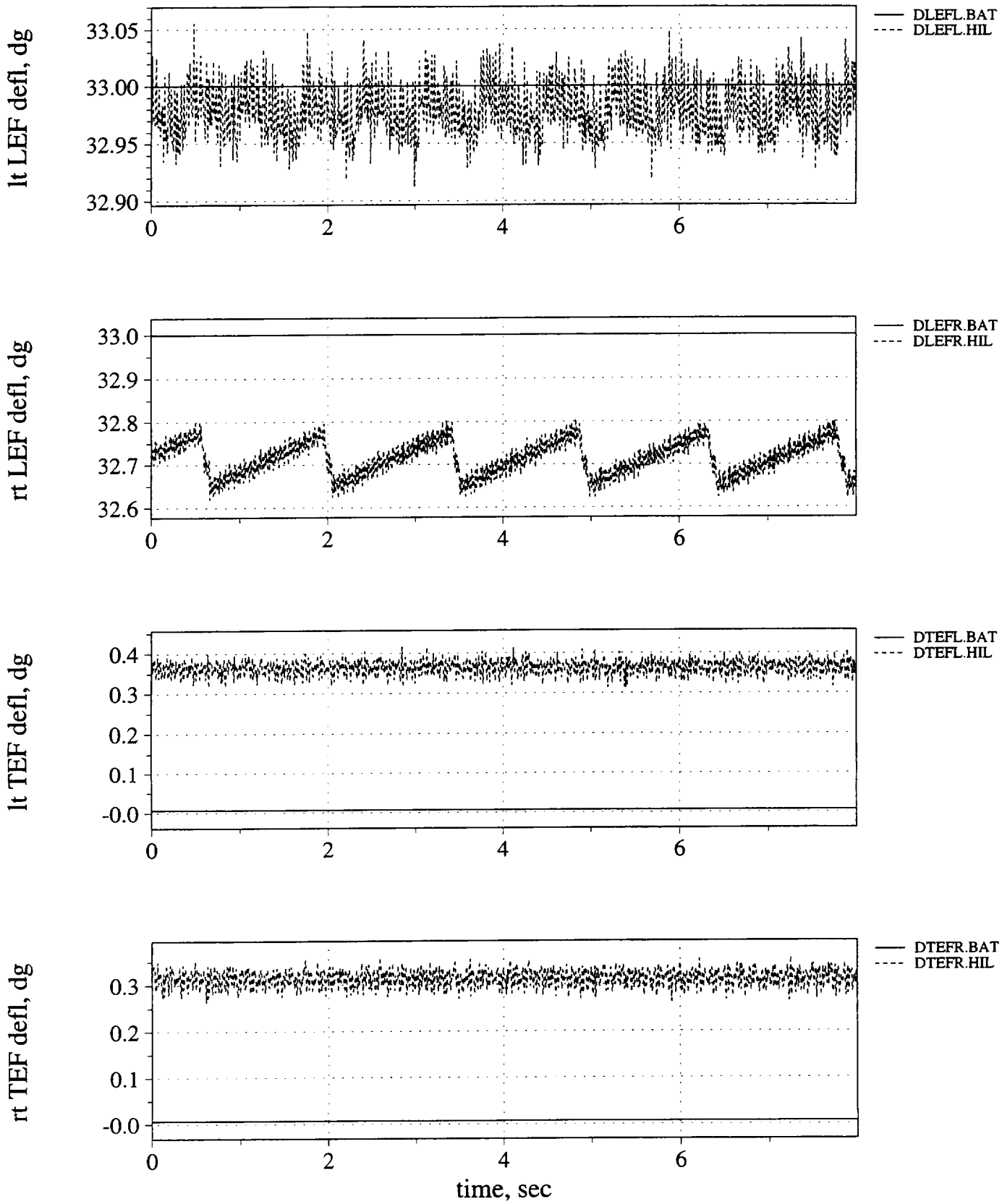
CASE_7__TV_Mode__50alp-16k_Max_AB_3_-2.5_in_ramp_dep page 2/12




rudder pedal, lbs
0.20
0.15
0.10
0.05
-0.00
0
2
4
6
DRP.BAT
DRP.HIL
RUDDER_PEDAL.BAT
RUDPED_LBS_1.HIL
yaw rate, d/s
1.0
0.5
0.0
-0.5
-1.0
-1.5
R.BAT
R.HIL
lt rudder defl, dg
40
30
20
10
0
-10
-20
-30
DRUDL.BAT
DRUDL.HIL
rt rudder defl, dg
DRUDR.BAT
DRUDR.HIL
time, sec

Appendix B - Batch versus HIL Version 154.0

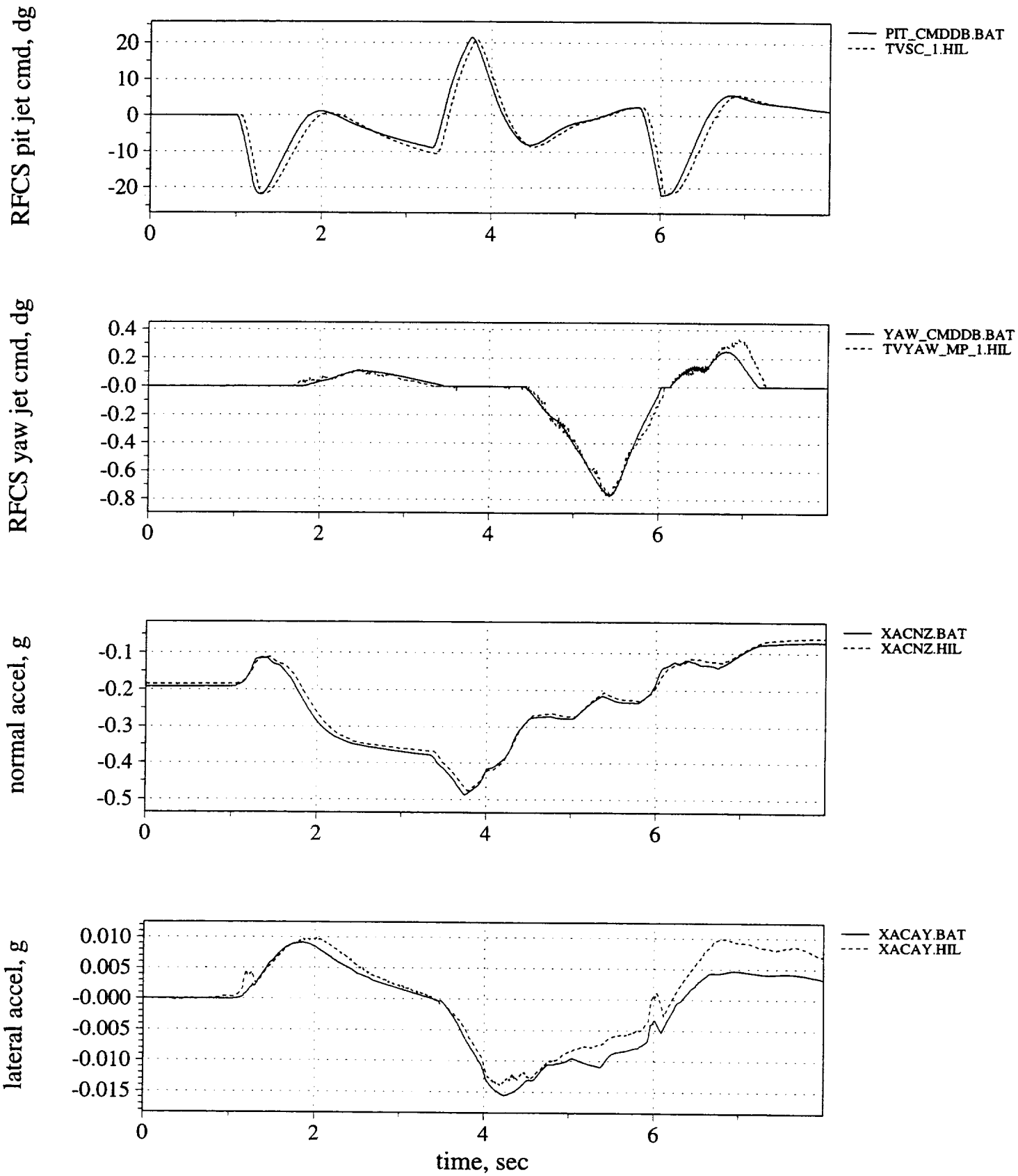
CASE_7__TV_Mode__50alp-16k_Max_AB_3_-2.5_in_ramp_dep page 4/12



Performance Validation Checkcases

Appendix B - Batch versus HIL Version 154.0

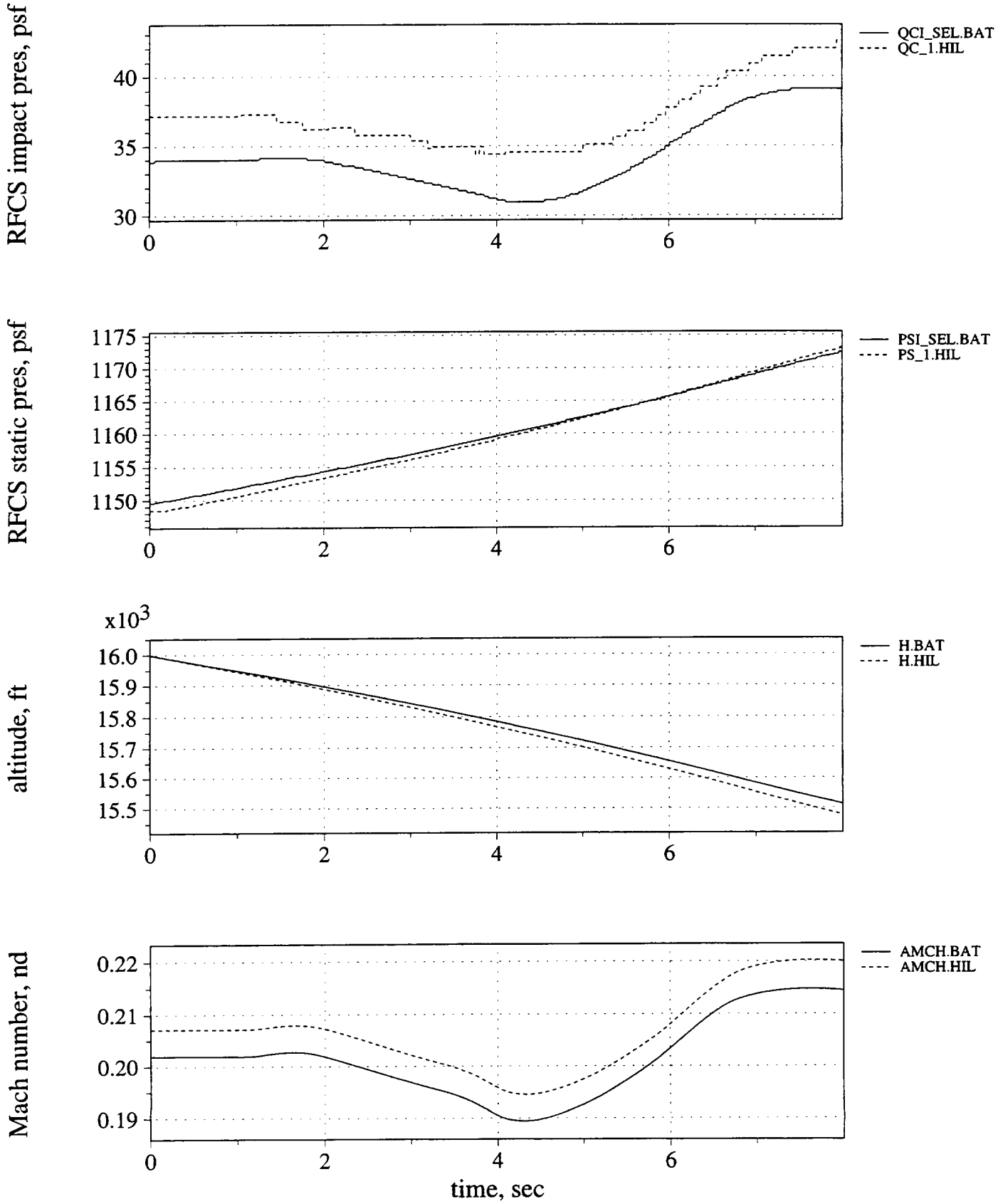
CASE_7__TV_Mode__50alp-16k_Max_AB_3_-2.5_in_ramp_dep page 5/12



Performance Validation Checkcases

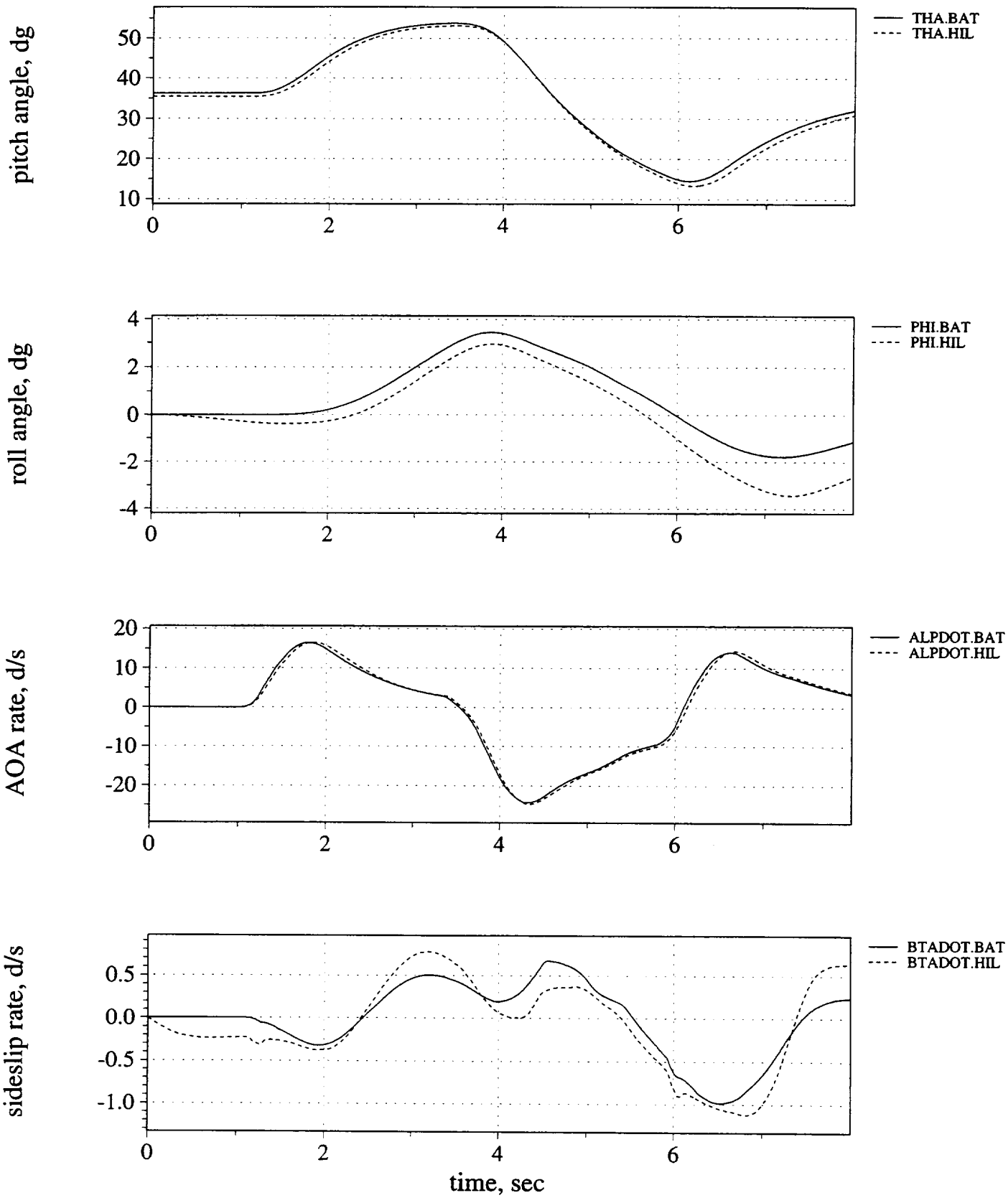
Appendix B - Batch versus HIL Version 154.0

CASE_7__TV_Mode__50alp-16k_Max_AB_3_-2.5_in_ramp_dep page 6/12

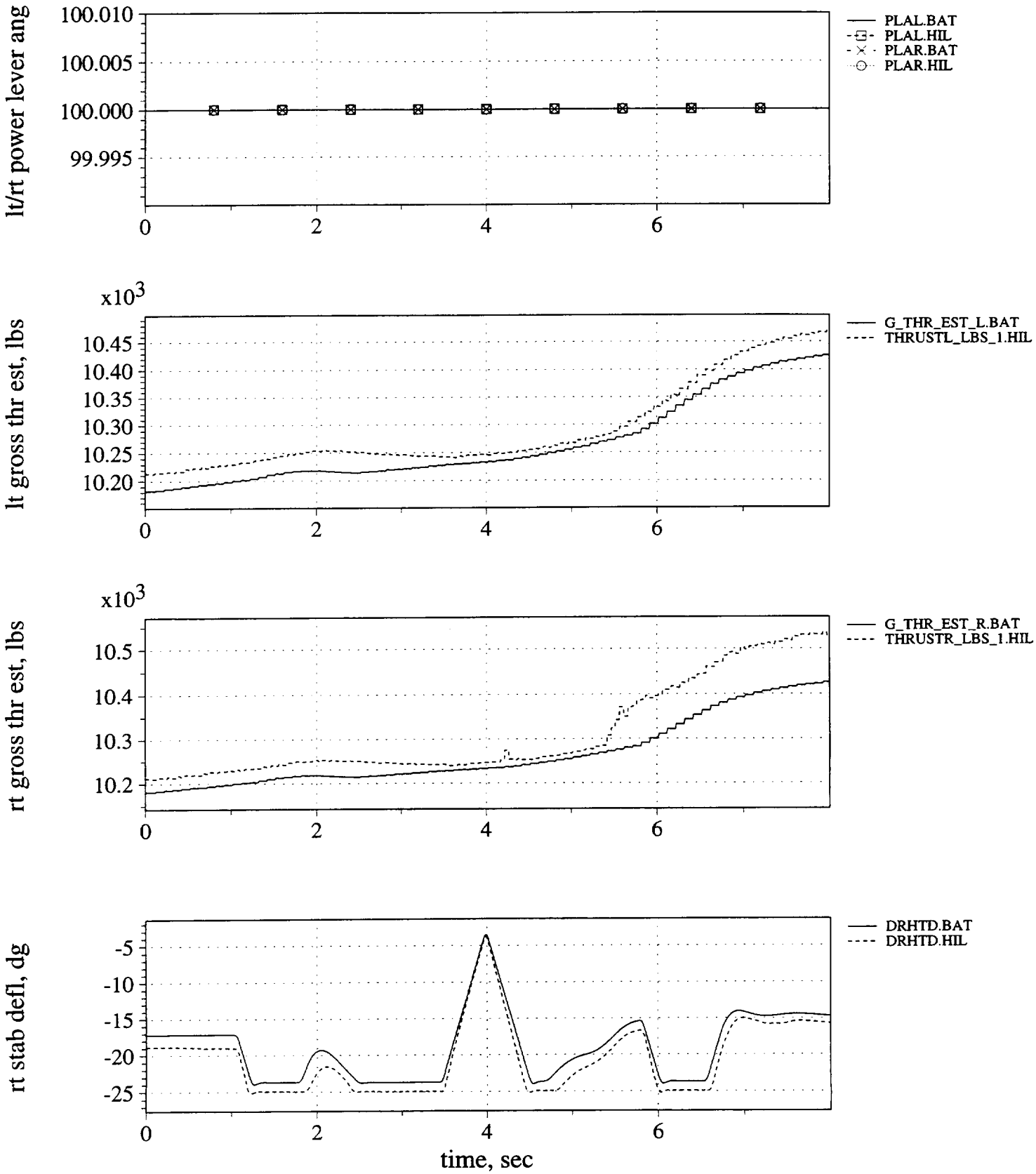


Appendix B - Batch versus HIL Version 154.0

CASE_7__TV_Mode__50alp-16k_Max_AB_3_-2.5_in_ramp_dep page 7/12

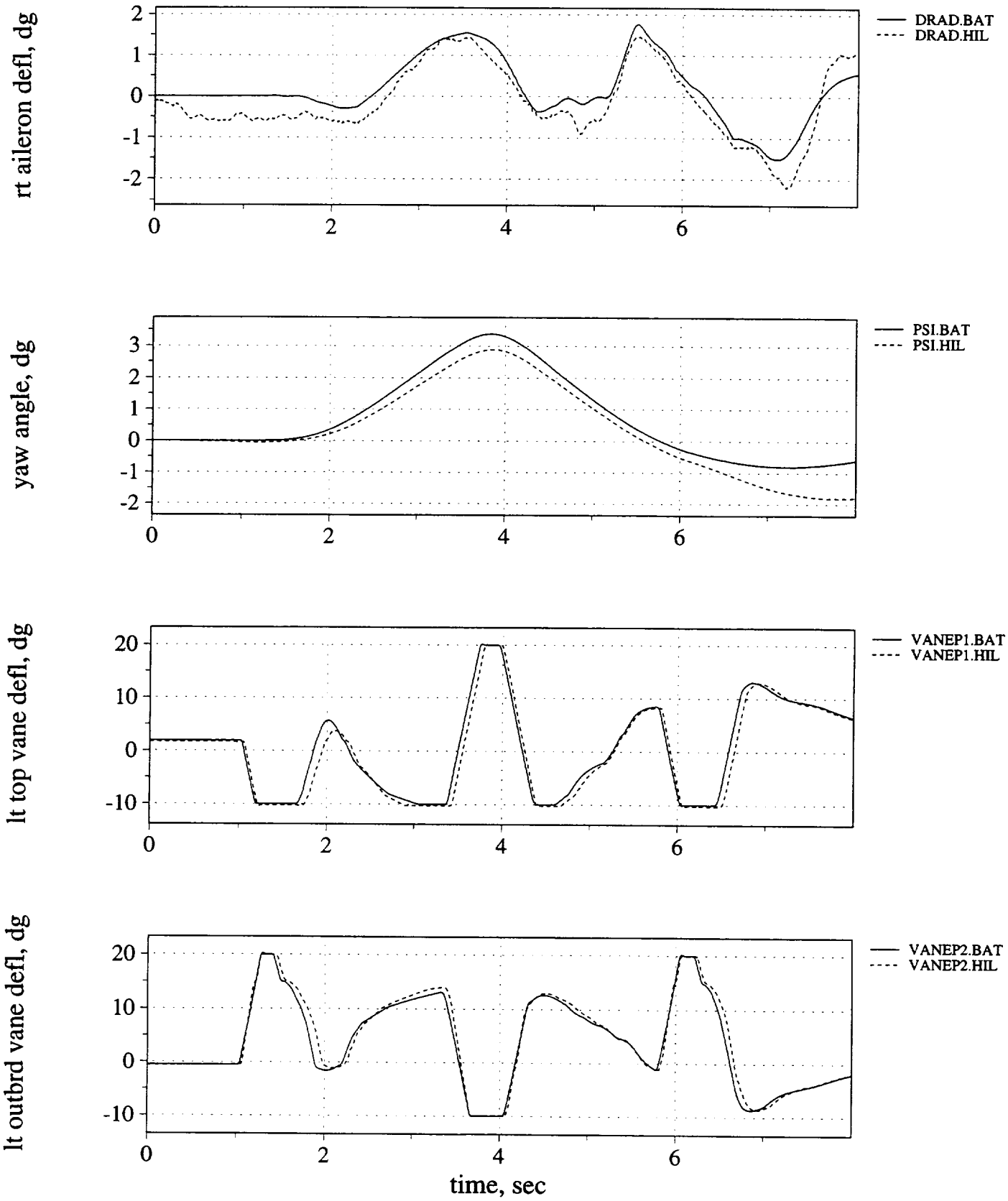


Performance Validation Checkcases

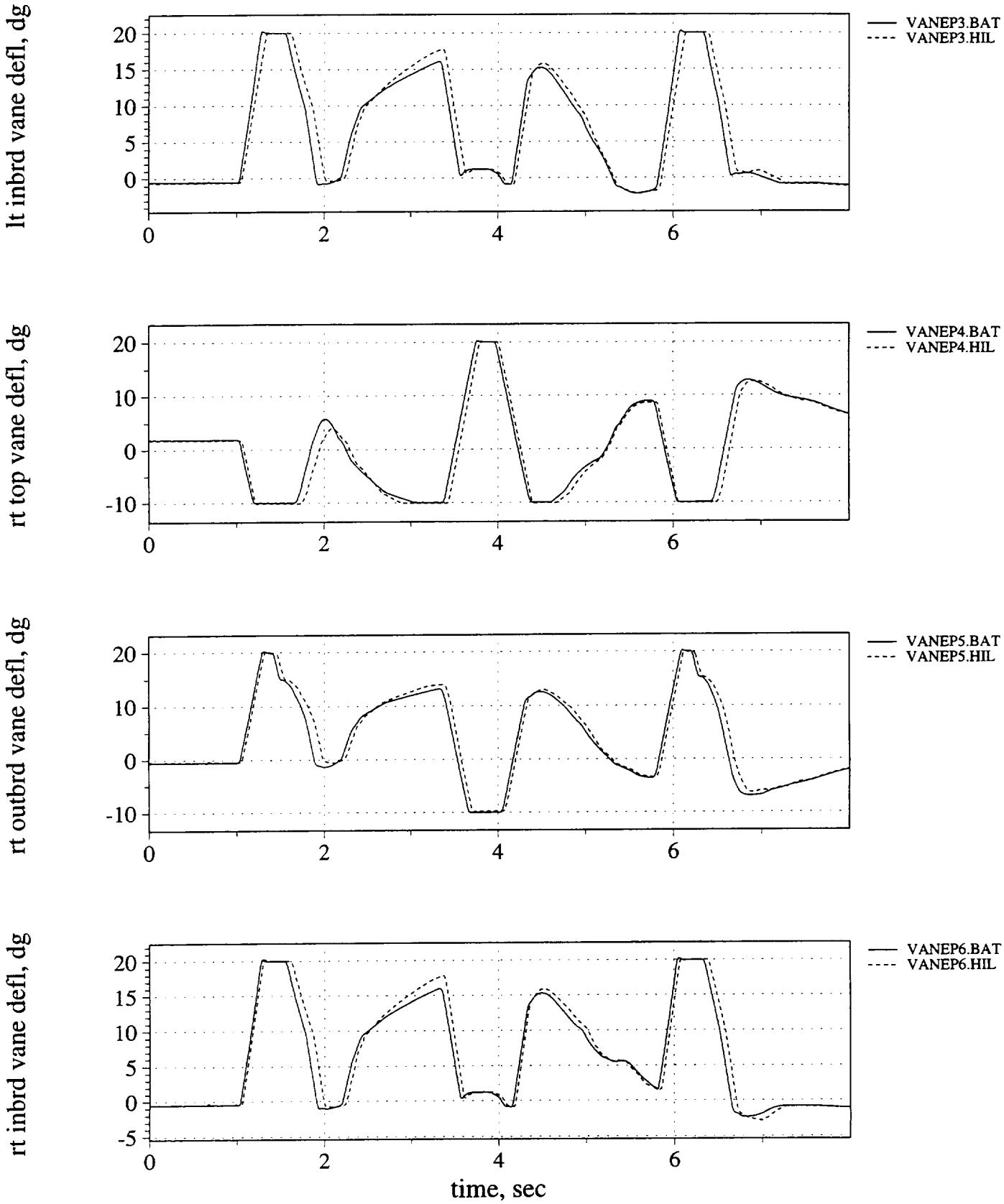

lt/rt power lever ang
100.010
100.005
100.000
99.995
0
2
4
6
PLAL.BAT
PLAL.HIL
PLAR.BAT
PLAR.HIL
lt gross thr est, lbs
x10^3
10.45
10.40
10.35
10.30
10.25
10.20
G_THR_EST_L.BAT
THRUSTL_LBS_1.HIL
rt gross thr est, lbs
x10^3
10.5
10.4
10.3
10.2
G_THR_EST_R.BAT
THRUSTR_LBS_1.HIL
rt stab defl, dg
-5
-10
-15
-20
-25
DRHTD.BAT
DRHTD.HIL
time, sec

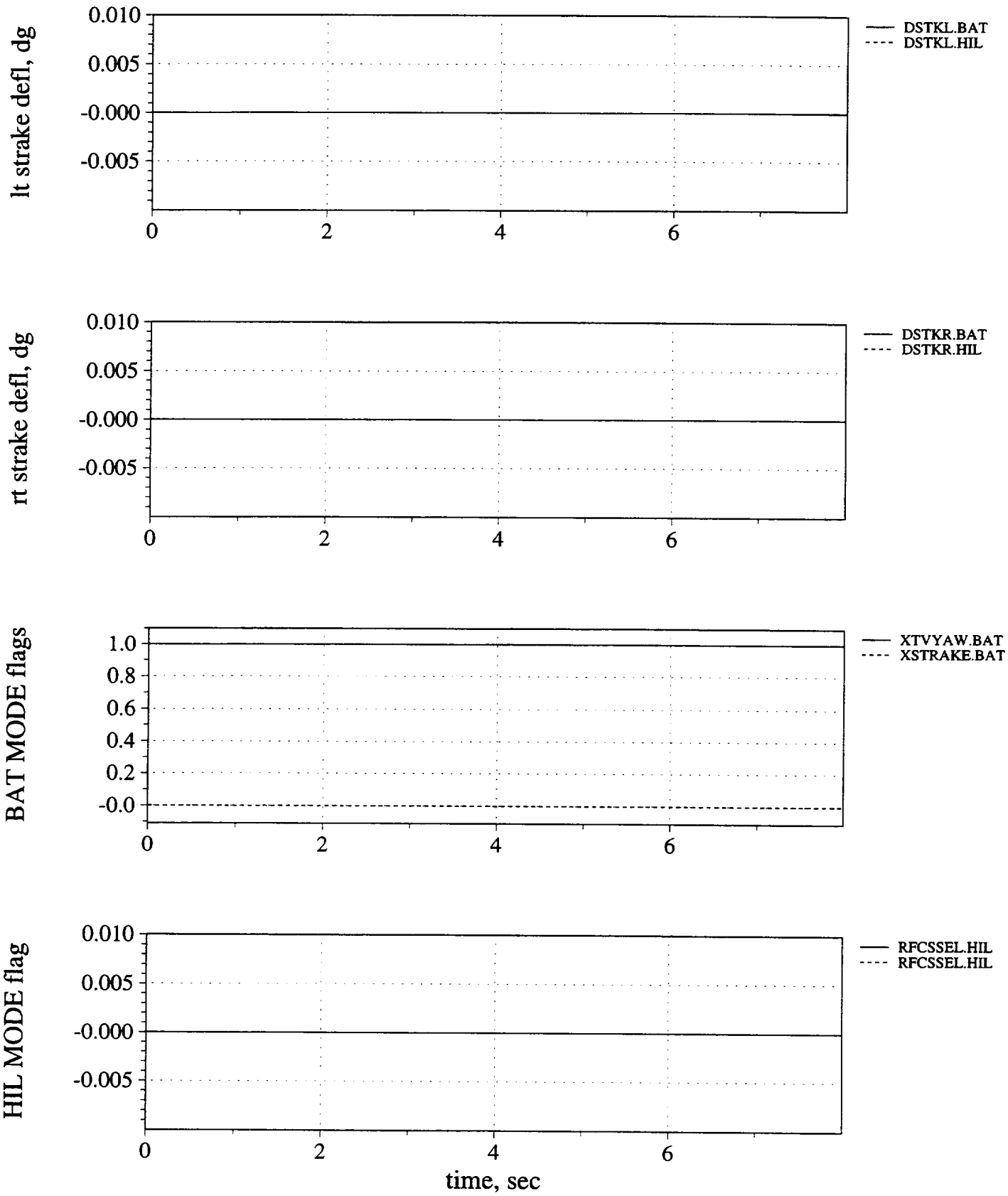
Appendix B - Batch versus HIL Version 154.0

CASE_7__TV_Mode__50alp-16k_Max_AB_3_-2.5_in_ramp_dep page 9/12



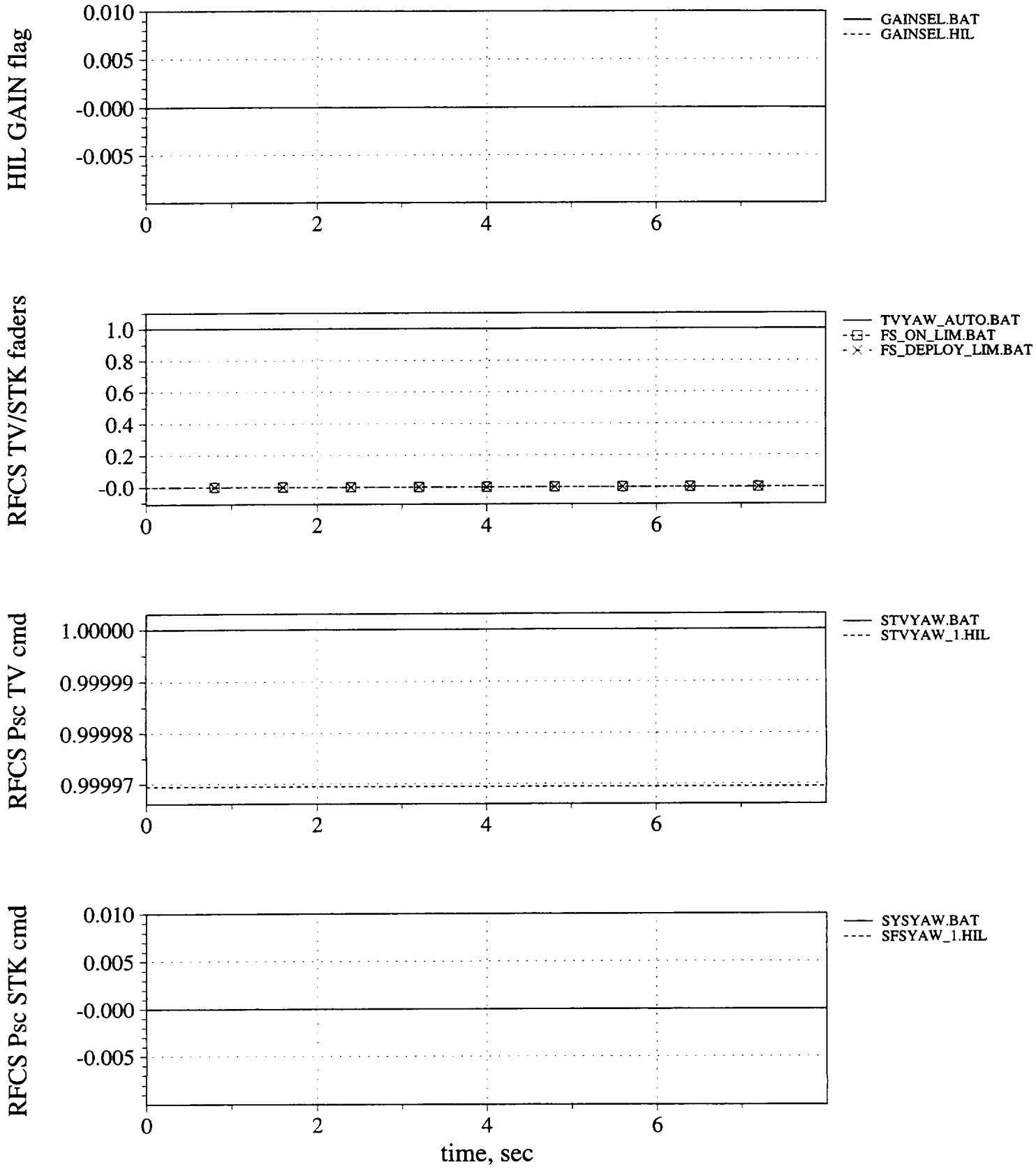
Performance Validation Checkcases


lt inbrd vane defl, dg
VANEP3.BAT
VANEP3.HIL
rt top vane defl, dg
VANEP4.BAT
VANEP4.HIL
rt outbrd vane defl, dg
VANEP5.BAT
VANEP5.HIL
rt inbrd vane defl, dg
VANEP6.BAT
VANEP6.HIL
time, sec


lt strake defl, dg
0.010
0.005
-0.000
-0.005
0
2
4
6
DSTKL.BAT
DSTKL.HIL
rt strake defl, dg
0.010
0.005
-0.000
-0.005
0
2
4
6
DSTKR.BAT
DSTKR.HIL
BAT MODE flags
1.0
0.8
0.6
0.4
0.2
-0.0
0
2
4
6
XTVYAW.BAT
XSTRAKE.BAT
HIL MODE flag
0.010
0.005
-0.000
-0.005
0
2
4
6
time, sec
RFCSSEL.HIL
RFCSSEL.HIL

Appendix B - Batch versus HIL Version 154.0

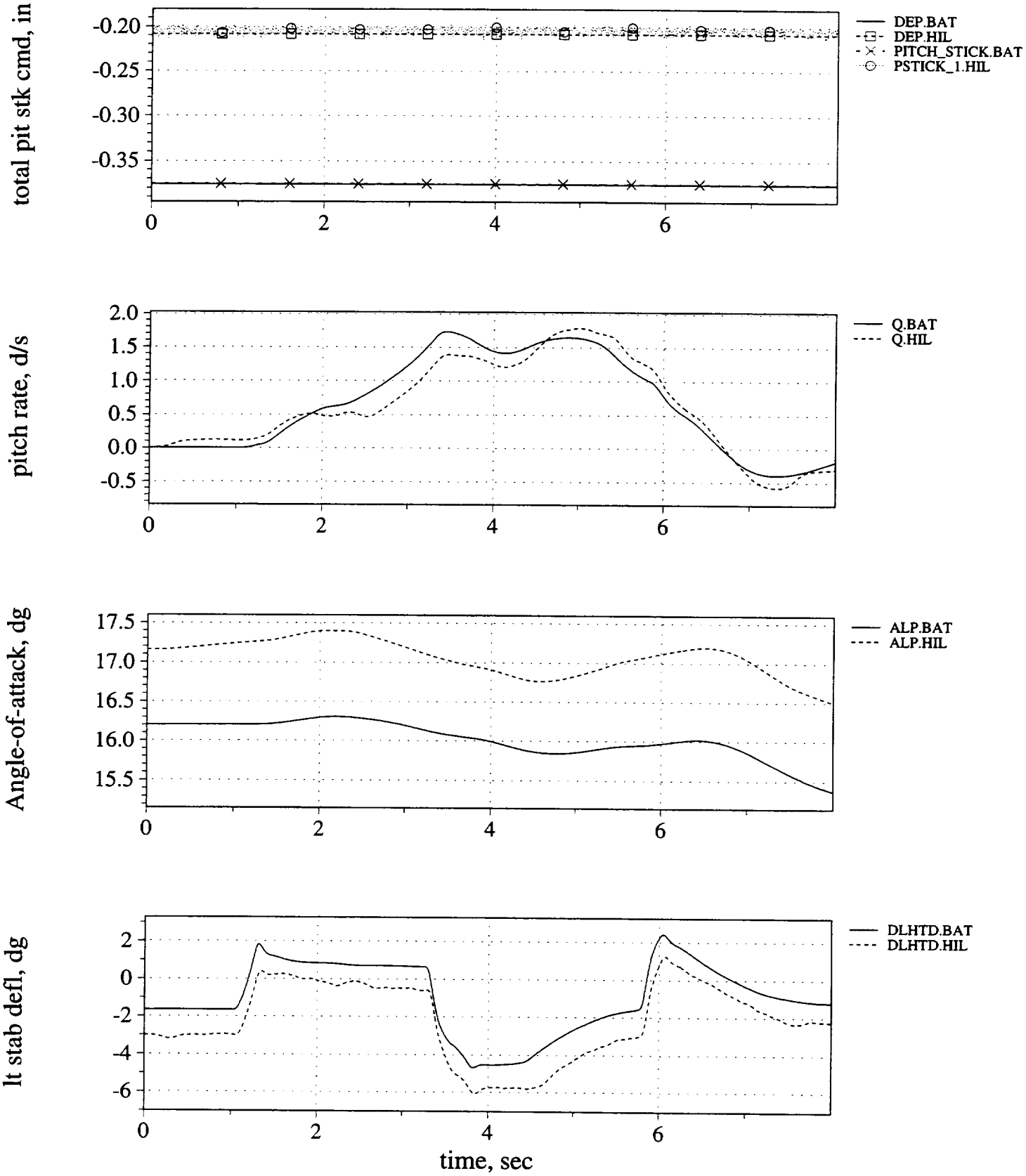
CASE_7__TV_Mode__50alp-16k_Max_AB_3_-2.5_in_ramp_dep page 12/12



Performance Validation Checkcases

Appendix B - Batch versus HIL Version 154.0

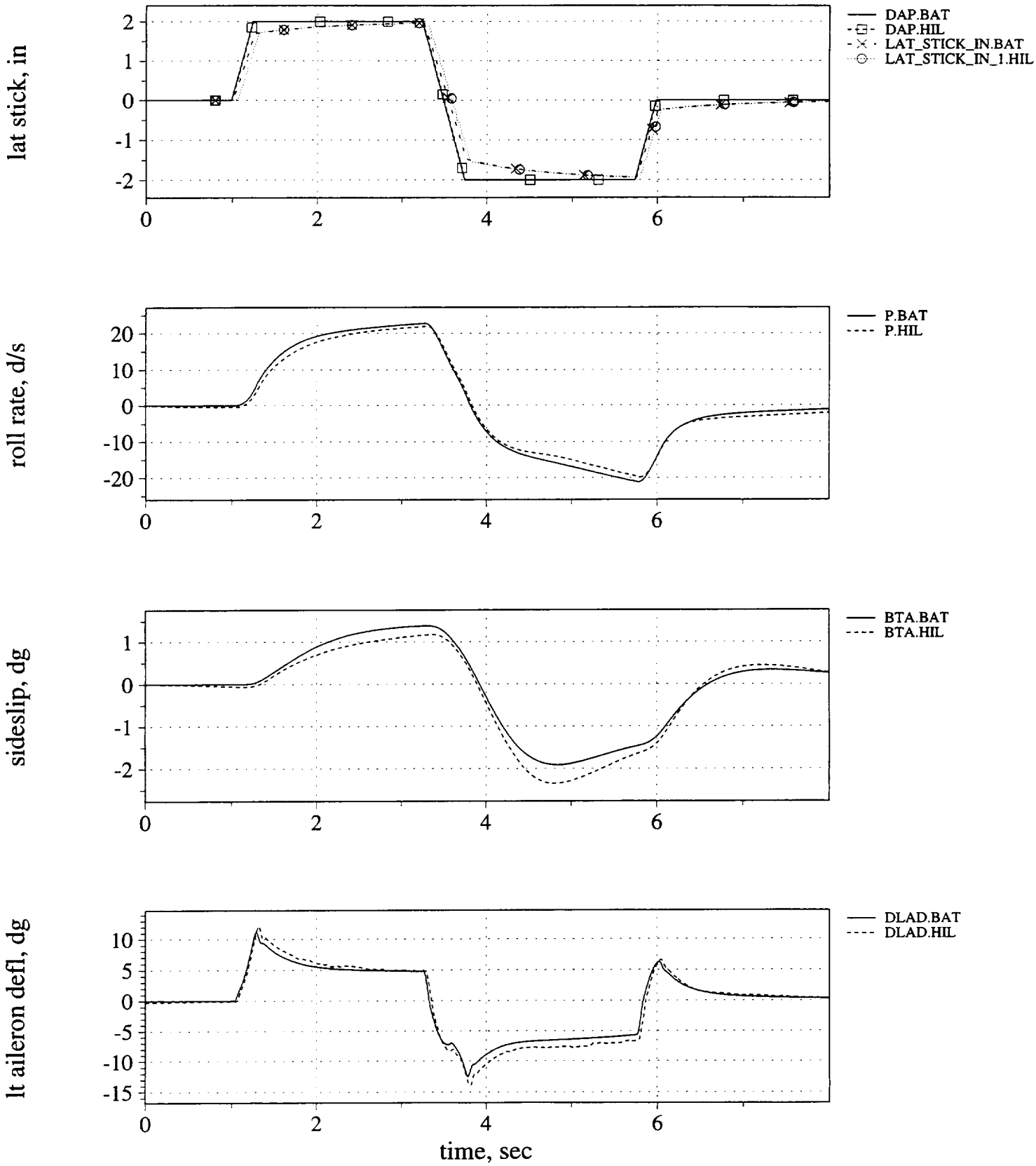
CASE_20__S_Mode__.35-25k_trim_AOA_2_in_ramp_dap page 1/12



Performance Validation Checkcases

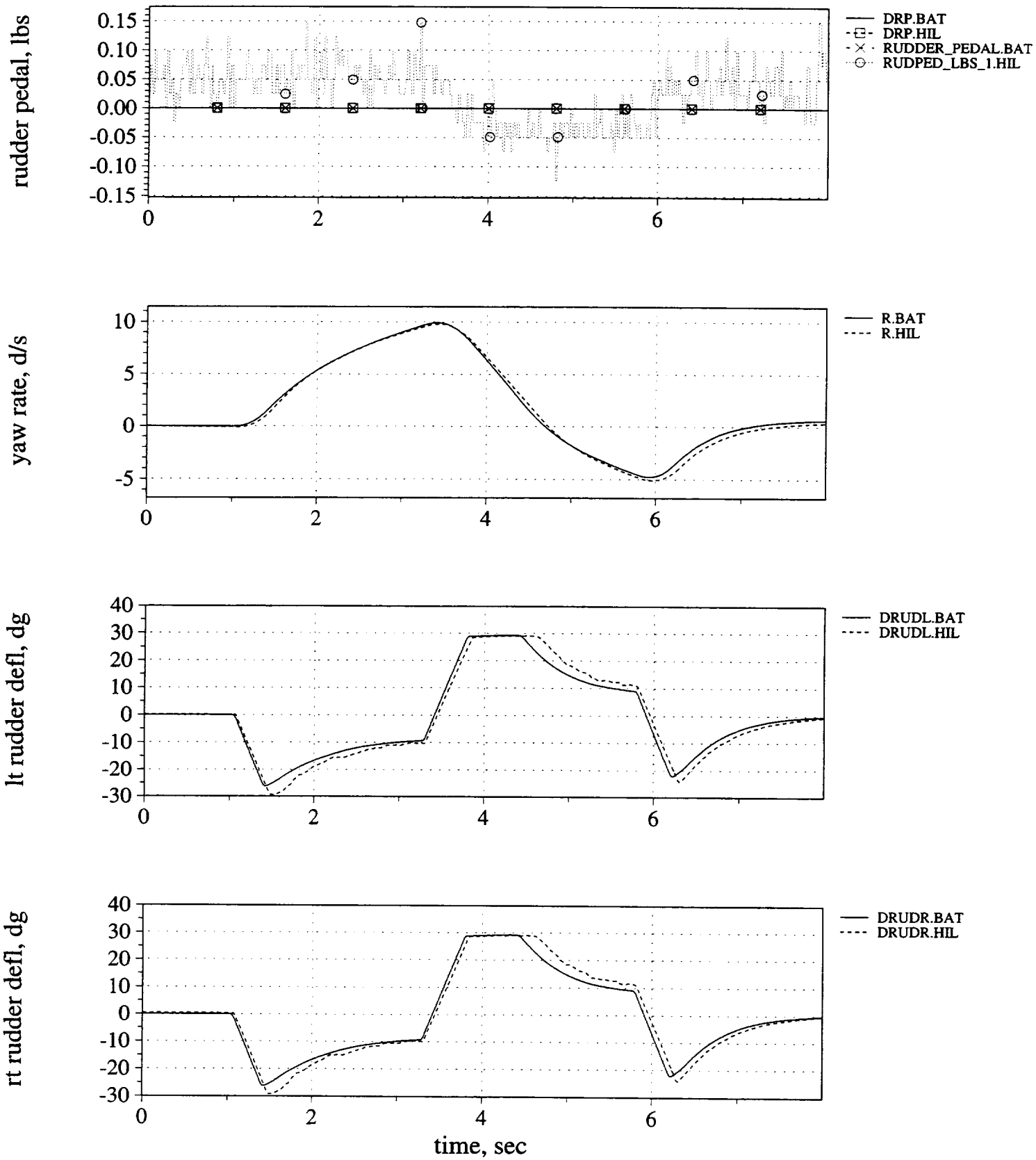
Appendix B - Batch versus HIL Version 154.0

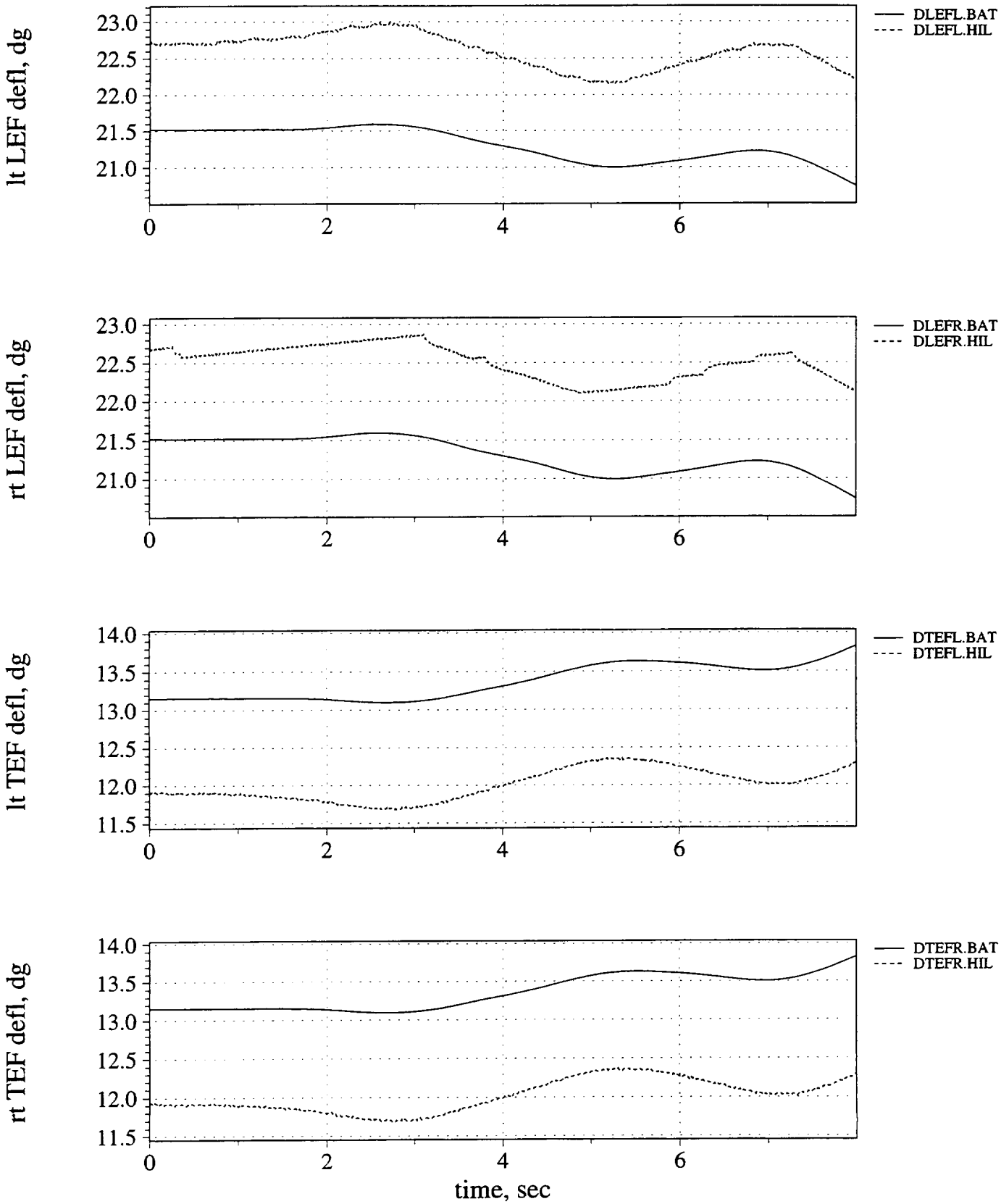
CASE_20__S_Mode__.35-25k_trim_AOA_2_in_ramp_dap page 2/12



Appendix B - Batch versus HIL Version 154.0

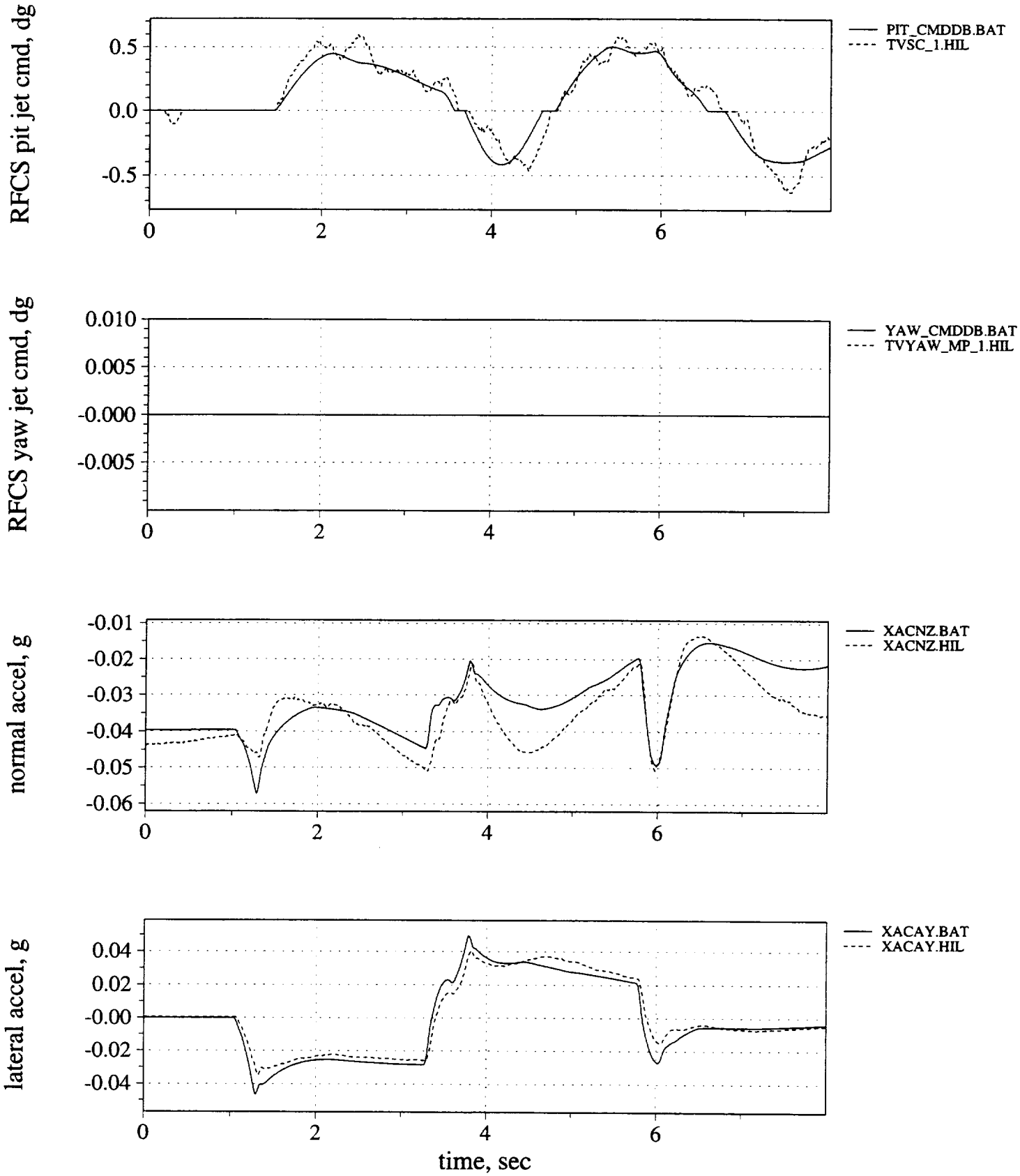
CASE_20__S_Mode__.35-25k_trim_AOA_2_in_ramp_dap page 3/12



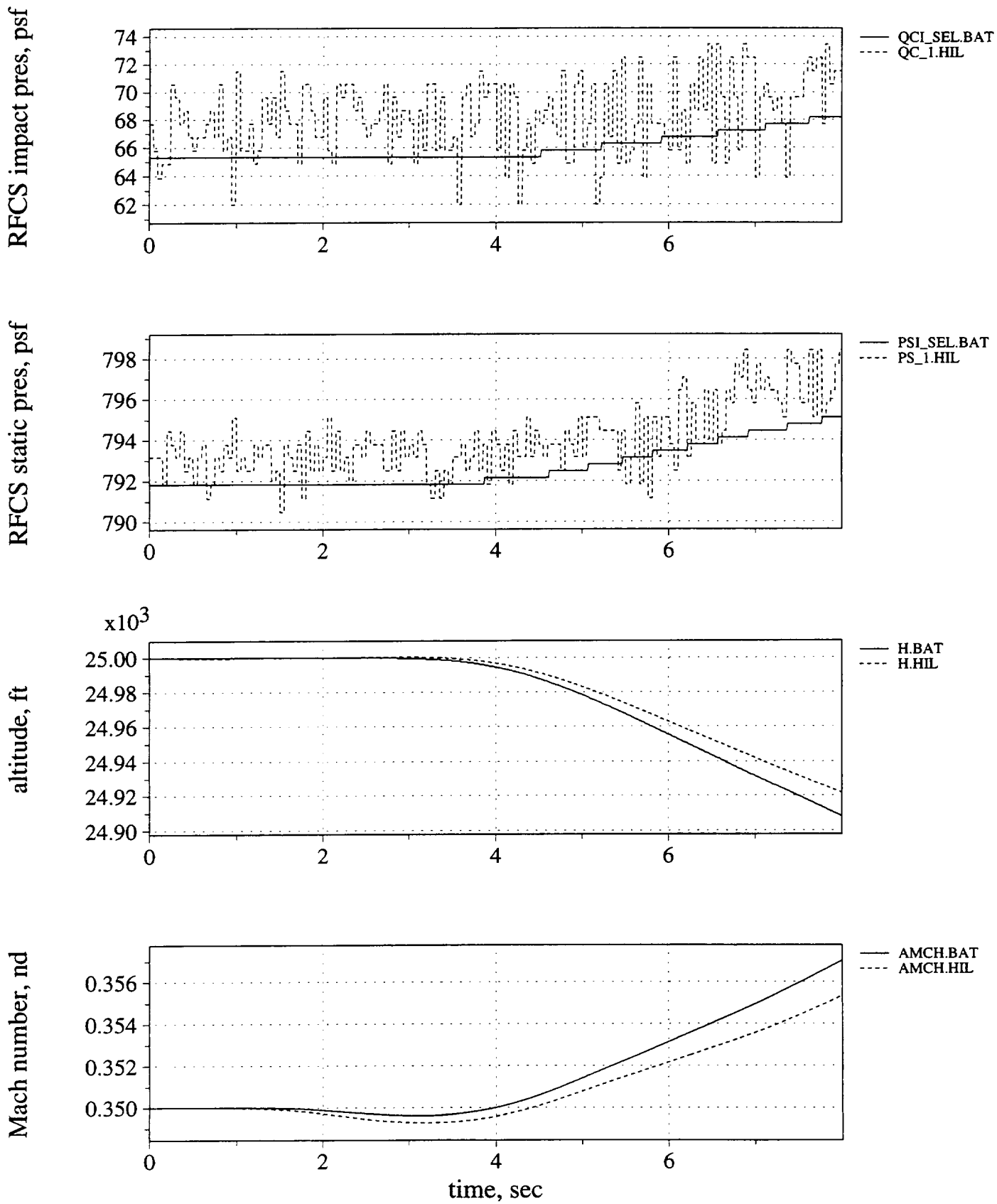

lt LEF defl, dg
23.0
22.5
22.0
21.5
21.0
0
2
4
6
DLEFL.BAT
DLEFL.HIL
rt LEF defl, dg
23.0
22.5
22.0
21.5
21.0
0
2
4
6
DLEFR.BAT
DLEFR.HIL
lt TEF defl, dg
14.0
13.5
13.0
12.5
12.0
11.5
0
2
4
6
DTEFL.BAT
DTEFL.HIL
rt TEF defl, dg
14.0
13.5
13.0
12.5
12.0
11.5
0
2
4
6
time, sec
DTEFR.BAT
DTEFR.HIL

Appendix B - Batch versus HIL Version 154.0

CASE_20__S_Mode__.35-25k_trim_AOA_2_in_ramp_dap page 5/12

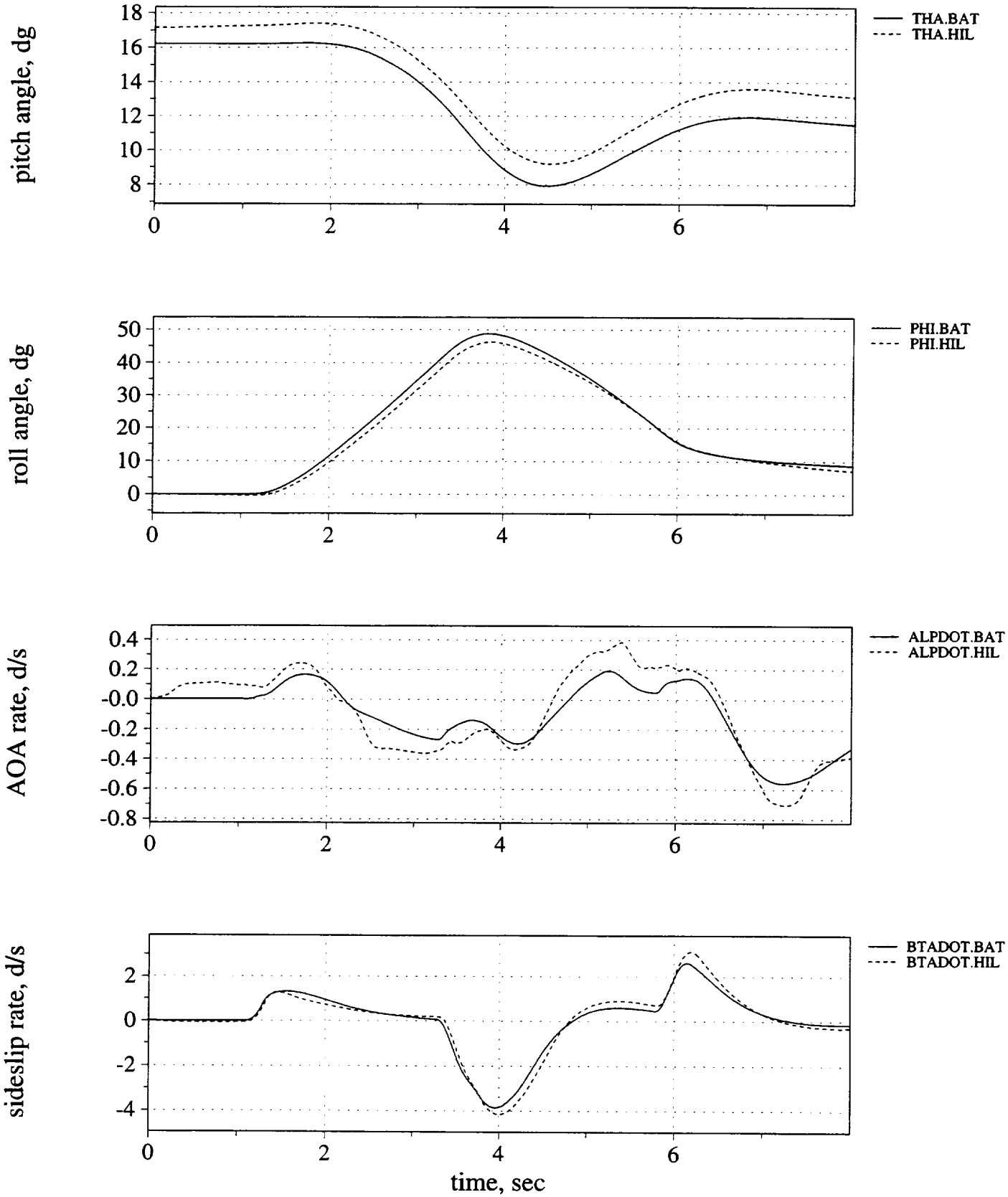


Performance Validation Checkcases

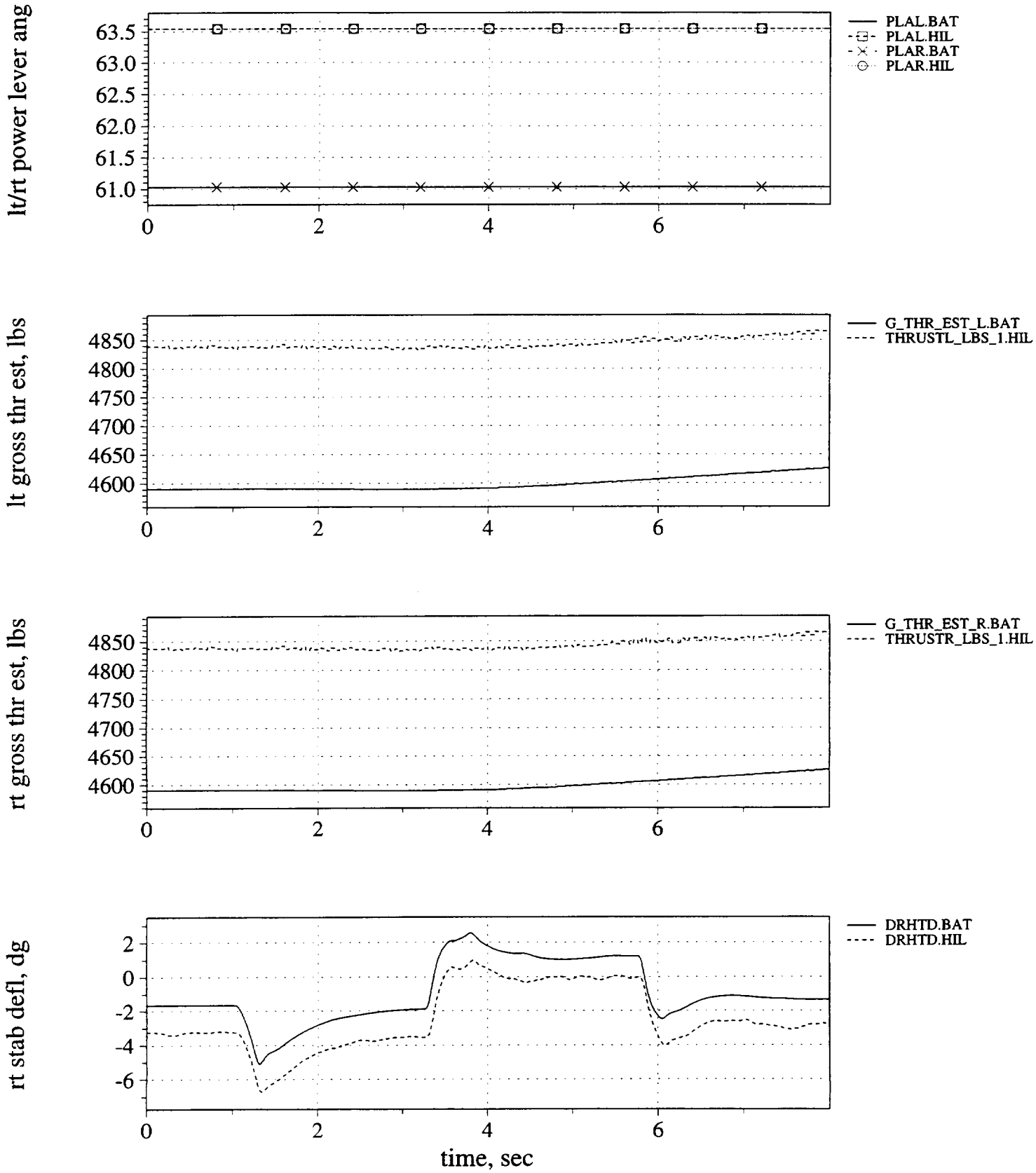

RFCS impact pres, psf
74
72
70
68
66
64
62
0
2
4
6
QCI_SEL.BAT
QC_1.HIL
RFCS static pres, psf
798
796
794
792
790
PSI_SEL.BAT
PS_1.HIL
altitude, ft
x10^3
25.00
24.98
24.96
24.94
24.92
24.90
H.BAT
H.HIL
Mach number, nd
0.356
0.354
0.352
0.350
AMCH.BAT
AMCH.HIL
time, sec

Appendix B - Batch versus HIL Version 154.0

CASE_20__S_Mode__.35-25k_trim_AOA_2_in_ramp_dap page 7/12

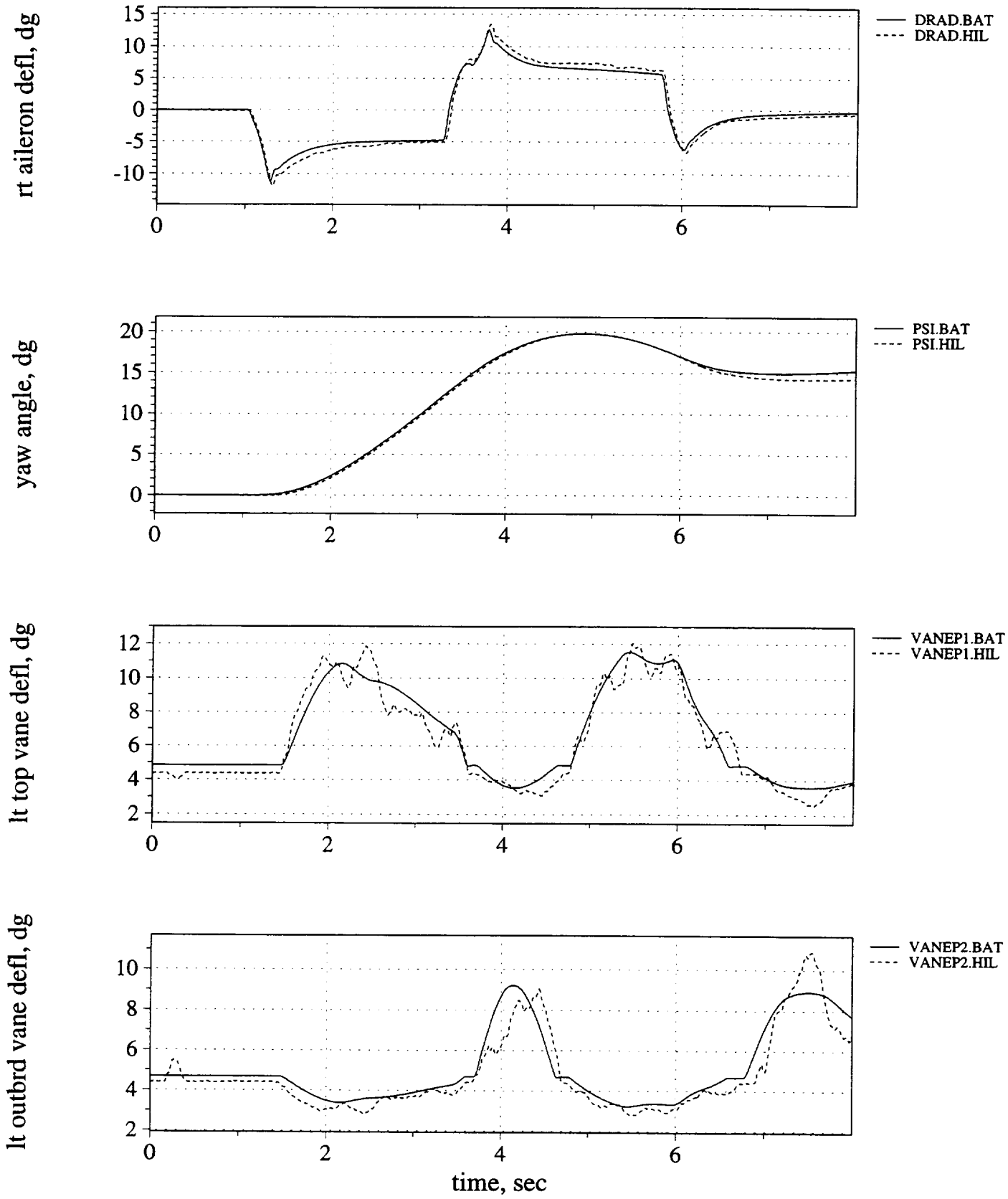


Performance Validation Checkcases


lt/rt power lever ang
63.5
63.0
62.5
62.0
61.5
61.0
0
2
4
6
PLAL.BAT
PLAL.HIL
PLAR.BAT
PLAR.HIL
lt gross thr est, lbs
4850
4800
4750
4700
4650
4600
G_THR_EST_L.BAT
THRUSTL_LBS_1.HIL
rt gross thr est, lbs
G_THR_EST_R.BAT
THRUSTR_LBS_1.HIL
rt stab defl, dg
2
0
-2
-4
-6
DRHTD.BAT
DRHTD.HIL
time, sec

Appendix B - Batch versus HIL Version 154.0

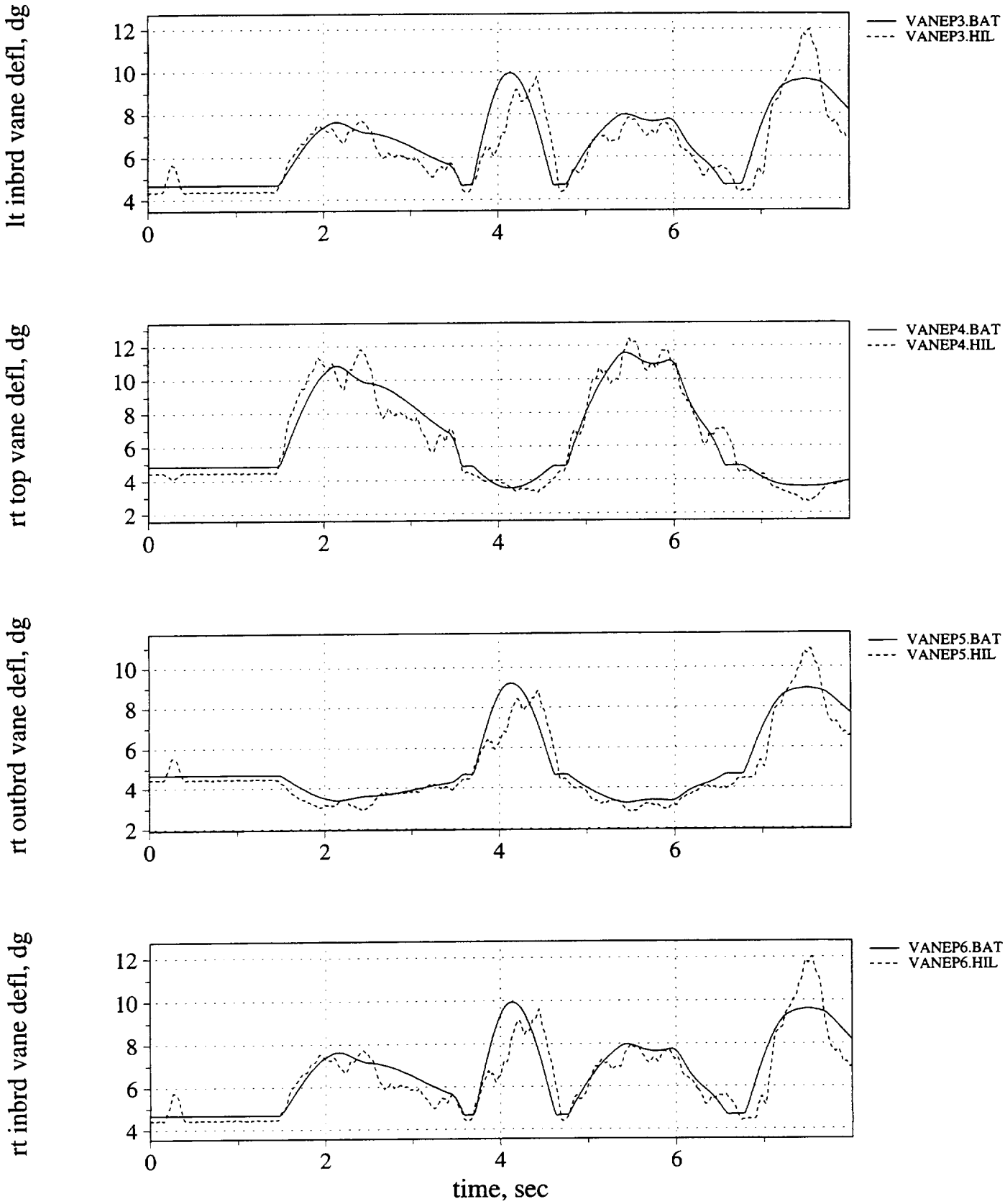
CASE_20__S_Mode__.35-25k_trim_AOA_2_in_ramp_dap page 9/12

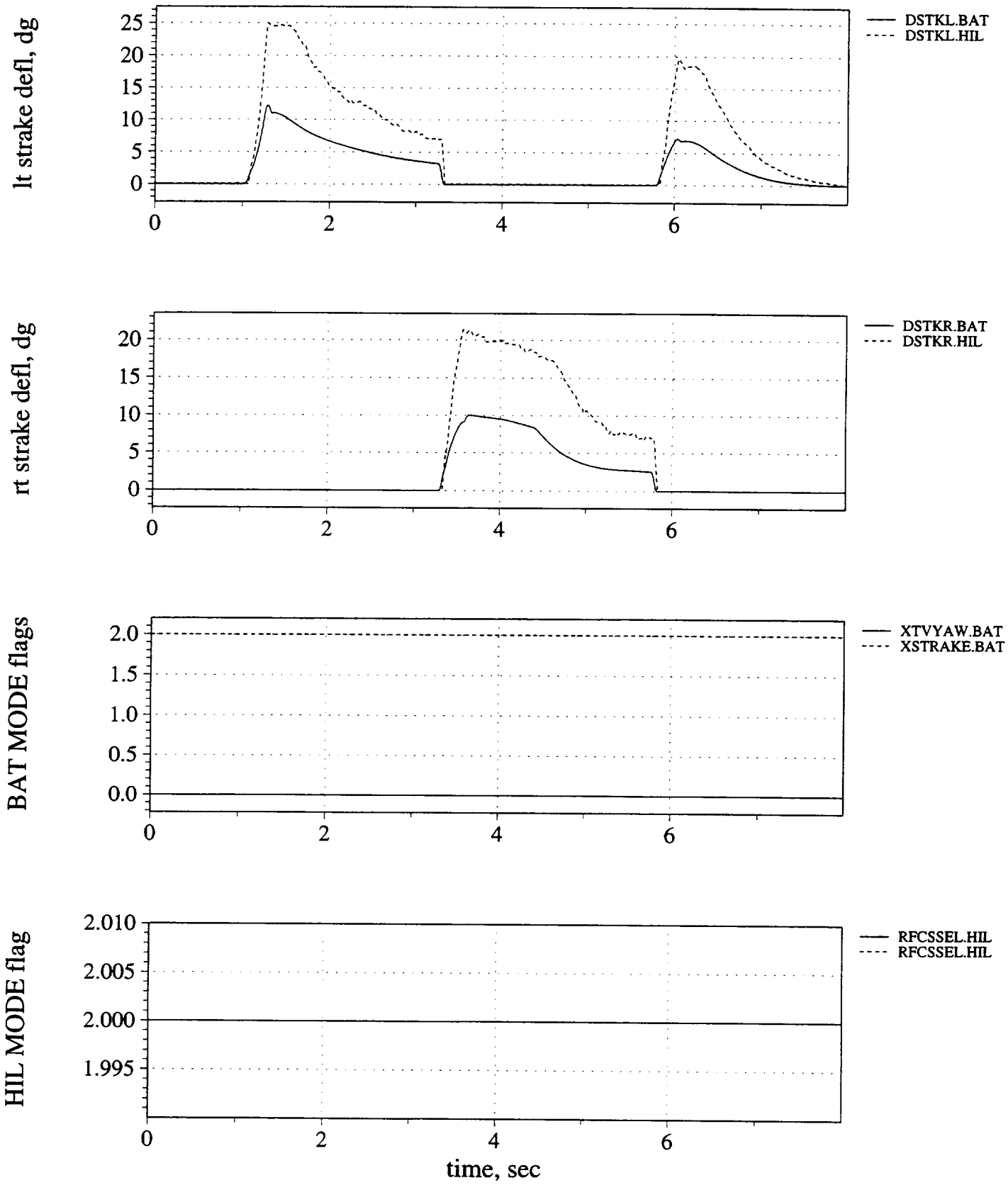


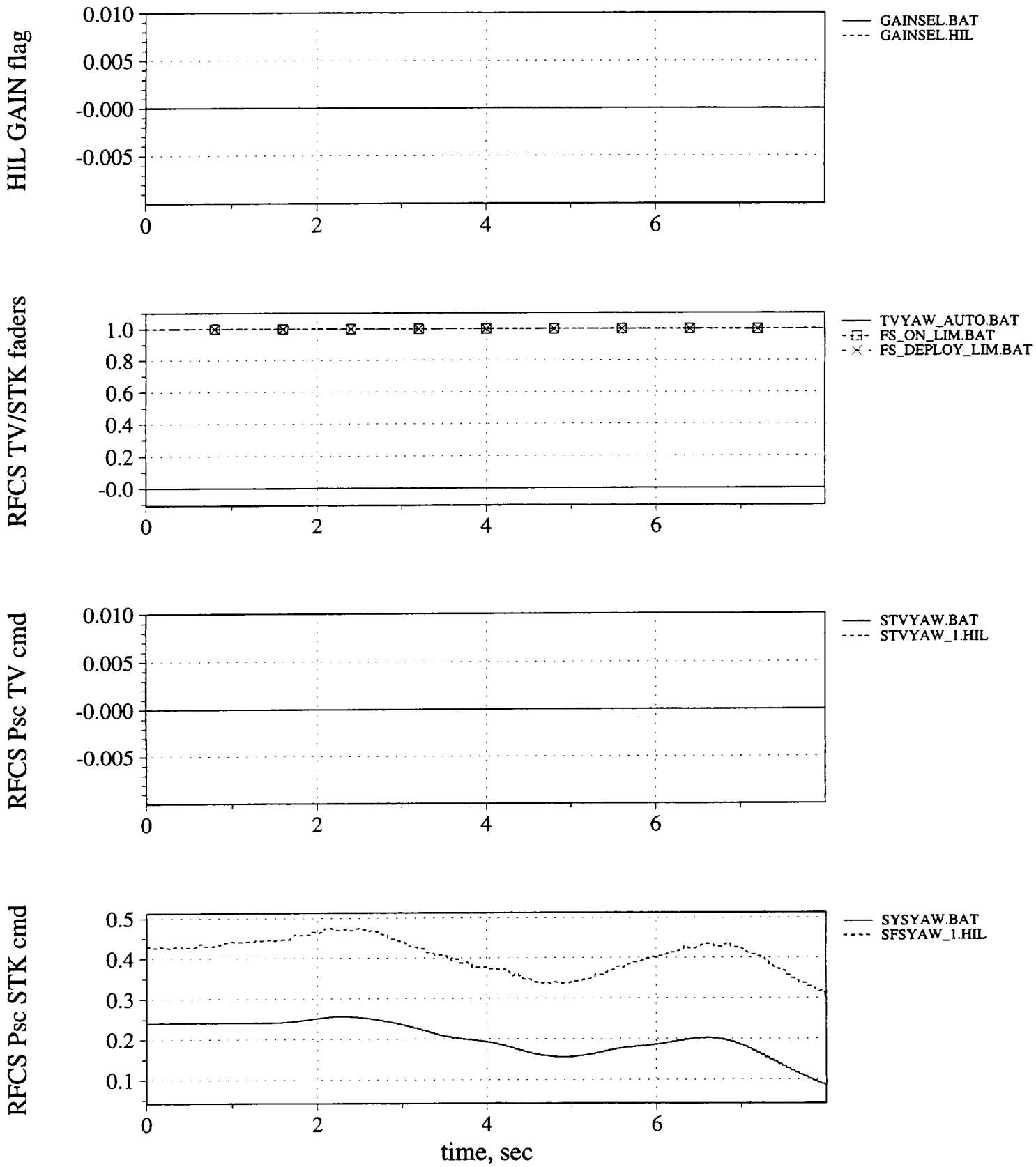
Performance Validation Checkcases

Appendix B - Batch versus HIL Version 154.0

CASE_20__S_Mode__.35-25k_trim_AOA_2_in_ramp_dap page 10/12

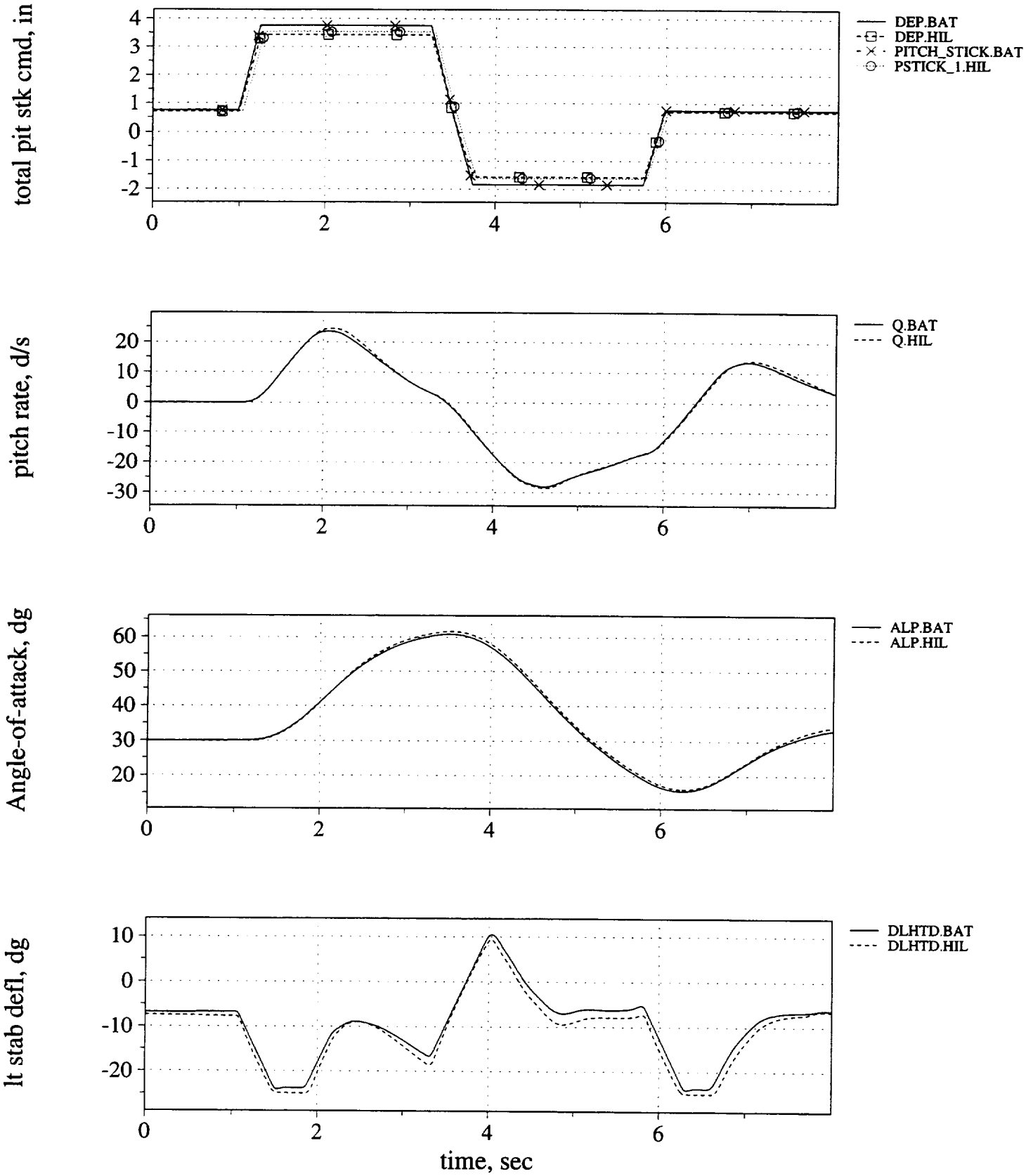



lt strake defl, dg
25
20
15
10
5
0
0
2
4
6
DSTKL.BAT
DSTKL.HIL
rt strake defl, dg
20
15
10
5
0
0
2
4
6
DSTKR.BAT
DSTKR.HIL
BAT MODE flags
2.0
1.5
1.0
0.5
0.0
0
2
4
6
XTVYAW.BAT
XSTRAKE.BAT
HIL MODE flag
2.010
2.005
2.000
1.995
0
2
4
6
time, sec
RFCSSEL.HIL
RFCSSEL.HIL


HIL GAIN flag
0.010
0.005
-0.000
-0.005
0
2
4
6
GAINSEL.BAT
GAINSEL.HIL
RFCS TV/STK faders
1.0
0.8
0.6
0.4
0.2
-0.0
TVYAW_AUTO.BAT
FS_ON_LIM.BAT
FS_DEPLOY_LIM.BAT
RFCS Psc TV cmd
STVYAW.BAT
STVYAW_1.HIL
RFCS Psc STK cmd
0.5
0.4
0.3
0.2
0.1
SYSYAW.BAT
SFSYAW_1.HIL
time, sec

Appendix B - Batch versus HIL Version 154.0

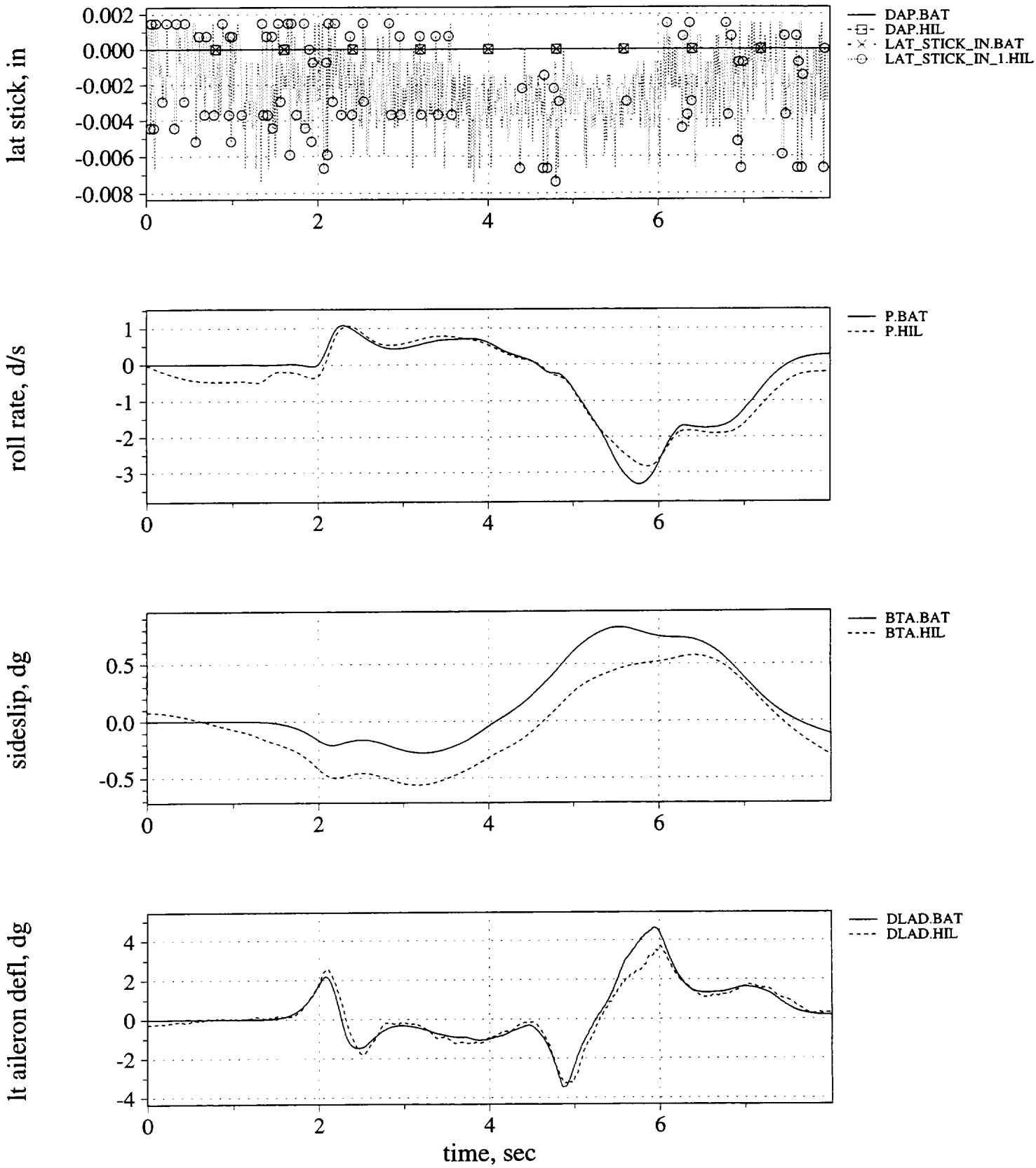
CASE_22__S_Mode__30alp-35k_Max_AB_2_in_ramp_dep page 1/12



Performance Validation Checkcases

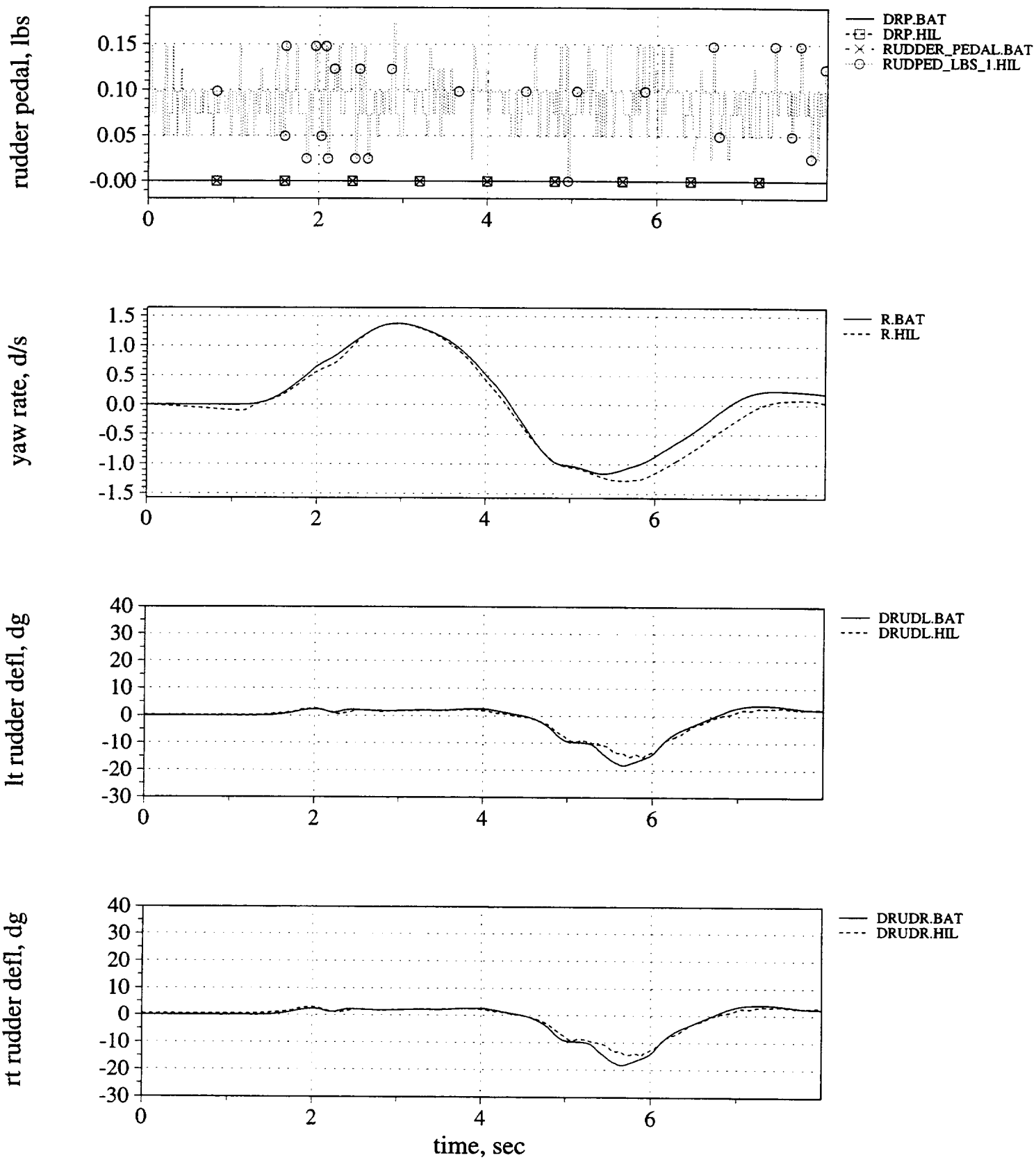
Appendix B - Batch versus HIL Version 154.0

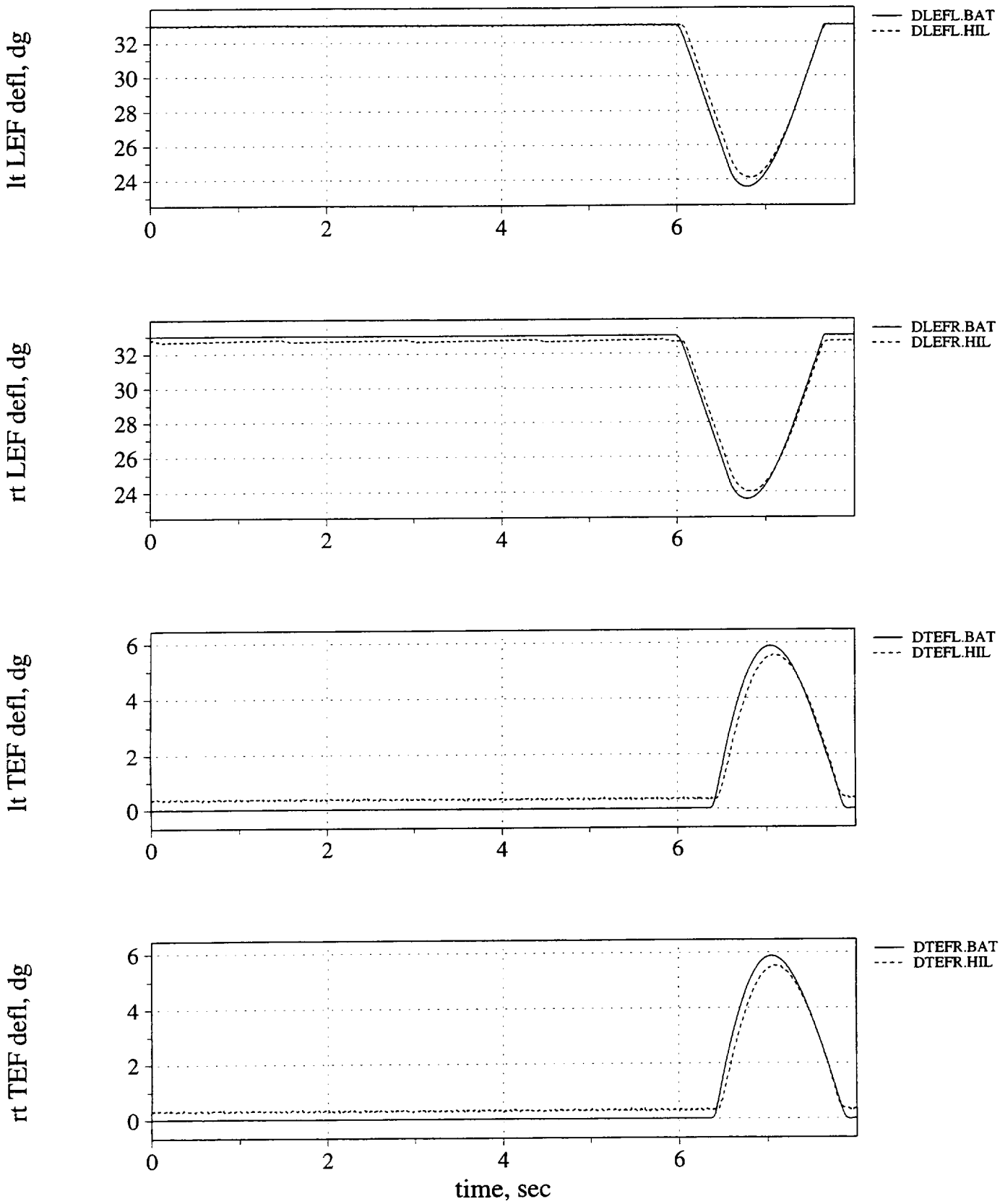
CASE_22__S_Mode__30alp-35k_Max_AB_2_in_ramp_dep page 2/12



Appendix B - Batch versus HIL Version 154.0

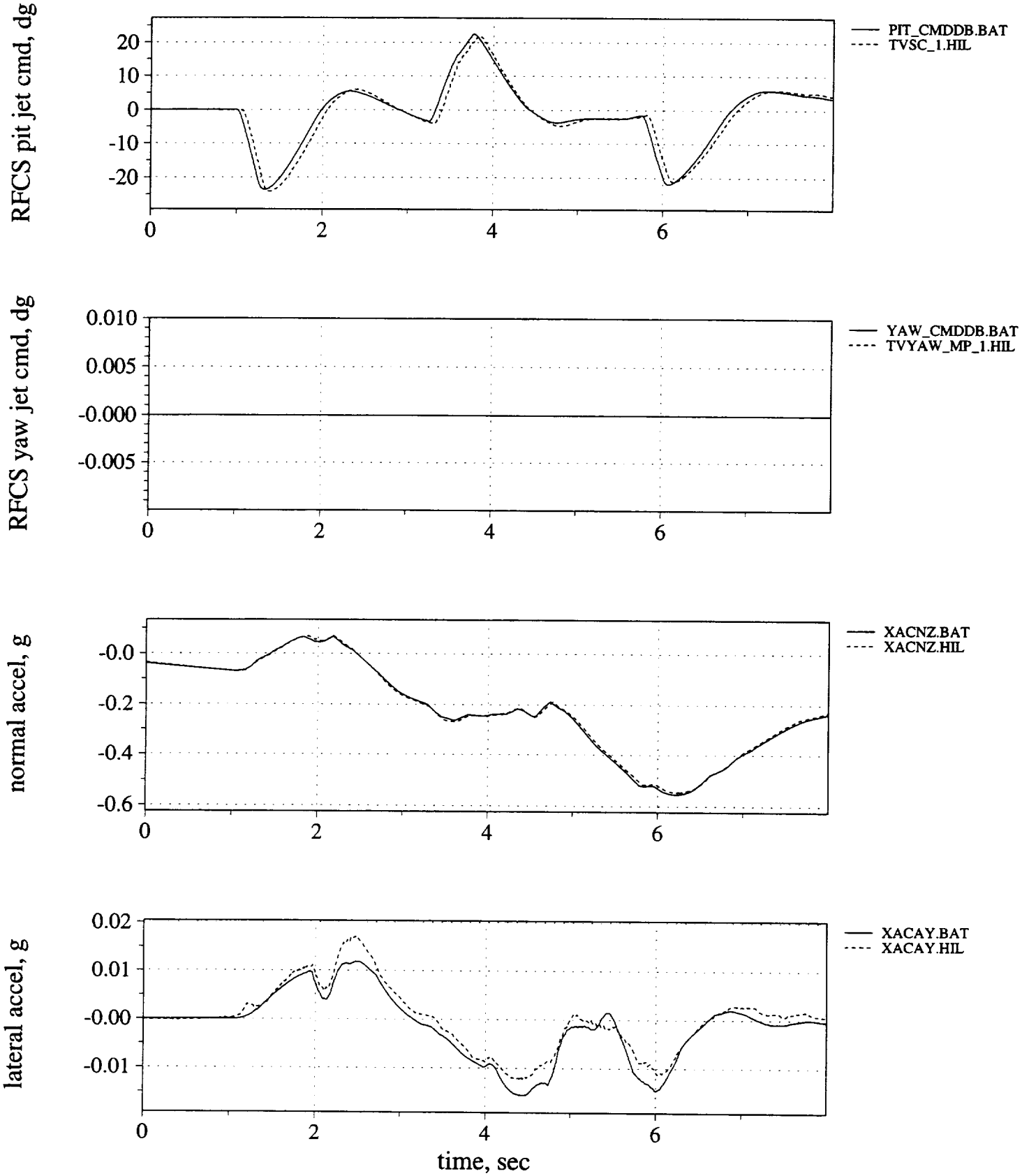
CASE_22__S_Mode__30alp-35k_Max_AB_2_in_ramp_dep page 3/12




lt LEF defl, dg
32
30
28
26
24
0
2
4
6
DLEFL.BAT
DLEFL.HIL
rt LEF defl, dg
DLEFR.BAT
DLEFR.HIL
lt TEF defl, dg
6
4
2
0
DTEFL.BAT
DTEFL.HIL
rt TEF defl, dg
DTEFR.BAT
DTEFR.HIL
time, sec

Appendix B - Batch versus HIL Version 154.0

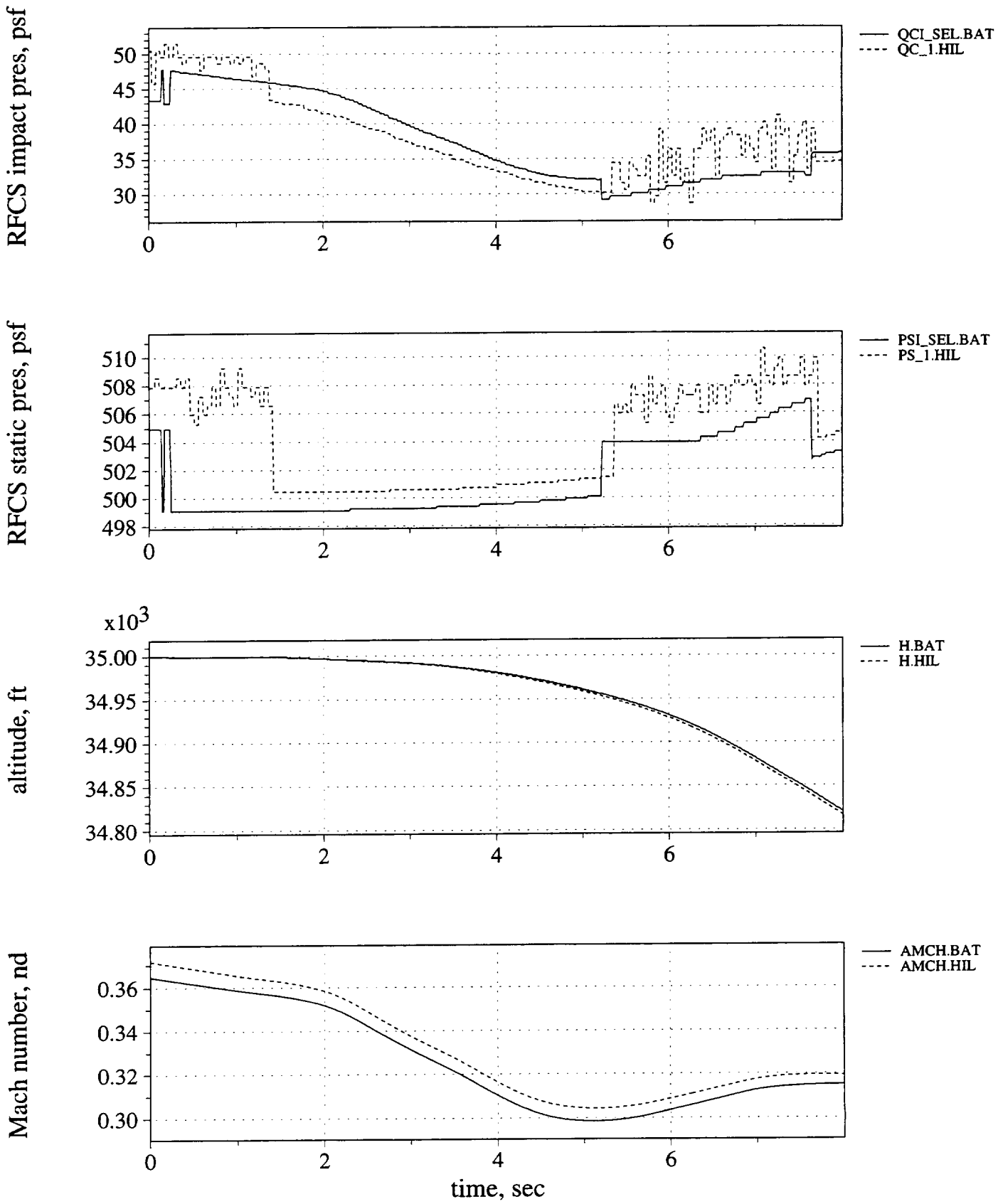
CASE_22__S_Mode__30alp-35k_Max_AB_2_in_ramp_dep page 5/12



Performance Validation Checkcases

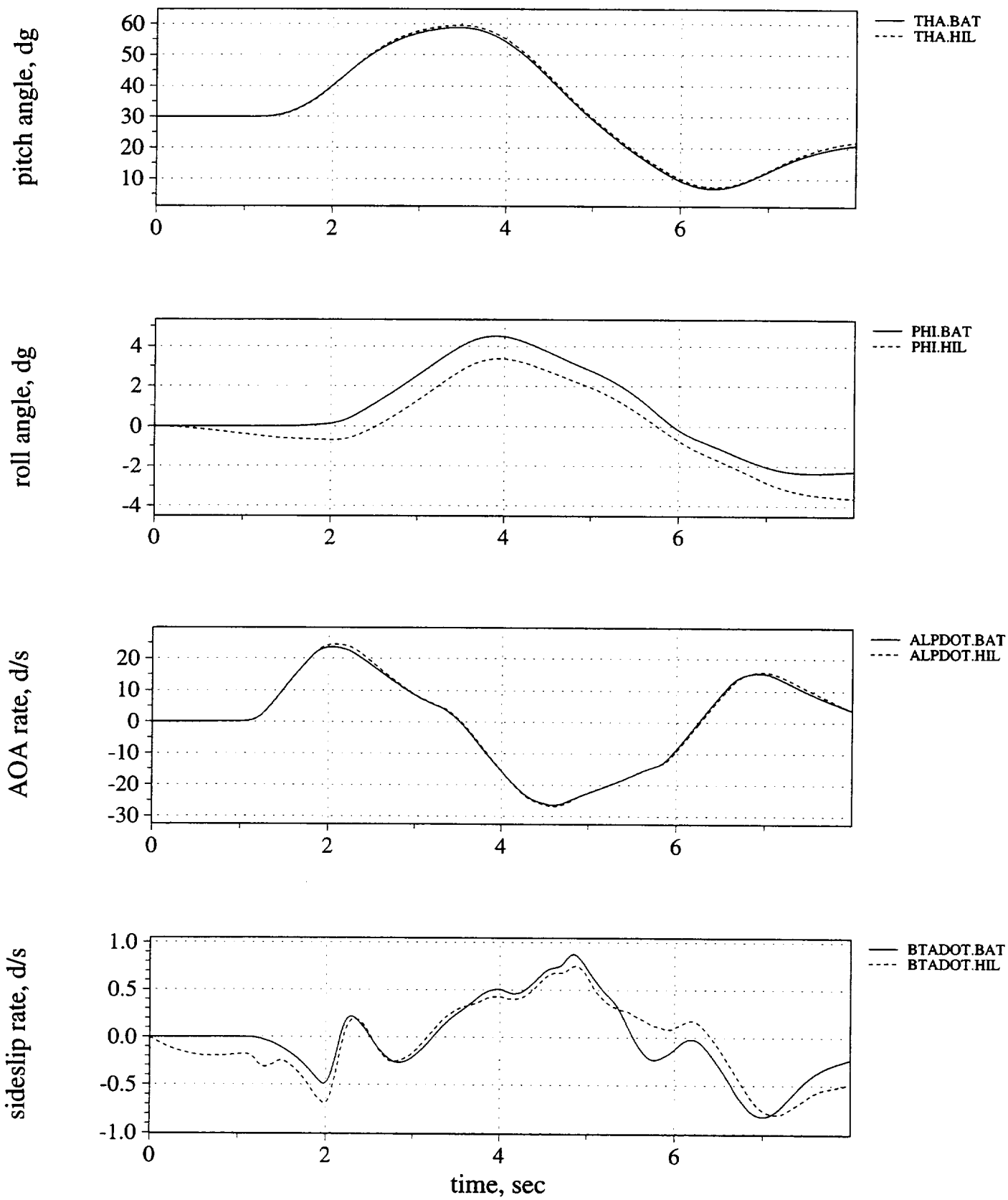
Appendix B - Batch versus HIL Version 154.0

CASE_22__S_Mode__30alp-35k_Max_AB_2_in_ramp_dep page 6/12



Appendix B - Batch versus HIL Version 154.0

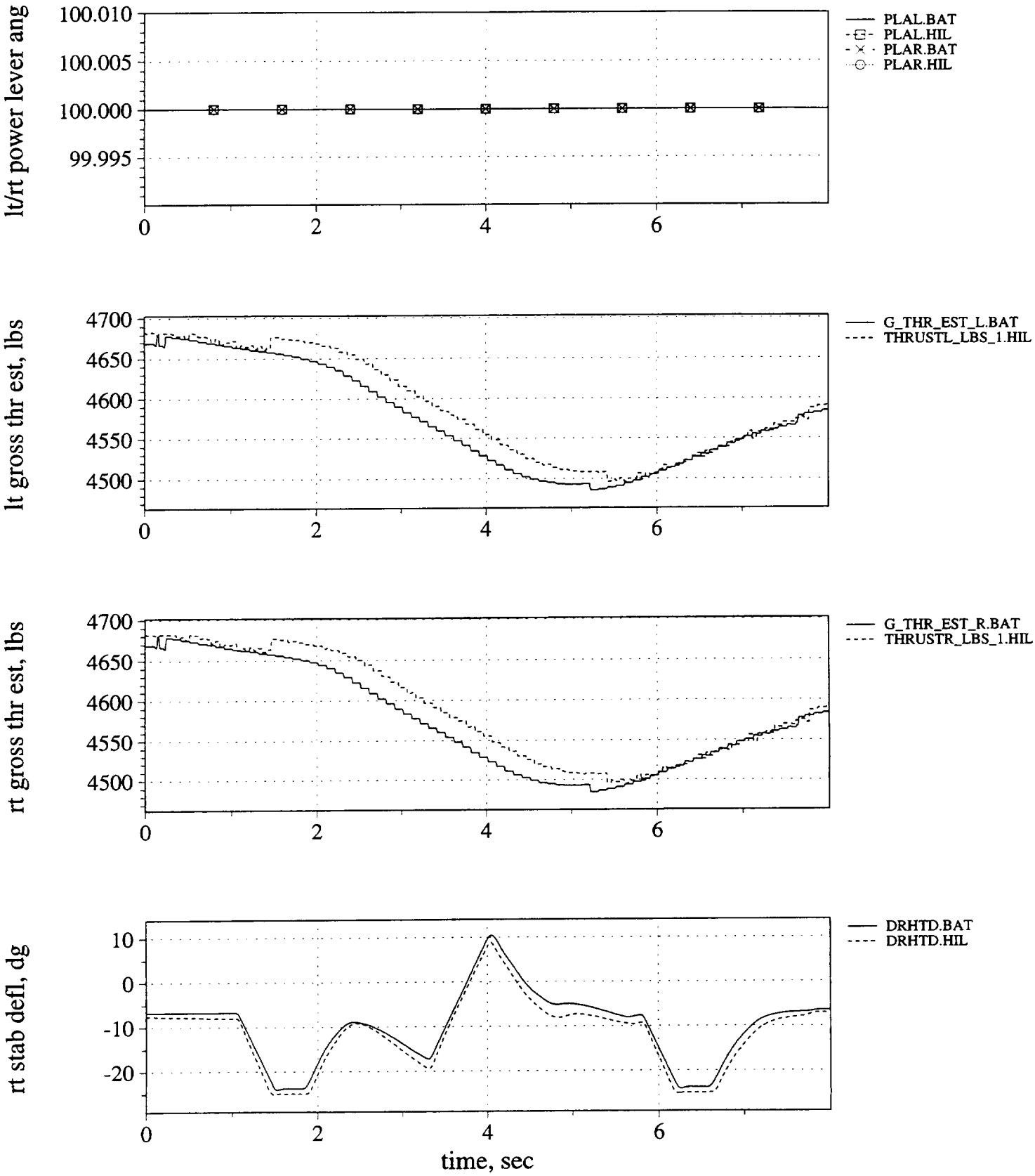
CASE_22__S_Mode__30alp-35k_Max_AB_2_in_ramp_dep page 7/12

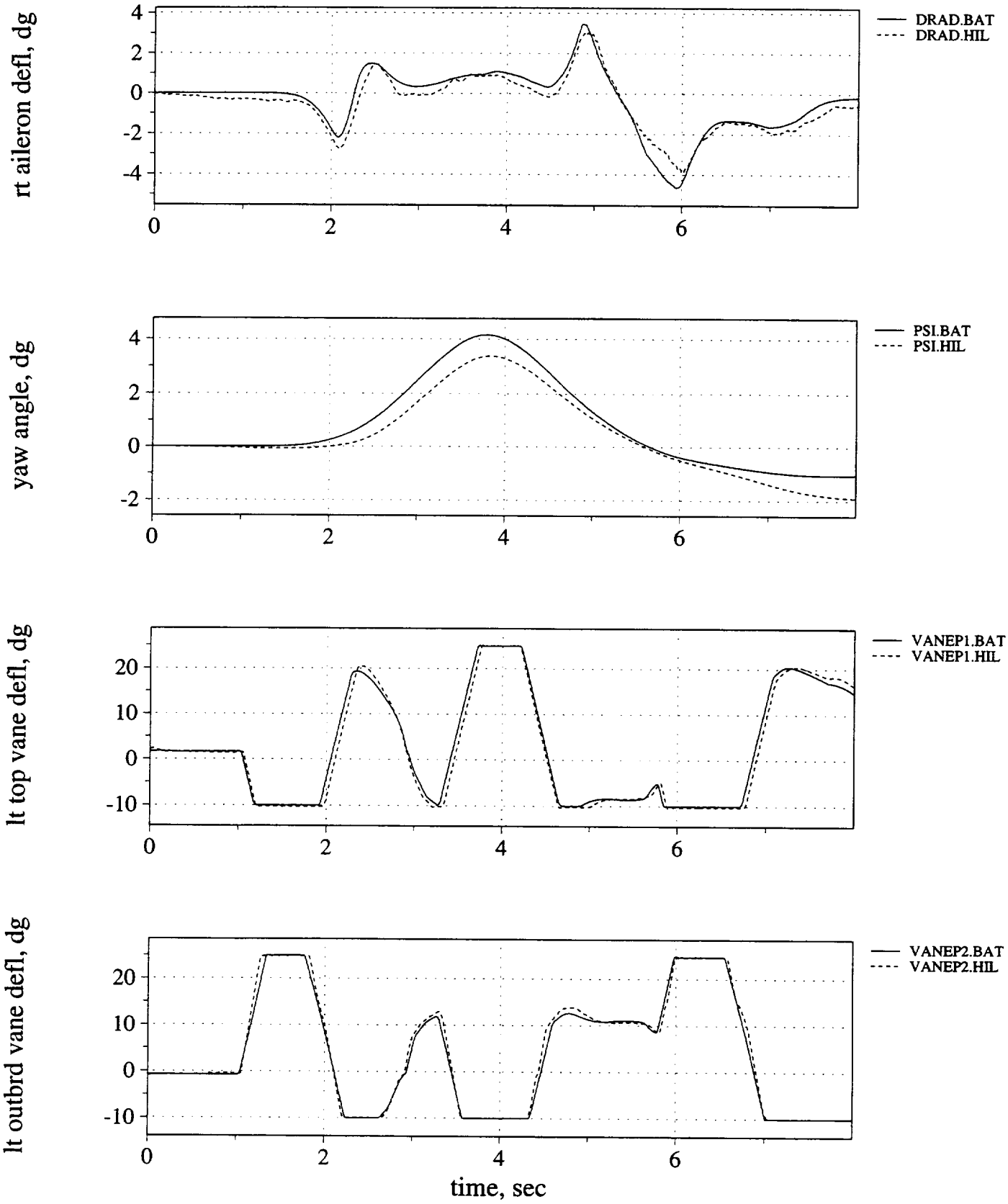


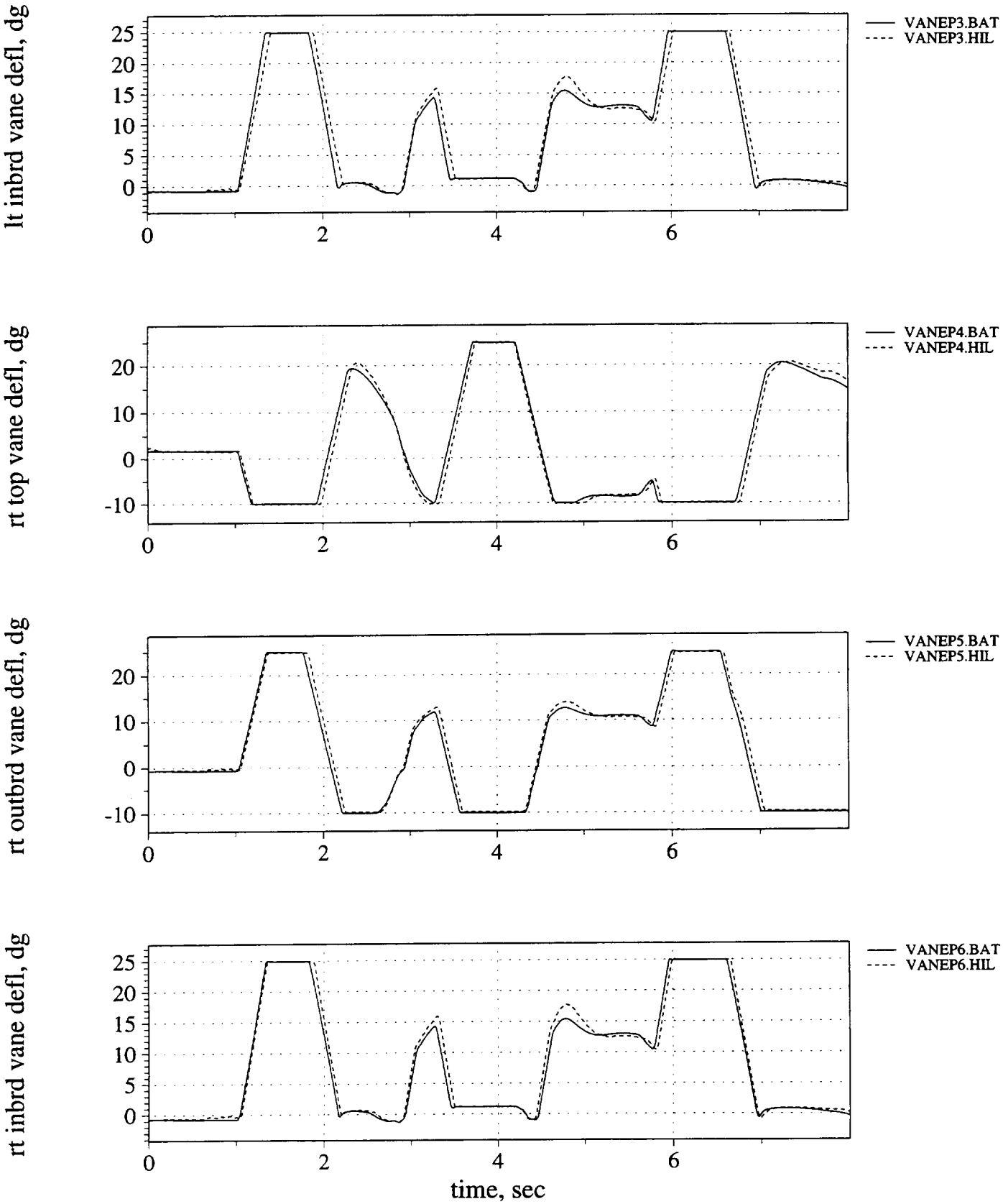
Performance Validation Checkcases

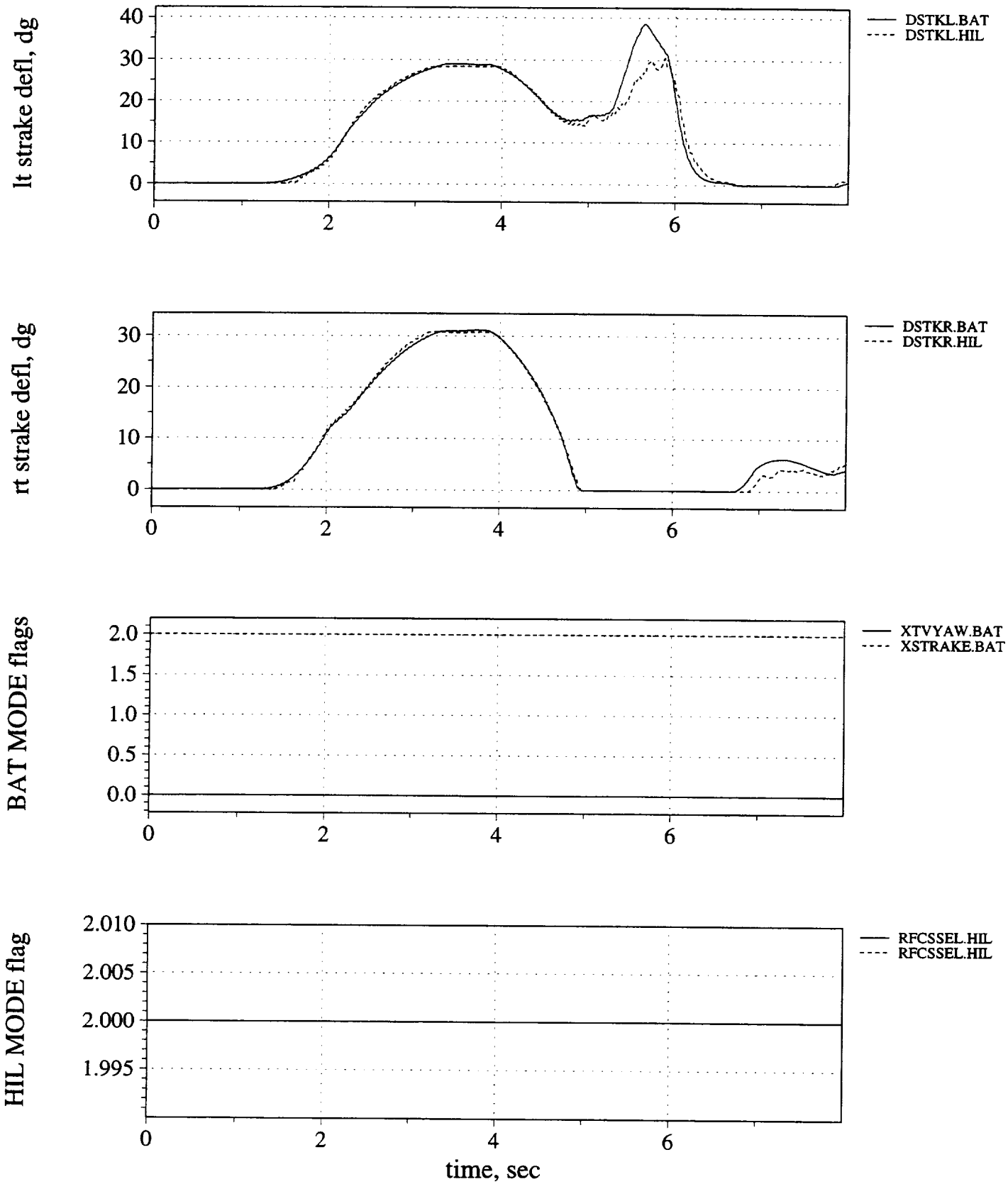
Appendix B - Batch versus HIL Version 154.0

CASE_22__S_Mode__30alp-35k_Max_AB_2_in_ramp_dep page 8/12



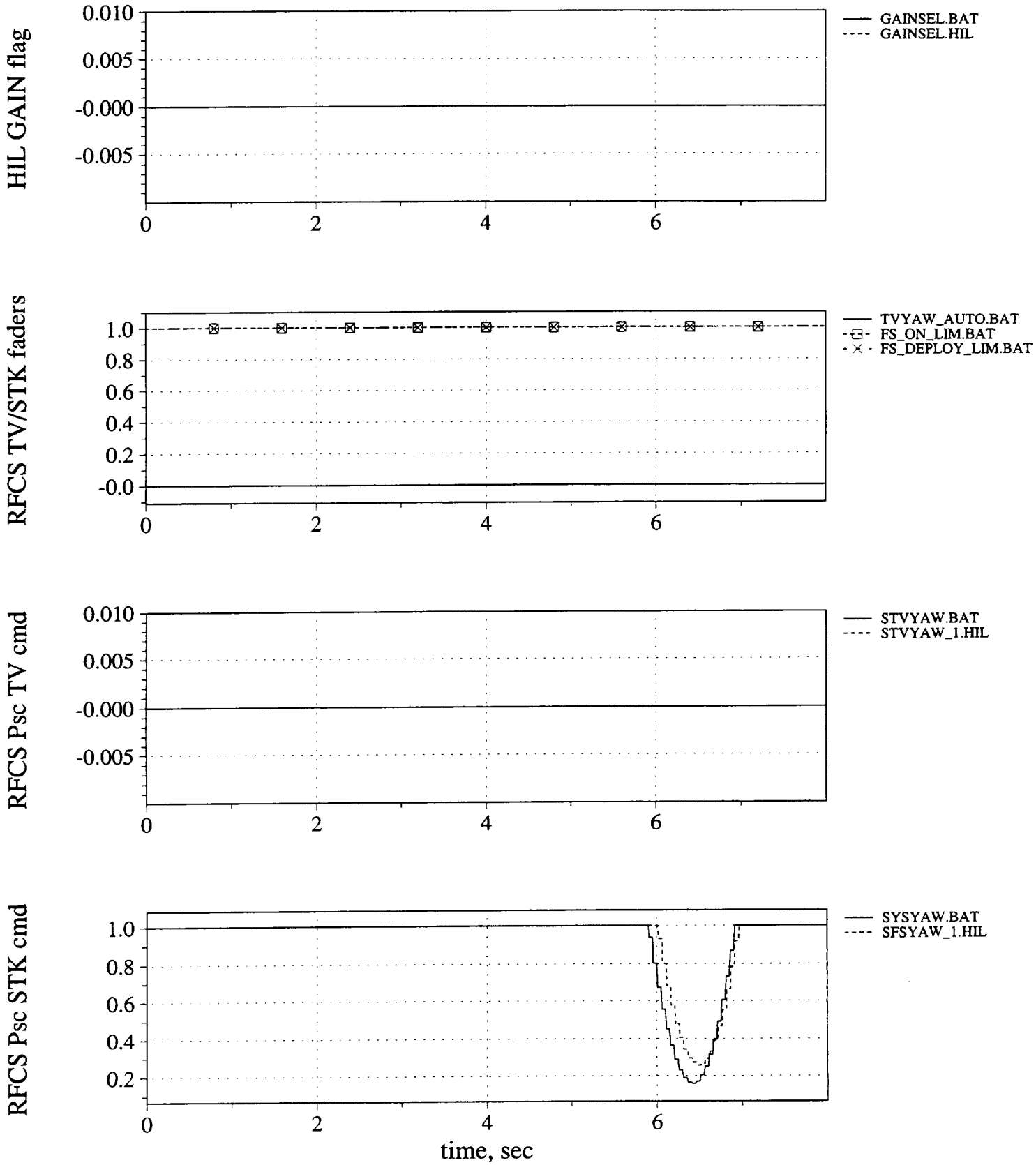

rt aileron defl, dg
DRAD.BAT
DRAD.HIL
yaw angle, dg
PSI.BAT
PSI.HIL
lt top vane defl, dg
VANEP1.BAT
VANEP1.HIL
lt outbrd vane defl, dg
VANEP2.BAT
VANEP2.HIL
time, sec


lt inbrd vane defl, dg
VANEP3.BAT
VANEP3.HIL
rt top vane defl, dg
VANEP4.BAT
VANEP4.HIL
rt outbrd vane defl, dg
VANEP5.BAT
VANEP5.HIL
rt inbrd vane defl, dg
VANEP6.BAT
VANEP6.HIL
time, sec


lt strake defl, dg
40
30
20
10
0
0
2
4
6
DSTKL.BAT
DSTKL.HIL
rt strake defl, dg
30
20
10
0
0
2
4
6
DSTKR.BAT
DSTKR.HIL
BAT MODE flags
2.0
1.5
1.0
0.5
0.0
0
2
4
6
XTVYAW.BAT
XSTRAKE.BAT
HIL MODE flag
2.010
2.005
2.000
1.995
0
2
4
6
RFCSSEL.HIL
RFCSSEL.HIL
time, sec

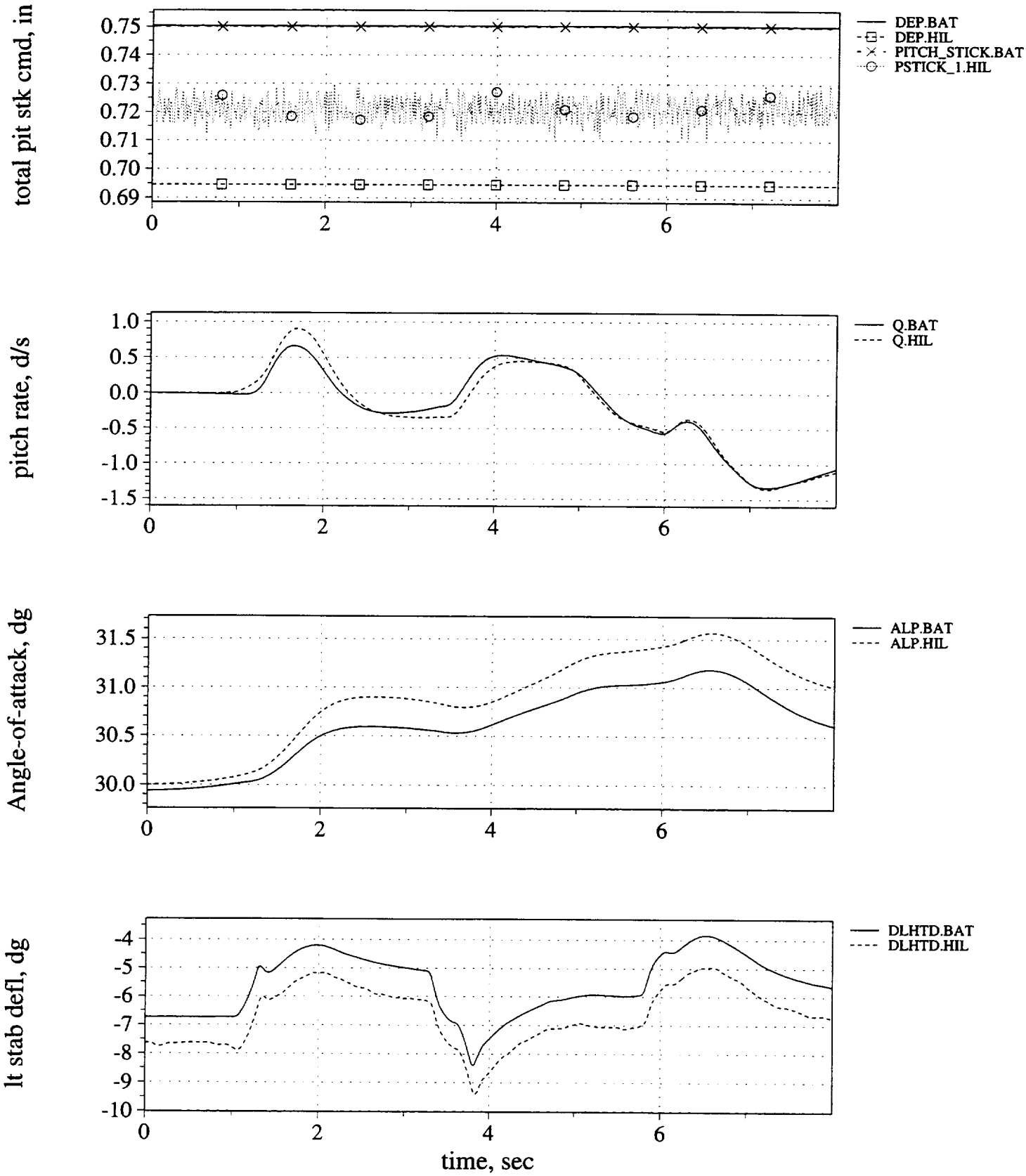
Appendix B - Batch versus HIL Version 154.0

CASE_22__S_Mode__30alp-35k_Max_AB_2_in_ramp_dep page 12/12



Appendix B - Batch versus HIL Version 154.0

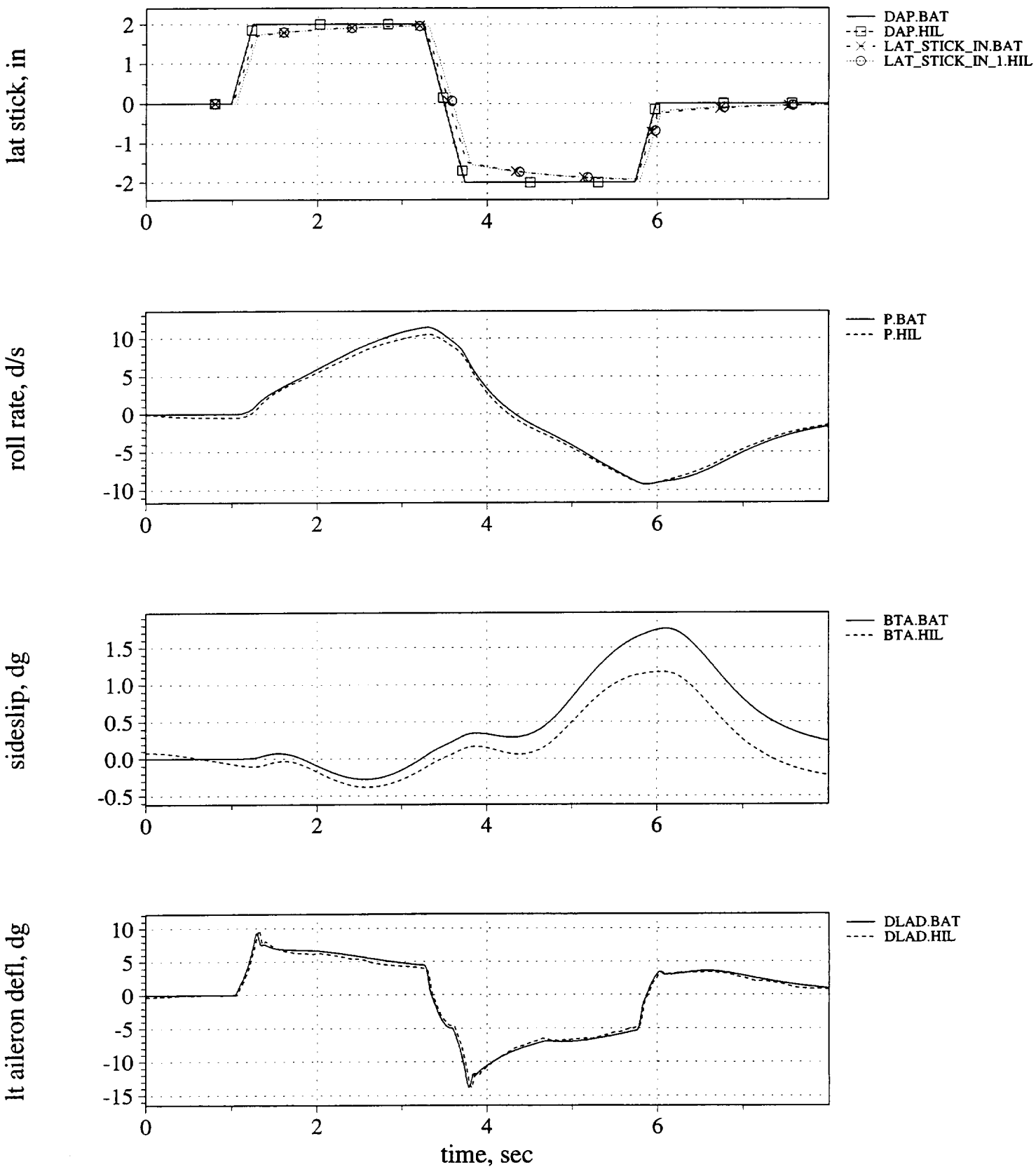
CASE_23__S_Mode__30alp-35k_Max_AB_2_in_ramp_dap page 1/12



Performance Validation Checkcases

Appendix B - Batch versus HIL Version 154.0

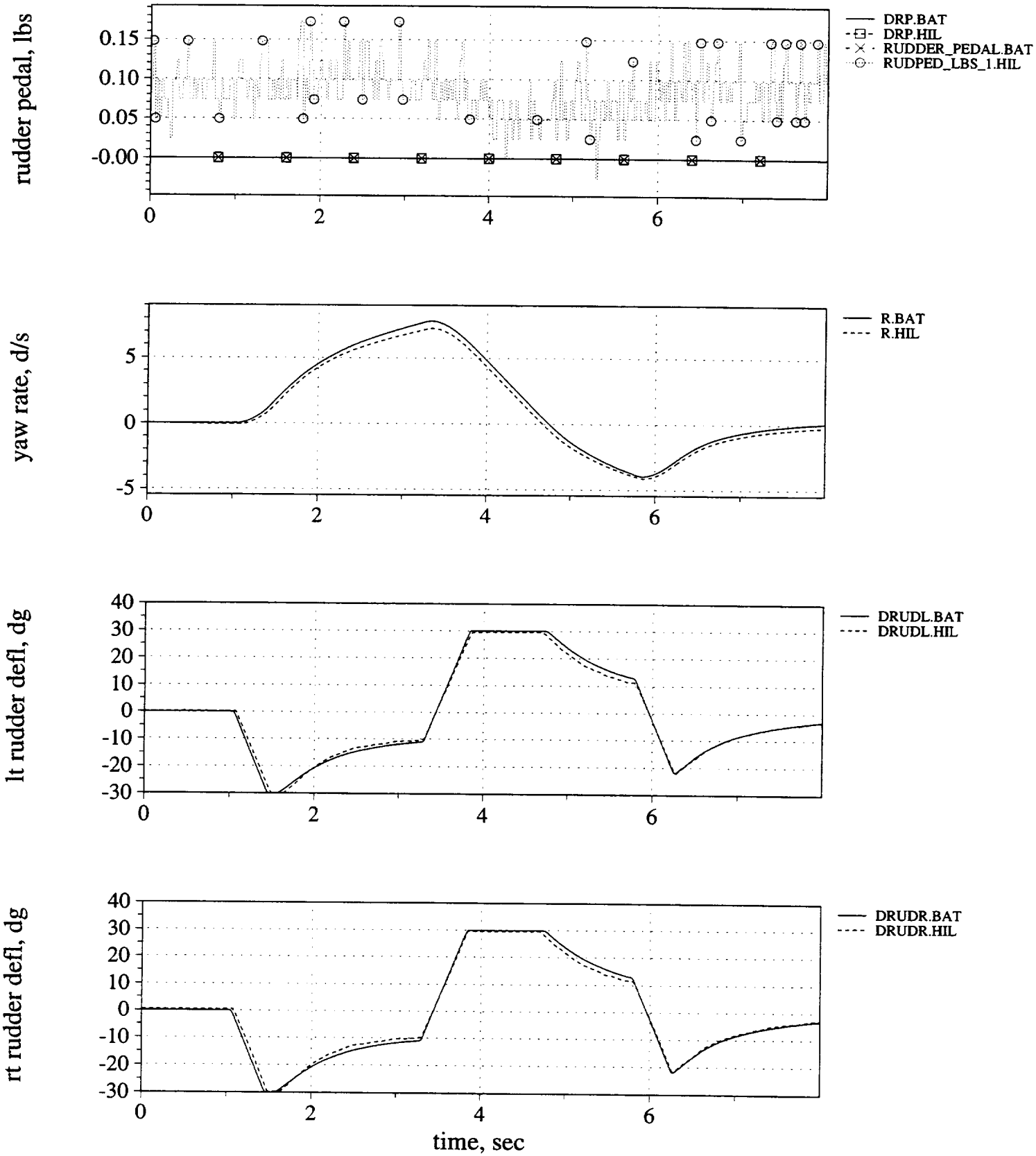
CASE_23__S_Mode__30alp-35k_Max_AB_2_in_ramp_dap page 2/12



Performance Validation Checkcases

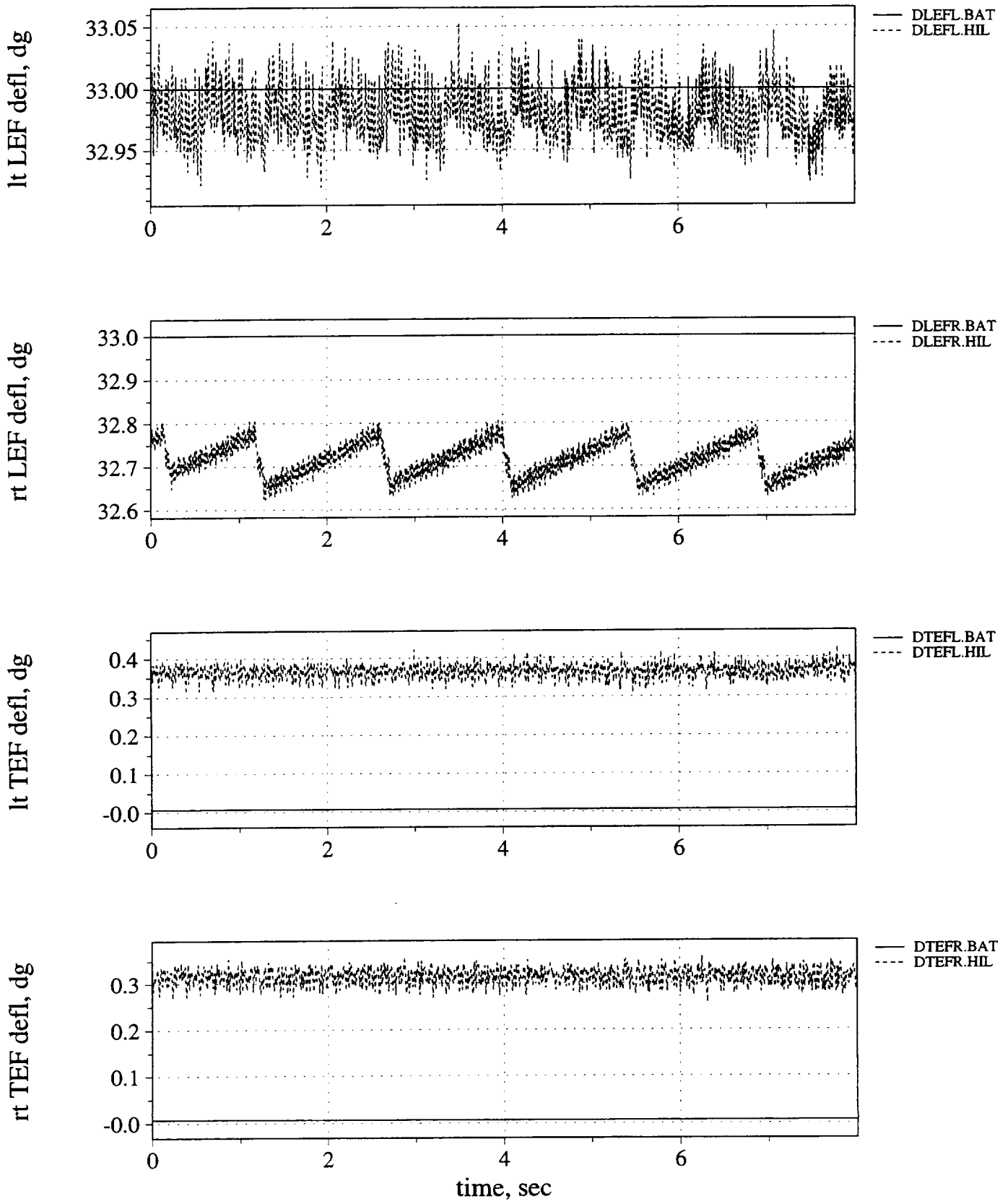
Appendix B - Batch versus HIL Version 154.0

CASE_23__S_Mode__30alp-35k_Max_AB_2_in_ramp_dap page 3/12



Appendix B - Batch versus HIL Version 154.0

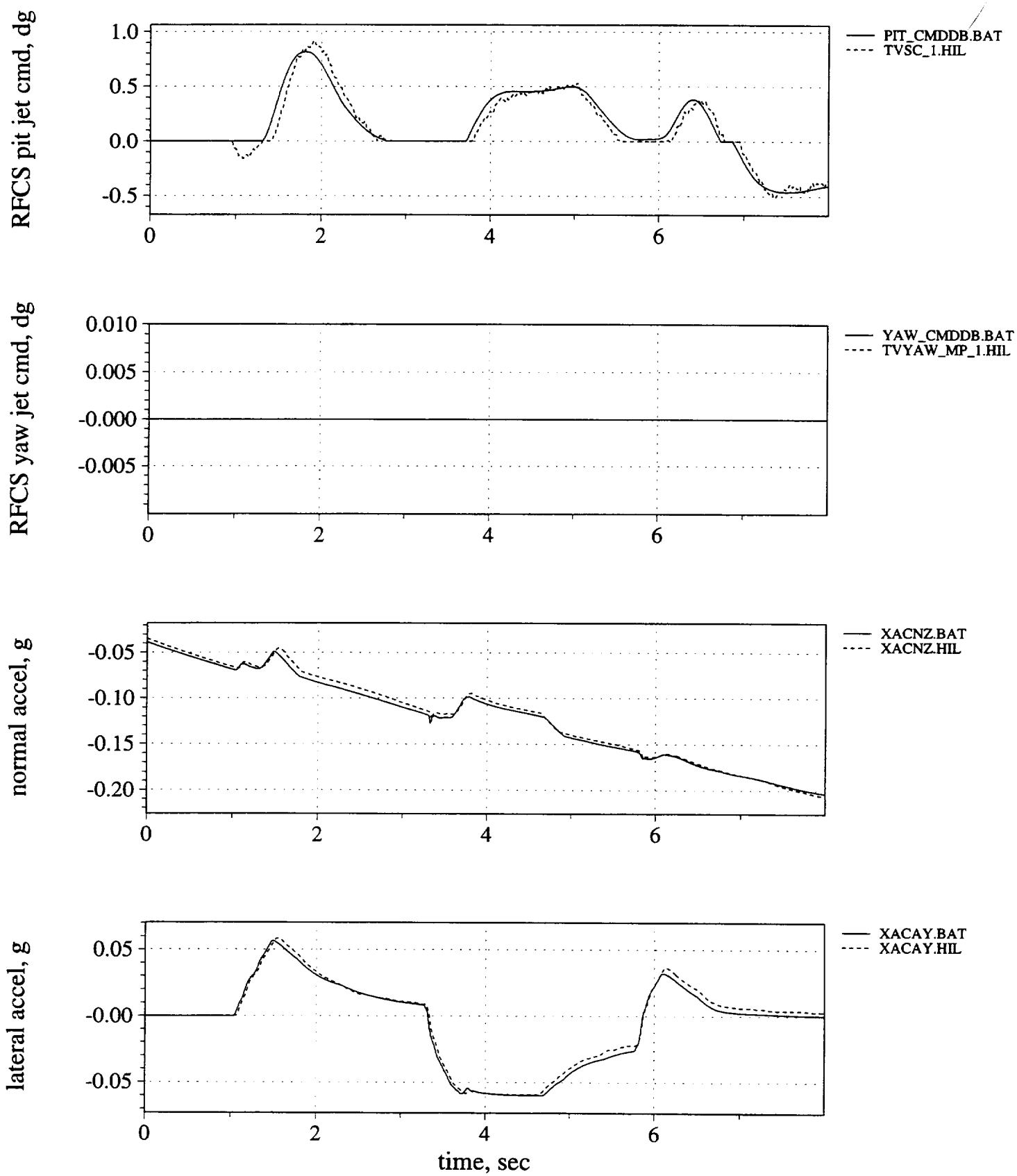
CASE_23__S_Mode__30alp-35k_Max_AB_2_in_ramp_dap page 4/12



Performance Validation Checkcases

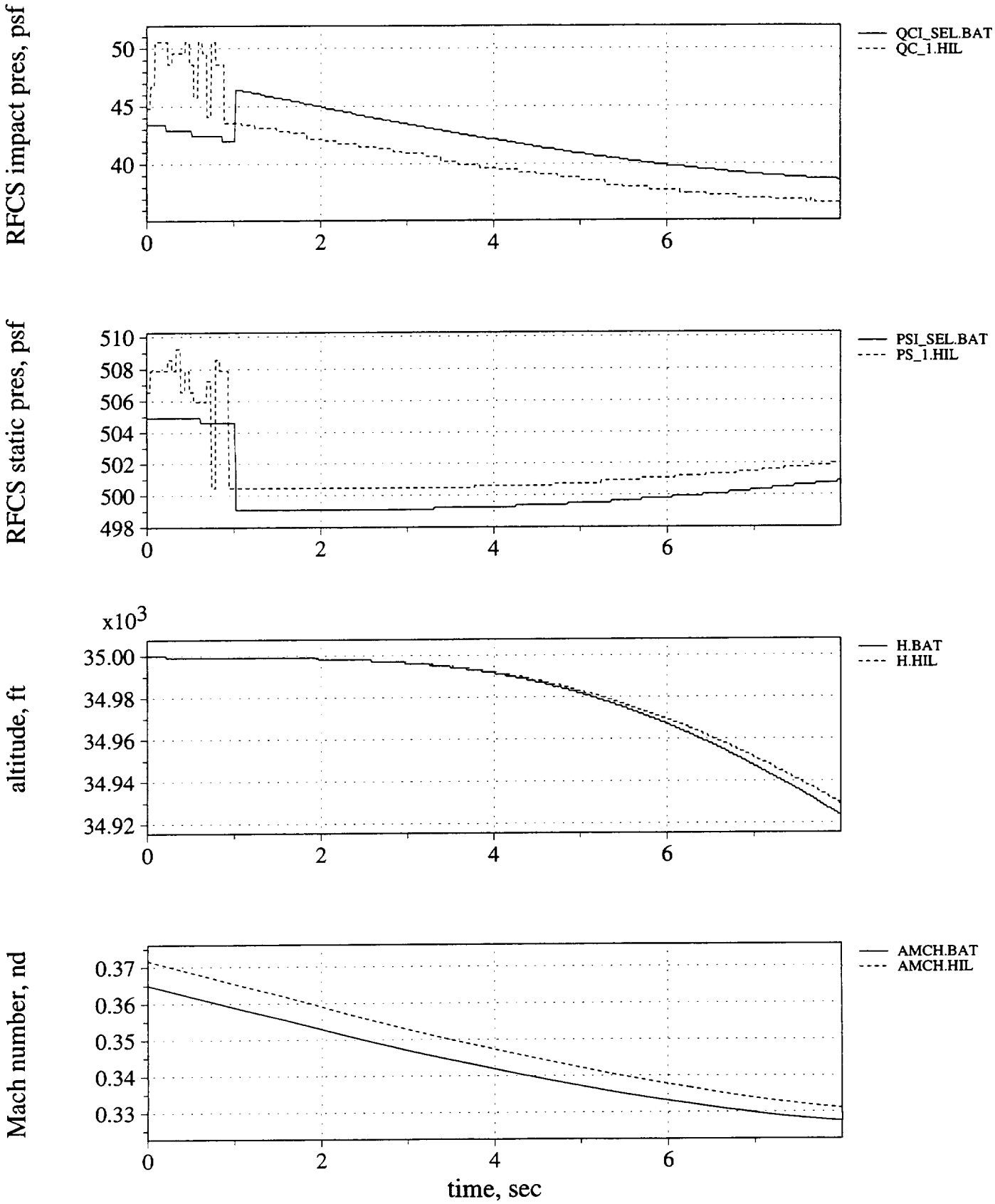
Appendix B - Batch versus HIL Version 154.0

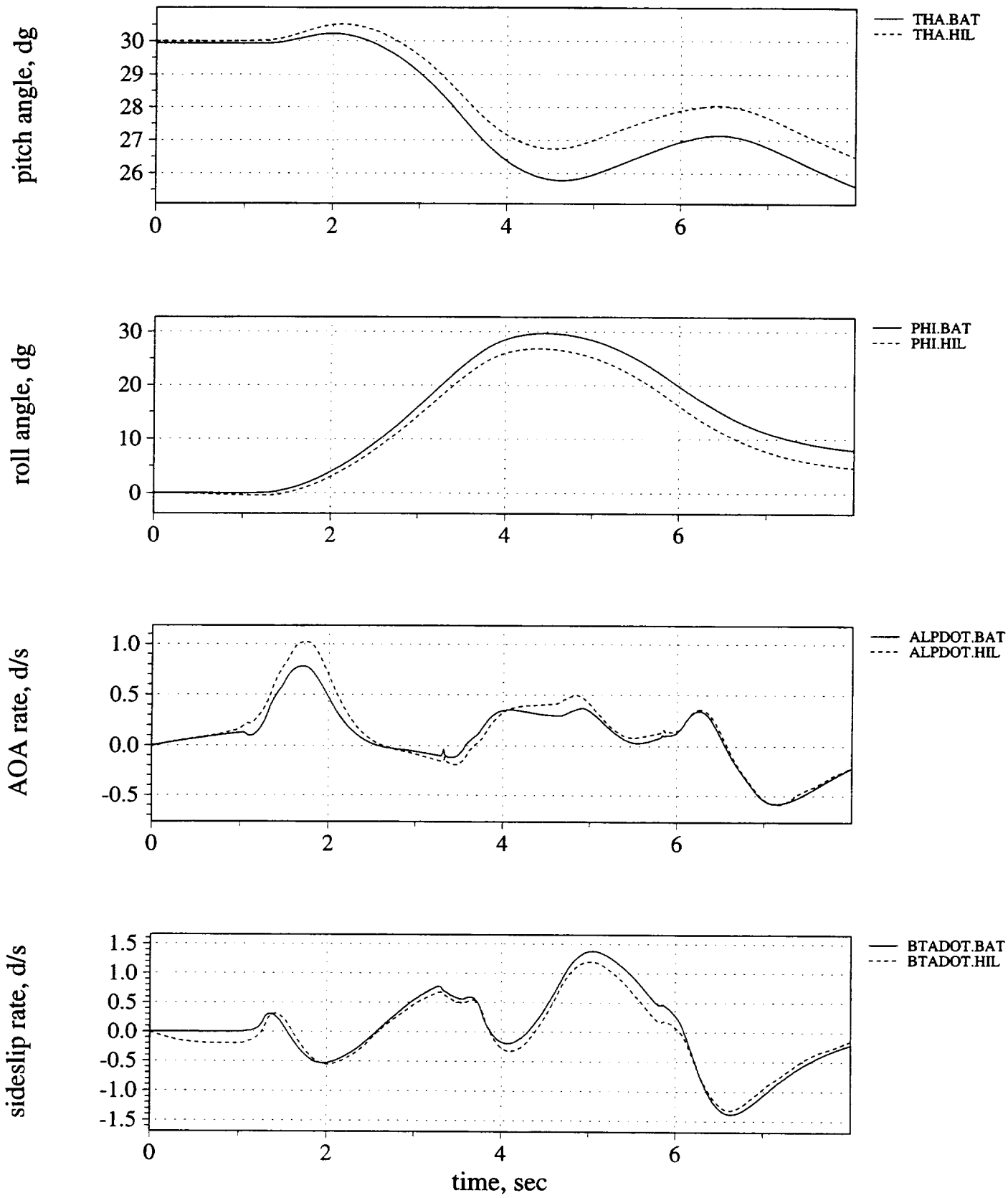
CASE_23__S_Mode__30alp-35k_Max_AB_2_in_ramp_dap page 5/12



Appendix B - Batch versus HIL Version 154.0

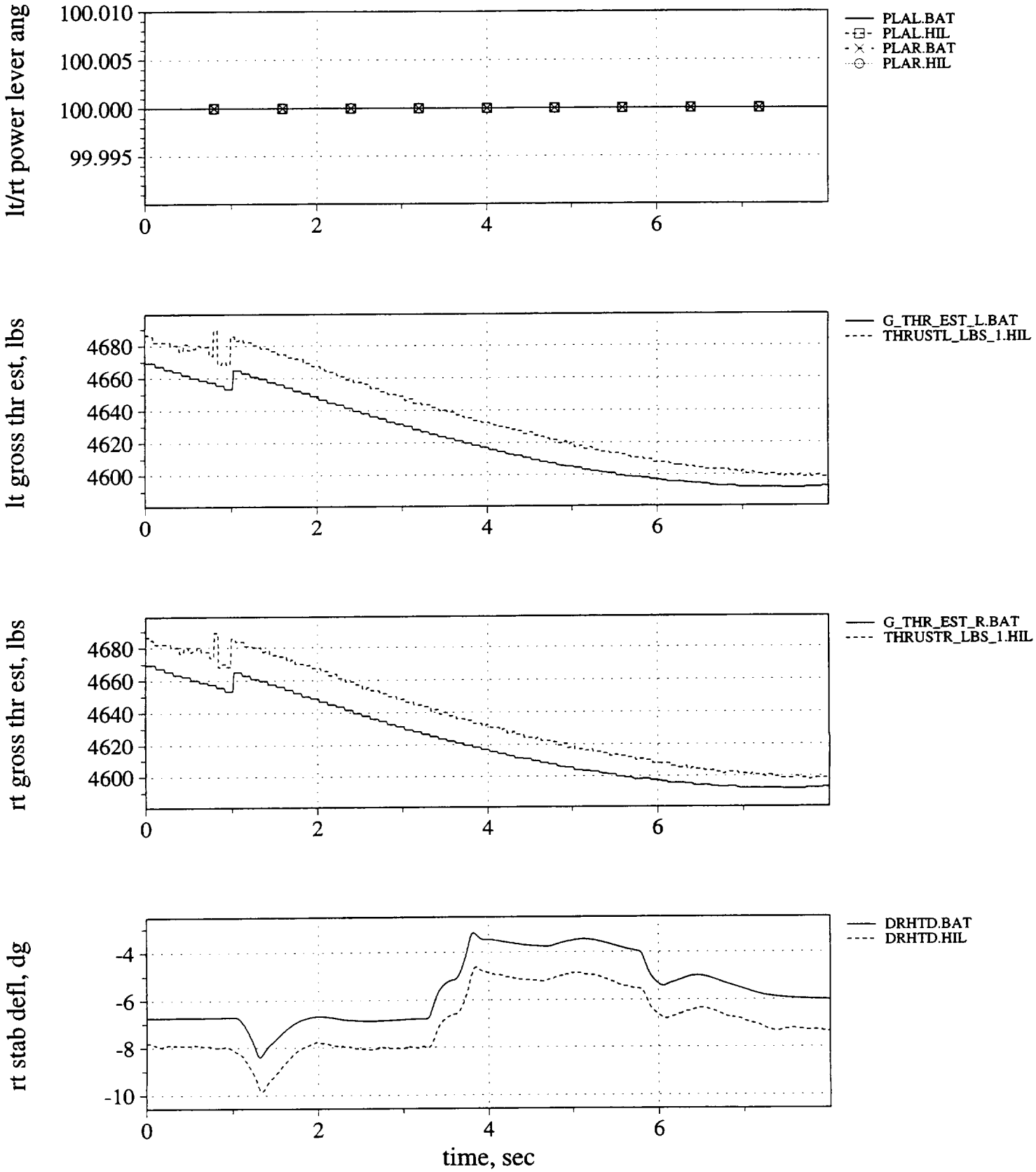
CASE_23__S_Mode__30alp-35k_Max_AB_2_in_ramp_dap page 6/12




pitch angle, dg
30
29
28
27
26
0
2
4
6
THA.BAT
THA.HIL
roll angle, dg
30
20
10
0
PHI.BAT
PHI.HIL
AOA rate, d/s
1.0
0.5
0.0
-0.5
ALPDOT.BAT
ALPDOT.HIL
sideslip rate, d/s
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
BTADOT.BAT
BTADOT.HIL
time, sec

Appendix B - Batch versus HIL Version 154.0

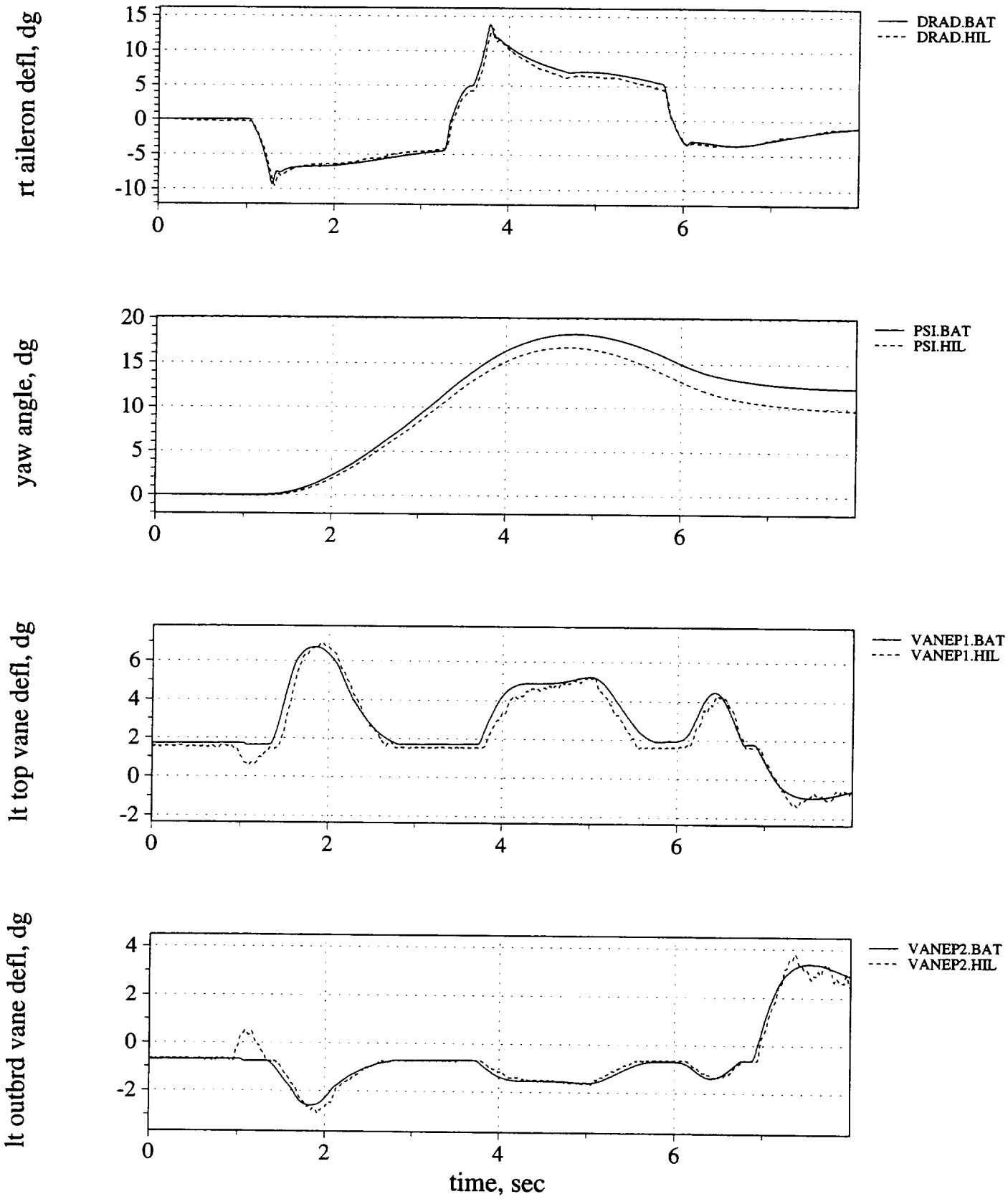
CASE_23__S_Mode__30alp-35k_Max_AB_2_in_ramp_dap page 8/12



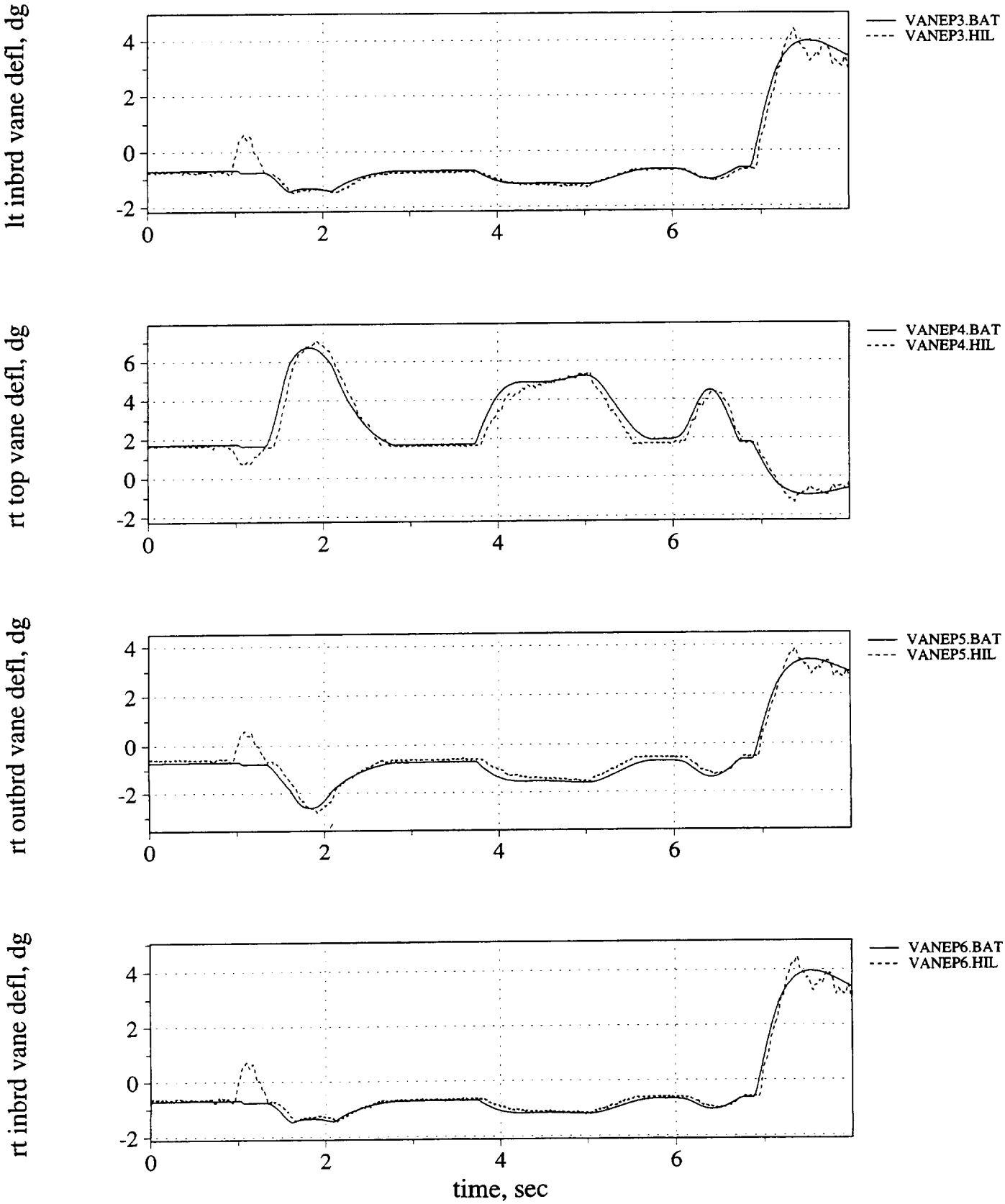
Performance Validation Checkcases

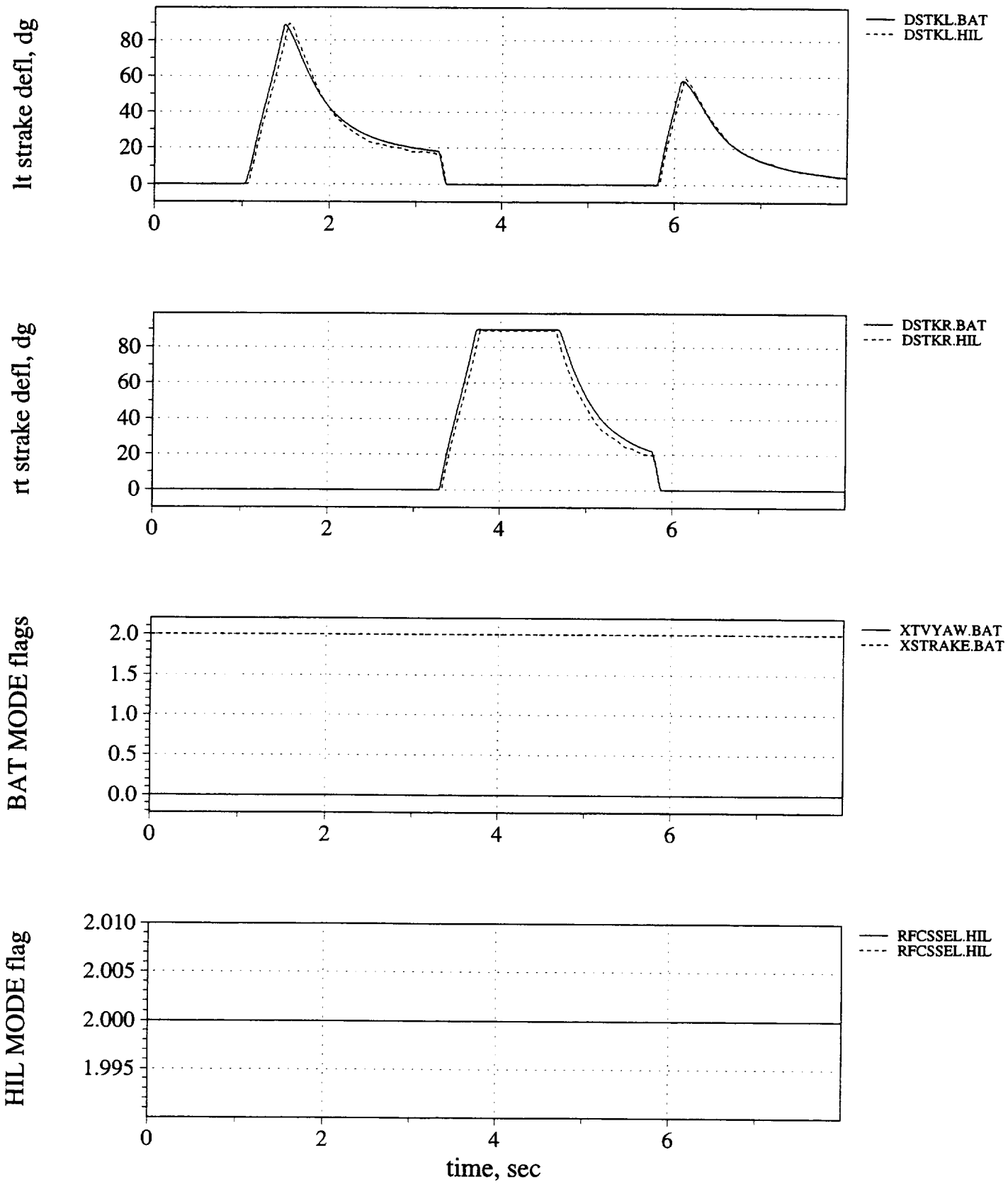
Appendix B - Batch versus HIL Version 154.0

CASE_23__S_Mode__30alp-35k_Max_AB_2_in_ramp_dap page 9/12



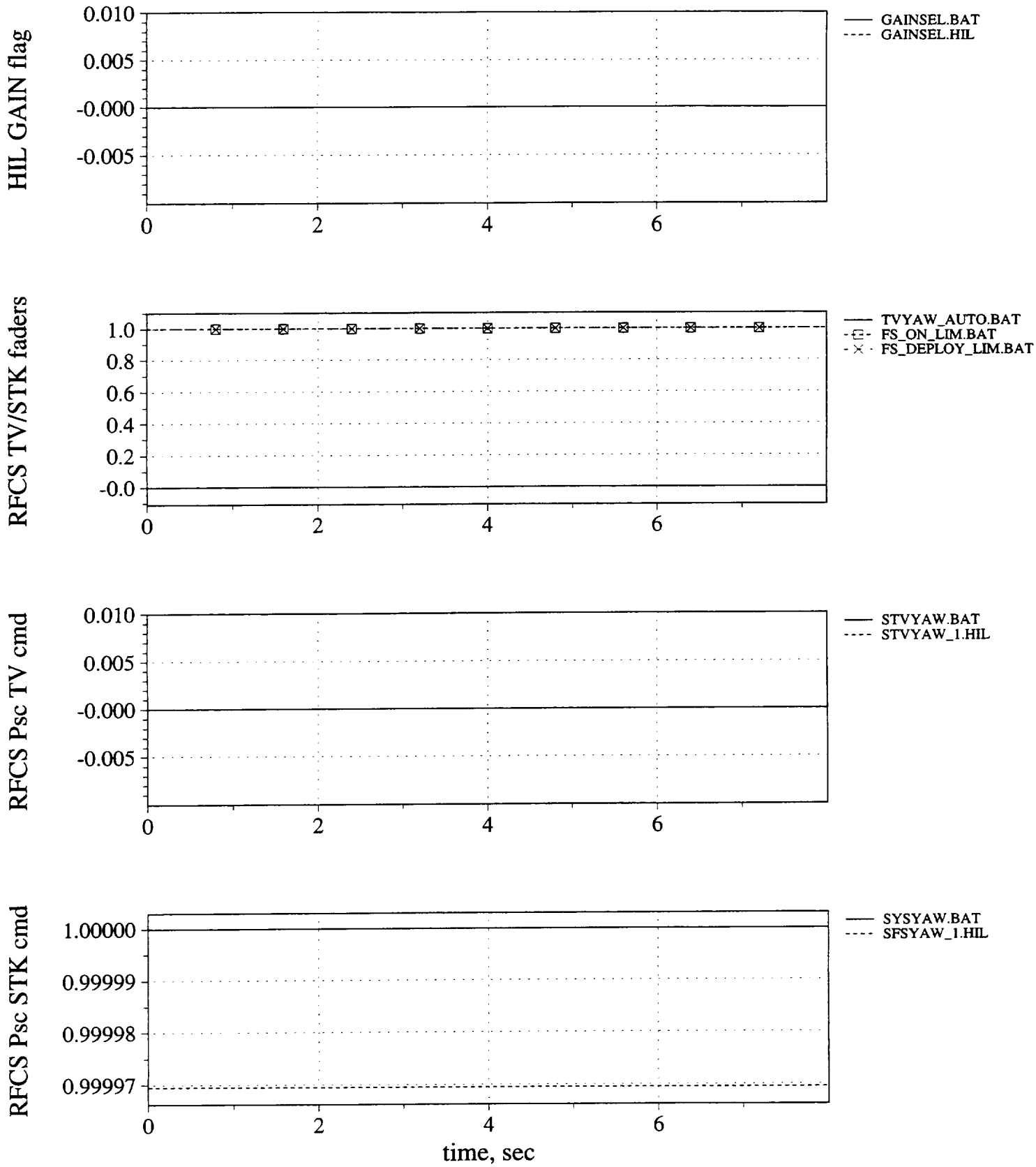
Performance Validation Checkcases


lt inbrd vane defl, dg
VANEP3.BAT
VANEP3.HIL
rt top vane defl, dg
VANEP4.BAT
VANEP4.HIL
rt outbrd vane defl, dg
VANEP5.BAT
VANEP5.HIL
rt inbrd vane defl, dg
VANEP6.BAT
VANEP6.HIL
time, sec


lt strake defl, dg
80
60
40
20
0
0
2
4
6
DSTKL.BAT
DSTKL.HIL
rt strake defl, dg
80
60
40
20
0
0
2
4
6
DSTKR.BAT
DSTKR.HIL
BAT MODE flags
2.0
1.5
1.0
0.5
0.0
0
2
4
6
XTVYAW.BAT
XSTRAKE.BAT
HIL MODE flag
2.010
2.005
2.000
1.995
0
2
4
6
time, sec
RFCSSEL.HIL
RFCSSEL.HIL

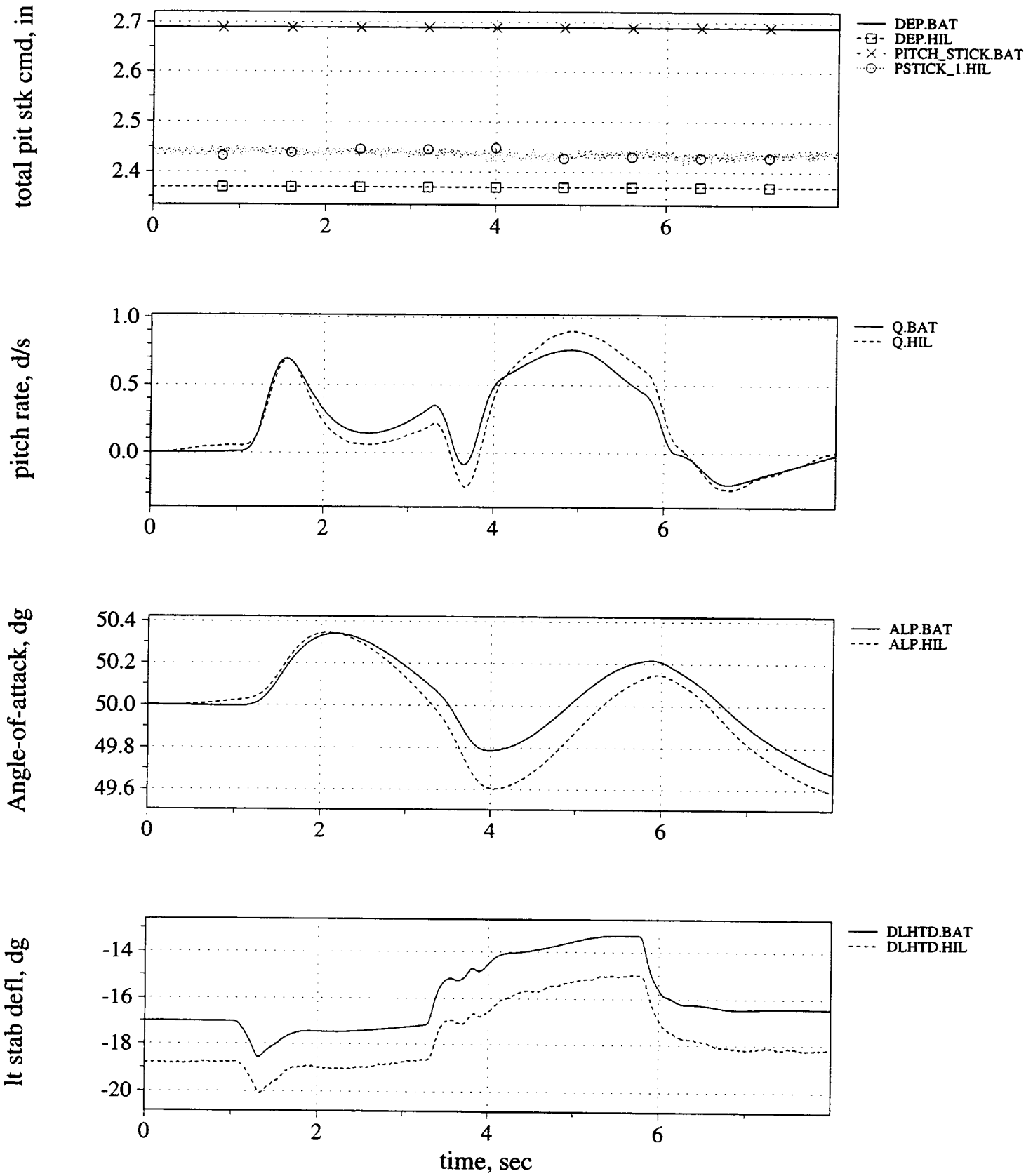
Appendix B - Batch versus HIL Version 154.0

CASE_23__S_Mode__30alp-35k_Max_AB_2_in_ramp_dap page 12/12



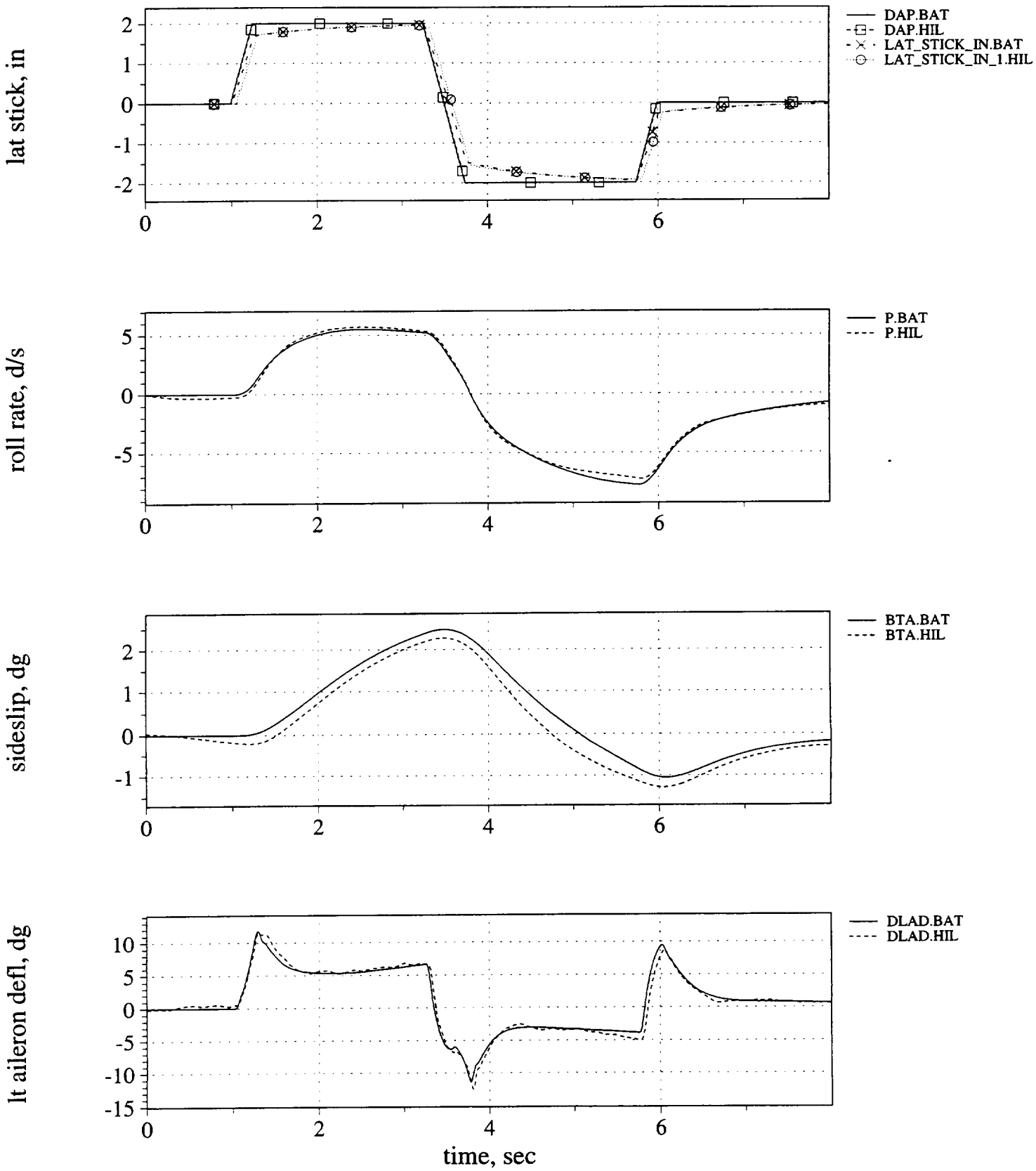
Appendix B - Batch versus HIL Version 154.0

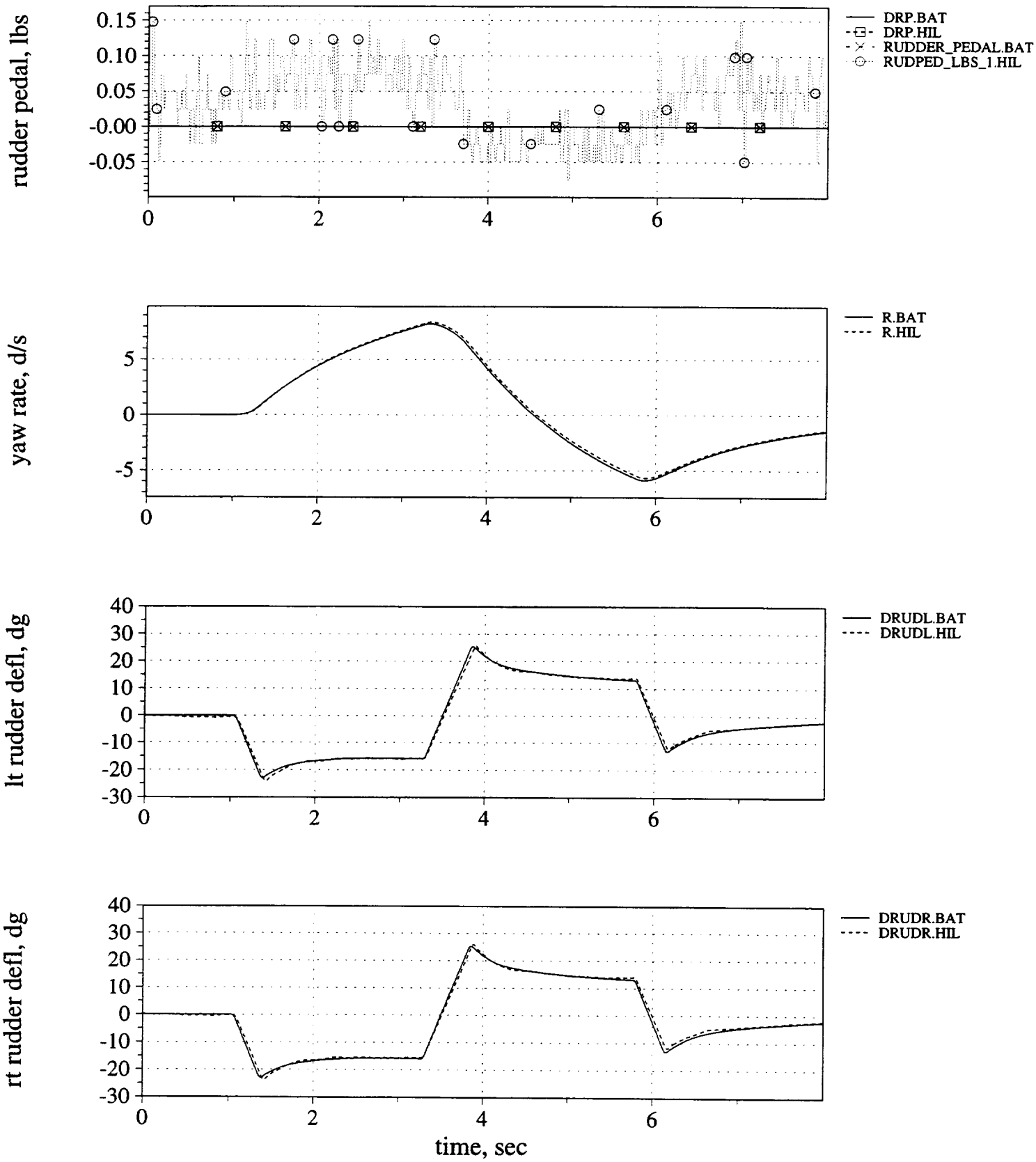
CASE_26__S_Mode__50alp-16k_Max_AB_2_in_ramp_dap page 1/12

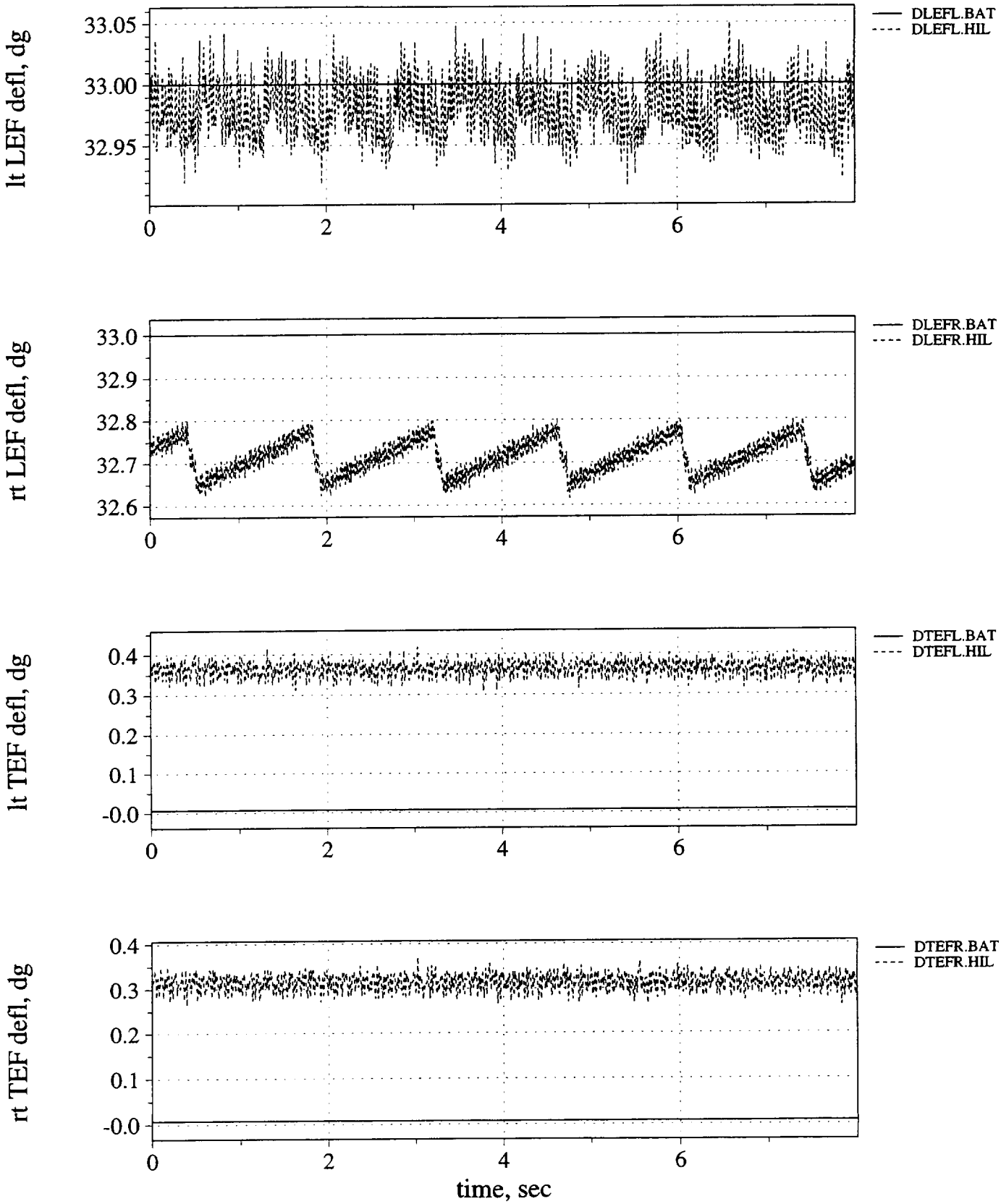


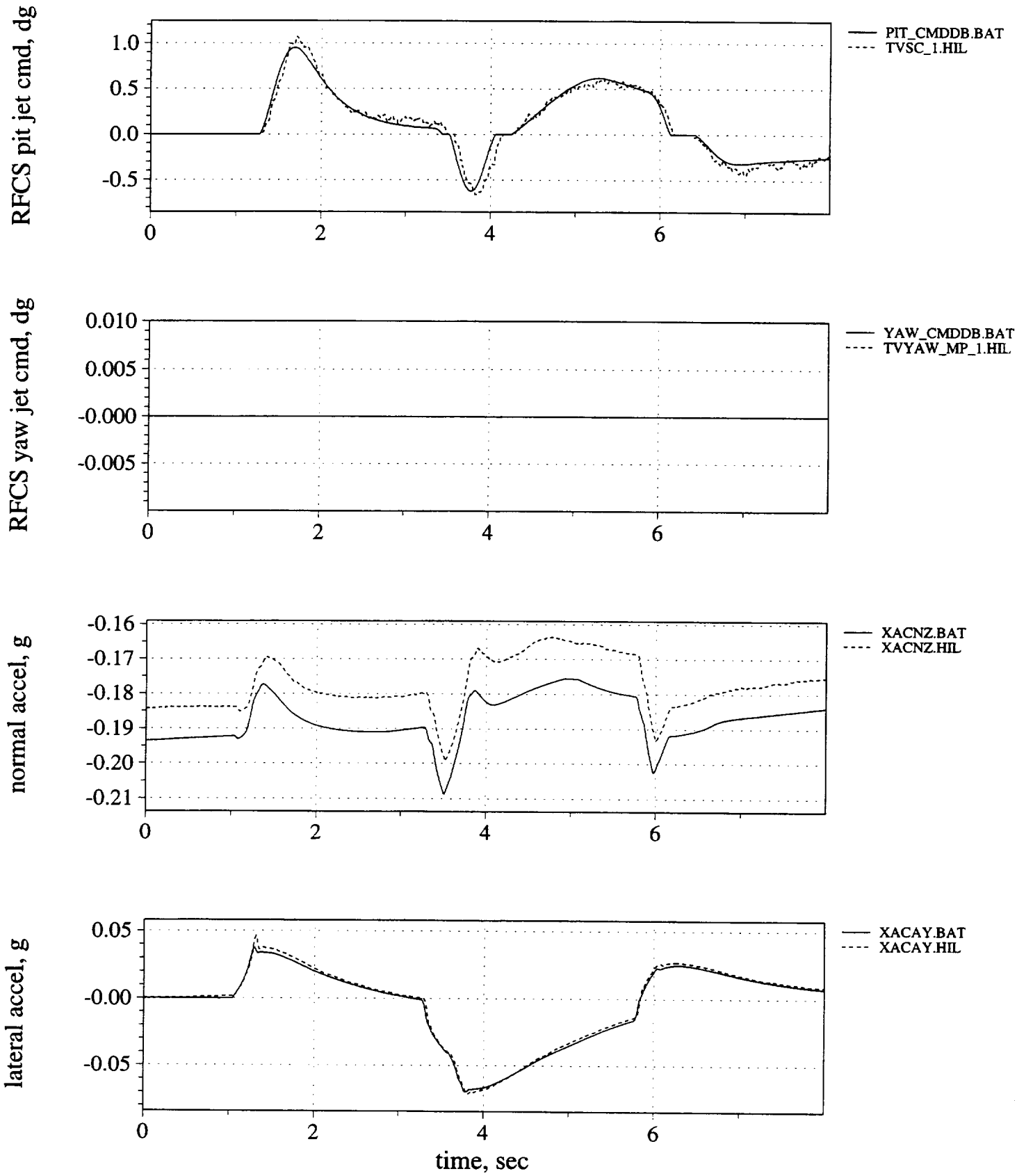
Appendix B - Batch versus HIL Version 154.0

CASE_26__S_Mode__50alp-16k_Max_AB_2_in_ramp_dap page 2/12



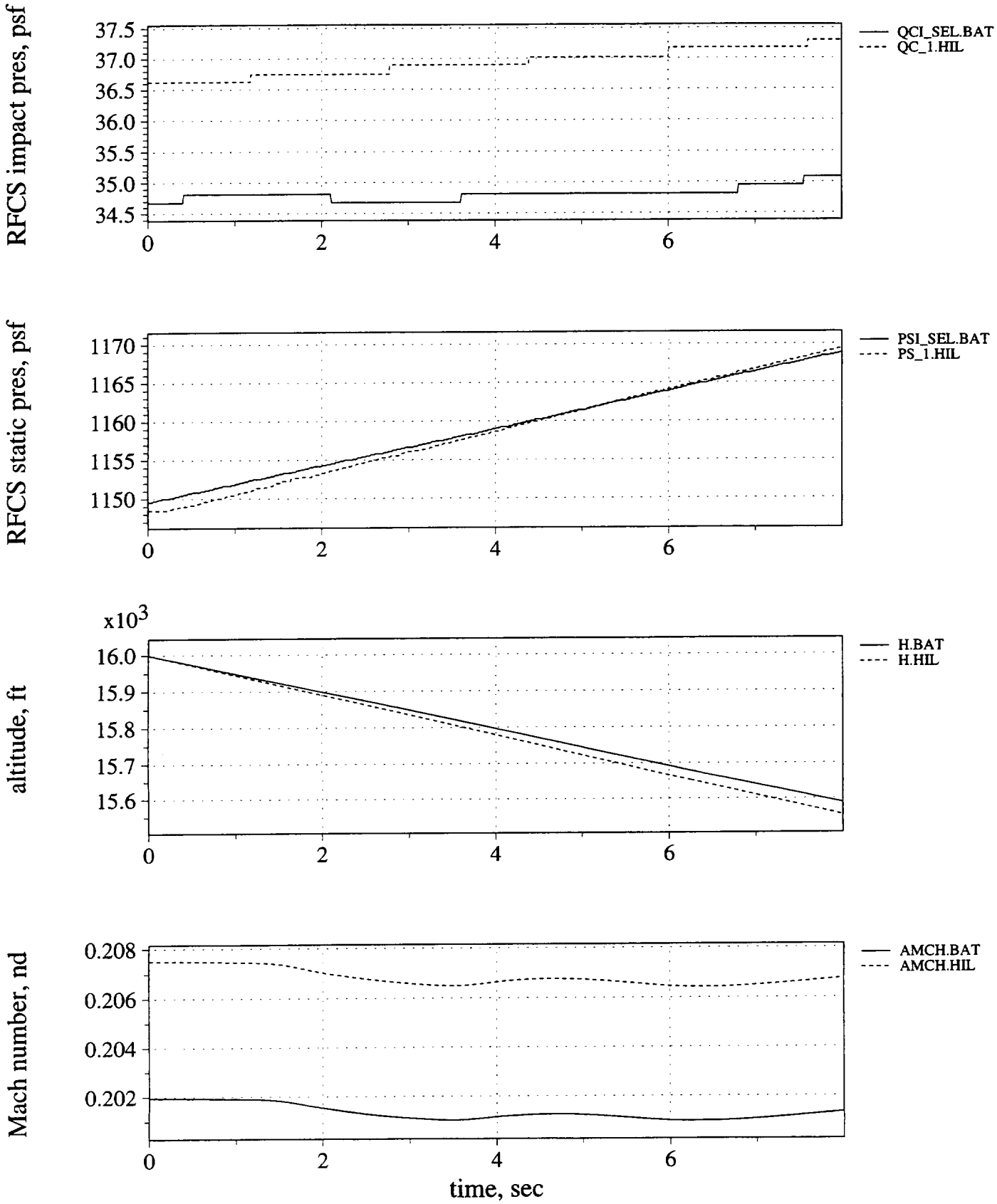

rudder pedal, lbs
0.15
0.10
0.05
-0.00
-0.05
0
2
4
6
DRP.BAT
DRP.HIL
RUDDER_PEDAL.BAT
RUDPED_LBS_1.HIL
yaw rate, d/s
5
0
-5
R.BAT
R.HIL
lt rudder defl, dg
40
30
20
10
0
-10
-20
-30
DRUDL.BAT
DRUDL.HIL
rt rudder defl, dg
DRUDR.BAT
DRUDR.HIL
time, sec


lt LEF defl, dg
33.05
33.00
32.95
0
2
4
6
DLEFL.BAT
DLEFL.HIL
rt LEF defl, dg
33.0
32.9
32.8
32.7
32.6
DLEFR.BAT
DLEFR.HIL
lt TEF defl, dg
0.4
0.3
0.2
0.1
-0.0
DTEFL.BAT
DTEFL.HIL
rt TEF defl, dg
DTEFR.BAT
DTEFR.HIL
time, sec


RFCS pit jet cmd, dg
1.0
0.5
0.0
-0.5
0
2
4
6
PIT_CMDDB.BAT
TVSC_1.HIL
RFCS yaw jet cmd, dg
0.010
0.005
-0.000
-0.005
YAW_CMDDB.BAT
TVYAW_MP_1.HIL
normal accel, g
-0.16
-0.17
-0.18
-0.19
-0.20
-0.21
XACNZ.BAT
XACNZ.HIL
lateral accel, g
0.05
-0.00
-0.05
XACAY.BAT
XACAY.HIL
time, sec

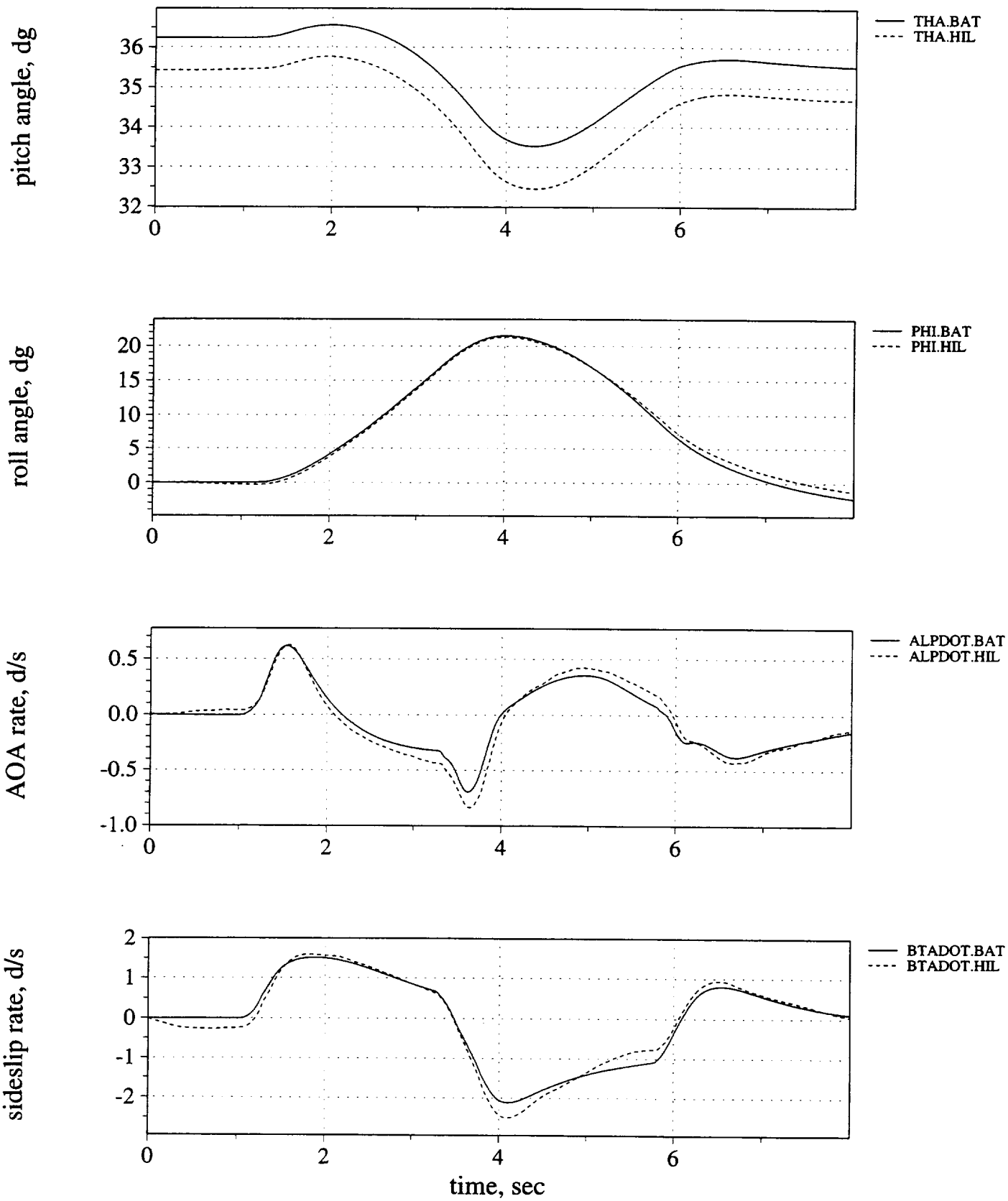
Appendix B - Batch versus HIL Version 154.0

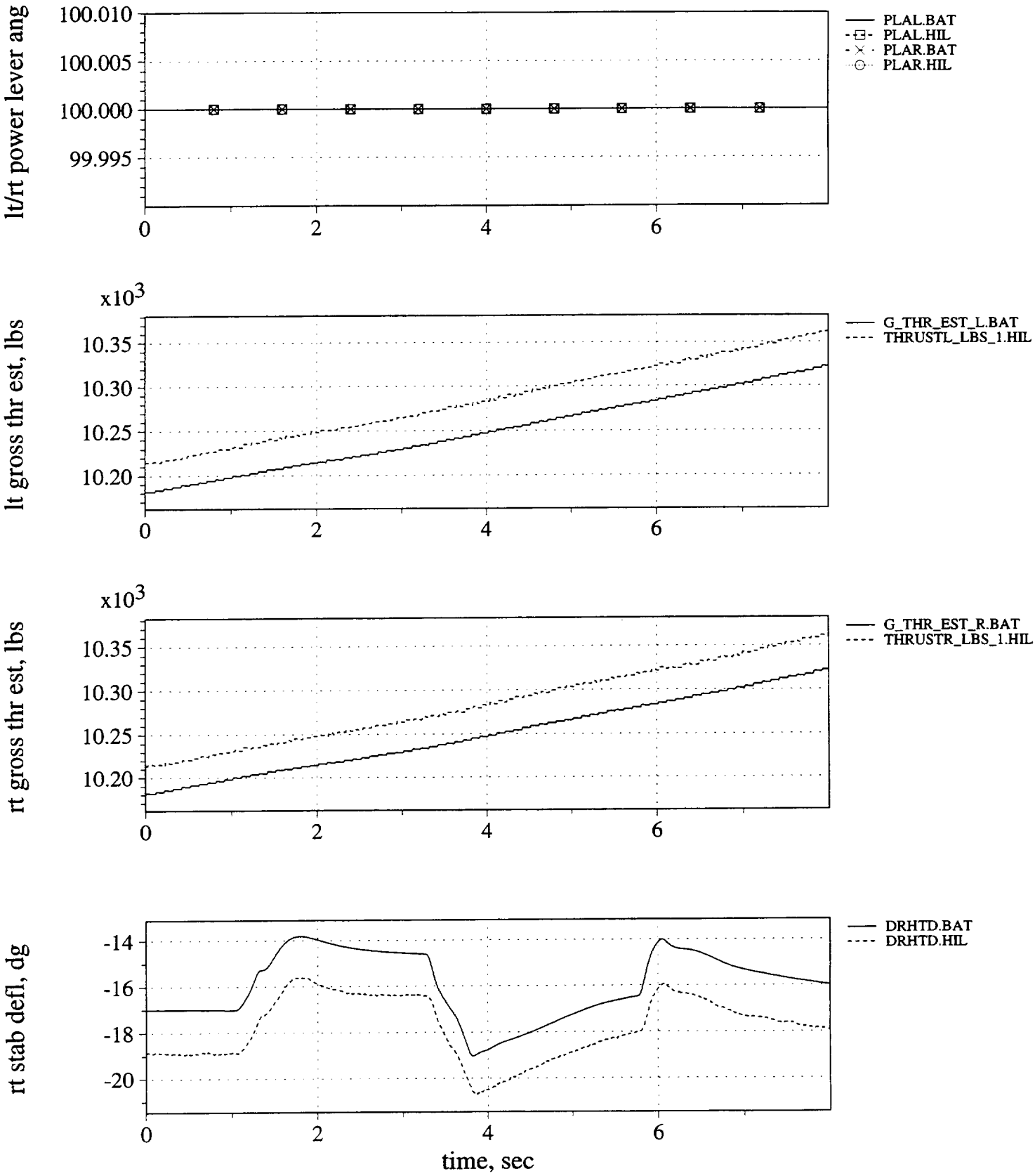
CASE_26__S_Mode__50alp-16k_Max_AB_2_in_ramp_dap page 6/12

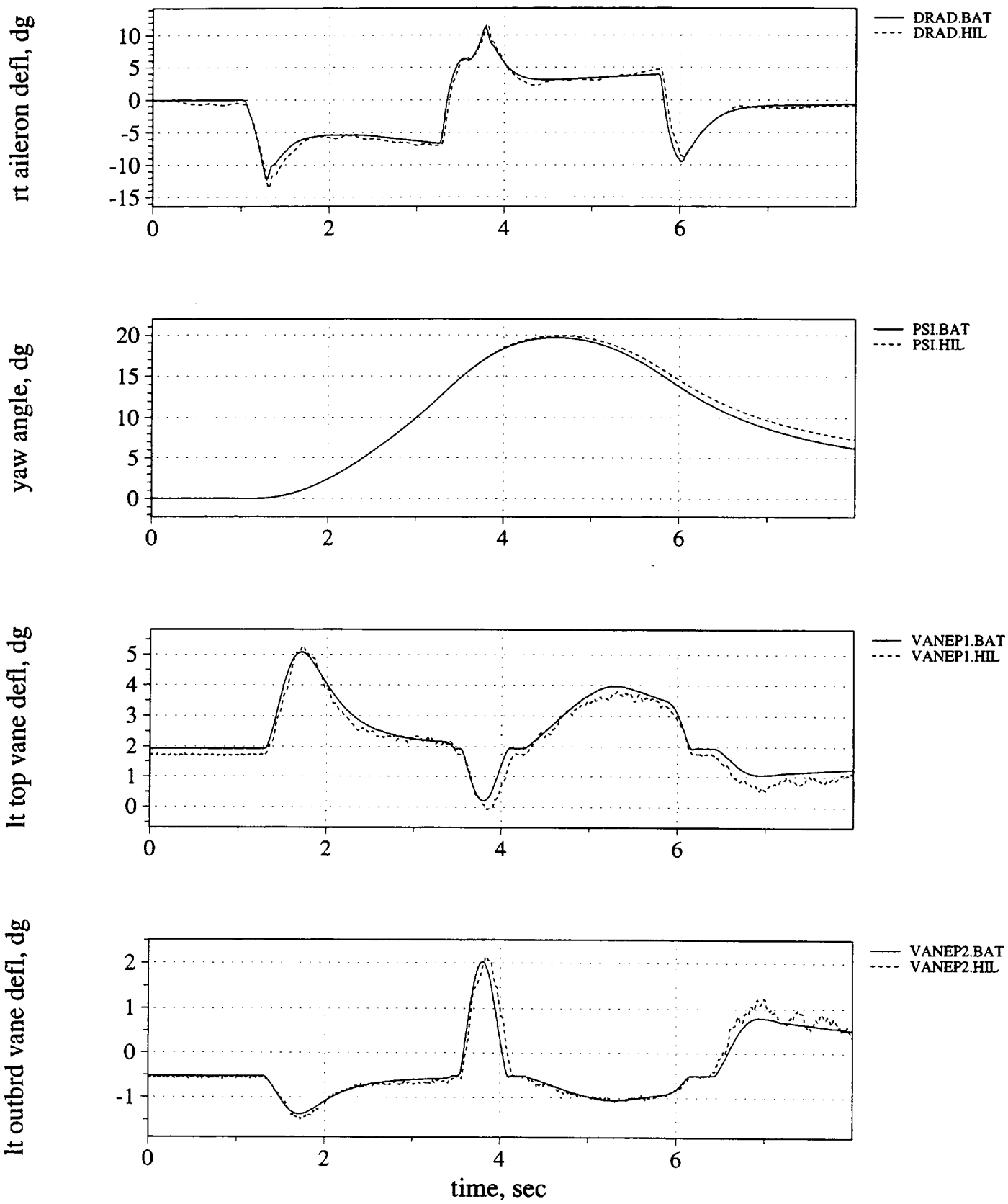


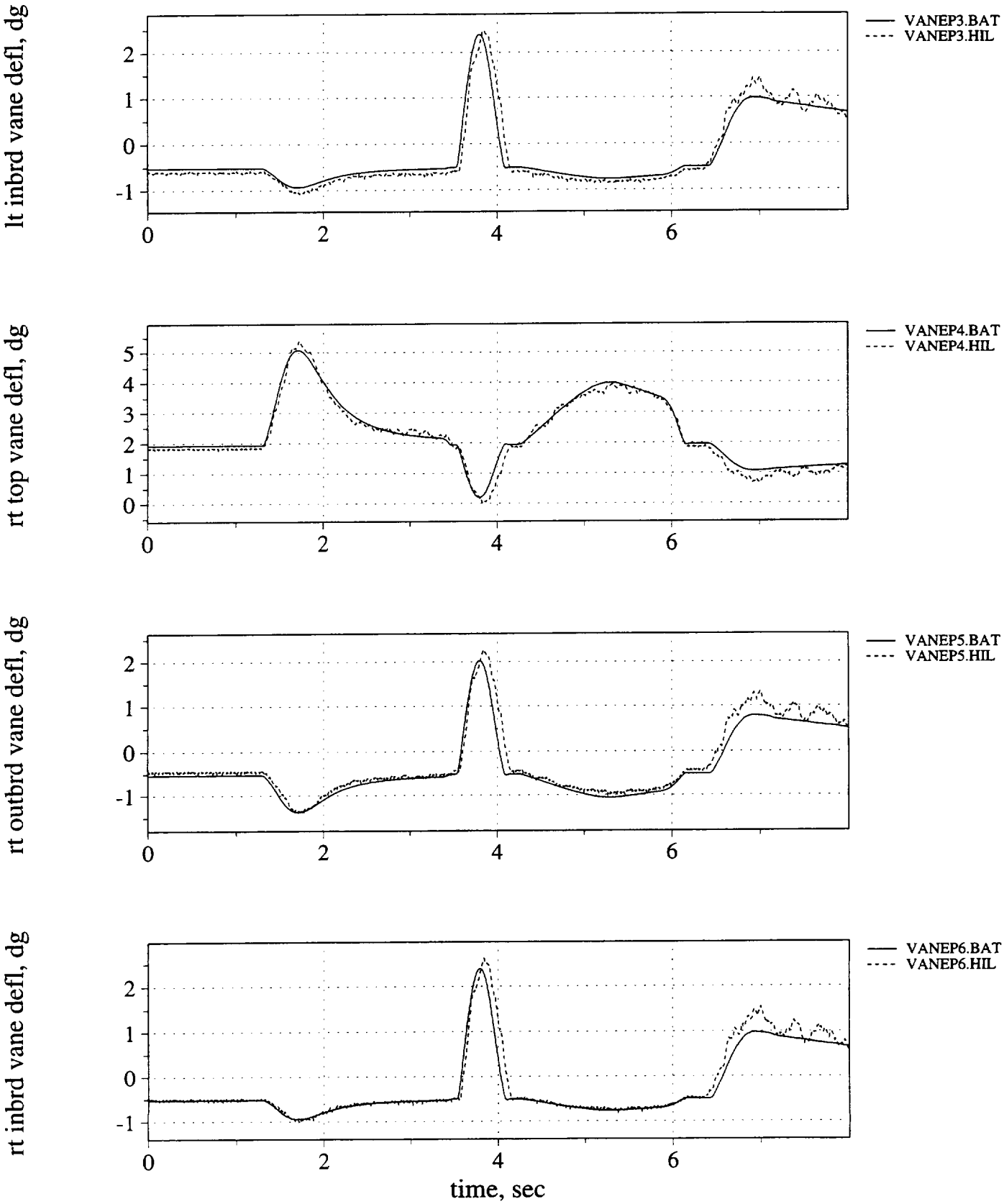
Appendix B - Batch versus HIL Version 154.0

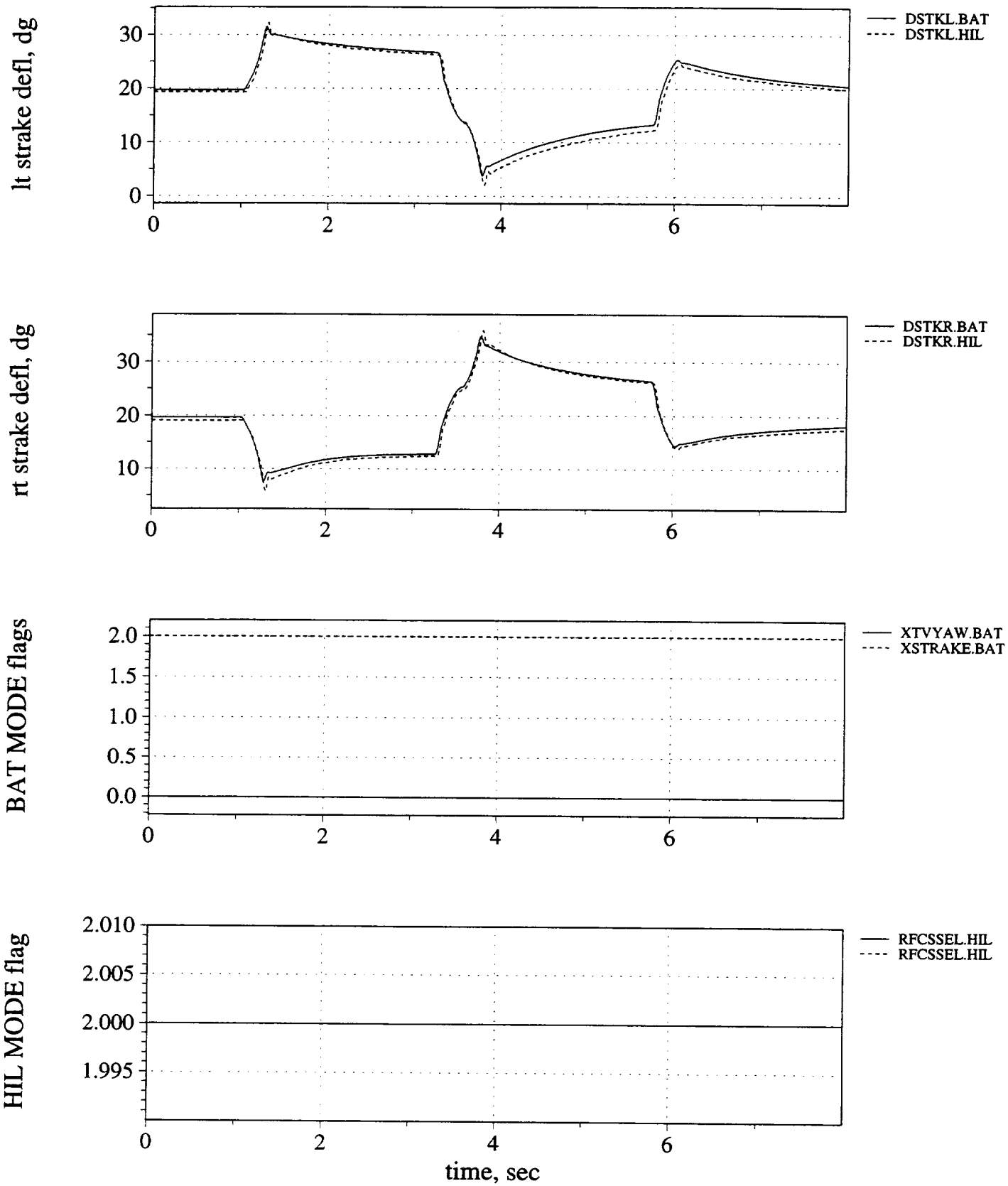
CASE_26__S_Mode__50alp-16k_Max_AB_2_in_ramp_dap page 7/12




lt/rt power lever ang
100.010
100.005
100.000
99.995
0
2
4
6
PLAL.BAT
PLAL.HIL
PLAR.BAT
PLAR.HIL
lt gross thr est, lbs
x10^3
10.35
10.30
10.25
10.20
G_THR_EST_L.BAT
THRUSTL_LBS_1.HIL
rt gross thr est, lbs
x10^3
10.35
10.30
10.25
10.20
G_THR_EST_R.BAT
THRUSTR_LBS_1.HIL
rt stab defl, dg
-14
-16
-18
-20
DRHTD.BAT
DRHTD.HIL
time, sec

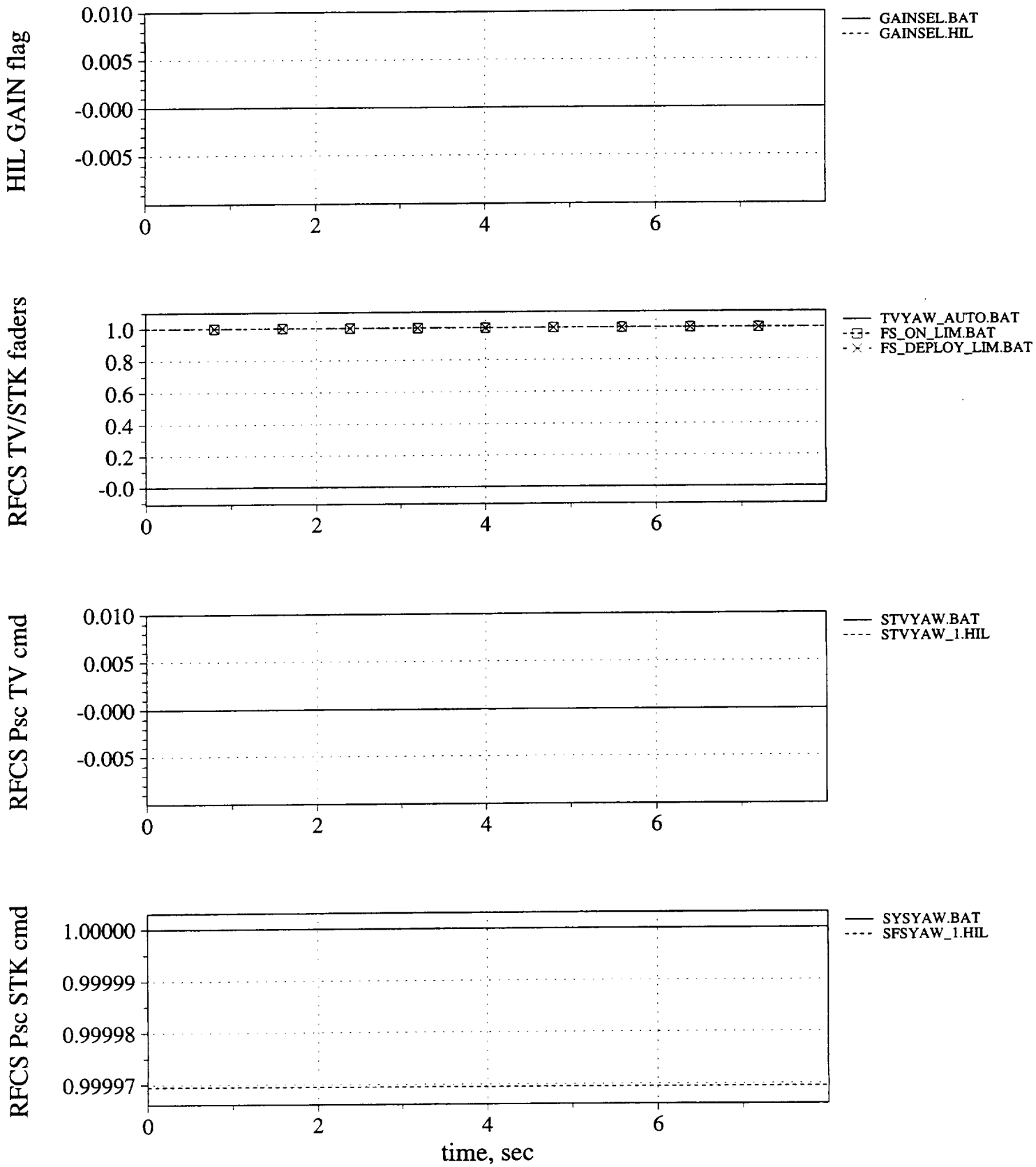

rt aileron defl, dg
DRAD.BAT
DRAD.HIL
yaw angle, dg
PSI.BAT
PSI.HIL
lt top vane defl, dg
VANEP1.BAT
VANEP1.HIL
lt outbrd vane defl, dg
VANEP2.BAT
VANEP2.HIL
time, sec


lt inbrd vane defl, dg
VANEP3.BAT
VANEP3.HIL
rt top vane defl, dg
VANEP4.BAT
VANEP4.HIL
rt outbrd vane defl, dg
VANEP5.BAT
VANEP5.HIL
rt inbrd vane defl, dg
VANEP6.BAT
VANEP6.HIL
time, sec


lt strake defl, dg
30
20
10
0
0
2
4
6
DSTKL.BAT
DSTKL.HIL
rt strake defl, dg
30
20
10
0
2
4
6
DSTKR.BAT
DSTKR.HIL
BAT MODE flags
2.0
1.5
1.0
0.5
0.0
0
2
4
6
XTVYAW.BAT
XSTRAKE.BAT
HIL MODE flag
2.010
2.005
2.000
1.995
0
2
4
6
time, sec
RFCSSEL.HIL
RFCSSEL.HIL

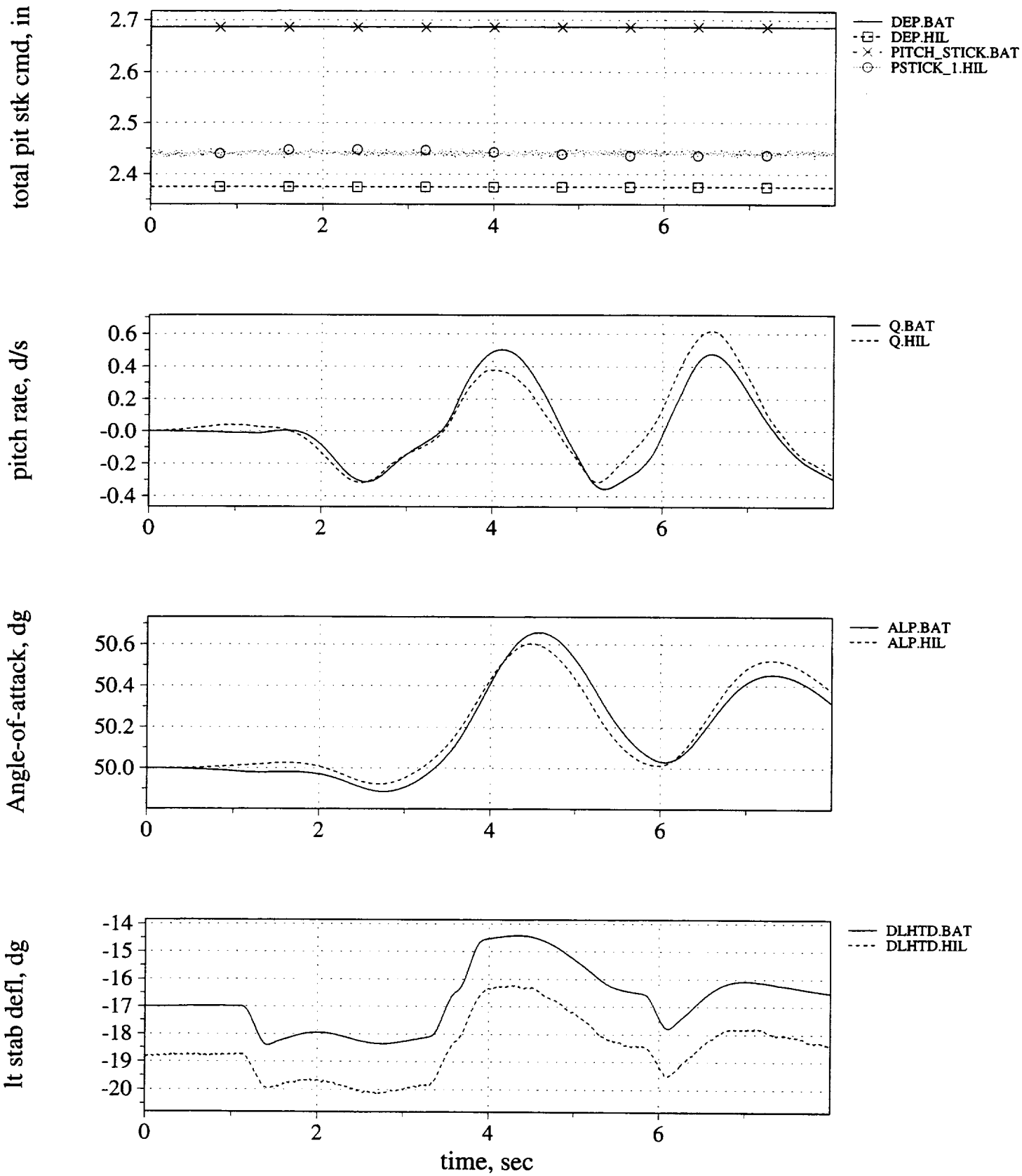
Appendix B - Batch versus HIL Version 154.0

CASE_26__S_Mode__50alp-16k_Max_AB_2_in_ramp_dap page 12/12



Appendix B - Batch versus HIL Version 154.0

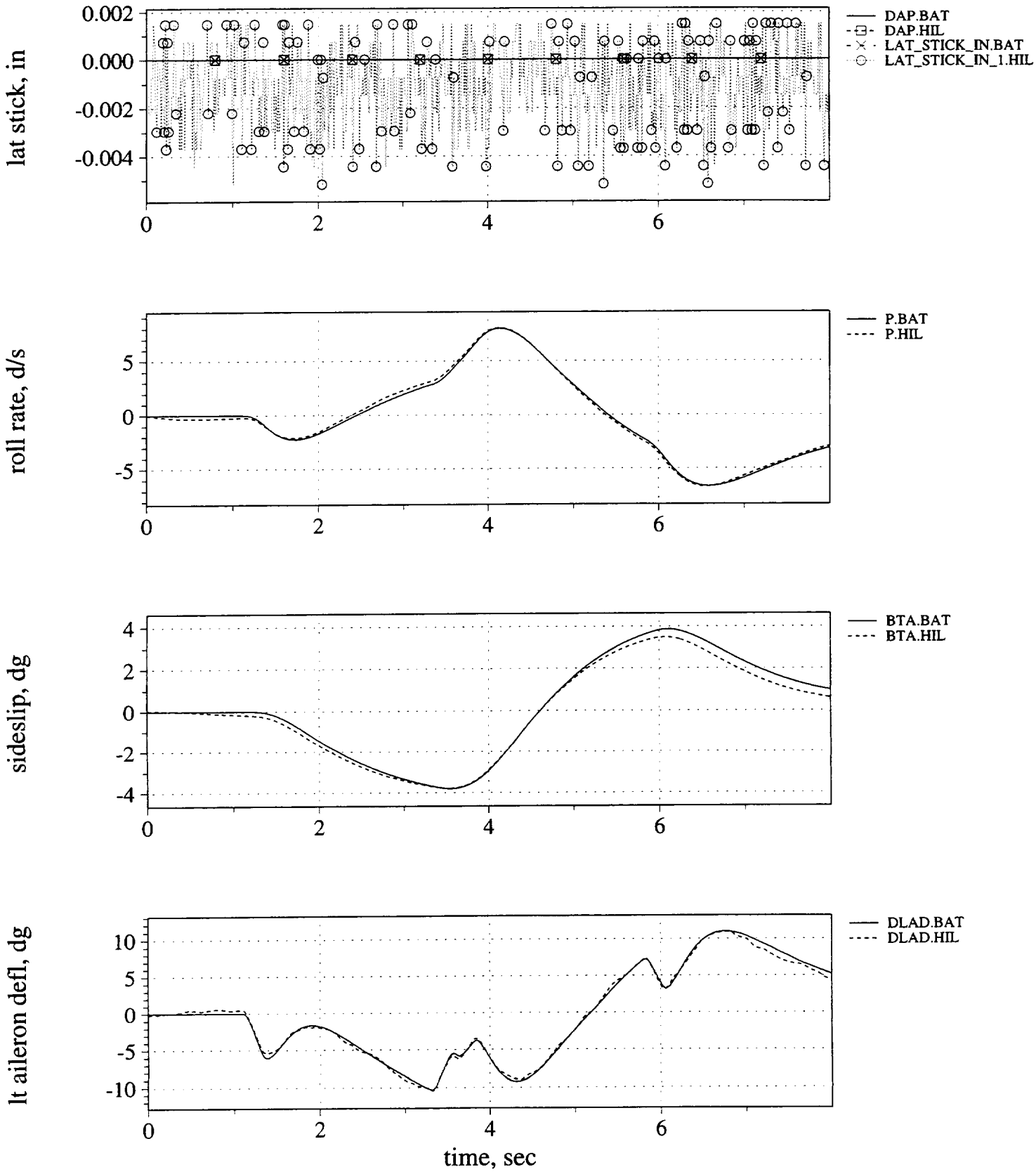
CASE_27__S_Mode__50alp-16k_Max_AB_2_in_ramp_drp page 1/12



Performance Validation Checkcases

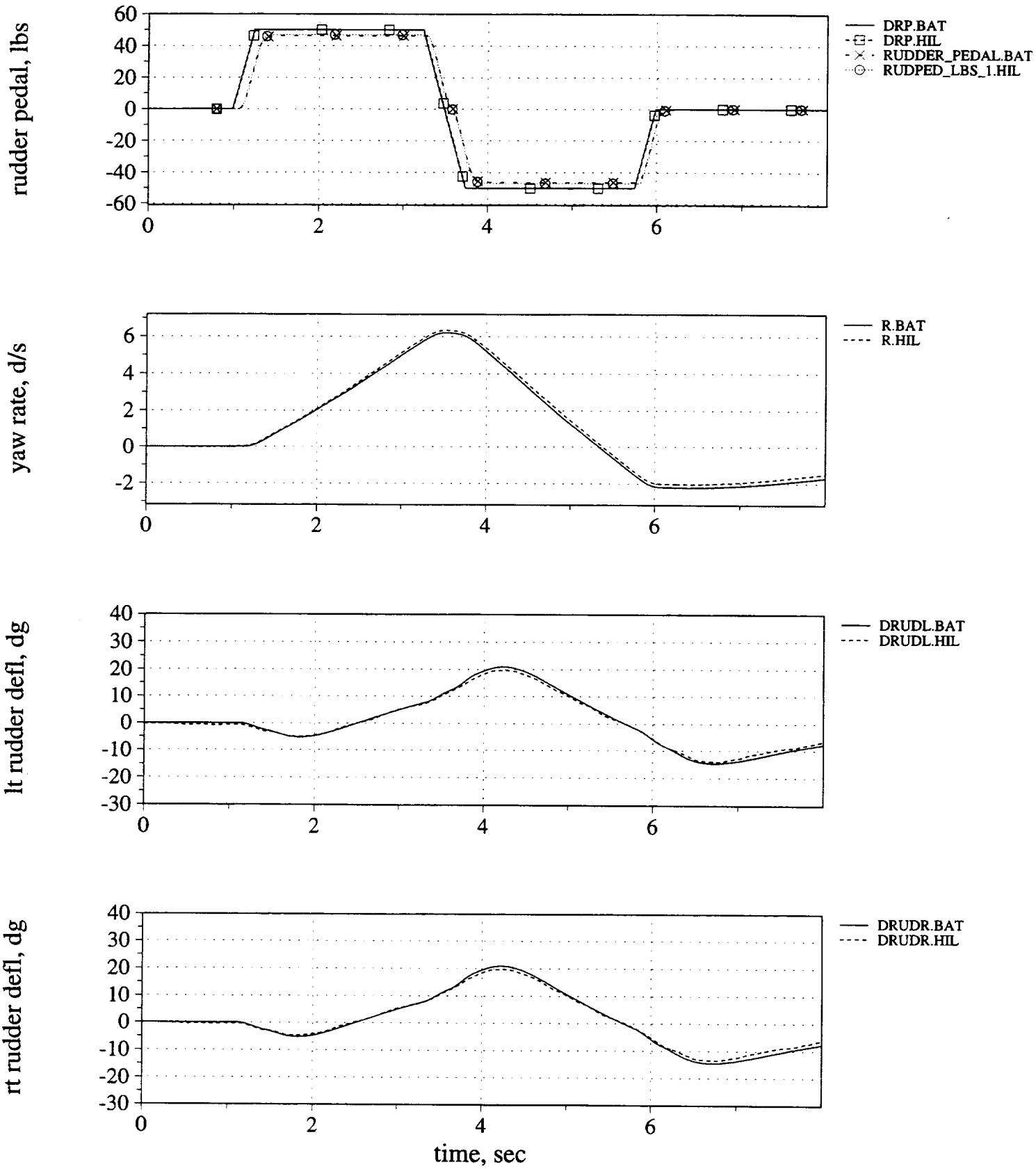
Appendix B - Batch versus HIL Version 154.0

CASE_27__S_Mode__50alp-16k_Max_AB_2_in_ramp_drp page 2/12



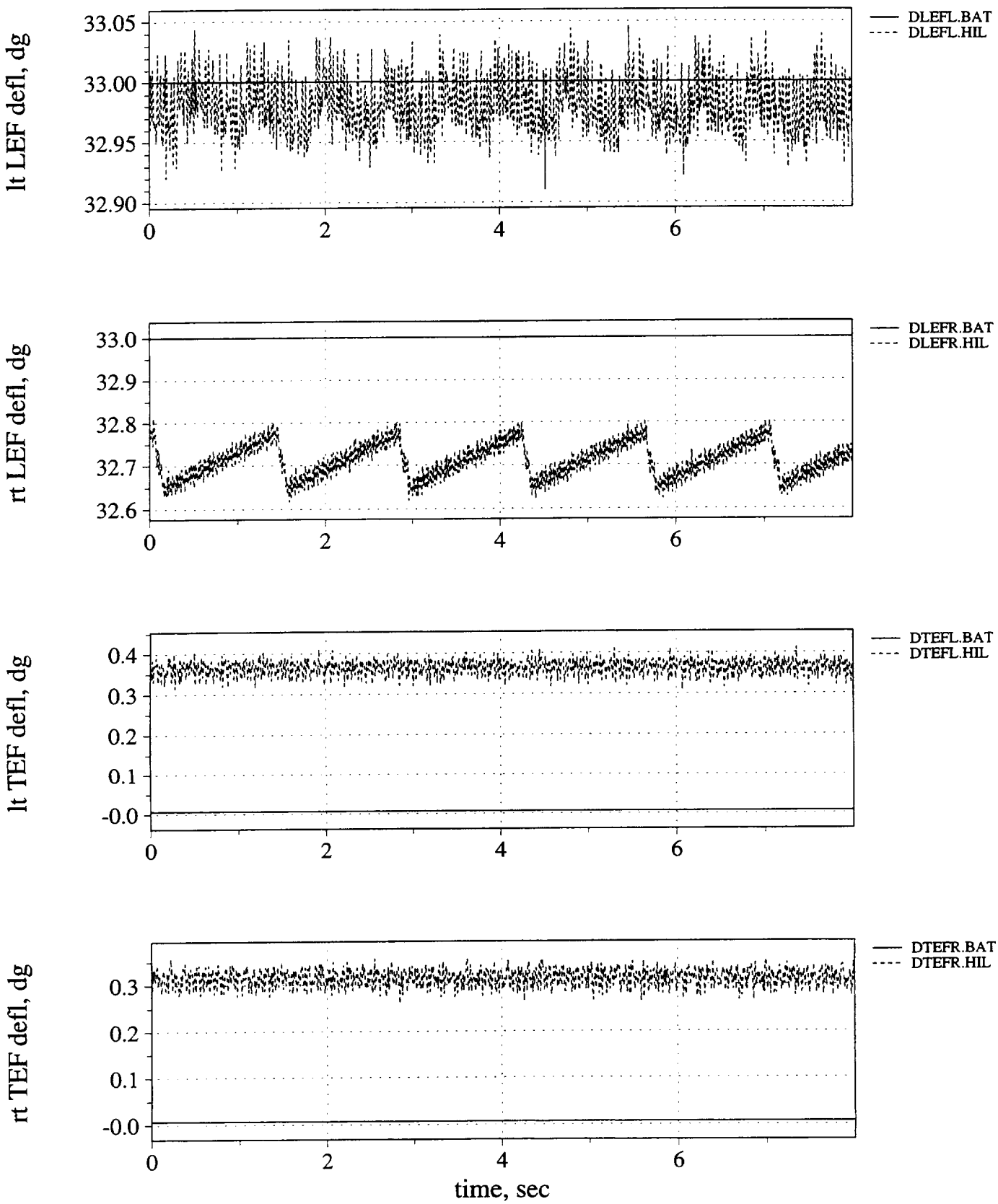
Appendix B - Batch versus HIL Version 154.0

CASE_27__S_Mode__50alp-16k_Max_AB_2_in_ramp_drp page 3/12



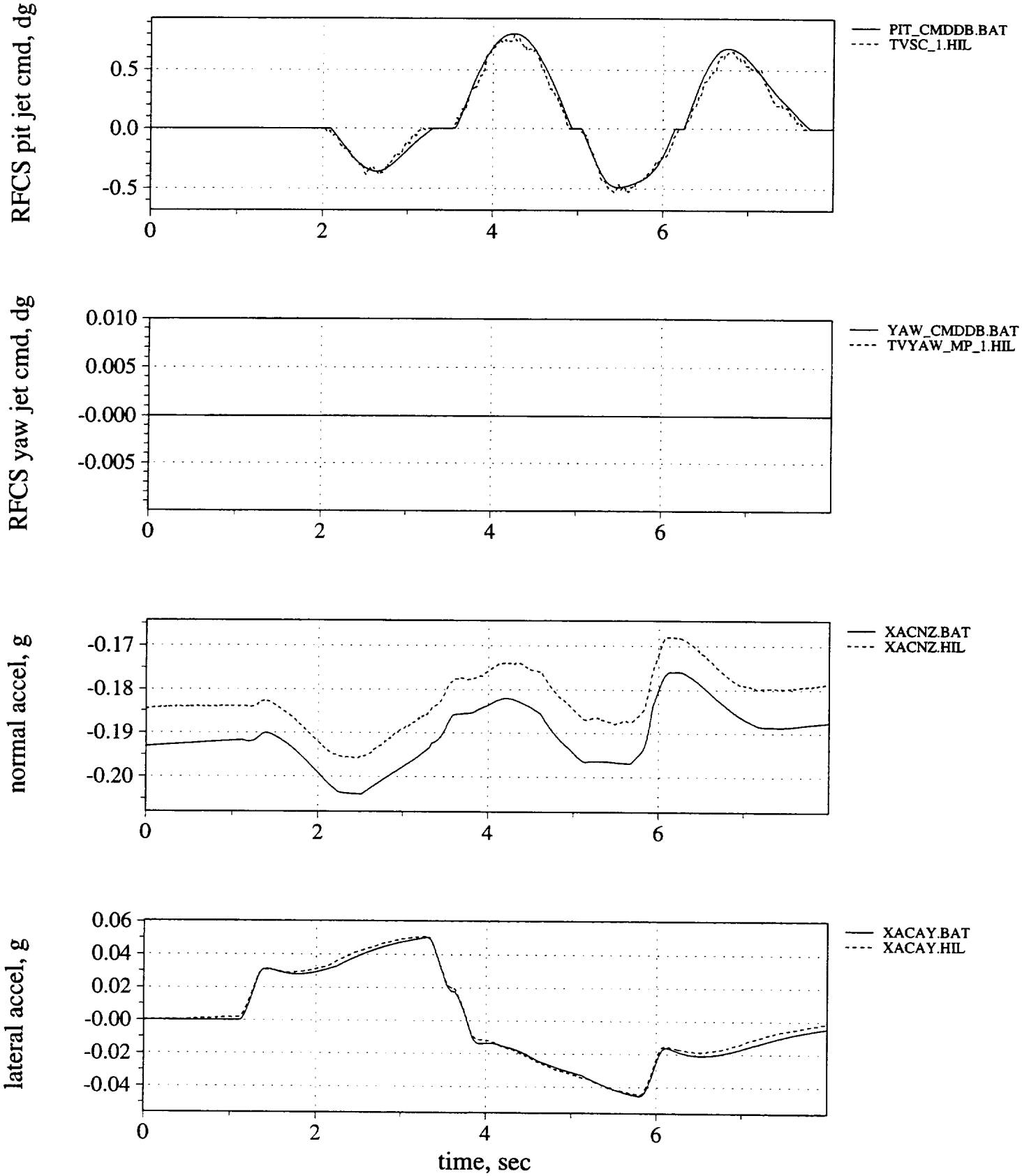
Appendix B - Batch versus HIL Version 154.0

CASE_27__S_Mode__50alp-16k_Max_AB_2_in_ramp_drp page 4/12



Appendix B - Batch versus HIL Version 154.0

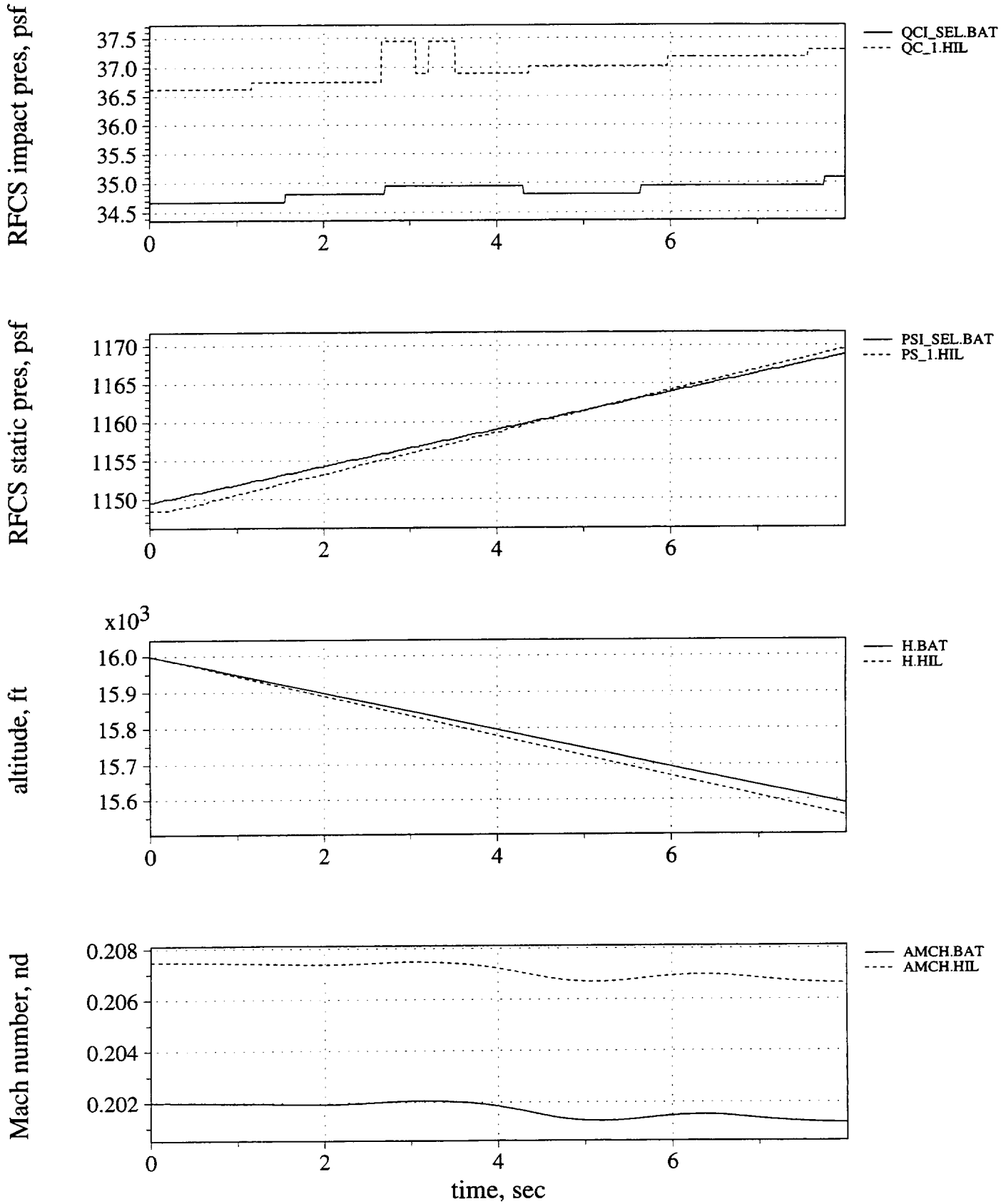
CASE_27__S_Mode__50alp-16k_Max_AB_2_in_ramp_drp page 5/12

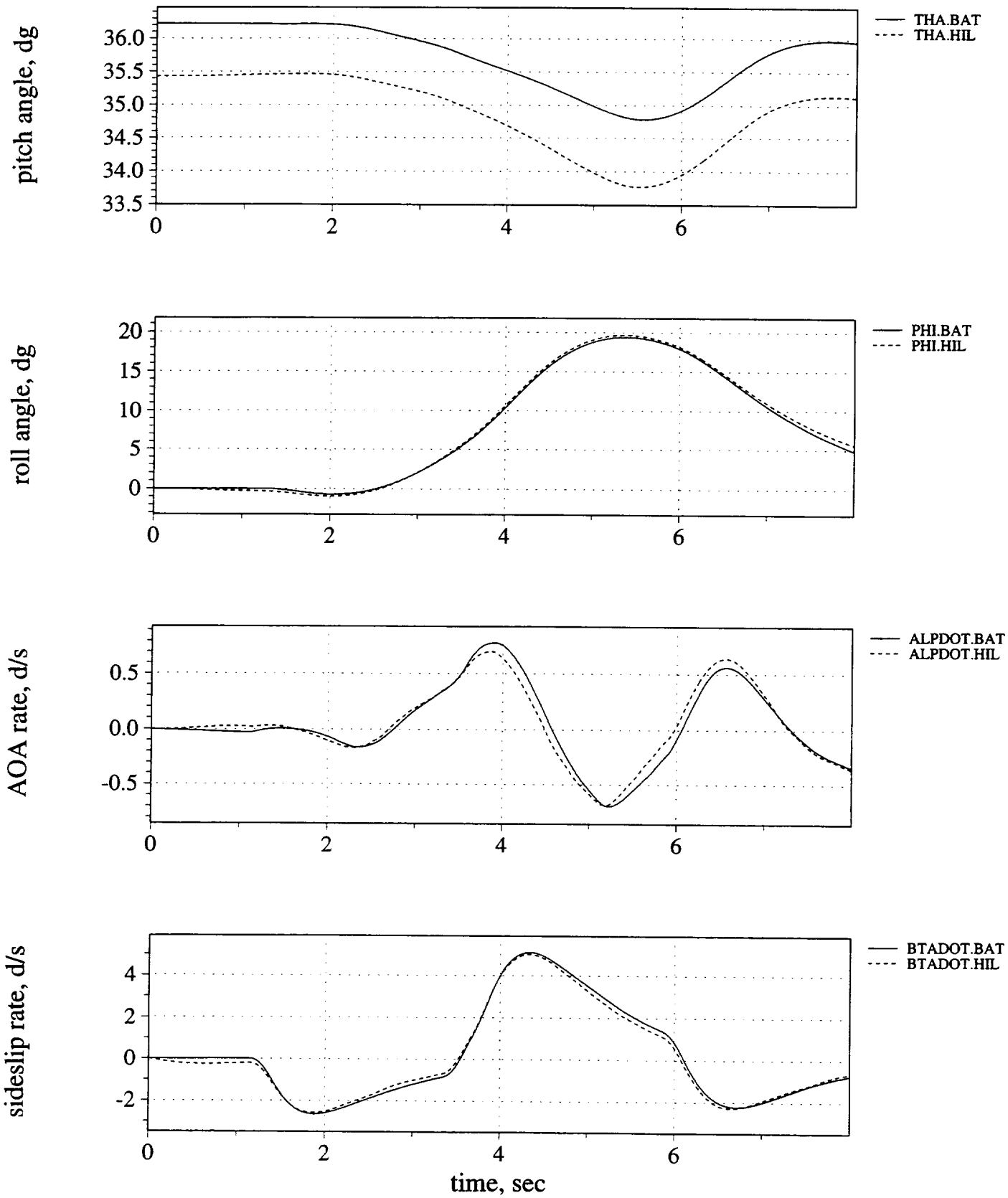


Performance Validation Checkcases

Appendix B - Batch versus HIL Version 154.0

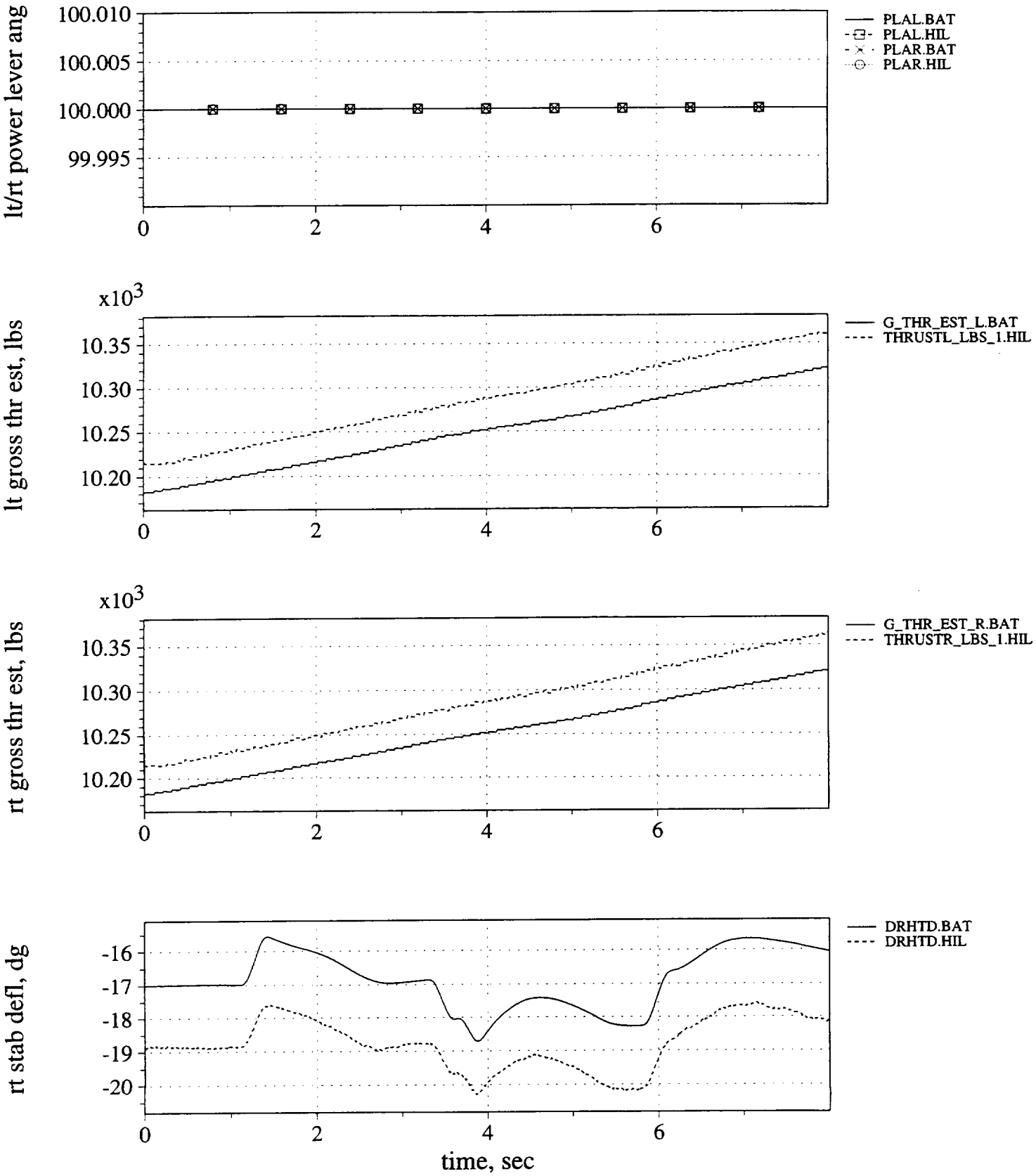
CASE_27__S_Mode__50alp-16k_Max_AB_2_in_ramp_drp page 6/12

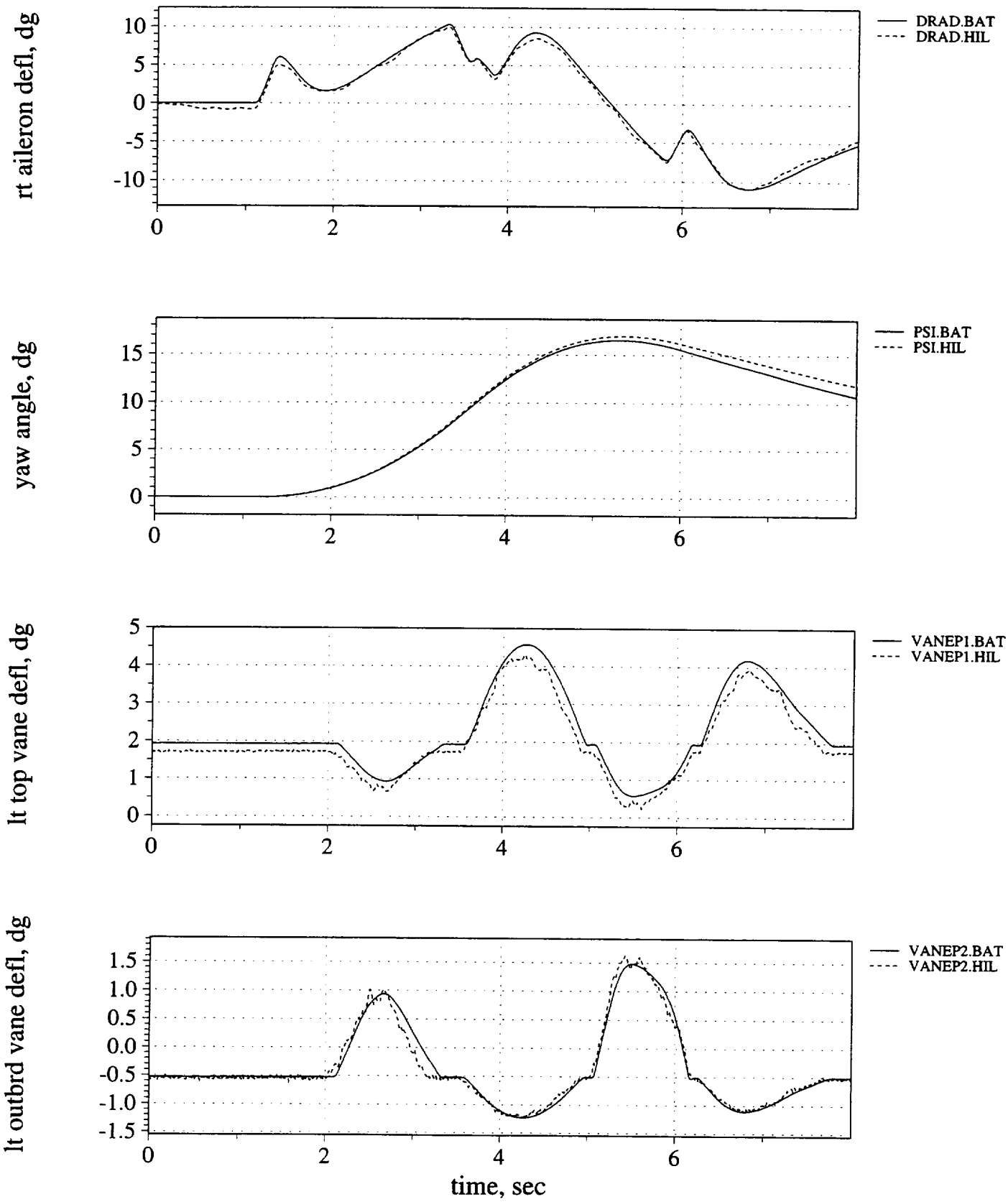


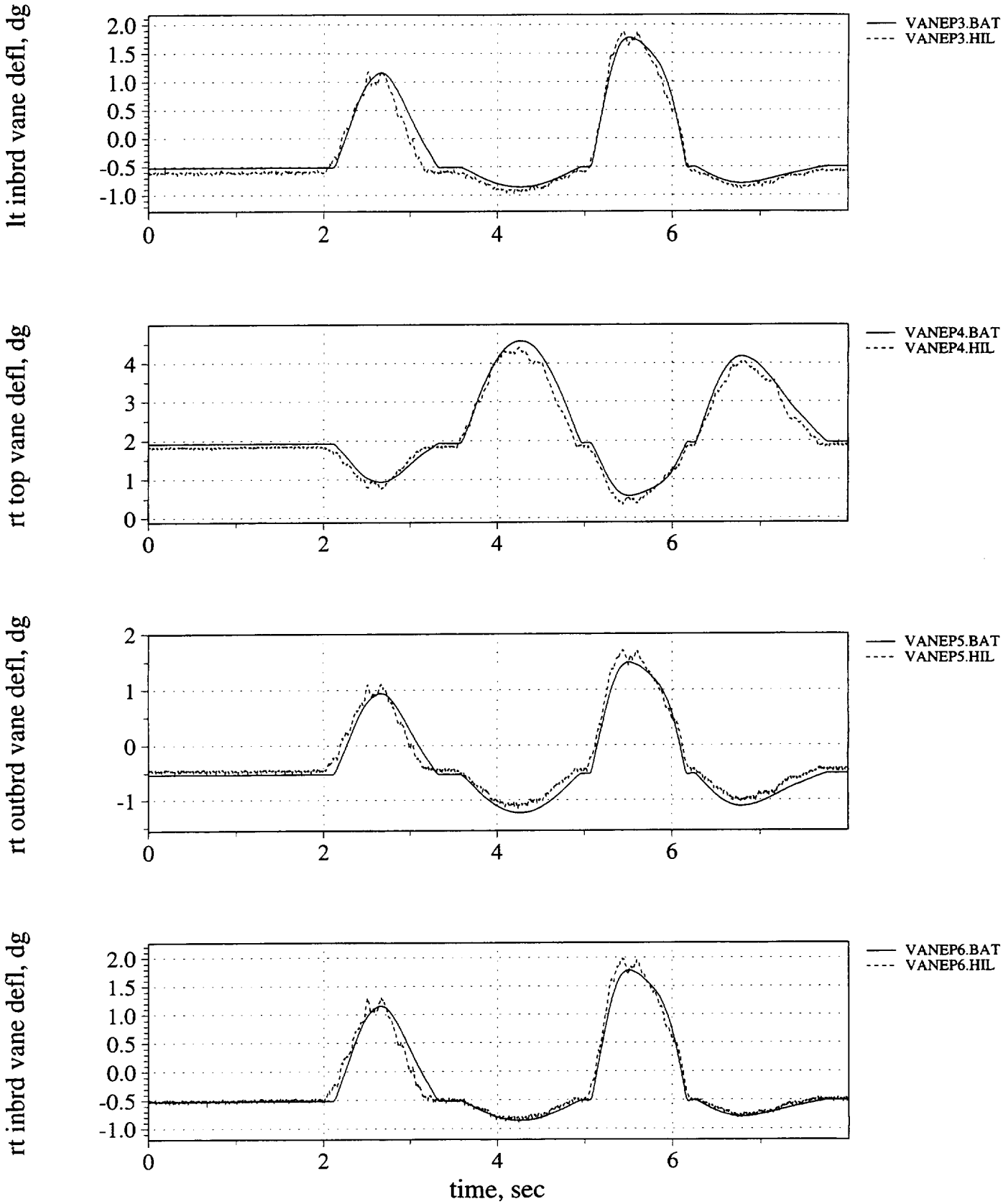

pitch angle, dg
36.0
35.5
35.0
34.5
34.0
33.5
0
2
4
6
THA.BAT
THA.HIL
roll angle, dg
20
15
10
5
0
PHI.BAT
PHI.HIL
AOA rate, d/s
0.5
0.0
-0.5
ALPDOT.BAT
ALPDOT.HIL
sideslip rate, d/s
4
2
0
-2
BTADOT.BAT
BTADOT.HIL
time, sec

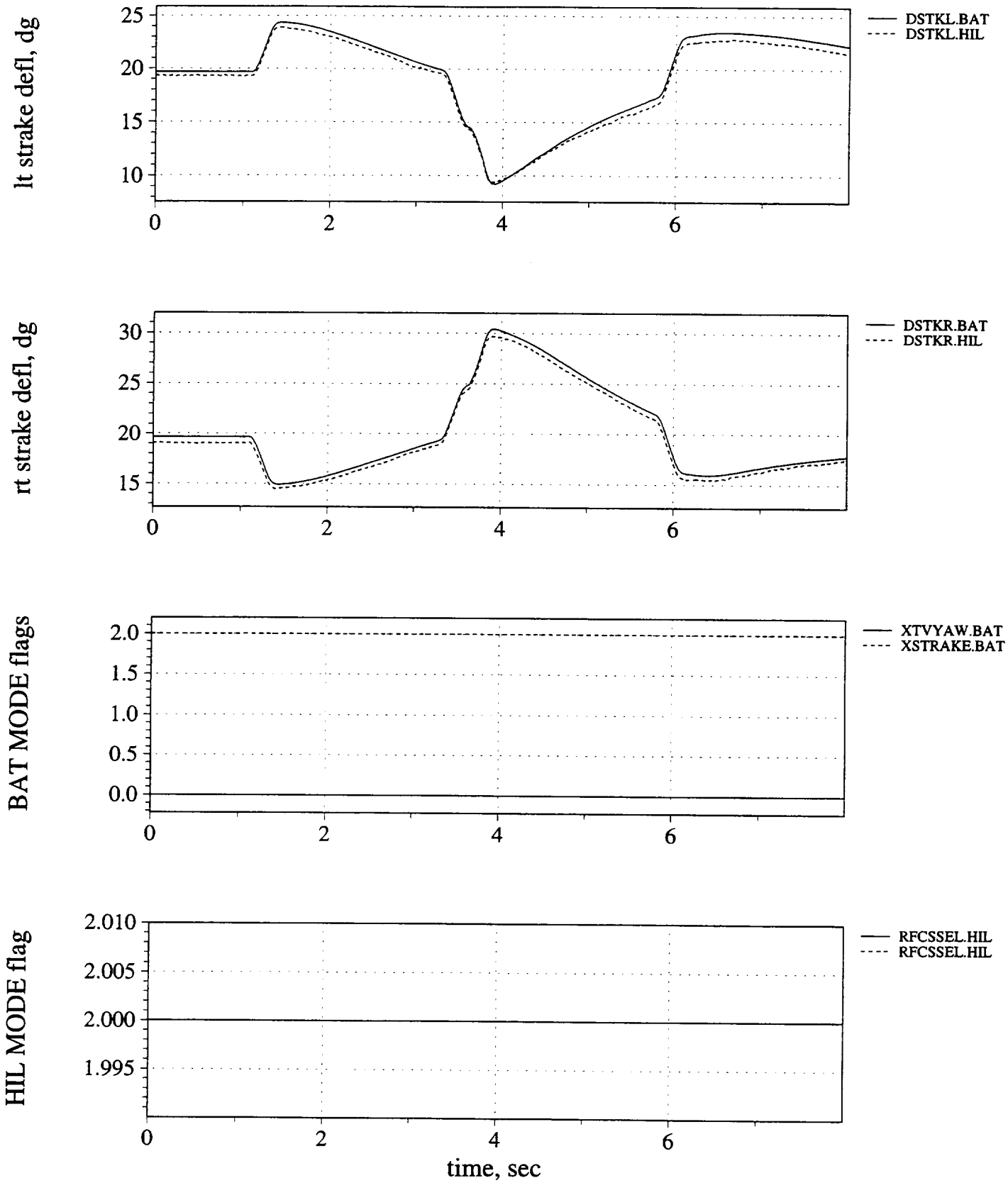
Appendix B - Batch versus HIL Version 154.0

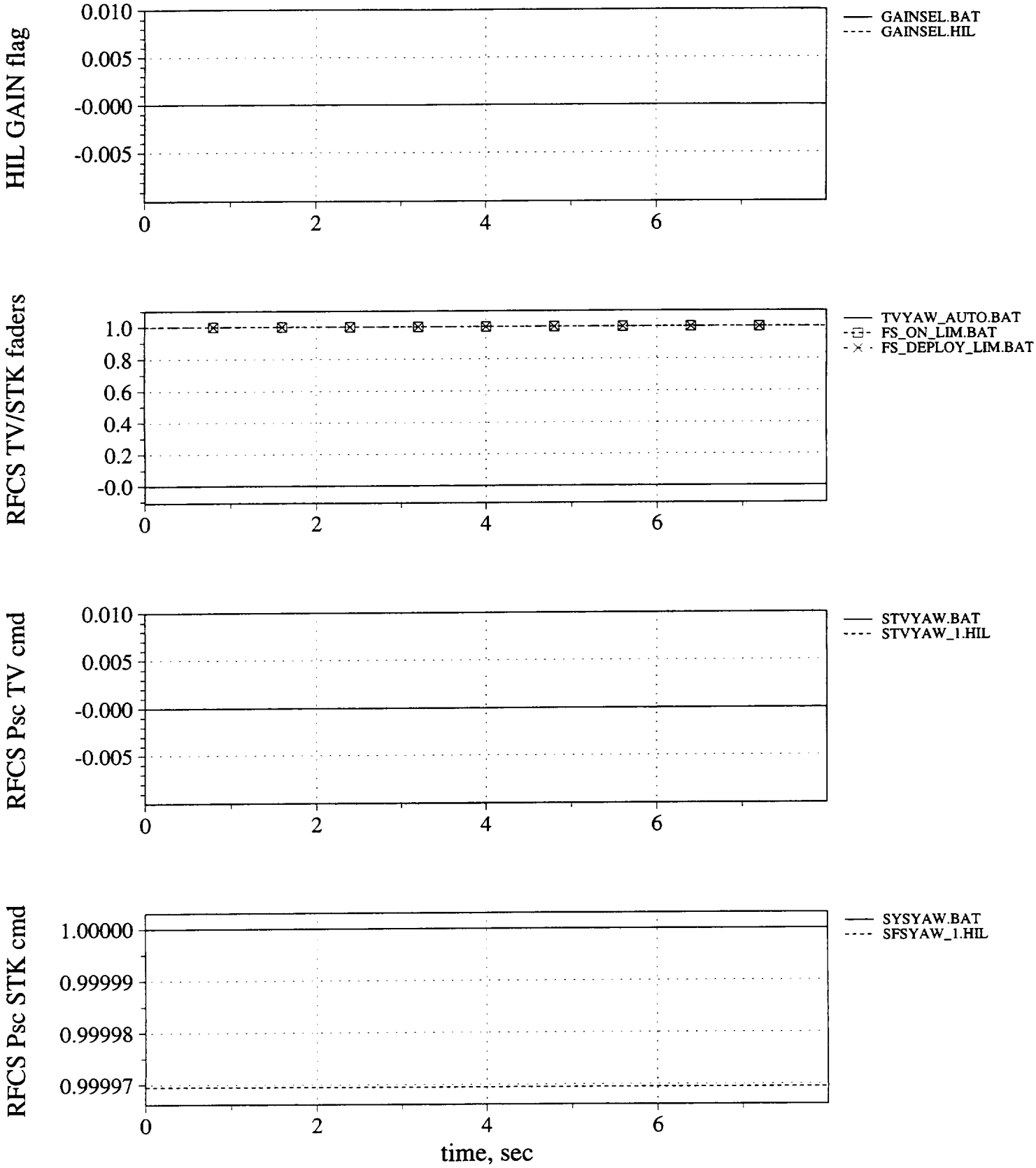
CASE_27__S_Mode__50alp-16k_Max_AB_2_in_ramp_drp page 8/12




rt aileron defl, dg
DRAD.BAT
DRAD.HIL
yaw angle, dg
PSI.BAT
PSI.HIL
lt top vane defl, dg
VANEP1.BAT
VANEP1.HIL
lt outbrd vane defl, dg
VANEP2.BAT
VANEP2.HIL
time, sec

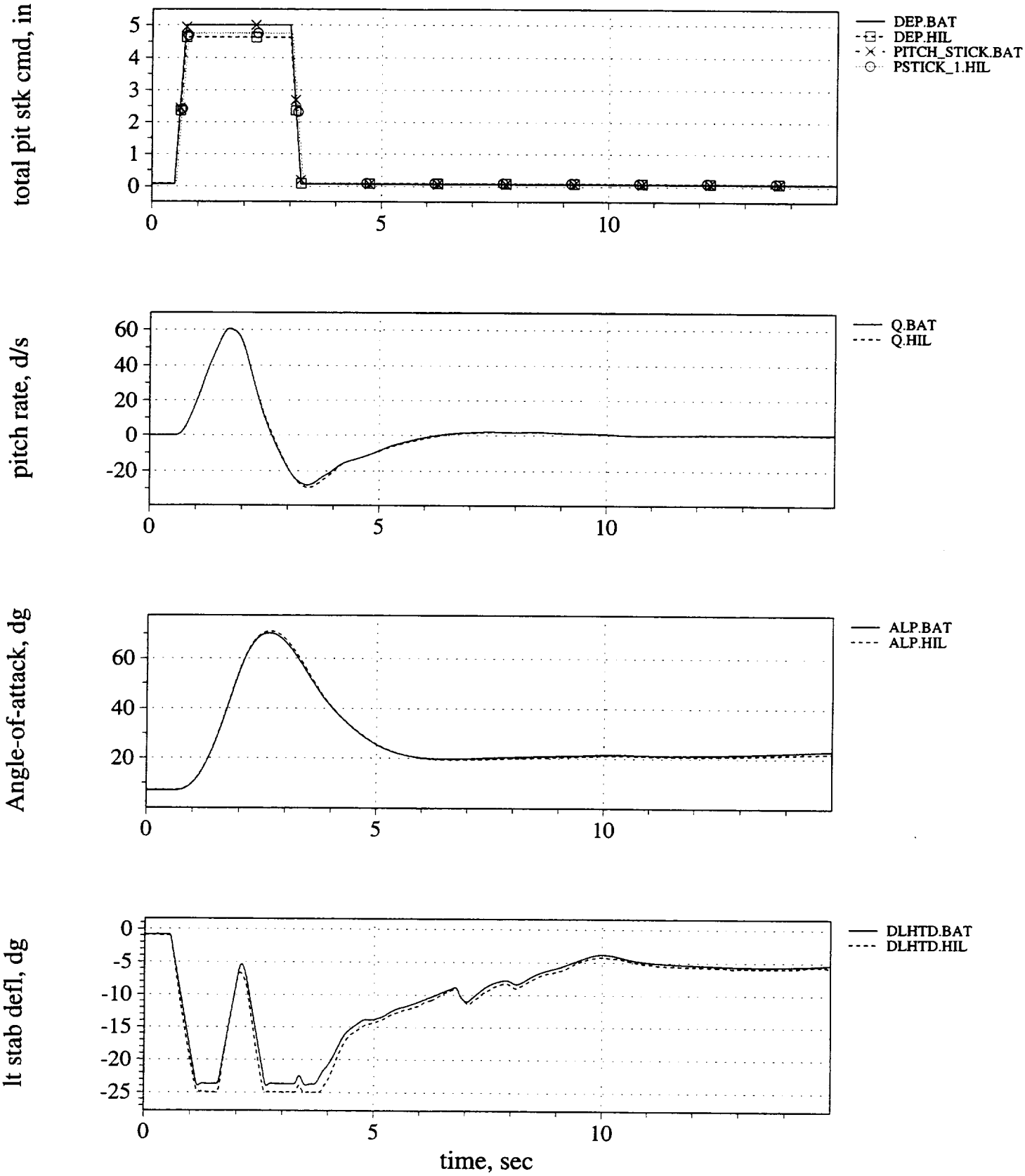

lt inbrd vane defl, dg
VANEP3.BAT
VANEP3.HIL
rt top vane defl, dg
VANEP4.BAT
VANEP4.HIL
rt outbrd vane defl, dg
VANEP5.BAT
VANEP5.HIL
rt inbrd vane defl, dg
VANEP6.BAT
VANEP6.HIL
time, sec


lt strake defl, dg
25
20
15
10
0
2
4
6
DSTKL.BAT
DSTKL.HIL
rt strake defl, dg
30
25
20
15
0
2
4
6
DSTKR.BAT
DSTKR.HIL
BAT MODE flags
2.0
1.5
1.0
0.5
0.0
0
2
4
6
XTVYAW.BAT
XSTRAKE.BAT
HIL MODE flag
2.010
2.005
2.000
1.995
0
2
4
6
RFCSSEL.HIL
RFCSSEL.HIL
time, sec


HIL GAIN flag
0.010
0.005
-0.000
-0.005
0
2
4
6
GAINSEL.BAT
GAINSEL.HIL
RFCS TV/STK faders
1.0
0.8
0.6
0.4
0.2
-0.0
TVYAW_AUTO.BAT
FS_ON_LIM.BAT
FS_DEPLOY_LIM.BAT
RFCS Psc TV cmd
STVYAW.BAT
STVYAW_1.HIL
RFCS Psc STK cmd
1.00000
0.99999
0.99998
0.99997
SYSYAW.BAT
SFSYAW_1.HIL
time, sec

Appendix B - Batch versus HIL Version 154.0

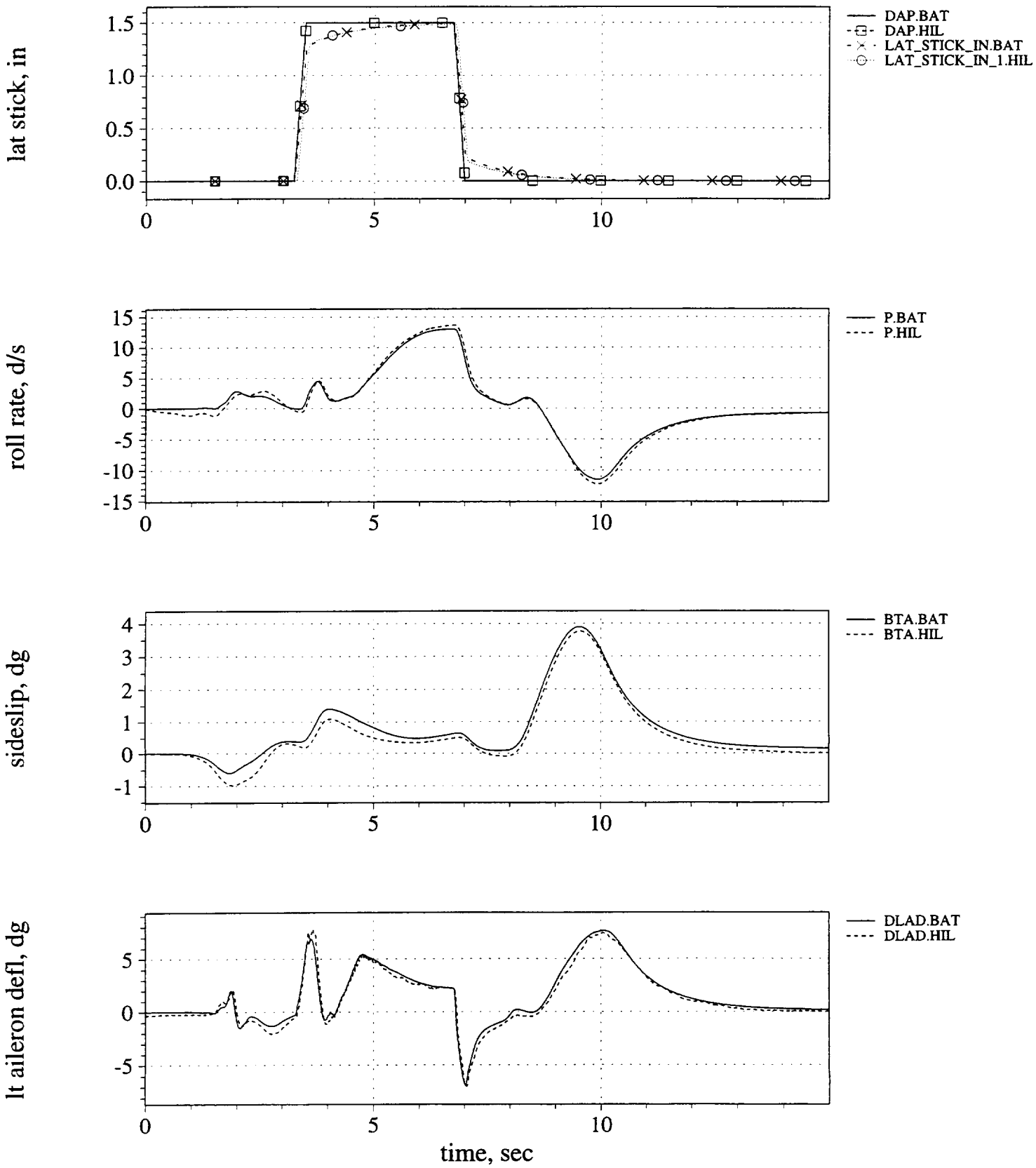
CASE_30__S_Mode__.68-40k_trim--3_axis_input page 1/12



Performance Validation Checkcases

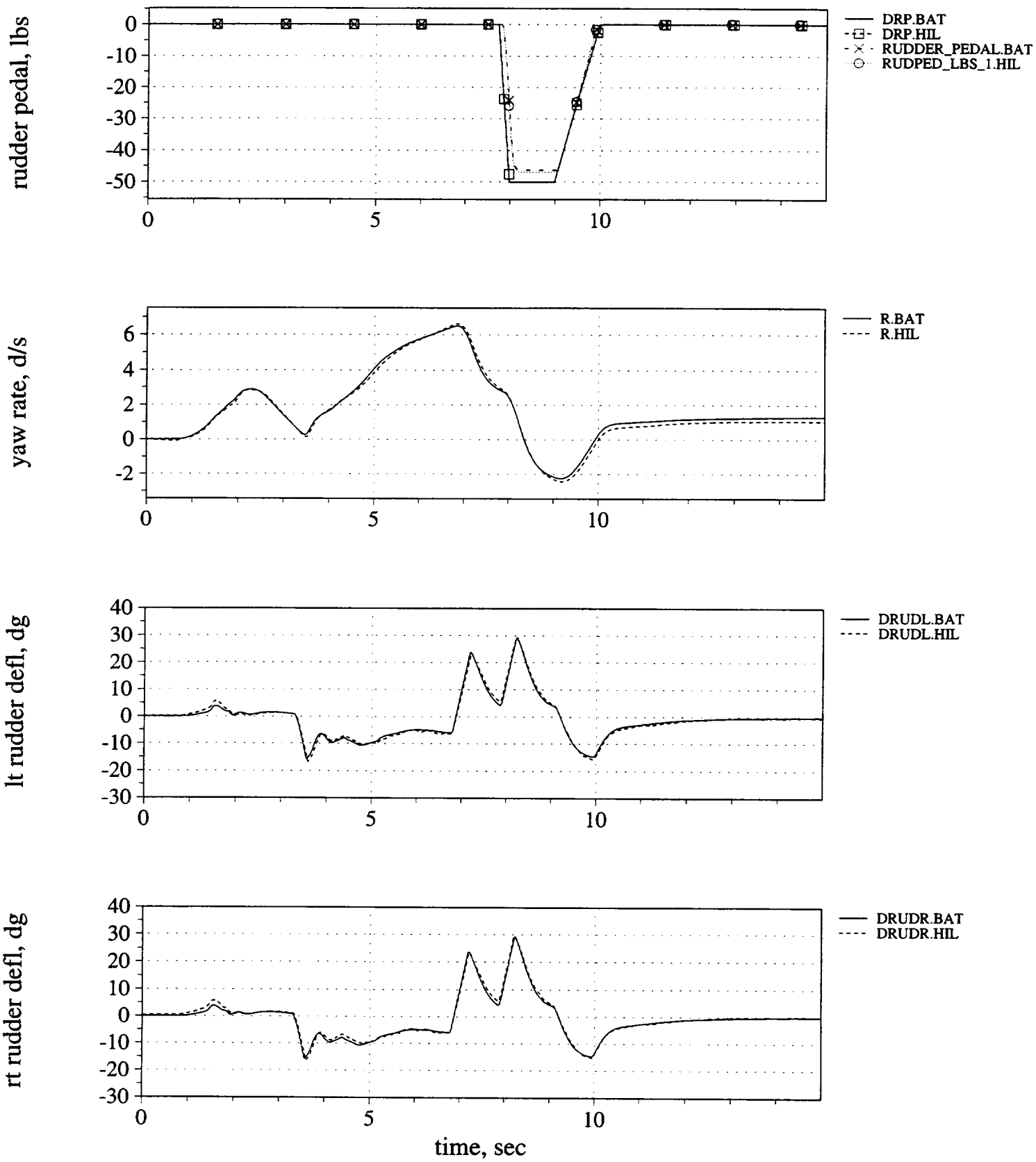
Appendix B - Batch versus HIL Version 154.0

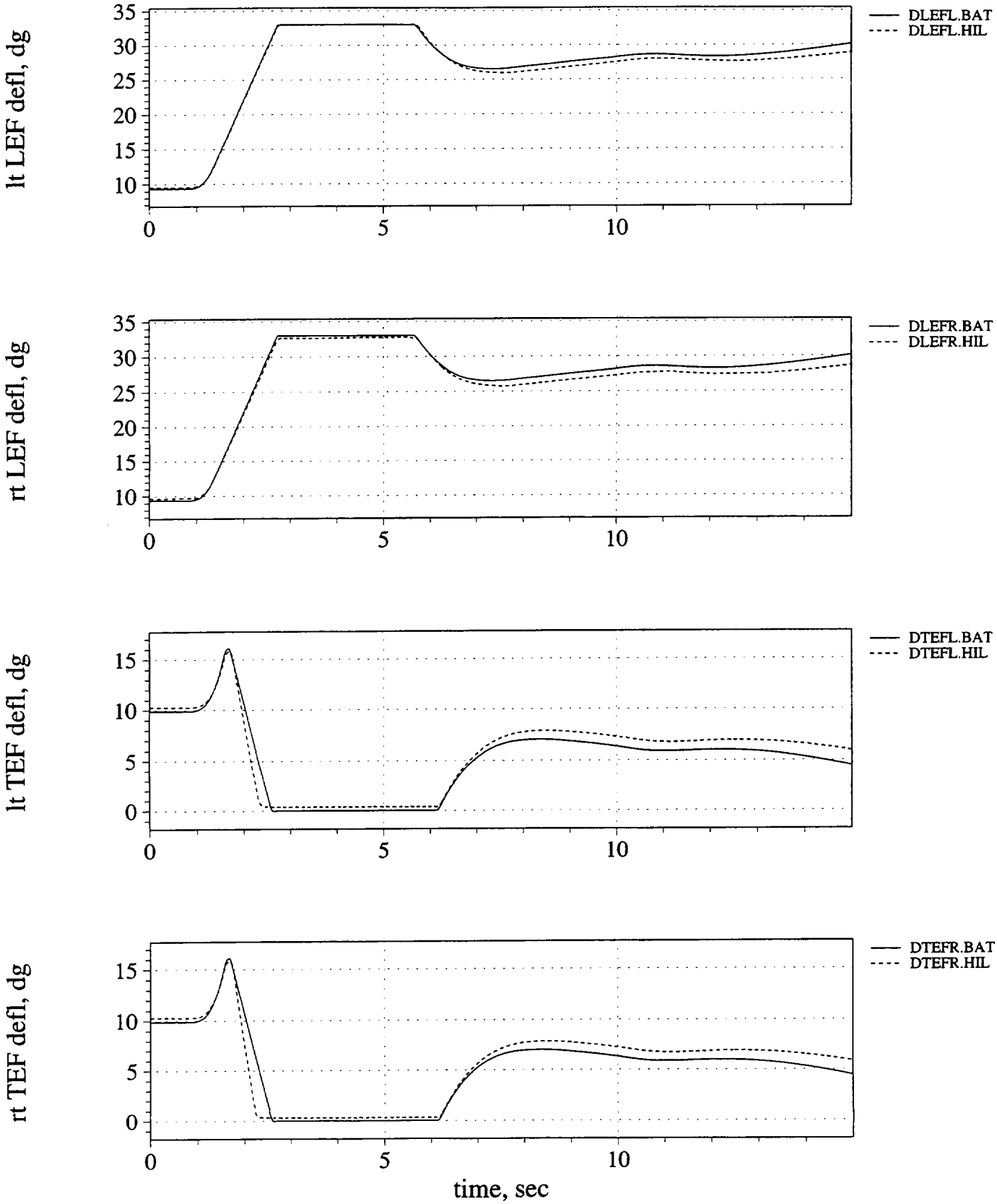
CASE_30__S_Mode__.68-40k_trim--3_axis_input page 2/12

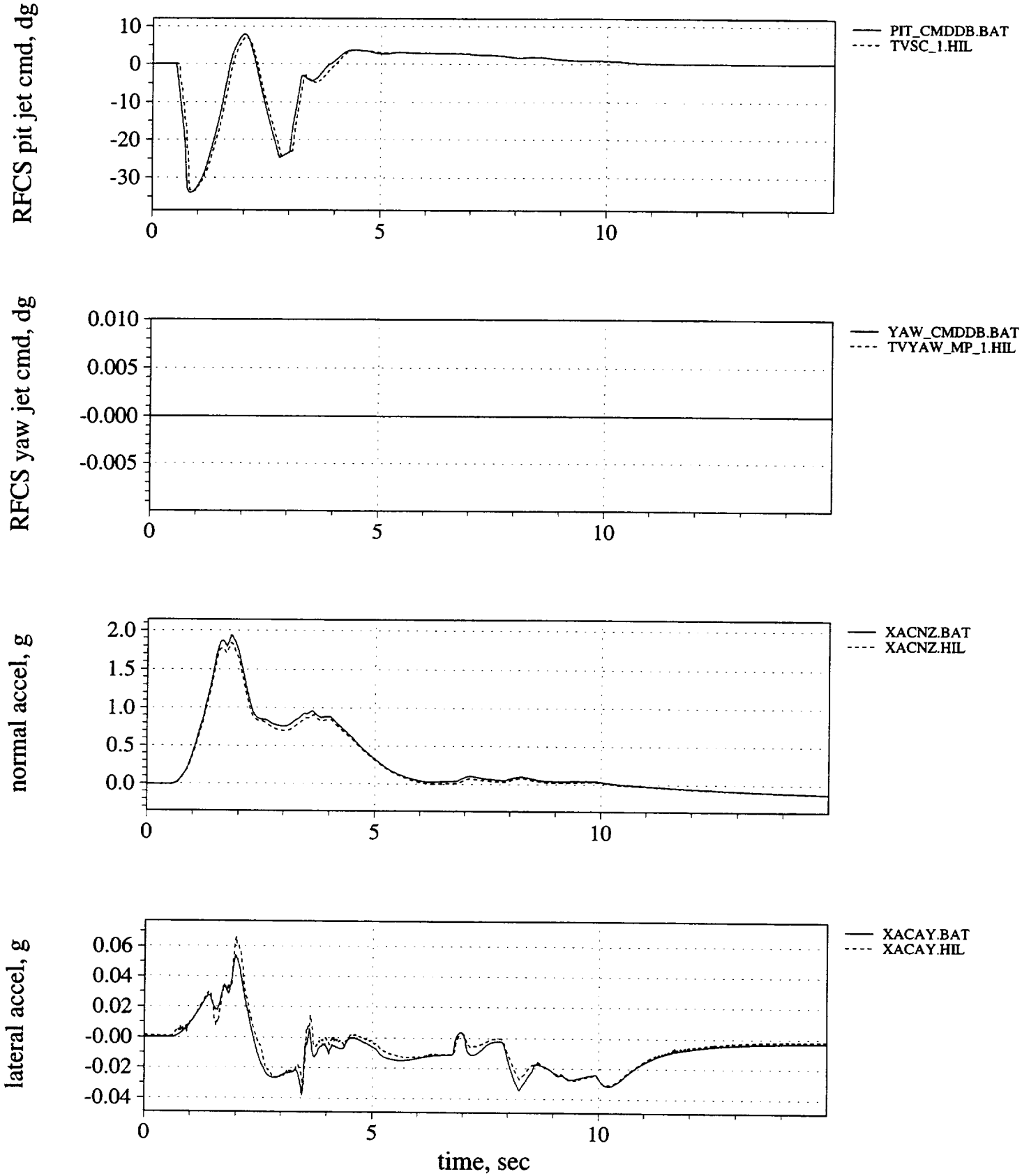


Appendix B - Batch versus HIL Version 154.0

CASE_30__S_Mode__.68-40k_trim--3_axis_input page 3/12

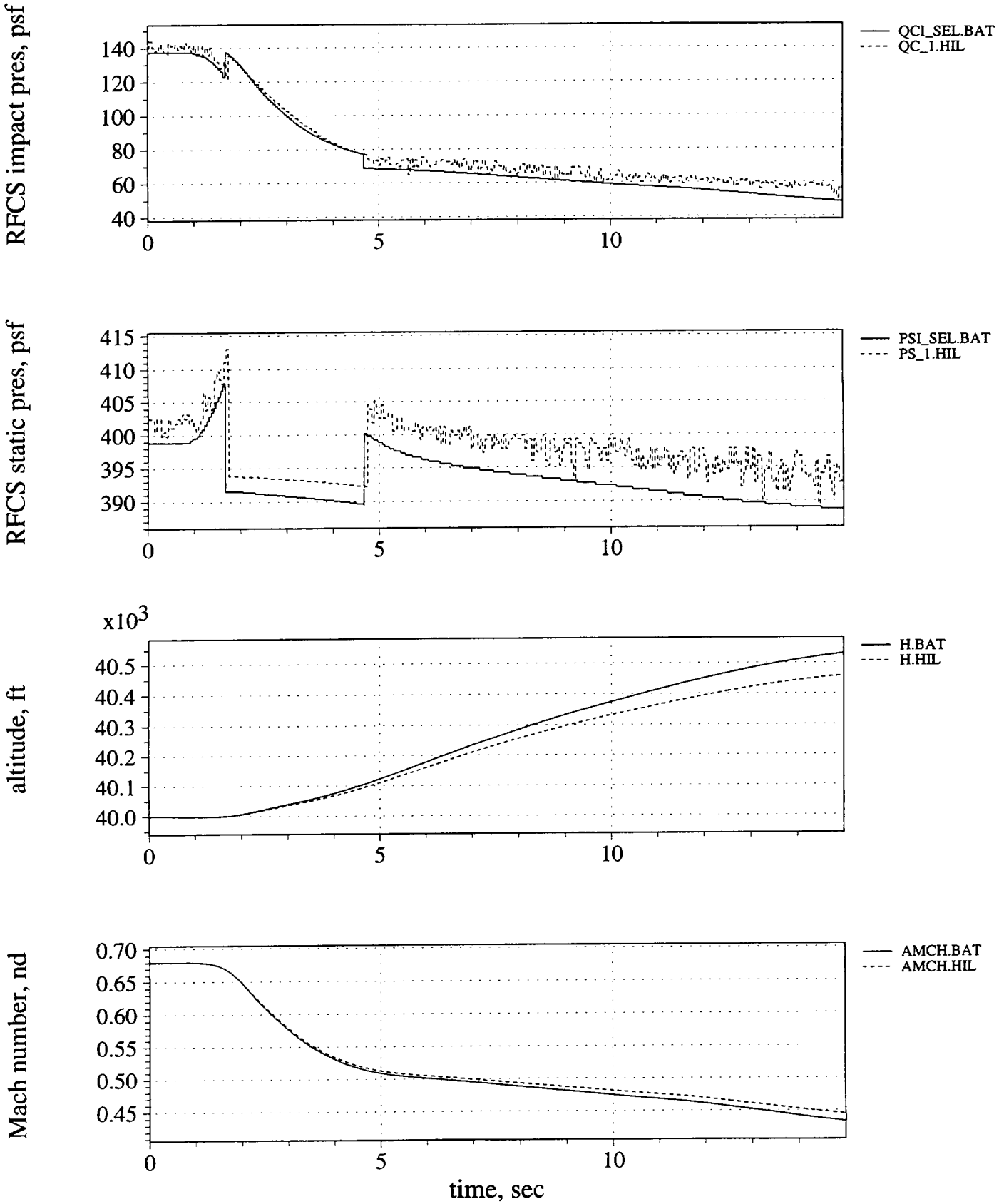



lt LEF defl, dg
DLEFL.BAT
DLEFL.HIL
rt LEF defl, dg
DLEFR.BAT
DLEFR.HIL
lt TEF defl, dg
DTEFL.BAT
DTEFL.HIL
rt TEF defl, dg
DTEFR.BAT
DTEFR.HIL
time, sec


RFCS pit jet cmd, dg
10
0
-10
-20
-30
0
5
10
PIT_CMDDB.BAT
TVSC_1.HIL
RFCS yaw jet cmd, dg
0.010
0.005
-0.000
-0.005
0
5
10
YAW_CMDDB.BAT
TVYAW_MP_1.HIL
normal accel, g
2.0
1.5
1.0
0.5
0.0
0
5
10
XACNZ.BAT
XACNZ.HIL
lateral accel, g
0.06
0.04
0.02
-0.00
-0.02
-0.04
0
5
10
XACAY.BAT
XACAY.HIL
time, sec

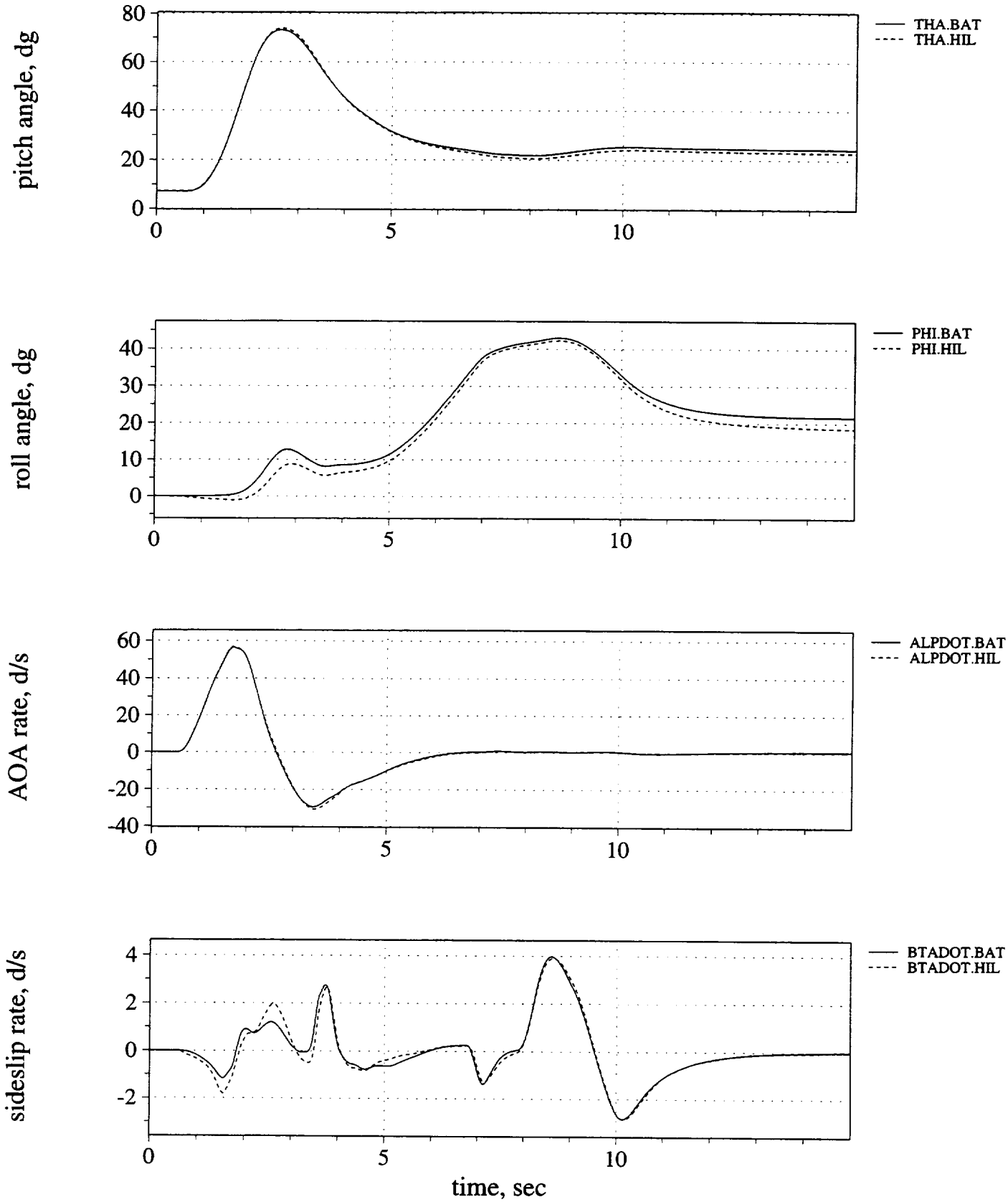
Appendix B - Batch versus HIL Version 154.0

CASE_30__S_Mode__.68-40k_trim--3_axis_input page 6/12



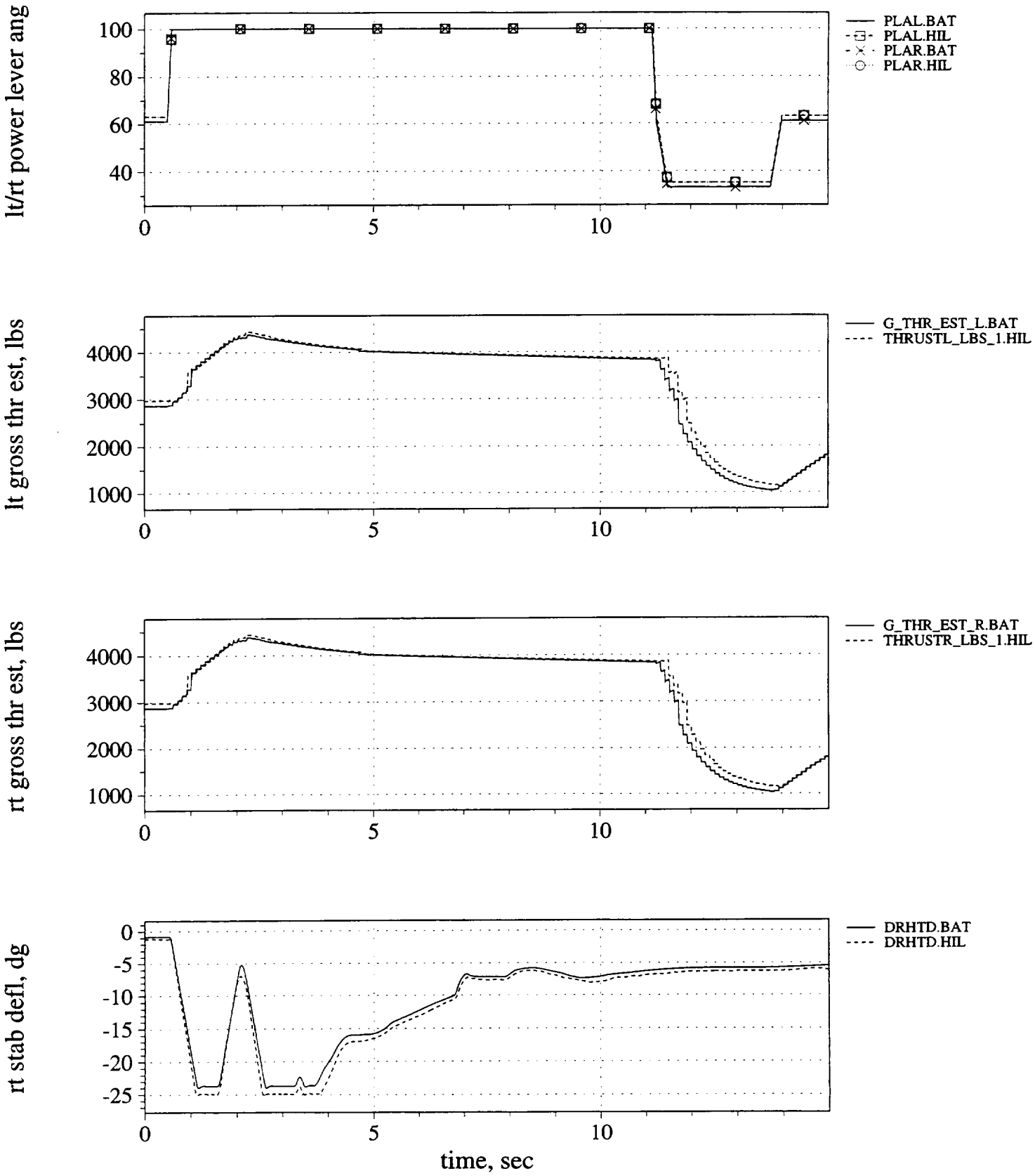
Appendix B - Batch versus HIL Version 154.0

CASE_30__S_Mode__.68-40k_trim--3_axis_input page 7/12



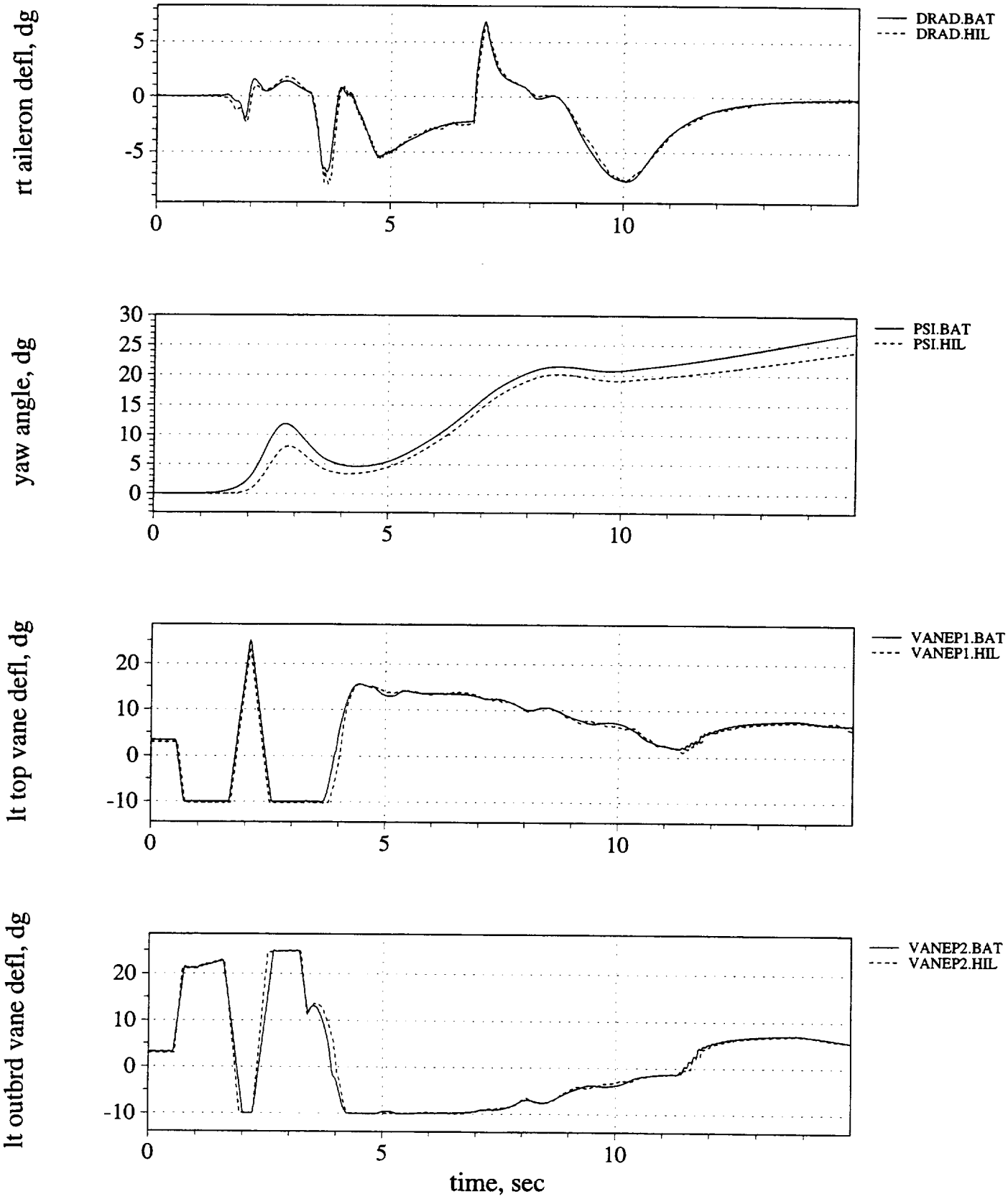
Appendix B - Batch versus HIL Version 154.0

CASE_30__S_Mode__.68-40k_trim--3_axis_input page 8/12

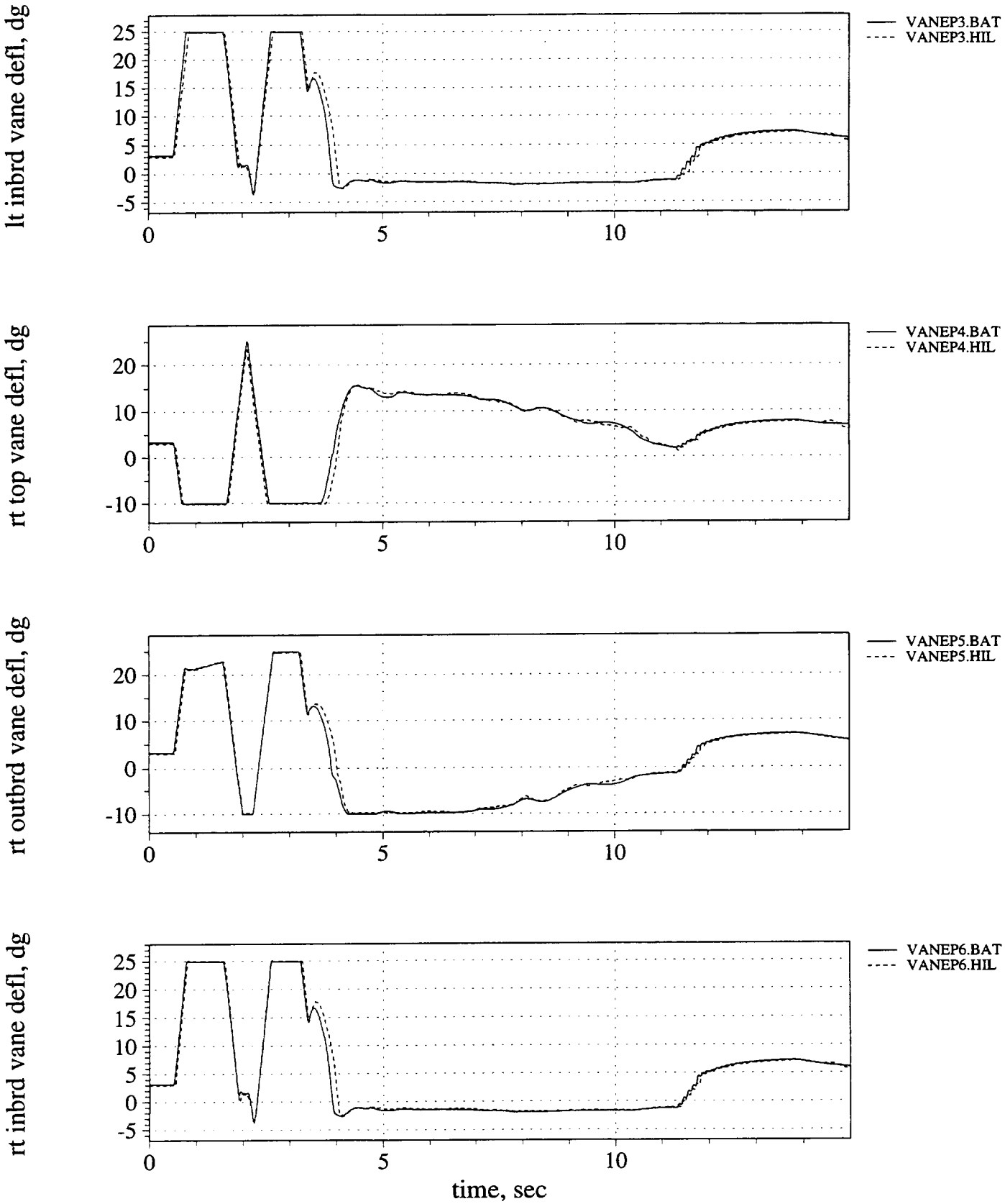


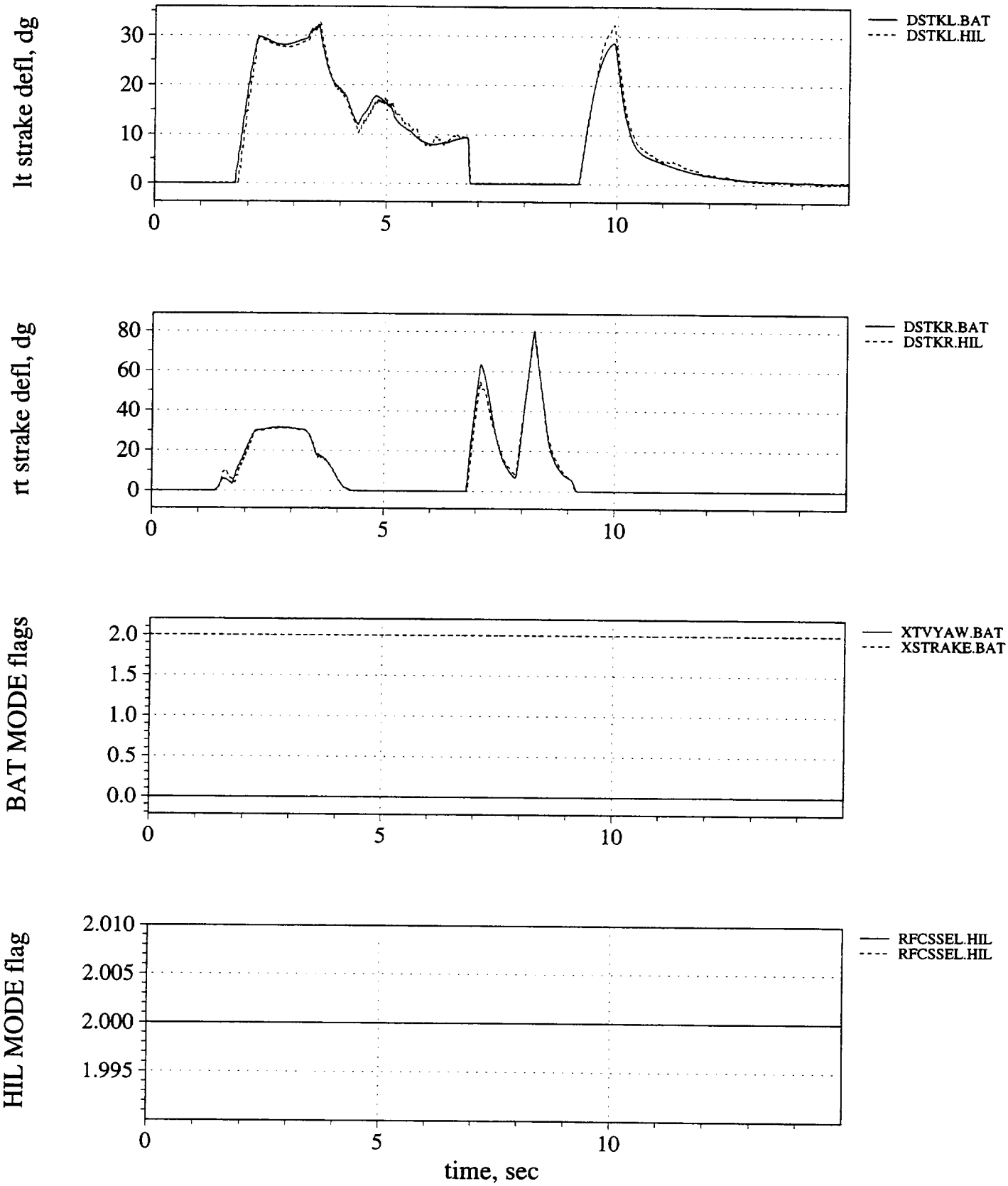
Appendix B - Batch versus HIL Version 154.0

CASE_30__S_Mode__.68-40k_trim--3_axis_input page 9/12



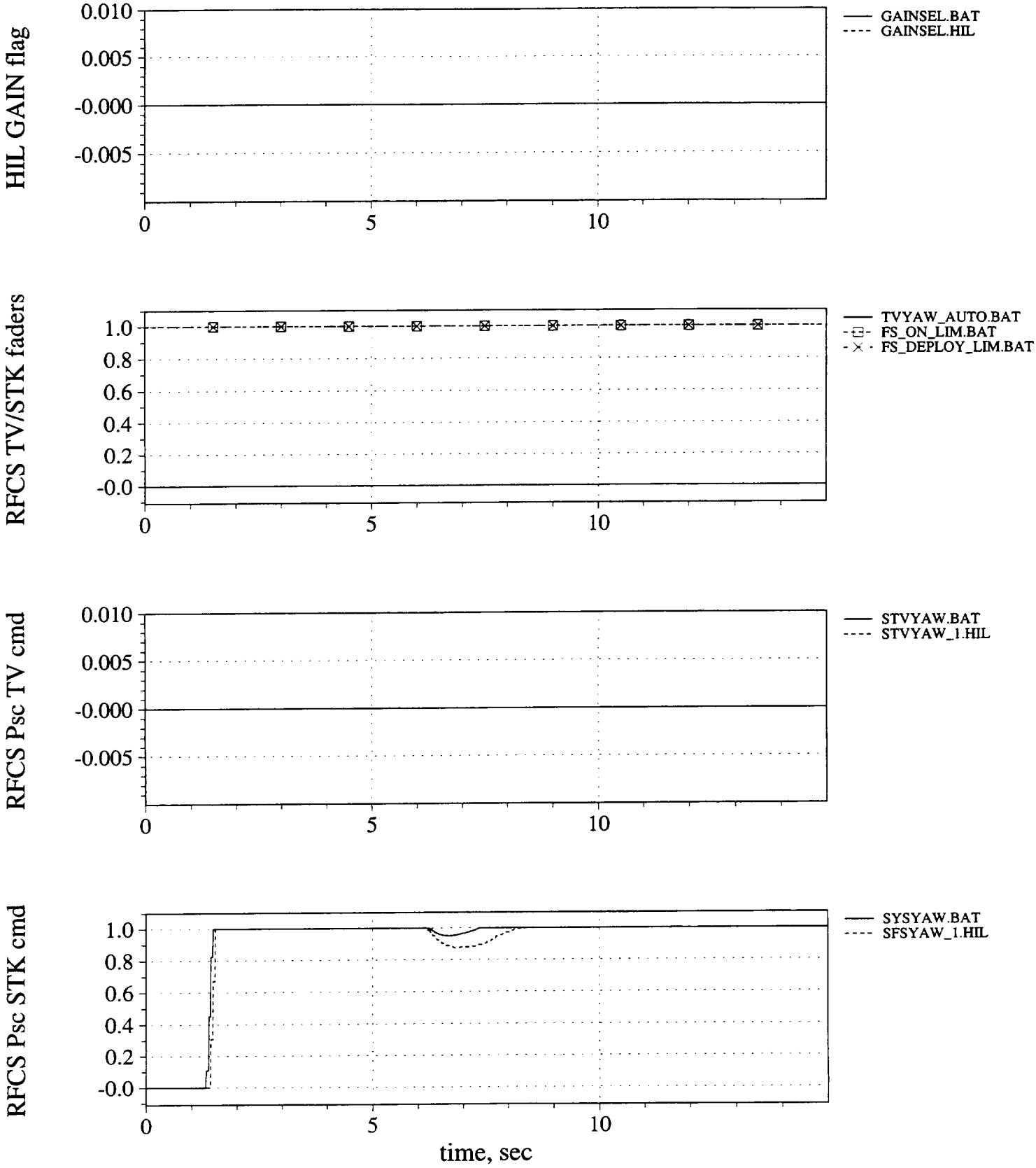
Performance Validation Checkcases


lt inbrd vane defl, dg
VANEP3.BAT
VANEP3.HIL
rt top vane defl, dg
VANEP4.BAT
VANEP4.HIL
rt outbrd vane defl, dg
VANEP5.BAT
VANEP5.HIL
rt inbrd vane defl, dg
VANEP6.BAT
VANEP6.HIL
time, sec


lt strake defl, dg
30
20
10
0
0
5
10
DSTKL.BAT
DSTKL.HIL
rt strake defl, dg
80
60
40
20
0
0
5
10
DSTKR.BAT
DSTKR.HIL
BAT MODE flags
2.0
1.5
1.0
0.5
0.0
0
5
10
XTVYAW.BAT
XSTRAKE.BAT
HIL MODE flag
2.010
2.005
2.000
1.995
0
5
10
time, sec
RFCSSEL.HIL
RFCSSEL.HIL

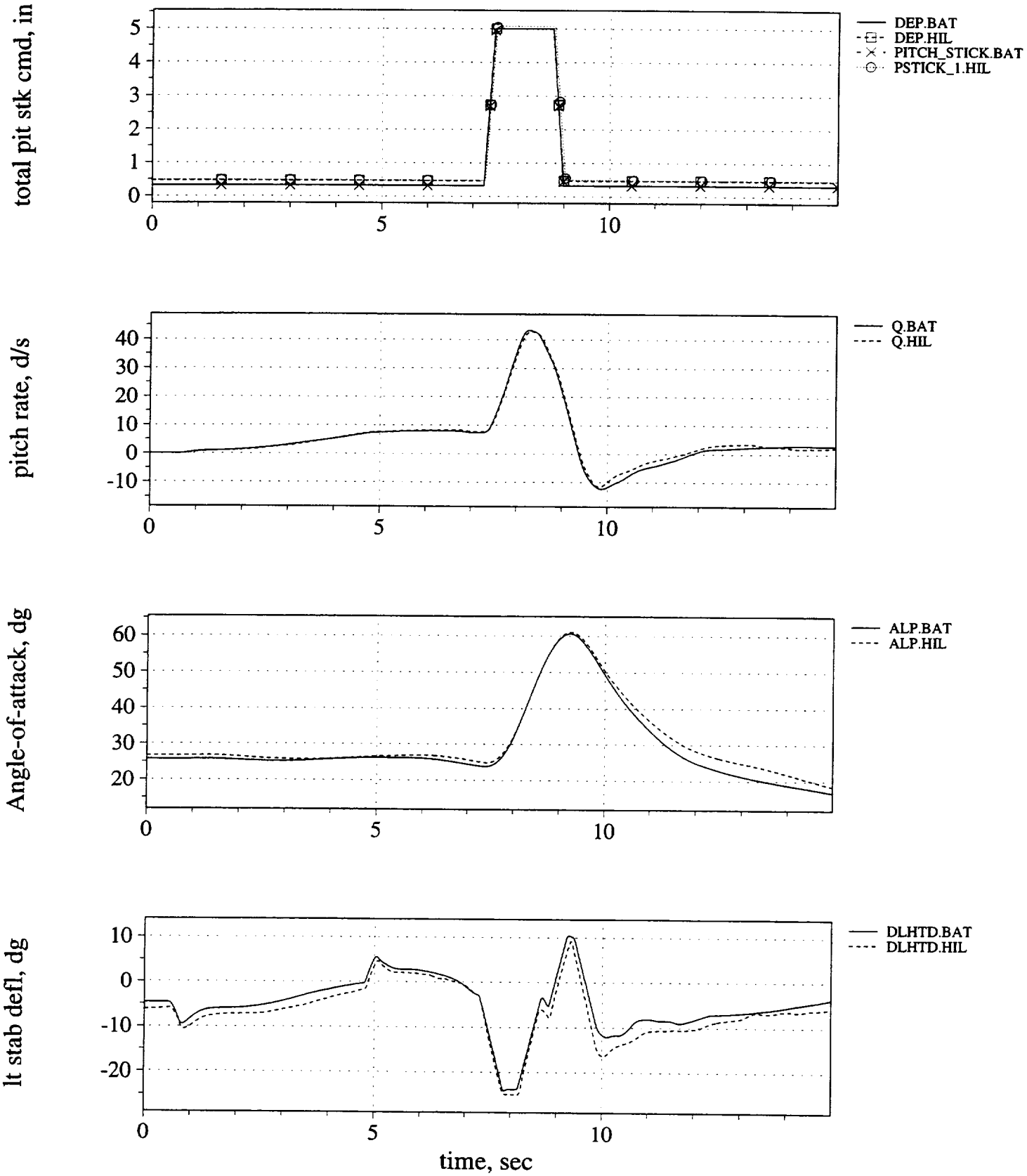
Appendix B - Batch versus HIL Version 154.0

CASE_30__S_Mode__.68-40k_trim--3_axis_input page 12/12



Appendix B - Batch versus HIL Version 154.0

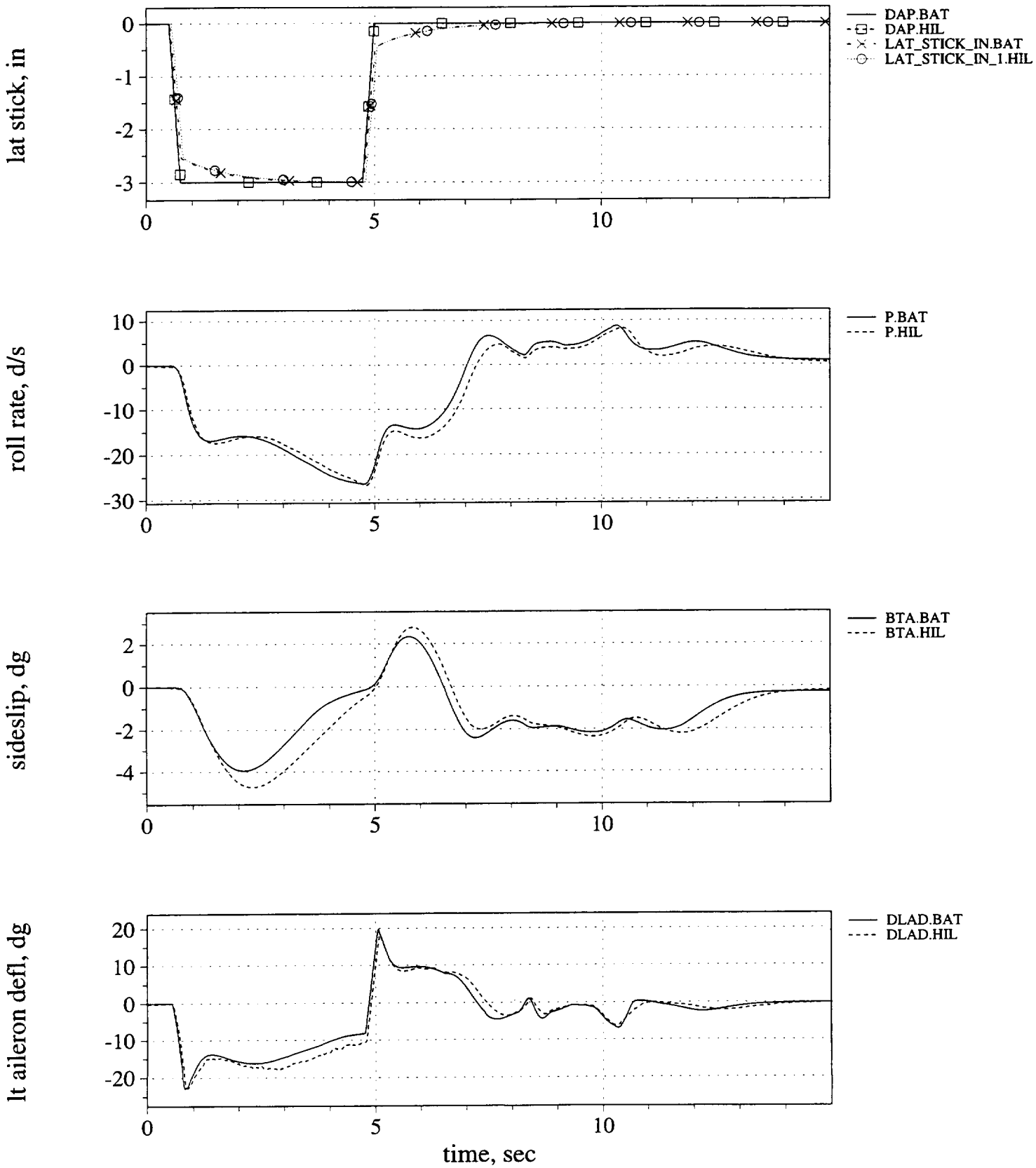
CASE_33__S_Mode__.35-25k_trim--3_axis_input page 1/12



Performance Validation Checkcases

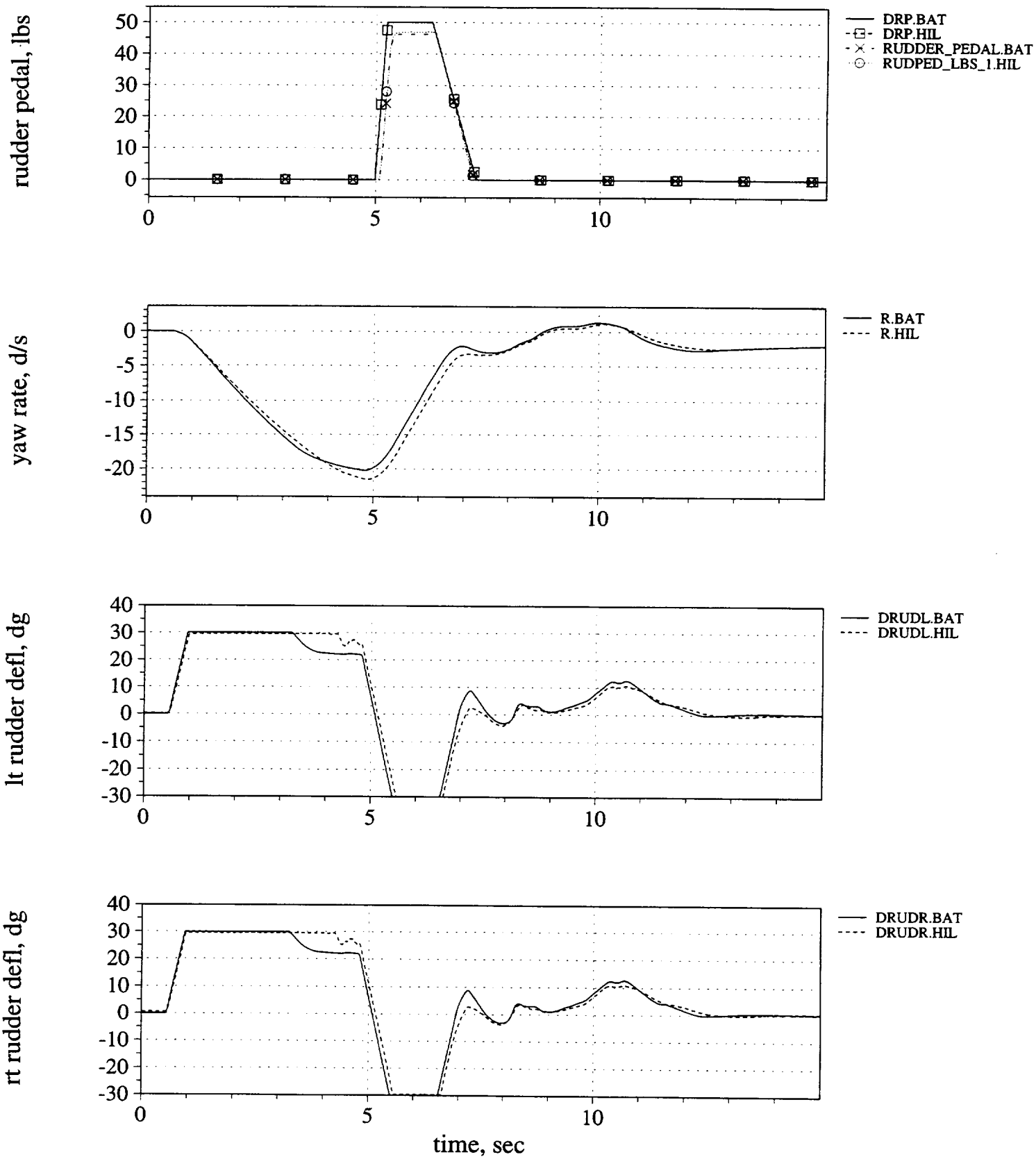
Appendix B - Batch versus HIL Version 154.0

CASE_33__S_Mode__.35-25k_trim--3_axis_input page 2/12



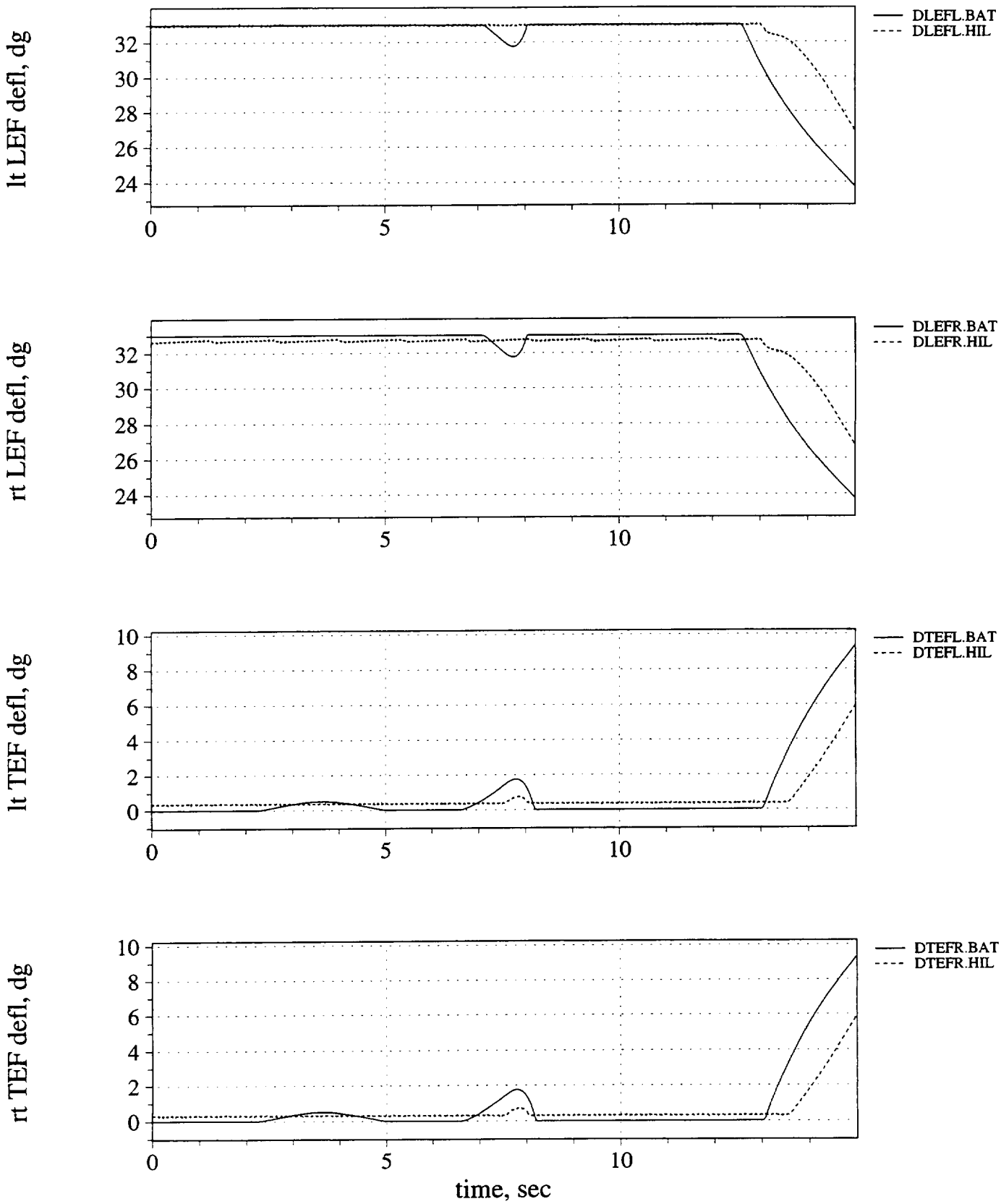
Appendix B - Batch versus HIL Version 154.0

CASE_33__S_Mode__.35-25k_trim--3_axis_input page 3/12



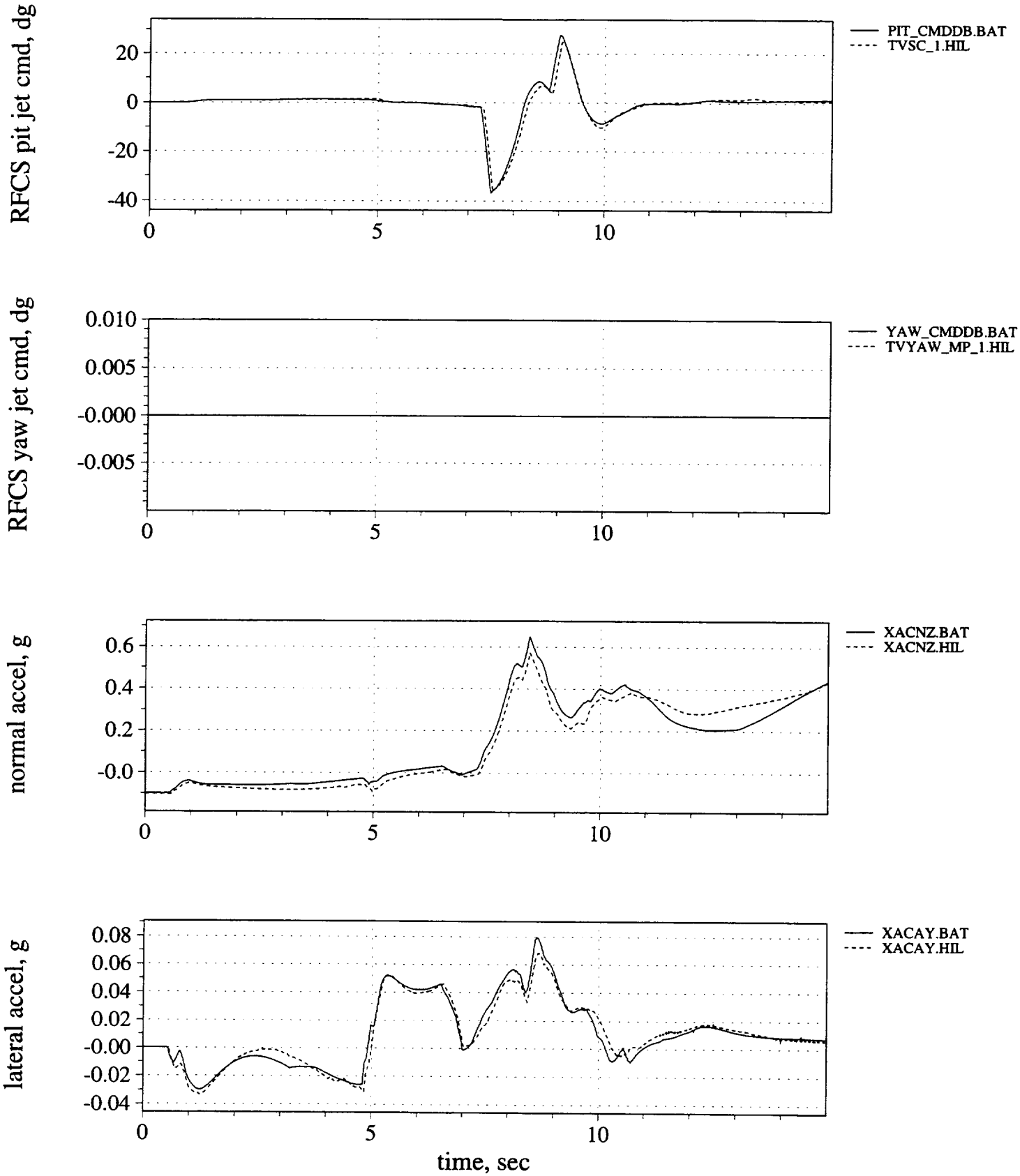
Appendix B - Batch versus HIL Version 154.0

CASE_33__S_Mode__.35-25k_trim--3_axis_input page 4/12



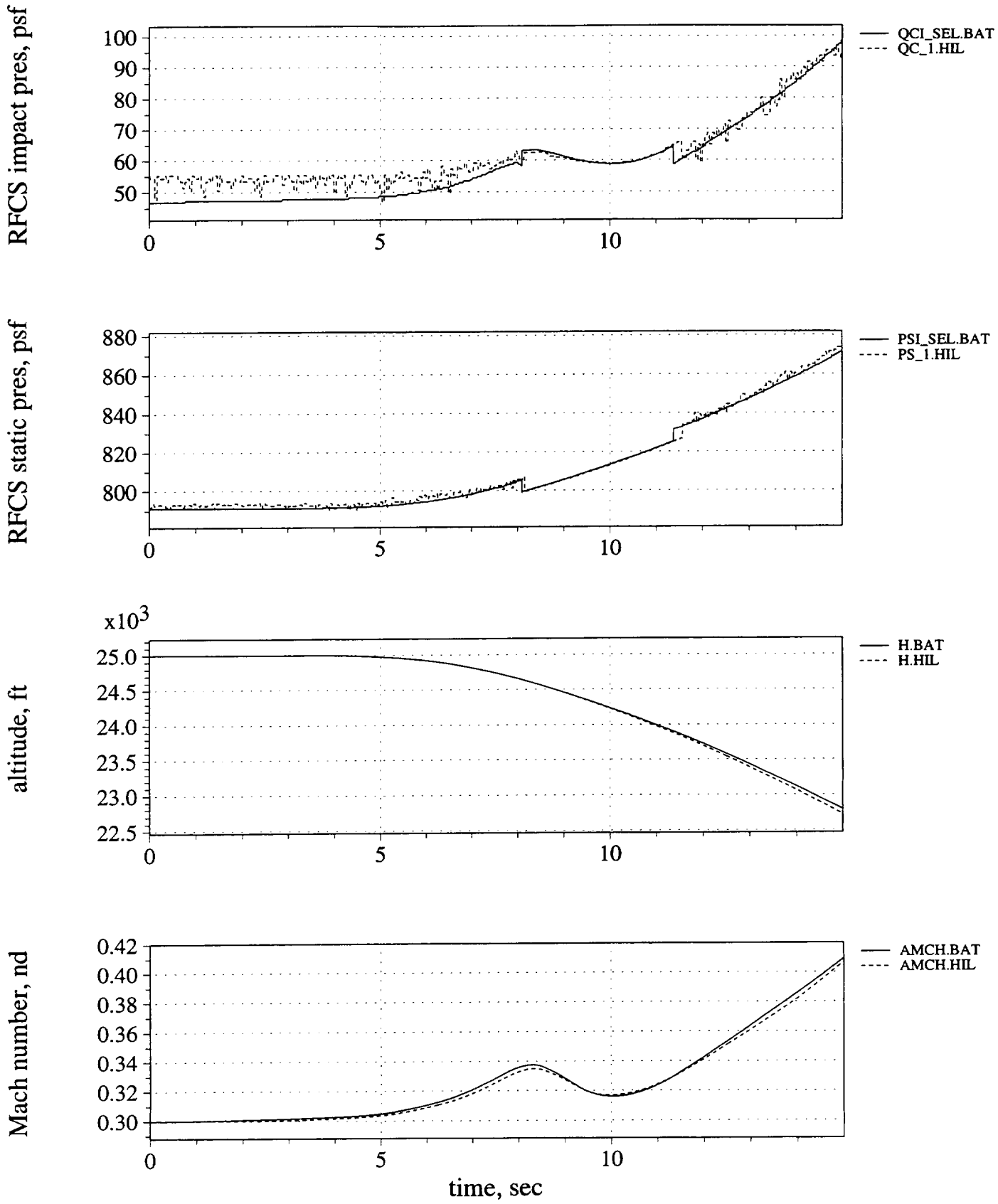
Appendix B - Batch versus HIL Version 154.0

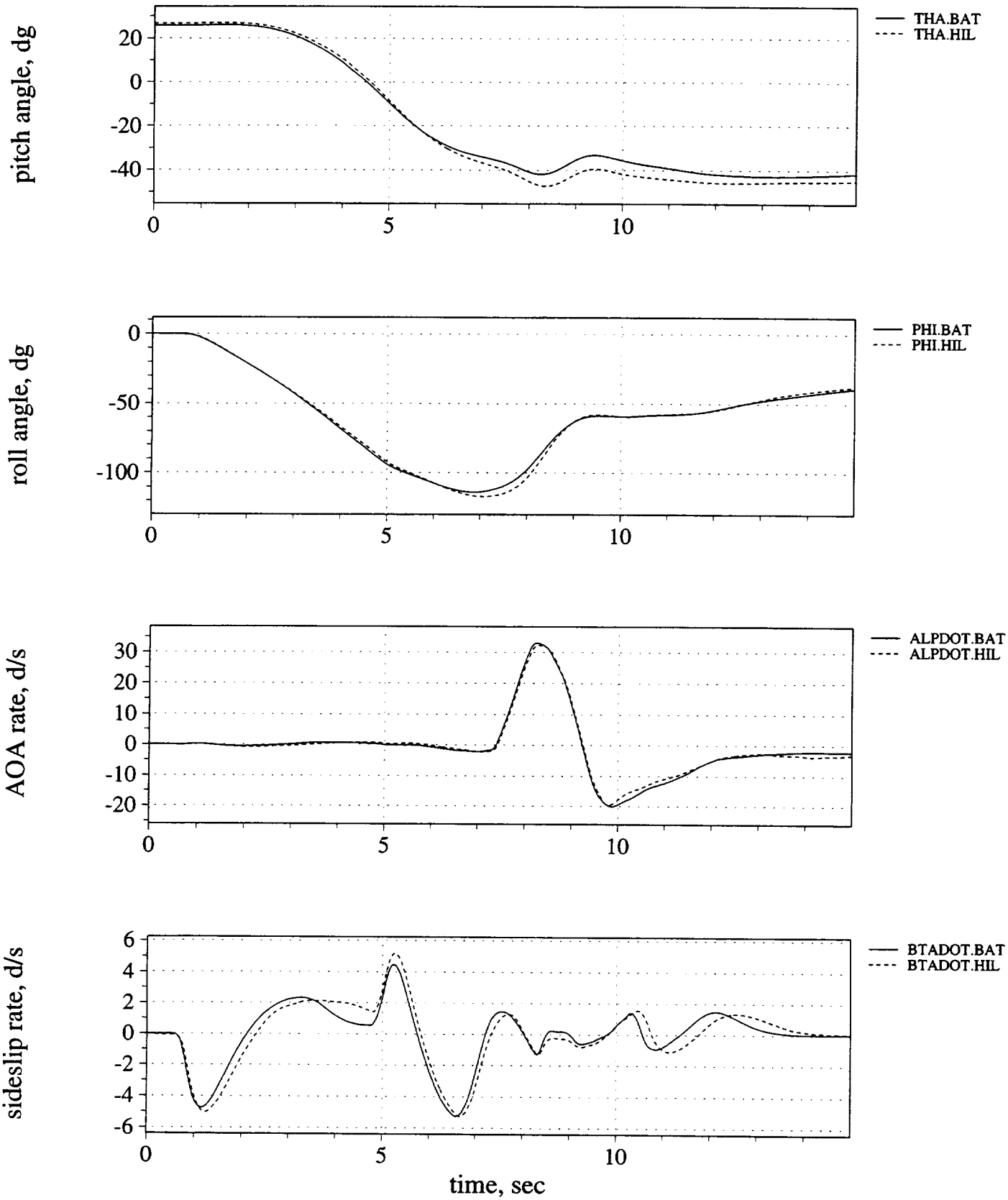
CASE_33__S_Mode__.35-25k_trim--3_axis_input page 5/12

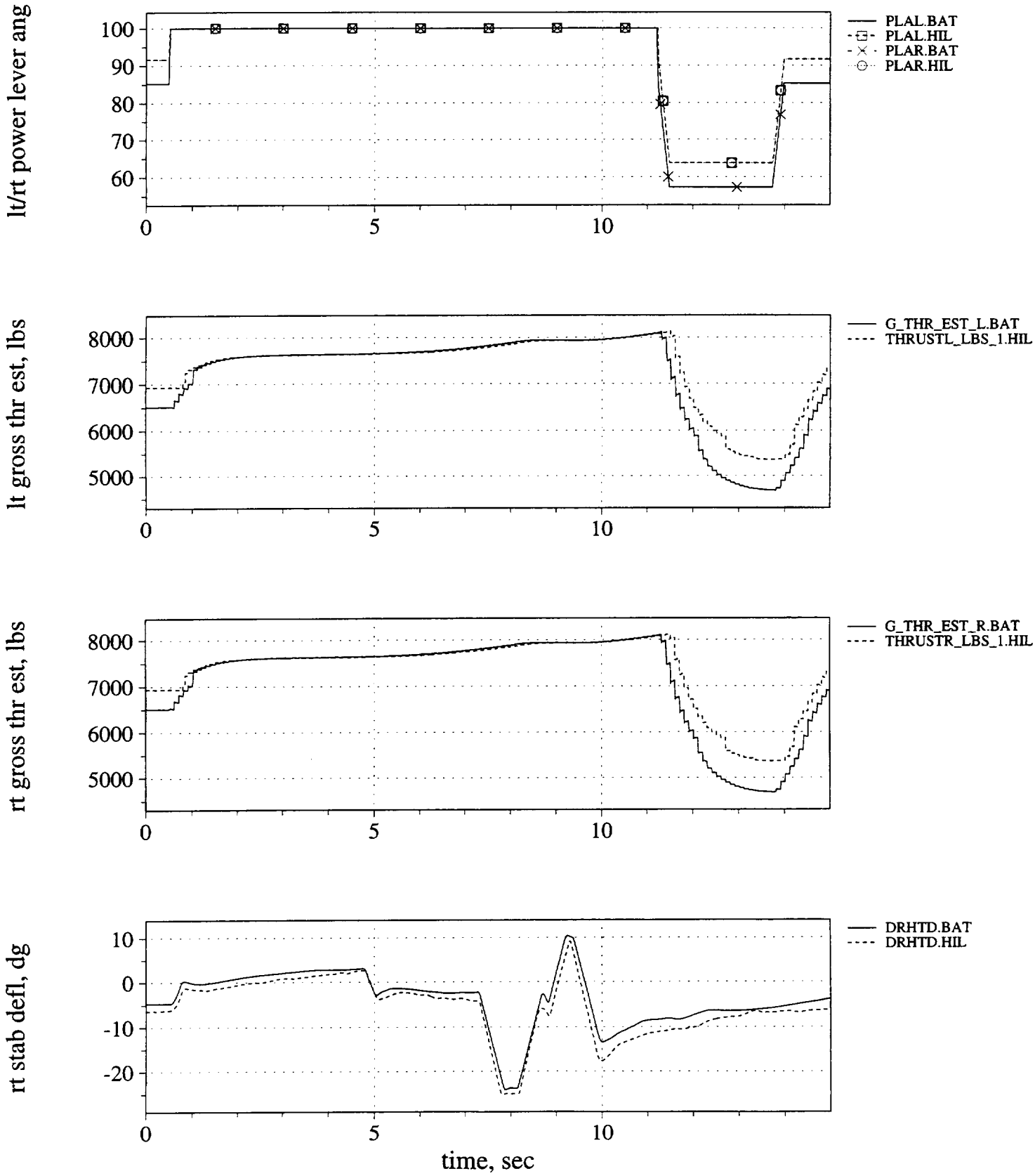


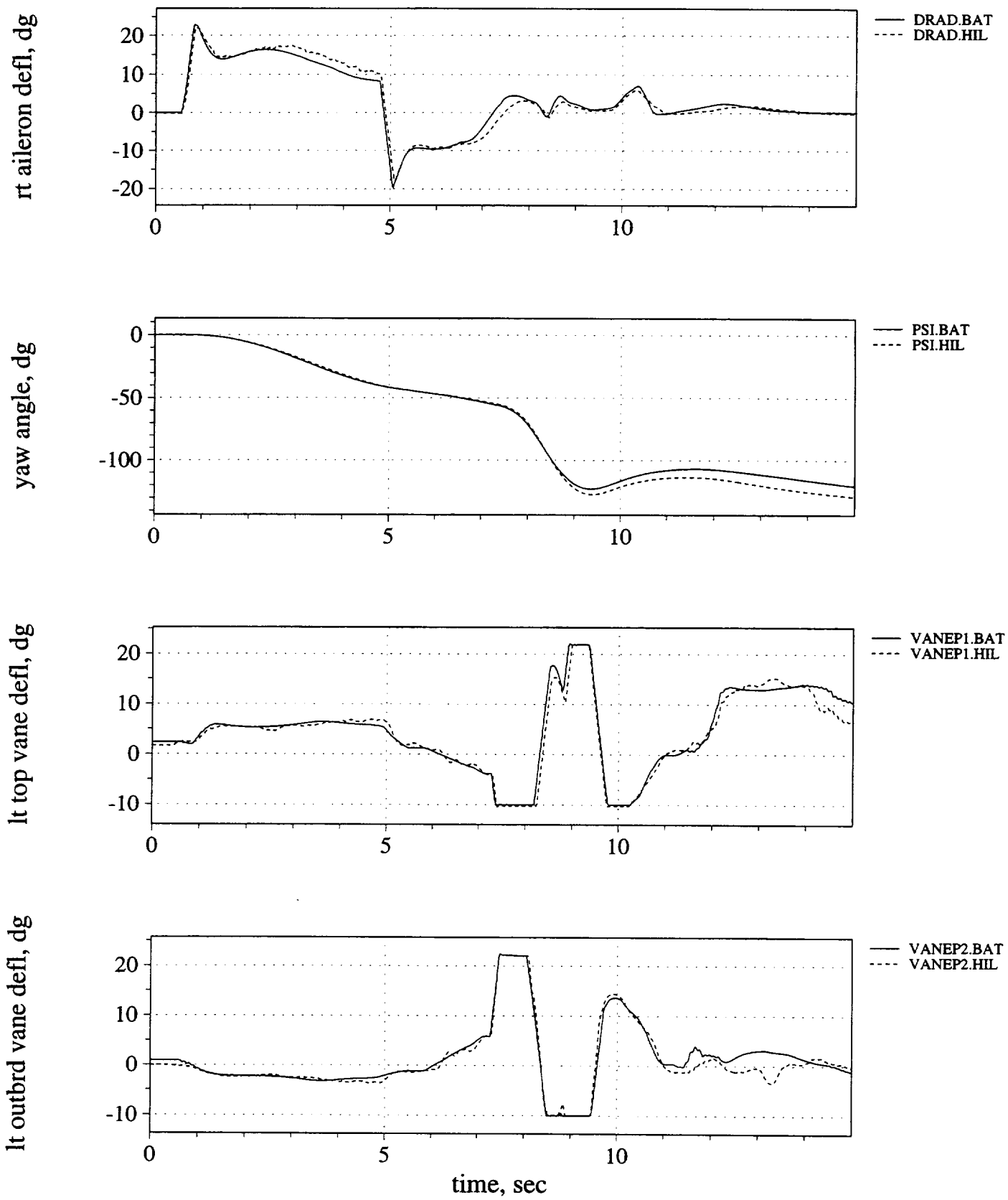
Appendix B - Batch versus HIL Version 154.0

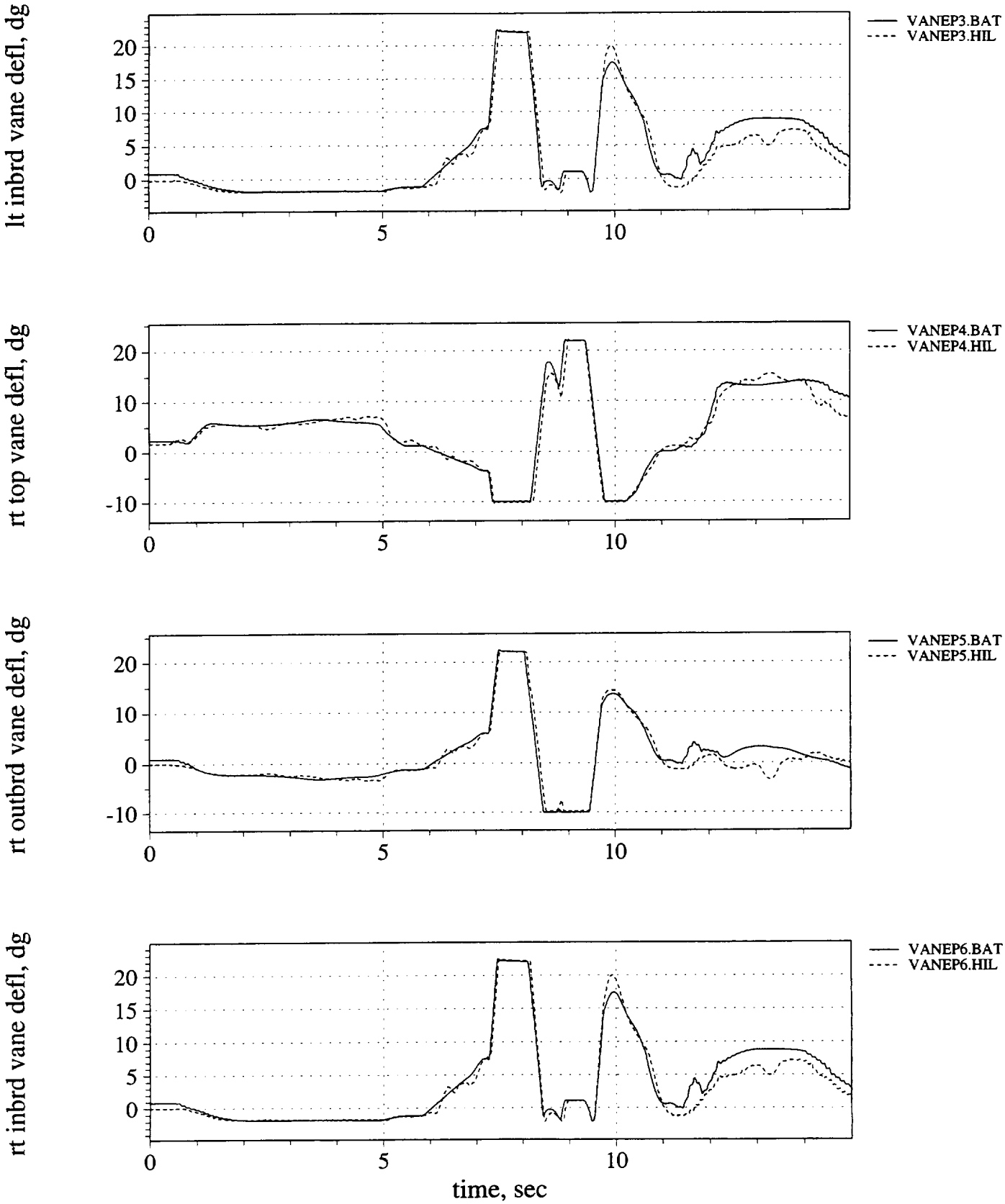
CASE_33__S_Mode__.35-25k_trim--3_axis_input page 6/12

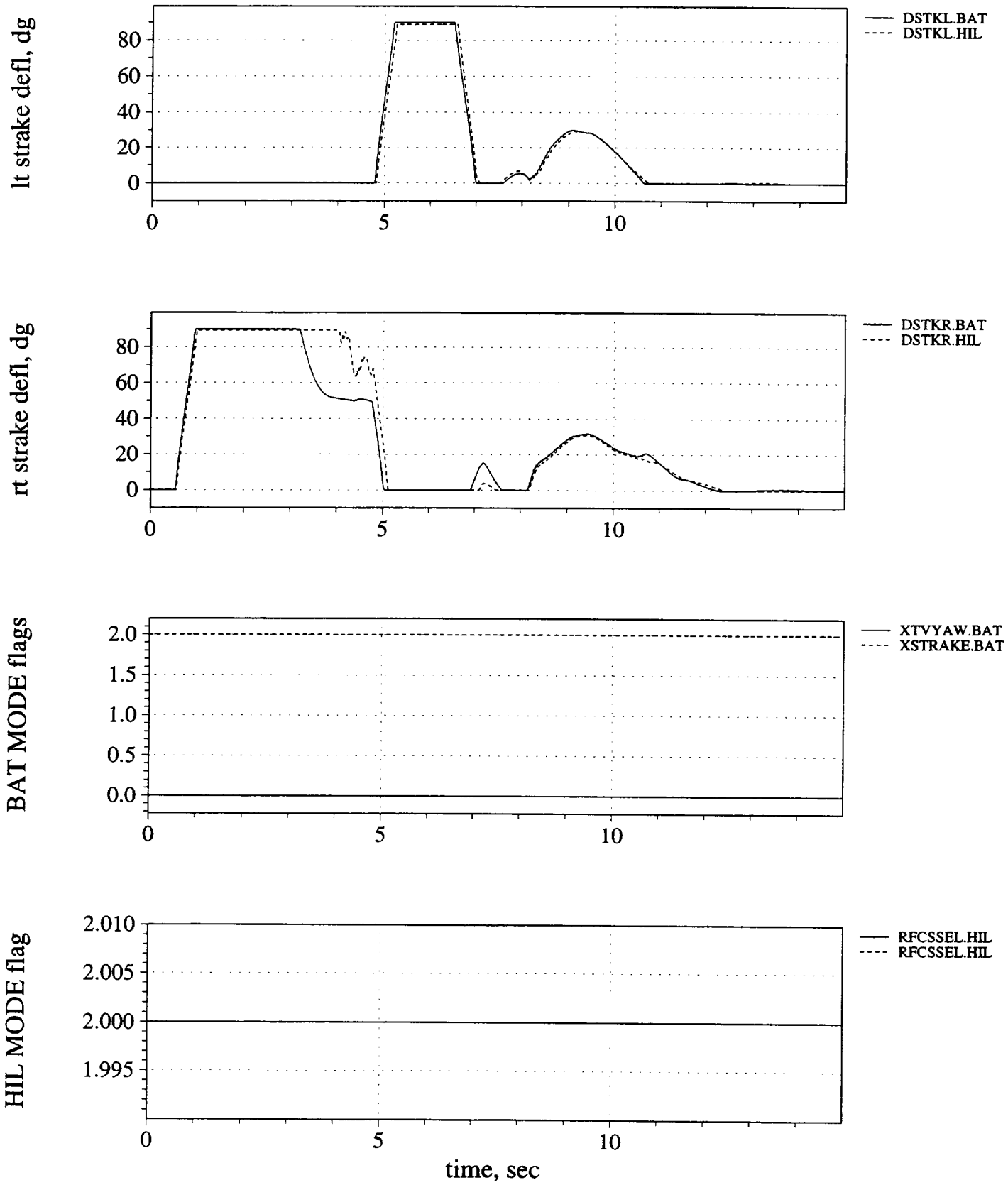


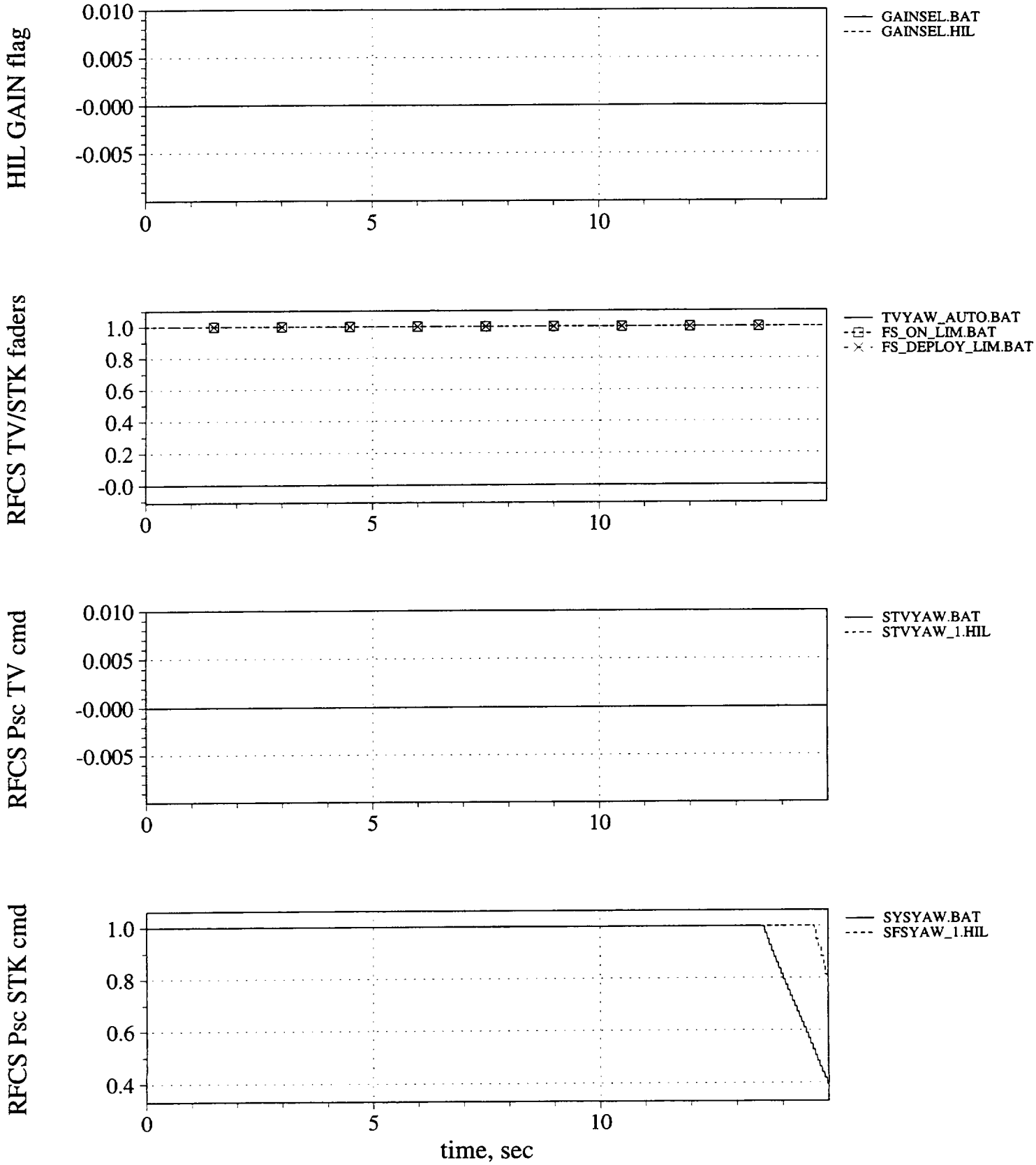

pitch angle, dg
20
0
-20
-40
0
5
10
THA.BAT
THA.HIL
roll angle, dg
0
-50
-100
0
5
10
PHI.BAT
PHI.HIL
AOA rate, d/s
30
20
10
0
-10
-20
0
5
10
ALPDOT.BAT
ALPDOT.HIL
sideslip rate, d/s
6
4
2
0
-2
-4
-6
0
5
10
time, sec
BTADOT.BAT
BTADOT.HIL


lt/rt power lever ang
100
90
80
70
60
0
5
10
PLAL.BAT
PLAL.HIL
PLAR.BAT
PLAR.HIL
lt gross thr est, lbs
8000
7000
6000
5000
G_THR_EST_L.BAT
THRUSTL_LBS_1.HIL
rt gross thr est, lbs
G_THR_EST_R.BAT
THRUSTR_LBS_1.HIL
rt stab defl, dg
10
0
-10
-20
DRHTD.BAT
DRHTD.HIL
time, sec


rt aileron defl, dg
20
10
0
-10
-20
0
5
10
DRAD.BAT
DRAD.HIL
yaw angle, dg
0
-50
-100
0
5
10
PSI.BAT
PSI.HIL
lt top vane defl, dg
20
10
0
-10
0
5
10
VANEP1.BAT
VANEP1.HIL
lt outbrd vane defl, dg
20
10
0
-10
0
5
10
time, sec
VANEP2.BAT
VANEP2.HIL

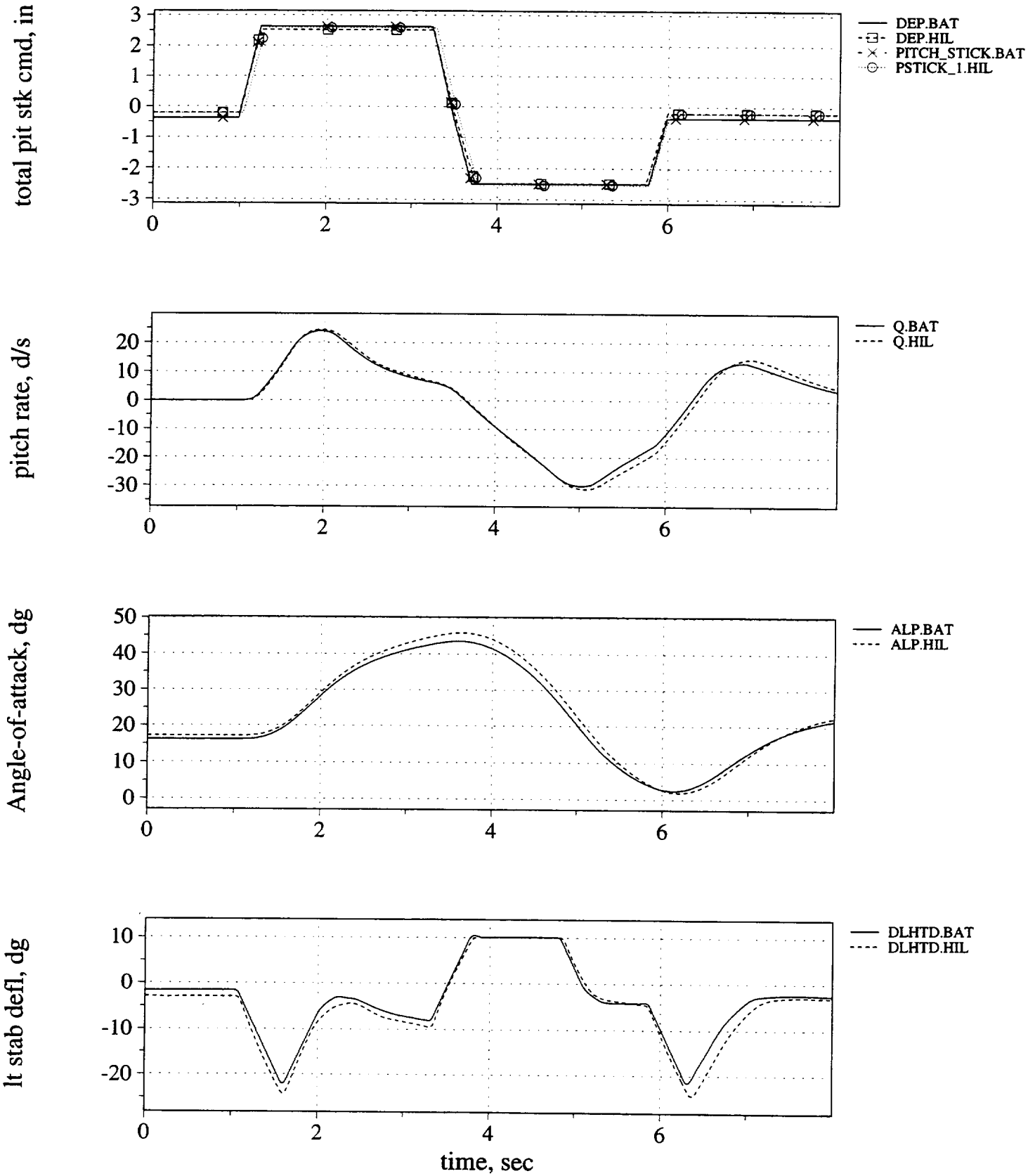

lt inbrd vane defl, dg
VANEP3.BAT
VANEP3.HIL
rt top vane defl, dg
VANEP4.BAT
VANEP4.HIL
rt outbrd vane defl, dg
VANEP5.BAT
VANEP5.HIL
rt inbrd vane defl, dg
VANEP6.BAT
VANEP6.HIL
time, sec


lt strake defl, dg
80
60
40
20
0
0
5
10
DSTKL.BAT
DSTKL.HIL
rt strake defl, dg
80
60
40
20
0
0
5
10
DSTKR.BAT
DSTKR.HIL
BAT MODE flags
2.0
1.5
1.0
0.5
0.0
0
5
10
XTVYAW.BAT
XSTRAKE.BAT
HIL MODE flag
2.010
2.005
2.000
1.995
0
5
10
time, sec
RFCSSEL.HIL
RFCSSEL.HIL

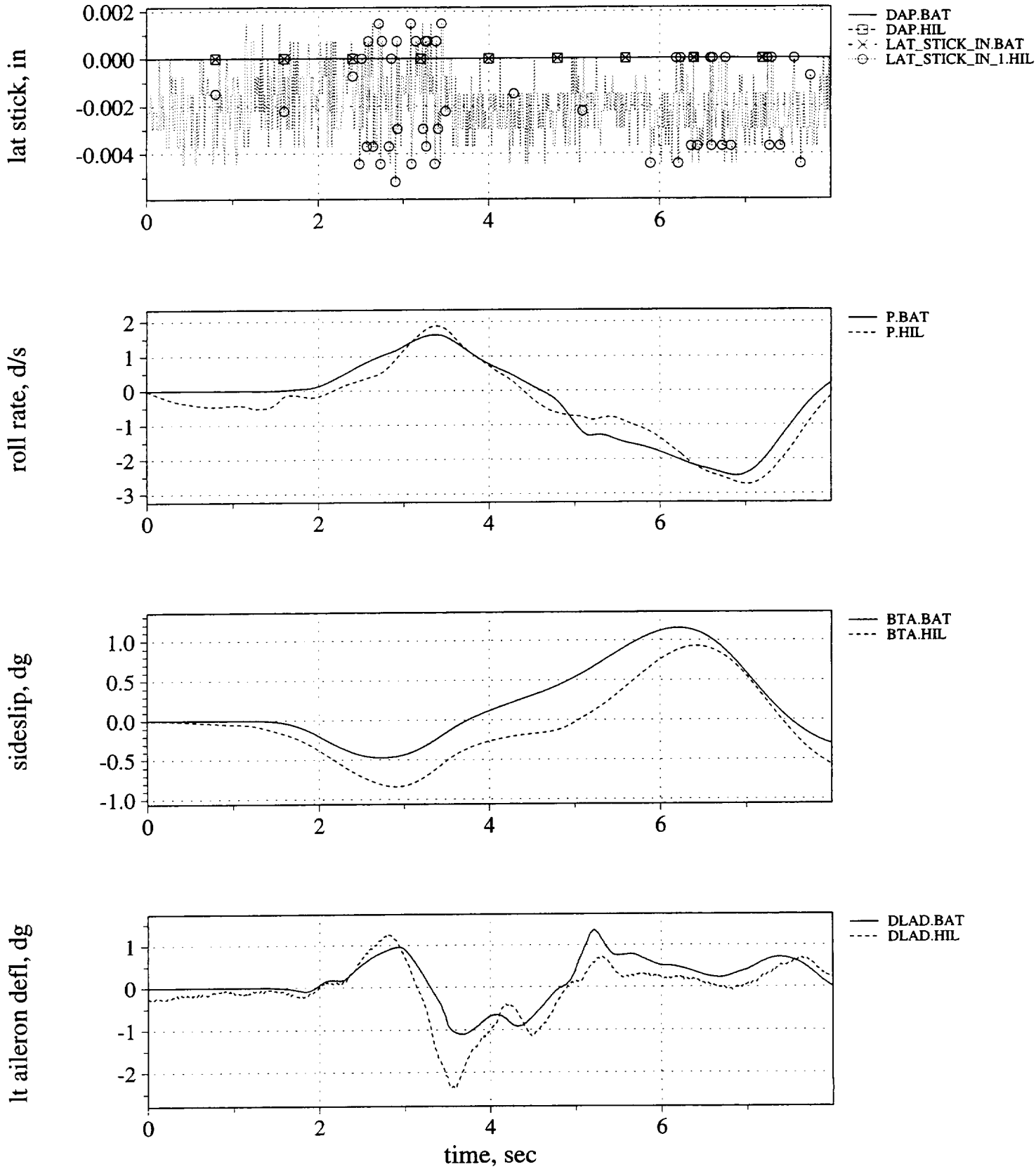

HIL GAIN flag
0.010
0.005
-0.000
-0.005
0
5
10
GAINSEL.BAT
GAINSEL.HIL
RFCS TV/STK faders
1.0
0.8
0.6
0.4
0.2
-0.0
TVYAW_AUTO.BAT
FS_ON_LIM.BAT
FS_DEPLOY_LIM.BAT
RFCS Psc TV cmd
STVYAW.BAT
STVYAW_1.HIL
RFCS Psc STK cmd
SYSYAW.BAT
SFSYAW_1.HIL
time, sec

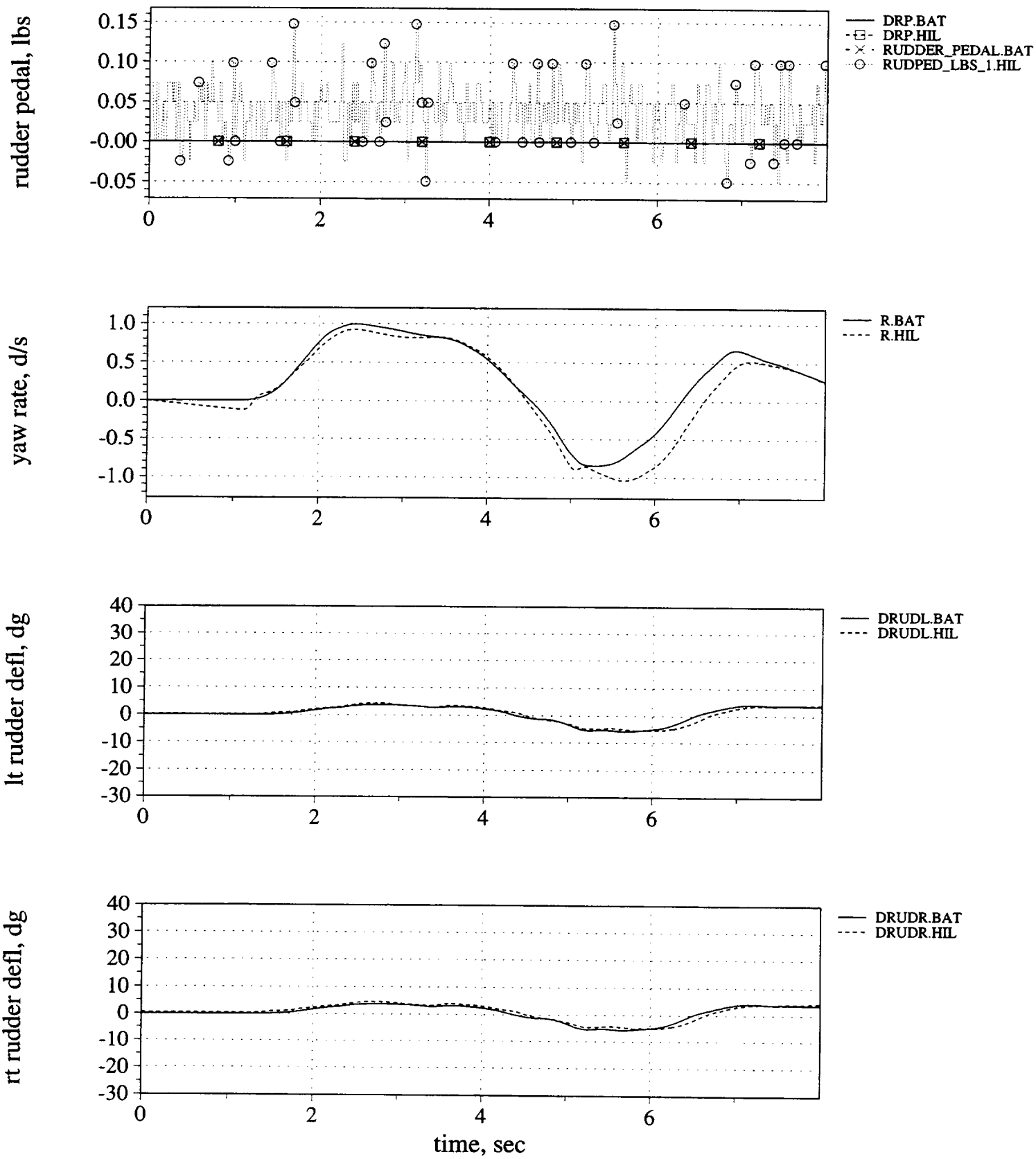
Appendix B - Batch versus HIL Version 154.0

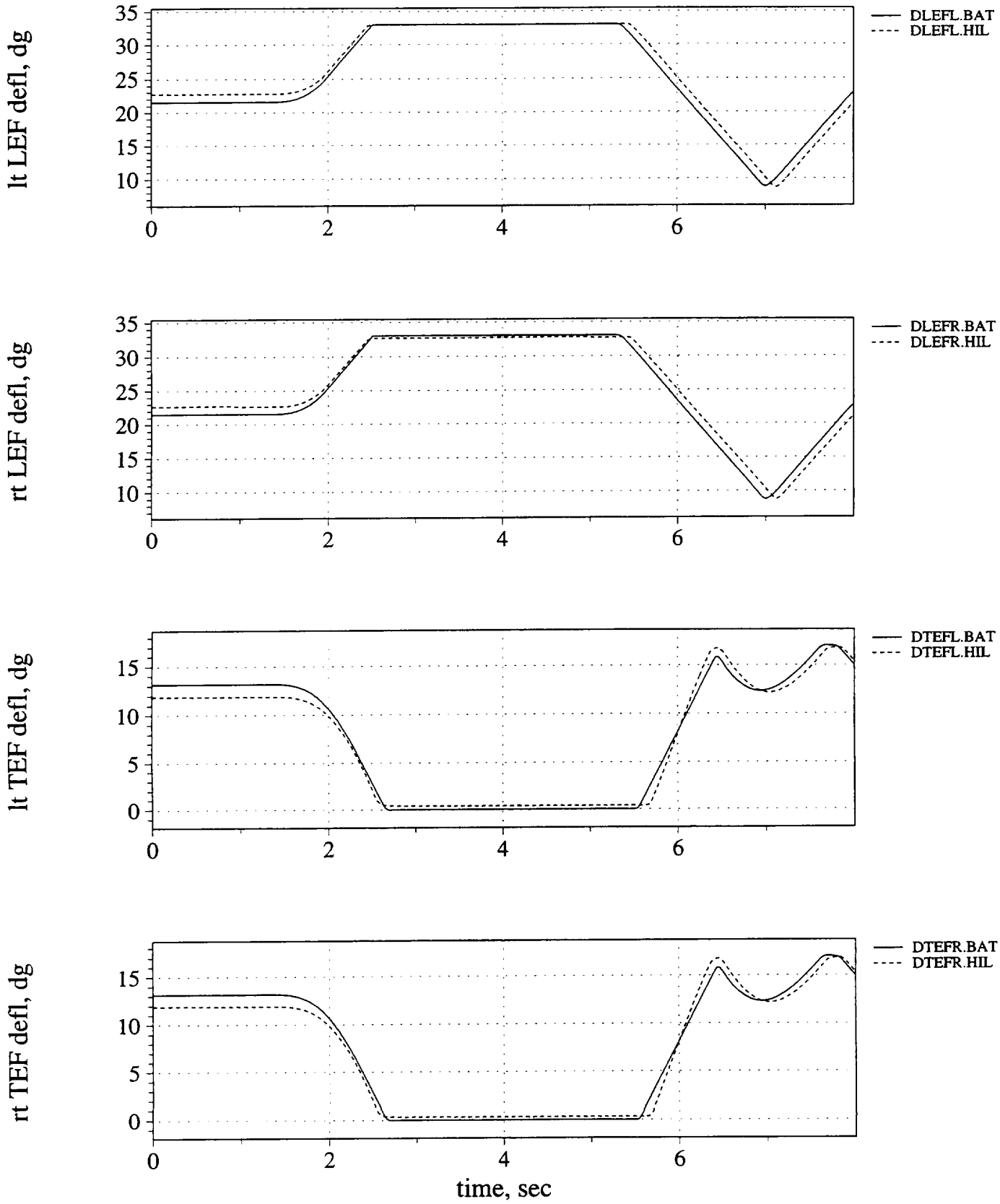
CASE_41__TV_Mode__.35-25k_trim_AOA_3_-2.5_in_ramp_dep_gainset_1 page 1/12

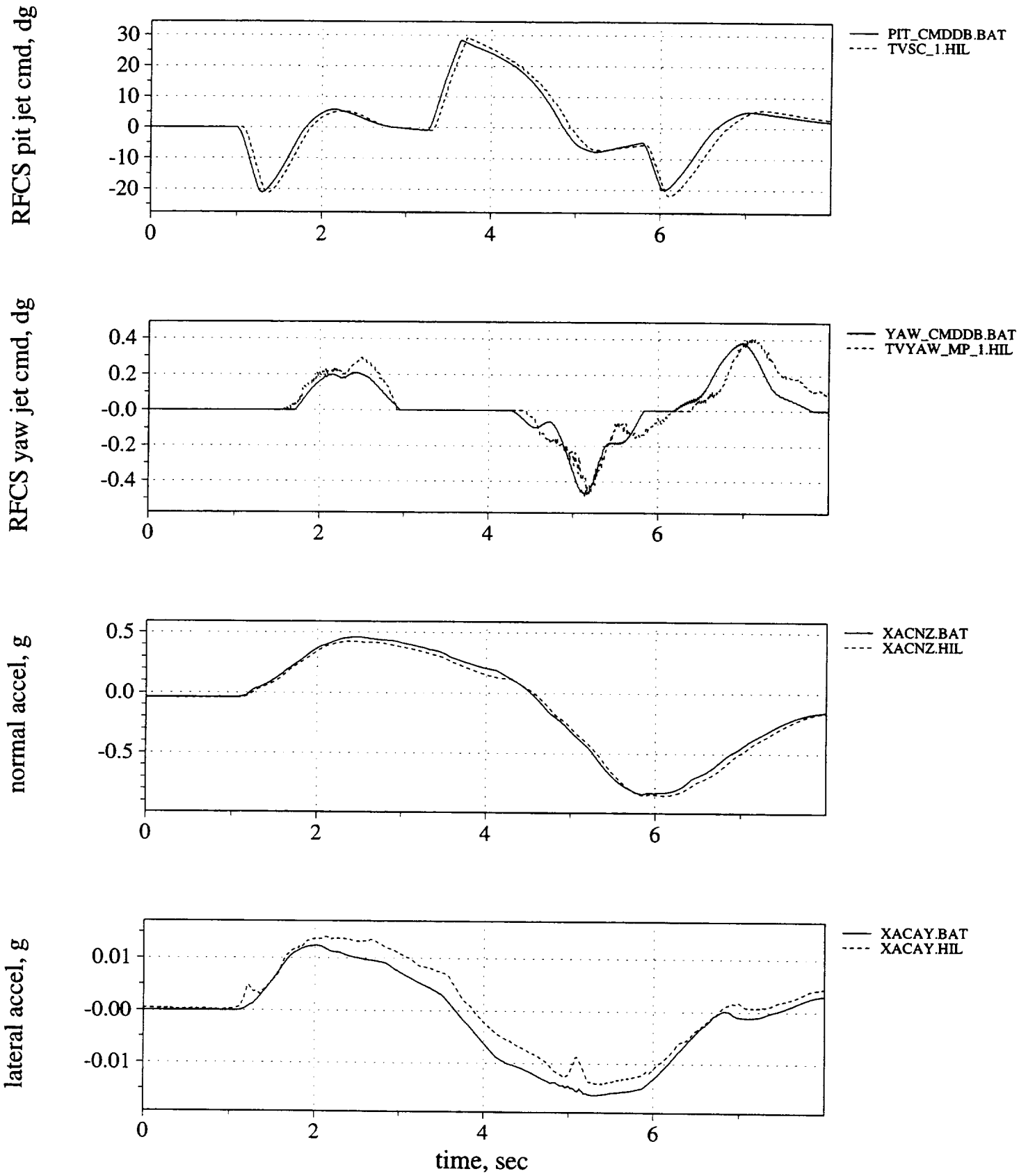


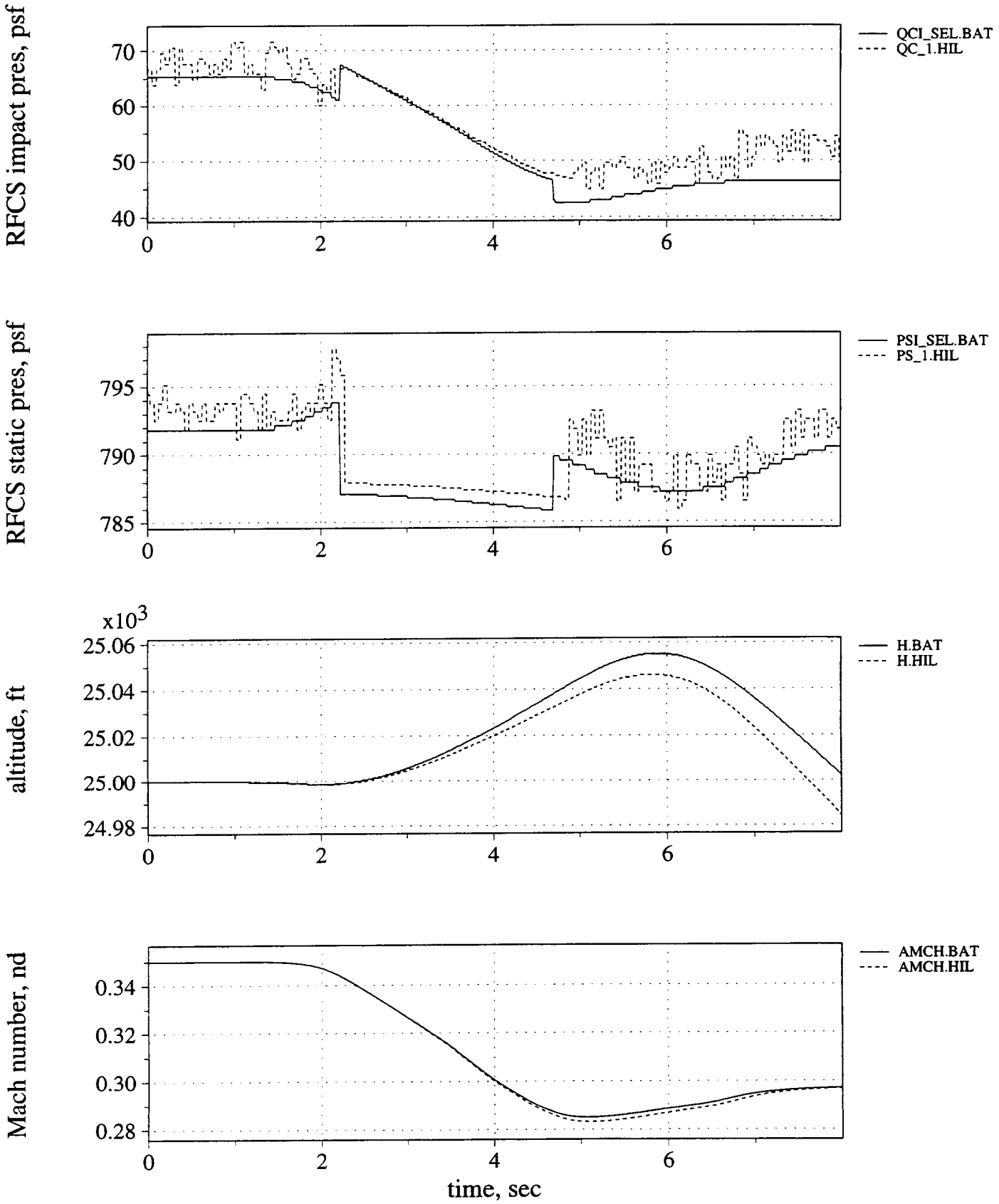
Performance Validation Checkcases

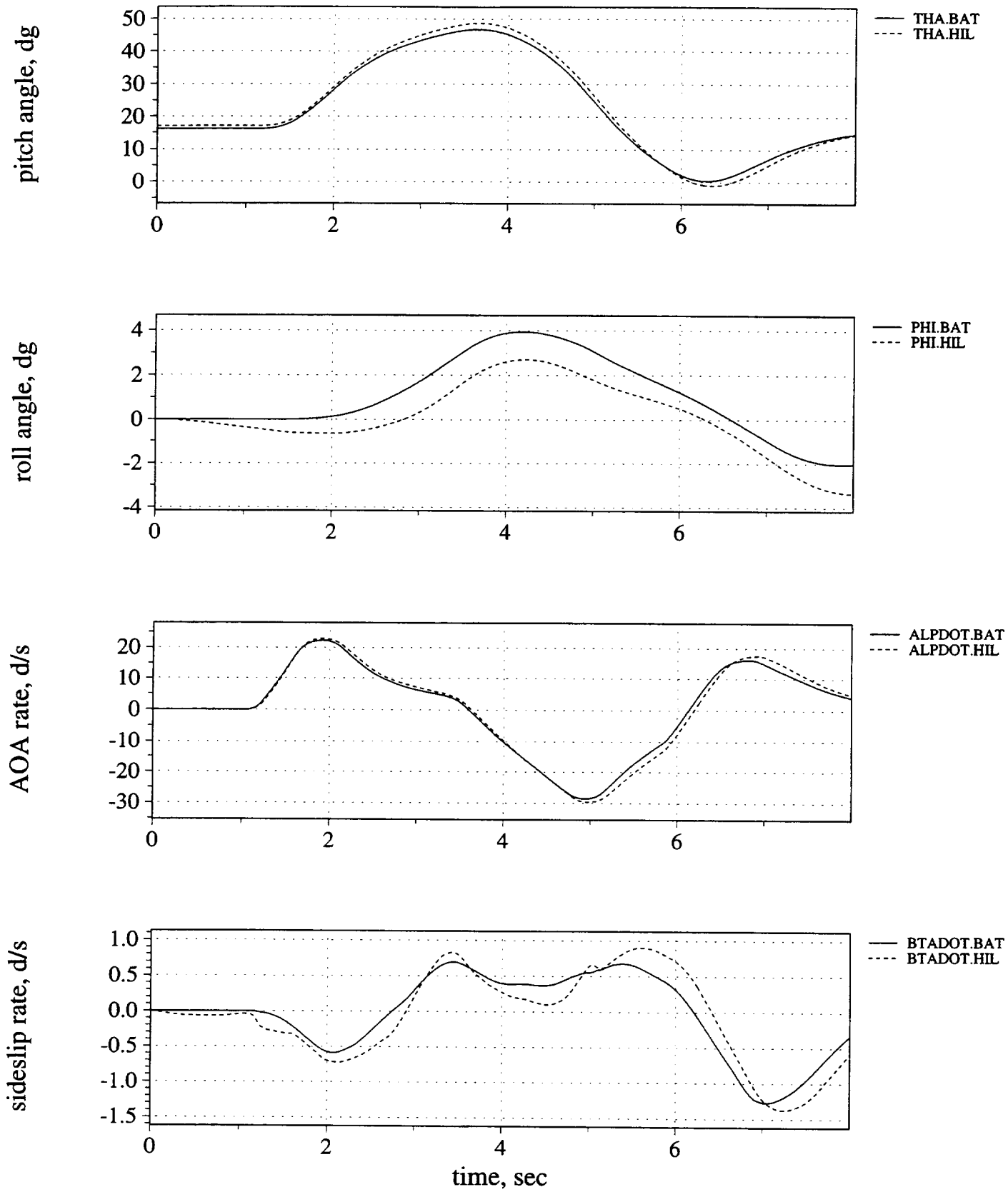

lat stick, in
0.002
0.000
-0.002
-0.004
0
2
4
6
DAP.BAT
DAP.HIL
LAT_STICK_IN.BAT
LAT_STICK_IN_1.HIL
roll rate, d/s
2
1
0
-1
-2
-3
P.BAT
P.HIL
sideslip, dg
1.0
0.5
0.0
-0.5
-1.0
BTA.BAT
BTA.HIL
lt aileron defl, dg
1
0
-1
-2
DLAD.BAT
DLAD.HIL
time, sec

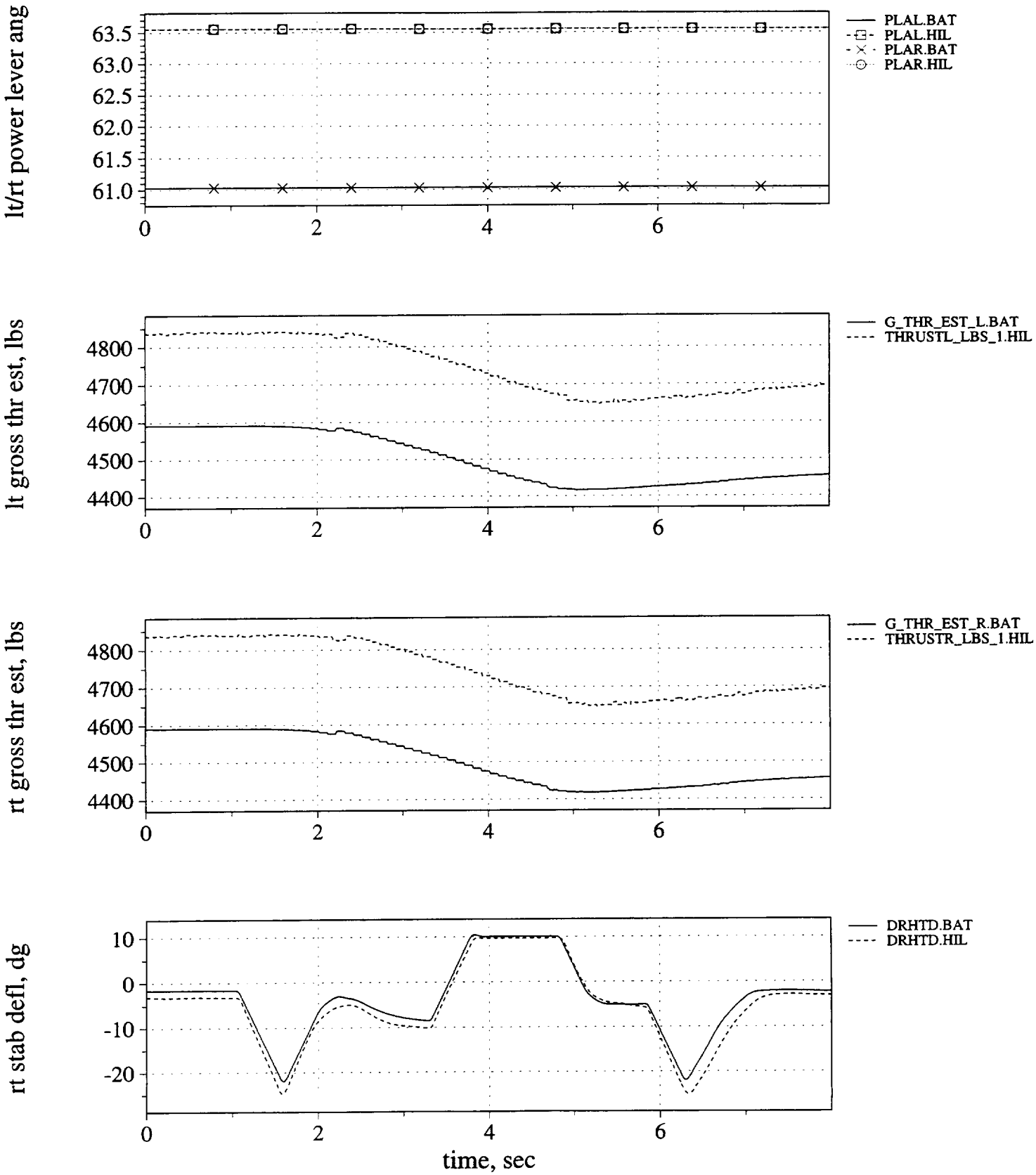

rudder pedal, lbs
0.15
0.10
0.05
-0.00
-0.05
0
2
4
6
DRP.BAT
DRP.HIL
RUDDER_PEDAL.BAT
RUDPED_LBS_1.HIL
yaw rate, d/s
1.0
0.5
0.0
-0.5
-1.0
R.BAT
R.HIL
lt rudder defl, dg
40
30
20
10
0
-10
-20
-30
DRUDL.BAT
DRUDL.HIL
rt rudder defl, dg
DRUDR.BAT
DRUDR.HIL
time, sec

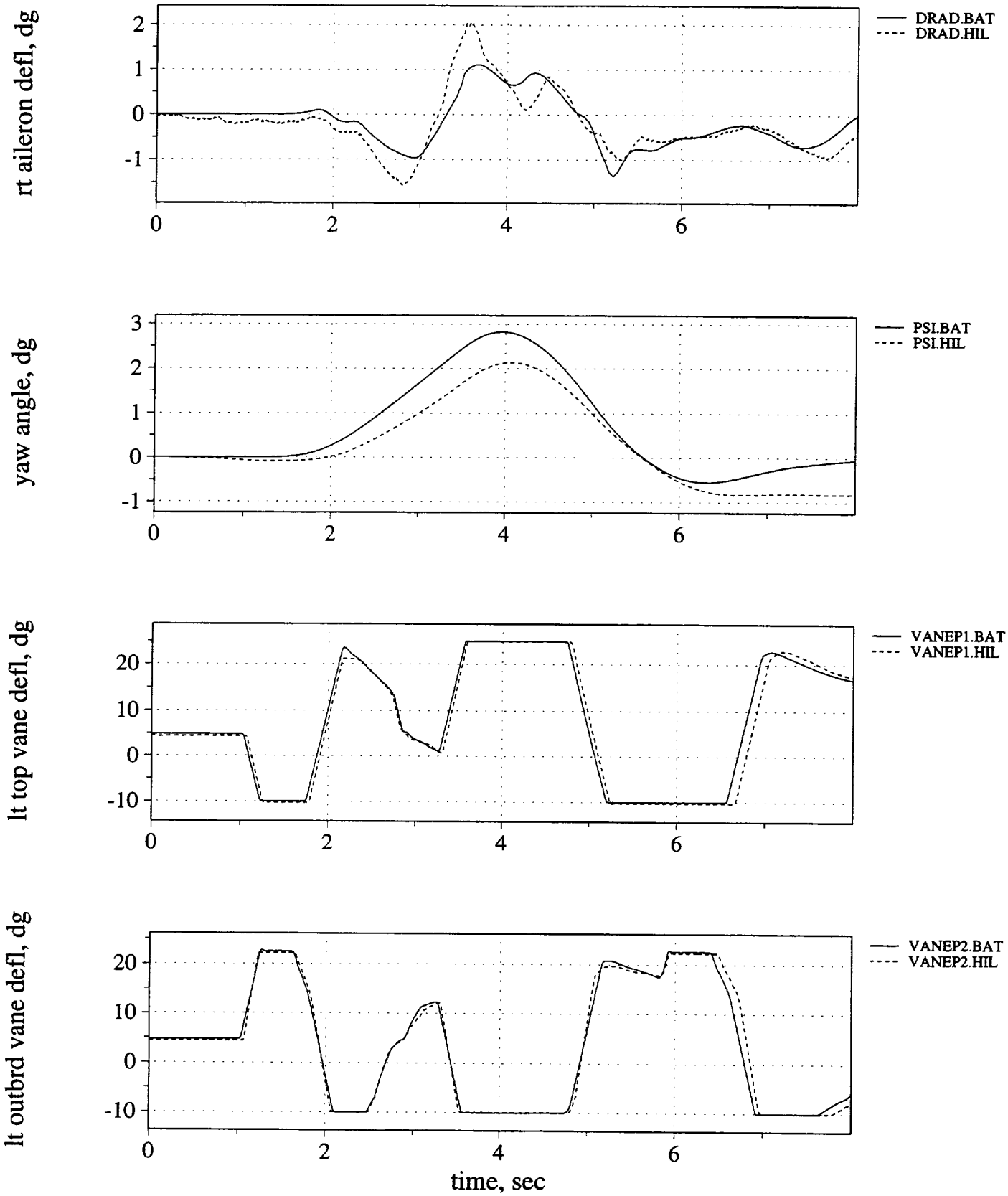

lt LEF defl, dg
DLEFL.BAT
DLEFL.HIL
rt LEF defl, dg
DLEFR.BAT
DLEFR.HIL
lt TEF defl, dg
DTEFL.BAT
DTEFL.HIL
rt TEF defl, dg
DTEFR.BAT
DTEFR.HIL
time, sec

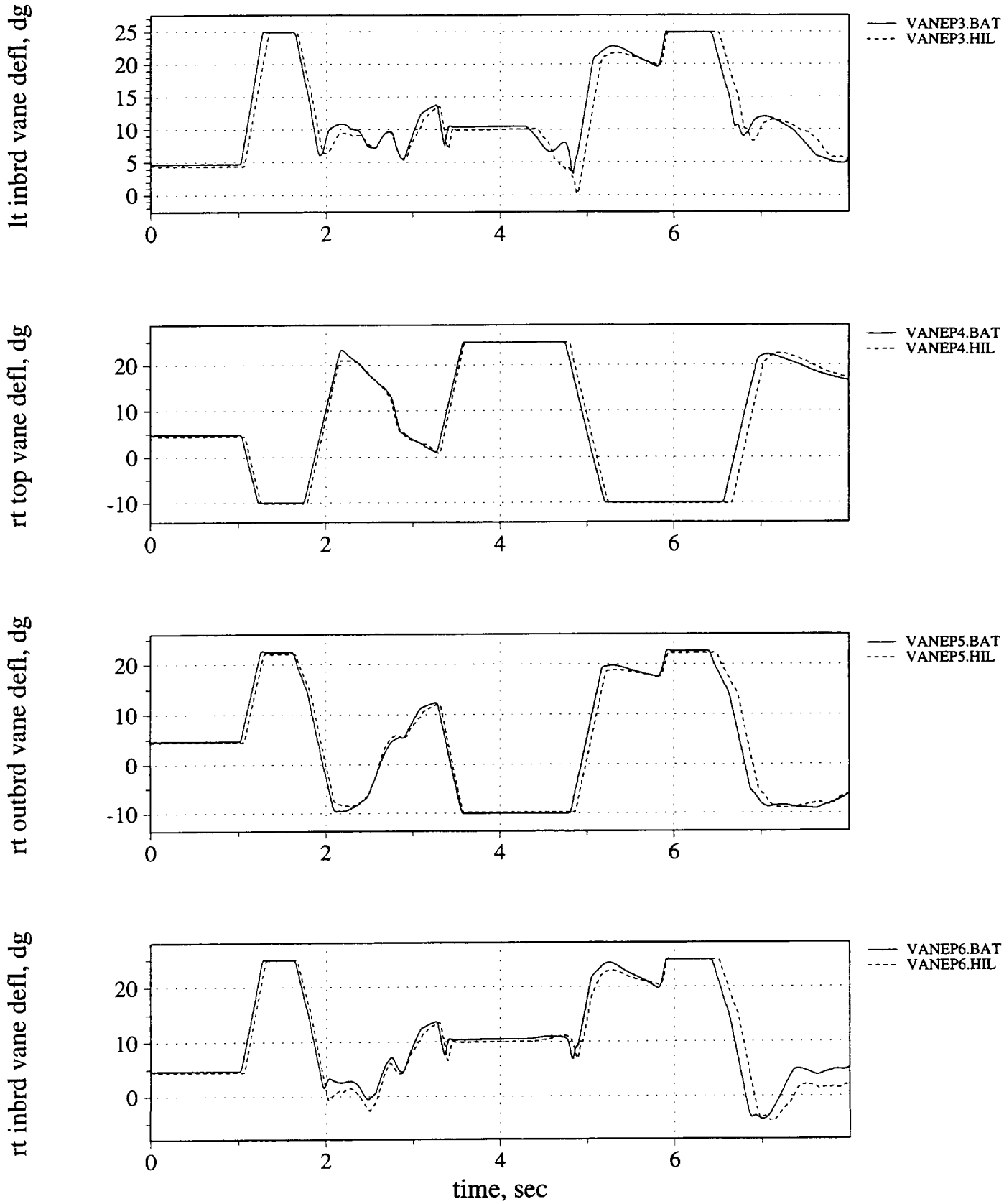

RFCS pit jet cmd, dg
30
20
10
0
-10
-20
0
2
4
6
PIT_CMDDB.BAT
TVSC_1.HIL
RFCS yaw jet cmd, dg
0.4
0.2
-0.0
-0.2
-0.4
YAW_CMDDB.BAT
TVYAW_MP_1.HIL
normal accel, g
0.5
0.0
-0.5
XACNZ.BAT
XACNZ.HIL
lateral accel, g
0.01
-0.00
-0.01
XACAY.BAT
XACAY.HIL
time, sec

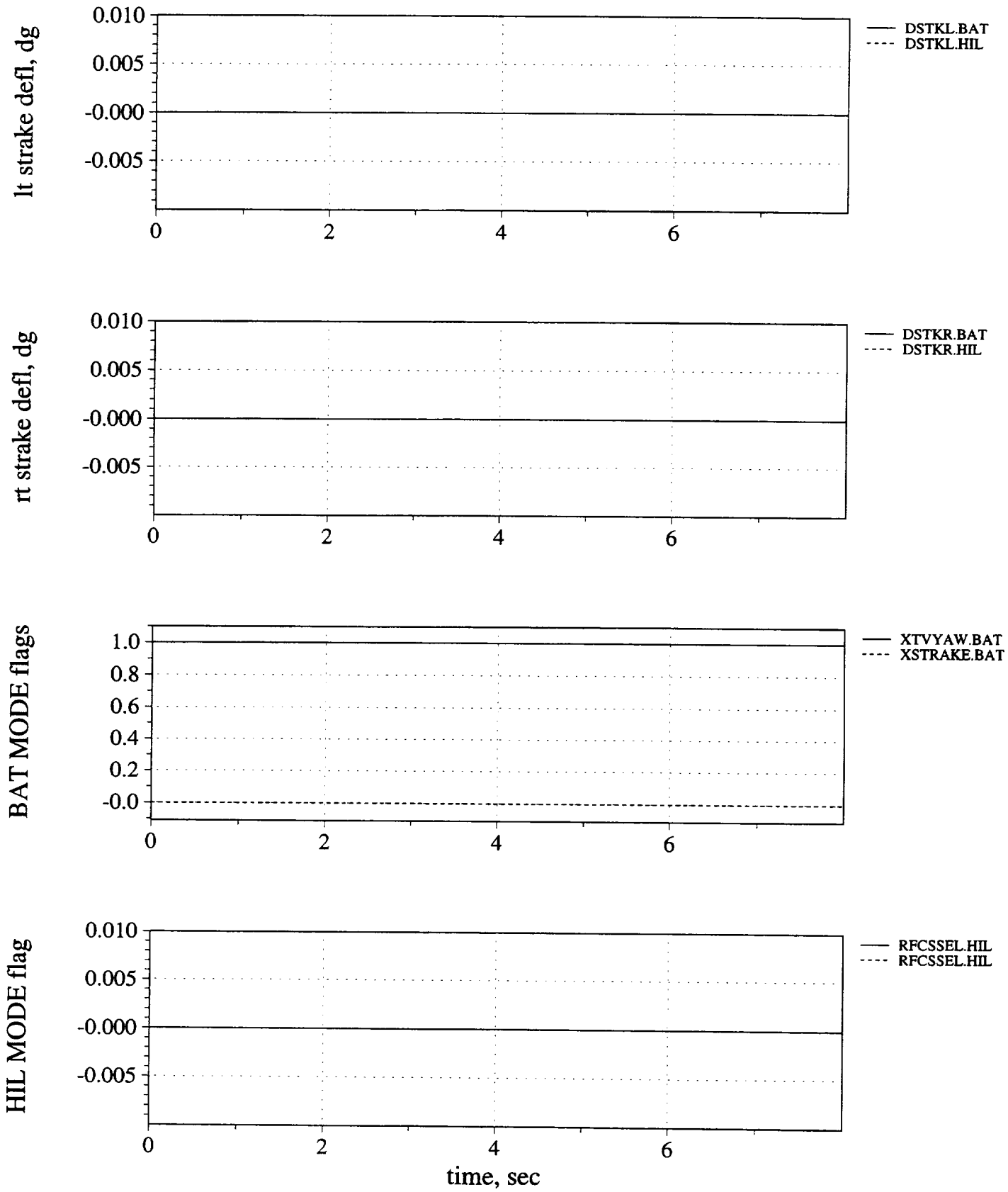

RFCS impact pres, psf
70
60
50
40
0
2
4
6
QCI_SEL.BAT
QC_1.HIL
RFCS static pres, psf
795
790
785
PSI_SEL.BAT
PS_1.HIL
x10^3
altitude, ft
25.06
25.04
25.02
25.00
24.98
H.BAT
H.HIL
Mach number, nd
0.34
0.32
0.30
0.28
AMCH.BAT
AMCH.HIL
time, sec

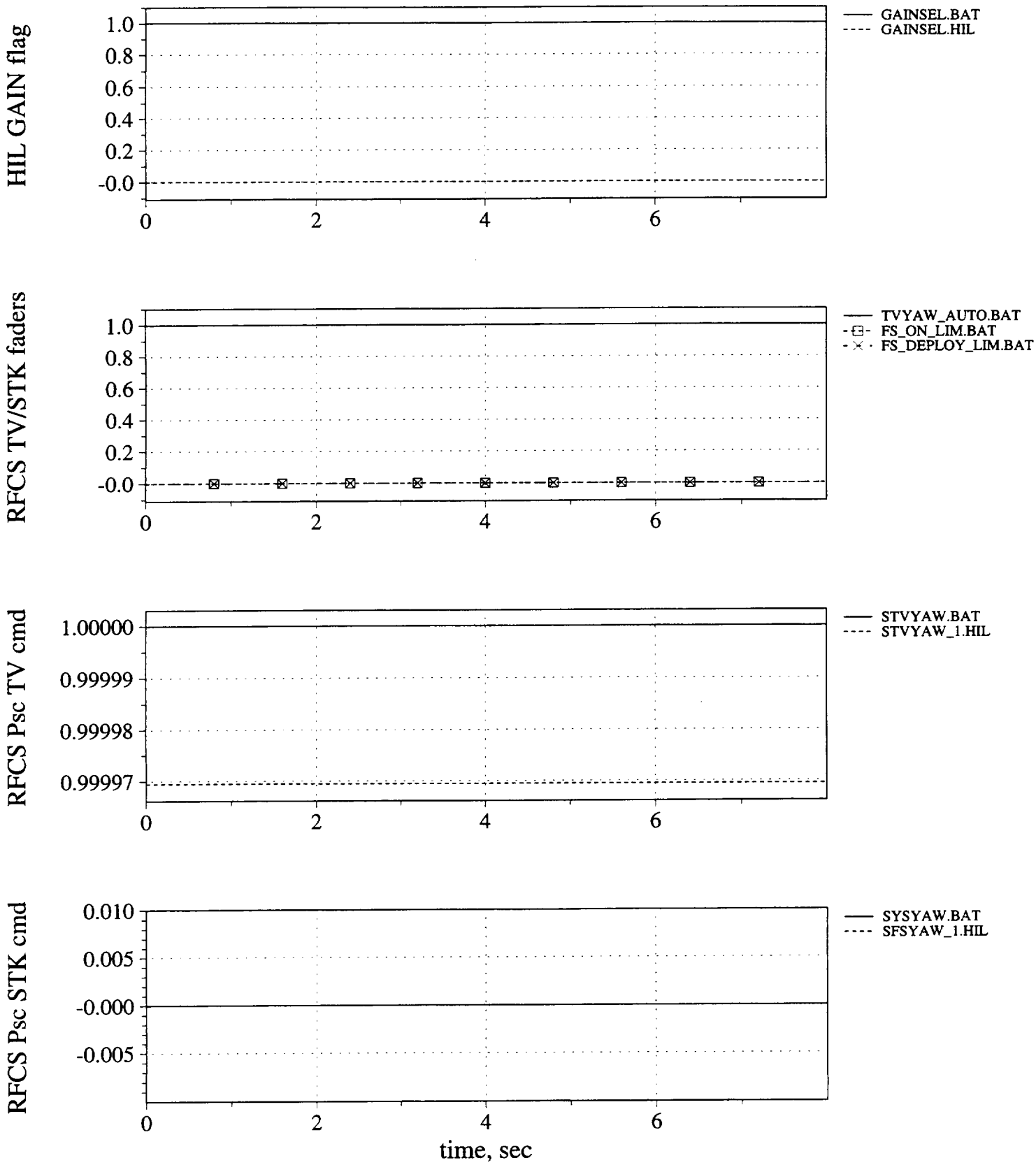

pitch angle, dg
50
40
30
20
10
0
0
2
4
6
THA.BAT
THA.HIL
roll angle, dg
4
2
0
-2
-4
PHI.BAT
PHI.HIL
AOA rate, d/s
20
10
0
-10
-20
-30
ALPDOT.BAT
ALPDOT.HIL
sideslip rate, d/s
1.0
0.5
0.0
-0.5
-1.0
-1.5
BTADOT.BAT
BTADOT.HIL
time, sec


lt/rt power lever ang
63.5
63.0
62.5
62.0
61.5
61.0
0
2
4
6
PLAL.BAT
PLAL.HIL
PLAR.BAT
PLAR.HIL
lt gross thr est, lbs
4800
4700
4600
4500
4400
G_THR_EST_L.BAT
THRUSTL_LBS_1.HIL
rt gross thr est, lbs
G_THR_EST_R.BAT
THRUSTR_LBS_1.HIL
rt stab defl, dg
10
0
-10
-20
DRHTD.BAT
DRHTD.HIL
time, sec


rt aileron defl, dg
DRAD.BAT
DRAD.HIL
yaw angle, dg
PSI.BAT
PSI.HIL
lt top vane defl, dg
VANEP1.BAT
VANEP1.HIL
lt outbrd vane defl, dg
VANEP2.BAT
VANEP2.HIL
time, sec

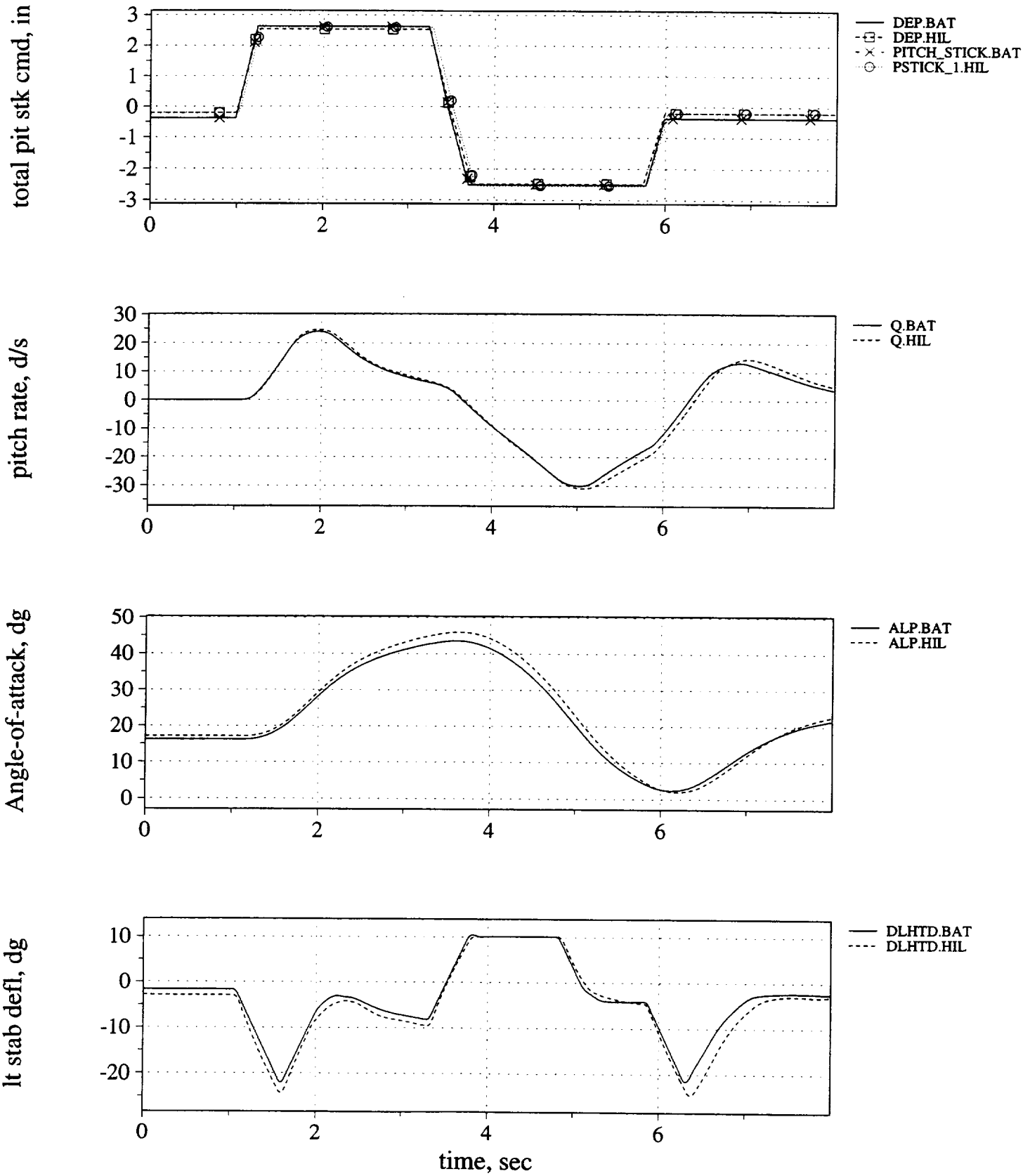

lt inbrd vane defl, dg
VANEP3.BAT
VANEP3.HIL
rt top vane defl, dg
VANEP4.BAT
VANEP4.HIL
rt outbrd vane defl, dg
VANEP5.BAT
VANEP5.HIL
rt inbrd vane defl, dg
VANEP6.BAT
VANEP6.HIL
time, sec


lt strake defl, dg
0.010
0.005
-0.000
-0.005
0
2
4
6
DSTKL.BAT
DSTKL.HIL
rt strake defl, dg
0.010
0.005
-0.000
-0.005
0
2
4
6
DSTKR.BAT
DSTKR.HIL
BAT MODE flags
1.0
0.8
0.6
0.4
0.2
-0.0
0
2
4
6
XTVYAW.BAT
XSTRAKE.BAT
HIL MODE flag
0.010
0.005
-0.000
-0.005
0
2
4
6
RFCSSEL.HIL
RFCSSEL.HIL
time, sec

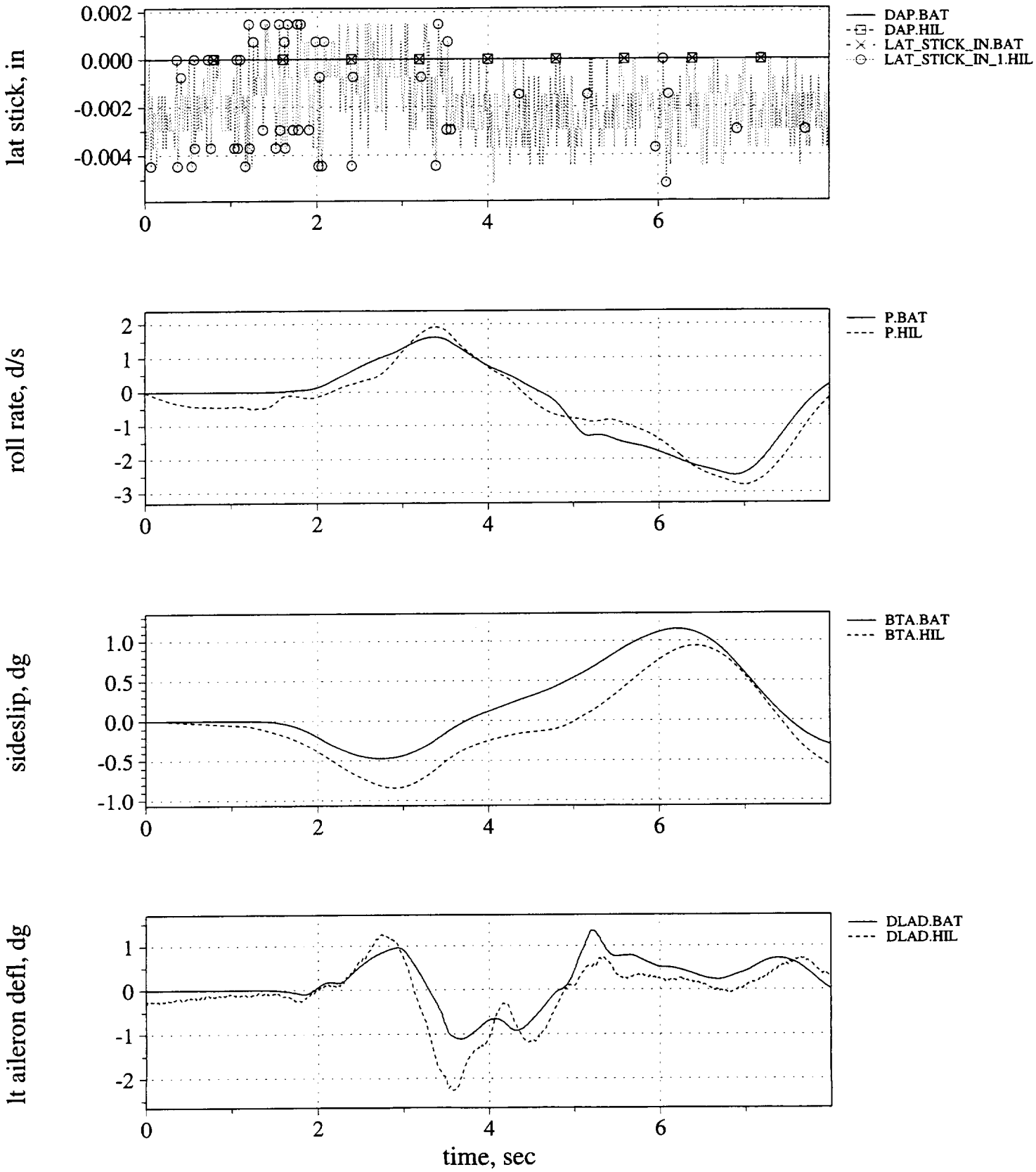

HIL GAIN flag
1.0
0.8
0.6
0.4
0.2
-0.0
0
2
4
6
GAINSEL.BAT
GAINSEL.HIL
RFCS TV/STK faders
TVYAW_AUTO.BAT
FS_ON_LIM.BAT
FS_DEPLOY_LIM.BAT
RFCS Psc TV cmd
1.00000
0.99999
0.99998
0.99997
STVYAW.BAT
STVYAW_1.HIL
RFCS Psc STK cmd
0.010
0.005
-0.000
-0.005
SYSYAW.BAT
SFSYAW_1.HIL
time, sec

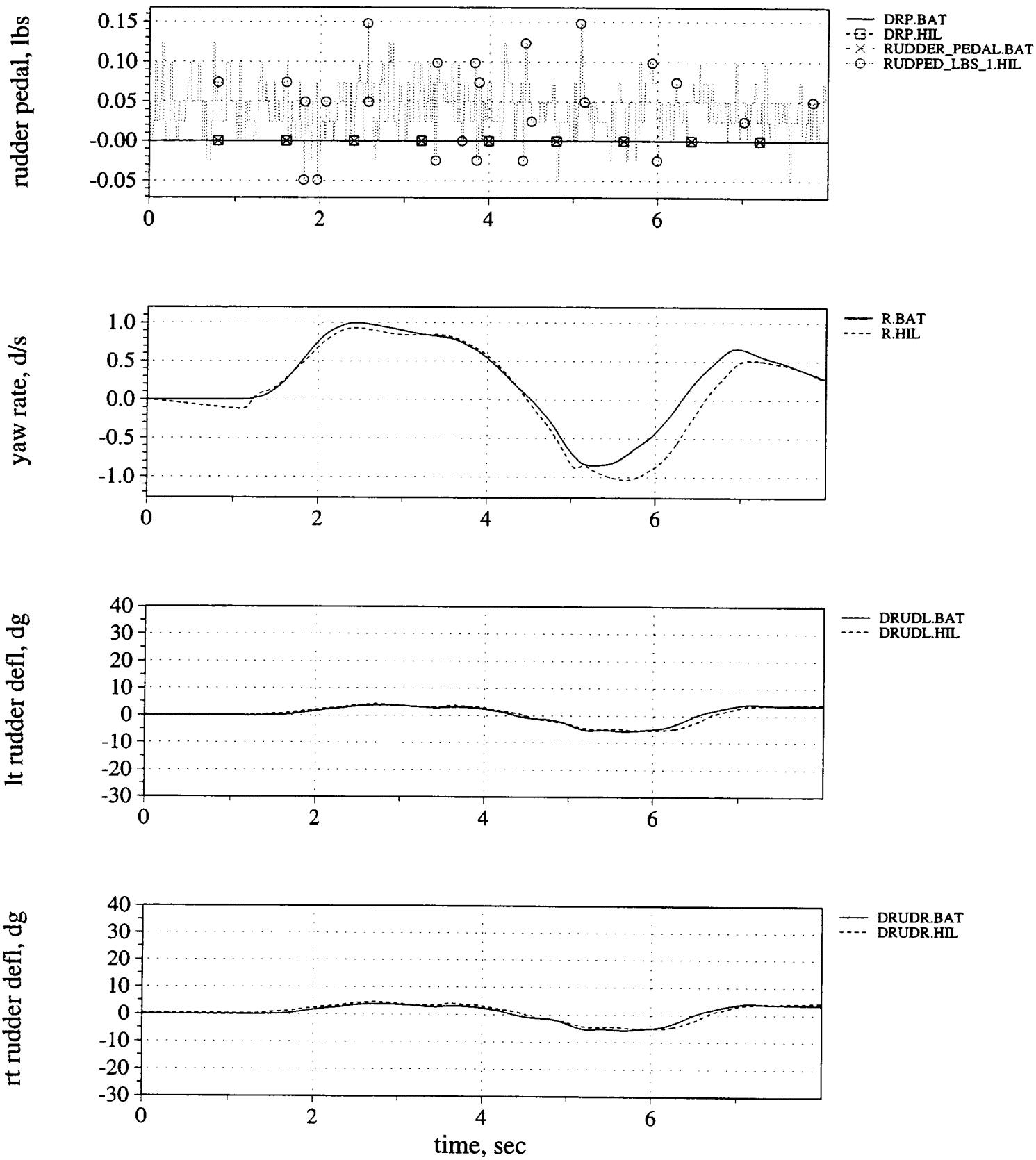
Appendix B - Batch versus HIL Version 154.0

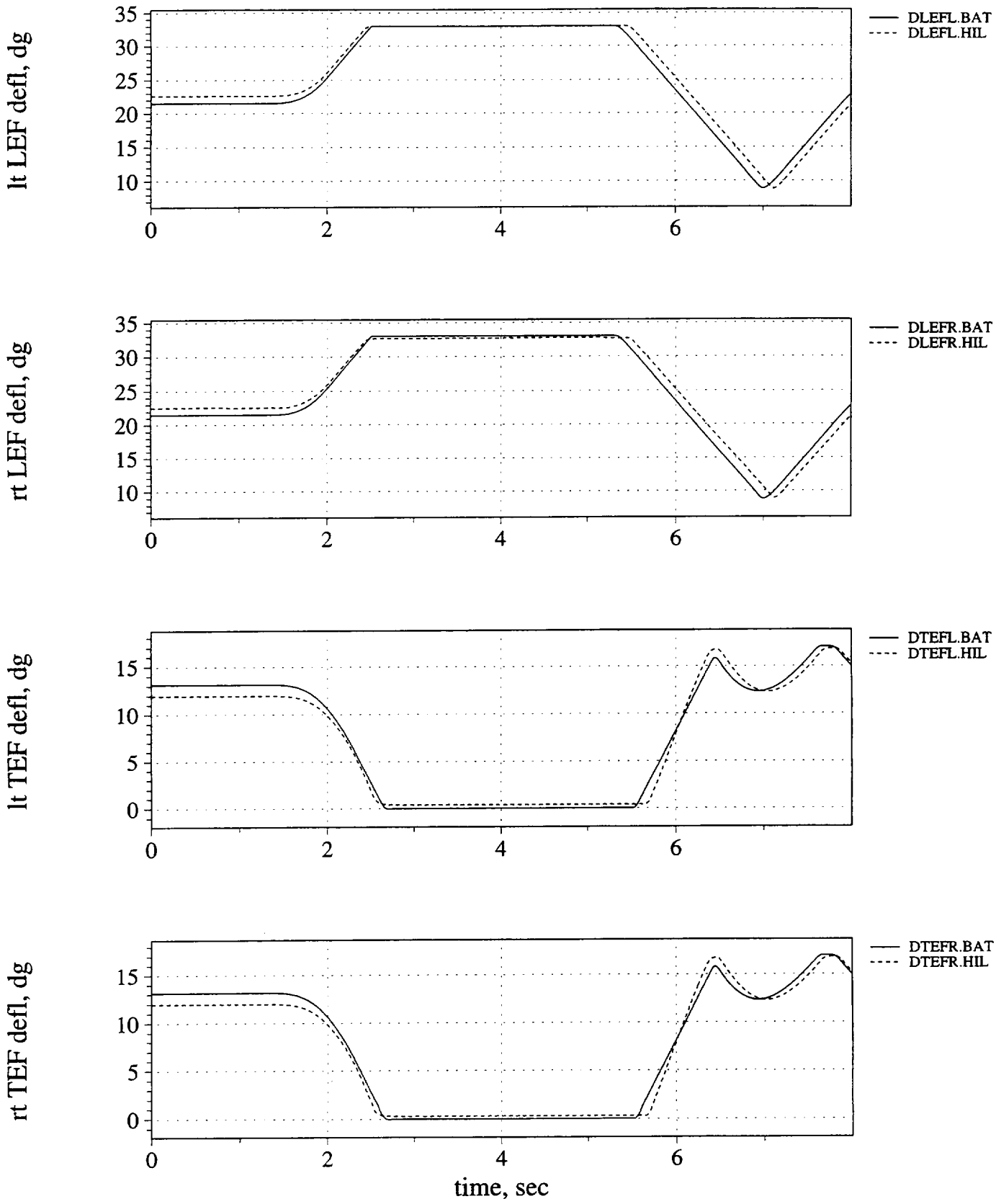
CASE_46__TV_Mode__.35-25k_trim_AOA_3_-2.5_in_ramp_dep_gainset_2 page 1/12

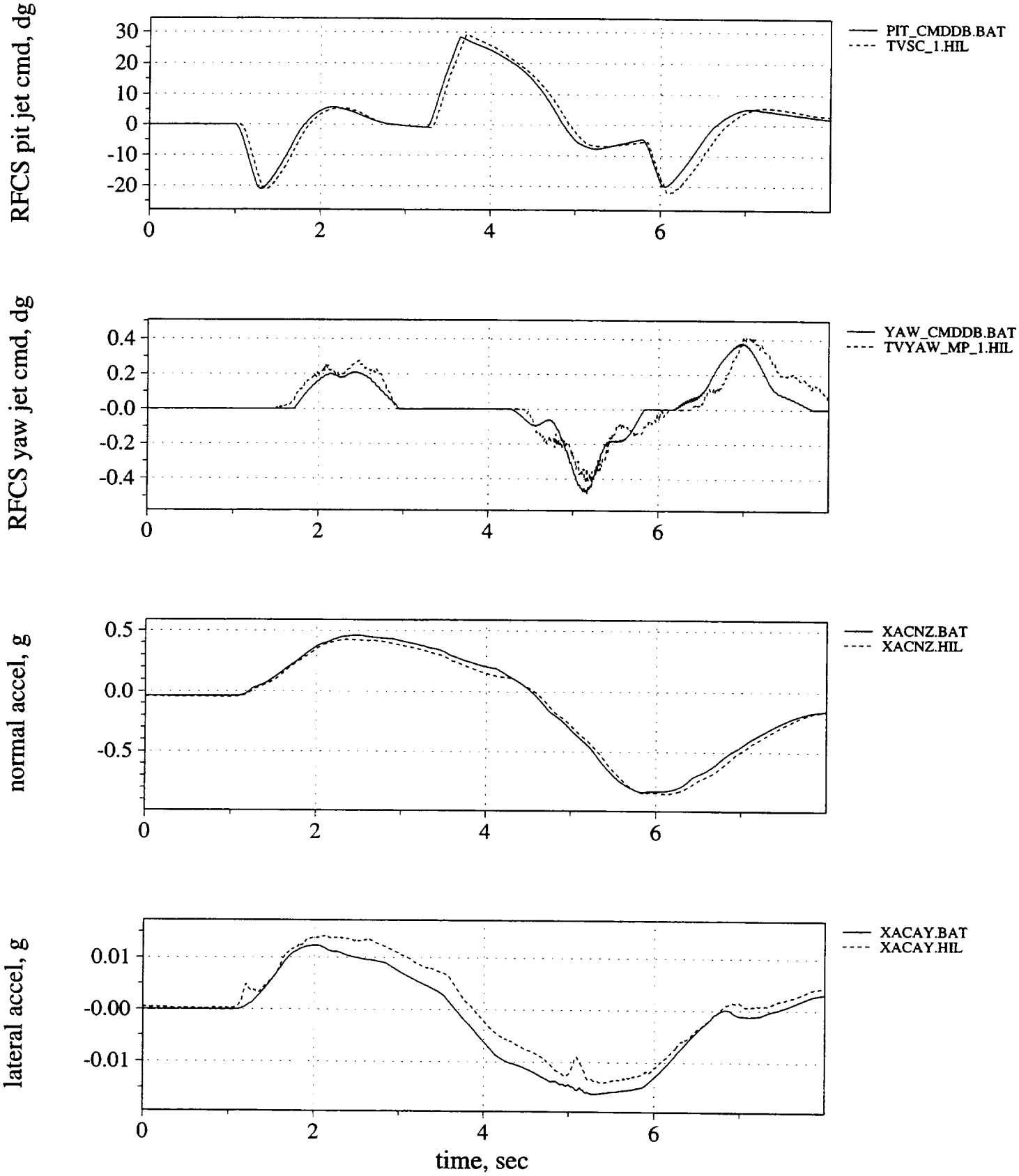


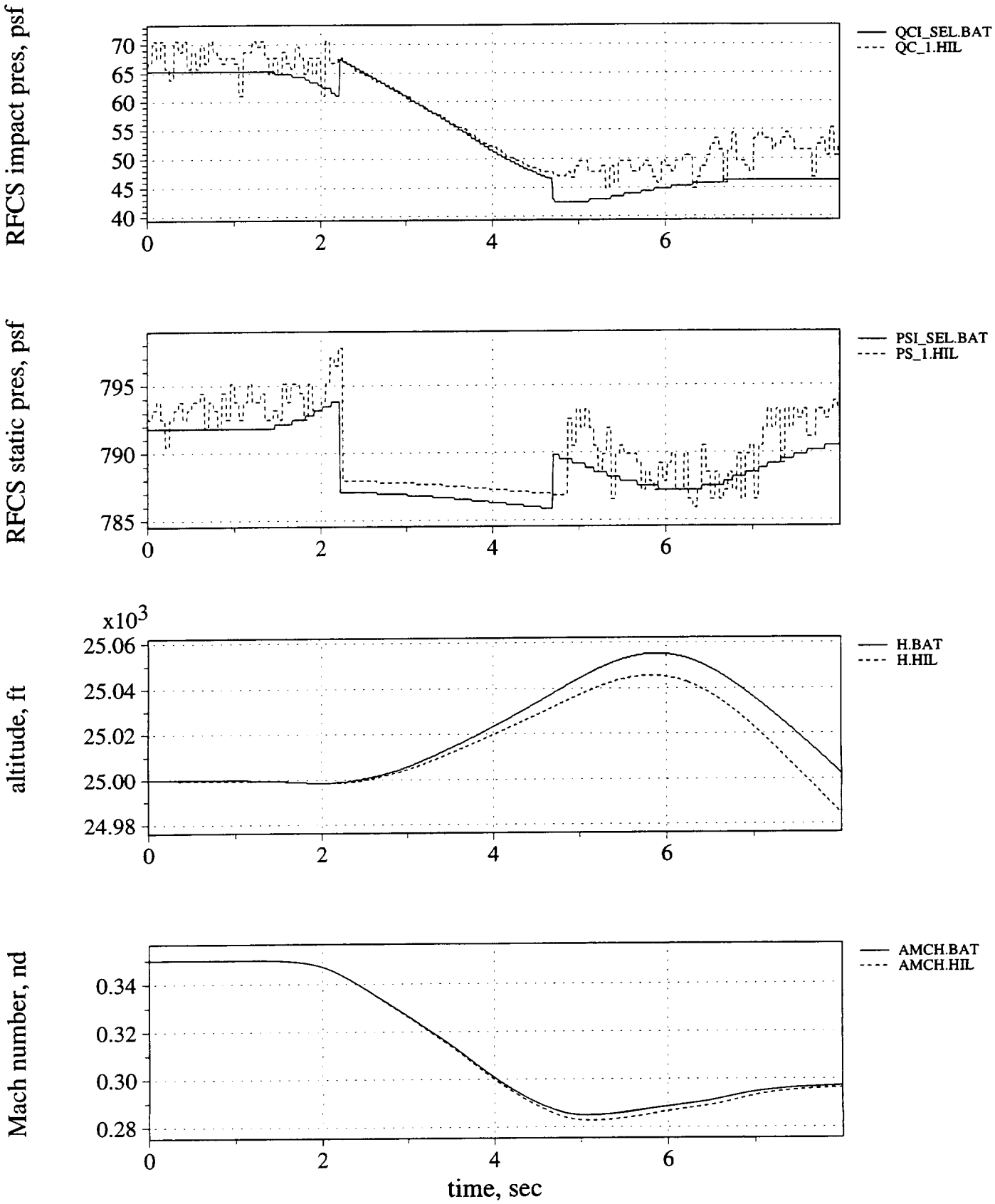
Performance Validation Checkcases

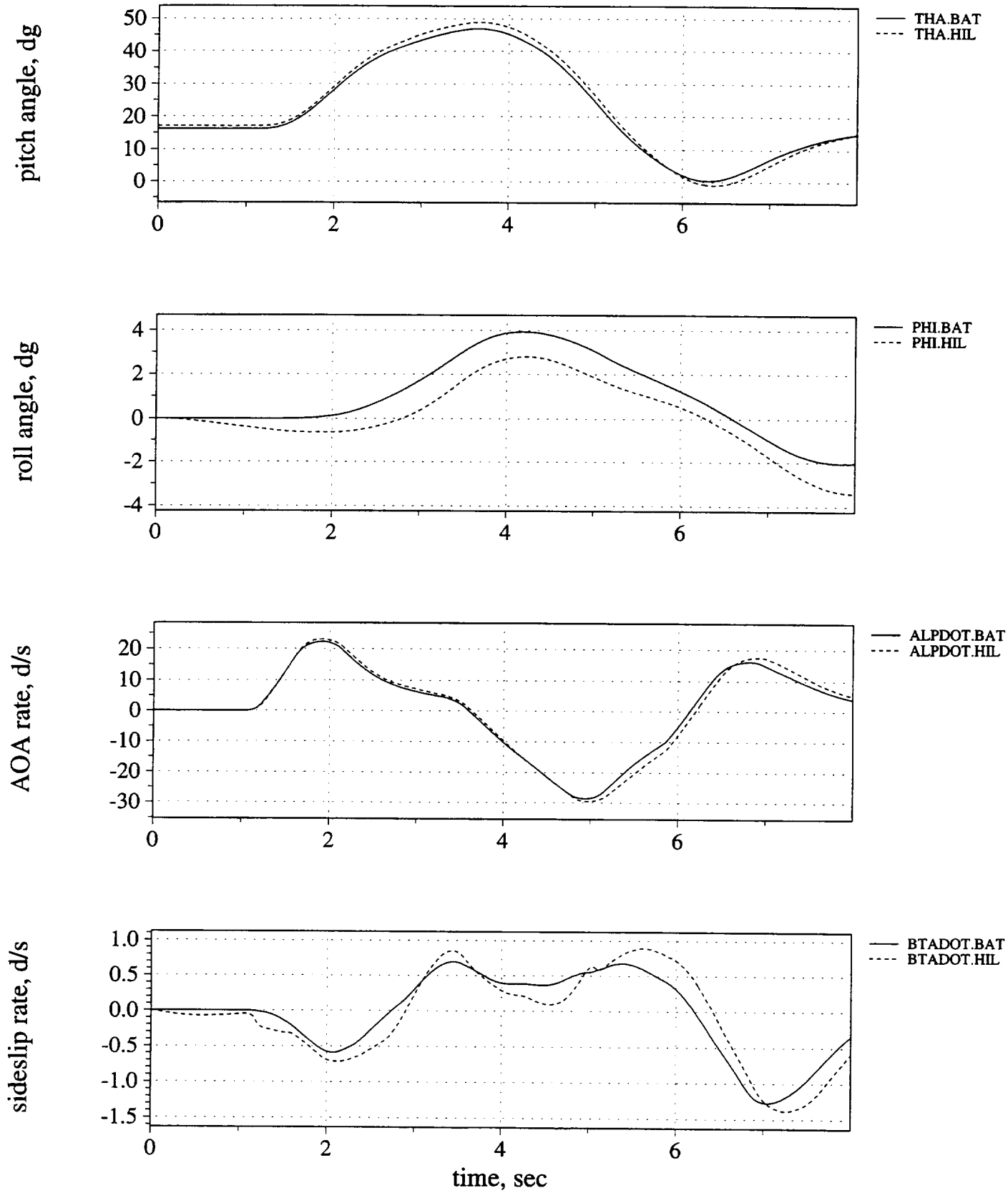

lat stick, in
0.002
0.000
-0.002
-0.004
DAP.BAT
DAP.HIL
LAT_STICK_IN.BAT
LAT_STICK_IN_1.HIL
roll rate, d/s
2
1
0
-1
-2
-3
P.BAT
P.HIL
sideslip, dg
1.0
0.5
0.0
-0.5
-1.0
BTA.BAT
BTA.HIL
lt aileron defl, dg
1
0
-1
-2
DLAD.BAT
DLAD.HIL
0
2
4
6
time, sec

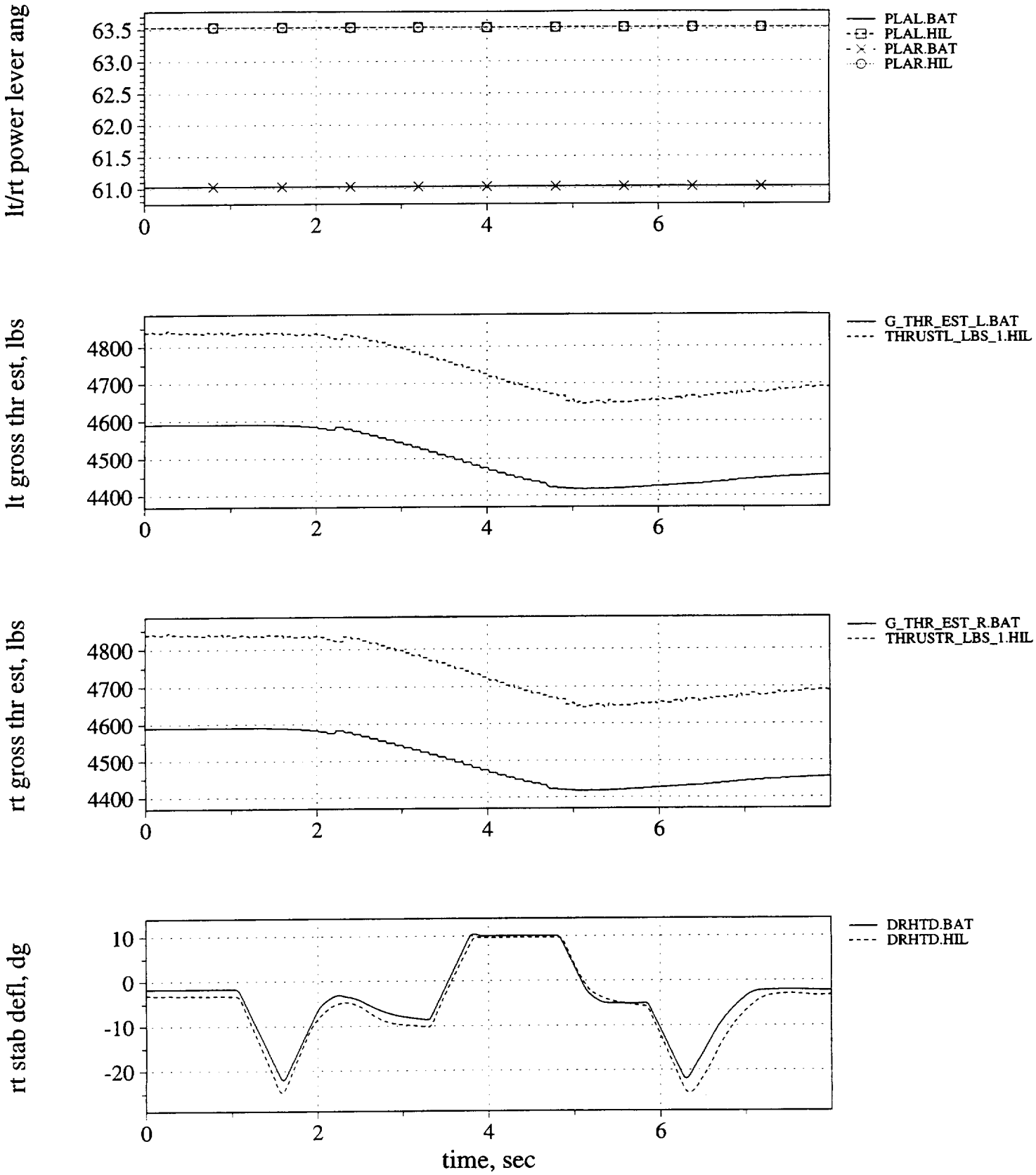

rudder pedal, lbs
0.15
0.10
0.05
-0.00
-0.05
0
2
4
6
DRP.BAT
DRP.HIL
RUDDER_PEDAL.BAT
RUDPED_LBS_1.HIL
yaw rate, d/s
1.0
0.5
0.0
-0.5
-1.0
R.BAT
R.HIL
lt rudder defl, dg
40
30
20
10
0
-10
-20
-30
DRUDL.BAT
DRUDL.HIL
rt rudder defl, dg
DRUDR.BAT
DRUDR.HIL
time, sec

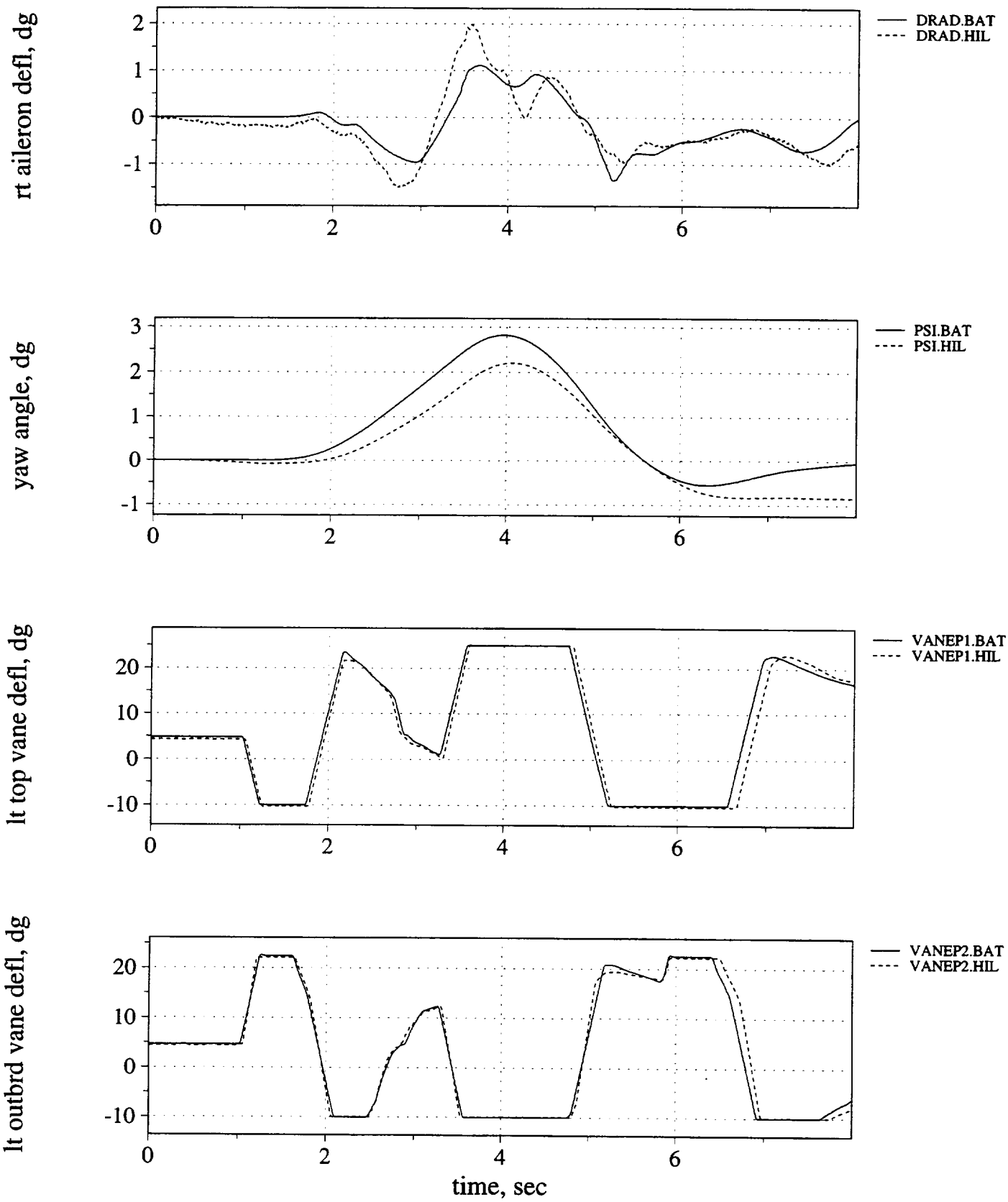

lt LEF defl, dg
DLEFL.BAT
DLEFL.HIL
rt LEF defl, dg
DLEFR.BAT
DLEFR.HIL
lt TEF defl, dg
DTEFL.BAT
DTEFL.HIL
rt TEF defl, dg
DTEFR.BAT
DTEFR.HIL
time, sec

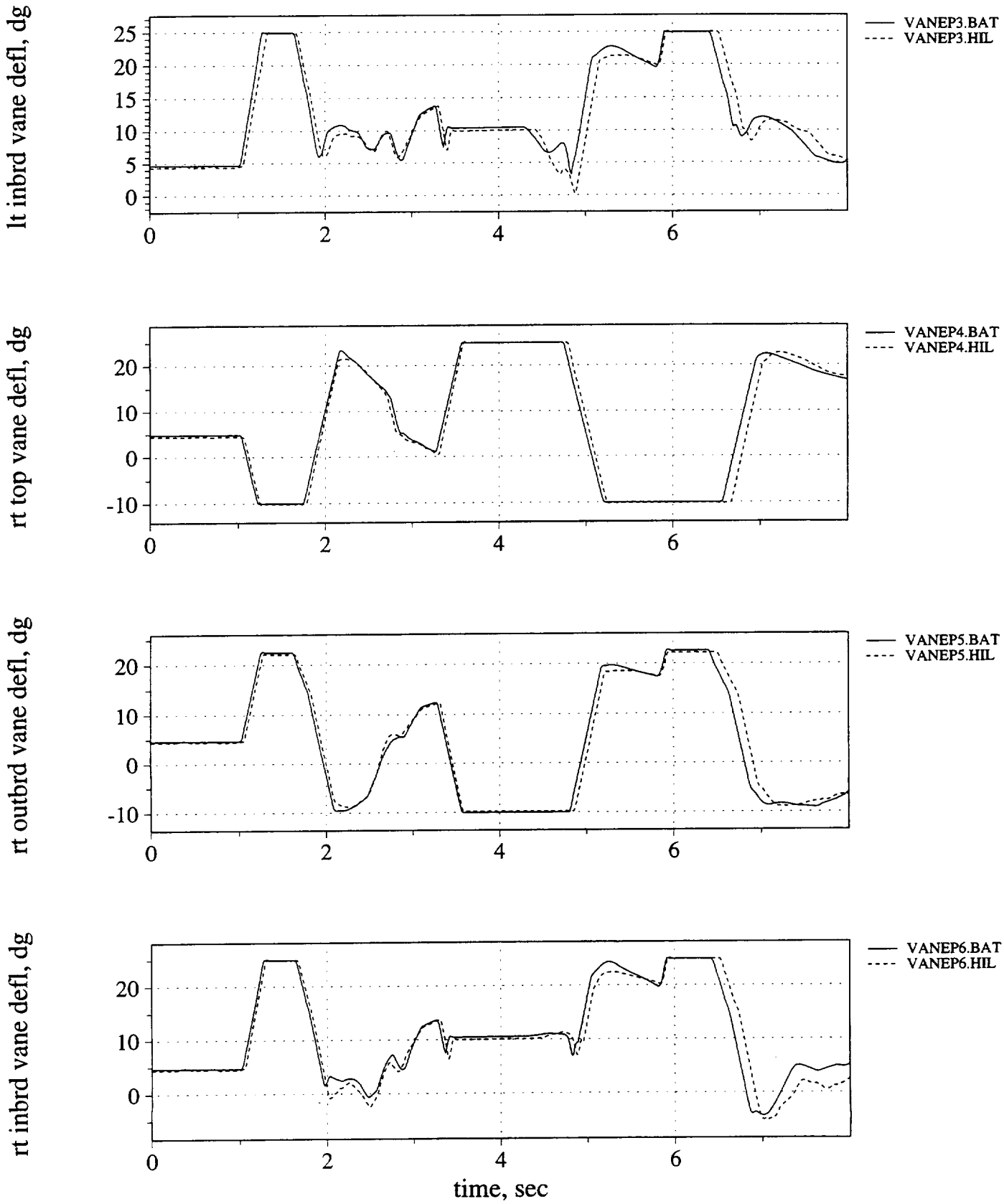

RFCS pit jet cmd, dg
30
20
10
0
-10
-20
0
2
4
6
PIT_CMDDB.BAT
TVSC_1.HIL
RFCS yaw jet cmd, dg
0.4
0.2
-0.0
-0.2
-0.4
YAW_CMDDB.BAT
TVYAW_MP_1.HIL
normal accel, g
0.5
0.0
-0.5
XACNZ.BAT
XACNZ.HIL
lateral accel, g
0.01
-0.00
-0.01
XACAY.BAT
XACAY.HIL
time, sec

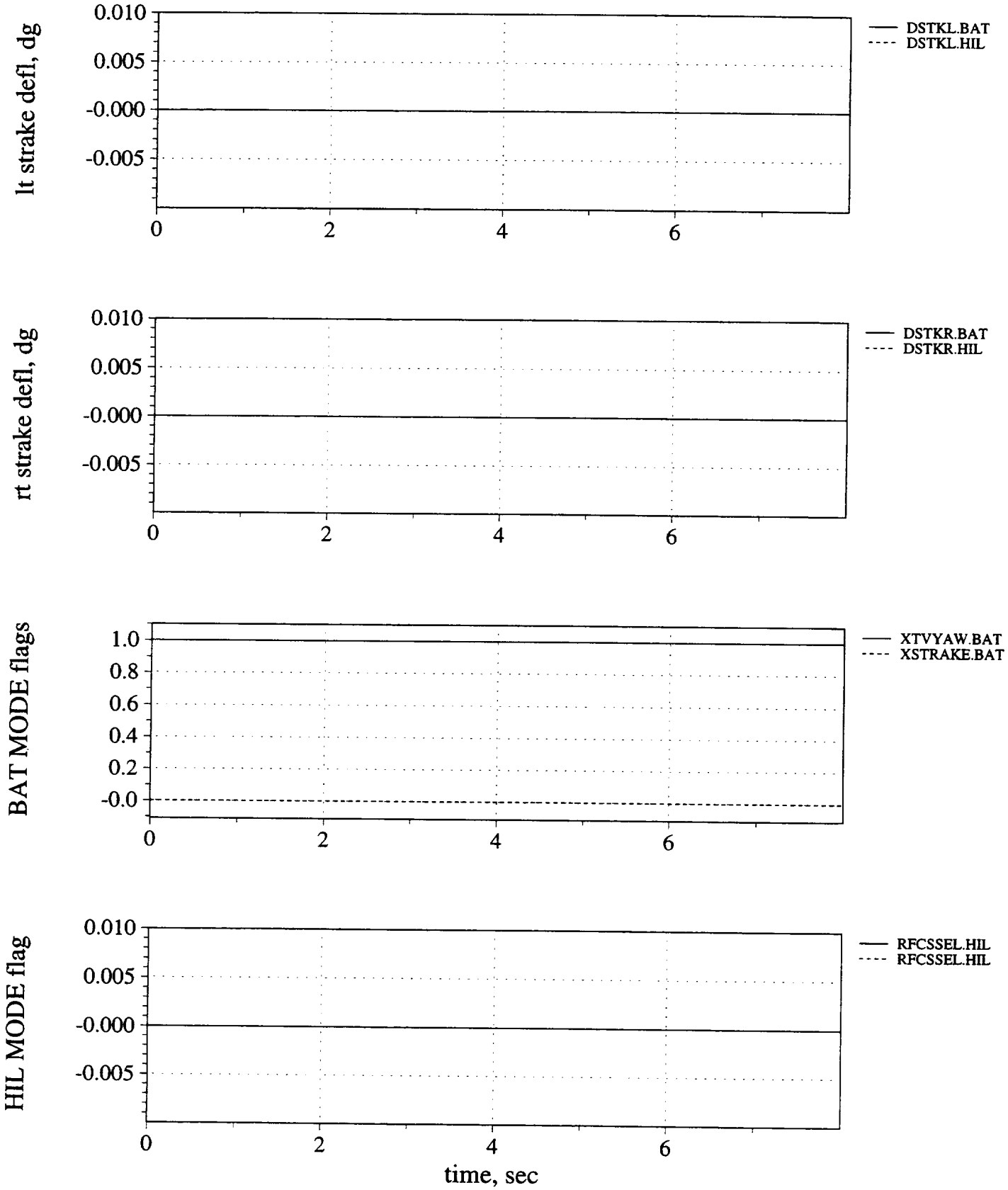

RFCS impact pres, psf
70
65
60
55
50
45
40
0
2
4
6
QCI_SEL.BAT
QC_1.HIL
RFCS static pres, psf
795
790
785
PSI_SEL.BAT
PS_1.HIL
altitude, ft
x10^3
25.06
25.04
25.02
25.00
24.98
H.BAT
H.HIL
Mach number, nd
0.34
0.32
0.30
0.28
AMCH.BAT
AMCH.HIL
time, sec

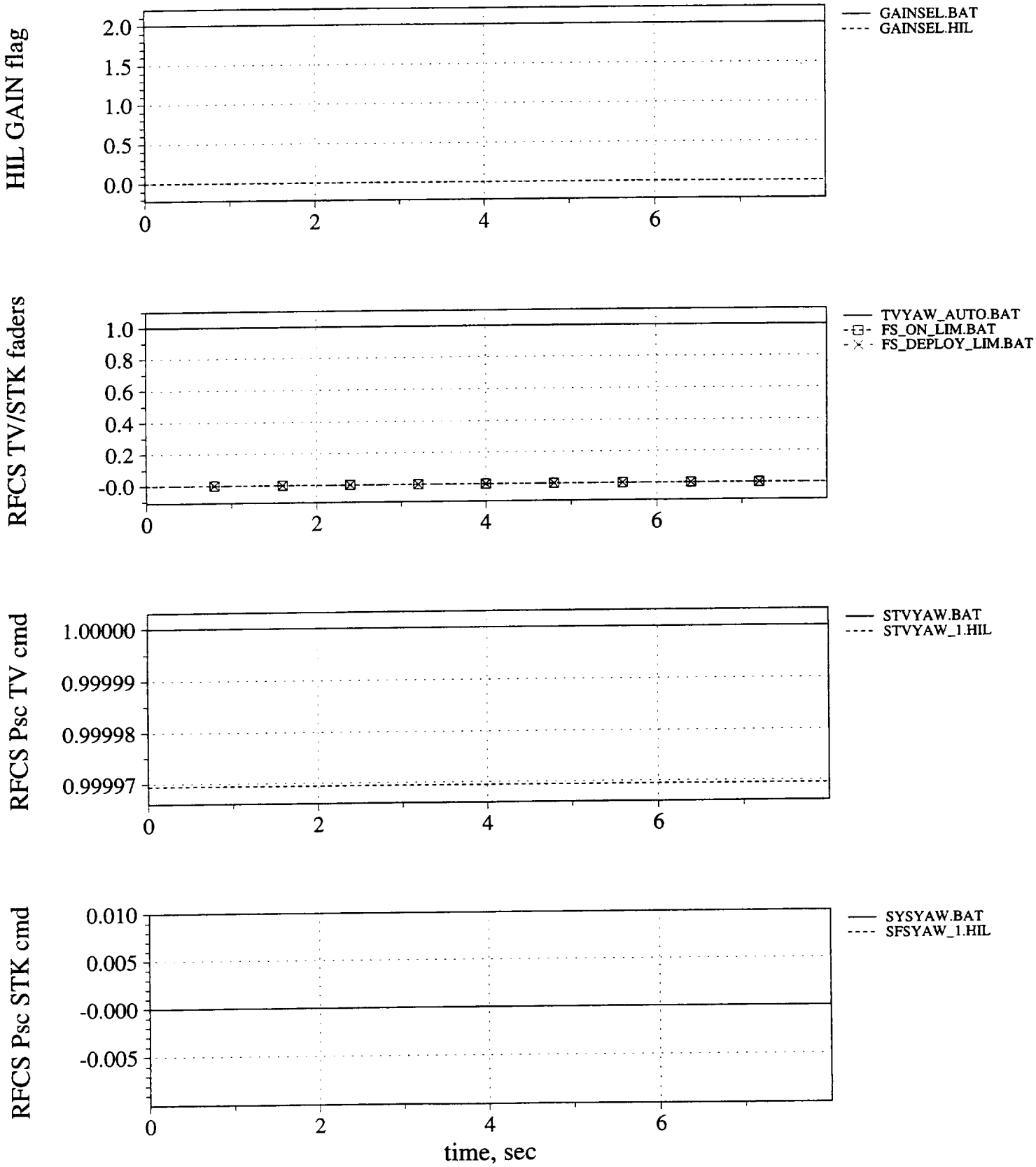

pitch angle, dg
50
40
30
20
10
0
0
2
4
6
THA.BAT
THA.HIL
roll angle, dg
4
2
0
-2
-4
PHI.BAT
PHI.HIL
AOA rate, d/s
20
10
0
-10
-20
-30
ALPDOT.BAT
ALPDOT.HIL
sideslip rate, d/s
1.0
0.5
0.0
-0.5
-1.0
-1.5
BTADOT.BAT
BTADOT.HIL
time, sec


lt/rt power lever ang
63.5
63.0
62.5
62.0
61.5
61.0
0
2
4
6
PLAL.BAT
PLAL.HIL
PLAR.BAT
PLAR.HIL
lt gross thr est, lbs
4800
4700
4600
4500
4400
G_THR_EST_L.BAT
THRUSTL_LBS_1.HIL
rt gross thr est, lbs
G_THR_EST_R.BAT
THRUSTR_LBS_1.HIL
rt stab defl, dg
10
0
-10
-20
DRHTD.BAT
DRHTD.HIL
time, sec


rt aileron defl, dg
DRAD.BAT
DRAD.HIL
yaw angle, dg
PSI.BAT
PSI.HIL
lt top vane defl, dg
VANEP1.BAT
VANEP1.HIL
lt outbrd vane defl, dg
VANEP2.BAT
VANEP2.HIL
time, sec


lt inbrd vane defl, dg
VANEP3.BAT
VANEP3.HIL
rt top vane defl, dg
VANEP4.BAT
VANEP4.HIL
rt outbrd vane defl, dg
VANEP5.BAT
VANEP5.HIL
rt inbrd vane defl, dg
VANEP6.BAT
VANEP6.HIL
time, sec


lt strake defl, dg
0.010
0.005
-0.000
-0.005
0
2
4
6
DSTKL.BAT
DSTKL.HIL
rt strake defl, dg
0.010
0.005
-0.000
-0.005
0
2
4
6
DSTKR.BAT
DSTKR.HIL
BAT MODE flags
1.0
0.8
0.6
0.4
0.2
-0.0
0
2
4
6
XTVYAW.BAT
XSTRAKE.BAT
HIL MODE flag
0.010
0.005
-0.000
-0.005
0
2
4
6
RFCSSEL.HIL
RFCSSEL.HIL
time, sec


HIL GAIN flag
2.0
1.5
1.0
0.5
0.0
0
2
4
6
GAINSEL.BAT
GAINSEL.HIL
RFCS TV/STK faders
1.0
0.8
0.6
0.4
0.2
-0.0
TVYAW_AUTO.BAT
FS_ON_LIM.BAT
FS_DEPLOY_LIM.BAT
RFCS Psc TV cmd
1.00000
0.99999
0.99998
0.99997
STVYAW.BAT
STVYAW_1.HIL
RFCS Psc STK cmd
0.010
0.005
-0.000
-0.005
SYSYAW.BAT
SFSYAW_1.HIL
time, sec

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A new software release designated version 154.0 has been developed and tested for use on the F/A-18 High Angle-of-Attack Research Vehicle (HARV). This software release incorporates all software changes to the Actuated Nose Strakes for Enhanced Rolling (ANSER) control laws through version 153.0 with the following exceptions. The first exception is a modification of the On-Board Excitation System (OBES) which replaces the OBES load in version 153.0 with 17 new maneuvers. The second exception is to change the symmetric strake deployment schedule back to the original schedule in ANSER control law version 151.1. The final change replaces two instrumentation parameters. These three modifications make up the new software release for use in the Research Flight Control System (RFCS) flight control computer. This report documents the batch versus Hardware-In-the-Loop Simulation test results for version 154.0.

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