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SIMULATION TEST RESULTS

FOR

LIFT/CRUISE FAN RESEARCH AND TECHNOLOGY AIRCRAFT

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SUMMARY

In September 1976 a flight simulation program was conducted at the NASA Ames Research Center on the Flight Simulator for Advanced Aircraft (FSAA). The flight simulation was a part of a contracted effort by MCAIR to provide a lift/cruise fan V/STOL aircraft mathematical model for flight simulation (Contract NAS2-9144).

The simulated aircraft is a MCAIR configuration of the Lift/Cruise Fan V/STOL Research Technology Aircraft (RTA). The aircraft is powered by three gas generators driving three fans. One lift fan is installed in the nose of the aircraft, and two lift/cruise fans at the wing root. The thrust of these fans is modulated to provide pitch and roll control, and vectored to provide yaw, side force control, and longitudinal translation.

Two versions of the RTA were defined. One is powered by the GE J97/LF460 propulsion system which is gas-coupled for power transfer between fans for control. The other version is powered by DDA XT701 gas generators driving Hamilton Standard 62 inch variable pitch fans. The mathematical models of both versions and the associated information for simulator programming are contained in Report MDC A4571.

The flight control system in both versions of the RTA is the same. It consists of a direct mechanical or electrical link from the pilot's controls to the control thrust or moment producers and a control augmentation system (CAS). The CAS has full authority and provides pitch and roll attitude command and yaw rate command in hover. In transition the CAS provides pitch and roll rate command/attitude hold, yaw rate damping, and turn coordination. The augmentation system is dualized and comparison monitored to guard against control hardover signals, so that in the event of a channel failure the CAS is disengaged in the failed axis.

The test plan consisted of: (1) evaluation of the basic handling qualities, (2) investigation of the characteristics and requirements associated with visual approaches to a vertical and short landing, and (3) evaluations of the effects on aircraft control and task performance resulting from major failures. The basic handling qualities were evaluated in hover, at discrete speeds, in transition and conversion, and in aerodynamic flight to 300 knots. Mission tasks, representative of NASA's typical research mission, were performed to study the takeoff and landing characteristics. While performing the mission tasks, engine and CAS failures in flight were simulated.

One NASA, two NATC, and two MCAIR pilots participated in the evaluations. All five pilots had previous V/STOL flight experience, and four of the five pilots have flown the AV-8A aircraft.

The simulation test program was highly successful with adequate coverage for all major areas of interest. Pilot general opinion of the simulator, the simulated model, and the test setup was favorable and highlighted by enthusiastic participation in the program.

The FSAA and the computer equipment functioned reliably throughout the simulation. One hundred ninety simulation flights were completed for a total of 25 hours of data taking on the motion base. An additional 10 hours with motion and 5 hours fixed base were used for pilot familiarization.

Some shortcomings in the simulator visual display, cockpit controls, and the head up display were encountered which detracted somewhat from the overall simulation results. The visual scene was too restricted for the mission tasks. At airspeeds of 200 knots or more it was nearly impossible to turn within the confines of the terrain map. The power management quadrant lever geometry was somewhat awkward, detents were incorrect, and the vector lever drive motor was not functioning. A head up display was not planned for these simulation tests but was later added at pilots' request before start of data taking. The HUD symbology was developed for a different simulation program and was therefore not optimized for the mission tasks of this experiment.

Despite the above shortcomings, which in themselves provide a lesson for future test programs and simulator hardware setup, the test results yield many valuable recommendations for further design and development of the RTA flight control system. The major results are briefly summarized as follows:

<u>Hovering</u>

1. All pilots were pleased with the aircraft's flying qualities with the CAS engaged. Average pilot rating was about 2 on the Cooper-Harper scale for the hover task without wind, and about 3 with a 15 knot wind and turbulence. The attitude command control augmentation system is credited for the favorable pilot opinion.
2. The most notable adverse characteristic in hover was a negative weathercocking tendency due to the momentum drag on the lift fan inlet. Another annoying characteristic was the overshoot in yaw rate for pedal input. Two of the five pilots thought the throttle sensitivity was somewhat too high and roll sensitivity too low.

3. Thrust vector change was preferred to pitch attitude change for longitudinal translations. Vector angle could be changed more quickly than pitch attitude which resulted in better translational response.
4. The aircraft could be hovered and landed without control augmentation. Pilot ratings were 6-7 for hovering without roll CAS, 5-6 without pitch CAS, and 4 without yaw CAS. With all control augmentation disengaged the average pilot rating was about 7 for the hover task.
5. With CAS engaged the only difference noted between the gas fan aircraft and the mechanical fan aircraft was the higher thrust-to-weight ratio in the gas fan aircraft. Some pilots said this made the gas fan aircraft slightly easier to hover than the mechanical fan aircraft. Average pilot rating for the mechanical fan RTA in hover was about 2 to 3.
6. The mechanical fan aircraft seemed easier to hover CAS off and was thought to be due to lower control lags. It must be noted, however, that up to 10% thrust modulation the control response is basically the same in both aircraft.

Transition

1. The mode change from attitude command below 35 knots to rate-command/attitude hold above 35 knots was unsatisfactory. As long as the pilot was not maneuvering during mode change, everything was satisfactory. During maneuvering flight, however, the mode change could result in a severe transient depending on the magnitude of the maneuver. A gradual rather than a discrete switchover is recommended.
2. Flying qualities in the 60 to 120 knot speed range were very good. Overall pilot ratings with CAS engaged and no wind were 2 to 3. Attitude hold mode of the CAS reduced pilot workload to a low level, and turn coordination characteristics were very good.
3. In the 60 knot speed range large commanded power changes coupled some changes in pitch attitude. A reduction in power causes a rapid increase in sink rate which tends to pitch the aircraft nose up. There is some direct thrust moment effect, but most of the pitch coupling is due to momentum drag on the lift fan.

4. The side velocity feedback in the yaw CAS is very effective in providing low speed turn coordination, but sensitivity to turbulence seemed to be increased.
5. Turn coordination at 150 knots was not as good as at the lower airspeeds. The pilots also noted a presence of negative dihedral effect at that speed. Scheduling of yaw CAS gains with airspeed and vector angle his condition requires further study.
6. The pitch attitude hold mode was not as effective as the pilots would have liked it to be. The system failed to hold the exact pitch attitude existing at stick release. This problem was attributed to unsatisfactory stick centering and subsequent drift in the simulator.
7. The flying qualities in the 60-150 knot speed range are acceptable with the roll or yaw CAS disengaged. With pitch CAS off, however, the pilots indicated the possibility of losing control of the aircraft.

Conversion

1. The conversion from powered-lift flight to aerodynamic flight and the reconversion from aerodynamic flight to powered lift were easy to perform and received pilot ratings of 2-3. Conversion and reconversion were generally performed at 180-240 knots and required little pilot workload. As lift/cruise fan vector angle was decreased from 30° to 0°, the lift fan was automatically shut down gradually and the third gas generator reduced to idle. The main pilot effort was changing pitch attitude to generate additional wing lift as the powered lift decreased to zero. Pilots suggested additional studies to determine the best combination of airspeed, power, flap, and pitch attitude so that conversion could be performed with minimum pitch change.

Aerodynamic Flight

1. Flying qualiites in aerodynamic flight at 200 and 300 knots were good but with some annoying deficiencies noted. Roll control was sluggish at 200 knots, too abrupt at 300 knots. Roll control at 300 knots was given a pilot rating of 5. It may be necessary to use a roll CAS prefilter or gain variation with airspeed.
2. Flying qualities with CAS off in conventional flight were generally acceptable.

3. The math model originally contained an angle of attack limiter, which was later removed because it restricted low speed approach to a conventional landing. The need for an α limiter is not certain. The aircraft becomes statically unstable for α greater than about 14° but the CAS stabilizes the aircraft. Even with CAS disengaged, the aircraft could be controlled at all high angles of attack investigated.

Mission Task Performance

1. The mission task performance was satisfactory except for the difficulty in performing the task within the confines of the visual scene. Average pilot ratings for the tasks were 2-3. Tasks involving vertical takeoffs and landings received the most favorable comments. There was no significant difference between the gas fan aircraft and the mechanical fan aircraft in the performance of the RTA mission tasks.

Engine Failures

1. Engine failures were controllable at any point in the mission task. The flight could be aborted or continued after the failure at pilot's discretion.
2. On two occasions the pilot attempted a very rapid descent and deceleration by reducing thrust on all fans to idle and selecting 90° thrust vector angle. As airspeed decreased, the pilot eventually lost control as the aerodynamic control surfaces lost effectiveness. Though maneuver such as this is not envisioned operationally, nevertheless it should be considered if some preventive measure is necessary to preclude such power reduction in flight.

Thrust Vectoring Rate

1. A brief investigation, not included in the test plan, was conducted to study the effects of reduced thrust vectoring rates on RTA mission performance and handling qualities. The nominal maximum thrust vectoring rate is 50 degrees/second. Mission tasks were flown with maximum vectoring rates of 25, 15, and 5 degrees/second. With a maximum rate of 25 degrees/second there was no apparent degradation in performance of the mission task or the associated handling qualities. At 15 degrees/second some degradation in task performance was apparent. A maximum rate of 5 degrees/second was too slow and the pilots could no longer perform transitions satisfactorily. It must be emphasized, however, that these test results are not generally conclusive

especially with respect to operational conditions. The thrust-to-weight ratio and mission tasks are not representative of an operational aircraft. Therefore, a more comprehensive operational evaluation is required.

Overall, this simulation program demonstrated a basically sound approach in aircraft and control system design, provided direction for further analysis and design studies, and provided a comprehensive and efficient mathematical model for future programs. The pilot ratings and comments along with other recorded data comprise a data bank from which important conclusions and guidelines for future design, analysis, and implementation effort can be drawn. Perhaps the most important conclusions with respect to the RTA are:

1. Both the gas-coupled and the shaft-coupled systems can provide good aircraft control characteristics.
2. The dual CAS flight control system falls short of the desired fail safe performance.

The dual CAS flight control system, evaluated in this simulation experiment, was considered a possible candidate for a cost saving approach to the RTA program. The summary of results with respect to this evaluation are shown in terms of the Cooper-Harper categories in the chart of Figure S-1. As the chart points out, roll CAS failure in hover and pitch CAS failure in transition or conversion results in control characteristics which are unacceptable and dictate improvement for safety of flight. The most direct approach to achieve the desired level of improvement is through the addition of a third control channel. This very significant conclusion substantiates MCAIR's recommendation of a triplex control-by-wire flight control system for the RTA.

FIGURE S-1
REDUCED COST ALTERNATE FCS SEP 1976 FSAA SIMULATION RESULTS

		SATISFACTORY WITHOUT IMPROVEMENT	ADEQUATE PERFORMANCE/ WORKLOAD TOLERABLE	IMPROVEMENT MANDATORY
CAS OPERATING				
COMPOSITE RATING		X		
CAS FAILED				
HOVER	ROLL			X
	PITCH		X	
	YAW		X	
TRANSITION & CONVERSION	ROLL		X	
	PITCH			X
	YAW		X	

TABLE OF CONTENTS

LIST OF PAGES

Title
ii through xiv
1 through 71
A-1 through A-21
B-1 through B-26

LIST OF FIGURES

LIST OF SYMBOLS

g	Acceleration due to gravity (32.174 feet/second^2)
HP_2	Horsepower supplied to fan 2 (horsepower)
n_X, n_Y, n_Z	Aircraft load factor components along x, y, and z body axes, respectively (g's)
N_G	Sum of N_G and N_{GDAMP} signals (percent)
N_{GDAMP}	Height damper engine RPM input (percent engine RPM)
N_{GI}	Engine Speed commanded by master power lever and height damper.
p	Airplane roll rate. Inertial velocity about x body axis (radians/second)
q	Airplane pitch rate. Inertial velocity about y body axis (radians/second)
r	Airplane yaw rate. Inertial velocity about z body axis (radians/second)
V	Airplane velocity with respect to air (feet/second)
W_F	Total usable fuel remaining in aircraft (pounds)
x,y,h	Aircraft CG position with respect to earth-fixed coordinate system (feet)
α	Airplane angle of attack (degrees)
β	Airplane sideslip angle (degrees)
δ_{AR}	Right aileron deflection (degrees)
δ_{FLAP}	Flap deflection angle (degrees)
δ_H	Stabilator deflection (degrees)
$\delta_{I\theta}$	Pitch stick input (inches)
$\delta_{I\phi}$	Lateral stick input (inches)
$\delta_{I\psi}$	Rudder pedal input (inches)
δ_θ	Powered-lift pitch command (percent of maximum)
δ_ϕ	Powered-lift roll command (percent of maximum)

LIST OF SYMBOLS (continued)

δ_ψ	Powered-lift yaw command (percent of maximum)
ε_{GS}	Glide slope error (degrees)
ε_{LOC}	Localizer error (degrees)
θ	Airplane pitch angle (degrees)
θ_J	Command thrust vector angle (degrees)
ϕ	Airplane roll angle (degrees)
ψ	Airplane heading angle (degrees)

ABBREVIATIONS

ADI	Attitude director indicator
ARC	Ames Research Center (NASA)
CAS	Control Augmentation System
c.g.	Center of gravity
ETaC	Energy Transfer and Control
FCS	Flight Control System
FSAA	Flight Simulator for Advanced Aircraft
HSI	Horizontal situation indicator
HUD	Head-up display
IFR	Instrument flight rules
ILS	Instrument landing system
PR	Pilot rating
RTA	Research Technology Aircraft
TRM	Thrust Reduction Modulation
T/W	Thrust-to-weight ratio

1. INTRODUCTION

This report documents the results of flight simulation tests of a Lift/Cruise Fan V/STOL Research Technology Aircraft (RTA). The tests were conducted on the Flight Simulator for Advanced Aircraft (FSAA) at the NASA Ames Research Center in September 1976.

The RTA was mathematically modeled in two versions, a gas-coupled and a shaft-coupled version. The mathematical model definition and all associated programming information are documented in a separate report (Reference 1).

The simulated flight control system is a direct mechanical or electrical link from pilot's controls to the thrust and moment producers, augmented with a dual channel control augmentation system (CAS). This flight control system was selected as a potential cost saving approach and, at the initiation of this simulation program, was considered to be the minimum acceptable flight control system for the RTA. Although it is not a MCAIR recommended system, its evaluation, nevertheless, establishes a reference for further development of a suitable flight control system for the RTA.

The RTA flight control system design and mathematical model formulation are based on valuable V/STOL simulation experience obtained during a series of simulation tests of the MCAIR Model 253 aircraft at NASA Ames Research Center. The Model 253 was a 6 engine/6 fan V/STOL transport type research aircraft design. The first simulation tests were performed on the S.01 motion base simulator in 1971 and are reported in References 2, 3, and 4. A second simulation program was conducted in 1972 on the FSAA and is reported in References 5 and 6. The final Model 253 simulation experiment, which was completed in 1973 using the FSAA, integrated the flight control system with advanced cockpit displays for performing decelerating instrument approaches to a vertical landing (References 7 through 10).

2. THE SIMULATOR

The Flight Simulator for Advanced Aircraft (FSAA) is a six-degree-of-freedom moving base simulator shown in Figure 2-1. The motion capabilities of this simulator are listed in Figure 2-2. The equations of motion are programmed on the Honeywell Information Systems (HIS) Sigma 8 digital computer with appropriate simulator motion scaling and washouts.

The simulator cockpit is a transport crew station containing side-by-side seating. The instruments and controls were mounted on the right side. Visual scenes were provided by a Redifon visual attachment at both sides of the crew station. The Redifon terrain map contained a conventional runway, a STOL runway, a VTOL port and a destroyer sized ship capable of roll, pitch and heave.

The crew station primary controls consisted of the control stick, rudder pedals, and a left hand power management quadrant. The FSAA has an adjustable control stick and rudder pedal feel system. This system was adjusted to provide the desired stick and rudder pedal force gradients.

A head-up display (HUD) was generated on the IMLAC computer, interfaced with the Redifon visual display, and superimposed on the visual scene. Operational instruments were installed on the instrument panel. The crew station is described in greater detail in Section 4.

The aircraft equations of motion for this simulation were programmed on the HIS Sigma 8 digital computer in sufficient detail to represent the dynamics of the control system including actuators, gas generators, and fans. Power transfer characteristics through gas ducts in the gas-coupled system, and high speed shafts with fan blade variation in the mechanically-coupled system were also simulated. A six-degree-of-freedom digital computer program, written to a similar level of detail, was used at MCAIR to generate program check cases for simulator checkout.

FIGURE 2-1
FLIGHT SIMULATOR FOR ADVANCED AIRCRAFT

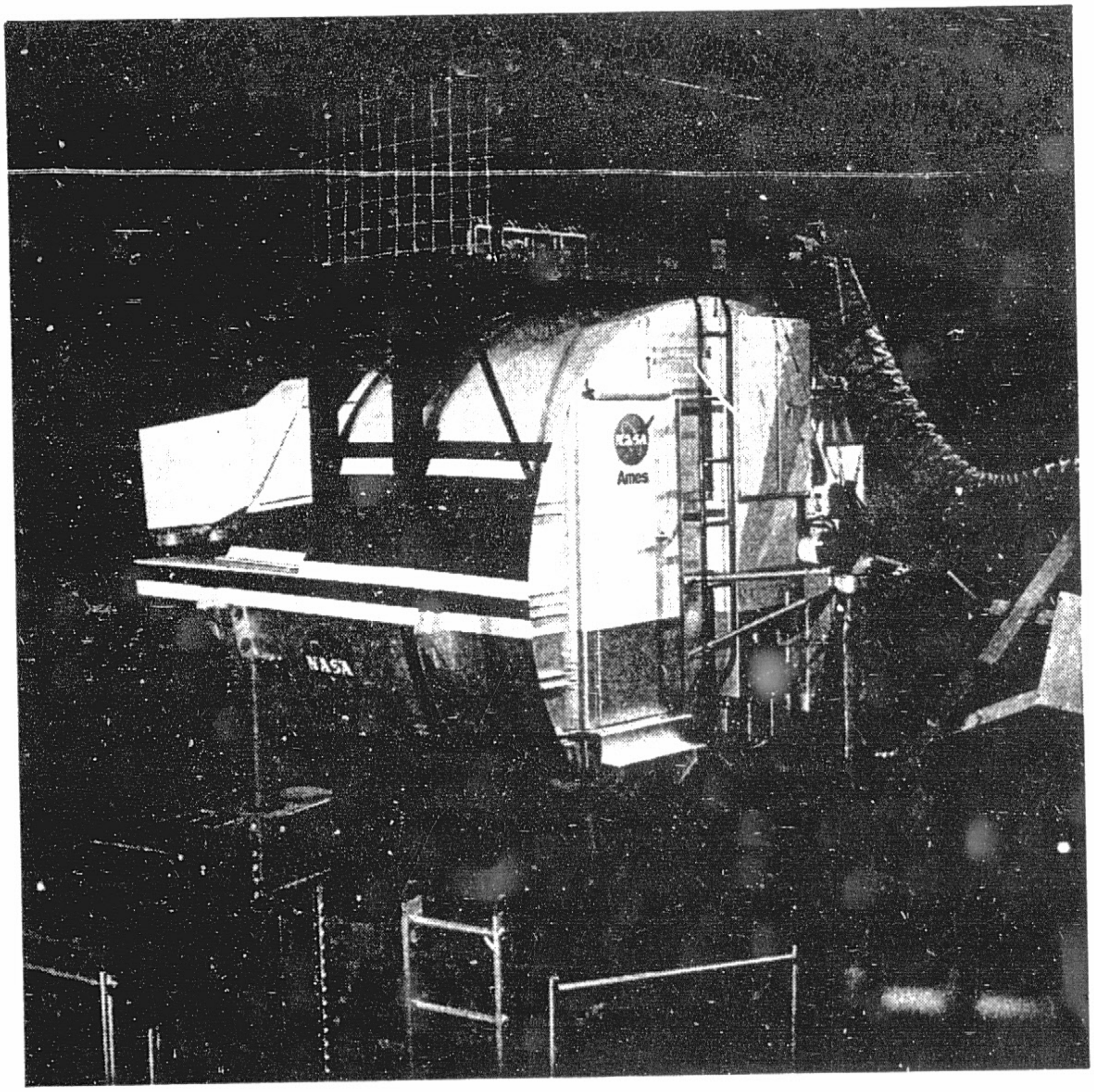


FIGURE 2-2
FLIGHT SIMULATOR FOR ADVANCED AIRCRAFT - PHYSICAL CHARACTERISTICS

Motion Generated:	Displacement	Acceleration	Velocity	Frequency at 30° Phase Lag
Roll	±45°	4 rad/sec^2	1.77 rad/sec	3.1 Hz
Pitch	±22½°	2 rad/sec^2	0.70 rad/sec	1.5 Hz
Yaw	±30°	2 rad/sec^2	0.70 rad/sec	1.7 Hz
Vertical	±5 ft	12 ft/sec^2	8.65 ft/sec	2.2 Hz
Longitudinal	±4 ft	10 ft/sec^2	6.32 ft/sec	1.8 Hz
Lateral	±50 ft	12 ft/sec^2	17.00 ft/sec	1.0 Hz

3. THE SIMULATED AIRCRAFT

The simulated aircraft is a Lift/Cruise Fan V/STOL Research Technology Aircraft (RTA). The aircraft is powered by three turbojet engines which drive three fans, one of which is a lift fan located in the forward fuselage and is used only during the powered-lift phase of flight. This lift fan is shut down during aerodynamic flight and its air exit is closed to reduce drag. The other two fans, called the lift/cruise fans, are installed at the wing roots and are used during both the powered lift and aerodynamic flight phases. The exhaust nozzles of the lift/cruise fans can be deflected such that the fan thrust can be directed at any angle between vertical for hover and horizontal for aerodynamic flight. In addition, the thrust from all three fans can be vectored side to side for lateral translation (side force) or yaw control.

Two different versions of the aircraft, differing in the methods of power transfer, were simulated. In one system, the power is transferred from the gas generators to the fans by means of gas ducts which supply high energy heated air to drive tip turbines on the periphery of each fan. This configuration is referred to as the gas-coupled system. The other configuration utilizes mechanical transfer of power through interconnecting shafts with all fans operating at the same rotational speed. This configuration is referred to as the shaft-coupled system.

3.1 GENERAL DESCRIPTION

The gas-coupled system is shown in Figure 3-1 where the gas ducts, which transfer energy from the engines to the fans, and the engine and fan locations are shown in detail. The shaft-coupled aircraft is shown in Figure 3-2, with engine and fan locations and some of the power transmission included.

Powered-lift and aerodynamic flight envelopes are presented in Figure 3-3 for the simulated RTA. The envelope applies specifically to a 28,000 lb aircraft at intermediate thrust and at standard atmospheric conditions. The simulation tests, however, are based on a 90°F tropical day. The powered lift envelope is for three gas generator/three fan operation; the aerodynamic envelope is for two gas generator/two fan operation.

3.2 AIRCRAFT CONTROL

The aircraft control system for the simulated Research Technology Aircraft is based on a three engine/three fan configuration using fan thrust modulation and vectoring in addition to conventional aerodynamic control surfaces. The

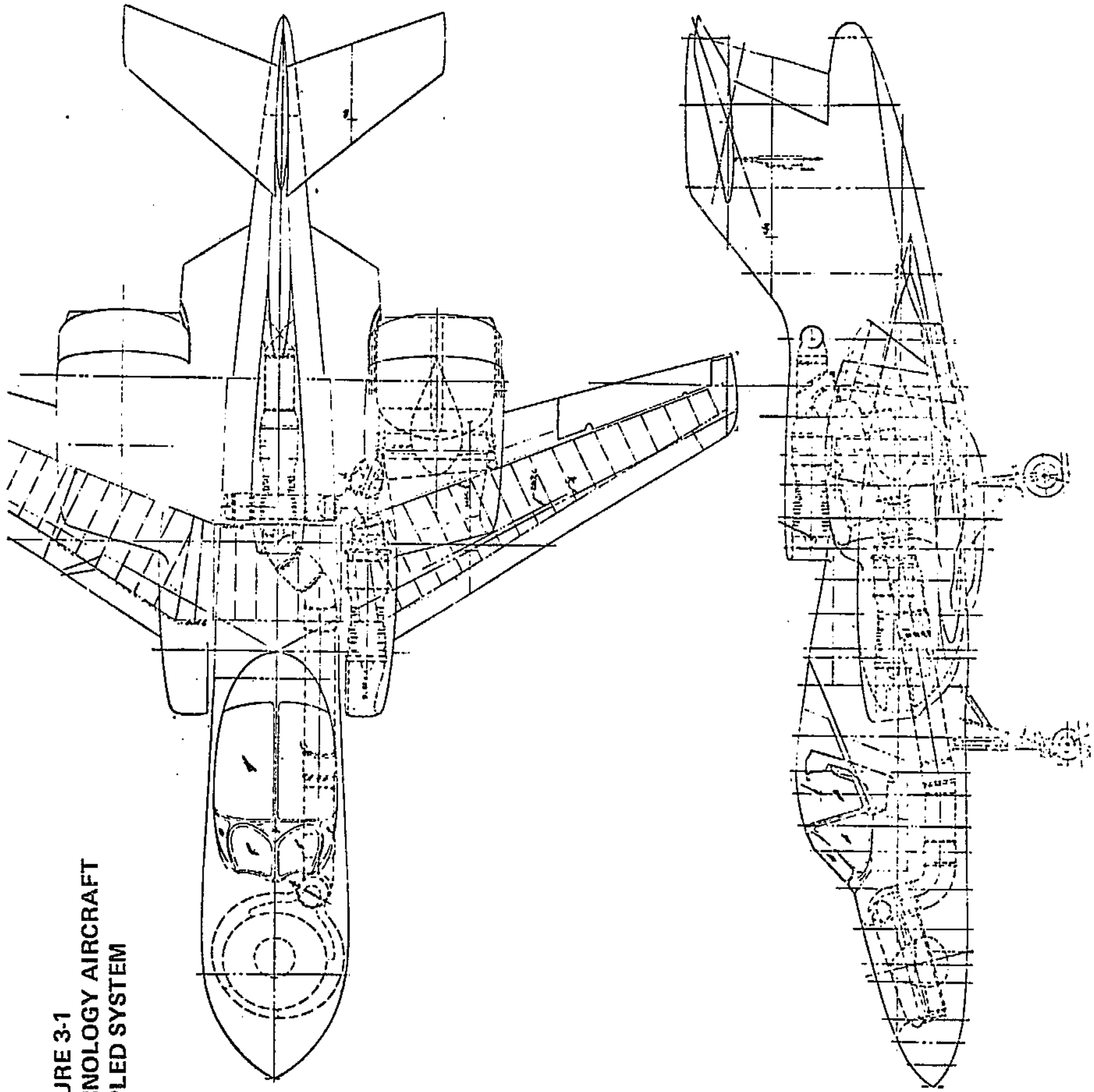


FIGURE 3-1
RESEARCH TECHNOLOGY AIRCRAFT
GAS COUPLED SYSTEM

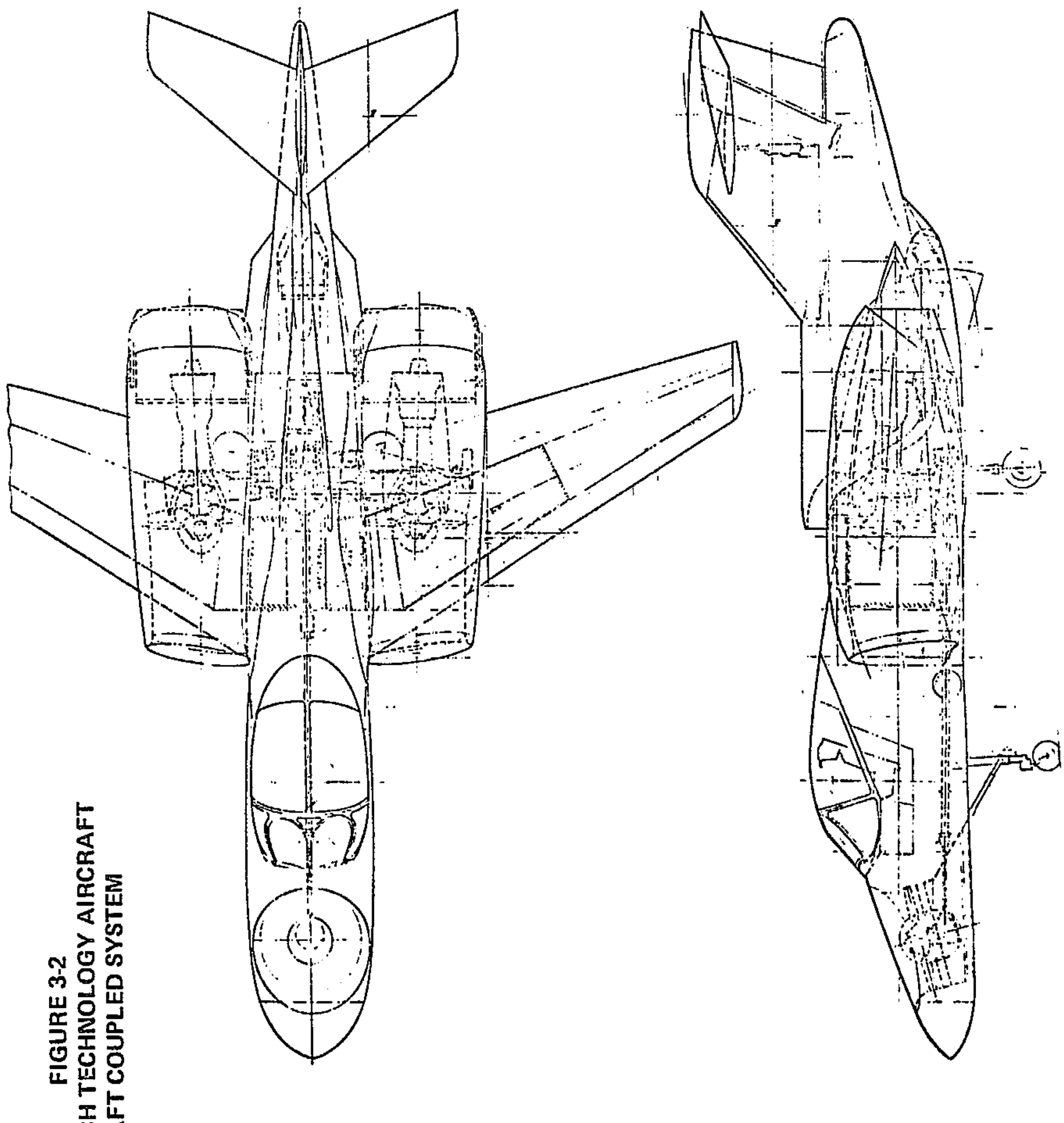
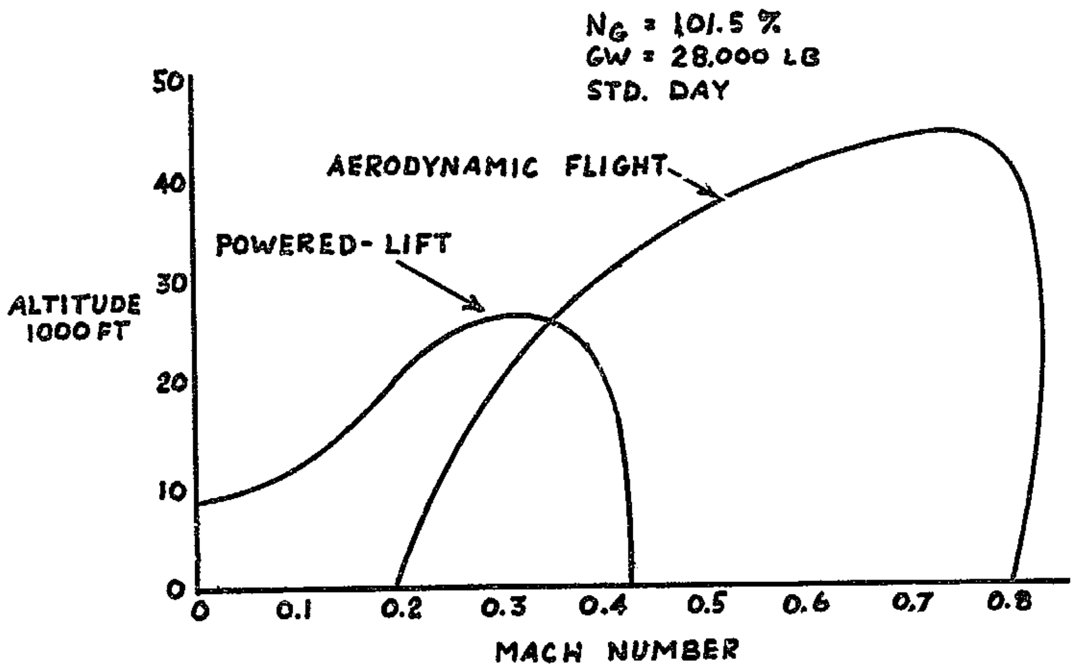


FIGURE 3-2
RESEARCH TECHNOLOGY AIRCRAFT
SHAFT COUPLED SYSTEM

FIGURE 3-3
TECHNOLOGY AIRCRAFT
FLIGHT ENVELOPES



aircraft is accelerated from hover through transition by appropriate vectoring of the fan thrust, commanded by the pilot by means of the thrust vector lever. During low speed flight, control moments are generated by differential fan thrust modulation for pitch and roll, and differential thrust vectoring for yaw control.

Differential fan thrust modulation in the gas-coupled system is achieved by means of the Energy Transfer and Control (ETaC) system. Valves, located at the inlets to the tip turbine of each fan, control the transfer of energy through the interconnecting ducts between the fans to accomplish the desired thrust changes. Partial closing of the ETaC valve at one of the fans causes the thrust of all the other fans to increase without a substantial change of thrust at that fan. The result is a net increase in total lift. The ETaC system is therefore effectively implemented in conjunction with a fan Thrust Reduction Modulation (TRM) system to provide greater thrust differential for control moments and better control response while maintaining constant total lift. Coordination of all three ETaC valves and TRM devices is provided to achieve aircraft control with minimum coupling between attitude control and total lift.

Yaw control is provided by laterally vectoring the thrust of the lift and lift/cruise fans differentially, such that the horizontal components of the lift vectors produce a yaw moment on the aircraft. To yaw right, for example, the fan flow of the forward fuselage mounted lift fan is deflected to the left so that the horizontal component of thrust is a force which moves the nose of the aircraft to the right. Simultaneously, flow of the lift/cruise fans is deflected to the right such that the side force moves the aft fuselage to the left. The effective deflection angles required are small so that negligible total lift losses result during yaw control applications.

Stabilator, ailerons, and rudder provide aircraft pitch, roll, and yaw control throughout the aerodynamic flight envelope and part of the powered lift flight envelope. All of these control surfaces are actuated by irreversible, hydraulically powered actuators. Thrust is generated in aerodynamic flight by two lift/cruise fans powered by two gas generators. Control of thrust is provided by means of a power lever located on the left of the pilot's seat.

3.3 THE FLIGHT CONTROL SYSTEM (FCS)

The simulated flight control system is an alternate system which has been proposed for the RTA as a potential cost reduction approach. The system is dual-channel using two flight control system computers which are cross-channel monitored. A failure of a motion sensor, computer or servo causes disengagement of the stability and control augmentation system and the pilot assumes open loop control of the aircraft. The major functions provided by the Control Augmentation System (CAS) are described as follows:

Pilot command of pitch and roll attitude provides superior VTOL handling characteristics at airspeeds near hover. In this mode pitch and roll attitude changes are proportional to control stick displacements. Feedback signals of pitch and roll attitude and pitch and roll rate are used to effect attitude stability and proper aircraft attitude response. At speeds of 30-40 knots and above, the pilots prefer to command aircraft rate rather than attitude. Pitch and roll rate feedback signals are used to provide aircraft rate response proportional to stick displacement during maneuver control inputs. The attitude feedback signals are used only during steady state flight to provide attitude hold for pilot workload reduction. The flight control system operation is mechanized through the powered lift control and the aerodynamic control surfaces. This provides a smoother transition, as the powered lift controls are phased out and the aerodynamic controls become more effective, and insures continuation of good control and stability through conversion. Forward and rate feedback gains are scheduled as a function of commanded thrust vector angle.

The outputs from the pitch and roll FCS channels are utilized as input into the manual control system.

Directional control is augmented by a yaw rate command system which provides lateral-directional stabilization and good directional control characteristics at hover and low speeds when the system operates mainly through the lift fan thrust deflection system.

A roll-to-yaw interconnect system coordinated with feedbacks of lateral acceleration and side velocity are used to provide turn coordination. This mechanization is particularly important because the turn coordination requirements change drastically with airspeed, particularly in the 0 to 100 knot range. At speed approaching hover, approximately 30-40 knots, coordinating of turns must yield to a pure sideslip mode of control.

4. CREW STATION

The simulated aircraft has a two-place cockpit with side-by-side seating. Both sides would normally be equipped with duplicate instruments and controls. In the simulator, however, only the right seat is equipped. The following paragraphs describe the basic controls, instruments, and arrangement of the crew station in this simulation experiment.

4.1 CREW STATION ARRANGEMENT

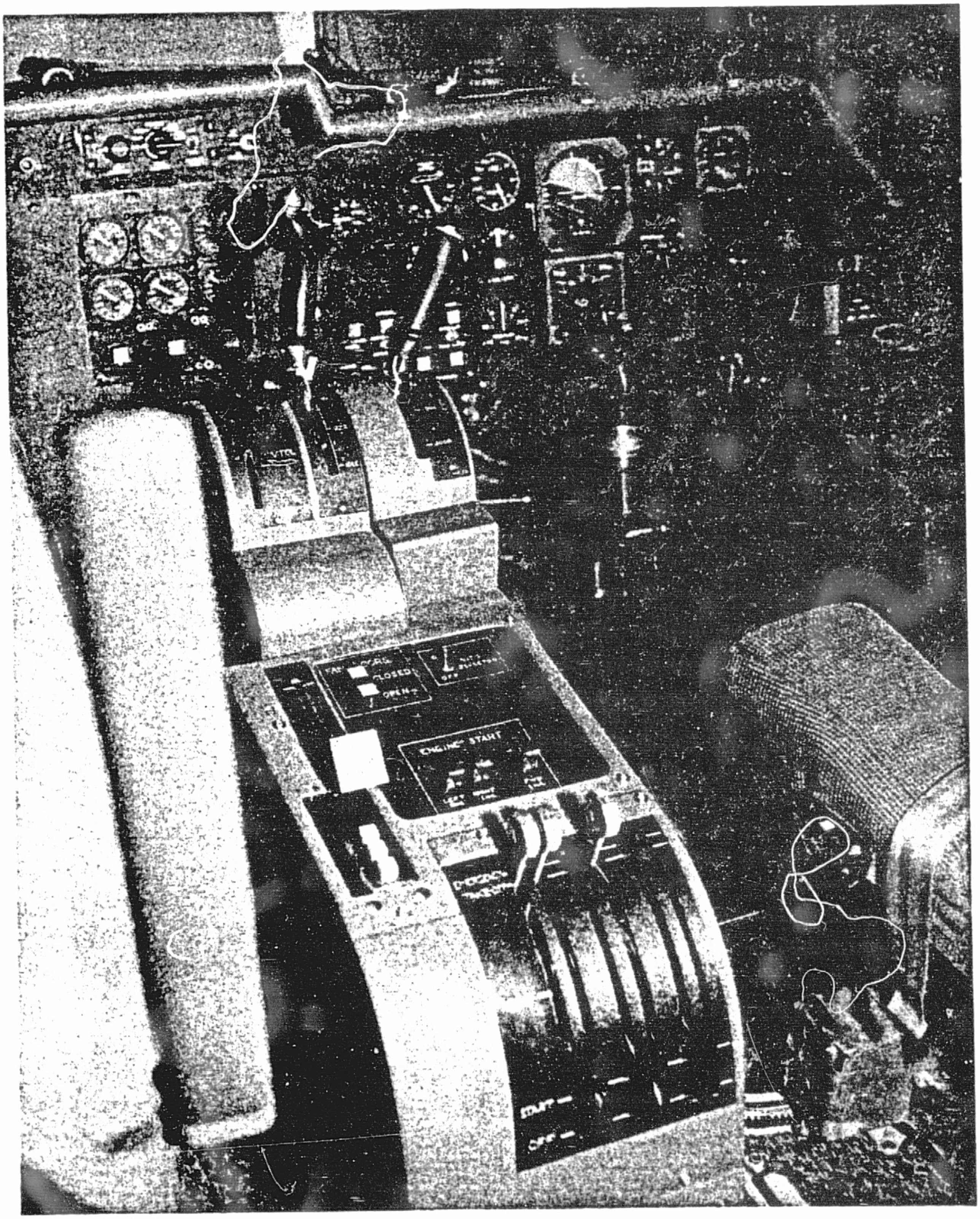
The basic controls consist of a control stick, rudder pedals, and a left-hand power management quadrant. A picture of the cockpit is shown in Figure 4-1. Specific attention is focused on the power management quadrant, the throttles, and the propulsion system status display. These items are basic to conversion, and the pilot's conversion procedures and subsequent discussions are referred to this arrangement.

The power management quadrant consists of a master power lever for height control and a transition lever for thrust vector control. The transition lever is mounted on the left of the power lever. A soft detent in its travel is provided at the hover vector angle which provides the pilot with a reference point when hovering. A hard detent is provided at 30 degrees which requires deliberate action by the pilot when performing conversion to aerodynamic flight. The transition lever can also be driven by an electric motor controlled by a thumb-operated switch on the power lever. The power lever is also equipped with a thumb button for direct side force control. Movement of the button sideways causes the yaw vanes to move collectively in the same direction to produce a side force on the aircraft. This permits lateral translation in hover without banking the aircraft.

Figure 4-1 shows an additional lever mounted to the right of the master power lever. This lever was installed for a previous simulation experiment which used the same cockpit arrangement. This lever was not used during this simulation.

The three individual throttle levers are used only for engine startup and shutdown. In the actual aircraft, the individual throttles will be mechanically coupled to the power lever and will normally follow the power lever motion. In the simulator, the individual throttles were not physically coupled to the power lever. Instead, appropriate mathematical logic was provided in the computer.

FIGURE 4-1
SIMULATOR COCKPIT



Gas generator and fan tachometers are provided on the instrument panel to permit pilot monitoring of engine and fan performance.

4.2 THE INSTRUMENT PANEL

The instrument panel, shown in Figure 4-2, is equipped with conventional instruments including an ADI and an HSI providing heading, lateral deviation, vertical deviation, and range information. Other instruments include barometric altimeter, radar altimeter, rate of climb, airspeed, angle of attack, sideslip, turn and slip, vector angle, and trim usage indicators. Three engine RPM and fan RPM gages and a flap position indicator are also provided. Various indicator lights are also provided. Three engine failure lights are installed on the power management panel. Mode select and failure indicators are provided for three axes of CAS engagement. Lights are also used to indicate status of the landing gear, fan doors, height damper, and CAS attitude/rate mode.

4.3 THE HEAD-UP DISPLAY

The head-up display provided essential information for piloting the aircraft. The basic display consists of an airplane symbol, horizon indicator, velocity vector indicator, pitch ladder, and scales of airspeed, rate of descent (or climb), and heading. Altitude, airspeed, thrust vector angle, and engine power are displayed in digital form; and lateral acceleration is indicated by a circle/bar display just below the heading scale. Airplane pitching is indicated by up-down motion of the horizon indicator and pitch ladder with respect to the airplane symbol, while rolling is shown by tilting of the horizon indicator and the pitch ladder. The basic format is shown in Figure 4-3.

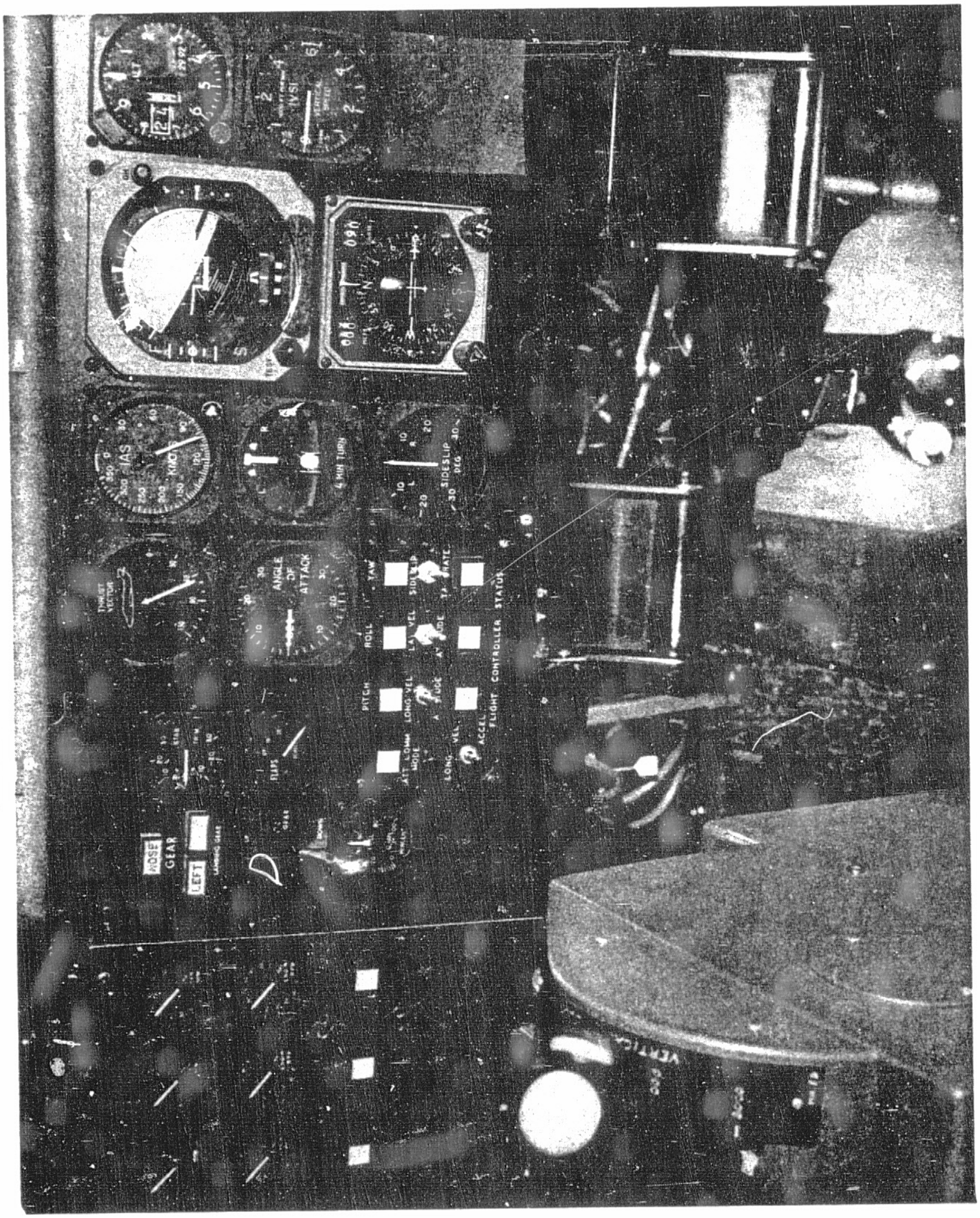
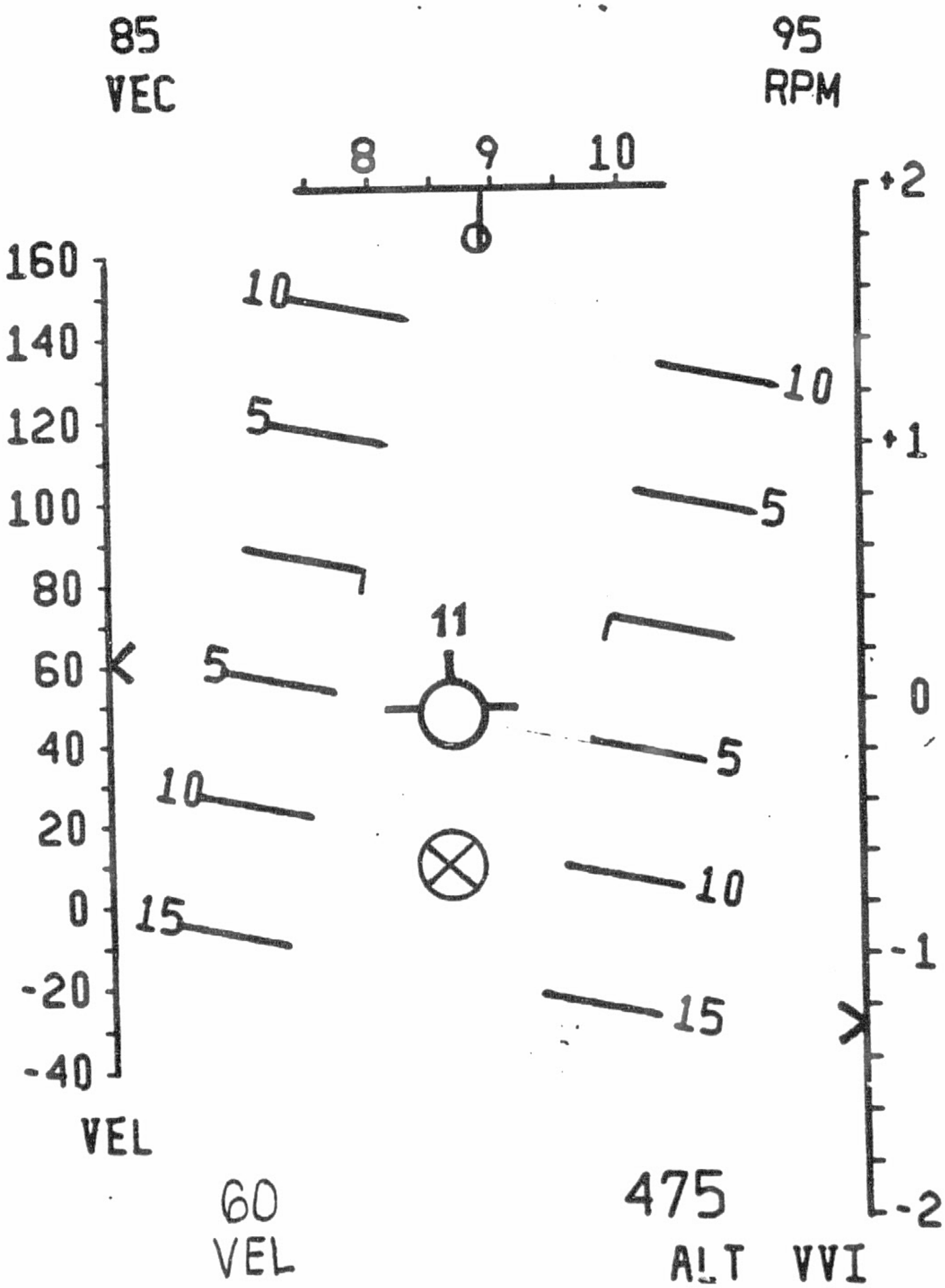


FIGURE 4-2
SIMULATOR INSTRUMENT PANEL

FIGURE 4-3
HEAD-UP DISPLAY



5. TEST PROGRAM

Flight simulation tests were performed on the NASA Flight Simulator for Advanced Aircraft (FSAA) at the Ames Research Center. The test program consisted of the following four parts:

1. Evaluation of the basic handling qualities of the Lift/Cruise Fan Research Technology Aircraft
2. Investigation of the characteristics and requirements associated with visual approaches to a vertical landing
3. Evaluations of the effects on aircraft controllability and task performance resulting from certain failure modes
4. Experiments in special cases of interest

This test plan was used with both the gas-coupled and shaft-coupled versions of the RTA.

5.1 HANDLING QUALITIES EVALUATION

The handling qualities evaluations were broken down into four separate tasks to cover the flight envelope of the RTA. The four handling qualities evaluation tasks were the following:

1. Hover
2. Discrete transition speed
3. Transition and conversion
4. Aerodynamic flight

5.1.1 HOVER - The FSAA is a six-degree-of-freedom motion base simulator with a closed transport-type crew station. The motion is scaled to correspond with a special hover display in the form of a VTOL port which is projected on a CRT in the crew station. During these evaluations the pilot was asked to make some allowance with respect to the visibility constraints which will not be present in the actual aircraft. The following maneuvers were performed as a minimum to evaluate the hovering handling qualities:

1. Deliberate pitch, roll, and yaw inputs to evaluate attitude response of the aircraft
2. Forward-aft translation, using the transition lever
3. Forward-aft translation using pitch attitude changes
4. Side-to-side translation by roll attitude changes
5. Side-to-side translation using side force control
6. Height control inputs

7. 180° turnaround and 360° turnaround
8. Spot hover in crosswind and turbulence

All flights were performed with CAS engaged and no wind except in cases where significant information could be gained from studying wind effects and CAS off operation.

5.1.2 DISCRETE TRANSITION SPEED EVALUATIONS - It was important that adequate test time was allotted to the transition flight regime because of the interaction of many variables affecting the characteristics of flight and handling qualities of the aircraft in that region. To ensure that this regime of flight was properly evaluated, it was necessary to stabilize the aircraft at selected airspeeds and perform a number of controlled maneuvers. The airspeeds selected were 60, 90, 120, and 150 knots. At each airspeed the pilot was asked to perform appropriate maneuvers and evaluate the following:

1. Holding attitude, altitude, and heading
2. Responses to pitch, roll, and yaw inputs
3. Intentional sideslipping
4. Turn coordination
5. Steady turns
6. Climb and descent

All flights were performed with CAS engaged and without wind unless specifically required for a meaningful evaluation.

5.1.3 TRANSITION AND CONVERSION - To evaluate the overall characteristics in transition between hover and cruise the following tasks were performed:

1. Establish hover
2. Accelerate to conversion speed
3. Convert to aerodynamic lift flight
4. Accelerate to 300 knots
5. Decelerate to reconversion speed
6. Reconvert to powered lift flight
7. Decelerate and reestablish hover

These evaluations were performed with CAS engaged in calm and windy conditions to obtain a more meaningful overall evaluation.

5.1.4 AERODYNAMIC FLIGHT - The pilot was asked to perform appropriate maneuvers to evaluate the six characteristics listed in Section 5.1.2 at 200 and 300 knots airspeed.

5.2 MISSION TASKS

This part of the program was intended to investigate specific operational characteristics and problems associated with a visual approach to a vertical landing without outer loop guidance. The task is shown in Figure 5-1 and consisted of the following:

1. Take off vertically or short, transition, and convert to aerodynamic flight
2. Accelerate to 300 knots and climb to 1000 feet
3. Fly to a specific I.P. on a specified heading
4. Decelerate and convert to powered lift flight at 1000 feet when landing site is at the proper (visually estimated) range
5. Approach to hover at 100 feet over landing spot
6. Make vertical descent and touchdown

The takeoffs for this task were split about equally between vertical and short.

Note that this experiment was specifically oriented to study pilot workload, vectoring rates, takeoff and landing time, and touchdown accuracy. These tests were performed with CAS engaged and varying wind conditions.

5.3 FAILURE MODE STUDY

This part of the simulation program was devoted to evaluation of the effects of potential system failures on the control characteristics and operational capabilities of the aircraft. To conduct this part of the simulation, failures were simulated at various points during the performance of the takeoff and landing approaches described in Section 5.2.

The control augmentation system is at least dual channel in all safety of flight affecting areas. Critical CAS failures therefore constitute loss of CAS in one affected axis at a time.

5.4 SPECIAL CASES

Sufficient time was allowed in formulating the test plan to study areas of special interest such as an alternate yaw control concept, thrust vectoring rates, and effect of control system lags on handling qualities.

5.5 EVALUATING PILOT BACKGROUND

Two McDonnell Douglas test pilots (A and B), one NASA pilot (C), one USMC pilot (D) and one USN pilot (E) participated in the simulator evaluations of the RTA. Pilot A has extensive flight experience in fighter aircraft with some time in helicopters and other aircraft. He has considerable flight time in the AV-8A Harrier. Pilot B is also an experienced fighter test pilot with time

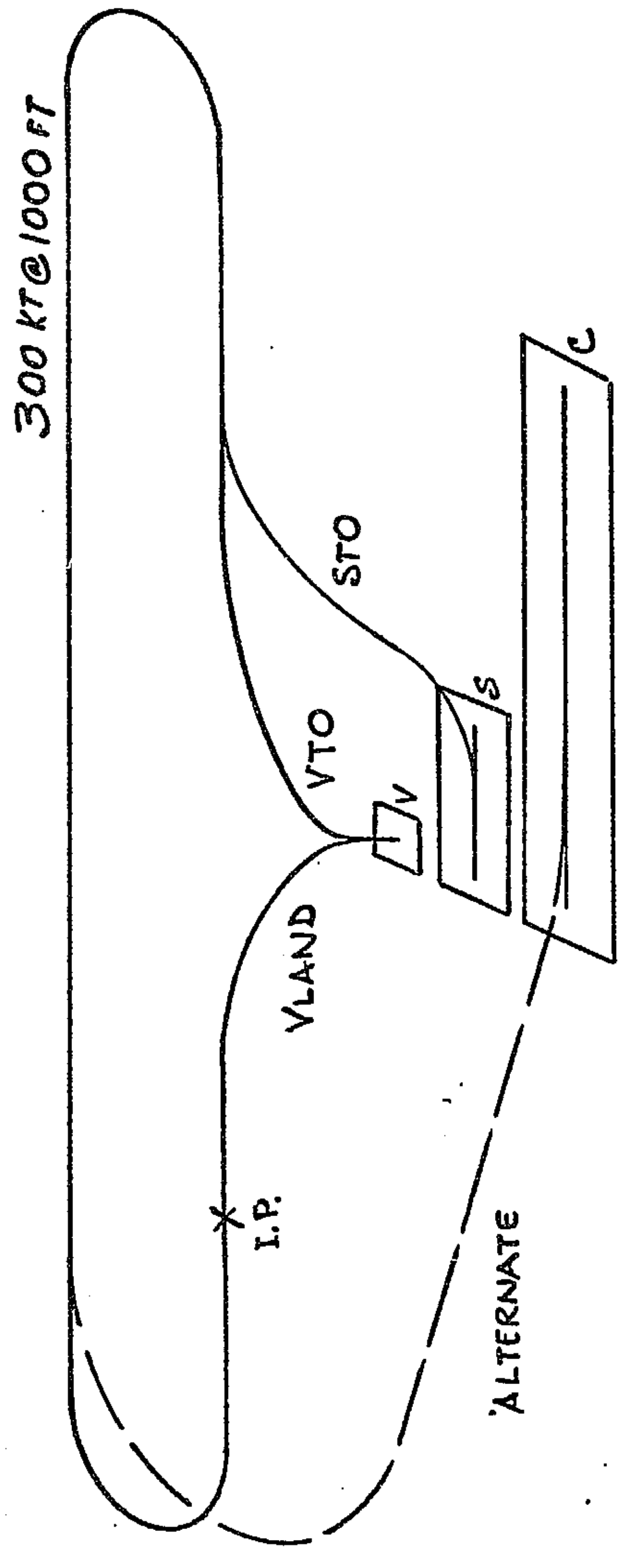


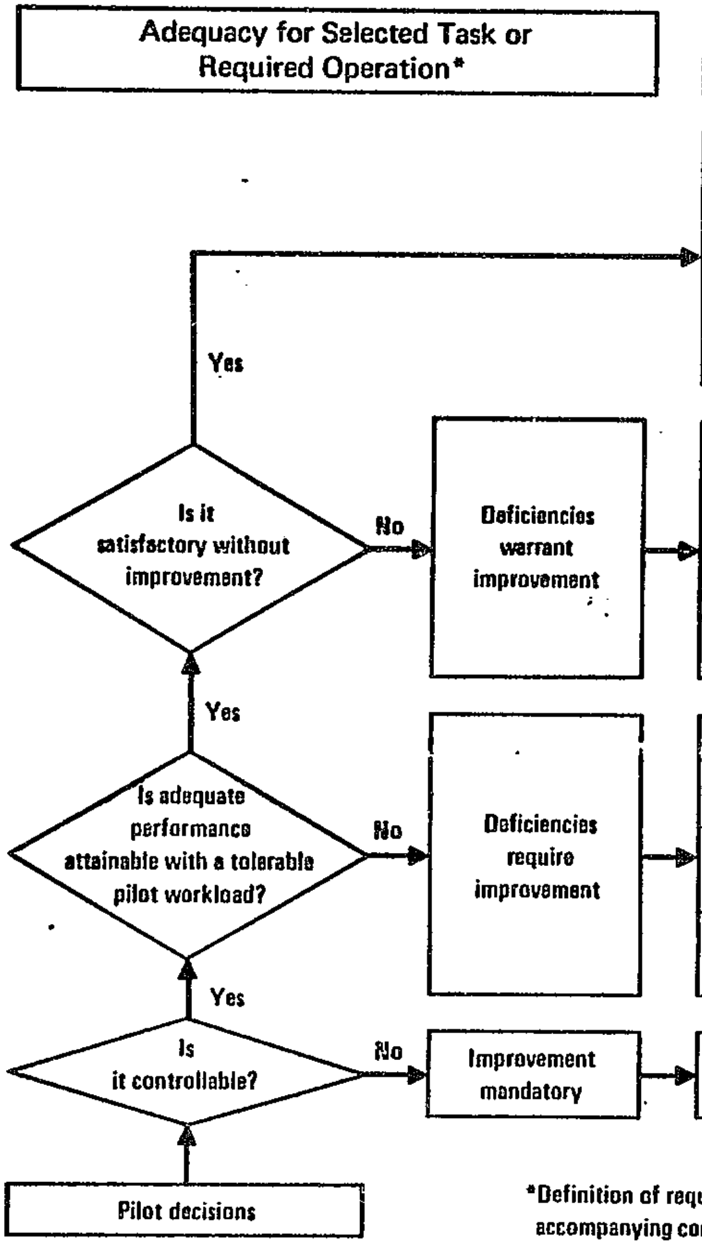
FIGURE 5-1
MISSION TASKS

in the AV-8A. Pilot C is an experienced test pilot with vast experience in helicopters and vectored thrust V/STOL aircraft. Pilot D is an experienced pilot with operational AV-8A experience and time in the VAK-191B. Pilot E is also an experienced pilot with AV-8A operational experience.

Pilot ratings presented in this report are according to the Cooper-Harper scale shown in Figure 5-2.

Time histories of various aircraft and control system motion parameters were recorded during the simulation flights using 24 strip chart recorder channels. Time histories for selected flights are presented in various figures throughout this report. The recorded parameters were multiplexed (two different parameters recorded on a single channel) as shown on the sample time history of Figure 5-3. The two signals are labeled "long" and "short" indicating that the recorder pen spends a longer amount of time recording the "long" signal and a shorter amount of time recording the "short" signal. The "long" signal has the appearance of a solid line, while the "short" signal is the locus of the pulse peaks. Where posible, variables are chosen to be mutually complementary. For example, flight director commanded bank angle and actual bank angle may be presented on the same channel so that an error will be represented by the spacing between the two signals.

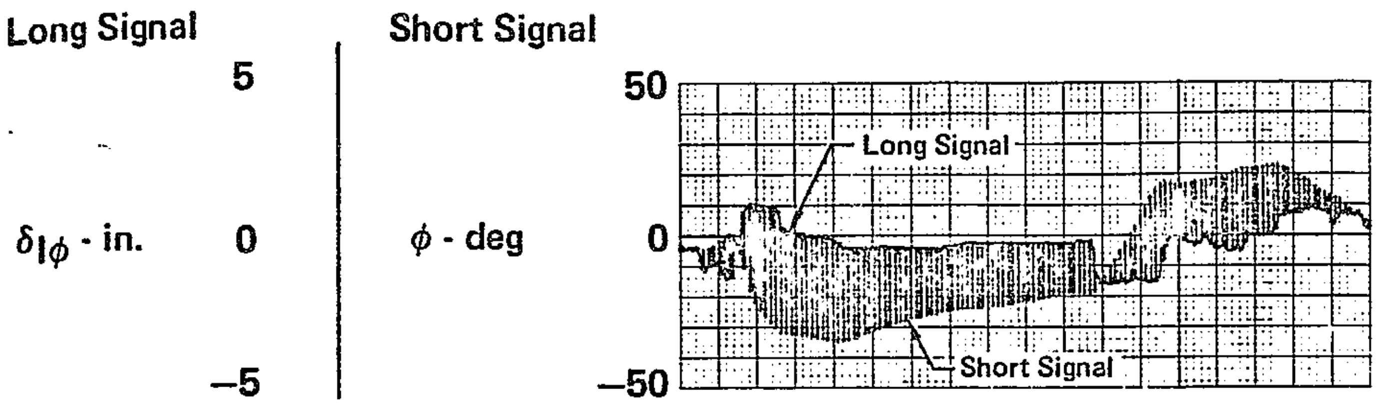
FIGURE 5-2
HANDLING QUALITIES RATING SCALE



Aircraft Characteristics	Demands on the Pilot in Selected Task or Required Operation*	Pilot Rating
Excellent Highly desirable	Pilot compensation not a factor for desired performance	1
Good Negligible deficiencies	Pilot compensation not a factor for desired performance	2
Fair - Some mildly unpleasant deficiencies	Minimal pilot compensation required for desired performance	3
Minor but annoying deficiencies	Desired performance requires moderate pilot compensation	4
Moderately objectionable deficiencies	Adequate performance requires considerable pilot compensation	5
Very objectionable but tolerable deficiencies	Adequate performance requires extensive pilot compensation	6
Major deficiencies	Adequate performance not attainable with maximum tolerable pilot compensation. Controllability not in question.	7
Major deficiencies	Considerable pilot compensation is required for control	8
Major deficiencies	Intense pilot compensation is required to retain control	9
Major deficiencies	Control will be lost during some portion of required operation	10

*Definition of required operation involves designation of flight phase and/or subphases with accompanying conditions.

FIGURE 5-3
STRIP CHART RECORDER MULTIPLEXING



6. HANDLING QUALITIES IN HOVER

A series of simulation flights was conducted to investigate the aircraft handling qualities in hover. The task consisted of hovering the aircraft over one end of the runway using the visual display. The maneuvers listed in Section 5.1 were performed.

Most flights were made with CAS engaged without wind and turbulence. Some flights were performed with turbulence and wind from various directions to determine the effect on flying qualities. The effect of CAS failures on handling qualities in hover was simulated by disengaging the CAS, one axis at a time, and sometimes by disengaging the CAS in all three axes simultaneously. A special study was made to determine the effect of existing control system lags on CAS off flying qualities.

6.1 HANDLING QUALITIES IN HOVER - CAS ON

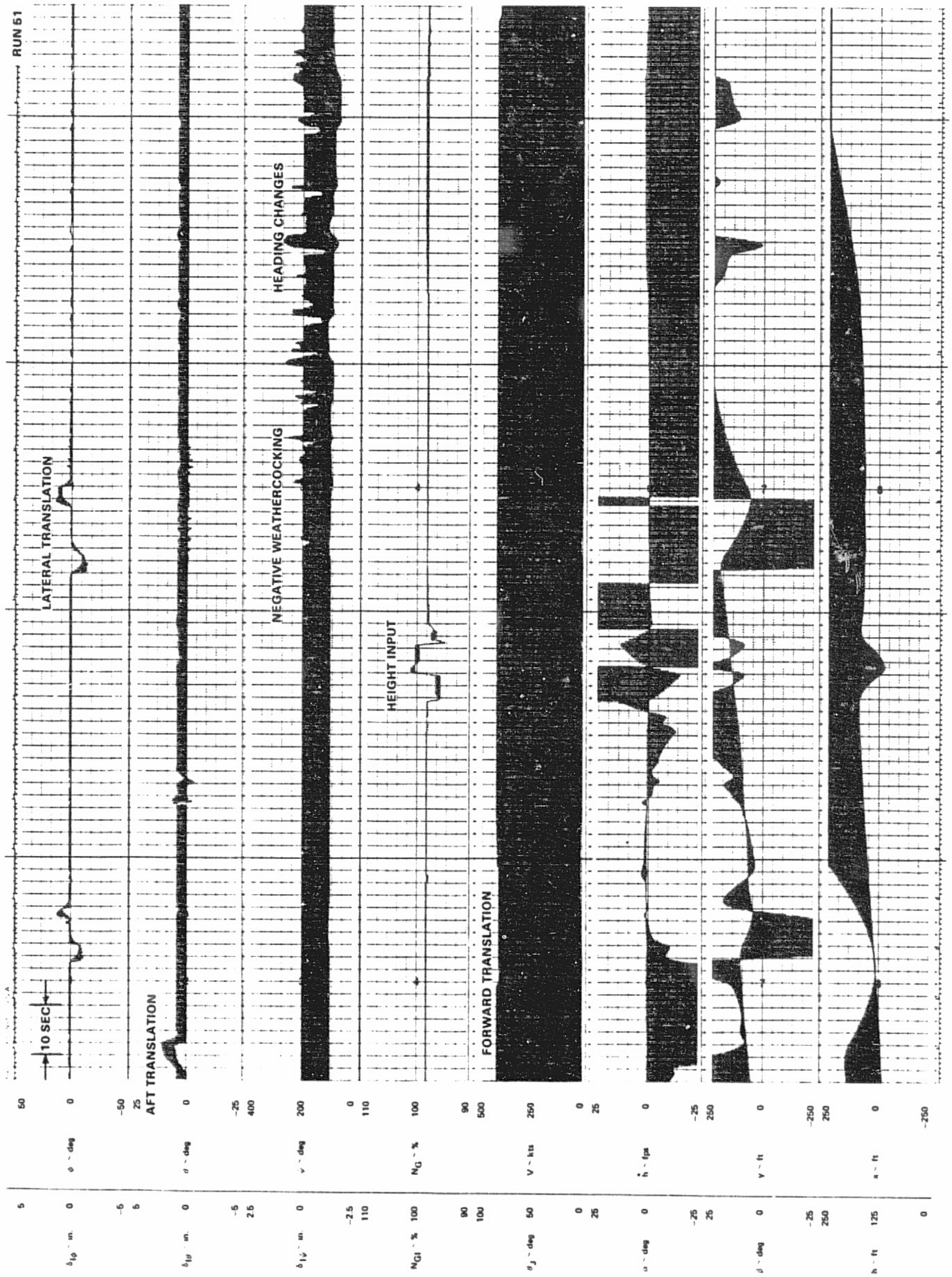
All pilots were pleased with the aircraft's flying qualities in hover with CAS on. Average pilot rating was about 2.0 on the Cooper-Harper scale for the hover task without wind. This is attributed primarily to the attitude command control augmentation system. Since the airplane is attitude stabilized, it is not necessary for the pilot to make continuous control inputs to maintain attitude. Anytime the stick is centered, the aircraft returns to the nominal wings-level attitude. The hover task consisted mainly of making small changes in roll and pitch attitude to maintain desired position over the ground. Time history traces of a typical hover task are shown in Figure 6-1.

6.1.1 NOMINAL HOVERING ATTITUDE - The pitch attitude command system was originally designed so that the aircraft would return to zero pitch attitude with the stick released. However, the RTA landing gear geometry was such that a zero pitch attitude landing resulted in a nose-wheel-first touchdown which is not desirable. To preclude this and to eliminate the need for the pilot to increase pitch attitude for landing, a bias was added to the pitch feedback in the attitude command mode. This results in a 5 degree nose up attitude during vertical takeoff and landing when the stick is centered as shown in Figure 6-1.

The 5 degree nose up bias has an additional advantage. On vertical take-off there is no pitch attitude change on liftoff since the airplane will maintain approximately the initial ground attitude. With a nose up attitude following vertical takeoff, the wing is already at an angle of attack conducive to generating lift during transition.

The disadvantage of the bias is a nose high hovering attitude with reduced over the nose visibility. While over the nose look-down angle could not be

FIGURE 6-1
HOVER HANDLING QUALITIES EVALUATION



accurately represented in the simulator, it must not be ignored on the actual aircraft. Desired nominal hover attitude and aircraft ground attitude require additional study. Other considerations should include nose wheel liftoff during short and conventional takeoff and possible exhaust gas reingestion.

6.1.2 NEGATIVE WEATHERCOCKING IN HOVER - A noted hover characteristic was a negative weathercocking tendency which was due to the momentum drag on the lift fan inlet. For example, when the aircraft was hovering in a left crosswind, the momentum drag on the nose fan inlet caused the nose to yaw to the right. The lift/cruise fan inlets had only a slight positive effect on the weathercocking tendency due to their proximity to the aircraft center of gravity.

The negative weathercocking tendency showed up also during the side-to-side translations. When the aircraft rolled and translated to the right, the nose tended to yaw left (see Figure 6-1). On occasion, this problem was described by the pilots as roll-yaw control coupling, but further investigation isolated the problem as negative weathercocking. This control characteristic was annoying, but did not interfere with the ability to perform the hover task.

The weathercocking tendency can be remedied. A high gain prefilter model following type control system will reduce the apparent weathercocking. In the simplified RTA system, however, a heading hold mode, which uses feedback of heading change in the yaw axis, could be used to control the weathercocking tendency.

Another problem, which the pilots described as annoying, was noted as an overshoot in yaw rate for a pedal input. When the pilot simulated a step pedal input, the airplane established a steady yaw rate. When the input was removed, the yaw rate returned to zero but with an overshoot to a negative value which caused a slight reversal in heading. A suitable gain change in the yaw CAS to produce an overdamped response is being considered.

6.1.3 LONGITUDINAL TRANSLATION IN HOVER - Thrust vector angle change was preferred to pitch attitude change as means for longitudinal translation in hover. Vector angle could be changed more quickly than pitch attitude which resulted in better translational response. There were some pilot comments indicating that the longitudinal response due to pitch attitude changes seemed much less than they experienced in other aircraft. However, longitudinal acceleration due to pitch attitude change in hover is an inertial effect and should not depend on aircraft configuration. It is possible that camera motion lags in the visual display contributed to this sensation. There was a discernible lag between the motion of the simulated aircraft, as generated by the computer, and the motion as seen from the display.

The height damper contributed favorably to the pilot's ability to perform the longitudinal translations by means of the thrust vector lever. Translating by means of thrust vector changes required the pilot to shift his hand from the power lever to the thrust vector lever. The height damper, by making small continuous adjustments in engine power in response to fluctuations in vertical rates, reduces the need for frequent power adjustments by the pilot while performing fore-aft translations.

Pilots further indicated that it would be desirable to have an additional longitudinal force controller similar to the sideforce controller. Some pilots thought the direct force controller should be located on the stick rather than on the power lever since the stick is normally used to make fore-aft and side-to-side translations when using pitch and roll attitude changes. Also, the stick mounted controller would yeild a more equal distribution of workload between the pilot's two hands due to the low workload needed for controlling attitude with an attitude stabilized control system.

While doing the fore-aft hover translations using the thrust vector lever, the pilots expressed a need for a positive, precise hover stop. The hover stop is required to be able to return the thrust vector quickly to the hover position entirely by feel. A lift-over type braking stop as used on the AV-8A may be applicable for the RTA.

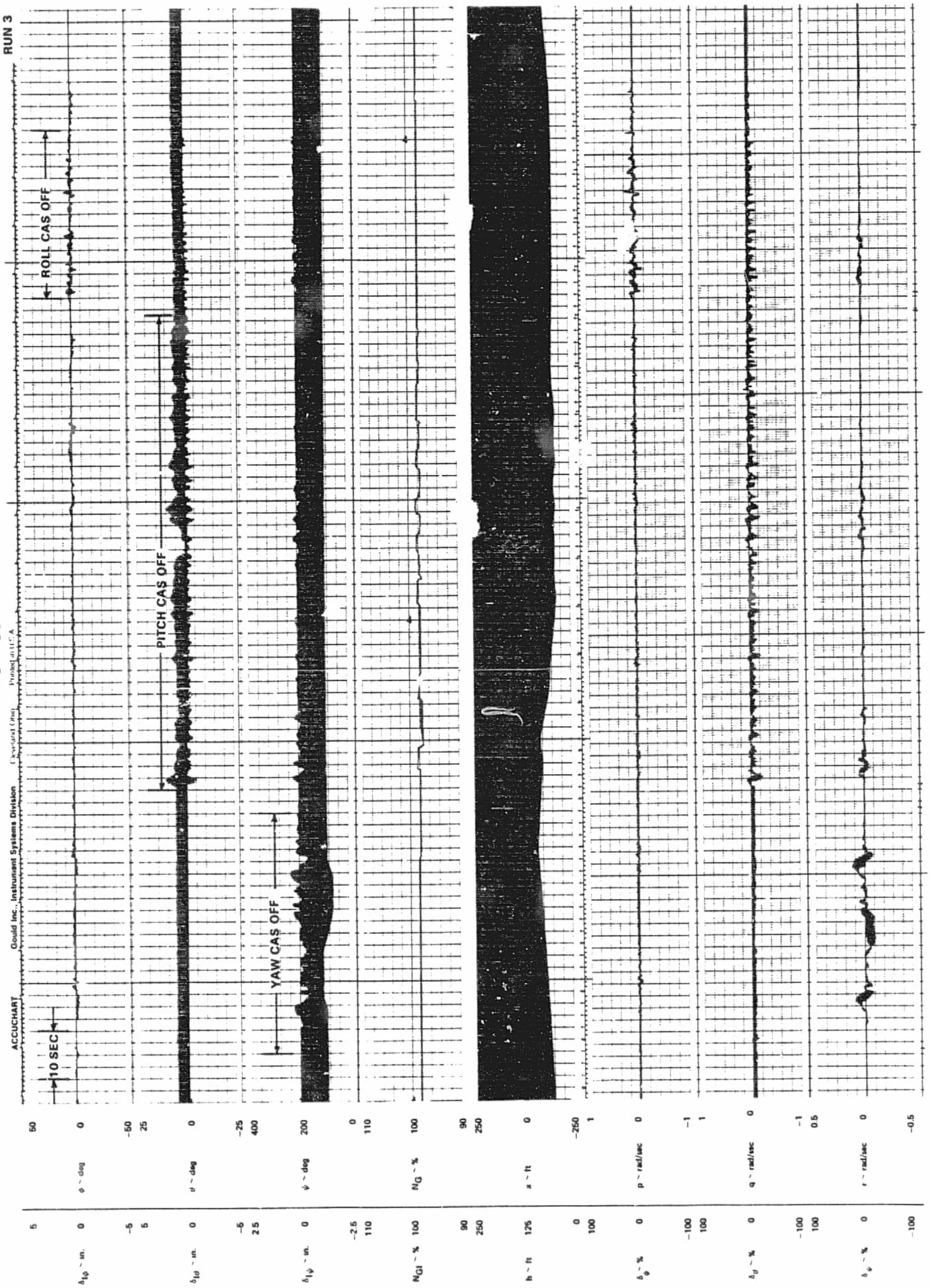
6.2 HANDLING QUALITIES IN HOVER - CAS OFF

Several simulation flights were made with CAS off to investigate the effect of CAS failures on aircraft controllability. The primary objective of these flights was to determine if the aircraft could be landed safely under emergency conditions after partial or total CAS failure. A typical hover task without CAS is shown in Figure 6-2.

The Lift/Cruise Fan Research Technology Aircraft has a dual channel control augmentation system in all three axes. The two channels in each axis are comparison monitored so that any component failure will cause CAS disengagement in that axes. The possibility of loss of CAS in all three axes simultaneously is considered extremely remote.

6.2.1 SINGLE AXIS CAS FAILURES - Both the shaft-coupled fan version and the gas-coupled fan version of the RTA could be hovered and landed with the CAS failed in any axis. Roll was the most difficult axis to control without CAS and received of pilot rating 6-7 for hovering. With the pitch CAS failed,

FIGURE 6-2
HOVER HANDLING QUALITIES EVALUATION, CAS OFF
$\Theta_J = 85°$



average pilot ratings were 5-6. It is probable that the airplane was easier to control in pitch than in roll because small changes in pitch attitude could be detected more readily than corresponding changes in roll. Both the visual out-of-the-window display and the HUD provide better angle resolution in pitch than in roll. Pitch changes can be detected as vertical movement of the horizon relative to the fixed TV display or HUD, but tilting of the horizon is more difficult to detect.

Hovering without the yaw CAS received pilot rating of 4 for the task. The most difficult aspect of the yaw control task was compensating for the negative weathercocking tendency. The ease with which the aircraft could be controlled in yaw, as compared with roll and pitch, is due to the low control lags in the yaw axis, and the fact that yaw angle does not cause aircraft translation and does not have to be adjusted continuously as does pitch and roll.

6.2.2 HOVERING WITH ALL CAS DISENGAGED - Both the gas-coupled fan version and the shaft-coupled fan version of the aircraft could be hovered and landed with all control augmentation systems disengaged. The pilot workload was intense and the average pilot rating was about 7. It is suggested however that the hovering task should be somewhat easier to perform in the real aircraft than in the simulator due to the typical lack of fidelity in the out-of-the-window display and the lack of peripheral visual cues in the simulator.

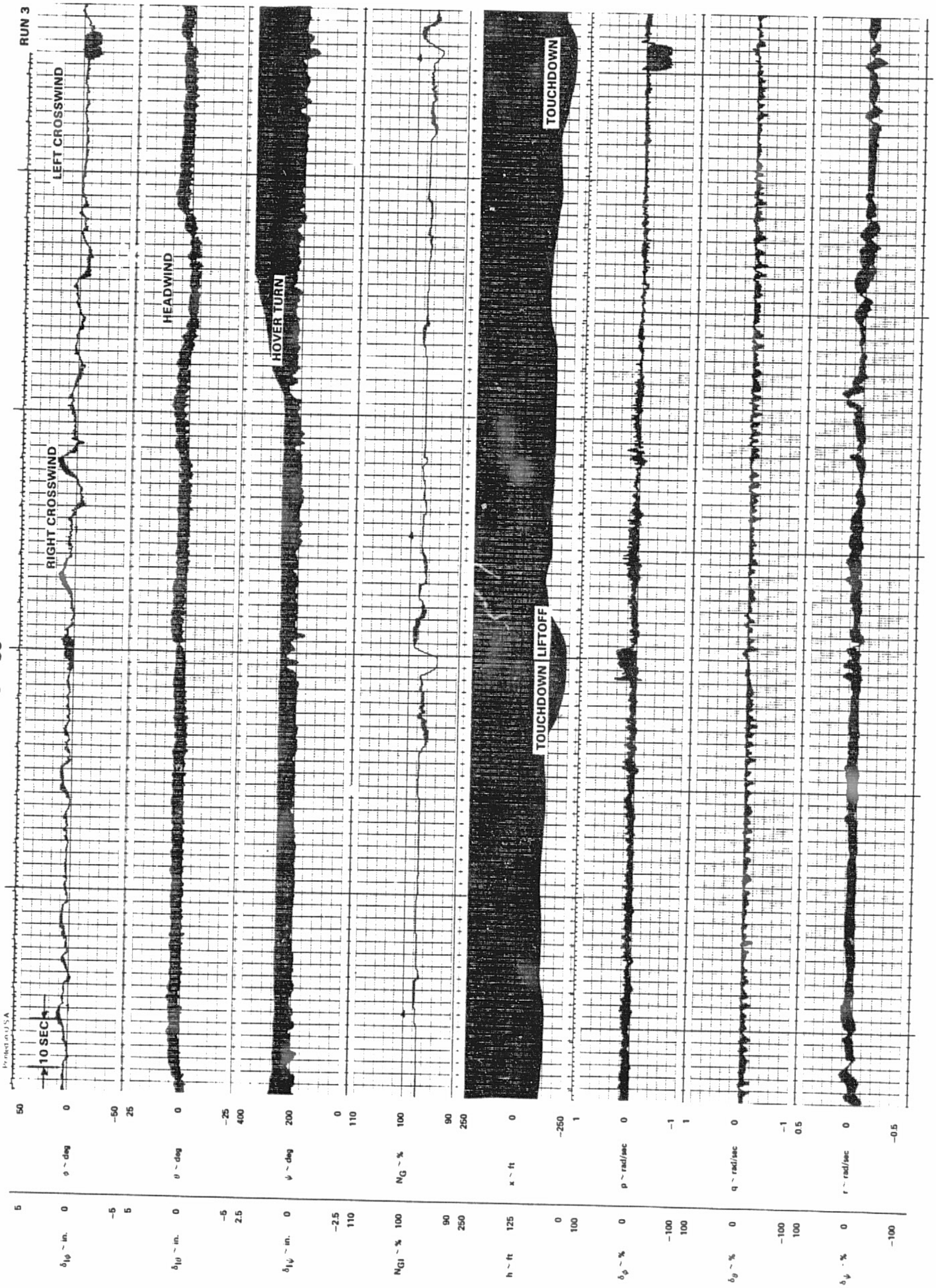
6.3 EFFECT OF WIND AND TURBULENCE ON HOVER TASK

The effect of wind and turbulence on aircraft flying qualities in hover was investigated with and without the control augmentation system engaged. Wind velocity was 15 knots and the turbulence was random with a 5 feet per second RMS intensity. The aircraft was hovered with the wind from various directions. A typical hover flight in wind and turbulence is shown in Figure 6-3.

The wind increased pilot workload but did not significantly influence the pilot's ability to perform the task. With CAS on, the average pilot rating for the hover task deteriorated from 2 to 3. Insufficient data was recorded with CAS disengaged to establish a numerical degradation in pilot rating due to wind and turbulence. Workload with CAS off was intense and pilots indicated they could not land with any precision.

When hovering in a headwind some pilots would hold the aircraft against the wind by lowering the nose, as in Figure 6-3, while others would tend to use thrust vector angle. The thrust vector angle technique was preferred. The aircraft was hovered in a crosswind by banking into the wind. This also required pedal input to prevent negative weathercocking as discussed in 6.1.2. The pilots

FIGURE 6-3
HOVER WITH 15 KNOT CROSSWIND AND TURBULENCE
$\Theta_J = 85°$



generally preferred to turn the aircraft into the wind and then trim against the wind with thrust vector angle.

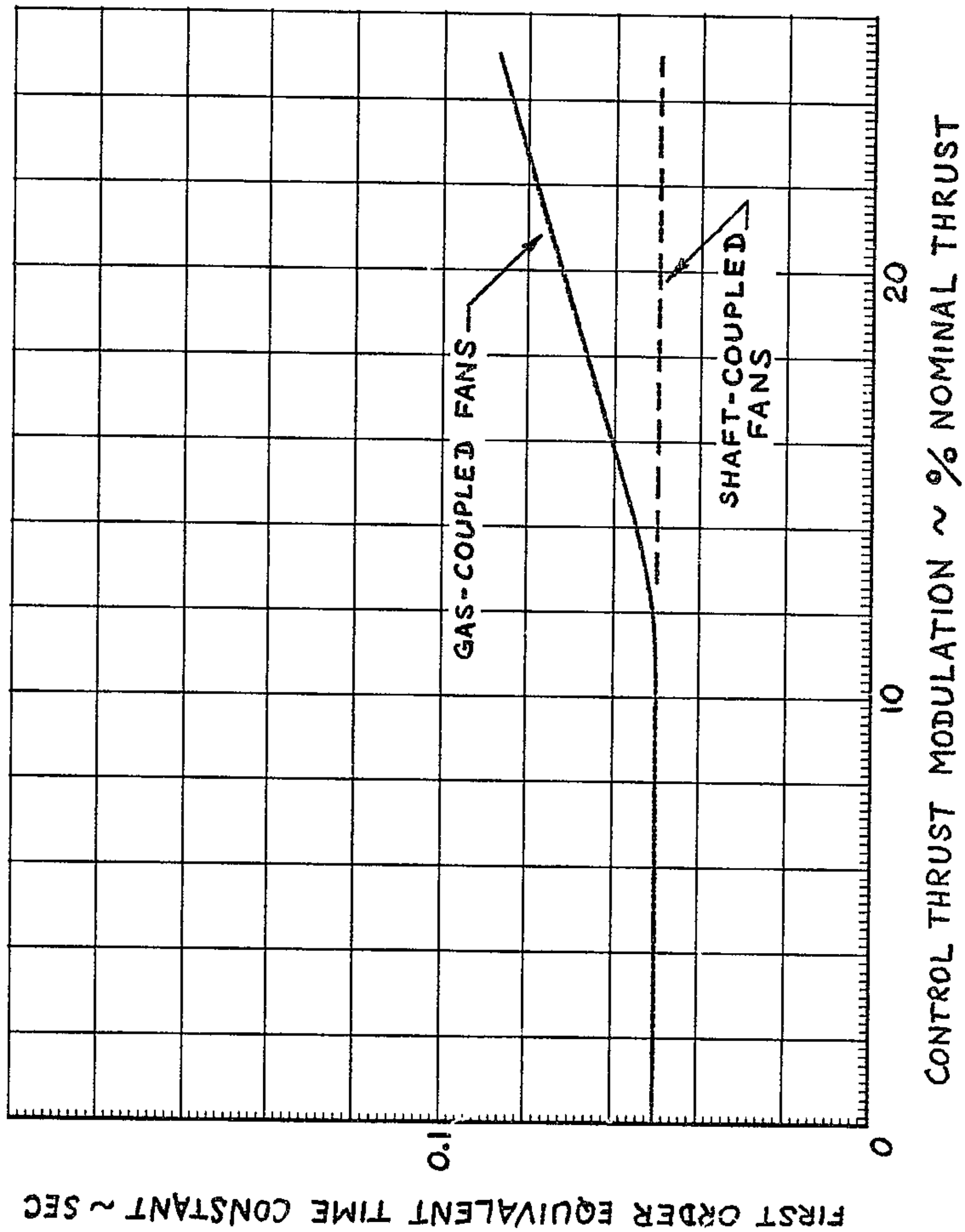
6.4 DIFFERENCES BETWEEN GAS-COUPLED AND SHAFT-COUPLED SYSTEMS IN HOVER

The initial gross weight of both airplanes was 27,500 pounds. At this weight the shaft-coupled fan aircraft had a 1.1 T/W capability while the gas-coupled fan thrust-to-weight ratio was 1.3. Some pilots thought the gas fan aircraft was slightly easier to hover than the shaft fan aircraft. Average pilot rating for the shaft fan aircraft in hover was about 3.0. The higher thrust-to-weight capability seemed to give the pilot more confidence in the ability to arrest high sink rates close to the ground. While the pilots generally preferred the higher T/W of the gas fan, two pilots indicated that the gas fan power lever sensitivity was too high.

One pilot thought the shaft-coupled fan aircraft was easier to hover than the gas-coupled fan aircraft due to lower control system lags. Another pilot could tell no difference in hover between the two aircraft other than the thrust-to-weight difference. In any case the ratings were about 7.

The gas fan RTA uses a 10% TRM preset to sharpen the thrust response of the thrust increasing fan. The TRM preset on the thrust increasing fan is initially removed to provide rapid increase in fan thrust, and then the preset is gradually returned as the fan speed increases. No difference was therefore programmed between the control responses of the shaft-coupled and gas-coupled systems for control inputs not exceeding 10% thrust modulation. A difference in control response was programmed for large control inputs exceeding the TRM preset as shown in Figure 6-4. Since control inputs exceeding 10% thrust modulation in hover are improbable, any differences noted in handling qualities in hover cannot justifiably be attributed to control lags.

FIGURE 6-4
CONTROL MOMENT TIME CONSTANTS



7. HANDLING QUALITIES IN TRANSITION

Simulation tests were made at discrete speeds of 60, 90, 120, and 150 knots to evaluate the handling qualities in the transition speed regime. This speed range requires careful evaluation because of the interaction of many variables such as airspeed, angle of attack, vector angle, and power which affect the characteristics of flight and handling qualities. This is the speed range where good handling qualities are required for precision landings; and it is also the speed range where other V/STOL aircraft have experienced difficult handling problems.

To assure that the transition regime was properly evaluated, the pilot was asked to stabilize the aircraft at the selected airspeed and perform a series of controlled maneuvers according to the program plan (Section 5).

The primary evaluations were made with the CAS engaged and without wind or turbulence. Additional flights were performed with wind and turbulence to determine their effects on handling qualities. CAS failures in transition were also simulated. A 60 knot evaluation task is shown in Figure 7-1.

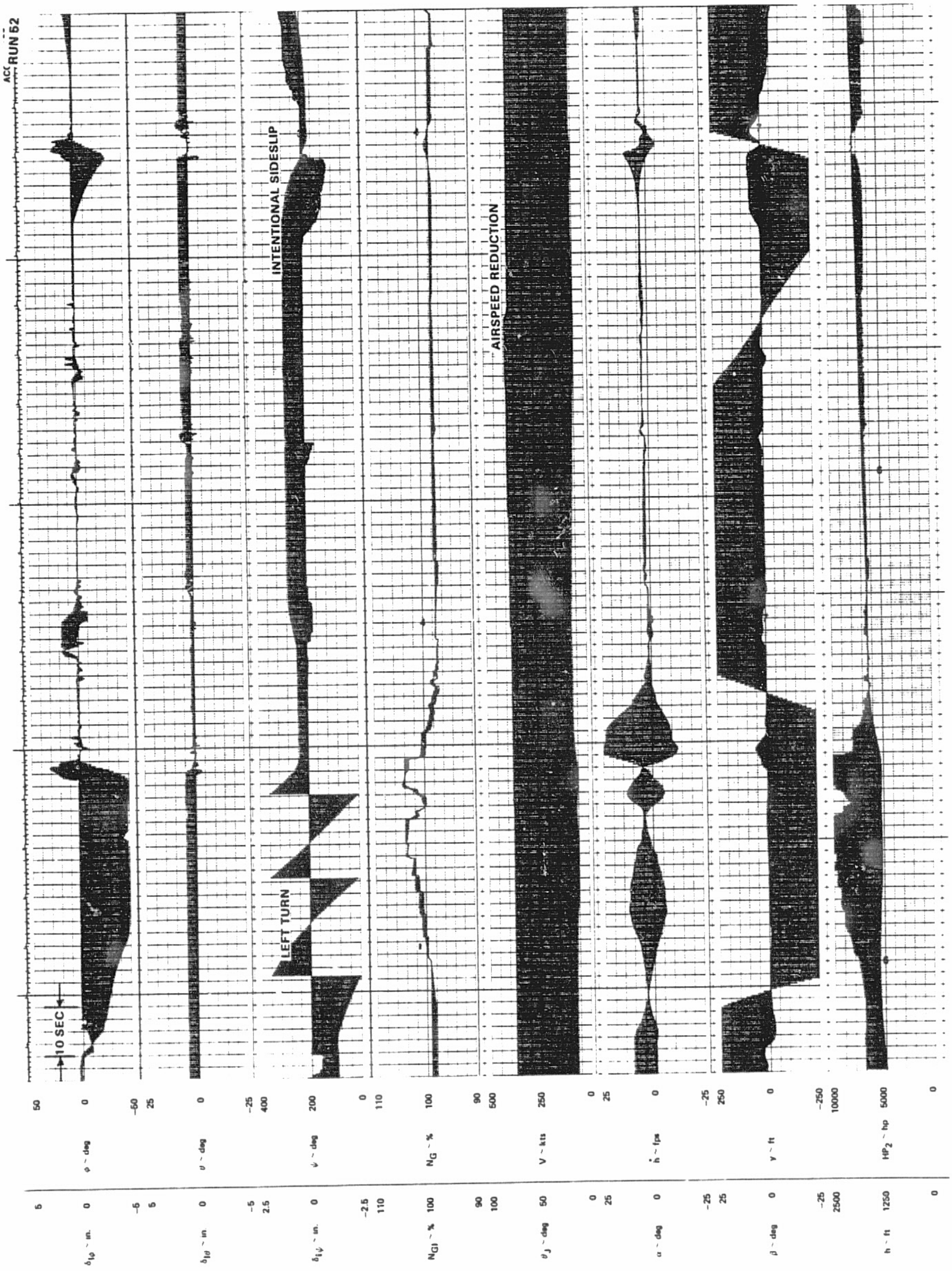
7.1 HANDLING QUALITIES IN TRANSITION - CAS ON

Flying qualities in the 60 to 120 knot speed range were reported to be very good. Overall pilot ratings with CAS on without wind were 2 to 3. The rate command/attitude hold CAS reduced pilot workload to a low level. This type of control law proved to be well suited for the transition flight regime. Rate command in pitch and roll provided precise maneuvering to the desired attitude, and the attitude hold feature reduced pilot workload by maintaining existing attitude when the stick was centered. The CAS contains a proportional plus integral controller in each axis which maintains the aircraft in a trimmed condition.

Turn coordination was satisfactory in the 60 to 120 knot speed range and received favorable pilot comments. The yaw CAS uses a blend of side velocity and lateral acceleration to provide turn coordination. The side velocity feedback is most effective at the lower speeds where lateral acceleration due to sideslip is low. At high speeds the lateral acceleration feedback becomes more effective as relatively small sideslip angles generate substantial lateral accelerations.

Pilots with considerable operational experience in fixed-wing V/STOL aircraft feel that 60 knots is an important operational speed where good handling

FIGURE 7-1
60 KNOT HANDLING QUALITIES EVALUATION



is mandatory. They indicate that for an IFR vertical landing, 60 knots is the speed they would prefer to maintain until break out of low cloud cover where they would then complete transition to hover and land. This speed appears to be a good compromise between a speed which is low enough to provide sufficient reaction and decision time under low visability conditions and a speed which is high enough to keep exposure time and fuel consumption to some satisfactory level. Since the handling qualities at this speed were satisfactory the simulated aircraft received many favorable pilot comments.

7.1.1 INTENTIONAL SIDESLIPS - Intentional sideslip maneuvers were satisfactory. The feedback of side velocity in the yaw CAS resulted in a steady state sideslip angle proportional to rudder pedal deflection. At 60 knots, full pedal input gave about 20 degrees sideslip angle. Roll due to sideslip was almost negligible. The dihedral effect of the basic aircraft was relatively low which was further controlled by the roll attitude hold CAS.

To establish a steady sideslip, the pilot held a rudder pedal input and rolled the airplane in the opposite direction to a bank angle which kept the airplane from turning. Once the bank angle was established, the stick was centered and the roll attitude hold function of the CAS maintained the bank angle. This can be seen in Figure 7-1. On one occasion, the pilot remarked that this felt a little strange since most aircraft require a crossed control condition to maintain a steady sideslip.

Removal of the steady sideslip was accomplished by releasing the pedal input and then rolling the airplane back to wings level. All pilots found it necessary to return the aircraft to wings level as the aircraft does not right itself upon removal of the pedal input.

Absence of roll coupling due to sideslip was a very strong point of the simulated aircraft because this typically is the area where many fixed wing V/STOL aircraft were shown to be deficient. The simulated aircraft has a relatively low dihedral effect and high control power capability; two factors which normally tend to minimize the impact of roll/sideslip coupling. Furthermore, the yaw CAS limits the sideslip angle while the roll CAS tends to offset the dihedral effect of the basic aircraft.

7.1.2 PITCH CHANGE DUE TO POWER - In the 60 knot speed regime large power changes caused changes in pitch attitude which the pilots found annoying. While some direct thrust moment was generated due to engine power changes, most of the pitch moment was apparently caused by momentum drag at the lift fan inlet. A reduction in power, causing a rapid increase in sink rate, tended to pitch the nose up. Similarly, power increase resulted in a tendency towards nose down pitch attitude.

7.1.3 PITCH ATTITUDE HOLD - The math model, as originally configured, used a combination of pitch rate and pitch attitude feedback in the pitch CAS at transition speeds. This control law caused the nose to drop when the airplane was rolled into a turn at low airspeeds. A steady turn holding the nose up requires a pitch rate $q = \dot{\psi} \sin \phi$. Therefore the pitch rate in a steady coordinated turn must be $q = g/V \sin \phi \tan \phi$. Since the pitch CAS tended to force the sum of q and θ to zero, a steady turn resulted in the reduction of θ. This effect is most pronounced at low values of airspeed.

The tendency for the nose to drop in a turn was corrected by using $\dot{\theta}$ feedback instead of q feedback. The $\dot{\theta}$ signal can be generated by sources already in the aircraft, since $\dot{\theta} = q \cos \phi - r \sin \phi$.

The pitch attitude hold system did not function according to expectations. The pilots complained that the airplane did not hold the exact pitch attitude when the stick was centered. The pitch attitude tended to drop below commanded attitude and sometimes drifted away so that continual corrections were required. Much of this problem was attributed to drift and poor centering characteristics of the simulator's stick loaders. Since the pitch attitude hold mode holds attitude only when the stick is centered, any drift in stick centering causes a continuous drift from the commended attitude. Variations in stick breakout and centering also drew some pilot complaints that it was too easy to put in pitch inputs when rolling the aircraft.

The basic implementation of the attitude control mode might have been the cause for some additional pilot comments. The attitude hold system is designed to hold the attitude which exists when the stick is centered. Since there usually exists an attitude rate when the stick is centered following a maneuvering input, the attitude will tend to overshoot and then return to the commanded attitude. The pilots tend to anticipate the pitch rate and remove their stick input slightly before reaching the desired attitude. The attitude then returns to that which existed at stick centering and the pilots interpret this as a change from commanded attitude. It may be worthwhile to modify the attitude hold mode by adding attitude hold anticipation based on attiude rate at the point the stick is centered.

7.1.4 TURN COORDINATION AT 150 KNOTS - Turn coordination at 150 knots was not as good as it was at the lower speeds. There was an initial sideslip and side acceleration when rolling into a turn. After the turn was established a small amount of rudder pedal in the direction of the turn was required to maintain a coordinated turn.

The degradation in turn coordination at 150 knots is due primarily to the way the yaw CAS feedback gains are scheduled with vector angle during transition and conversion. In powered-lift flight a blend of lateral acceleration and side velocity feedback provide the required turn coordination. Side velocity feedback gain is phased out with thrust vector angle between 45 degrees and 0 degrees. At 150 knots the thrust vector angle is in the phase-out region and the turn coordination characteristics are therefore degraded. Further study is required to develop the optimum scheduling of CAS gains in the overlap region between powered lift and aerodynamic flight.

The pilots also noted a negative dihedral effect at 150 knots. For a right rudder pedal input, the aircraft rolled slightly to the left. The roll due to sideslip stability derivative is negative for any positive angle of attack which should normally produce a positive dihedral effect. However, the combination of roll due to sideslip, roll due to rudder, and roll due to yaw rate results in a left roll for a right rudder input. This characteristic will be further studied and the roll and yaw CAS will be modified as required.

7.1.5 PITCH CONTROL - 120 TO 150 KNOTS - There were numerous unfavorable comments about pitch control in the 120 to 150 knot speed range. The cause of this has not been exactly determined and further study of the problem is required. However, the problem seems to be related to the variation in CAS gains with vector angle.

The pitch CAS uses pitch attitude rate feedback to provide a rate command capability in transition. In conventional flight, the pitch CAS uses a feedback signal which is a blend of pitch rate and normal acceleration to provide a normal acceleration command system with desired variation of stick force per g with airspeed. The pitch rate and normal acceleration feedback gains are scheduled with thrust vector angle to achieve the desired gains in both flight regimes. The selected schedule yields satisfactory flying qualities in conventional flight, in hover, and at low transition speeds. However, insufficient time was available to perform detailed studies of flying qualities during the change from one set of gains to another.

Scheduling of system gains with thrust vector angle deserves a special review. During powered-lift flight there is no unique relationship between vector angle and airspeed. At any given speed, the aircraft can be trimmed over a range of power settings and thrust vector angles depending on angle of attack. Also, during transition, the pilot often trims the aircraft to high longitudinal acceleration levels. Therefore, there is a wide range of vector angles which may be used at each airspeed. This seems to devalue the use of the vector angle as a gain scheduling parameter. Further study is required.

7.2 HANDLING QUALITIES IN TRANSITION - CAS OFF

Several simulated flights were made with CAS off to investigate the effects of CAS failures on aircraft control. The primary objective of these experiments was to determine if the aircraft could be controlled through transition and then landed safely after partial or total CAS failure.

7.2.1 SINGLE AXIS CAS FAILURES - Handling qualities in transition without roll CAS were acceptable. Pilot ratings for the overall transition without CAS were about 4.0. For airspeeds greater than about 60 knots, the natural aerodynamic roll damping was sufficient to make the task relatively easy.

Flying qualities in transition were much degraded with the pitch CAS failed. Pilot ratings fell in the 6 to 8 range. Pilots complained of a general looseness and a lag in pitch response. They thought it might be possible to get into pilot induced oscillations with eventual loss of control in pitch. Pitch control power in transition is believed to be adequate. The trouble however, may be due to lack of good static stability at this speed range. The power-off aerodynamic characteristics show adequate stability margin for low angle of attack. However, the momentum drag on the lift fan inlet is destabilizing and exceeds the aerodynamic stability in this speed range. This problem is further aggravated if the angle of attack is allowed to increase to approximately 14 degrees at which point the aerodynamic stability becomes negative.

Transition flight is no problem without yaw CAS. Pilot ratings for this case were about 4. While the dutch roll mode is lightly damped, it is stable, and is not easily excited by roll inputs.

7.2.2 TRANSITION FLIGHT WITH ALL CAS DISENGAGED - Both the gas-coupled fan version and the shaft-coupled fan version could be flown in the 60 to 150 knot speed range with all control augmentation systems disengaged. Handling qualities, however, were poor due to loose control characteristics and PIO tendency in the pitch axis. Pilot ratings, where available, were the same whether all CAS was off or just the pitch CAS was off.

7.3 EFFECT OF WIND AND TURBULENCE ON TRANSITION TASK

The effect of wind and turbulence on aircraft flying qualities in the 60 to 150 knot speed range was investigated with and without the control augmentation system engaged. Wind velocity was 15 knots and turbulence was random with a 5 feet per second RMS gust intensity. Since the transition task did not require maneuvering relative to any fixed ground reference, the mean wind component had no effect on task performance. The turbulence increased pilot workload but did not significantly influence the pilot's ability to perform the task.

The effects of turbulence were most apparent in the yaw axis. The side velocity feedback in the yaw CAS is very effective in providing good low speed turn coordination, but the ride qualities in turbulent air were rougher than with the yaw CAS disengaged. The ride qualities were acceptable, but any increase in side velocity feedback gain would aggravate the ride qualities and therefore should be constrained.

7.4 DIFFERENCES BETWEEN GAS-COUPLED AND SHAFT-COUPLED FAN AIRCRAFT IN TRANSITION

The only difference noted between the flying qualities of the gas-coupled fan aircraft and the shaft-coupled fan aircraft in transition was due to the difference in installed thrust-to-weight capabilities of the two aircraft. Pilots like the snappier performance of the gas-coupled fan aircraft, but found that it was also easier to overpower the aircraft and generate negative angle of attack during transition. A large power increase necessitated a corresponding large increase in pitch attitude to prevent climbing at a negative angle of attack.

8. TRANSITION AND CONVERSION

A series of simulation flights was made to investigate the aircraft handling characteristics during conversion from powered-lift flight to aerodynamic lift flight, and reconversion from aerodynamic lift flight to powered-lift flight. Conversion requires an extensive change in aircraft configuration. During reconversion to powered-lift flight, for example, the procedure involves lift engine startup, opening fan doors, changes in various duct valves or blade pitch angle and clutching in the forward fan, and phasing in all powered lift control devices. The pilot procedure is to initiate the conversion sequence by means of the thrust vector lever.

The objective of the transition and conversion investigation was to study the stability and control characteristics during the configuration change and to determine the impact on pilot workload. To evaluate the overall characteristics in transition between hover and cruise flight, the pilot was asked to perform a series of tasks described in the test plan (Section 5).

At initiation of these tests an optimum speed for conversion had not been established. A speed of 200 knots was suggested to the pilot as an approximate point in the conversion investigation. The task was primarily VFR since the pilot was using the out-of-the window TV display. Most flights were made with the control augmentation system engaged and without wind or turbulence. Some additional flights were performed in wind and turbulence to evaluate their effect on flying qualities, and some CAS failures were also evaluated.

8.1 CONVERSION PROCEDURE

The conversion investigation flights began from hover at about 50 feet altitude. The thrust vector angle was 85 degrees and pitch attitude was 5 degrees nose up. The transition was initiated by adding power and slowly moving the thrust vector lever forward to increase airspeed. The rate at which the pilot moves the vector lever is sufficiently fast to produce a rapid acceleration, but no so fast as to reduce the vertical thrust component faster than the lift increases. As the vector lever is moved forward, the lift/cruise fan and lift fan thrust vector angles remain approximately equal. When the thrust vector angle reaches 45 degrees, the powered-lift controls begin to phase out. At this vector angle the airspeed is usually greater than 150 knots and the aerodynamic controls are adequate for aircraft control. At a 30 degree thrust vector angle the powered-lift controls are completely phased out and the conversion sequence begins. The lift fan thrust vectoring louvers are limited to 30 degrees from horizontal. When the thrust vector lever is moved beyond the 30 degree position, the lift fan thrust vector angle remains at 30 degrees and the lift/cruise fan thrust continues to be vectored toward the horizontal. In this range nominal pitch trim is maintained by reducing the thrust of the lift fan as the lift/cruise fan thrust vectoring is continued toward the horizontal. The mechanization for lift fan thrust control as the lift/cruise fan thrust is vectored toward the horizontal is different for the two RTA propulsion system concepts.

8.1.1 SHAFT-COUPLED FAN CONVERSION MECHANIZATION - When the shaft fan thrust vector angle becomes less than 30 degrees, the lift fan thrust is automatically reduced by changing the lift fan blade angle as a scheduled function of the lift/cruise fan vector angle. The lift engine power setting is also reduced according to a schedule as the fan blade angle is decreased. When the lift/cruise fan vector angle approaches zero, the lift fan is at flat pitch (developing zero thrust) and the third gas generator is at idle (producing zero power). When the thrust vector lever is pushed fully forward, the lift/cruise fans reach full horizontal position, the lift fan is declutched and spins down, the lift fan doors close, and the lift/cruise fan VTOL nozzle exit doors close. This procedure provides a gradual conversion with minimum pitch disturbances.

8.1.2 GAS FAN CONVERSION MECHANIZATION - When the gas fan thrust vector angle becomes less than 30 degrees, the forward gas duct is isolated so that the third gas generator drives only the forward fan. The third gas generator power setting is then reduced according to a schedule with the lift/cruise fan thrust vector angle. This causes the lift fan to spin down gradually; and as the lift/cruise fan vector angle approaches zero, the third gas generator is at idle and the lift fan thrust is approximately zero. When the thrust vector lever is fully forward, the forward duct is closed and the third gas generator dump valve is opened. The third engine can now be shut down. At this time also, the lift and lift/cruise fan doors are closed.

This entire conversion sequence is automatic and is controlled by the thrust vector lever position. Each event in the sequence is scheduled with lift/cruise vector angle so that the sequence can be stopped at any position and continued or reversed as desired. Since the lift fan is shut down gradually as a function of the lift/cruise fan vector angle, pitch disturbances from direct thrust effects during conversion are minimized.

With any engine failed, the conversion sequence is altered and no longer possesses the slow gradual characteristics. In this case, the lift fan duct valve is closed and the lift engine dump valve is opened as soon as the commanded vector angle becomes less than 30 degrees. This causes a rapid spin-down of the front fan, and pitch balance is maintained by changing the lift/cruise fan vector angle to horizontal at a rate which approximates the fan spin-down rate. In the 0 to 30 degree thrust vector range, the pilot no longer maintains control of intermediate vector position. As the pilot commands a vector angle less than 30 degrees, the configuration change is discrete and the vector angle is automatically brought to 0 degrees at appropriate system rate.

After the thrust vector angle reaches the zero degree, or horizontal position, the aircraft is in the aerodynamic flight configuration with the third gas generator still running at idle. The pilot may then choose to shut down the thrid gas generator or leave it in idle to eliminate the need for restarting.

The reconversion sequence is simply the reverse of the conversion sequence. The pilot verifies that the lift engine is operating, and then moves the thrust vector lever from the 0 degree to the 30 degree position. This causes the lift engine and fan to come up to speed and the thrust of all three fans is vectored to 30 degrees.

8.2 TRANSITION AND CONVERSION WITH CAS ON

The transition and conversion from powered-lift flight to aerodynamic flight and the reconversion and transition from aerodynamic flight to powered-lift flight were easy to perform and received pilot ratings of 2 to 3. Conversion and reconversion were generally initiated in the 180-240 knot speed range. Airspeed generally increased during the conversion sequence and decreased during reconversion as shown in Figures 8-1 and 8-2, respectively.

The main pilot effort required during conversion was changing pitch attitude to generate additional wing lift as the powered lift decreased. Similarly, during reconversion it was necessary to decrease pitch attitude and angle of attack to reduce wing lift as powered lift increased. The pilots suggested the performance of additional studies to determine the combination of airspeed, power, flap, and pitch attitude so conversion could be accomplished with minimum pitch change. It may be desirable to include an interconnect between vector angle and stabilator position to produce automatic changes in

FIGURE 8-1
CONVERSION FROM POWERED-LIFT TO AERODYNAMIC FLIGHT

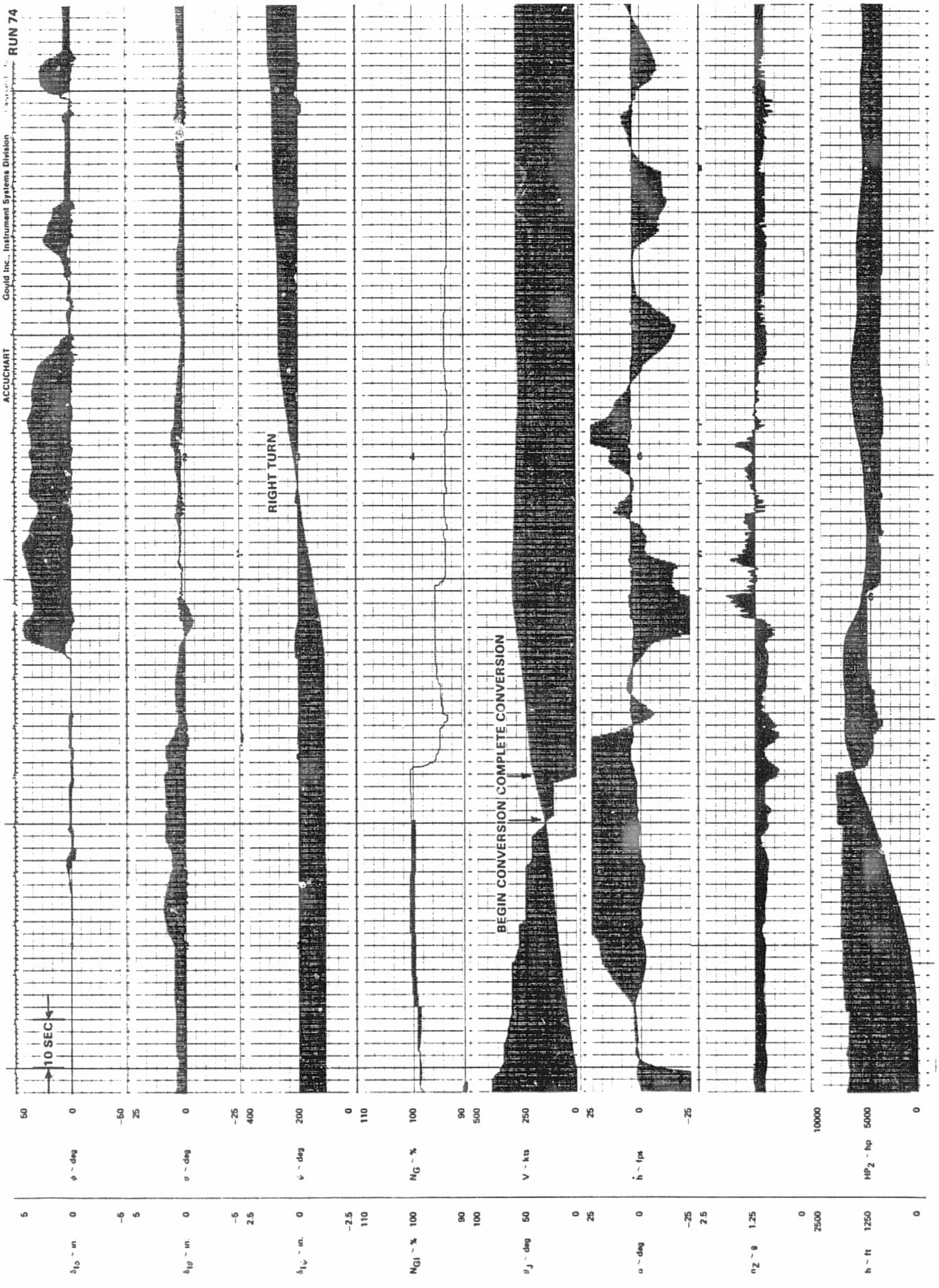
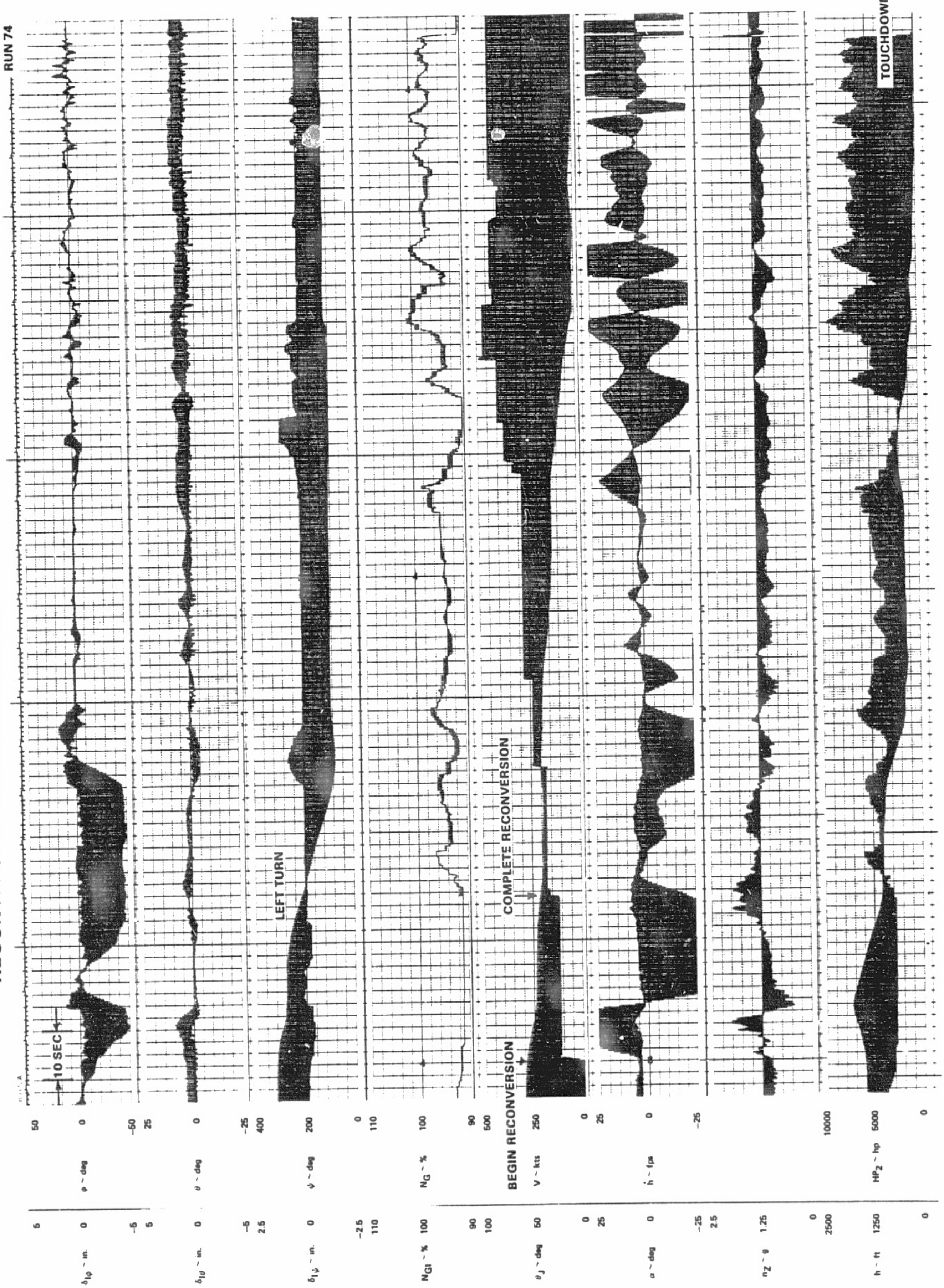


FIGURE 8-2
RECONVERSION FROM AERODYNAMIC TO POWERED-LIFT FLIGHT



pitch attitude and angle of attack to generate desired changes in wing lift during conversion and reconversion.

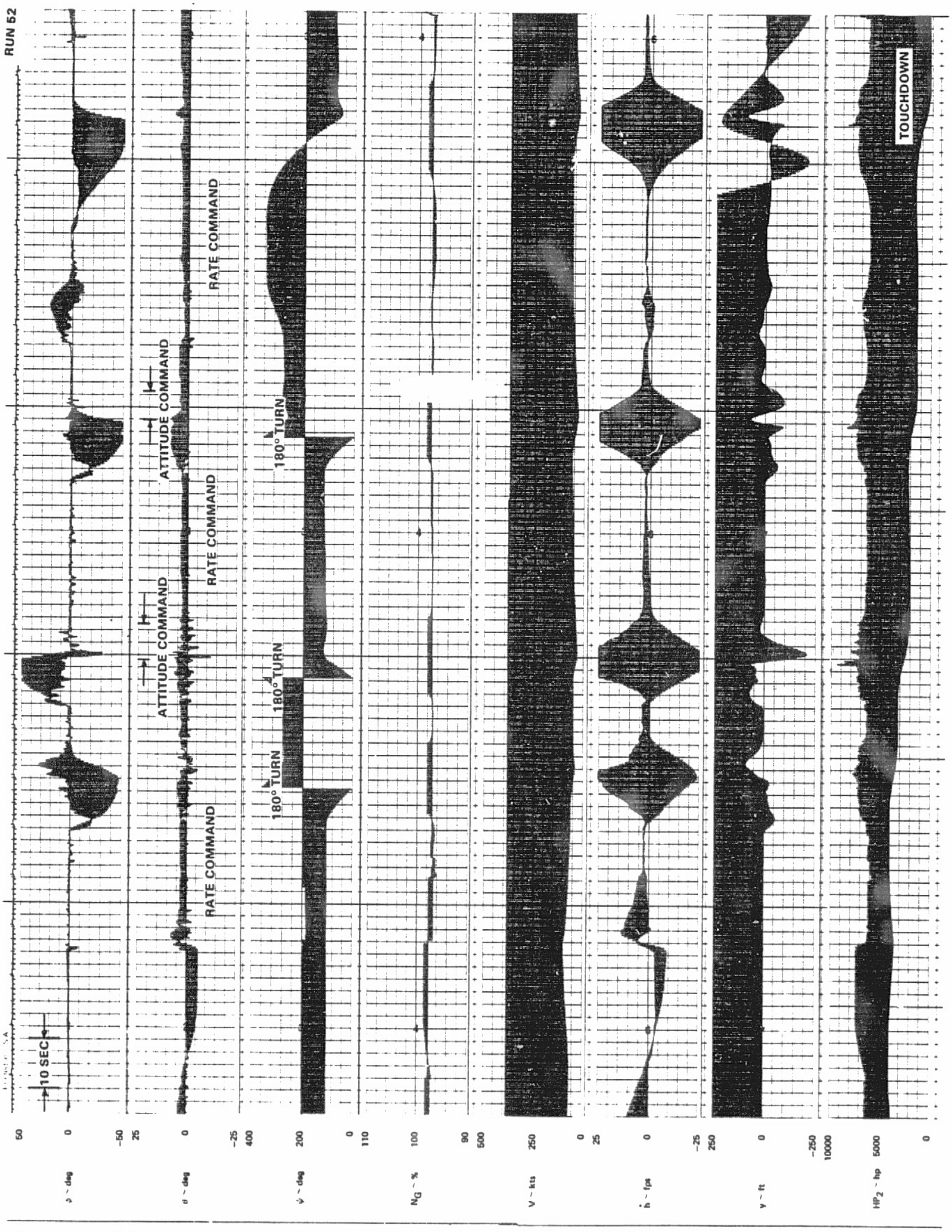
8.2.1 ATTITUDE COMMAND/RATE COMMAND MODE CHANGE - The mode change from attitude command below 35 knots to rate command/attitude hold above 35 knots was unsatisfactory. This deficiency in the control law mechanization was the subject of repeated pilot comments, indicating an area requiring some improvement.

The attitude command mode in pitch and roll is preferred by pilots in hover. In the transition regime, a rate command/attitude hold mode is preferred to achieve an optimum combination of desired maneuverability and low pilot workload. These modes were provided in the simulated aircraft and switching between them was automatically implemented as a function of airspeed. When the airspeed increases to 40 knots, the rate command/attitude hold mode is switched on. This mode is in effect during transition until the airspeed decreases below 30 knots. The hysteresis switching precludes oscillations between the two modes at one otherwise critical speed. When attitude command mode is on in pitch and roll, the yaw axis is in a rate command mode. When rate command/attitude hold is on in pitch and roll, the yaw axis is in effect a turn-following mode. A feedback of yaw rate through a washout provides yaw damping, and a blend of lateral acceleration and side velocity controls sideslip.

When the system changes from attitude command to rate command/attitude hold at 40 knots, everything works smoothly as long as the controls are centered. The airplane simply maintains a reference of wings level and 5 degree nose up attitude. When the controls are not centered, however, because the pilot is holding other than the reference attitude, the airplane goes through a transient during switching to rate command/attitude hold. This occurs because the stick now commands rate of change of attitude rather than the attitude which was proportional to stick deflection existing at time of mode change. This transient is shown in Figure 8-3.

When the system changes from rate command/attitude hold mode to attitude command mode at 30 knots, there is also a switching transient unless the stick and pedals are centered, and the airplane is at wings level and 5 degree nose up attitude. The switching initiates a system command to return existing attitude to the reference attitude. A transient also occurs in the directional

FIGURE 8-3
MODE CHANGE BETWEEN ATTITUDE AND RATE COMMAND



axis because in one mode the pedals command yaw rate and in the other mode they command sideslip angle.

The mode change is one of the major areas recommended for further study.

8.2.2 EFFECT OF FLAP AND LANDING GEAR ON CONVERSION - Transitions, conversions, and reconversions were done with flaps up and with flaps down. Effects of landing gear position on conversion and reconversion were also investigated. Results show that gear and flap positions had no measurable effect on pilot workload or task performance.

8.2.3 CONVERSION WITH WIND AND TURBULENCE - Only a few conversion evaluations were made with wind and turbulence. During these evaluations no significant difficulties were encountered.

8.3 TRANSITION AND CONVERSION WITH CAS OFF

Several transition and conversion flights were made with CAS off to investigate the effect of CAS failures on aircraft controllability. The primary objective of these flights was to determine if the aircraft could be converted between flight regimes so that a safe emergency landing could be made after a partial or total CAS failure.

The conclusions about conversion and reconversion without control augmentation are basically identical to those obtained from the discrete speed transition flight evaluation. Conversion from powered lift flight to aerodynamic flight, and reconversion from aerodynamic flight to powered lift flight were not difficult with the roll or yaw CAS disengaged. With pitch CAS off, the pilots indicated that it may be possible to lose control during conversion or reconversion.

8.4 DIFFERENCE BETWEEN GAS-COUPLED AND SHAFT-COUPLED FAN AIRCRAFT IN CONVERSION

During normal operation (CAS on, all engines operating) there was no significant difference noted between the conversion/reconversion characteristics of the shaft-coupled fan aircraft and the gas-coupled fan aircraft. Some differences in characteristics were noted with an engine failure, which are discussed later in this report.

9. HANDLING QUALITIES IN AERODYNAMIC FLIGHT

Aerodynamic flight handling qualities evaluations were performed at 200 and 300 knots. The maneuvers performed to evaluate the handling qualities were according to the test plan as presented in Section 5.

This was primarily a visual flight rules task which was performed using the out-of-the-window TV display. The visual display, however, was too restrictive for the task. At airspeeds of 200 knots or more it was nearly impossible to turn within the confines of the terrain map. It was necessary therefore to turn almost continuously at bank angles in excess of 60 degrees. Consequently, evaluation of handling qualities during this task resulted in high pilot workload. In future simulations the evaluation task should be designed to be compatible with the size of the terrain map, or the task redefined to fly the high speed phase of the mission under IFR conditions with suitable guidance for the pilot to find his way back to the terrain map for visual landings.

9.1 HANDLING QUALITIES IN AERODYNAMIC FLIGHT - CAS ON

Flying qualities in conventional flight at 200 and 300 knots were generally good; however, several annoying deficiencies were noted. The pilot ratings were scattered around 3.5, although some aspects were rated considerably worse and require improvement. Simulation flights at speeds of 200 and 300 knots are shown in Figure 9-1 and 9-2, respectively.

The CAS stabilized the aircraft so that the pilot workload in maintaining attitude, heading, and altitude was low. The pitch CAS has a feedback of pitch rate and normal acceleration. A high gain proportional plus integral controller forces the feedback to follow the pilot input so that steady state normal acceleration is proportional to pitch stick input. This results in a fairly constant stick force per normal acceleration of about 5 pounds per g over the aerodynamic flight regime. The control and stability characteristics were satisfactory and received favorable pilot comments.

The proportional plus integral controller in the pitch CAS continues integrating any error signal so that in steady flight the integration always keeps the aircraft trimmed in 1 g flight if the stick is centered. This automatic trimming reduces pilot workload, but also results in an apparent neutral speed stability. A decrease in airspeed does not require an aft stick force, and vice versa. The comments of one pilot indicated he would have preferred a more conventional stick displacement with airspeed.

FIGURE 9-1
200 KNOT HANDLING QUALITIES EVALUATION
$\delta_{flap} = 50°$, NG = 91%, $\theta_J = 0$

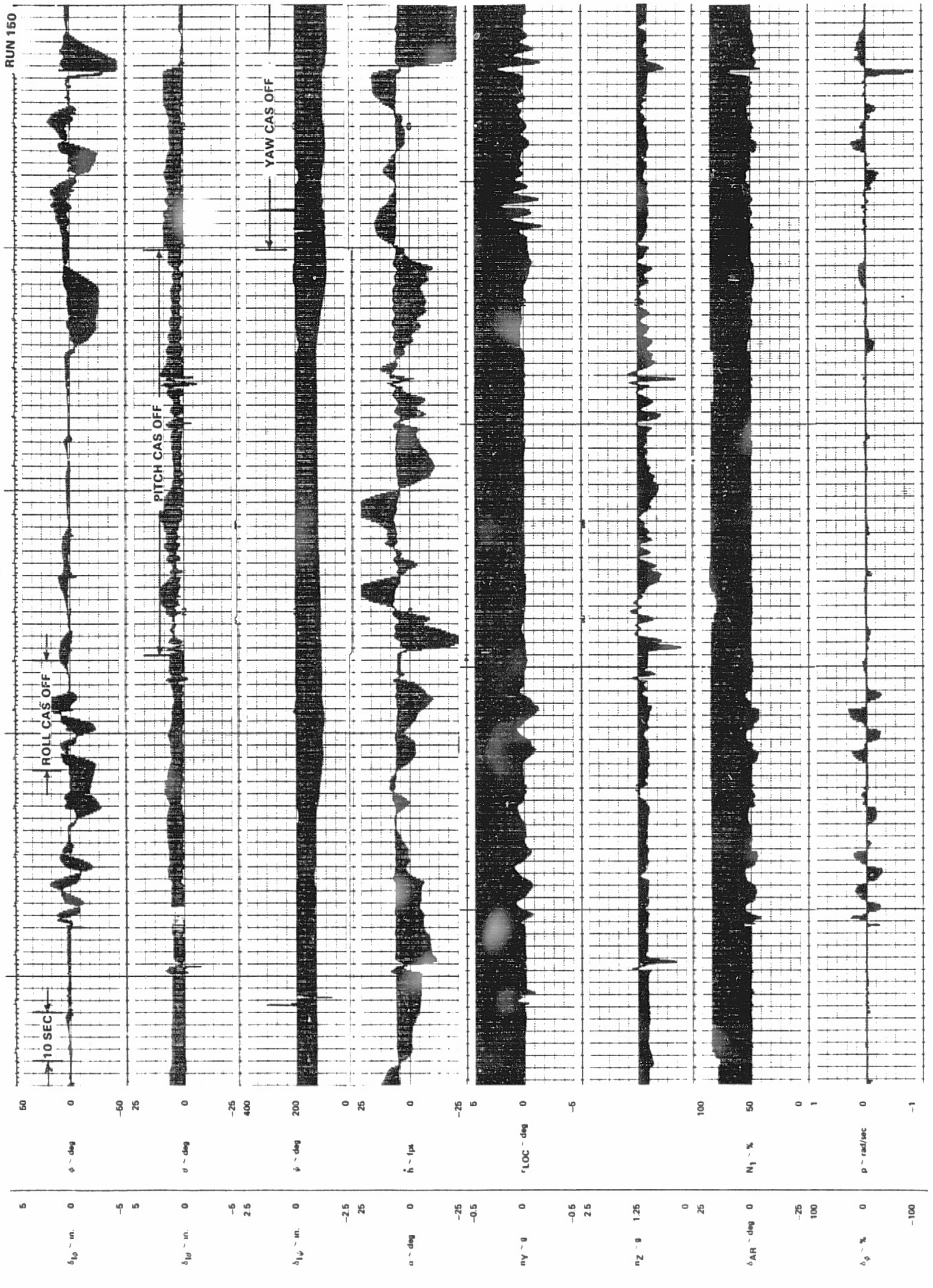
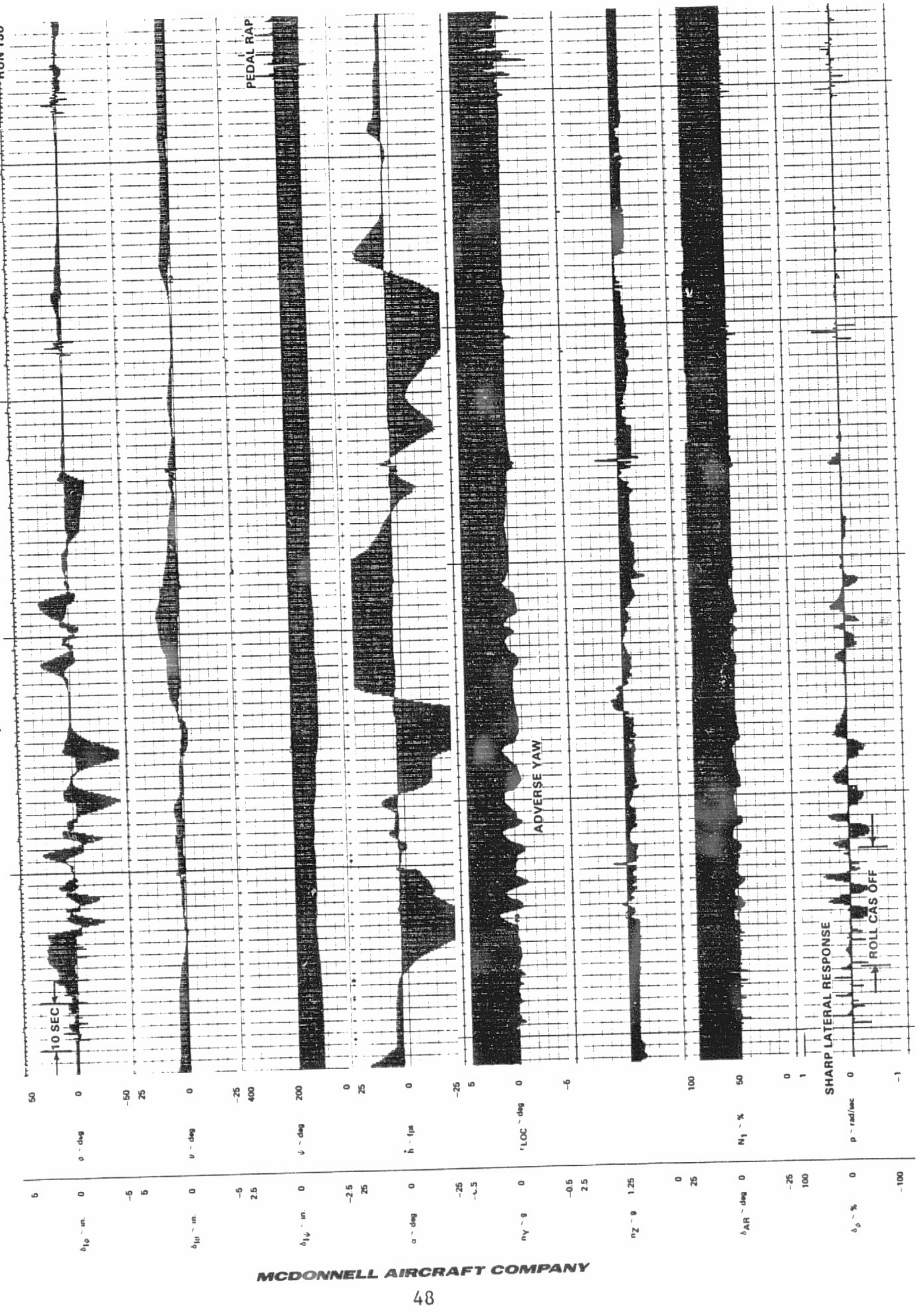


FIGURE 9-2
300 KNOT HANDLING QUALITIES EVALUATION
δ flap = 0°, NG = 93%, υJ = 0



The roll CAS uses a roll rate feedback so that steady state roll rate is proportional to stick force. At the selected CAS gains, the commanded roll rate per stick force is approximaely 15 degrees/second/pound. Due to high roll damping in aerodynamic flight, actual roll rate never reached the commanded value. The initial CAS design contained a proportional plus integral controller to force actual roll rate to follow the command. The integrator was later removed because it caused a slow residual response which manifested itself as a low roll damping characteristic.

The yaw CAS uses a feedback of lateral acceleration and washed out yaw rate. Yaw rate feedback improves Dutch roll damping, and the lateral acceleration feedback increases directional stability and improves turn coordination. A high gain proportional plus integral controller results in a steady state lateral acceleration proportional to pedal force.

9.1.1 ROLL CONTROL AT 200 AND 300 KNOTS - Roll control was somewhat deficient in the aerodynamic flight regime. Roll control was too sluggish at 200 knots, but too abrupt at 300 knots. One pilot gave a rating of 5 at 300 knots. The sluggish roll response at 200 knots could be improved by using a higher gain of aileron deflection per stick deflection, but this increases the problem at 300 knots where the roll acceleration per stick deflection is too high.

The roll control characteristics in aerodynamic flight need improvement. This is not expected to be difficult, but some study effort is required. It will probably be necessary to use a roll CAS prefilter or a gain variation with airspeed.

9.1.2 ADVERSE YAW AND NEGATIVE DIHEDRAL AT 300 KNOTS - At 300 knots one pilot rated the aircraft a 6 on the Cooper-Harper pilot rating scale due to adverse yaw and negative dihedral effects. All pilots noted some adverse yaw and negative dihedral. A positive roll rate results in a positive sideslip angle, as shown in Figure 9-2. Yaw moment due to aileron deflection is positive, so the ailerons do not contribute to the adverse yaw characteristic. Adverse yaw appears to be due to a high negative yaw moment generated by roll rate, and therefore some type of roll-yaw interconnect may be required.

The negative dihedral effect at 300 knots was objectionable. For a right rudder pedal input, the aircraft rolled left. The roll due to sideslip stability derivative is negative, which should produce a positive dihedral effect. However, the combination of roll due to sideslip, roll due to rudder, and roll due to yaw rate results in a left roll for a right rudder input.

Both of the above characteristics should be further studied and corrected.

9.1.3 ANGLE OF ATTACK LIMITER - The math model originally contained an angle of attack limiter in the pitch CAS. This α limiter was intended to prevent angle of attack from exceeding 11 degrees, thus preventing wing stall and possible departure and loss of control due to stall.

The angle of attack limiter was removed during the simulation tests because it was too restrictive as designed and interfered with low speed approach during a conventional landing. The lift curve exhibits a slight break at 12 degrees angle of attack, but continues to increase to angles of attack in excess of 30 degrees. (Simulation data was available only for α less than 32 degrees.) The aircraft becomes statically unstable for α greater than about 14 degrees. Several stall approaches were made with angles of attack up to 30 degrees and airspeed down to 80 knots. The pitch CAS was effective in stabilizing the aircraft even at those high angles of attack. Recovery was accomplished easily. The need for an α limiter is therefore not certain. Example of an approach to stall is shown in Figure 9-3.

9.2 HANDLING QUALITIES IN AERODYNAMIC FLIGHT - CAS OFF

CAS off conventional flight handling qualities were generally acceptable. The roll CAS made little difference in this flight regime because natural roll damping of the basic aircraft is satisfactory. The pitch axis was more sensitive and less stable with pitch CAS disengaged but was easily controllable. Dutch roll damping was low but was not easily excited by roll inputs.

With the CAS disengaged, approaches to a stall were no problem and even at high angles of attack there was adequate pitch control.

9.3 EFFECT OF WIND AND TURBULENCE ON HANDLING QUALITIES IN AERODYNAMIC FLIGHT

Since the aerodynamic flight handling qualities evaluation did not require maneuvering relative to a ground reference, the mean wind component had no effect on task performance. Turbulence increased pilot workload but did not significantly degrade the pilot's ability to perform the task.

FIGURE 9-3
APPROACH TO WING STALL
$\delta_{flap} = 0°, \Theta_J = 0$

10. MISSION TASKS

The mission task evaluations were intended to investigate specific operational characteristics and problems associated with a typical mission of the Research Technology Aircraft. Description of the mission tasks is provided in Section 5.

The takeoffs and landings for this task were split about equally between vertical and short. The mission tasks were performed satisfactorily except for the difficulty in performing the task within the confines of the visual scene. Average pilot ratings, based on the Cooper-Harper scale, were 2 to 3.

This was primarily a visual flight rules task and the pilot flew using the out-of-the-window TV display. As in the case of the aerodynamic flight evaluations, the boundaries of the terrain map contributed to pilot workload. Maneuvering within the confines of the terrain map was rather demanding and the pilot workload was probably higher than would be experienced in the real world. Another difference noted between the simulator and the real world was the lack of peripheral visual cues which is typical of simulators. This was a problem in performing the traffic pattern type circuit but not during final approach when the pilot had the runway in sight.

In future simulations the mission task should be more compatible with the capabilities of the terrain map, or it may be advantageous to fly part of the mission task under simulated IFR conditions. When the airplanes flies off the terrain map, the visual scene could be fogged to simulate flying in clouds. With suitable guidance the pilot could then fly on instruments to an approach fix and capture an ILS for guidance back to the runway. When back on the terrain map, the visual scene could be restored and a visual landing made.

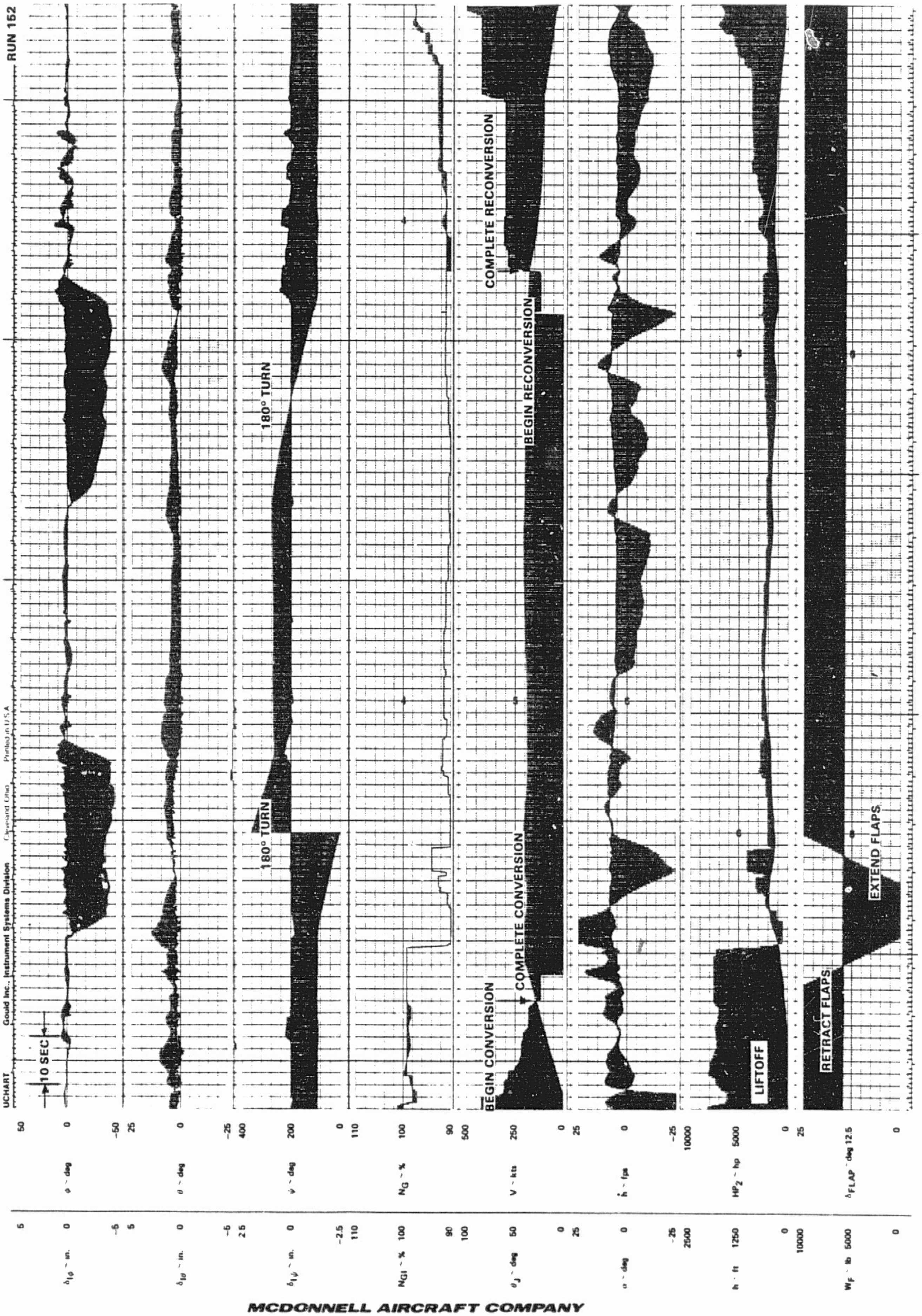
The head up display (HUD) was very valuable and to a certain extent compensated for some of the missing real world visual cues. During these tests the pilots also evaluated the HUD and recommended certain improvements in the symbology and format.

10.1 VTOL MISSION TASK

The VTOL mission task received favorable pilot comments. Some pilots commented that the task was enjoyable. Generally, pilot ratings were 2 to 3.

A vertical takeoff was initiated by increasing power until the aircraft lifted off and began climbing. Thrust vector lever was moved forward and the aircraft accelerated rapidly. Most pilots seemed surprised at the rapid increase in airspeed. A typical VTOL mission task is shown in Figure 10-1.

FIGURE 10-1
VERTICAL TAKEOFF AND LANDING TASK



Pilot criticism was again noted about the mode change from attitude command to rate command/attitude hold. After takeoff, the airplane was often held in a nose up attitude greater than 5 degrees and the aircraft tended to pitch nose up when going through the mode change at 40 knots. This characteristic of the flight control system was mentioned frequently by all pilots, and the desire for possible improvement was emphasized.

It was relatively easy to overpower the aircraft and generate negative angle of attack during the takeoff transition. Negative angles of attack generate negative wing lift, decreasing aircraft performance, and often cause a reversal in the sense of dihedral effect. While this was not a major problem on the simulated airplane, it could cause serious control problems on aircraft with high roll/sideslip coupling tendencies.

Conversion was usually initiated at 180 to 240 knots with the aircraft still accelerating rapidly. Conversion was not a difficult task, although there was usually some transient change in load factor as the pilot corrected pitch attitude to transfer lift from the fans to the wing. After conversion, the aircraft continued accelerating. There was never a tendency to lose speed in conversion and encounter a situation of pure aerodynamic flight with insufficient airspeed and too little powered lift to maintain flight speed without a large altitude loss. The effect of gear and flap retraction on pitch trim was minimal.

Flying the airplane in the traffic pattern at 300 knots was not a problem except for the requirement of excessive banking turns to remain within the confines of the terrain map. Deceleration from 300 knots to reconversion speed required considerable time and thus used up a lot of space. All pilots noted that the airplane felt unusually clean. Extending gear and flaps helped increase the deceleration, but some pilots felt some type of speed brake would be desirable.

As airspeed decreased to the 180 to 240 knot range, reconversion was initiated by bringing power up to around 90 to 94 percent, and then bringing the thrust vector lever out of the 0 degree detent back to the 30 degree position. There was usually some transient in load factor, although not uncomfortable, as the pilot found a suitable combination of pitch attitude and power as lift was transferred from the wing to the fans.

During the traffic pattern circuit the pilot had the option of shutting down the lift engine after conversion and then restarting the engine prior to reconversion, or letting the engine idle through the entire aerodynamic flight phase. This seemed to be a matter of personal preference; fuel used in idle was low.

The transition from reconversion to hover was usually performed on the final approach leg with the runway in sight. This was entirely a visual task with no outer loop guidance. The technique most often used was to keep pitch attitude fairly constant while controlling airspeed with vector angle and altitude with power as evident in Figure 10-1. Actual vertical landing was no problem and always received favorable pilot comments.

10.1.1 POSSIBLE LOSS OF POWERED LIFT CONTROL WITH POWER REDUCTION - On at least two occasions the pilot attempted a very rapid descent and deceleration by reducing engine power to idle and selecting a thrust vector angle near 90 degrees. As the airspeed decreased very rapidly and the aerodynamic control effectiveness decreased, the pilot lost control of the aircraft due to absence of powered lift control capability. While this is an unusual maneuver and would not normally be attempted in a real world situation, it points out a potential problem of an inadvertent control input in the cockpit. It deserves sufficient study to determine if measures such as adding a throttle stop to prevent such power reduction are needed.

10.2 STOL MISSION TASK

STO was somewhat of a problem because the aircraft tended to overrotate on takeoff. The RTA landing gear geometry, which places a relatively large percentage of the aircraft weight on the nose wheel, causes an overrotation tendency as the main gear leaves the runway. The overrotation tendency experienced on the simulator may have been far worse than that which can be expected in the actual aircraft. Much of the problem could be attributed to the landing gear mathematical model, which was designed for a different simulation program and was not specifically suited to the RTA simulation experiment.

A jump STOL takeoff, where the thrust vector is placed in the maximum horizontal position available in powered lift flight and then rapidly changed to the STO position when takeoff speed is attained, could not be performed satisfactorily. This was partly due to the inappropriate landing gear model. The selected powered-lift control phase-out schedule was the other reason why evaluation of the jump STOL takeoff could not be made. As simulated, powered lift control was phased out between 45 degrees and 30 degrees thrust vector angle. At 30 degrees thrust vector angle, therefore, all powered-lift control was phased out and so no powered-lift control was available during the takeoff run. This mechanization error in powered lift control phase-out requires revision.

A typical STOL mission task is shown in Figure 10-2. The STOL takeoffs worked very well at a constant vector angle of 55 degrees. The aircraft flew off the runway at about 80 knots. The takeoff required a ground run of about 700 feet at a 30,000 pound aircraft weight.

The transition, conversion, aerodynamic flight, reconversion, and transition in the STOL mission tasks were identical to the VTOL mission tasks. The increase in gross weight from 27,500 pounds for the VTOL mission to 30,000 pounds for the STOL mission task had no effect on these phases of the mission.

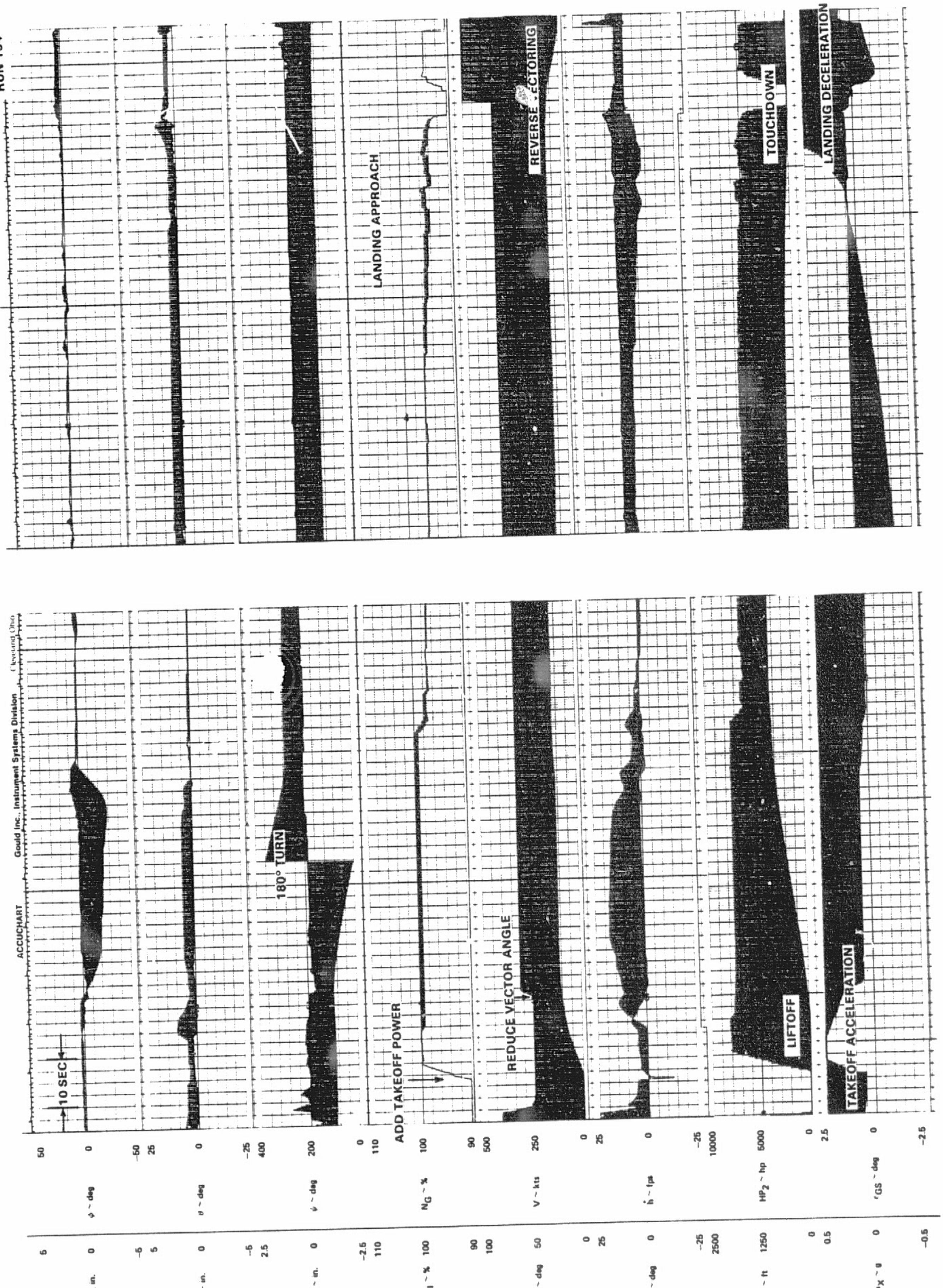
A typical short landing was made at about 80 knots and 5 degrees angle of attack. Thrust vector angle was about 70 degrees and engine power approximately 96 percent. The landings were entirely visual as no ILS type guidance was provided. Flight path angle on approach was 5 to 7 degrees. The short landing generally received pilot ratings of 3 to 3 1/2.

10.3 POWER LEVER AND THRUST VECTOR LEVER

To a large extent, the power lever and thrust vector lever geometry affected the pilot's ability to adequately perform the VTOL and STOL mission tasks. The power lever/thrust vector lever quadrant, as used in the simulator, should be modified to incorporate at least the following recommended changes:

1. The thrust vector lever should have a positive hover stop.
2. Forward conversion stop must limit thrust vector angle below value which shuts off powered lift control.
3. Power lever must have an intermediate power detent or stop.
4. An adjustable STO stop is required for jump STOL takeoffs.
5. A high quality drive motor is needed on the vector lever which can be controlled by a thumb switch on the power lever. Response preference is for rate proportional to switch deflection.
6. Side force control might be better located on the stick than on the power lever.
7. Power lever needs to be reshaped and some type of arm or wrist support should be considered.

FIGURE 10-2
SHORT TAKEOFF AND LANDING TASK



10.4 HEAD UP DISPLAY

The head up display was a valuable asset in performing the mission tasks. In many respects, the HUD compensated for the lack of some real world visual cues. The velocity vector on the HUD was especially valuable during short landing since the required flight path angle could be achieved by simply superimposing the projection of the velocity vector symbol on the desired touchdown spot. Recommendations with respect to the HUD are as follows:

1. Angle of attack should be added to the HUD.
2. Engine power and thrust vector angle should be scales rather than digital readouts.
3. A precise bank angle indication should be added.
4. The fixed aircraft symbol was easily confused with the velocity vector symbol and should be changed.
5. There should be an engine failure indicator on the HUD.
6. The entire field of view should be lowered so velocity vector symbol is more usable on approach.

11. FAILURE MODE STUDIES

This part of the simulation program was devoted to evaluation of the effects of potential system failures on the control characteristics and operational capabilities of the aircraft. Failures were simulated at various points during the performance of the takeoff and landing approaches. The two basic types of failures evaluated were engine failures and control augmentation system failures.

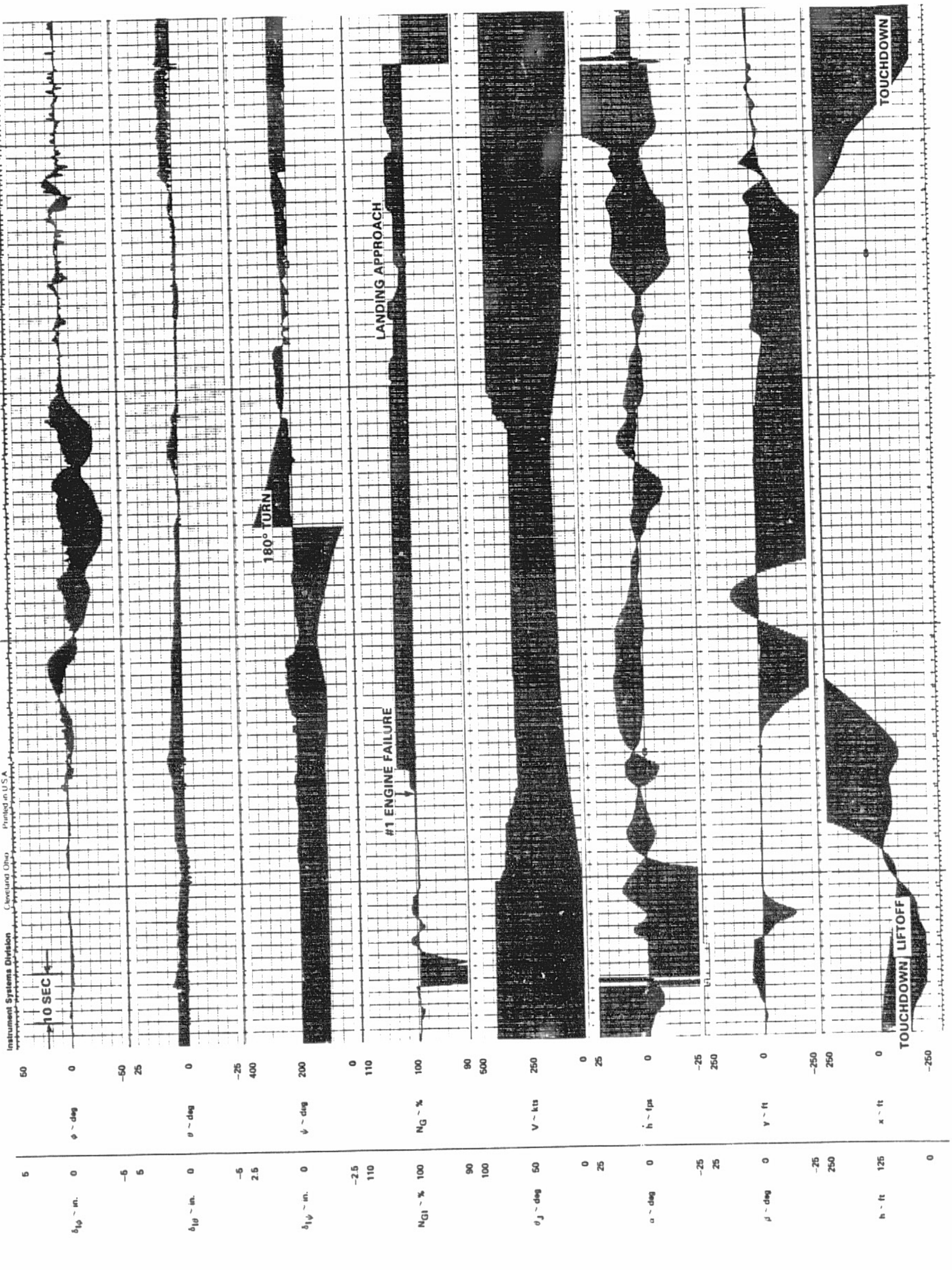
11.1 ENGINE FAILURES

The simulation mathematical model has the capability of simulating failures of any of the three engines. For the engine failure investigation, aircraft gross weight was reduced to 26,000 pounds. While the pilot was performing a typical VTOL or STOL mission task, an unannounced engine failure was introduced. Engine failure effects were investigated at several different points in the mission task. A typical engine failure exemplified by loss of the No. 1 engine is shown in Figure 11-1.

Engine failures were not difficult to control and the flight could be either aborted or continued after the failure. Disturbing moments on the aircraft following an engine failure were almost nonexistent. In both the gas-coupled and shaft-coupled versions of the aircraft, the engines and fans are interconnected so the power is redistributed to maintain aircraft moment balance and the only pilot action required is to increase power to compensate for the failure. If the engine failed during either a vertical or short takeoff, the flight could be aborted and the aircraft could remain in the powered-lift regime. The pilot could return for a vertical or short landing. Altitude loss following an engine failure on vertical takeoff was typically around 50 feet. If the failure occurred at lower altitude than this, the sink rate at impact was within the capability of the landing gear. On the other hand, it was not difficult to convert to aerodynamic flight following the failure. Also, an engine failure during a short or vertical landing presented no serious difficulty.

11.1.1 ENGINE FAILURES - SHAFT-COUPLED VS GAS-COUPLED - The handling qualities and performance characteristics of both aircraft versions were acceptable following an engine failure. The gas-coupled fan aircraft had a higher thrust-to-weight ratio so an engine failure close to the ground was less critical than in the shaft-coupled fan aircraft. For this reason the pilots preferred the gas fan aircraft's engine-out capabilities. However, with an engine failed in the gas-coupled fan aircraft, the conversion sequence is not gradual as in

FIGURE 11-1
VERTICAL TAKEOFF AND LANDING WITH NO. 1 ENGINE FAILURE



normal operation. This is because with an engine failed, it is not possible to close the duct isolation valves and shut down the lift fan gradually as the lift/cruise fan thrust is vectored toward the horizontal. Instead, the lift fan duct valve is closed abruptly as the dump valve is opened. This causes the lift fan to spin down quickly and the lift/cruise fan thrust must be vectored quickly to keep pace with the spin down to maintain moment balance on the aircraft. This results in a sizeable, but acceptable pitching transient.

In the case of the shaft-coupled fan aircraft, the lift fan blade pitch and lift engine power setting are reduced gradually as the lift/cruise fan thrust vector approaches horizontal. This procedure is also used in the event of an engine failure. Therefore, the shaft-fan aircraft has lower pitching transients when going through conversion/reconversion following engine failure.

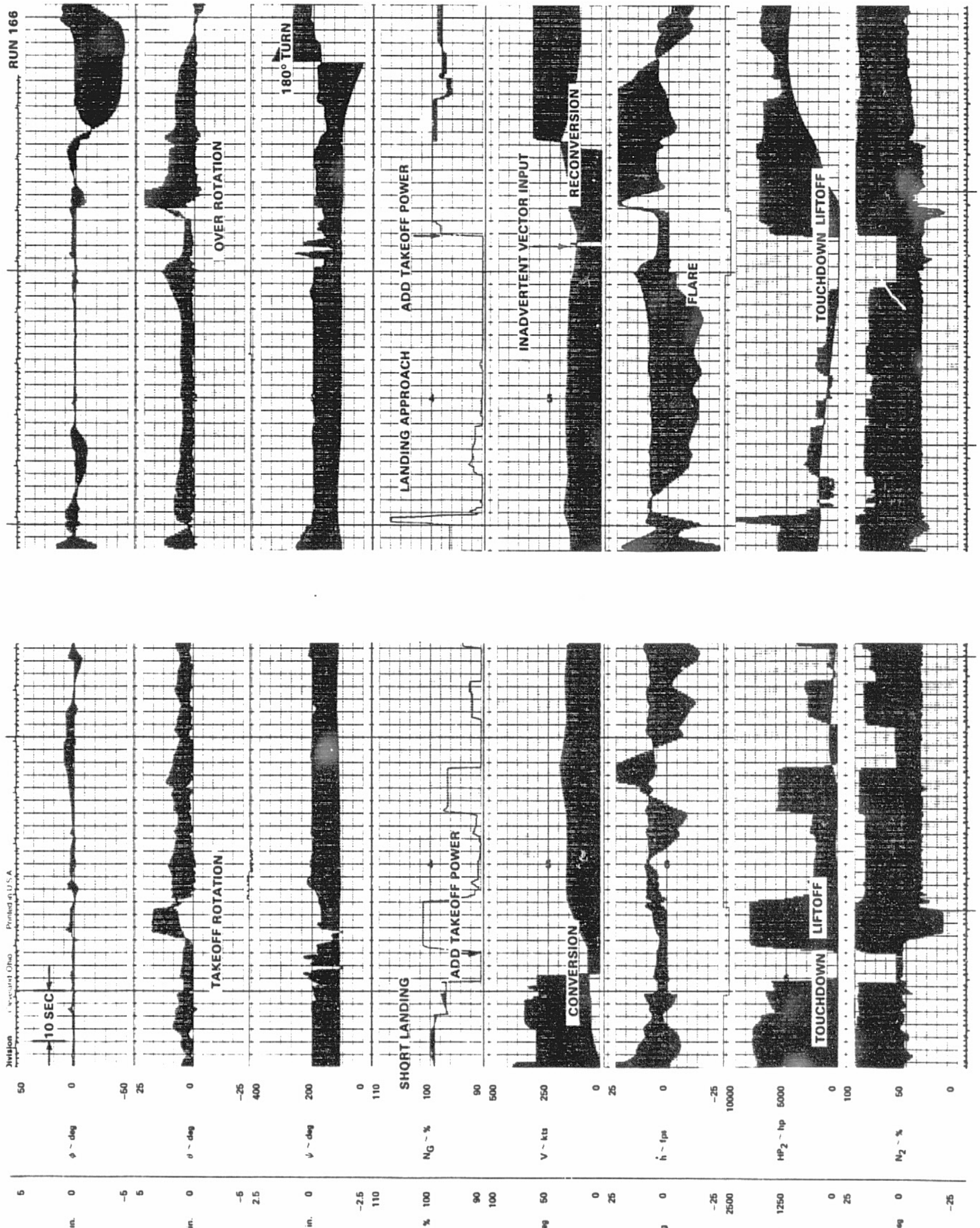
11.1.2 CONVENTIONAL LANDINGS WITH A FAILED ENGINE - On several flights the pilot was asked to land conventionally following an engine failure in cruise flight. There were no difficulties encountered in making the conventional landing as affected by the engine failure. However, after the first few conventional landings, the pilot complained of insufficient lift and drag to fly at a more desirable approach speed. The flaps on the Research Technology Aircraft were therefore augmented with drooped ailerons and a conventional landing was made at 25 degrees of flap and ailerons drooped 15 degrees. This permitted a comfortable approach at 150 knots. A conventional takeoff and time history is shown in Figure 11-2.

Conventional landing characteristics were generally good but some comments were noted. The pilots would have preferred more drag in the landing configuration. Adverse yaw was a problem as mentioned in the aerodynamic flight handling qualities evaluations. Some pilots did not like the apparent neutral speed stability which was caused by the pitch CAS integrator. Some pilots apparently rely on stick force as a speed cue during landing approach. All systems affected by these comments should be reviewed and revised as necessary.

11.2 CAS FAILURES

The control augmentation system is dual channel in all safety of flight areas. Critical CAS failures, therefore, constitute a passive loss of CAS in one affected axis at a time. CAS failures were simulated at various points in the mission task. In some cases the pilot was asked to abort the mission, remain in powered-lift flight and land. In other cases he was asked to continue the mission task through conversion, reconversion, and landing. A few

FIGURE 11-2
CONVENTIONAL TAKEOFF AND LANDING TASK

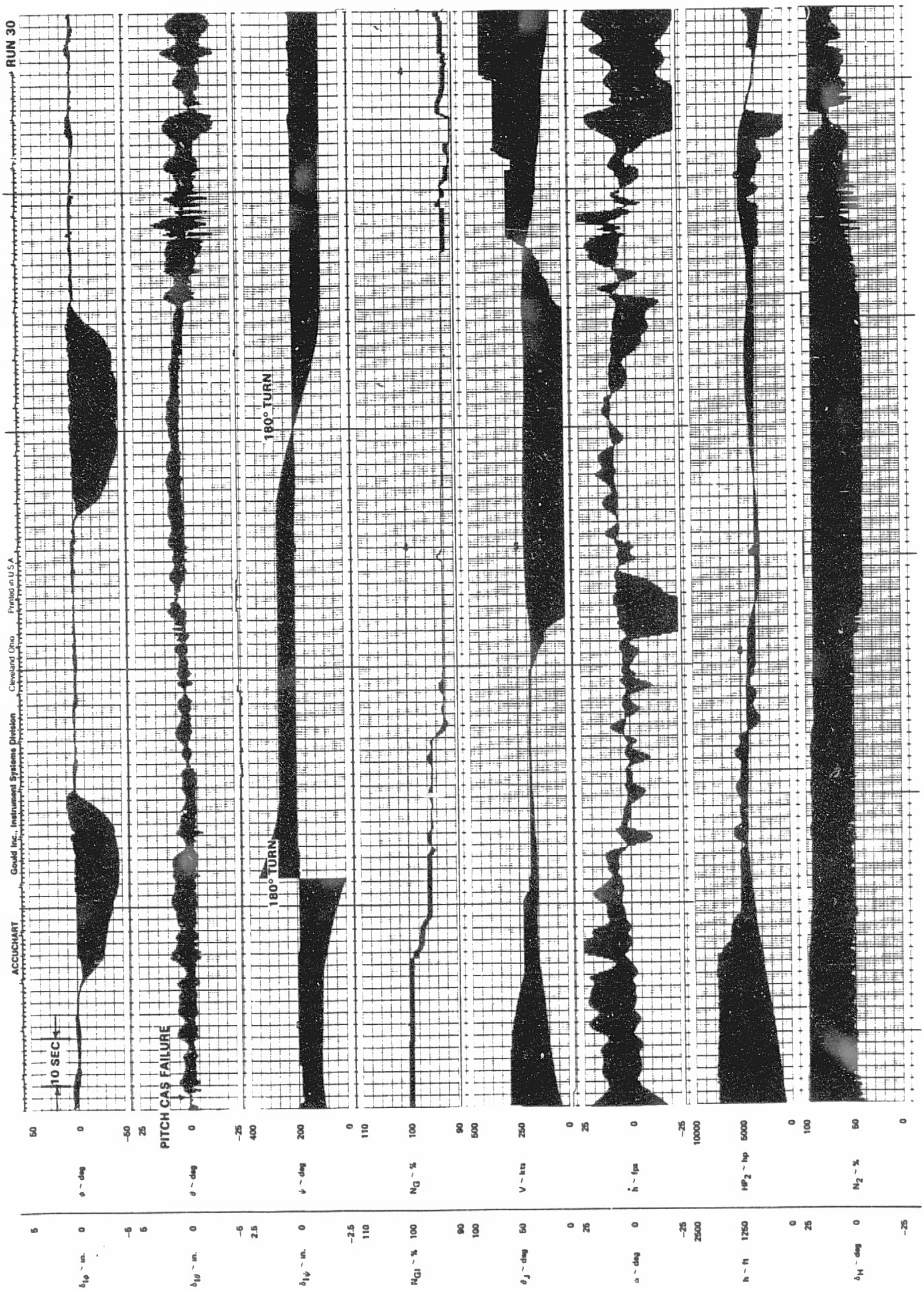


conventional landings were also evaluated following some CAS failures.

The mission task could be safely aborted or continued following either a roll or yaw CAS failure. Pilot ratings for completing the task with a failed roll or yaw CAS were about 4 to 5 on the Cooper-Harper pilot rating scale. Pitch CAS failures however were a serious problem. Transitions and conversions without pitch CAS were considered hazardous and received pilot ratings of 8 to 8.5. Figure 11-3 shows a vertical mission task with a pitch CAS failure occuring at 60 knots. The difficulty in controlling pitch in transition was discussed in Sections 7 and 8.

Roll and yaw were acceptable, and the only concern was adverse yaw. Pitch control during conventional landings with CAS off was not acceptable although consistent landings were performed. At a 150 knot approach speed, angle of attack is in the region of neutral static stability. Pilots commented that the aircraft tended to pitch up strongly during flare.

FIGURE 11-3
CONVERSION AND RECONVERSION WITH PITCH CAS FAILURE



12. SPECIAL TESTS

The special tests included studies of the effect of thrust vectoring rate on mission performance, and a brief investigation of the effect of control system lag on controllability in hover.

12.1 THRUST VECTORING RATE

Several flights were made to study the effects of reduced thrust vectoring rates on mission performance and handling qualities. The installed nominal maximum thrust vectoring rate was 50 degrees/second. Mission tasks were flown with reduced maximum vectoring rates of 25, 15, and 5 degrees/second. At 25 degrees/second there was no apparent difference in task performance or in the associated handling qualities. At 15 degrees/second some degradation in task performance was noted. A maximum rate of 5 degrees/second was too slow and the pilots could no longer perform transitions acceptably. It must be emphasized however that these tests were exploratory in nature, and the results are not considered conclusive. Jump STOL takeoffs, for example, were not attempted, and the evaluation task was not specifically designed for establishing of the vectoring rate requirement.

12.2 EFFECT OF CONTROL SYSTEM LAG ON HOVERING PERFORMANCE

Results of the hover handling qualities evaluation, described in Section 6, showed that both the gas-coupled version and the shaft-coupled version of the RTA could be hovered and landed without control augmentation. Since control system lags have a strong impact on controllability in hover without stability augmentation, several hover flights were made to study these effects.

As described in Section 6, the control response characteristics of the gas-coupled and shaft-coupled systems were nearly the same except for large control inputs which exceeded the TRM preset in the gas-coupled system. It was not surprising that there were no differences noted in CAS off control characteristics in hover between the two versions of the aircraft. Since the TRM preset is applicable only to the RTA there was some question whether the gas-coupled system could be controlled CAS off in hover without the TRM preset. Several hovering flights were therefore made with the TRM preset removed, which resulted in some degradation in the ability to perform the hover task without CAS. Some pilots felt there was considerable degradation while others were just able to detect the change. The aircraft was considered controllable with a pilot rating of about 7 to 8.

This experiment has significance only with respect to the reduced cost dual CAS flight control system approach for the RTA where use of the preset TRM in the gas-coupled system is recommended to take advantage of the high thrust-to-weight capability. For the operational aircraft without the TRM preset, a triplex control-by-wire flight control system is recommended which eliminates any considerations of pilot open loop control of the aircraft at any time. Furthermore, the critical control task with CAS off is not in hover but in transition and conversion where both aircraft versions have unacceptable handling characteristics. The reduced cost dual CAS flight control system is therefore not recommended for the RTA in either version.

13. CONCLUSIONS AND RECOMMENDATIONS

The flight simulation test program of the Lift/Cruise Fan V/STOL Research Technology Aircraft was very successful. The program demonstrated the basic soundness of the aircraft and control system design in terms of handling qualities, provided direction for further analysis and design studies, and generated a comprehensive and efficient mathematical model for future study and evaluation programs.

The test plan was executed with adequate coverage of all major areas of interest. Pilot general opinion of the simulator, the simulated article, and the test setup was favorable and highlighted by enthusiastic participation in the program. The pilot ratings and comments, along with other recorded data in the form of time history traces, produced a data bank from which important conclusions and guidelines for future design, analysis, and implementation effort can be drawn.

While many of the conclusions presented in this section are generally applicable to V/STOL, some of the conclusions and recommendations are applicable only to the simulated aircraft model. Those conclusions are therefore specific to the three gas generator/three fan configuration as shown in Section 3, which is equipped with a control augmentation system (CAS). The CAS is dual channel selected with the intent of providing a fail safe operating capability. Projection of these results to other configurations and flight control system concepts should not be made without a careful consideration of the differences involved.

13.1 CONCLUSIONS

The following is a list of major conclusions reached from the simulation test data on record:

1. The pitch and roll attitude command system and yaw rate command system, as implemented in the CAS, provide satisfactory handling qualities in hover.
2. The CAS functions of pitch and roll rate command/attitude hold, yaw damping, and turn coordination provide satisfactory control characteristics in transition.
3. Switching between the attitude command and rate command/attitude hold modes of the CAS can cause disturbing transients during low speed maneuvering, and therefore warrants design improvement.

4. Engine failures are controllable throughout the mission task. Vertical, short, or conventional landings with one engine out can be completed.
5. Both the gas-coupled and the shaft-coupled systems can be designed to provide satisfactory handling qualities.
6. Control of longitudinal translation by means of the transition lever was preferred over pitch attitude changes.
7. High thrust-to-weight capability enhances good takeoff performance but makes the aircraft easier to overpower and generate negative angles of attack in transition which affects aircraft control.
8. Momentum drag at the lift fan inlet affects directional aircraft stability and makes it desirable to implement directional angle feedbacks for additional stability and reduced pilot workload.
9. Side velocity feedback is very effective for low speed turn coordination but makes the aircraft more sensitive to side gust disturbances. Design of appropriate filtering is needed.
10. Gain scheduling with vector angle is generally adequate, except areas where control loop performance is highly sensitive to airspeed variation such as in turn coordination in transition.
11. Momentum drag at the lift fan inlet results in aircraft pitching moments in transition during power changes. Power changes cause changes in the two components of momentum drag, fan flow and aircraft rate of climb (or descent).
12. Roll control characteristics are sensitive to airspeed in the aerodynamic flight regime (200-300 knots) requiring some form of gain scheduling.
13. Basic handling qualities of the aircraft in aerodynamic flight without CAS are acceptable.
14. Handling qualities following the loss of pitch or yaw CAS in hover results in acceptable handling qualities but with considerable pilot workload increase.
15. Handling qualities following the loss of roll CAS in hover border on unacceptability.
16. Loss of roll or yaw CAS in transition and conversion increases pilot workload but remains within acceptable boundaries of handling qualities.
17. Loss of pitch CAS in transition and conversion results in unacceptable handling qualities.

18. Need for angle of attack limiter is uncertain. Aircraft is controllable at all angles of attack investigated.
19. Vectoring rate of 15 degrees/second is minimum for performance of the mission task defined in this simulation experiment. Vectoring rate of 25 degrees/second is more desirable.
20. The HUD is a valuable aid even in visual flight conditions. The HUD, though not specifically designed for this experiment, contributed favorably to the performance of the all visual mission task.
21. Simplification and geometry optimization of the power management quadrant are essential to good handling qualities because of the heavy impact on pilot workload.

13.2 RECOMMENDATIONS

The following recommendations are derived from the results of this simulation experiment and apply to the design of the RTA configuration, CAS, crew station, the simulator, and the simulation program plan.

1. Increase redundancy to provide safe landing capability vertically, short, or conventionally following a CAS failure. Dual CAS in the roll axis during hover and in the pitch axis during transition and conversion does not insure fail safe operation.
2. Design appropriate control laws to eliminate or reduce transients during switching between attitude command and rate command/attitude hold modes.
3. Add attitude stability in the directional axis to prevent aircraft weathercocking tendencies.
4. Improve gain scheduling in transition to be more adaptive to flight condition, primarily airspeed.
5. Design appropriate control filters for side velocity feedback to attain optimum compromise between good turn coordination and sensitivity to side gusts.
6. Optimize the combination of airspeed, power, flap, and pitch attitude to minimize pitching disturbances during conversion.
7. Change powered-lift control phaseout schedule and add appropriate safety margins to preclude inadvertent phaseout.
8. Consider gain variation with airspeed in the roll axis in the aerodynamic flight regime. Constant gains appear to be inadequate.

9. Study apparent dihedral effect at high airspeeds and add appropriate flight control system compensation.
10. Study need for angle of attack limiter, and if required, determine appropriate angle of attack values at which limiter is to become effective.
11. Review automatic pitch trim system and its effect on speed stability. Modify as necessary.
12. A thrust vector rate of 25 degrees/second is recommended based on the mission tasks evaluated.
13. Review landing gear model and landing gear design geometry with respect to problems with overrotation during short and conventional takeoffs.
14. Consider implementing a minimum power lever position stop to correspond to minimum flight operational thrust setting to prevent inadvertent excessive power reduction in flight.
15. Add intermediate power detent on power lever.
16. Add motor drive to transition lever and a control switch on power lever for thumb operation. Make transition lever rate proportional to switch deflection.
17. Add hover stop on transition lever.
18. Add adjustable STO stop on transition lever for jump takeoffs.
19. Optimize power lever and transition lever geometry and add an arm or wrist support.
20. Place side force control on control stick in preference to the power lever.
21. Improve stick centering and breakout characteristics.
22. Add angle of attack, bank angle, and engine failure indication on the HUD. Make power and thrust vector angle indication in scale format rather than digital readout, and provide better contrast between aircraft and velocity vector symbols. Increase or lower field of view to make velocity vector symbol more usable on approach.
23. Design high speed portion of simulation tasks to be compatible with size of terrain map. Add IFR operation for high speed part of task if necessary.

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APPENDIX A

SUMMARY OF SIMULATION FLIGHTS AND PILOT COMMENTS

Run	Flight Condition	Fan	Pilot	Off Normal Condition
1	Hover	Gas	C	Height damper shut off
2	Hover	Gas	C	
3	Hover	Gas	C	Individual CAS system turned off
4	60 knots	Gas	C	
5	90 knots	Gas	C	
6	90 knots	Gas	C	
7	120 knots	Gas	C	
8	Transition/Conversion	Gas	C	
9	Transition/Conversion	Gas	C	
10	200 knots	Gas	C	
11	300 knots	Gas	C	
12	STO, V Land	Gas	C	
13	STO, Short Land	Gas	C	
14	STO, Conv. Land	Gas	C	
15	STO, Conv. Land	Gas	C	
16	VTO, V Land	Gas	C	#3 engine fail at 100 ft
17	VTO, Conv. Land	Gas	C	#3 engine fail, conv. land.
18	VTO, V Land	Gas	C	#3 engine fail, reconversion
19	VTO, V Land	Gas	C	#3 engine fail on landing
20	VTO, V Land	Gas	C	#1 engine fail on takeoff
21	STO, V Land	Gas	C	#3 engine failure on takeoff
22	STO, V Land	Gas	C	#3 engine failure on takeoff
23	STO, V Land	Gas	C	#3 engine failure on takeoff
24	STO, V Land	Gas	C	#3 engine failure on takeoff
25	VTO, V Land	Gas	C	#1 engine fail during conversion
26	Special Test	Gas	C	TRM preset removed CAS off 1 axis
27	Special Test	Gas	C	TRM preset removed All CAS off
28	Hover	Gas	C	Wind and turbulence
29	VTO, V Land	Gas	C	Pitch CAS fail on VTO
30	VTO, V Land	Gas	C	Pitch CAS fail on VTO
31	VTO, V Land	Gas	C	Roll CAS fail
32	VTO, V Land	Gas	C	Yaw CAS fail
33	Hover	Shaft	C	
34	60 knots	Shaft	C	
35	Transition/Conversion	Shaft	C	
36	VTO, V Land	Shaft	C	Pitch CAS fail
37	VTO, V Land	Shaft	C	Pitch CAS fail
38	VTO, Conv. Land	Shaft	C	#1 engine fail

Run	Flight Condition	Fan	Pilot	Off Normal Condition
39	STO, V Land	Shaft	C	
40	Hover	Shaft	C	CAS off
41	Hover	Shaft	C	CAS off
42	Special Test	Shaft	C	Vector rate 15°/sec
43	STO, Short Land	Shaft	C	Alternate control laws
44	VTO, V Land	Shaft	C	#1 engine fail at 50 ft
45	VTO, V Land	Shaft	C	#1 engine fail at 50 ft
46	VTO, V Land	Shaft	C	Yaw CAS fail
47	VTO, Conv. Land	Shaft	C	Yaw CAS fail
48	VTO, Conv. Land	Shaft	C	Vector rate 5°/sec. Pitch CAS fail 300 knots
49	No Go	Shaft	C	
50	VTO, Conv. Land	Shaft	C	Vector rate 5°/sec. Pitch CAS fail 300 knots
51	Hover	Gas	D	
52	60 knots	Gas	D	
53	60 knots	Gas	D	
54	Hover	Gas	E	
55	Hover	Gas	D	
56	60 knots	Gas	D	
57	60 knots	Gas	D	
58	60 knots	Gas	D	
59	60 knots	Gas	E	
60	60, 90, 120 knots	Gas	E	
61	Conversion	Gas	E	
62	Conversion	Gas	E	
63	Conversion	Gas	E	
64	Conversion	Gas	D	
65	Conversion	Gas	D	
66	Hover	Gas	B	
67	60 knots	Gas	B	
68	90 knots	Gas	B	
69	120 knots	Gas	B	
70	150 knots	Gas	B	
71	150 knots	Gas	B	
72	150 knots	Gas	B	
73	Conversion	Gas	B	
74	Conversion	Gas	B	
75	200 knots	Gas	B	
76	STO, Short Land	Gas	B	

Run	Flight Condition	Fan	Pilot	Off Normal Condition
77	STO, Short Land	Gas	B	
78	Hover	Shaft	B	
79	Hover	Shaft	B	
80	60 → 150 knots	Shaft	B	
81	60 → 150 knots	Shaft	B	
82	VTO - abort	Shaft	B	#3 engine fail at 100 ft
83	VTO - abort	Shaft	B	#1 engine fail 60 knots
84	VTO, Conv. Land	Shaft	B	
85	VTO, Conv. Land	Shaft	B	
86	VTO, Conv. Land	Shaft	B	
87	VTO, V Land	Shaft	B	Pitch CAS fail 100 ft
88	VTO, V Land	Shaft	B	Roll CAS fail 100 ft
89	VTO, V Land	Shaft	B	Yaw CAS fail 100 ft
90	VTO, V Land	Shaft	B	Yaw CAS fail 100 ft
91	Hover	Shaft	B	15 knot crosswind
92	Hover	Shaft	B	15 knot crosswind
93	Hover	Shaft	B	15 knot crosswind
94	Hover	Shaft	B	15 knot crosswind and turbulence
95	Hover	Shaft	B	15 knot crosswind and turbulence
96	Hover	Shaft	B	15 know headwind and turbulence
97	Hover	Shaft	B	15 knot headwind and turbulence
98	V Land on ship	Shaft	B	
99	V Land on ship	Shaft	B	
100	V Land on ship	Shaft	B	
101	V Land on ship	Shaft	B	
102	V Land on ship	Shaft	B	Ship motion
103	V Land on ship	Shaft	B	Ship motion
104	V Land on Ship	Shaft	B	Ship motion
105	VTO, Short Land	Gas	D	Crosswind and Turbulence
106	VTO, Short Land	Gas	D	Crosswind and Turbulence
107	VTO, Short Land	Gas	D	Crosswind and Turbulence
108	Hover	Gas	D	Height damper fail
109	VTO, V Land	Gas	E	
110	STO, Conv. land	Gas	E	
111	STO, Conv. land	Gas	E	
112	STO, Conv. land	Gas	E	
113	STO, Conv. land	Gas	E	

Run	Flight Condition	Fan	Pilot	Off Normal Condition
114	VTO, Conv. Land	Gas	E	
115	VTO, V Land	Gas	B	
116	STO, V Land	Gas	B	
117	STO, V Land	Gas	B	
118	STO, V Land	Gas	B	
119	STO, Conv. Land	Gas	B	
120	STO, Conv. Land	Gas	B	
121	VTO, V Land	Gas	B	
122	Hover	Gas	B	With and without headwind and turbulence
123	Hover	Gas	B	CAS off
124	Hover	Gas	B	CAS off, no height damper
125	Hover	Gas	B	CAS off, no height damper, no TRM preset
126	Hover	Gas	B	CAS off, no height damper, no TRM preset
127	Hover	Gas	B	CAS off, no height damper, no TRM preset
128	Hover	Gas	B	CAS off, no height damper
129	Hover	GAS	B	CAS off, no height damper, double TRM lags
130	VTO, V Land	Gas	B	
131	VTO, V Land	Gas	B	Yaw CAS off
132	VTO, V Land	Gas	B	Roll CAS off
133	VTO, V Land	Gas	B	Pitch CAS off
134	VTO, V Land	Gas	B	Pitch CAS off
135	VTO, V Land	Gas	B	Pitch CAS off
136	30 knots	Gas	B	
137	Special Test	Gas	B	Fwd. fan vector limit 45°
138	Special Test	Gas	B	Fwd fan vector limit 60°
139	VTO, V Land	Gas	B	#1 engine fail in cruise
140	Hover	Gas	A	CAS off individually, paired and all
141	Hover	Gas	A	Single CAS off
142	Hover	Gas	A	CAS off, crosswind and turbulence
143	Hover	Gas	A	
144	Hover	Gas	A	
145	60 knots	Gas	A	CAS off, with and without wind and turbulence
146	90 knots	Gas	A	With and without wind and turbulence and CAS
147	120 knots	Gas	A	Single CAS off
148	120 knots	Gas	A	Single CAS off
149	Conversion	Gas	A	
150	200 knots	Gas	A	With and without single axis CAS disengagement

Run	Flight Condition	Fan	Pilot	Off Normal Condition
151	300 Knots	Gas	A	CAS off individually
152	VTO, V Land	Gas	A	
153	STO, V Land	Gas	A	
154	STO, Short Land	Gas	A	
155	STO, Short Land	Gas	A	
156	STO, Conv. Land	Gas	A	
157	STO, Conv. Land	Gas	A	
158	STO, Conv. Land	Gas	A	
159	Conv. TO, Conv. Land	Gas	A	
160	Conv. TO, Conv. Land	Gas	A	
161-169	Conv. TO, Conv. Land	Gas	A	Fixed Base
170	VTO, V Land	Gas	A	#1 engine fail at 100 ft
171	VTO, V Land	Gas	A	#1 engine fail at 100 ft
172	Hover	Shaft	A	Pitch CAS off
173	Hover	Shaft	A	Roll CAS off
174	Hover	Shaft	A	Crosswind and turbulence, CAS off
175	60 knots	Shaft	A	
176	60 knots	Shaft	A	Motion off
177-185	STO, Short Land	Shaft	A	Motion off
186	Special Test	Shaft	A	15°/sec vectoring rate
187-190	Special Test	Shaft	A	10°/sec vectoring rate
191	Special Test	Shaft	A	15°/sec vectoring rate

Run 1, 2 Hover Gas Fan Pilot C

(Height damper shut off on Run #1)
Height damper makes a big difference
Good attitude stability - can hold it where I want
Yaw rate response looks good
HUD makes task easier
Negative weathercock but good yaw damping and directional control takes care of it.
Must be ginger with vector lever, easy to overshoot, visual cues not as good in pitch as roll.
Overall PR 2 1/2 for hover - biggest problem is negative weathercock

Run 3 Hover Gas Fan Pilot C CAS off

Yaw CAS off no problem
Pitch CAS off gives problem, transient, general wandering, SAFE but must concentrate on attitude
Roll CAS off gave slight roll right
General wandering, must be ginger
PR 6 1/2 Pitch failed)
PR 6 Roll failed) no wind
PR 4 Yaw failed)
(CAS Back on, 15 knots crosswind and turbulence)
Don't see much attitude disturbance.
Must hold wing down.
Holding over a point problem with visual display.
PR 3 overall with wind for hover with CAS on
(CAS failures with wind)
Yaw CAS off with wind get transient
Negative weathercocking problem with CAS off and wind
Roll CAS off no big problem
No easier with yaw off than roll off when wind present
Pitch axis most difficult with CAS off
PR 7 with wind and turbulence and any axis CAS off

Run 4 60 Knots Gas Fan Pilot C

Change from attitude command to rate command too abrupt.
θ_J = 80 gives 60 knots
Nose wants to drop, quality of attitude hold system not good
Can really see the nose drop on the HUD
Looseness in pitch attitude more apparent with HUD
Does not hold pitch attitude as well as I would like
Loose in pitch
Roll and heading good
Everything but pitch attitude hold looks good
No dihedral effect in sideship
Turn coordination looks good
PR 3→3 1/2 because nose drops in turn

Runs 5, 6 90 Knots Gas Fan Pilot C

Very similar to 60 knots. PR 3 - 3 1/2
Pitch most objectionable.
θ_J = 74° No big change from 60 knots

Run 7 120 Knots Gas Fan Pilot C

Stick not centering on previous runs.
Corrected stick (pitch); attitude hold in pitch now not too bad.
Nose still drops in turn
Slight negative dihedral
PR 3→3 1/2 would be better if nose did not drop in turn

Run 7 150 Knots Gas Fan Pilot C

Looks good
Slight deterioration in turn coordination
Overall better because nose doesn't drop
PR 3
Dihedral overpowers CAS in developing sideslip, then bank angle stays when take out sideslip.

Run 8,9 Transition/Conversion Gas Fan Pilot C

Everything looks good.
Only problem is pitch changes
HUD really helps
PR 3

Run 10 200 Knots Gas Fan Pilot C

Attitude, altitude, and heading hold good
Positive dihedral
Can't bank too steep at 200 knots.
PR 6 because of low speed operation
PR 3 1/2 for small banks
Lost altitude due to α limiter

Run 11 300 Knots Gas Fan Pilot C

Getting adverse yaw worst thing
Pitch damping good
Negative dihedral
PR 6 due to adverse yaw
Would be PR 3 if adverse yaw fixed

Run 12 STO, V Land Gas Fan Pilot C

Overrotated on STO, hairy, need to develop techniques.
Did not optimize STO
Got to be enjoyable.
Don't like transient from attitude to rate command. Needs improvement
Conversion process good.
Need devector schedule (V vs θ_J).
PR 3

Run 13 STO, Short Land Gas Fan Pilot C

Pitches up when it unsticks
$\theta_J = 75°$ for landing 60 knots
Take off at $\theta_J = 60°$, hard to rotate, was very ginger
Control airspeed with vector angle O.K.
Need to move HUD down
PR 3

Run 14, 15 STO, Conv. Land Gas Fan Pilot C

Lost Redifon on landing and crashed!
Difficult to stabilize airspeed on landing.
Lacks high lift/drag devices.
PR 4 1/2 because of conventional landing

Run 16 VTO, V Land Gas Fan Pilot C #3 Fail @ 100 ft

No problem, plenty excess thrust PR 1 1/2

Run 17 VTO, Conv. Land Gas Fan Pilot C #3 Fail @ 60 knots

Slight pitch down
Developing conventional landing skill
Not critical

Run 18 VTO, V Land Gas Fan Pilot C #3 Fail, Reconversion

Only problem was abrupt transient when reconverting. Was not expecting failure
Most critical failure so far but no big problem.

Run 19 VTO, V Land Gas Fan Pilot C #3 Fail on Landing

Run 20 VTO, V Land Gas Fan Pilot C #1 Fail on TO

No different than #3

Run 21, 22, 23, 24 STO, V Land Gas Fan Pilot C #3 Failure on TO

Must fix vector detent at 30°
Continues to climb after failure
O.K.

Run 25 VTO, V Land Gas Fan Pilot C #1 Failure in Conversion

Run 26 Special Test Gas Fan Pilot C No TRM preset, CAS off

(TRM preset removed CAS off 1 axis)

Run 27 Special Test Gas Fan Pilot C No TRM preset, CAS off

(TRM preset removed all CAS off)
(Add wind and turbulence)
Negative weathercocking
Can't tell much difference with TRM off

Run 28 | Hover | Gas Fan | Pilot C | Wind & Turbulence

(W still 26000)
Can land with wind and turbulence with all CAS off.
Little easier than no TRM present but not much different.

Runs 29, 30 | VTO, V Land | Gas Fan | Pilot C | Pitch CAS fail at 60 knots

(Pitch CAS fail on VTO)
Crashed on Run 29, lost it in pitch.
Big moment to trim out during conversion.
Helps to trim it out before conversion
Easy to get into PIO
100 knots - reduce power and nose comes up
Requires a lot of pilot attention
Dangerous!
First really bad failure
Could get away any time above 60 knots
PR 8 1/2

Run 31 | VTO, V Land | Gas Fan | Pilot C | Roll CAS Fail

No transient, no problem
No problem at all.

Run 32 | VTO, V Land | Gas Fan | Pilot C | Yaw CAS Fail at 60 knots

No problem, slightly worse than roll fail

Run 33 | Hover | Shaft Fan | Pilot C

Seems stiffer in roll than gas fan
Looks fine with CAS on
Lower T/W makes height control more difficult
Less vertical velocity damping
PR 3 for pitch, roll & yaw
PR 3 1/2→4 height control and overall rating

Run 34 | 60 Knots | Shaft Fan | Pilot C

Nose drops in turn
Looks same as gas fan
90 knots turn coordination looks good
No different than gas fan
120 knots same
150 knots can see effects of less T/W

Run 35 | Transition/Conversion | Shaft Fan | Pilot C

Conversion is better than gas fan, not as much transient.

Run 36, 37 VTO, V Land Shaft Fan Pilot C Pitch CAS Fail

Lost control in pitch axis
Got big change in pitch with vector angle around 35°
Big nose down pitch change going to 0° θ_J.
Pitch squirrelly

Run 38 VTO, Conv. Land Shaft Fan Pilot C #1 Fail Conv. Flight

(Conventional Landing)

Run 39 STO, V Land Shaft Fan Pilot C 30000 lb.

Looked same as gas airplane
Does not accelerate as fast, have more time

Run 40, 41 Hover Shaft Fan Pilot C CAS off

Pitch axis requres most attention CAS off

Run 42 Special Test Shaft Fan Pilot C Vector Rate 15°/sec

Can't tell any difference with 15°/sec rate
Nose does not drop in turn - looks good
Conventional landing - turn coordination really bad
Drooped ailerons real good

Run 43 STO, Short Land Shaft Fan Pilot C Alternate Control Laws

(Alternate control laws)
Bad - ball pegs into turns
A/C doesn't turn when banked
Uncomfortable

Run 44 VTO, V Land Shaft Fan Pilot C #1 Fail on Landing

(Vector rate 50°/sec. #1 fails at 60 knots on landing)
No transient, only takes more power

Run 45 VTO, V Land Shaft Fan Pilot C #1 Fail on TO

(#1 fail at 50 ft.)
Did not arrest sink rate, hit 9 FPS

Run 46 VTO, V Land Shaft Fan Pilot C Yaw CAS Fail

Passive failure

Run 47 VTO, Conv. Land Shaft Fan Pilot C Yaw CAS Fail

No problem, even turn coordination

Run 48 VTO, Conv. Land Shaft Fan Pilot C Pitch CAS Fail

(Pitch Fail 300 Knots, Vector rate 5°/sec.)
Very squirrelly in pitch CAS off

Run 49 No Go Shaft Fan Pilot C

Run 50 VTO, Conv. Land Shaft Fan Pilot C

(Pitch fail, 300 knots, vector rate 5°sec.)
PR worse than 6 1/2

Run 51 Hover Gas Fan Pilot D

Throttle sensitivity too high.
Nose goes left for roll right.
Good yaw sensitivity.
Tend to overshoot in yaw but control is positive.
Tend to overcontrol in yaw when in loop, otherwise nice and steady.
No coupling for yaw input.
Quite happy with yaw.
Speed response due to attitude change seems too slow.
Speed response better with vector change.
Like vector change better than vector change for translation.
Positive damping in height.
Sideforce control looks good.
Roll response a little sluggish, but like when attitude goes to zero when release stick.
Good landing accuracy.
Think sideforce control should be on stick - tend to move throttle.
PR 4 - height too sensitive, roll sluggish

Run 52, 53 60 Knots Gas Fan Pilot D

Good pitch damping, little sensitive.
Don't like transition from rate to attitude command.
Must add power in turn to keep from decelerating.
Don't need to coordinate with rudder.
Tend to put in pitch inputs when I roll, would maybe like high control forces near center.
Positive dihedral, never departed for full rudder, had to watch airspeed.
Must improve mode change PR 5
Too easy to put in pitch inputs.

Run 54 Hover Gas Fan Pilot E

Sluggish in roll.
Don't like the yaw coupling.
Rock steady in hover.
Overshoot in yaw.
Yaw rate higher than I need.
Need better stick centering.
Excellent in hover compared with Harrier.

Run 55 | Hover | Gas Fan | Pilot D

Stick is underdamped in pitch.
Force gradients & travel good.
PR 3 1/2 hover, throttle too sensitive
PR 4 height control in hover
PR 4 for hover turns
PR 4 for lateral translations because of negative directional stability
PR 2 for speed control with vector
PR 4 speed control with pitch
PR 3 for spot hover
PR 4 overall, needs directional stability, lower throttle sensitivity
(60 Knots)
Easy to couple pitch for roll input
Mode change no good
Turn coordination good

Run 56,57,58 | 60 Knots | Gas Fan | Pilot D

Tend to make A/C overbank.
Speed coupling with power.
Good touchdown accuracy at 60 knots.
60 knots very important operationally.
Really have to work to find problems.
Must change control law switching.
Got a tuck under with power change.

Run 59 | 60 Knots | Gas Fan | Pilot E

Good turn coordination at 60 knots 60° bank
12° right bank for full rudder
Have to take bank out when I remove rudder

Run 60 | 60,90,120 Knots | Gas Fan | Pilot E

Doesn't hold exact pitch attitude where I let go of stick.
Pitch damping seems low at 160 knots
Lateral stick free oscillation at 180 knots
150 knots exhibited anhedral
Don't like negative dihedral at 150 knots
Attitude command undershoots.
Sideforce weak at 60 knots.

Run 61,62 | Conversion | Gas Fan | Pilot E

Crashed!

Run 63 | Conversion | Gas Fan | Pilot E

Can't do good conversion due to Redifon travel.

Run 64,65 Conversion Gas Fan Pilot D

Mode change no problem if attitude is right.
Need more practice to develop conversion technique.
Outbound no problem, inbound little difficult

Run 66 Hover Gas Fan Pilot B

Vector lever too crude
PR3 hover overall

Run 67 60 Knots Gas Fan Pilot B

Handles quite well
PR3, same comments as hover. Any problems are associated with the visual scene.

Run 68 90 Knots Gas Fan Pilot B

No different than 60 knots. PR3

Run 69 120 Knots Gas Fan Pilot B

Detent on vector not good enough
More natural at 120 knots
PR2

Runs 70, 71 150 Knots Gas Fan Pilot B

Cant maneuver on map at 150 knots.

Run 72 150 Knots Gas Fan Pilot B

Hit mirror!
Speed control poor, altitude control bad
PR5 due to tight maneuvering task

Runs 73, 74 Conversion Gas Fan Pilot B

Pretty rough finding way around
Controllability good
No doubts we can do the job.
Just another airplane at 300 knots.

Run 75 200 Knots Gas Fan Pilot B

Not an unreasonable speed
PR2-3 but don't like trim rate
Went down to 80 knots, recoverable

Runs 76, 77 STO, Short Land Gas Fan Pilot B

Need brakes, throttle and vector stops

Runs 78, 79 Hover Shaft Fan Pilot B

Working harder in height control.
Miss engine noise cueing from height control.
Very little difference in flyability.

Runs 80, 81 60-150 Knots Shaft Fan Pilot B

No different than gas airplane
Power response no problem at 60 knots

Run 82 VTO & Abort Shaft Fan Pilot B #3 Fail at 100 Feet

(#3 fail at 100 ft.)
Makes task more difficult

Run 83 VTO & Abort Shaft Fan Pilot B #1 Fail at 60 knots

(#1 fail 60 knots abort)

Using rudder to get a better look at things.
Reasonably controllable.
Seemed to be more critical than #3 fail.

Runs 84, 85, 86 VTO, Conv. Land Shaft Fan Pilot B

Run 87 VTO, V Land Shaft Fan Pilot B Pitch CAS Fail at 100 feet

(Pitch CAS fail at 100 ft, abort)
Work load higher but can land safely.

Run 88 VTO, V Land Shaft Fan Pilot B Roll CAS Fail at 100 feet

Work load higher down below 30 ft.
More work load than pitch fail

Runs 89, 90 VTO, V Land Shaft Fan Pilot B Yaw CAS Fail at 100 feet

(Yaw CAS fail at 100 Ft. abort)
No trouble, more subtle failure

Runs 91, 92, 93 Hover Shaft Fan Pilot B 15 Knot Crosswind, Turbulence

(15 Knot Crosswind)
Can hold with either bank or sideforce
Difficult to set down on one wheel

Runs 94, 95 Hover Shaft Fan Pilot B 15 Knot Crosswind and Turbulence

Not too bad but high workload

Runs 96, 97 Hover Shaft Fan Pilot B 15 Knot Headwind and Turbulence

No Problem
Turbulence makes you work harder

Runs 98, 99 VTO, V Land on Ship Shaft Fan Pilot B

Runs 100, 101 VTO and V Land on Ship Shaft Fan Pilot B

Runs 102, 103, 104 VTO and V Land on Ship with Motion Shaft Fan Pilot B

Runs 105, 106, 107 VTO, Short Land Gas Fan Pilot D Crosswind and Turbulence

Pitch coupling with nozzle in hover.
Need better detent at 85°.
Sluggish in roll at 350 knots.
Trim rate too slow.
Reconvert at 300 knots. Get initial climb.
Landing at 120 knots powered lift with 15 knots wind & turbulence, worked O.K.

Run 108 Hover Gas Fan Pilot D Height Damper Failed

(Height damper fail)
Overcontrol when coming down from 100 feet.
Used to no height damping on Harrier, but work load is higher.

Run 109 VTO, V Land Gas Fan Pilot E

Run 110, 111, 112, 113 STO, V Land Gas Fan Pilot E

Had problems with landing gear model on runway.

Run 114 VTO, Conv. Land Gas Fan Pilot E

Need to use rudder to coordinate turn at 300 knots.
Trim rate too slow at 300 knots.

Run 115 VTO, V Land Gas Fan Pilot B

Very little pitching moment with flaps.

Run 116 STO, V Land Gas Fan Pilot B

(θ_J = 50°)

Runs 117, 118 STO, V Land Gas Fan Pilot B

(θ_J = 40°)
Moment disturbances during conversion not bad.

Runs 119, 120 STO, Conv. Land Gas Fan Pilot B

(θ_J = 30°)

Run 121 VTO, V Land Gas Fan Pilot B Max Performance Conversion

<u>Run 122 Hover Gas Fan Pilot B</u>

Get a lot of pitch down with power when on the landing gear.
(Add 15 knot headwind and turbulence)
Should trim with either vector or pitch because if hold stick force it increases workload.
PR 1 for no wind
PR 4 for wind and turbulence

<u>Run 123 Hover Gas Fan Pilot B CAS Off</u>

Very demanding task
PR 7
Can load safely but can not make precise landing.

<u>Run 124 Hover Gas Fan Pilot B CAS off, no Height Damper</u>

Really adds to workload PR 7
Might not be safe

<u>Runs 125, 126, 127 Hover Gas Fan Pilot B CAS Off, Height Damper Off, No TRM Preset</u>

Seems to be working harder in pitch now.
Roll seems easier to handle, PR 7.

<u>Run 128 Hover Gas Fan Pilot B CAS Off, Height Damper Off</u>

Pitch seems better balanced, roll more difficult PR 7.

<u>Run 129 Hover Gas Fan Pilot B CAS Off, Damper Off, 2 X TRM Lags</u>

Terrible, can't translate much at all
Can not safely land the airplane

<u>Run 130 VTO, V Land Gas Fan Pilot B</u>

PR 2

<u>Run 131 VTO, V Land Gas Fan Pilot B Yaw CAS Off</u>

Did not notice yaw CAS off at high speed
Yaw CAS off disturbing at 40 knots
PR 3

Run 132 VTO, V Land Gas Fan Pilot B Roll CAS Off

PR 4

Runs 133, 134, 135 VTO, V Land Gas Fan Pilot B Pitch CAS off

An untrained pilot would crash during conversion
Strong pitch down as first move vector lever
Pitch down through conversion
Pitched up during reconversion, crashed!
PR 6

Run 136 30 Knots Gas Fan Pilot B

Run 137 Special Test Gas Fan Pilot B Fwd fan vector limit 45°

Pitch up in conversion, down later
Only slightly more transient during outbound conversion.

Run 138 Special Test Gas Fan Pilot B Fwd fan vector limit 60°

Same, but was worst than last time
Degradation now is more than annoying, it is worrysome degrades rating by 3.
Pitch crispness seems low at 135 knots.

Run 139 VTO, V Land Gas Fan Pilot B #1 Fail in Cruise

Increases workload a bit but not as bad as CAS failure PR4

Run 140 Hover Gas Fan Pilot A

No problem hovering
Pitch reference poor
Must look at A/S indicator to determine translation

(Pitch CAS off)
Pitch time constant seems slow but not real bad

(Roll CAS Off)
Awfully sensitive in roll CAS off.
Almost seems like acceleration continues after I remove input.

(Yaw CAS Off)
No big problems
Slight bias in the pedals

(Roll and Yaw Off)

(All off)
Roll is the least comfortable
Could land it though

(CAS on wind and turbulence)
Need more visual reference

Run 141 Hover Gas Fan Pilot A

PR 1 CAS on, no wind
PR 2 hover CAS on wind
PR 5 Pitch CAS off
PR 6 8 roll CAS off
PR 4 yaw CAS off

Run 142 Hover Gas Fan Pilot A CAS off, Crosswind and Turbulence

Don't think turbulence is realistic
Visual cues are bad
PR 6 pitch CAS off
PR 6-7 roll CAS off, Don't like it.
PR 3 yaw CAS off, no big problem

Run 143, 144 Hover Gas Fan Pilot A

(Hover over VTOL port)

Run 145 60 Knots Gas Fan Pilot A

Fly nicely at 60 knots!
Pitch CAS off, lots of lag, need more down trim, sluggish, very poor
Add wind & turbulence, too much work

(Roll CAS off)
Feels better than roll CAS off in hover.
Might be realistically flyable in real life
Yaw CAS off better than pitch and roll

Run 146 90 Knots Gas Fan Pilot A

Real good

(Add wind & turbulence)
Lot of yaw activity +2° sideslip.
(Remove wind and turbulence)
Pitch CAS off not as bad as at 60 knots but still sluggish in pitch.
Roll CAS off feels pretty good, no problem.
Getting aerodynamic damping.
(Add wind and turbulence)
Yaw CAS off no problem, some roll oscillations.

sluggish in pitch
(Pitch CAS off)
Can go out of contol

Runs 147, 148 120 Knots Gas Fan Pilot A

Pitch CAS off not comfortable, sloppy
Roll CAS off no problem.
Yaw CAS off no problem.
150 knots brought up gear & flaps make no difference
Pitch still sluggish at 150 knots
Pitch CAS off wind and turbulence, lacks solid pitch feel. Not real bad.
Roll CAS off no problem.

Runs 147, 148 (Cont'd)

Yaw CAS off feels pretty good.
Little uncomfortable in turbulence with yaw CAS on.
Pitch 4-5 CAS on - needs improvements
Pitch 6-7 CAS off

Run 149 Conversion Gas Fan Pilot A

No problem except for nose down at 0° θ_J, PR 2-3

Run 150 200 Knots Gas Fan Pilot A

Roll really heavy
Pitch CAS off not bad at 200 knots
Yaw CAS off is O.K.
(300 knots)
Roll way too sharp

Run 151 300 Knots Gas Fan Pilot A

Pitch CAS off, not too bad PR 4
PR 5 harsh lateral with roll CAS off, yaw OK

Run 152 VTO, V Land Gas Fan Pilot A

PR 2-3 no problem

Run 153 STO, V Land Gas Fan Pilot A

50° nozzles work real good
tend to over rotate at 45° nozzles

Runs 154, 155 STO, Short Land Gas Fan Pilot A

(Weight 30,000 lb)

$\theta_J = 50°$
Flew off at 55 knots by itself
Rotated by itself
Control α with vector
101.5% N_G 50° θ_J fly itself off at 40 knots
Approach $N_G = 95\%$, $\alpha = 5°$, V = 88 knots

$\theta_J = 70$, $\alpha = 5°$, 80 knots, $N_G = 96\%$
Pitch dependent on nozzle angle

Runs 156, 157, 158 STO Conv. Land Gas Fan Pilot A
(30,000 Weight)
$\theta_J = 55$ works best for STO
8° α at 168 knots

Runs 159, 160 Conv. TO, Conv. Land Gas Fan Pilot A

Conventional landing no problem but tended to pitch up in flare.
Nose wheel lift off is terrible!
Flaps up better than flaps down for takeoff

Runs 161 - 169 Conv. TO, Conv. Land Gas Fan Pilot A

(Fixed base)

Runs 170, 171 VTO, V Land Gas Fan Pilot A

No big deal
#1 fail Convert - reconvert V land.

Runs 172, 173 Hover Shaft Fan Pilot A

Pitch CAS off doesn't feel bad at all
Roll CAS off very uncomfortable
No damping, little more comfortable with CAS off than gas fan

Run 174 Hover Shaft Fan Pilot A Wind & Turbulence CAS Off

Pitch CAS off better than gas fan
Yaw CAS off no problem
Height damper off can't tell much difference.
Not as positive as I like but not too bad
PR 5 for no wind

Run 175 60 Knots Shaft Fan Pilot A

Computer Crash!

Run 176 60 Knots Shaft Fan Pilot A

(Motion off)
Shaft fan has more tendency to pitch up than gas fan

Runs 177-185 STO, Short Land Shaft Fan Pilot A
(Motion Off)

Run 186 Special Test Shaft Fan Pilot A 15° Sec Vectoring Rate

Runs 187-190 Special Test Shaft Fan Pilot A 10°/sec vectoring rate

Begin to see a little problem
Seems too slow, way too slow

Run 191 Special Test Shaft Fan Pilot A 15°/sec vectoring rate

Not too bad, but still too slow.

APPENDIX B

COMPUTED TIME HISTORIES

FOR

SIMULATOR CHECKOUT

Development of the mathematical model on which the simulation experiment was based involved an extensive study and analysis effort. First, the basic control law concept was established and the flight control system was formulated in three degree-of-freedom block diagram form. Simplified three degree-of-freedom linearized mathematical models were then defined for computer analyses using a root locus digital program. System gains were then selected based on closed loop stability and open and closed loop response characteristics. Responses were initially checked using linearized three degree-of-freedom program written in the CSMP computer language.

Stability and response analyses were divided into hover, transition and aerodynamic flight regions. Gain schedules were kept to a minimum. Various applicable design guidelines as provided in AGARD R-577 and MIL-F-83300 were used to aid in the selection of system gains. During the system design effort, basic programming of a six degree-of-freedom mathematical model was performed. As the control laws and system gains became finalized, the six degree-of-freedom digital program was completed and a series of sample time histories prepared. The FSAA program was then checked by comparison of the simulator computer output with the sample time histories generated at MCAIR.

Output listings of two sample check cases are presented in this appendix. The first is for an input of 10% of roll control capability in the shaft coupled version and the second is for the same input in the gas coupled aircraft. Definition of the output terms is provided in the following listing.

NPER	Fan speed (percent) (Shaft-coupled system)
PEDAL	Rudder pedal input (inches) (Gas-coupled system)
PEDALP	Powered lift yaw command (volts) (Gas-coupled system)
PDEG	Airplane roll rate. Inertial velocity about x body axis (degrees/second)
PHI	Airplane roll angle (degrees) (Gas-coupled system)
PHIDEG	Airplane roll angle (degrees) (Shaft-coupled system)
PITCH	Pitch stick input (inches) (Shaft-coupled system)
POWLV	Power lever position (percent) (Shaft-coupled system)
PSI	Airplane heading angle (degrees) (Gas-coupled system)
PSIDEG	Airplane heading angle (degrees) (Shaft-coupled system)
QDEG	Airplane pitch rate. Inertial velocity about y body axis (degrees/second)
RDEG	Airplane yaw rate. Inertial velocity about z body axis (degrees/second)
RNG	Engine speed commanded by master power lever and height damper (percent) (Gas-coupled system)
ROLLSK	Lateral stick input (inches) (Shaft-coupled system)
RUDDER	Rudder deflection (degrees) (Gas-coupled system)
STAB	Stabilator deflection (degrees) (Gas-coupled system)
SIG1,2,3	TRM port opening on left, right and forward fans, respectively (degrees) (Gas-coupled system)
STLAT	Lateral stick input (inches) (Gas-coupled system)
STLATP	Powered lift roll command (volts) (Gas-coupled system)
STLON	Pitch stick input (inches) (Gas-coupled system)
STLONP	Powered lift pitch command (volts) (Gas-coupled system)
THA	Airplane pitch angle (degrees) (Gas-coupled system)
THETAJ	Command thrust vector angle (degrees)
THETDG	Airplane pitch angle (degrees) (Shaft-coupled system)

COMPUTER OUTPUT IDENTIFICATION

AILERON	Left aileron deflection (degrees) (Gas-coupled system)
ALPHA	Angle of attack (degrees)
BETA	Sideslip angle (degrees)
BETA1,2,3	Fan blade pitch angle (degrees) (Shaft-coupled system)
DELIPS	Rudder input (inches) (Shaft-coupled system)
FG1,2,3	Gross thrust of left, right and forward fan, respectively (pounds)
FGU1,2,3	Gross uninstalled thrust on left, right and forward fan, respectively (pounds)
FT1,2,3	Tip turbine residual thrust developed by left, right and forward fans, respectively (pounds) (Gas-coupled fans only)
FY1,3	Resultant side directed thrust of left and forward fans, respectively (pounds)
FZ1,3	Resultant vertical thrust of left and forward fans, respectively (pounds)
GAM1,2,3 GAMA1,2,3	Yaw vane angles for left, right and forward fans, respectively (degrees)
H	Altitude (feet)
HDØT	Time rate of altitude change (feet/second)
HPE	Total horsepower generated by engines in shaft-coupled system (horsepower)
HP1,2,3	Tip turbine gas horsepower supplied to left, right and forward gas-coupled fans, respectively (horsepower)
LAERO MAERO NAERO	Aerodynamic moments (excluding ram drag effects) about body x, y, z axes (foot pounds)
LB MB NB	Total external moments exerted on the vehicle about body x, y, z axes (foot pounds)
LF MF NF	Moments produced by fan forces about x, y and z body axes (foot pounds)
LRAM MRAM NRAM	Moments produced by ram drag forces about x, y and z body axes (foot pounds)

THV1,2,3	ETaC valve angle on left, right and forward fans (degrees) (Gas-coupled system)
TIME	Independent variable. Control commands input at one second (seconds)
UE,VE,WE	Airplane CG velocity components with respect to the earth-fixed coordinate system (feet/second)
VGDAMF	Altitude rate damping for power lever control (volts) (Shaft-coupled system)
VT	Airplane velocity with respect to air (feet/second)
WF1	Fuel flow rate to right engine (pounds/hour) (Shaft-coupled system)
X,Y,H	Aircraft CG position with respect to earth-fixed coordinate system (feet)
XAERO YAERO ZAERO	Aerodynamic forces (excluding ram drag effects) along body x, y, z axes (pounds)
XB YB ZB	Total forces exerted on the airplane along the x, y, z body axes (pounds)
XF YF ZF	Total fan and nozzle thrust forces along the x, y, z body axes (pounds)
XRAM YRAM ZRAM	Ram drag force components along the x, y, z body axes (pounds)

Shaft Coupled System Hover Time History
Step Input Of Roll Control

TIME	POWIV	PITCH	ROLLSK	DELIPS	VGDAMF	FSIDEG	HCCT	FHIDEG	THETDG
.1000E+00	.7531E+00	0.	0.	0.	.1169E-02	0.	.2406E-01	0.	-.1848E-01
.2000E+00	.7531E+00	0.	0.	0.	.2390E-02	0.	.3983E-01	0.	-.6827E-01
.3000E+00	.7531E+00	0.	0.	0.	.3281E-02	0.	.5711E-01	0.	-.1397E+00
.4000E+00	.7531E+00	0.	0.	0.	.3910E-02	0.	.6517E-01	0.	-.2242E+00
.5000E+00	.7531E+00	0.	0.	0.	.4314E-02	0.	.7266E-01	0.	-.3143E+00
.6000E+00	.7531E+00	0.	0.	0.	.4545E-02	0.	.7576E-01	0.	-.4039E+00
.7000E+00	.7531E+00	0.	0.	0.	.4679E-02	0.	.7634E-01	0.	-.4860E+00
.8000E+00	.7531E+00	0.	0.	0.	.4780E-02	0.	.7967E-01	0.	-.5629E+00
.9000E+00	.7531E+00	0.	0.	0.	.4871E-02	0.	.8144E-01	0.	-.6261E+00
.1000E+01	.7531E+00	0.	.2857E+00	0.	.4934E-02	0.	.8223E-01	0.	-.6758E+00
.1100E+01	.7531E+00	0.	.2857E+00	0.	.4961E-02	.2901E-02	.8271E-01	.6768E-01	-.7116E+00
.1200E+01	.7531E+00	0.	.2857E+00	0.	.4932E-02	.1178E-01	.8220E-01	.2964E+00	-.7334E+00
.1300E+01	.7531E+00	0.	.2857E+00	0.	.4901E-02	.2332E-01	.8160E-01	.6391E+00	-.7416E+00
.1400E+01	.7531E+00	0.	.2857E+00	0.	.4881E-02	.3482E-01	.8139E-01	.1048E+01	-.7379E+00
.1500E+01	.7531E+00	0.	.2857E+00	0.	.4857E-02	.4457E-01	.8080E-01	.1467E+01	-.7230E+00
.1600E+01	.7531E+00	0.	.2857E+00	0.	.4797E-02	.5157E-01	.7996E-01	.1929E+01	-.6987E+00
.1700E+01	.7531E+00	0.	.2857E+00	0.	.4693E-02	.5531E-01	.7779E-01	.2355E+01	-.6666E+00
.1800E+01	.7531E+00	0.	.2857E+00	0.	.4561E-02	.5563E-01	.7602E-01	.2753E+01	-.6285E+00
.1900E+01	.7531E+00	0.	.2857E+00	0.	.4432E-02	.5259E-01	.7347E-01	.3114E+01	-.5856E+00
.2000E+01	.7531E+00	0.	.2857E+00	0.	.4322E-02	.4640E-01	.7203E-01	.3437E+01	-.5402E+00
.2100E+01	.7531E+00	0.	.2857E+00	0.	.4224E-02	.3732E-01	.7009E-01	.3719E+01	-.4931E+00
.2200E+01	.7531E+00	0.	.2857E+00	0.	.4130E-02	.2565E-01	.6864E-01	.3963E+01	-.4456E+00
.2300E+01	.7531E+00	0.	.2857E+00	0.	.4042E-02	.1170E-01	.6710E-01	.4170E+01	-.3993E+00
.2400E+01	.7531E+00	0.	.2857E+00	0.	.3975E-02	-.4235E-02	.6626E-01	.4344E+01	-.3547E+00
.2500E+01	.7531E+00	0.	.2857E+00	0.	.3946E-02	-.2187E-01	.6575E-01	.4489E+01	-.3125E+00
.2600E+01	.7531E+00	0.	.2857E+00	0.	.3954E-02	-.4094E-01	.6590E-01	.4602E+01	-.2735E+00
.2700E+01	.7531E+00	0.	.2857E+00	0.	.3985E-02	-.6123E-01	.6659E-01	.4707E+01	-.2379E+00
.2800E+01	.7531E+00	0.	.2857E+00	0.	.4026E-02	-.8251E-01	.6711E-01	.4787E+01	-.2061E+00
.2900E+01	.7531E+00	0.	.2857E+00	0.	.4076E-02	-.1046E+00	.6813E-01	.4853E+01	-.1780E+00
.3000E+01	.7531E+00	0.	.2857E+00	0.	.4142E-02	-.1274E+00	.6904E-01	.4907E+01	-.1537E+00
.3100E+01	.7531E+00	0.	.2857E+00	0.	.4229E-02	-.1506E+00	.7081E-01	.4952E+01	-.1333E+00
.3200E+01	.7531E+00	0.	.2857E+00	0.	.4330E-02	-.1742E+00	.7217E-01	.4989E+01	-.1157E+00
.3300E+01	.7531E+00	0.	.2857E+00	0.	.4435E-02	-.1980E+00	.7425E-01	.5021E+01	-.1015E+00
.3400E+01	.7531E+00	0.	.2857E+00	0.	.4534E-02	-.2220E+00	.7557E-01	.5049E+01	-.9104E-01
.3500E+01	.7531E+00	0.	.2857E+00	0.	.4630E-02	-.2459E+00	.7750E-01	.5073E+01	-.8106E-01
.3600E+01	.7531E+00	0.	.2857E+00	0.	.4730E-02	-.2699E+00	.7864E-01	.5095E+01	-.7416E-01
.3700E+01	.7531E+00	0.	.2857E+00	0.	.4836E-02	-.2936E+00	.8095E-01	.5116E+01	-.6901E-01
.3800E+01	.7531E+00	0.	.2857E+00	0.	.4942E-02	-.3171E+00	.8237E-01	.5136E+01	-.6526E-01
.3900E+01	.7531E+00	0.	.2857E+00	0.	.5042E-02	-.3404E+00	.8435E-01	.5155E+01	-.6261E-01
.4000E+01	.7531E+00	0.	.2857E+00	0.	.5134E-02	-.3632E+00	.8556E-01	.5173E+01	-.6173E-01
.4100E+01	.7531E+00	0.	.2857E+00	0.	.5220E-02	-.3857E+00	.8728E-01	.5191E+01	-.5954E-01
.4200E+01	.7531E+00	0.	.2857E+00	0.	.5306E-02	-.4077E+00	.8844E-01	.5208E+01	-.5866E-01
.4300E+01	.7531E+00	0.	.2857E+00	0.	.5394E-02	-.4292E+00	.9019E-01	.5225E+01	-.5797E-01
.4400E+01	.7531E+00	0.	.2857E+00	0.	.5479E-02	-.4501E+00	.9131E-01	.5242E+01	-.5733E-01
.4500E+01	.7531E+00	0.	.2857E+00	0.	.5557E-02	-.4705E+00	.9286E-01	.5258E+01	-.5664E-01
.4600E+01	.7531E+00	0.	.2857E+00	0.	.5628E-02	-.4903E+00	.9360E-01	.5279E+01	-.5581E-01
.4700E+01	.7531E+00	0.	.2857E+00	0.	.5696E-02	-.5094E+00	.9516E-01	.5290E+01	-.5480E-01
.4800E+01	.7531E+00	0.	.2857E+00	0.	.5765E-02	-.5279E+00	.9606E-01	.5305E+01	-.5357E-01
.4900E+01	.7531E+00	0.	.2857E+00	0.	.5833E-02	-.5458E+00	.9744E-01	.5320E+01	-.5213E-01
.5000E+01	.7531E+00	0.	.2857E+00	0.	.5898E-02	-.5631E+00	.9830E-01	.5335E+01	-.5046E-01
.5100E+01	.7531E+00	0.	.2857E+00	0.	.5958E-02	-.5797E+00	.9949E-01	.5348E+01	-.4860E-01
.5200E+01	.7531E+00	0.	.2857E+00	0.	.6014E-02	-.5956E+00	.1002E+00	.5362E+01	-.4658E-01
.5300E+01	.7531E+00	0.	.2857E+00	0.	.6068E-02	-.6109E+00	.1013E+00	.5374E+01	-.4442E-01
.5400E+01	.7531E+00	0.	.2857E+00	0.	.6122E-02	-.6256E+00	.1020E+00	.5387E+01	-.4216E-01
.5500E+01	.7531E+00	0.	.2857E+00	0.	.6176E-02	-.6397E+00	.1031E+00	.5399E+01	-.3984E-01
.5600E+01	.7531E+00	0.	.2857E+00	0.	.6227E-02	-.6532E+00	.1036E+00	.5410E+01	-.3750E-01
.5700E+01	.7531E+00	0.	.2857E+00	0.	.6274E-02	-.6661E+00	.1047E+00	.5420E+01	-.3517E-01
.5800E+01	.7531E+00	0.	.2857E+00	0.	.6319E-02	-.6785E+00	.1053E+00	.5431E+01	-.3288E-01
.5900E+01	.7531E+00	0.	.2857E+00	0.	.6362E-02	-.6903E+00	.1062E+00	.5441E+01	-.3066E-01
.6000E+01	.7531E+00	0.	.2857E+00	0.	.6406E-02	-.7016E+00	.1066E+00	.5450E+01	-.2852E-01

Shaft Coupled System Hover Time History (Continued)

Step Input Of Roll Control

.6100E+01	.7531E+00	0.	.2857E+00	0.	.6449E-02	-.7123E+00	.1076E+00	.5459E+01	-.2650E-01
.6200E+01	.7531E+00	0.	.2857E+00	0.	.6489E-02	-.7226E+00	.1082E+00	.5467E+01	-.2459E-01
.6300E+01	.7531E+00	0.	.2857E+00	0.	.6527E-02	-.7324E+00	.1089E+00	.5475E+01	-.2282E-01
.6400E+01	.7531E+00	0.	.2857E+00	0.	.6562E-02	-.7417E+00	.1094E+00	.5483E+01	-.2116E-01
.6500E+01	.7531E+00	0.	.2857E+00	0.	.6598E-02	-.7507E+00	.1101E+00	.5490E+01	-.1966E-01
.6600E+01	.7531E+00	0.	.2857E+00	0.	.6633E-02	-.7592E+00	.1106E+00	.5497E+01	-.1831E-01
.6700E+01	.7531E+00	0.	.2857E+00	0.	.6667E-02	-.7673E+00	.1112E+00	.5504E+01	-.1707E-01
.6800E+01	.7531E+00	0.	.2857E+00	0.	.6698E-02	-.7750E+00	.1116E+00	.5511E+01	-.1595E-01
.6900E+01	.7531E+00	0.	.2857E+00	0.	.6728E-02	-.7824E+00	.1122E+00	.5517E+01	-.1494E-01
.7000E+01	.7531E+00	0.	.2857E+00	0.	.6756E-02	-.7894E+00	.1126E+00	.5522E+01	-.1404E-01
.7100E+01	.7531E+00	0.	.2857E+00	0.	.6785E-02	-.7961E+00	.1132E+00	.5528E+01	-.1324E-01
.7200E+01	.7531E+00	0.	.2857E+00	0.	.6812E-02	-.8025E+00	.1135E+00	.5533E+01	-.1251E-01
.7300E+01	.7531E+00	0.	.2857E+00	0.	.6839E-02	-.8086E+00	.1141E+00	.5538E+01	-.1187E-01
.7400E+01	.7531E+00	0.	.2857E+00	0.	.6863E-02	-.8144E+00	.1144E+00	.5543E+01	-.1128E-01
.7500E+01	.7531E+00	0.	.2857E+00	0.	.6887E-02	-.8200E+00	.1149E+00	.5548E+01	-.1075E-01
.7600E+01	.7531E+00	0.	.2857E+00	0.	.6909E-02	-.8252E+00	.1152E+00	.5552E+01	-.1027E-01
.7700E+01	.7531E+00	0.	.2857E+00	0.	.6931E-02	-.8303E+00	.1156E+00	.5557E+01	-.9831E-02
.7800E+01	.7531E+00	0.	.2857E+00	0.	.6953E-02	-.8351E+00	.1159E+00	.5561E+01	-.9421E-02
.7900E+01	.7531E+00	0.	.2857E+00	0.	.6973E-02	-.8397E+00	.1163E+00	.5565E+01	-.9038E-02
.8000E+01	.7531E+00	0.	.2857E+00	0.	.6992E-02	-.8440E+00	.1165E+00	.5568E+01	-.8677E-02
.8100E+01	.7531E+00	0.	.2857E+00	0.	.7011E-02	-.8482E+00	.1169E+00	.5572E+01	-.8333E-02
.8200E+01	.7531E+00	0.	.2857E+00	0.	.7028E-02	-.8522E+00	.1171E+00	.5575E+01	-.8005E-02
.8300E+01	.7531E+00	0.	.2857E+00	0.	.7046E-02	-.8560E+00	.1175E+00	.5578E+01	-.7688E-02
.8400E+01	.7531E+00	0.	.2857E+00	0.	.7062E-02	-.8596E+00	.1177E+00	.5582E+01	-.7381E-02
.8500E+01	.7531E+00	0.	.2857E+00	0.	.7078E-02	-.8631E+00	.1180E+00	.5585E+01	-.7083E-02
.8600E+01	.7531E+00	0.	.2857E+00	0.	.7093E-02	-.8664E+00	.1182E+00	.5587E+01	-.6794E-02
.8700E+01	.7531E+00	0.	.2857E+00	0.	.7107E-02	-.8696E+00	.1185E+00	.5590E+01	-.6512E-02
.8800E+01	.7531E+00	0.	.2857E+00	0.	.7121E-02	-.8726E+00	.1187E+00	.5593E+01	-.6237E-02
.8900E+01	.7531E+00	0.	.2857E+00	0.	.7134E-02	-.8755E+00	.1189E+00	.5595E+01	-.5970E-02
.9000E+01	.7531E+00	0.	.2857E+00	0.	.7147E-02	-.8783E+00	.1191E+00	.5598E+01	-.5711E-02
.9100E+01	.7531E+00	0.	.2857E+00	0.	.7159E-02	-.8809E+00	.1194E+00	.5600E+01	-.5460E-02
.9200E+01	.7531E+00	0.	.2857E+00	0.	.7171E-02	-.8835E+00	.1195E+00	.5602E+01	-.5217E-02
.9300E+01	.7531E+00	0.	.2857E+00	0.	.7182E-02	-.8859E+00	.1197E+00	.5604E+01	-.4983E-02
.9400E+01	.7531E+00	0.	.2857E+00	0.	.7192E-02	-.8882E+00	.1199E+00	.5606E+01	-.4758E-02
.9500E+01	.7531E+00	0.	.2857E+00	0.	.7203E-02	-.8904E+00	.1201E+00	.5608E+01	-.4542E-02
.9600E+01	.7531E+00	0.	.2857E+00	0.	.7213E-02	-.8925E+00	.1202E+00	.5610E+01	-.4336E-02
.9700E+01	.7531E+00	0.	.2857E+00	0.	.7222E-02	-.8945E+00	.1204E+00	.5612E+01	-.4139E-02
.9800E+01	.7531E+00	0.	.2857E+00	0.	.7231E-02	-.8965E+00	.1205E+00	.5613E+01	-.3952E-02
.9900E+01	.7531E+00	0.	.2857E+00	0.	.7239E-02	-.8983E+00	.1207E+00	.5615E+01	-.3775E-02
.9980E+01	.7531E+00	0.	.2857E+00	0.	.7246E-02	-.8997E+00	.1208E+00	.5616E+01	-.3639E-02

TIME	QDEG	PDEG	RDEG	UE	VE	WE	X	Y	H
.1000E+00	-.4186E+00	0.	0.	.2274E-02	0.	-.2406E-01	.2093E+08	0.	.5000E+02
.2000E+00	-.6628E+00	0.	0.	.5456E-02	0.	-.4320E-01	.2093E+08	0.	.5000E+02
.3000E+00	-.8173E+00	0.	0.	.1200E-01	0.	-.5714E-01	.2093E+08	0.	.5001E+02
.4000E+00	-.8939E+00	0.	0.	.2285E-01	0.	-.6688E-01	.2093E+08	0.	.5002E+02
.5000E+00	-.9052E+00	0.	0.	.3852E-01	0.	-.7307E-01	.2093E+08	0.	.5002E+02
.6000E+00	-.8637E+00	0.	0.	.5913E-01	0.	-.7671E-01	.2093E+08	0.	.5003E+02
.7000E+00	-.7615E+00	0.	0.	.8450E-01	0.	-.7907E-01	.2093E+08	0.	.5004E+02
.8000E+00	-.6699E+00	0.	0.	.1142E+00	0.	-.8112E-01	.2093E+08	0.	.5005E+02
.9000E+00	-.5393E+00	0.	0.	.1475E+00	0.	-.8306E-01	.2093E+08	0.	.5005E+02
.1000E+01	-.3993E+00	.1555E+00	.6913E-02	.1839E+00	0.	-.8453E-01	.2093E+08	0.	.5006E+02
.1100E+01	-.2594E+00	.1859E+01	.7595E-01	.2224E+00	.8665E-03	-.8548E-01	.2093E+08	.4432E-04	.5007E+02
.1200E+01	-.1223E+00	.3164E+01	.1128E+00	.2624E+00	.9708E-02	-.8550E-01	.2093E+08	.7066E-03	.5008E+02
.1300E+01	.5504E-02	.3953E+01	.1180E+00	.3029E+00	.3435E-01	-.8591E-01	.2093E+08	.3372E-02	.5009E+02
.1400E+01	.1202E+00	.4345E+01	.1022E+00	.3433E+00	.7841E-01	-.8717E-01	.2093E+08	.9917E-02	.5010E+02
.1500E+01	.2192E+00	.4443E+01	.7320E-01	.3830E+00	.1439E+00	-.8941E-01	.2093E+08	.2244E-01	.5010E+02
.1600E+01	.3013E+00	.4330E+01	.3697E-01	.4214E+00	.2314E+00	-.9265E-01	.2093E+08	.4313E-01	.5011E+02
.1700E+01	.3660E+00	.4075E+01	-.2076E-02	.4579E+00	.3393E+00	-.9715E-01	.2093E+08	.7409E-01	.5012E+02
.1800E+01	.4137E+00	.3733E+01	-.4095E-01	.4922E+00	.4654E+00	-.1034E+00	.2093E+08	.1172E+00	.5013E+02
.1900E+01	.4455E+00	.3345E+01	-.7765E-01	.5240E+00	.6071E+00	-.1120E+00	.2093E+08	.1741E+00	.5013E+02
.2000E+01	.4626E+00	.2942E+01	-.1110E+00	.5530E+00	.7612E+00	-.1228E+00	.2093E+08	.2462E+00	.5014E+02
.2100E+01	.4663E+00	.2547E+01	-.1404E+00	.5793E+00	.9250E+00	-.1354E+00	.2093E+08	.3344E+00	.5015E+02

Shaft Coupled System Hover Time History (Continued)
Step Input Of Roll Control

.2200E+01	.4584E+00	.2174E+01	-.1656E+00	.6026E+00	.1095E+01	-.1493E+00	.2093E+08	.4396E+00	.5016E+02
.2300E+01	.4408E+00	.1834E+01	-.1866E+00	.6231E+00	.1270E+01	-.1642E+00	.2093E+08	.5622E+00	.5016E+02
.2400E+01	.4154E+00	.1530E+01	-.2039E+00	.6407E+00	.1447E+01	-.1802E+00	.2093E+08	.7025E+00	.5017E+02
.2500E+01	.3843E+00	.1266E+01	-.2177E+00	.6558E+00	.1624E+01	-.1970E+00	.2093E+08	.8606E+00	.5018E+02
.2600E+01	.3492E+00	.1041E+01	-.2285E+00	.6683E+00	.1799E+01	-.2144E+00	.2093E+08	.1036E+01	.5018E+02
.2700E+01	.3115E+00	.8522E+00	-.2366E+00	.6786E+00	.1972E+01	-.2319E+00	.2093E+08	.1229E+01	.5019E+02
.2800E+01	.2723E+00	.6968E+00	-.2425E+00	.6869E+00	.2140E+01	-.2492E+00	.2093E+08	.1440E+01	.5020E+02
.2900E+01	.2341E+00	.5710E+00	-.2465E+00	.6933E+00	.2304E+01	-.2662E+00	.2093E+08	.1666E+01	.5020E+02
.3000E+01	.1969E+00	.4708E+00	-.2489E+00	.6980E+00	.2463E+01	-.2829E+00	.2093E+08	.1909E+01	.5021E+02
.3100E+01	.1619E+00	.3925E+00	-.2500E+00	.7015E+00	.2617E+01	-.2994E+00	.2093E+08	.2168E+01	.5022E+02
.3200E+01	.1297E+00	.3323E+00	-.2500E+00	.7037E+00	.2765E+01	-.3156E+00	.2093E+08	.2441E+01	.5022E+02
.3300E+01	.1003E+00	.2869E+00	-.2491E+00	.7050E+00	.2907E+01	-.3312E+00	.2093E+08	.2729E+01	.5023E+02
.3400E+01	.7515E-01	.2532E+00	-.2474E+00	.7054E+00	.3044E+01	-.3462E+00	.2093E+08	.3031E+01	.5024E+02
.3500E+01	.5319E-01	.2286E+00	-.2451E+00	.7053E+00	.3174E+01	-.3606E+00	.2093E+08	.3347E+01	.5025E+02
.3600E+01	.3486E-01	.2110E+00	-.2422E+00	.7046E+00	.3299E+01	-.3746E+00	.2093E+08	.3674E+01	.5025E+02
.3700E+01	.2000E-01	.1986E+00	-.2388E+00	.7036E+00	.3419E+01	-.3883E+00	.2093E+08	.4015E+01	.5026E+02
.3800E+01	.8350E-02	.1898E+00	-.2350E+00	.7023E+00	.3534E+01	-.4019E+00	.2093E+08	.4366E+01	.5027E+02
.3900E+01	-.4022E-03	.1836E+00	-.2308E+00	.7008E+00	.3644E+01	-.4141E+00	.2093E+08	.4729E+01	.5028E+02
.4000E+01	-.6574E-02	.1789E+00	-.2262E+00	.6991E+00	.3748E+01	-.4263E+00	.2093E+08	.5103E+01	.5029E+02
.4100E+01	-.1046E-01	.1752E+00	-.2213E+00	.6974E+00	.3849E+01	-.4380E+00	.2093E+08	.5487E+01	.5030E+02
.4200E+01	-.1246E-01	.1719E+00	-.2162E+00	.6956E+00	.3945E+01	-.4494E+00	.2093E+08	.5880E+01	.5030E+02
.4300E+01	-.1289E-01	.1687E+00	-.2108E+00	.6937E+00	.4037E+01	-.4604E+00	.2093E+08	.6283E+01	.5031E+02
.4400E+01	-.1214E-01	.1654E+00	-.2052E+00	.6919E+00	.4125E+01	-.4711E+00	.2093E+08	.6695E+01	.5032E+02
.4500E+01	-.1053E-01	.1618E+00	-.1994E+00	.6900E+00	.4209E+01	-.4813E+00	.2093E+08	.7115E+01	.5033E+02
.4600E+01	-.8324E-02	.1579E+00	-.1935E+00	.6881E+00	.4290E+01	-.4911E+00	.2093E+08	.7544E+01	.5034E+02
.4700E+01	-.5742E-02	.1537E+00	-.1874E+00	.6862E+00	.4367E+01	-.5006E+00	.2093E+08	.7981E+01	.5035E+02
.4800E+01	-.2984E-02	.1493E+00	-.1813E+00	.6843E+00	.4441E+01	-.5098E+00	.2093E+08	.8425E+01	.5036E+02
.4900E+01	-.2385E-03	.1445E+00	-.1751E+00	.6823E+00	.4512E+01	-.5187E+00	.2093E+08	.8876E+01	.5037E+02
.5000E+01	.2340E-02	.1396E+00	-.1688E+00	.6803E+00	.4581E+01	-.5273E+00	.2093E+08	.9334E+01	.5038E+02
.5100E+01	.4649E-02	.1345E+00	-.1626E+00	.6783E+00	.4646E+01	-.5354E+00	.2093E+08	.9799E+01	.5039E+02
.5200E+01	.6636E-02	.1293E+00	-.1564E+00	.6761E+00	.4708E+01	-.5433E+00	.2093E+08	.1027E+02	.5040E+02
.5300E+01	.8276E-02	.1241E+00	-.1503E+00	.6739E+00	.4768E+01	-.5509E+00	.2093E+08	.1075E+02	.5041E+02
.5400E+01	.9551E-02	.1189E+00	-.1443E+00	.6717E+00	.4826E+01	-.5582E+00	.2093E+08	.1123E+02	.5042E+02
.5500E+01	.1045E-01	.1138E+00	-.1383E+00	.6693E+00	.4881E+01	-.5653E+00	.2093E+08	.1172E+02	.5043E+02
.5600E+01	.1097E-01	.1088E+00	-.1325E+00	.6669E+00	.4934E+01	-.5721E+00	.2093E+08	.1221E+02	.5044E+02
.5700E+01	.1114E-01	.1039E+00	-.1268E+00	.6644E+00	.4984E+01	-.5785E+00	.2093E+08	.1271E+02	.5045E+02
.5800E+01	.1103E-01	.9919E-01	-.1212E+00	.6618E+00	.5033E+01	-.5848E+00	.2093E+08	.1322E+02	.5046E+02
.5900E+01	.1068E-01	.9463E-01	-.1158E+00	.6592E+00	.5079E+01	-.5908E+00	.2093E+08	.1373E+02	.5047E+02
.6000E+01	.1013E-01	.9025E-01	-.1106E+00	.6565E+00	.5124E+01	-.5965E+00	.2093E+08	.1424E+02	.5048E+02
.6100E+01	.9417E-02	.8607E-01	-.1056E+00	.6537E+00	.5166E+01	-.6021E+00	.2093E+08	.1476E+02	.5049E+02
.6200E+01	.8579E-02	.8207E-01	-.1007E+00	.6509E+00	.5207E+01	-.6074E+00	.2093E+08	.1528E+02	.5050E+02
.6300E+01	.7661E-02	.7827E-01	-.9602E-01	.6480E+00	.5246E+01	-.6125E+00	.2093E+08	.1581E+02	.5051E+02
.6400E+01	.6711E-02	.7464E-01	-.9154E-01	.6451E+00	.5284E+01	-.6174E+00	.2093E+08	.1634E+02	.5053E+02
.6500E+01	.5766E-02	.7119E-01	-.8724E-01	.6421E+00	.5319E+01	-.6221E+00	.2093E+08	.1687E+02	.5054E+02
.6600E+01	.4847E-02	.6792E-01	-.8312E-01	.6391E+00	.5354E+01	-.6266E+00	.2093E+08	.1741E+02	.5055E+02
.6700E+01	.3970E-02	.6482E-01	-.7919E-01	.6361E+00	.5387E+01	-.6310E+00	.2093E+08	.1795E+02	.5056E+02
.6800E+01	.3150E-02	.6188E-01	-.7544E-01	.6331E+00	.5418E+01	-.6351E+00	.2093E+08	.1849E+02	.5057E+02
.6900E+01	.2402E-02	.5908E-01	-.7186E-01	.6300E+00	.5448E+01	-.6391E+00	.2093E+08	.1904E+02	.5058E+02
.7000E+01	.1743E-02	.5642E-01	-.6846E-01	.6270E+00	.5477E+01	-.6429E+00	.2093E+08	.1959E+02	.5059E+02
.7100E+01	.1177E-02	.5390E-01	-.6522E-01	.6239E+00	.5505E+01	-.6466E+00	.2093E+08	.2014E+02	.5060E+02
.7200E+01	.6988E-03	.5150E-01	-.6214E-01	.6209E+00	.5531E+01	-.6501E+00	.2093E+08	.2069E+02	.5061E+02
.7300E+01	.3015E-03	.4922E-01	-.5922E-01	.6179E+00	.5556E+01	-.6535E+00	.2093E+08	.2125E+02	.5063E+02
.7400E+01	-.1938E-04	.4706E-01	-.5644E-01	.6148E+00	.5580E+01	-.6567E+00	.2093E+08	.2181E+02	.5064E+02
.7500E+01	-.2659E-03	.4499E-01	-.5380E-01	.6118E+00	.5604E+01	-.6598E+00	.2093E+08	.2237E+02	.5065E+02
.7600E+01	-.4418E-03	.4302E-01	-.5130E-01	.6088E+00	.5626E+01	-.6628E+00	.2093E+08	.2294E+02	.5066E+02
.7700E+01	-.5560E-03	.4115E-01	-.4892E-01	.6059E+00	.5647E+01	-.6656E+00	.2093E+08	.2351E+02	.5067E+02
.7800E+01	-.6213E-03	.3936E-01	-.4666E-01	.6029E+00	.5667E+01	-.6683E+00	.2093E+08	.2407E+02	.5068E+02
.7900E+01	-.6489E-03	.3766E-01	-.4452E-01	.5999E+00	.5686E+01	-.6709E+00	.2093E+08	.2465E+02	.5070E+02
.8000E+01	-.6460E-03	.3603E-01	-.4249E-01	.5970E+00	.5705E+01	-.6734E+00	.2093E+08	.2522E+02	.5071E+02
.8100E+01	-.6169E-03	.3447E-01	-.4055E-01	.5941E+00	.5723E+01	-.6758E+00	.2093E+08	.2579E+02	.5072E+02
.8200E+01	-.5667E-03	.3299E-01	-.3872E-01	.5912E+00	.5740E+01	-.6781E+00	.2093E+08	.2637E+02	.5073E+02
.8300E+01	-.5030E-03	.3157E-01	-.3697E-01	.5883E+00	.5756E+01	-.6803E+00	.2093E+08	.2695E+02	.5074E+02
.8400E+01	-.4342E-03	.3021E-01	-.3532E-01	.5855E+00	.5771E+01	-.6824E+00	.2093E+08	.2753E+02	.5075E+02
.8500E+01	-.3660E-03	.2891E-01	-.3374E-01	.5826E+00	.5786E+01	-.6844E+00	.2093E+08	.2811E+02	.5077E+02
.8600E+01	-.3006E-03	.2767E-01	-.3224E-01	.5798E+00	.5800E+01	-.6863E+00	.2093E+08	.2869E+02	.5078E+02

Shaft Coupled System Hover Time History (Continued)

Step Input Of Roll Control

.8700E+01	-.2382E-03	.2649E-01	-.3081E-01	.5770E+00	.5814E+01	-.6882E+00	.2093E+08	.2927E+02	.5079E+02
.8800E+01	-.1802E-03	.2535E-01	-.2945E-01	.5742E+00	.5827E+01	-.6896E+00	.2093E+08	.2986E+02	.5080E+02
.8900E+01	-.1296E-03	.2426E-01	-.2815E-01	.5714E+00	.5839E+01	-.6916E+00	.2093E+08	.3045E+02	.5081E+02
.9000E+01	-.8890E-04	.2322E-01	-.2691E-01	.5686E+00	.5851E+01	-.6932E+00	.2093E+08	.3104E+02	.5082E+02
.9100E+01	-.5866E-04	.2223E-01	-.2573E-01	.5659E+00	.5862E+01	-.6948E+00	.2093E+08	.3162E+02	.5084E+02
.9200E+01	-.3731E-04	.2127E-01	-.2460E-01	.5632E+00	.5873E+01	-.6962E+00	.2093E+08	.3221E+02	.5085E+02
.9300E+01	-.2274E-04	.2036E-01	-.2353E-01	.5604E+00	.5883E+01	-.6977E+00	.2093E+08	.3280E+02	.5086E+02
.9400E+01	-.1418E-04	.1949E-01	-.2250E-01	.5577E+00	.5893E+01	-.6990E+00	.2093E+08	.3340E+02	.5087E+02
.9500E+01	-.1203E-04	.1866E-01	-.2151E-01	.5551E+00	.5903E+01	-.7003E+00	.2093E+08	.3399E+02	.5088E+02
.9600E+01	-.1643E-04	.1786E-01	-.2057E-01	.5524E+00	.5912E+01	-.7015E+00	.2093E+08	.3458E+02	.5090E+02
.9700E+01	-.2614E-04	.1709E-01	-.1967E-01	.5497E+00	.5920E+01	-.7027E+00	.2093E+08	.3518E+02	.5091E+02
.9800E+01	-.3890E-04	.1636E-01	-.1881E-01	.5471E+00	.5928E+01	-.7038E+00	.2093E+08	.3577E+02	.5092E+02
.9900E+01	-.5284E-04	.1566E-01	-.1799E-01	.5445E+00	.5936E+01	-.7049E+00	.2093E+08	.3637E+02	.5093E+02
.9980E+01	-.6439E-04	.1512E-01	-.1735E-01	.5424E+00	.5942E+01	-.7057E+00	.2093E+08	.3685E+02	.5094E+02

TIME	HF1	HPE	NPER	FG1	FG2	FG3	BETA1	BETA2	BETA3
.1000E+00	.3099E+04	.1961E+05	.9859E+02	.9163E+04	.9163E+04	.9341E+04	-.1662E+01	-.1662E+01	-.1548E+01
.2000E+00	.3092E+04	.1957E+05	.9862E+02	.9131E+04	.9131E+04	.9353E+04	-.1786E+01	-.1786E+01	-.1523E+01
.3000E+00	.3087E+04	.1953E+05	.9865E+02	.9104E+04	.9104E+04	.9366E+04	-.1893E+01	-.1893E+01	-.1498E+01
.4000E+00	.3080E+04	.1947E+05	.9867E+02	.9082E+04	.9082E+04	.9378E+04	-.1961E+01	-.1981E+01	-.1471E+01
.5000E+00	.3075E+04	.1942E+05	.9867E+02	.9063E+04	.9063E+04	.9388E+04	-.2043E+01	-.2043E+01	-.1437E+01
.6000E+00	.3072E+04	.1940E+05	.9865E+02	.9050E+04	.9050E+04	.9398E+04	-.2061E+01	-.2081E+01	-.1398E+01
.7000E+00	.3073E+04	.1941E+05	.9864E+02	.9042E+04	.9042E+04	.9408E+04	-.2104E+01	-.2104E+01	-.1362E+01
.8000E+00	.3074E+04	.1942E+05	.9865E+02	.9037E+04	.9037E+04	.9417E+04	-.2122E+01	-.2122E+01	-.1337E+01
.9000E+00	.3074E+04	.1942E+05	.9866E+02	.9034E+04	.9034E+04	.9422E+04	-.2139E+01	-.2139E+01	-.1327E+01
.1000E+01	.3072E+04	.1940E+05	.9866E+02	.9179E+04	.8883E+04	.9423E+04	-.1642E+01	-.2659E+01	-.1325E+01
.1100E+01	.3070E+04	.1938E+05	.9865E+02	.9663E+04	.8399E+04	.9421E+04	.2679E-01	-.4333E+01	-.1324E+01
.1200E+01	.3070E+04	.1939E+05	.9864E+02	.9492E+04	.8606E+04	.9419E+04	-.6883E+00	-.3603E+01	-.1323E+01
.1300E+01	.3072E+04	.1940E+05	.9864E+02	.9284E+04	.8779E+04	.9418E+04	-.1264E+01	-.3006E+01	-.1327E+01
.1400E+01	.3073E+04	.1941E+05	.9864E+02	.9157E+04	.8912E+04	.9415E+04	-.1708E+01	-.2551E+01	-.1340E+01
.1500E+01	.3072E+04	.1940E+05	.9865E+02	.9064E+04	.9010E+04	.9411E+04	-.2033E+01	-.2216E+01	-.1357E+01
.1600E+01	.3071E+04	.1939E+05	.9865E+02	.8998E+04	.9080E+04	.9405E+04	-.2257E+01	-.1975E+01	-.1373E+01
.1700E+01	.3071E+04	.1939E+05	.9864E+02	.8956E+04	.9127E+04	.9400E+04	-.2395E+01	-.1807E+01	-.1383E+01
.1800E+01	.3072E+04	.1940E+05	.9863E+02	.8934E+04	.9158E+04	.9397E+04	-.2466E+01	-.1698E+01	-.1395E+01
.1900E+01	.3074E+04	.1942E+05	.9863E+02	.8927E+04	.9175E+04	.9395E+04	-.2493E+01	-.1639E+01	-.1396E+01
.2000E+01	.3075E+04	.1942E+05	.9863E+02	.8929E+04	.9181E+04	.9392E+04	-.2487E+01	-.1623E+01	-.1406E+01
.2100E+01	.3074E+04	.1942E+05	.9863E+02	.8938E+04	.9179E+04	.9390E+04	-.2456E+01	-.1629E+01	-.1415E+01
.2200E+01	.3074E+04	.1942E+05	.9863E+02	.8951E+04	.9171E+04	.9387E+04	-.2413E+01	-.1655E+01	-.1422E+01
.2300E+01	.3074E+04	.1942E+05	.9862E+02	.8967E+04	.9159E+04	.9385E+04	-.2353E+01	-.1691E+01	-.1424E+01
.2400E+01	.3075E+04	.1943E+05	.9862E+02	.8985E+04	.9146E+04	.9384E+04	-.2290E+01	-.1733E+01	-.1426E+01
.2500E+01	.3076E+04	.1944E+05	.9862E+02	.9003E+04	.9133E+04	.9384E+04	-.2230E+01	-.1782E+01	-.1428E+01
.2600E+01	.3077E+04	.1944E+05	.9863E+02	.9019E+04	.9118E+04	.9383E+04	-.2175E+01	-.1835E+01	-.1433E+01
.2700E+01	.3076E+04	.1944E+05	.9863E+02	.9034E+04	.9103E+04	.9382E+04	-.2126E+01	-.1886E+01	-.1439E+01
.2800E+01	.3075E+04	.1943E+05	.9863E+02	.9047E+04	.9089E+04	.9381E+04	-.2081E+01	-.1937E+01	-.1441E+01
.2900E+01	.3075E+04	.1943E+05	.9863E+02	.9058E+04	.9075E+04	.9380E+04	-.2040E+01	-.1981E+01	-.1442E+01
.3000E+01	.3076E+04	.1943E+05	.9863E+02	.9068E+04	.9064E+04	.9380E+04	-.2006E+01	-.2022E+01	-.1443E+01
.3100E+01	.3076E+04	.1943E+05	.9863E+02	.9077E+04	.9053E+04	.9380E+04	-.1974E+01	-.2061E+01	-.1445E+01
.3200E+01	.3075E+04	.1943E+05	.9864E+02	.9083E+04	.9043E+04	.9380E+04	-.1950E+01	-.2097E+01	-.1449E+01
.3300E+01	.3074E+04	.1942E+05	.9864E+02	.9088E+04	.9034E+04	.9379E+04	-.1944E+01	-.2130E+01	-.1452E+01
.3400E+01	.3074E+04	.1941E+05	.9864E+02	.9092E+04	.9026E+04	.9378E+04	-.1931E+01	-.2157E+01	-.1453E+01
.3500E+01	.3073E+04	.1941E+05	.9864E+02	.9095E+04	.9019E+04	.9378E+04	-.1920E+01	-.2181E+01	-.1454E+01
.3600E+01	.3073E+04	.1941E+05	.9864E+02	.9097E+04	.9013E+04	.9378E+04	-.1913E+01	-.2202E+01	-.1455E+01
.3700E+01	.3073E+04	.1941E+05	.9864E+02	.9099E+04	.9008E+04	.9378E+04	-.1909E+01	-.2222E+01	-.1457E+01
.3800E+01	.3072E+04	.1940E+05	.9865E+02	.9100E+04	.9003E+04	.9378E+04	-.1908E+01	-.2241E+01	-.1460E+01
.3900E+01	.3071E+04	.1940E+05	.9865E+02	.9100E+04	.8998E+04	.9377E+04	-.1907E+01	-.2257E+01	-.1463E+01
.4000E+01	.3071E+04	.1939E+05	.9865E+02	.9100E+04	.8994E+04	.9376E+04	-.1906E+01	-.2271E+01	-.1465E+01
.4100E+01	.3071E+04	.1939E+05	.9865E+02	.9100E+04	.8991E+04	.9376E+04	-.1905E+01	-.2282E+01	-.1466E+01
.4200E+01	.3070E+04	.1939E+05	.9865E+02	.9101E+04	.8988E+04	.9375E+04	-.1906E+01	-.2293E+01	-.1466E+01
.4300E+01	.3070E+04	.1939E+05	.9865E+02	.9101E+04	.8985E+04	.9375E+04	-.1907E+01	-.2304E+01	-.1472E+01
.4400E+01	.3070E+04	.1938E+05	.9865E+02	.9100E+04	.8982E+04	.9374E+04	-.1909E+01	-.2315E+01	-.1475E+01
.4500E+01	.3069E+04	.1937E+05	.9865E+02	.9100E+04	.8980E+04	.9373E+04	-.1910E+01	-.2324E+01	-.1478E+01
.4600E+01	.3069E+04	.1937E+05	.9865E+02	.9100E+04	.8977E+04	.9372E+04	-.1910E+01	-.2332E+01	-.1481E+01
.4700E+01	.3068E+04	.1937E+05	.9865E+02	.9100E+04	.8975E+04	.9371E+04	-.1910E+01	-.2339E+01	-.1484E+01

Shaft Coupled System Hover Time History (Continued)

Step Input Of Roll Control

.4800E+01	.3066E+04	.1937E+05	.9866E+02	.9100E+04	.8973E+04	.9370E+04	-.1911E+01	-.2347E+01	-.1487E+01
.4900E+01	.3066E+04	.1937E+05	.9866E+02	.9100E+04	.8971E+04	.9369E+04	-.1912E+01	-.2355E+01	-.1491E+01
.5000E+01	.3067E+04	.1936E+05	.9866E+02	.9100E+04	.8969E+04	.9368E+04	-.1912E+01	-.2362E+01	-.1494E+01
.5100E+01	.3067E+04	.1936E+05	.9866E+02	.9100E+04	.8967E+04	.9367E+04	-.1912E+01	-.2369E+01	-.1498E+01
.5200E+01	.3067E+04	.1936E+05	.9866E+02	.9100E+04	.8966E+04	.9366E+04	-.1912E+01	-.2375E+01	-.1500E+01
.5300E+01	.3067E+04	.1935E+05	.9866E+02	.9100E+04	.8964E+04	.9366E+04	-.1912E+01	-.2381E+01	-.1503E+01
.5400E+01	.3067E+04	.1935E+05	.9866E+02	.9100E+04	.8962E+04	.9365E+04	-.1912E+01	-.2387E+01	-.1506E+01
.5500E+01	.3066E+04	.1935E+05	.9866E+02	.9100E+04	.8961E+04	.9364E+04	-.1912E+01	-.2393E+01	-.1509E+01
.5600E+01	.3066E+04	.1935E+05	.9866E+02	.9100E+04	.8959E+04	.9363E+04	-.1912E+01	-.2399E+01	-.1512E+01
.5700E+01	.3066E+04	.1934E+05	.9866E+02	.9100E+04	.8958E+04	.9362E+04	-.1912E+01	-.2404E+01	-.1515E+01
.5800E+01	.3065E+04	.1934E+05	.9866E+02	.9101E+04	.8956E+04	.9362E+04	-.1912E+01	-.2409E+01	-.1517E+01
.5900E+01	.3065E+04	.1934E+05	.9866E+02	.9101E+04	.8955E+04	.9361E+04	-.1912E+01	-.2414E+01	-.1519E+01
.6000E+01	.3065E+04	.1934E+05	.9866E+02	.9101E+04	.8954E+04	.9360E+04	-.1912E+01	-.2419E+01	-.1522E+01
.6100E+01	.3065E+04	.1934E+05	.9866E+02	.9101E+04	.8952E+04	.9360E+04	-.1912E+01	-.2424E+01	-.1524E+01
.6200E+01	.3065E+04	.1934E+05	.9866E+02	.9101E+04	.8951E+04	.9359E+04	-.1912E+01	-.2429E+01	-.1527E+01
.6300E+01	.3064E+04	.1933E+05	.9866E+02	.9101E+04	.8950E+04	.9359E+04	-.1912E+01	-.2433E+01	-.1528E+01
.6400E+01	.3064E+04	.1933E+05	.9866E+02	.9101E+04	.8948E+04	.9358E+04	-.1911E+01	-.2437E+01	-.1530E+01
.6500E+01	.3064E+04	.1933E+05	.9867E+02	.9101E+04	.8947E+04	.9358E+04	-.1911E+01	-.2441E+01	-.1532E+01
.6600E+01	.3064E+04	.1933E+05	.9867E+02	.9101E+04	.8946E+04	.9357E+04	-.1911E+01	-.2446E+01	-.1534E+01
.6700E+01	.3064E+04	.1933E+05	.9867E+02	.9101E+04	.8945E+04	.9357E+04	-.1912E+01	-.2450E+01	-.1535E+01
.6800E+01	.3064E+04	.1933E+05	.9867E+02	.9101E+04	.8944E+04	.9356E+04	-.1912E+01	-.2454E+01	-.1537E+01
.6900E+01	.3063E+04	.1933E+05	.9867E+02	.9101E+04	.8943E+04	.9356E+04	-.1912E+01	-.2457E+01	-.1538E+01
.7000E+01	.3063E+04	.1933E+05	.9867E+02	.9102E+04	.8942E+04	.9356E+04	-.1912E+01	-.2460E+01	-.1539E+01
.7100E+01	.3063E+04	.1932E+05	.9867E+02	.9102E+04	.8941E+04	.9355E+04	-.1912E+01	-.2464E+01	-.1541E+01
.7200E+01	.3063E+04	.1932E+05	.9867E+02	.9102E+04	.8940E+04	.9355E+04	-.1912E+01	-.2467E+01	-.1542E+01
.7300E+01	.3063E+04	.1932E+05	.9867E+02	.9102E+04	.8939E+04	.9354E+04	-.1912E+01	-.2470E+01	-.1543E+01
.7400E+01	.3063E+04	.1932E+05	.9867E+02	.9102E+04	.8939E+04	.9354E+04	-.1912E+01	-.2473E+01	-.1545E+01
.7500E+01	.3063E+04	.1932E+05	.9867E+02	.9102E+04	.8938E+04	.9354E+04	-.1912E+01	-.2476E+01	-.1546E+01
.7600E+01	.3063E+04	.1932E+05	.9867E+02	.9102E+04	.8937E+04	.9354E+04	-.1912E+01	-.2478E+01	-.1547E+01
.7700E+01	.3063E+04	.1932E+05	.9867E+02	.9102E+04	.8937E+04	.9353E+04	-.1912E+01	-.2481E+01	-.1548E+01
.7800E+01	.3062E+04	.1932E+05	.9867E+02	.9102E+04	.8936E+04	.9353E+04	-.1912E+01	-.2483E+01	-.1549E+01
.7900E+01	.3062E+04	.1932E+05	.9867E+02	.9102E+04	.8935E+04	.9352E+04	-.1913E+01	-.2486E+01	-.1550E+01
.8000E+01	.3062E+04	.1932E+05	.9867E+02	.9102E+04	.8935E+04	.9352E+04	-.1913E+01	-.2488E+01	-.1551E+01
.8100E+01	.3062E+04	.1931E+05	.9867E+02	.9102E+04	.8934E+04	.9352E+04	-.1913E+01	-.2490E+01	-.1551E+01
.8200E+01	.3062E+04	.1931E+05	.9867E+02	.9102E+04	.8933E+04	.9352E+04	-.1913E+01	-.2492E+01	-.1552E+01
.8300E+01	.3062E+04	.1931E+05	.9867E+02	.9102E+04	.8933E+04	.9352E+04	-.1913E+01	-.2494E+01	-.1553E+01
.8400E+01	.3062E+04	.1931E+05	.9867E+02	.9102E+04	.8932E+04	.9352E+04	-.1913E+01	-.2496E+01	-.1554E+01
.8500E+01	.3062E+04	.1931E+05	.9867E+02	.9102E+04	.8932E+04	.9351E+04	-.1913E+01	-.2498E+01	-.1555E+01
.8600E+01	.3062E+04	.1931E+05	.9867E+02	.9102E+04	.8931E+04	.9351E+04	-.1913E+01	-.2499E+01	-.1556E+01
.8700E+01	.3062E+04	.1931E+05	.9867E+02	.9102E+04	.8931E+04	.9351E+04	-.1913E+01	-.2501E+01	-.1557E+01
.8800E+01	.3062E+04	.1931E+05	.9867E+02	.9102E+04	.8931E+04	.9351E+04	-.1913E+01	-.2503E+01	-.1557E+01
.8900E+01	.3062E+04	.1931E+05	.9867E+02	.9102E+04	.8930E+04	.9351E+04	-.1913E+01	-.2504E+01	-.1558E+01
.9000E+01	.3062E+04	.1931E+05	.9867E+02	.9102E+04	.8930E+04	.9350E+04	-.1913E+01	-.2506E+01	-.1559E+01
.9100E+01	.3061E+04	.1931E+05	.9867E+02	.9102E+04	.8929E+04	.9350E+04	-.1913E+01	-.2507E+01	-.1559E+01
.9200E+01	.3061E+04	.1931E+05	.9867E+02	.9102E+04	.8929E+04	.9350E+04	-.1913E+01	-.2508E+01	-.1560E+01
.9300E+01	.3061E+04	.1931E+05	.9867E+02	.9102E+04	.8929E+04	.9350E+04	-.1913E+01	-.2509E+01	-.1560E+01
.9400E+01	.3061E+04	.1931E+05	.9867E+02	.9102E+04	.8928E+04	.9350E+04	-.1913E+01	-.2511E+01	-.1561E+01
.9500E+01	.3061E+04	.1931E+05	.9867E+02	.9102E+04	.8928E+04	.9350E+04	-.1913E+01	-.2512E+01	-.1561E+01
.9600E+01	.3061E+04	.1931E+05	.9867E+02	.9102E+04	.8928E+04	.9349E+04	-.1913E+01	-.2513E+01	-.1562E+01
.9700E+01	.3061E+04	.1931E+05	.9867E+02	.9102E+04	.8927E+04	.9349E+04	-.1914E+01	-.2514E+01	-.1562E+01
.9800E+01	.3061E+04	.1931E+05	.9867E+02	.9102E+04	.8927E+04	.9349E+04	-.1914E+01	-.2515E+01	-.1562E+01
.9900E+01	.3061E+04	.1931E+05	.9867E+02	.9102E+04	.8927E+04	.9349E+04	-.1914E+01	-.2516E+01	-.1563E+01
.9980E+01	.3061E+04	.1930E+05	.9867E+02	.9102E+04	.8927E+04	.9349E+04	-.1914E+01	-.2517E+01	-.1563E+01

TIME	XRAM	YRAM	ZRAM	LRAM	MRAM	NRAM	LE	ME	NE
.1000E+00	-.4046E+00	0.	-.7616E+00	0.	.4024E+02	0.	0.	.4027E+02	0.
.2000E+00	-.7863E+00	0.	-.1246E+01	0.	.6945E+02	0.	0.	.6954E+02	0.
.3000E+00	-.1284E+01	0.	-.1483E+01	0.	.8818E+02	0.	0.	.8834E+02	0.
.4000E+00	-.1960E+01	0.	-.1482E+01	0.	.9770E+02	0.	0.	.9792E+02	0.
.5000E+00	-.2852E+01	0.	-.1279E+01	0.	.9949E+02	0.	0.	.9975E+02	0.
.6000E+00	-.3977E+01	0.	-.8918E+00	0.	.9492E+02	0.	0.	.9521E+02	0.
.7000E+00	-.5335E+01	0.	-.3202E+00	0.	.8515E+02	0.	0.	.8548E+02	0.
.8000E+00	-.6908E+01	0.	.4227E+00	0.	.7139E+02	0.	0.	.7173E+02	0.

Shaft Coupled System Hover Time History (Continued)

Step Input Of Roll Control

.9000E+00	-.8871E+01	0.	.1284E+01	0.	.5497E+02	0.	0.	.5532E+02	0.
.1000E+01	-.1053E+02	0.	.2186E+01	0.	.3733E+02	0.	.2188E-02	.3765E+02	.1009E-03
.1100E+01	-.1263E+02	-.1610E+01	.3062E+01	-.5812E+02	.1984E+02	-.2466E+02	-.5901E+02	.2012E+02	-.2467E+02
.1200E+01	-.1475E+02	-.3464E+01	.3888E+01	-.1123E+03	.2820E+01	-.4769E+02	-.1143E+03	.3019E+01	-.4770E+02
.1300E+01	-.1692E+02	-.5584E+01	.4681E+01	-.1466E+03	-.1310E+02	-.6959E+02	-.1506E+03	-.1300E+02	-.6530E+02
.1400E+01	-.1908E+02	-.8328E+01	.5446E+01	-.1659E+03	-.2761E+02	-.8246E+02	-.1745E+03	-.2764E+02	-.8149E+02
.1500E+01	-.2122E+02	-.1194E+02	.6176E+01	-.1742E+03	-.4043E+02	-.1013E+03	-.1858E+03	-.4059E+02	-.1035E+03
.1600E+01	-.2329E+02	-.1655E+02	.6861E+01	-.1749E+03	-.5137E+02	-.1242E+03	-.1963E+03	-.5167E+02	-.1278E+03
.1700E+01	-.2528E+02	-.2217E+02	.7515E+01	-.1707E+03	-.6047E+02	-.1521E+03	-.2036E+03	-.6092E+02	-.1573E+03
.1800E+01	-.2716E+02	-.2872E+02	.8169E+01	-.1636E+03	-.6797E+02	-.1852E+03	-.2065E+03	-.6857E+02	-.1925E+03
.1900E+01	-.2891E+02	-.3612E+02	.8852E+01	-.1552E+03	-.7415E+02	-.2234E+03	-.2138E+03	-.7468E+02	-.2329E+03
.2000E+01	-.3052E+02	-.4421E+02	.9572E+01	-.1467E+03	-.7919E+02	-.2662E+03	-.2203E+03	-.8001E+02	-.2781E+03
.2100E+01	-.3198E+02	-.5287E+02	.1031E+02	-.1387E+03	-.8312E+02	-.3129E+03	-.2288E+03	-.8398E+02	-.3273E+03
.2200E+01	-.3329E+02	-.6195E+02	.1105E+02	-.1318E+03	-.8600E+02	-.3628E+03	-.2390E+03	-.8663E+02	-.3797E+03
.2300E+01	-.3444E+02	-.7131E+02	.1180E+02	-.1262E+03	-.8801E+02	-.4151E+03	-.2513E+03	-.8870E+02	-.4344E+03
.2400E+01	-.3545E+02	-.8084E+02	.1255E+02	-.1222E+03	-.8939E+02	-.4690E+03	-.2656E+03	-.8984E+02	-.4907E+03
.2500E+01	-.3632E+02	-.9042E+02	.1331E+02	-.1197E+03	-.9035E+02	-.5239E+03	-.2814E+03	-.9047E+02	-.5477E+03
.2600E+01	-.3704E+02	-.9996E+02	.1408E+02	-.1186E+03	-.9101E+02	-.5792E+03	-.2988E+03	-.9070E+02	-.6049E+03
.2700E+01	-.3765E+02	-.1094E+03	.1483E+02	-.1188E+03	-.9144E+02	-.6343E+03	-.3172E+03	-.9059E+02	-.6617E+03
.2800E+01	-.3813E+02	-.1186E+03	.1557E+02	-.1201E+03	-.9169E+02	-.6889E+03	-.3366E+03	-.9023E+02	-.7177E+03
.2900E+01	-.3852E+02	-.1277E+03	.1629E+02	-.1224E+03	-.9193E+02	-.7425E+03	-.3566E+03	-.8978E+02	-.7729E+03
.3000E+01	-.3882E+02	-.1365E+03	.1700E+02	-.1254E+03	-.9231E+02	-.7949E+03	-.3770E+03	-.8941E+02	-.8259E+03
.3100E+01	-.3903E+02	-.1449E+03	.1771E+02	-.1291E+03	-.9295E+02	-.8459E+03	-.3976E+03	-.8926E+02	-.8776E+03
.3200E+01	-.3918E+02	-.1531E+03	.1842E+02	-.1333E+03	-.9388E+02	-.8952E+03	-.4181E+03	-.8938E+02	-.9276E+03
.3300E+01	-.3927E+02	-.1610E+03	.1911E+02	-.1378E+03	-.9510E+02	-.9430E+03	-.4384E+03	-.8977E+02	-.9757E+03
.3400E+01	-.3931E+02	-.1686E+03	.1979E+02	-.1425E+03	-.9659E+02	-.9891E+03	-.4586E+03	-.9044E+02	-.1022E+04
.3500E+01	-.3932E+02	-.1759E+03	.2046E+02	-.1473E+03	-.9842E+02	-.1033E+04	-.4781E+03	-.9149E+02	-.1066E+04
.3600E+01	-.3929E+02	-.1829E+03	.2113E+02	-.1521E+03	-.1006E+03	-.1076E+04	-.4971E+03	-.9285E+02	-.1109E+04
.3700E+01	-.3924E+02	-.1895E+03	.2180E+02	-.1570E+03	-.1032E+03	-.1117E+04	-.5156E+03	-.9466E+02	-.1150E+04
.3800E+01	-.3918E+02	-.1959E+03	.2246E+02	-.1617E+03	-.1060E+03	-.1156E+04	-.5335E+03	-.9679E+02	-.1189E+04
.3900E+01	-.3910E+02	-.2021E+03	.2311E+02	-.1663E+03	-.1091E+03	-.1194E+04	-.5507E+03	-.9918E+02	-.1226E+04
.4000E+01	-.3901E+02	-.2079E+03	.2375E+02	-.1708E+03	-.1124E+03	-.1230E+04	-.5672E+03	-.1018E+03	-.1262E+04
.4100E+01	-.3891E+02	-.2135E+03	.2438E+02	-.1752E+03	-.1159E+03	-.1265E+04	-.5831E+03	-.1046E+03	-.1296E+04
.4200E+01	-.3881E+02	-.2189E+03	.2500E+02	-.1793E+03	-.1195E+03	-.1298E+04	-.5983E+03	-.1076E+03	-.1329E+04
.4300E+01	-.3871E+02	-.2240E+03	.2561E+02	-.1833E+03	-.1232E+03	-.1330E+04	-.6129E+03	-.1106E+03	-.1360E+04
.4400E+01	-.3860E+02	-.2290E+03	.2620E+02	-.1871E+03	-.1270E+03	-.1361E+04	-.6269E+03	-.1140E+03	-.1390E+04
.4500E+01	-.3849E+02	-.2337E+03	.2678E+02	-.1908E+03	-.1307E+03	-.1390E+04	-.6402E+03	-.1173E+03	-.1419E+04
.4600E+01	-.3838E+02	-.2382E+03	.2734E+02	-.1942E+03	-.1344E+03	-.1418E+04	-.6530E+03	-.1205E+03	-.1446E+04
.4700E+01	-.3827E+02	-.2425E+03	.2788E+02	-.1976E+03	-.1380E+03	-.1445E+04	-.6652E+03	-.1236E+03	-.1472E+04
.4800E+01	-.3816E+02	-.2467E+03	.2841E+02	-.2007E+03	-.1415E+03	-.1471E+04	-.6766E+03	-.1267E+03	-.1498E+04
.4900E+01	-.3805E+02	-.2507E+03	.2892E+02	-.2037E+03	-.1450E+03	-.1496E+04	-.6880E+03	-.1298E+03	-.1522E+04
.5000E+01	-.3793E+02	-.2545E+03	.2941E+02	-.2066E+03	-.1483E+03	-.1520E+04	-.6987E+03	-.1327E+03	-.1545E+04
.5100E+01	-.3781E+02	-.2582E+03	.2988E+02	-.[illegible]93E+03	-.1515E+03	-.1543E+04	-.7089E+03	-.1355E+03	-.1567E+04
.5200E+01	-.3769E+02	-.2617E+03	.3033E+02	-.2120E+03	-.1545E+03	-.1565E+04	-.7187E+03	-.1381E+03	-.1589E+04
.5300E+01	-.3757E+02	-.2650E+03	.3076E+02	-.2145E+03	-.1574E+03	-.1587E+04	-.7281E+03	-.1406E+03	-.1609E+04
.5400E+01	-.3744E+02	-.2682E+03	.3117E+02	-.2169E+03	-.1602E+03	-.1607E+04	-.7370E+03	-.1430E+03	-.1629E+04
.5500E+01	-.3730E+02	-.2713E+03	.3157E+02	-.2192E+03	-.1628E+03	-.1626E+04	-.7456E+03	-.1453E+03	-.1647E+04
.5600E+01	-.3717E+02	-.2743E+03	.3195E+02	-.2213E+03	-.1652E+03	-.1645E+04	-.7539E+03	-.1473E+03	-.1665E+04
.5700E+01	-.3703E+02	-.2771E+03	.3231E+02	-.2234E+03	-.1676E+03	-.1663E+04	-.7618E+03	-.1493E+03	-.1683E+04
.5800E+01	-.3688E+02	-.2799E+03	.3266E+02	-.2254E+03	-.1698E+03	-.1680E+04	-.7693E+03	-.1511E+03	-.1699E+04
.5900E+01	-.3673E+02	-.2825E+03	.3299E+02	-.2274E+03	-.1719E+03	-.1697E+04	-.7766E+03	-.1529E+03	-.1715E+04
.6000E+01	-.3658E+02	-.2850E+03	.3331E+02	-.2292E+03	-.1739E+03	-.1713E+04	-.7835E+03	-.1546E+03	-.1730E+04
.6100E+01	-.3642E+02	-.2874E+03	.3361E+02	-.2310E+03	-.1758E+03	-.1728E+04	-.7902E+03	-.1561E+03	-.1745E+04
.6200E+01	-.3627E+02	-.2896E+03	.3390E+02	-.2327E+03	-.1776E+03	-.1742E+04	-.7966E+03	-.1576E+03	-.1759E+04
.6300E+01	-.3610E+02	-.2918E+03	.3418E+02	-.2343E+03	-.1793E+03	-.1756E+04	-.8027E+03	-.1590E+03	-.1772E+04
.6400E+01	-.3594E+02	-.2939E+03	.3445E+02	-.2358E+03	-.1810E+03	-.1770E+04	-.8086E+03	-.1604E+03	-.1785E+04
.6500E+01	-.3578E+02	-.2960E+03	.3470E+02	-.2373E+03	-.1825E+03	-.1783E+04	-.8142E+03	-.1617E+03	-.1797E+04
.6600E+01	-.3561E+02	-.2979E+03	.3495E+02	-.2388E+03	-.1841E+03	-.1795E+04	-.8196E+03	-.1629E+03	-.1808E+04
.6700E+01	-.3544E+02	-.2997E+03	.3518E+02	-.2401E+03	-.1856E+03	-.1808E+04	-.8246E+03	-.1641E+03	-.1820E+04
.6800E+01	-.3527E+02	-.3015E+03	.3541E+02	-.2414E+03	-.1870E+03	-.1818E+04	-.8293E+03	-.1653E+03	-.1830E+04
.6900E+01	-.3510E+02	-.3032E+03	.3563E+02	-.2427E+03	-.1883E+03	-.1828E+04	-.8345E+03	-.1664E+03	-.1840E+04
.7000E+01	-.3493E+02	-.3048E+03	.3583E+02	-.2439E+03	-.1897E+03	-.1839E+04	-.8390E+03	-.1675E+03	-.1850E+04
.7100E+01	-.3476E+02	-.3064E+03	.3603E+02	-.2450E+03	-.1910E+03	-.1849E+04	-.8434E+03	-.1685E+03	-.1859E+04
.7200E+01	-.3459E+02	-.3078E+03	.3623E+02	-.2461E+03	-.1922E+03	-.1858E+04	-.8475E+03	-.1696E+03	-.1868E+04
.7300E+01	-.3442E+02	-.3092E+03	.3641E+02	-.2472E+03	-.1934E+03	-.1867E+04	-.8519E+03	-.1706E+03	-.1877E+04

Shaft Coupled System Hover Time History (Continued)

Step Input Of Roll Control

.7400E+01	-.3426E+02	-.3106E+03	.3659E+02	-.2482E+03	-.1946E+03	-.1876E+04	-.8554E+03	-.1715E+03	-.1885E+04
.7500E+01	-.3409E+02	-.3119E+03	.3676E+02	-.2491E+03	-.1958E+03	-.1884E+04	-.8590E+03	-.1725E+03	-.1893E+04
.7600E+01	-.3392E+02	-.3131E+03	.3692E+02	-.2501E+03	-.1969E+03	-.1892E+04	-.8629E+03	-.1734E+03	-.1900E+04
.7700E+01	-.3375E+02	-.3143E+03	.3708E+02	-.2510E+03	-.1979E+03	-.1899E+04	-.8659E+03	-.1743E+03	-.1907E+04
.7800E+01	-.3359E+02	-.3155E+03	.3723E+02	-.2518E+03	-.1990E+03	-.1906E+04	-.8691E+03	-.1752E+03	-.1914E+04
.7900E+01	-.3342E+02	-.3165E+03	.3737E+02	-.2526E+03	-.2000E+03	-.1913E+04	-.8722E+03	-.1760E+03	-.1921E+04
.8000E+01	-.3326E+02	-.3176E+03	.3751E+02	-.2534E+03	-.2009E+03	-.1920E+04	-.8752E+03	-.1768E+03	-.1927E+04
.8100E+01	-.3310E+02	-.3186E+03	.3764E+02	-.2541E+03	-.2019E+03	-.1926E+04	-.8780E+03	-.1776E+03	-.1933E+04
.8200E+01	-.3293E+02	-.3195E+03	.3777E+02	-.2548E+03	-.2028E+03	-.1932E+04	-.8807E+03	-.1784E+03	-.1938E+04
.8300E+01	-.3277E+02	-.3204E+03	.3789E+02	-.2555E+03	-.2037E+03	-.1938E+04	-.8833E+03	-.1791E+03	-.1944E+04
.8400E+01	-.3261E+02	-.3213E+03	.3801E+02	-.2561E+03	-.2045E+03	-.1943E+04	-.8858E+03	-.1798E+03	-.1949E+04
.8500E+01	-.3245E+02	-.3221E+03	.3812E+02	-.2568E+03	-.2053E+03	-.1948E+04	-.8881E+03	-.1805E+03	-.1954E+04
.8600E+01	-.3230E+02	-.3229E+03	.3823E+02	-.2573E+03	-.2061E+03	-.1953E+04	-.8904E+03	-.1812E+03	-.1959E+04
.8700E+01	-.3214E+02	-.3237E+03	.3833E+02	-.2579E+03	-.2068E+03	-.1958E+04	-.8926E+03	-.1818E+03	-.1963E+04
.8800E+01	-.3198E+02	-.3244E+03	.3843E+02	-.2584E+03	-.2076E+03	-.1963E+04	-.8947E+03	-.1824E+03	-.1967E+04
.8900E+01	-.3183E+02	-.3251E+03	.3852E+02	-.2590E+03	-.2083E+03	-.1967E+04	-.8967E+03	-.1830E+03	-.1971E+04
.9000E+01	-.3167E+02	-.3258E+03	.3861E+02	-.2595E+03	-.2089E+03	-.1971E+04	-.8986E+03	-.1836E+03	-.1975E+04
.9100E+01	-.3152E+02	-.3264E+03	.3870E+02	-.2599E+03	-.2096E+03	-.1975E+04	-.9004E+03	-.1842E+03	-.1979E+04
.9200E+01	-.3137E+02	-.3270E+03	.3878E+02	-.2604E+03	-.2102E+03	-.1979E+04	-.9022E+03	-.1847E+03	-.1983E+04
.9300E+01	-.3122E+02	-.3276E+03	.3886E+02	-.2608E+03	-.2108E+03	-.1983E+04	-.9038E+03	-.1852E+03	-.1986E+04
.9400E+01	-.3107E+02	-.3281E+03	.3893E+02	-.2612E+03	-.2114E+03	-.1986E+04	-.9054E+03	-.1857E+03	-.1989E+04
.9500E+01	-.3092E+02	-.3286E+03	.3901E+02	-.2616E+03	-.2119E+03	-.1990E+04	-.9070E+03	-.1862E+03	-.1993E+04
.9600E+01	-.3077E+02	-.3292E+03	.3907E+02	-.2620E+03	-.2125E+03	-.1993E+04	-.9084E+03	-.1866E+03	-.1995E+04
.9700E+01	-.3062E+02	-.3296E+03	.3914E+02	-.2623E+03	-.2130E+03	-.1996E+04	-.9098E+03	-.1871E+03	-.1998E+04
.9800E+01	-.3047E+02	-.3301E+03	.3920E+02	-.2627E+03	-.2135E+03	-.1999E+04	-.9112E+03	-.1875E+03	-.2001E+04
.9900E+01	-.3032E+02	-.3305E+03	.3926E+02	-.2630E+03	-.2139E+03	-.2001E+04	-.9125E+03	-.1879E+03	-.2004E+04
.9980E+01	-.3021E+02	-.3309E+03	.3931E+02	-.2632E+03	-.2143E+03	-.2004E+04	-.9135E+03	-.1882E+03	-.2006E+04

TIME	GAMA1	GAMA2	GAMA3	FY1	FY3	FZ1	FZ2
.1000E+00	0.	0.	0.	0.	0.	-.9163E+04	-.9341E+04
.2000E+00	0.	0.	0.	0.	0.	-.9131E+04	-.9353E+04
.3000E+00	0.	0.	0.	0.	0.	-.9104E+04	-.9366E+04
.4000E+00	0.	0.	0.	0.	0.	-.9082E+04	-.9376E+04
.5000E+00	0.	0.	0.	0.	0.	-.9063E+04	-.9388E+04
.6000E+00	0.	0.	0.	0.	0.	-.9050E+04	-.9396E+04
.7000E+00	0.	0.	0.	0.	0.	-.9042E+04	-.9406E+04
.8000E+00	0.	0.	0.	0.	0.	-.9037E+04	-.9417E+04
.9000E+00	0.	0.	0.	0.	0.	-.9034E+04	-.9422E+04
.1000E+01	.8766E-04	.8766E-04	-.1753E-03	.1404E-01	-.2883E-01	-.9179E+04	-.9423E+04
.1100E+01	.1208E-01	.1208E-01	-.2416E-01	.2037E+01	-.3972E+01	-.9663E+04	-.9421E+04
.1200E+01	.2632E-01	.2632E-01	-.5265E-01	.4342E+01	-.8654E+01	-.9452E+04	-.9419E+04
.1300E+01	.3251E-01	.3251E-01	-.6502E-01	.5267E+01	-.1069E+02	-.9284E+04	-.9418E+04
.1400E+01	.3288E-01	.3288E-01	-.6577E-01	.5255E+01	-.1081E+02	-.9157E+04	-.9415E+04
.1500E+01	.2930E-01	.2930E-01	-.5861E-01	.4635E+01	-.9625E+01	-.9064E+04	-.9411E+04
.1600E+01	.2305E-01	.2305E-01	-.4611E-01	.3620E+01	-.7567E+01	-.8995E+04	-.9405E+04
.1700E+01	.1512E-01	.1512E-01	-.3025E-01	.2364E+01	-.4961E+01	-.8956E+04	-.9400E+04
.1800E+01	.6224E-02	.6224E-02	-.1245E-01	.9703E+00	-.2041E+01	-.8934E+04	-.9397E+04
.1900E+01	-.3129E-02	-.3129E-02	.6258E-02	-.4874E+00	.1026E+01	-.8927E+04	-.9395E+04
.2000E+01	-.1257E-01	-.1257E-01	.2514E-01	-.1959E+01	.4121E+01	-.8929E+04	-.9392E+04
.2100E+01	-.2186E-01	-.2186E-01	.4372E-01	-.3409E+01	.7163E+01	-.8938E+04	-.9390E+04
.2200E+01	-.3084E-01	-.3094E-01	.6168E-01	-.4817E+01	.1010E+02	-.8951E+04	-.9387E+04
.2300E+01	-.3943E-01	-.3943E-01	.7885E-01	-.6169E+01	.1291E+02	-.8967E+04	-.9385E+04
.2400E+01	-.4759E-01	-.4759E-01	.9517E-01	-.7461E+01	.1559E+02	-.8985E+04	-.9384E+04
.2500E+01	-.5532E-01	-.5532E-01	.1106E+00	-.8690E+01	.1812E+02	-.9003E+04	-.9384E+04
.2600E+01	-.6263E-01	-.6263E-01	.1253E+00	-.9857E+01	.2051E+02	-.9019E+04	-.9383E+04
.2700E+01	-.6956E-01	-.6956E-01	.1391E+00	-.1097E+02	.2278E+02	-.9034E+04	-.9382E+04
.2800E+01	-.7614E-01	-.7614E-01	.1523E+00	-.1202E+02	.2493E+02	-.9047E+04	-.9381E+04
.2900E+01	-.8241E-01	-.8241E-01	.1648E+00	-.1303E+02	.2698E+02	-.9058E+04	-.9380E+04
.3000E+01	-.8840E-01	-.8840E-01	.1768E+00	-.1399E+02	.2894E+02	-.9068E+04	-.9380E+04
.3100E+01	-.9413E-01	-.9413E-01	.1883E+00	-.1491E+02	.3082E+02	-.9077E+04	-.9380E+04
.3200E+01	-.9964E-01	-.9964E-01	.1993E+00	-.1579E+02	.3262E+02	-.9083E+04	-.9380E+04
.3300E+01	-.1049E+00	-.1049E+00	.2099E+00	-.1664E+02	.3439E+02	-.9088E+04	-.9379E+04
.3400E+01	-.1100E+00	-.1100E+00	.2201E+00	-.1746E+02	.3602E+02	-.9092E+04	-.9376E+04

Shaft Coupled System Hover Time History (Continued)
Step Input Of Roll Control

.3500E+01	-.1150E+00	-.1150E+00	.2299E+00	-.1825E+02	.3763E+02	-.9098E+04	-.9378E+04
.3600E+01	-.1197E+00	-.1197E+00	.2394E+00	-.1900E+02	.3916E+02	-.9097E+04	-.9378E+04
.3700E+01	-.1243E+00	-.1243E+00	.2486E+00	-.1973E+02	.4068E+02	-.9099E+04	-.9378E+04
.3800E+01	-.1287E+00	-.1287E+00	.2574E+00	-.2043E+02	.4211E+02	-.9100E+04	-.9377E+04
.3900E+01	-.1329E+00	-.1329E+00	.2658E+00	-.2110E+02	.4349E+02	-.9100E+04	-.9377E+04
.4000E+01	-.1370E+00	-.1370E+00	.2739E+00	-.2175E+02	.4482E+02	-.9100E+04	-.9376E+04
.4100E+01	-.1409E+00	-.1409E+00	.2817E+00	-.2237E+02	.4609E+02	-.9100E+04	-.9376E+04
.4200E+01	-.1446E+00	-.1446E+00	.2892E+00	-.2296E+02	.4731E+02	-.9101E+04	-.9375E+04
.4300E+01	-.1481E+00	-.1481E+00	.2963E+00	-.2352E+02	.4846E+02	-.9101E+04	-.9375E+04
.4400E+01	-.1515E+00	-.1515E+00	.3030E+00	-.2406E+02	.4957E+02	-.9100E+04	-.9374E+04
.4500E+01	-.1547E+00	-.1547E+00	.3095E+00	-.2457E+02	.5062E+02	-.9100E+04	-.9373E+04
.4600E+01	-.1578E+00	-.1578E+00	.3156E+00	-.2506E+02	.5161E+02	-.9100E+04	-.9372E+04
.4700E+01	-.1607E+00	-.1607E+00	.3214E+00	-.2552E+02	.5256E+02	-.9100E+04	-.9371E+04
.4800E+01	-.1635E+00	-.1635E+00	.3269E+00	-.2596E+02	.5348E+02	-.9100E+04	-.9370E+04
.4900E+01	-.1661E+00	-.1661E+00	.3321E+00	-.2637E+02	.5430E+02	-.9100E+04	-.9369E+04
.5000E+01	-.1685E+00	-.1685E+00	.3370E+00	-.2676E+02	.5510E+02	-.9100E+04	-.9368E+04
.5100E+01	-.1708E+00	-.1708E+00	.3417E+00	-.2713E+02	.5585E+02	-.9100E+04	-.9367E+04
.5200E+01	-.1730E+00	-.1730E+00	.3460E+00	-.2747E+02	.5656E+02	-.9100E+04	-.9366E+04
.5300E+01	-.1751E+00	-.1751E+00	.3502E+00	-.2780E+02	.5723E+02	-.9100E+04	-.9366E+04
.5400E+01	-.1770E+00	-.1770E+00	.3541E+00	-.2811E+02	.5788E+02	-.9100E+04	-.9365E+04
.5500E+01	-.1789E+00	-.1789E+00	.3577E+00	-.2840E+02	.5849E+02	-.9100E+04	-.9364E+04
.5600E+01	-.1806E+00	-.1806E+00	.3612E+00	-.2868E+02	.5901E+02	-.9100E+04	-.9363E+04
.5700E+01	-.1822E+00	-.1822E+00	.3644E+00	-.2894E+02	.5954E+02	-.9100E+04	-.9362E+04
.5800E+01	-.1837E+00	-.1837E+00	.3675E+00	-.2918E+02	.6003E+02	-.9101E+04	-.9361E+04
.5900E+01	-.1852E+00	-.1852E+00	.3704E+00	-.2941E+02	.6050E+02	-.9101E+04	-.9361E+04
.6000E+01	-.1866E+00	-.1866E+00	.3731E+00	-.2963E+02	.6094E+02	-.9101E+04	-.9360E+04
.6100E+01	-.1878E+00	-.1878E+00	.3757E+00	-.2983E+02	.6136E+02	-.9101E+04	-.9360E+04
.6200E+01	-.1891E+00	-.1891E+00	.3781E+00	-.3003E+02	.6175E+02	-.9101E+04	-.9359E+04
.6300E+01	-.1902E+00	-.1902E+00	.3804E+00	-.3021E+02	.6213E+02	-.9101E+04	-.9358E+04
.6400E+01	-.1913E+00	-.1913E+00	.3826E+00	-.3038E+02	.6248E+02	-.9101E+04	-.9358E+04
.6500E+01	-.1923E+00	-.1923E+00	.3847E+00	-.3055E+02	.6282E+02	-.9101E+04	-.9357E+04
.6600E+01	-.1933E+00	-.1933E+00	.3867E+00	-.3070E+02	.6313E+02	-.9101E+04	-.9357E+04
.6700E+01	-.1943E+00	-.1943E+00	.3885E+00	-.3085E+02	.6343E+02	-.9101E+04	-.9356E+04
.6800E+01	-.1951E+00	-.1951E+00	.3903E+00	-.3099E+02	.6372E+02	-.9101E+04	-.9356E+04
.6900E+01	-.1960E+00	-.1960E+00	.3920E+00	-.3113E+02	.6399E+02	-.9101E+04	-.9355E+04
.7000E+01	-.1968E+00	-.1968E+00	.3936E+00	-.3125E+02	.6425E+02	-.9102E+04	-.9355E+04
.7100E+01	-.1976E+00	-.1976E+00	.3951E+00	-.3138E+02	.6450E+02	-.9102E+04	-.9355E+04
.7200E+01	-.1983E+00	-.1983E+00	.3966E+00	-.3149E+02	.6474E+02	-.9102E+04	-.9354E+04
.7300E+01	-.1990E+00	-.1990E+00	.3980E+00	-.3160E+02	.6496E+02	-.9102E+04	-.9354E+04
.7400E+01	-.1997E+00	-.1997E+00	.3993E+00	-.3171E+02	.6518E+02	-.9102E+04	-.9354E+04
.7500E+01	-.2003E+00	-.2003E+00	.4006E+00	-.3181E+02	.6538E+02	-.9102E+04	-.9354E+04
.7600E+01	-.2009E+00	-.2009E+00	.4018E+00	-.3191E+02	.6558E+02	-.9102E+04	-.9353E+04
.7700E+01	-.2015E+00	-.2015E+00	.4030E+00	-.3200E+02	.6577E+02	-.9102E+04	-.9353E+04
.7800E+01	-.2020E+00	-.2020E+00	.4041E+00	-.3209E+02	.6595E+02	-.9102E+04	-.9353E+04
.7900E+01	-.2026E+00	-.2026E+00	.4052E+00	-.3218E+02	.6612E+02	-.9102E+04	-.9353E+04
.8000E+01	-.2031E+00	-.2031E+00	.4062E+00	-.3226E+02	.6629E+02	-.9102E+04	-.9352E+04
.8100E+01	-.2036E+00	-.2036E+00	.4072E+00	-.3233E+02	.6645E+02	-.9102E+04	-.9352E+04
.8200E+01	-.2041E+00	-.2041E+00	.4081E+00	-.3241E+02	.6660E+02	-.9102E+04	-.9352E+04
.8300E+01	-.2045E+00	-.2045E+00	.4090E+00	-.3248E+02	.6675E+02	-.9102E+04	-.9352E+04
.8400E+01	-.2049E+00	-.2049E+00	.4099E+00	-.3255E+02	.6689E+02	-.9102E+04	-.9351E+04
.8500E+01	-.2054E+00	-.2054E+00	.4107E+00	-.3262E+02	.6702E+02	-.9102E+04	-.9351E+04
.8600E+01	-.2058E+00	-.2058E+00	.4115E+00	-.3268E+02	.6715E+02	-.9102E+04	-.9351E+04
.8700E+01	-.2061E+00	-.2061E+00	.4123E+00	-.3274E+02	.6727E+02	-.9102E+04	-.9351E+04
.8800E+01	-.2065E+00	-.2065E+00	.4130E+00	-.3280E+02	.6739E+02	-.9102E+04	-.9350E+04
.8900E+01	-.2069E+00	-.2069E+00	.4137E+00	-.3286E+02	.6751E+02	-.9102E+04	-.9350E+04
.9000E+01	-.2072E+00	-.2072E+00	.4144E+00	-.3291E+02	.6761E+02	-.9102E+04	-.9350E+04
.9100E+01	-.2075E+00	-.2075E+00	.4150E+00	-.3296E+02	.6772E+02	-.9102E+04	-.9350E+04
.9200E+01	-.2078E+00	-.2078E+00	.4157E+00	-.3301E+02	.6782E+02	-.9102E+04	-.9350E+04
.9300E+01	-.2081E+00	-.2081E+00	.4162E+00	-.3306E+02	.6791E+02	-.9102E+04	-.9350E+04
.9400E+01	-.2084E+00	-.2084E+00	.4168E+00	-.3310E+02	.6800E+02	-.9102E+04	-.9350E+04
.9500E+01	-.2087E+00	-.2087E+00	.4174E+00	-.3314E+02	.6809E+02	-.9102E+04	-.9349E+04
.9600E+01	-.2089E+00	-.2089E+00	.4179E+00	-.3318E+02	.6817E+02	-.9102E+04	-.9349E+04
.9700E+01	-.2092E+00	-.2092E+00	.4184E+00	-.3322E+02	.6825E+02	-.9102E+04	-.9349E+04
.9800E+01	-.2094E+00	-.2094E+00	.4188E+00	-.3326E+02	.6833E+02	-.9102E+04	-.9349E+04
.9900E+01	-.2096E+00	-.2096E+00	.4193E+00	-.3330E+02	.6840E+02	-.9102E+04	-.9349E+04

Gas Coupled System Hover Time History
Step Input Of Roll Control

TIME	RNG	THETAJ	VT	ALPHA	BETA	HP1	HP2	HP3
.1000E+00	.9832E+02	.9000E+02	.4976E-02	.3270E+02	0.	.7069E+04	.7069E+04	.6218E+04
.2000E+00	.9832E+02	.9000E+02	.7157E-02	.3662E+02	0.	.7069E+04	.7069E+04	.6219E+04
.3000E+00	.9832E+02	.9000E+02	.8502E-02	.3600E+02	0.	.7070E+04	.7070E+04	.6219E+04
.4000E+00	.9832E+02	.9000E+02	.9401E-02	.3269E+02	0.	.7070E+04	.7070E+04	.6220E+04
.5000E+00	.9832E+02	.9000E+02	.1007E-01	.2759E+02	0.	.7070E+04	.7070E+04	.6220E+04
.6000E+00	.9832E+02	.9000E+02	.1057E-01	.2142E+02	0.	.7070E+04	.7070E+04	.6220E+04
.7000E+00	.9832E+02	.9000E+02	.1130E-01	.1477E+02	0.	.7070E+04	.7070E+04	.6219E+04
.8000E+00	.9832E+02	.9000E+02	.1201E-01	.8155E+01	0.	.7070E+04	.7070E+04	.6219E+04
.9000E+00	.9832E+02	.9000E+02	.1282E-01	.1928E+01	0.	.7069E+04	.7069E+04	.6219E+04
.1000E+01	.9832E+02	.9000E+02	.1372E-01	-.3710E+01	0.	.7069E+04	.7069E+04	.6218E+04
.1100E+01	.9832E+02	.9000E+02	.2385E-01	.5278E+02	.3205E+01	.7136E+04	.7092E+04	.6222E+04
.1200E+01	.9833E+02	.9000E+02	.4386E-01	.7036E+02	.1693E+02	.7320E+04	.7156E+04	.6224E+04
.1300E+01	.9833E+02	.9000E+02	.6073E-01	.7434E+02	.4288E+02	.7372E+04	.7176E+04	.6237E+04
.1400E+01	.9833E+02	.9000E+02	.9495E-01	.7546E+02	.7007E+02	.7282E+04	.7146E+04	.6225E+04
.1500E+01	.9832E+02	.9000E+02	.1567E+00	.7944E+02	.8384E+02	.7125E+04	.7105E+04	.6209E+04
.1600E+01	.9832E+02	.9000E+02	.2386E+00	.1096E+03	.8826E+02	.7061E+04	.7097E+04	.6203E+04
.1700E+01	.9832E+02	.9000E+02	.3349E+00	.1718E+03	.8863E+02	.7068E+04	.7118E+04	.6208E+04
.1800E+01	.9832E 02	.9000E+02	.4419E+00	-.1638E+03	.8822E+02	.7092E+04	.7141E+04	.621[illegible]E+04
.1900E+01	.9832E+02	.9000E+02	.5968E+00	-.1506E+03	.8787E+02	.7104E+04	.7149E+04	.6218E+04
.2000E+01	.9832E+02	.9000E+02	.6767E+00	-.1411E+03	.8755E+02	.7102E+04	.7145E+04	.6219E+04
.2100E+01	.9832E+02	.9000E+02	.7992E+00	-.1341E+03	.8729E+02	.7095E+04	.7133E+04	.6217E+04
.2200E+01	.9832E+02	.9000E+02	.9223E+00	-.1291E+03	.8709E+02	.7093E+04	.7117E+04	.6207E+04
.2300E+01	.9832E+02	.9000E+02	.1044E+01	-.1256E+03	.8699E+02	.7094E+04	.7096E+04	.6194E+04
.2400E+01	.9832E+02	.9000E+02	.1164E+01	-.1232E+03	.8698E+02	.7094E+04	.7088E+04	.6191E+04
.2500E+01	.9832E+02	.9000E+02	.1279E+01	-.1212E+03	.8703E+02	.7092E+04	.7083E+04	.6197E+04
.2600E+01	.9832E+02	.9000E+02	.1391E+01	-.1191E+03	.8711E+02	.7090E+04	.7083E+04	.6204E+04
.2700E+01	.9832E+02	.9000E+02	.1498E+01	-.1167E+03	.8719E+02	.7087E+04	.7082E+04	.6212E+04
.2800E+01	.9832E+02	.9000E+02	.160[illegible]E+01	-.1139E+03	.8726E+02	.7077E+04	.7082E+04	.6229E+04
.2900E+01	.9832E+02	.9000E+02	.1696E+01	-.1107E+03	.8731E+02	.7071E+04	.7082E+04	.6241E+04
.3000E+01	.9832E+02	.9000E+02	.1787E+01	-.1071E+03	.873[illegible]E+02	.7072E+04	.7081E+04	.6242E+04
.3100E+01	.9832E+02	.9000E+02	.1872E+01	-.1035E+03	.8726E+02	.7073E+04	.7078E+04	.6237E+04
.3200E+01	.9832E+02	.9000E+02	.1952E+01	-.10[illegible]2E+03	.8723E+02	.7076E+04	.7074E+04	.6231E+04
.3300E+01	.9832E+02	.9000E+02	.2025E+01	-.9735E+02	.8721E+02	.7078E+04	.7072E+04	.6231E+04
.3400E+01	.9832E+02	.9000E+02	.2093E+01	-.9485E+02	.8718E+02	.7082E+04	.7070E+04	.6230E+04
.3500E+01	.9832E+02	.9000E+02	.2155E+01	-.9273E+02	.8715E+02	.7090E+04	.7071E+04	.6223E+04
.3600E+01	.9832E+02	.9000E+02	.2213E+01	-.91[illegible]3E+02	.871[illegible]E+02	.7095E+04	.7074E+04	.6218E+04
.3700E+01	.9832E+02	.9000E+02	.2266E+01	-.8971E+02	.8704E+02	.7097E+04	.7076E+04	.6215E+04
.3800E+01	.9832E+02	.9000E+02	.2315E+01	-.8874E+02	.8698E+02	.7095E+04	.7076E+04	.6215E+04
.3900E+01	.9832E+02	.9000E+02	.2360E+01	-.88[illegible]5E+02	.8691E+02	.7094E+04	.7075E+04	.6215E+04
.4000E+01	.9832E+02	.9000E+02	.2401E+01	-.8759E+02	.8685E+02	.7093E+04	.7075E+04	.6215E+04
.4100E+01	.9832E+02	.9000E+02	.2440E+01	-.8730E+02	.8679E+02	.7093E+04	.7074E+04	.6214E+04
.4200E+01	.9831E+02	.9000E+02	.2475E+01	-.8713E+02	.8673E+02	.7093E+04	.7074E+04	.6214E+04
.4300E+01	.9831E+02	.9000E+02	.2508E+01	-.8705E+02	.8668E+02	.7093E+04	.7074E+04	.6213E+04
.4400E+01	.9831E+02	.9000E+02	.2538E+01	-.8703E+02	.8662E+02	.7093E+04	.7073E+04	.6213E+04
.4500E+01	.9831E+02	.9000E+02	.2566E+01	-.8704E+02	.8657E+02	.7093E+04	.7073E+04	.6213E+04
.4600E+01	.9831E+02	.9000E+02	.2592E+01	-.8708E+02	.8652E+02	.7093E+04	.7073E+04	.6212E+04
.4700E+01	.9831E+02	.9000E+02	.2615E+01	-.8711E+02	.8648E+02	.7093E+04	.7072E+04	.6212E+04
.4800E+01	.9831E+02	.9000E+02	.2638E+01	-.8714E+02	.8643E+02	.7093E+04	.7072E+04	.6212E+04
.4900E+01	.9831E+02	.9000E+02	.2659E+01	-.8716E+02	.8639E+02	.7093E+04	.7071E+04	.6212E+04
.5000E+01	.9831E+02	.9000E+02	.267[illegible]E+01	-.8715E+02	.8635E+02	.7093E+04	.7071E+04	.6211E+04
.5100E+01	.9831E+02	.9000E+02	.2696E+01	-.8711E+02	.8631E+02	.7092E+04	.7071E+04	.6211E+04
.5200E+01	.9831E+02	.9000E+02	.2712E+01	-.8705E+02	.8628E+02	.7092E+04	.7070E+04	.6211E+04
.5300E+01	.9831E+02	.9000E+02	.2728E+01	-.8695E+02	.8624E+02	.7092E+04	.7070E+04	.6211E+04
.5400E+01	.9831E+02	.9000E+02	.2743E+01	-.8683E+02	.8621E+02	.7092E+04	.7069E+04	.6211E+04
.5500E+01	.9831E+02	.9000E+02	.2756E+01	-.8667E+02	.8618E+02	.7091E+04	.7069E+04	.6211E+04
.5600E+01	.9831E+02	.9000E+02	.2769E+01	-.8648E+02	.8615E+02	.7091E+04	.7069E+04	.6211E+04
.5700E+01	.9831E+02	.9000E+02	.2781E+01	-.8626E+02	.8612E+02	.7091E+04	.7068E+04	.6210E+04
.5800E+01	.9831E+02	.9000E+02	.2793E+01	-.8602E+02	.8610E+02	.7091E+04	.7068E+04	.6210E+04
.5900E+01	.9831E+02	.9000E+02	.2803E+01	-.8576E+02	.8607E+02	.7091E+04	.7068E+04	.6210E+04
.6000E+01	.9831E+02	.9000E+02	.2814E+01	-.8548E+02	.8605E+02	.7090E+04	.7068E+04	.6210E+04

Gas Coupled System Hover Time History (Continued)

Step Input Of Roll Control

.6100E+01	.9830E+02	.9000E+02	.2823E+01	-.8518E+02	.8603E+02	.7093E+04	.7067E+04	.6211E+04
.6200E+01	.9830E+02	.9000E+02	.2832E+01	-.8486E+02	.8600E+02	.7090E+04	.7067E+04	.6211E+04
.6300E+01	.9830E+02	.9000E+02	.2841E+01	-.8454E+02	.8598E+02	.7090E+04	.7067E+04	.6211E+04
.6400E+01	.9830E+02	.9000E+02	.2849E+01	-.8420E+02	.8596E+02	.7090E+04	.7067E+04	.6210E+04
.6500E+01	.9830E+02	.9000E+02	.2856E+01	-.8386E+02	.8594E+02	.7089E+04	.7066E+04	.6209E+04
.6600E+01	.9830E+02	.9000E+02	.2864E+01	-.8352E+02	.8592E+02	.7089E+04	.7066E+04	.6209E+04
.6700E+01	.9830E+02	.9000E+02	.2870E+01	-.8317E+02	.8591E+02	.7089E+04	.7066E+04	.6209E+04
.6800E+01	.9830E+02	.9000E+02	.2877E+01	-.8283E+02	.8589E+02	.7089E+04	.7066E+04	.6209E+04
.6900E+01	.9830E+02	.9000E+02	.2883E+01	-.8249E+02	.8587E+02	.7089E+04	.7066E+04	.6209E+04
.7000E+01	.9830E+02	.9000E+02	.2889E+01	-.8215E+02	.8586E+02	.7089E+04	.7066E+04	.6209E+04
.7100E+01	.9830E+02	.9000E+02	.2895E+01	-.8182E+02	.8584E+02	.7089E+04	.7066E+04	.6209E+04
.7200E+01	.9830E+02	.9000E+02	.2900E+01	-.8149E+02	.8582E+02	.7089E+04	.7066E+04	.6209E+04
.7300E+01	.9830E+02	.9000E+02	.2905E+01	-.8119E+02	.8581E+02	.7089E+04	.7066E+04	.6209E+04
.7400E+01	.9830E+02	.9000E+02	.2910E+01	-.8087E+02	.8580E+02	.7088E+04	.7065E+04	.6208E+04
.7500E+01	.9830E+02	.9000E+02	.2914E+01	-.8057E+02	.8578E+02	.7088E+04	.7065E+04	.6208E+04
.7600E+01	.9830E+02	.9000E+02	.2919E+01	-.8029E+02	.8577E+02	.7088E+04	.7065E+04	.6208E+04
.7700E+01	.9830E+02	.9000E+02	.2923E+01	-.8001E+02	.8576E+02	.7088E+04	.7065E+04	.6208E+04
.7800E+01	.9830E+02	.9000E+02	.2927E+01	-.7974E+02	.8574E+02	.7088E+04	.7065E+04	.6208E+04
.7900E+01	.9830E+02	.9000E+02	.2931E+01	-.7948E+02	.8573E+02	.7088E+04	.7065E+04	.6208E+04
.8000E+01	.9830E+02	.9000E+02	.2934E+01	-.7923E+02	.8572E+02	.7088E+04	.7065E+04	.6208E+04
.8100E+01	.9830E+02	.9000E+02	.2937E+01	-.7899E+02	.8571E+02	.7088E+04	.7065E+04	.6208E+04
.8200E+01	.9830E+02	.9000E+02	.2940E+01	-.7877E+02	.8570E+02	.7088E+04	.7065E+04	.6208E+04
.8300E+01	.9830E+02	.9000E+02	.2943E+01	-.7854E+02	.8569E+02	.7088E+04	.7065E+04	.6208E+04
.8400E+01	.9830E+02	.9000E+02	.2946E+01	-.7833E+02	.8568E+02	.7088E+04	.7065E+04	.6208E+04
.8500E+01	.9830E+02	.9000E+02	.2949E+01	-.7813E+02	.8567E+02	.7088E+04	.7065E+04	.6208E+04
.8600E+01	.9830E+02	.9000E+02	.2952E+01	-.7793E+02	.8566E+02	.7088E+04	.7065E+04	.6208E+04
.8700E+01	.9830E+02	.9000E+02	.2954E+01	-.7774E+02	.8565E+02	.7088E+04	.7065E+04	.6208E+04
.8800E+01	.9830E+02	.9000E+02	.2956E+01	-.7756E+02	.8564E+02	.7088E+04	.7065E+04	.6207E+04
.8900E+01	.9830E+02	.9000E+02	.2959E+01	-.7738E+02	.8563E+02	.7088E+04	.7065E+04	.6207E+04
.9000E+01	.9830E+02	.9000E+02	.2961E+01	-.7721E+02	.8562E+02	.7088E+04	.7065E+04	.6207E+04
.9100E+01	.9830E+02	.9000E+02	.2963E+01	-.7704E+02	.8562E+02	.7088E+04	.7065E+04	.6207E+04
.9200E+01	.9830E+02	.9000E+02	.2965E+01	-.7688E+02	.8561E+02	.7088E+04	.7064E+04	.6207E+04
.9300E+01	.9830E+02	.9000E+02	.2967E+01	-.7672E+02	.8560E+02	.7086E+04	.7064E+04	.6207E+04
.9400E+01	.9830E+02	.9000E+02	.2968E+01	-.7656E+02	.8559E+02	.7088E+04	.7064E+04	.6207E+04
.9500E+01	.9830E+02	.9000E+02	.2970E+01	-.7641E+02	.8559E+02	.7088E+04	.7064E+04	.6207E+04
.9600E+01	.9830E+02	.9000E+02	.2972E+01	-.7626E+02	.8558E+02	.7088E+04	.7064E+04	.6207E+04
.9700E+01	.9830E+02	.9000E+02	.2973E+01	-.7612E+02	.8557E+02	.7088E+04	.7064E+04	.6207E+04
.9800E+01	.9830E+02	.9000E+02	.2975E+01	-.7597E+02	.8557E+02	.7088E+04	.7064E+04	.6207E+04
.9900E+01	.9830E+02	.9000E+02	.2976E+01	-.7583E+02	.8556E+02	.7088E+04	.7064E+04	.6207E+04
.9980E+01	.9830E+02	.9000E+02	.2977E+01	-.7572E+02	.8556E+02	.7088E+04	.7064E+04	.6207E+04

TIME	FT1	FT2	FT3	FGU1	FGU2	FGU3	FG1	FG2	FG3
.1000E+00	.1614E+04	.1614E+04	.1454E+04	.1165E+05	.1165E+05	.1061E+05	.9432E+04	.9432E+04	.8594E+04
.2000E+00	.1614E+04	.1614E+04	.1454E+04	.1166E+05	.1166E+05	.1061E+05	.9435E+04	.9435E+04	.8597E+04
.3000E+00	.1614E+04	.1614E+04	.1454E+04	.1166E+05	.1166E+05	.1062E+05	.9436E+04	.9436E+04	.8600E+04
.4000E+00	.1614E+04	.1614E+04	.1454E+04	.1166E+05	.1166E+05	.1062E+05	.9438E+04	.9438E+04	.8602E+04
.5000E+00	.1614E+04	.1614E+04	.1454E+04	.1166E+05	.1166E+05	.1062E+05	.9439E+04	.9439E+04	.8603E+04
.6000E+00	.1614E+04	.1614E+04	.1454E+04	.1166E+05	.1166E+05	.1062E+05	.9440E+04	.9440E+04	.8604E+04
.7000E+00	.1614E+04	.1614E+04	.1454E+04	.1167E+05	.1167E+05	.1062E+05	.9441E+04	.9441E+04	.8604E+04
.8000E+00	.1614E+04	.1614E+04	.1454E+04	.1167E+05	.1167E+05	.1062E+05	.9441E+04	.9441E+04	.8605E+04
.9000E+00	.1614E+04	.1614E+04	.1454E+04	.1167E+05	.1167E+05	.1062E+05	.9441E+04	.9441E+04	.8605E+04
.1000E+01	.1614E+04	.1614E+04	.1454E+04	.1167E+05	.1167E+05	.1062E+05	.9544E+04	.9299E+04	.8605E+04
.1100E+01	.1627E+04	.1616E+04	.1454E+04	.1169E+05	.1167E+05	.1062E+05	.9761E+04	.8894E+04	.8597E+04
.1200E+01	.1664E+04	.1631E+04	.1457E+04	.1177E+05	.1170E+05	.1063E+05	.9593E+04	.9181E+04	.8592E+04
.1300E+01	.1674E+04	.1636E+04	.1457E+04	.1185E+05	.1173E+05	.1064E+05	.9542E+04	.9382E+04	.8592E+04
.1400E+01	.1652E+04	.1629E+04	.1455E+04	.1187E+05	.1174E+05	.1063E+05	.9496E+04	.9512E+04	.8594E+04
.1500E+01	.1625E+04	.1621E+04	.1452E+04	.1183E+05	.1173E+05	.1063E+05	.9426E+04	.9545E+04	.8593E+04
.1600E+01	.1612E+04	.1619E+04	.1451E+04	.1178E+05	.1172E+05	.1062E+05	.9375E+04	.9542E+04	.8594E+04
.1700E+01	.1614E+04	.1624E+04	.1452E+04	.1174E+05	.1172E+05	.1062E+05	.9353E+04	.9535E+04	.8594E+04
.1800E+01	.1618E+04	.1628E+04	.1453E+04	.1173E+05	.1173E+05	.1062E+05	.9354E+04	.9531E+04	.8596E+04
.1900E+01	.1621E+04	.1630E+04	.1454E+04	.1172E+05	.1174E+05	.1062E+05	.9365E+04	.9527E+04	.8598E+04
.2000E+01	.1620E+04	.1629E+04	.1454E+04	.1172E+05	.1175E+05	.1062E+05	.9377E+04	.9520E+04	.8601E+04
.2100E+01	.1619E+04	.1627E+04	.1454E+04	.1171E+05	.1175E+05	.1062E+05	.9389E+04	.9510E+04	.8603E+04

Gas Coupled System Hover Time History (Continued)

Step Input Of Roll Control

.2200E+01	.1619E+04	.1623E+04	.1452E+04	.1171E+05	.1174E+05	.1062E+05	.9398E+04	.9496E+04	.8633E+04
.2300E+01	.1619E+04	.1619E+04	.1449E+04	.1170E+05	.1173E+05	.1061E+05	.9407E+04	.9479E+04	[illegible]
.2400E+01	.1619E+04	.1617E+04	.1449E+04	.1170E+05	.1172E+05	.1060E+05	.9413E+04	.9464E+04	.8596E+04
.2500E+01	.1618E+04	.1617E+04	.1450E+04	.1170E+05	.1171E+05	.1060E+05	.9417E+04	.9453E+04	.8595E+04
.2600E+01	.1618E+04	.1617E+04	.1451E+04	.1170E+05	.1170E+05	.1060E+05	.9421E+04	.9443E+04	.8597E+04
.2700E+01	.1617E+04	.1616E+04	.1453E+04	.1169E+05	.1169E+05	.1061E+05	.9424E+04	.9438E+04	.8599E+04
.2800E+01	.1615E+04	.1616E+04	.1456E+04	.1169E+05	.1169E+05	.1061E+05	.9428E+04	.9434E+04	.8606E+04
.2900E+01	.1614E+04	.1616E+04	.1458E+04	.1168E+05	.1169E+05	.1063E+05	.9433E+04	.9432E+04	.8613E+04
.3000E+01	.1614E+04	.1616E+04	.1458E+04	.1168E+05	.1169E+05	.1063E+05	.9437E+04	.9436E+04	.8617E+04
.3100E+01	.1615E+04	.1616E+04	.1457E+04	.1168E+05	.1168E+05	.1064E+05	.9442E+04	.9431E+04	.8618E+04
.3200E+01	.1615E+04	.1615E+04	.1456E+04	.1167E+05	.1168E+05	.1064E+05	[illegible]	.9422E+04	.8616E+04
.3300E+01	.1616E+04	.1614E+04	.1456E+04	.1168E+05	.1168E+05	.1064E+05	.9454E+04	.9415E+04	.8615E+04
.3400E+01	.1616E+04	.1614E+04	.1456E+04	.1168E+05	.1167E+05	.1064E+05	.9460E+04	.9410E+04	.8613E+04
.3500E+01	.1618E+04	.1614E+04	.1455E+04	.1168E+05	.1167E+05	.1064E+05	.9465E+04	.9409E+04	.8613E+04
.3600E+01	.1619E+04	.1615E+04	.1454E+04	.1169E+05	.1167E+05	.1063E+05	.9470E+04	.9410E+04	.8607E+04
.3700E+01	.1619E+04	.1615E+04	.1453E+04	.1169E+05	.1167E+05	.1063E+05	.9472E+04	.9411E+04	.8604E+04
.3800E+01	.1619E+04	.1615E+04	.1453E+04	.1169E+05	.1167E+05	.1063E+05	.9473E+04	.9412E+04	.8603E+04
.3900E+01	.1619E+04	.1615E+04	.1453E+04	.1169E+05	.1167E+05	.1062E+05	.9472E+04	.9412E+04	.8603E+04
.4000E+01	.1619E+04	.1615E+04	.1453E+04	.1169E+05	.1167E+05	.1062E+05	.9472E+04	.9411E+04	.8602E+04
.4100E+01	.1619E+04	.1615E+04	.1453E+04	.1169E+05	.1167E+05	.1062E+05	.9472E+04	.9410E+04	.8602E+04
.4200E+01	.1619E+04	.1615E+04	.1453E+04	.1169E+05	.1167E+05	.1062E+05	.9471E+04	.9410E+04	.8602E+04
.4300E+01	.1619E+04	.1615E+04	.1453E+04	.1169E+05	.1167E+05	.1062E+05	.9471E+04	.9409E+04	.8601E+04
.4400E+01	.1619E+04	.1615E+04	.1453E+04	.1170E+05	.1167E+05	.1062E+05	.9470E+04	.9408E+04	.8601E+04
.4500E+01	.1619E+04	.1615E+04	.1453E+04	.1170E+05	.1167E+05	.1062E+05	.9470E+04	.9407E+04	.8601E+04
.4600E+01	.1619E+04	.1615E+04	.1453E+04	.1170E+05	.1167E+05	.1062E+05	.9469E+04	.9406E+04	.8601E+04
.4700E+01	.1619E+04	.1614E+04	.1453E+04	.1169E+05	.1167E+05	.1062E+05	.9469E+04	.9405E+04	.8600E+04
.4800E+01	.1619E+04	.1614E+04	.1453E+04	.1169E+05	.1167E+05	.1062E+05	.9468E+04	.9405E+04	.8600E+04
.4900E+01	.1619E+04	.1614E+04	.1453E+04	.1169E+05	.1167E+05	.1062E+05	.9467E+04	.9404E+04	.8600E+04
.5000E+01	.1619E+04	.1614E+04	.1453E+04	.1169E+05	.1167E+05	.1062E+05	.9467E+04	.9403E+04	.8600E+04
.5100E+01	.1618E+04	.1614E+04	.1453E+04	.1169E+05	.1167E+05	.1062E+05	.9466E+04	.9403E+04	.8600E+04
.5200E+01	.1618E+04	.1614E+04	.1452E+04	.1169E+05	.1167E+05	.1062E+05	.9466E+04	.9402E+04	.8599E+04
.5300E+01	.1618E+04	.1614E+04	.1452E+04	.1169E+05	.1167E+05	.1062E+05	.9465E+04	.9402E+04	.8599E+04
.5400E+01	.1618E+04	.1614E+04	.1452E+04	.1169E+05	.1167E+05	.1062E+05	.9465E+04	.9401E+04	.8599E+04
.5500E+01	.1618E+04	.1614E+04	.1452E+04	.1169E+05	.1167E+05	.1061E+05	.9464E+04	.9401E+04	.8599E+04
.5600E+01	.1618E+04	.1614E+04	.1452E+04	.1169E+05	.1167E+05	.1061E+05	.9464E+04	.9400E+04	.8599E+04
.5700E+01	.1618E+04	.1614E+04	.1452E+04	.1169E+05	.1167E+05	.1061E+05	.9463E+04	.9400E+04	.8598E+04
.5800E+01	.1618E+04	.1614E+04	.1452E+04	.1169E+05	.1167E+05	.1061E+05	.9463E+04	.9399E+04	.8598E+04
.5900E+01	.1618E+04	.1614E+04	.1452E+04	.1169E+05	.1167E+05	.1061E+05	.9463E+04	.9399E+04	.8598E+04
.6000E+01	.1618E+04	.1614E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9462E+04	.9399E+04	.8598E+04
.6100E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9462E+04	.9398E+04	.8598E+04
.6200E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9462E+04	.9398E+04	.8597E+04
.6300E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9462E+04	.9398E+04	.8597E+04
.6400E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9462E+04	.9397E+04	.8597E+04
.6500E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9461E+04	.9397E+04	.8597E+04
.6600E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9461E+04	.9397E+04	.8597E+04
.6700E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9461E+04	.9397E+04	.8597E+04
.6800E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9461E+04	.9397E+04	.8596E+04
.6900E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9461E+04	.9396E+04	.8596E+04
.7000E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9461E+04	.9396E+04	.8596E+04
.7100E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9461E+04	.9396E+04	.8596E+04
.7200E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9461E+04	.9396E+04	.8596E+04
.7300E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9461E+04	.9396E+04	.8596E+04
.7400E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9461E+04	.9395E+04	.8596E+04
.7500E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9461E+04	.9395E+04	.8596E+04
.7600E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9395E+04	.8595E+04
.7700E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9395E+04	.8595E+04
.7800E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9395E+04	.8595E+04
.7900E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9395E+04	.8595E+04
.8000E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9395E+04	.8595E+04
.8100E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9395E+04	.8595E+04
.8200E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9395E+04	.8595E+04
.8300E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9395E+04	.8595E+04
.8400E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9394E+04	.8595E+04
.8500E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9394E+04	.8595E+04
.8600E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9394E+04	.8595E+04

Gas Coupled System Hover Time History (Continued)

Step Input Of Roll Control

.8700E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9394E+04	.8594E+04
.8800E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9394E+04	.8594E+04
.8900E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9394E+04	.8594E+04
.9000E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9394E+04	.8594E+04
.9100E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9394E+04	.8594E+04
.9200E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9394E+04	.8594E+04
.9300E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9394E+04	.8594E+04
.9400E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9394E+04	.8594E+04
.9500E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9394E+04	.8594E+04
.9600E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9394E+04	.8594E+04
.9700E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9394E+04	.8594E+04
.9800E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9393E+04	.8594E+04
.9900E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9393E+04	.8594E+04
.9990E+01	.1618E+04	.1613E+04	.1452E+04	.1169E+05	.1166E+05	.1061E+05	.9460E+04	.9393E+04	.8594E+04

TIME	XF	YF	ZF	LF	MF	NF	XRAM	YRAM	ZRAM
.1000E+00	.1745E+02	0.	-.2746E+05	0.	-.2804E+02	0.	-.2333E+00	0.	-.1657E+00
.2000E+00	.1073E+02	0.	-.2747E+05	0.	-.1063E+02	0.	-.3208E+00	0.	-.2839E+00
.3000E+00	.8916E+01	0.	-.2747E+05	0.	.5231E+01	0.	-.3833E+00	0.	-.3040E+00
.4000E+00	.8424E+01	0.	-.2748E+05	0.	.1555E+02	0.	-.4393E+00	0.	-.3001E+00
.5000E+00	.8292E+01	0.	-.2748E+05	0.	.2064E+02	0.	-.4935E+00	0.	-.2644E+00
.6000E+00	.8256E+01	0.	-.2743E+05	0.	.2159E+02	0.	-.5470E+00	0.	-.2075E+00
.7000E+00	.8247E+01	0.	-.2749E+05	0.	.1964E+02	0.	-.5598E+00	0.	-.1376E+00
.8000E+00	.8245E+01	0.	-.2749E+05	0.	.1595E+02	0.	-.6513E+00	0.	-.6112E-01
.9000E+00	.8244E+01	0.	-.2749E+05	0.	.1146E+02	0.	-.7011E+00	0.	.1779E-01
.1000E+01	.8232E+01	.1740E-02	-.2745E+05	.1847E+04	.3737E+03	-.1051E-02	-.7489E+00	0.	.9590E-01
.1100E+01	.8173E+01	.3102E+00	-.2729E+05	.6539E+04	.1960E+04	-.1089E+03	-.6508E+00	-.1959E+01	-.3019E-02
.1200E+01	.8208E+01	.6798E+00	-.2737E+05	.3113E+04	.7516E+03	-.2226E+03	-.5140E+00	-.3845E+01	-.2637E+00
.1300E+01	.8253E+01	.8277E+00	-.2752E+05	.1215E+04	-.6235E+03	-.2493E+03	-.3597E+00	-.5862E+01	-.4562E+00
.1400E+01	.8279E+01	.7879E+00	-.2763E+05	-.1132E+03	-.1357E+04	-.2276E+03	-.2790E+00	-.8482E+01	-.4991E+00
.1500E+01	.8267E+01	.5931E+00	-.2758E+05	-.9053E+03	-.1003E+04	-.1760E+03	-.1059E+00	-.1180E+02	-.4476E+00
.1600E+01	.8251E+01	.3637E+00	-.2751E+05	-.1253E+04	-.5317E+03	-.1107E+03	.1324E+00	-.1587E+02	-.3977E+00
.1700E+01	.8243E+01	.1305E+00	-.2748E+05	-.1375E+04	-.2658E+03	-.4074E+02	.4329E+00	-.2164E+02	-.3129E+00
.1800E+01	.8242E+01	-.9599E-01	-.2748E+05	-.1341E+04	-.1976E+03	.2929E+02	.6740E+00	-.2601E+02	-.1759E+00
.1900E+01	.8245E+01	-.3141E+00	-.2740E+05	-.1226E+04	-.2020E+03	.9681E+02	.9273E+00	-.3186E+02	.5177E-01
.2000E+01	.8247E+01	-.5203E+00	-.2750E+05	-.1079E+04	-.1982E+03	.1607E+03	.1154E+01	-.3864E+02	.3670E+00
.2100E+01	.8249E+01	-.7127E+00	-.2753E+05	-.9227E+03	-.1656E+03	.2207E+03	.1352E+01	-.4441E+02	.7522E+00
.2200E+01	.8247E+01	-.6911E+00	-.2750E+05	-.7427E+03	-.1239E+03	.2768E+03	.1516E+01	-.5087E+02	.1175E+01
.2300E+01	.8243E+01	-.1058E+01	-.2749E+05	-.5505E+03	-.1332E+03	.3286E+03	.1639E+01	-.5732E+02	.1549E+01
.2400E+01	.8240E+01	-.1211E+01	-.2747E+05	-.3928E+03	-.1226E+03	.3764E+03	.1718E+01	-.6369E+02	.1839E+01
.2500E+01	.8238E+01	-.1330E+01	-.2747E+05	-.2796E+03	-.6713E+02	.4212E+03	.1751E+01	-.6990E+02	.2080E+01
.2600E+01	.8236E+01	-.1480E+01	-.2745E+05	-.1932E+03	.7927E+01	.4640E+03	.1739E+01	-.7592E+02	.2321E+01
.2700E+01	.8236E+01	-.1602E+01	-.2746E+05	-.1201E+03	.9058E+02	.5049E+03	.1681E+01	-.8170E+02	.2558E+01
.2800E+01	.8237E+01	-.1722E+01	-.2747E+05	-.7169E+02	.2394E+03	.5444E+03	.1583E+01	-.8723E+02	.2918E+01
.2900E+01	.8240E+01	-.1817E+01	-.2747E+05	-.3556E+02	.3638E+03	.5825E+03	.1453E+01	-.9247E+02	.3267E+01
.3000E+01	.8245E+01	-.1933E+01	-.2749E+05	-.7442E+01	.3493E+03	.6193E+03	.1292E+01	-.9741E+02	.3911E+01
.3100E+01	.8245E+01	-.2040E+01	-.2749E+05	.5723E+02	.3658E+03	.6541E+03	.1108E+01	-.1020E+03	.4456E+01
.3200E+01	.8243E+01	-.2137E+01	-.2748E+05	.1639E+03	.3793E+03	.6851E+03	.9105E+00	-.1064E+03	.5026E+01
.3300E+01	.8243E+01	-.2232E+01	-.2748E+05	.2763E+03	.3376E+03	.7145E+03	.7119E+00	-.1104E+03	.5509E+01
.3400E+01	.8243E+01	-.2316E+01	-.2749E+05	.3532E+03	.2944E+03	.7395E+03	.5197E+00	-.1142E+03	.5949E+01
.3500E+01	.8243E+01	-.2412E+01	-.2748E+05	.4044E+03	.1559E+03	.7620E+03	.3402E+00	-.1177E+03	.6337E+01
.3600E+01	.8244E+01	-.2485E+01	-.2749E+05	.4318E+03	.7797E+02	.7825E+03	.1764E+00	-.1209E+03	.6659E+01
.3700E+01	.8244E+01	-.2559E+01	-.2749E+05	.4372E+03	-.5359E+01	.8016E+03	.3201E-01	-.1239E+03	.6924E+01
.3800E+01	.8244E+01	-.2622E+01	-.2749E+05	.4348E+03	-.4292E+02	.8196E+03	-.8551E-01	-.1266E+03	.7156E+01
.3900E+01	.8244E+01	-.2678E+01	-.2749E+05	.4322E+03	-.5158E+02	.8365E+03	-.1875E+00	-.1291E+03	.7372E+01
.4000E+01	.8244E+01	-.2728E+01	-.2749E+05	.4325E+03	-.4932E+02	.8523E+03	-.2639E+00	-.1314E+03	.7576E+01
.4100E+01	.8243E+01	-.2774E+01	-.2748E+05	.4349E+03	-.4466E+02	.8669E+03	-.3216E+00	-.1336E+03	.7777E+01
.4200E+01	.8243E+01	-.2816E+01	-.2749E+05	.4380E+03	-.3914E+02	.8802E+03	-.3640E+00	-.1356E+03	.7968E+01
.4300E+01	.8242E+01	-.2853E+01	-.2748E+05	.4409E+03	-.3233E+02	.8923E+03	-.3944E+00	-.1374E+03	.8153E+01
.4400E+01	.8242E+01	-.2887E+01	-.2749E+05	.4434E+03	-.2415E+02	.9033E+03	-.4155E+00	-.1391E+03	.8332E+01
.4500E+01	.8241E+01	-.2916E+01	-.2748E+05	.4454E+03	-.1529E+02	.9131E+03	-.4301E+00	-.1407E+03	.8506E+01
.4600E+01	.8241E+01	-.2943E+01	-.2748E+05	.4471E+03	-.6229E+01	.9219E+03	-.4409E+00	-.1421E+03	.8676E+01
.4700E+01	.8240E+01	-.2966E+01	-.2747E+05	.4484E+03	.2635E+01	.9297E+03	-.4488E+00	-.1435E+03	.8842E+01

Gas Coupled System Hover Time History (Continued)

Step Input Of Roll Control

.4800E+01	.8240E+01	-.2987E+01	-.2747E+05	.4494E+03	.1114E+02	.9366E+03	-.4570E+00	-.1443E+03	.9003E+01
.4900E+01	.8239E+01	-.3014E+01	-.2747E+05	.4501E+03	.1922E+02	.9427E+03	-.4665E+00	-.1459E+03	.9156E+01
.5000E+01	.8239E+01	-.3026E+01	-.2747E+05	.4506E+03	.2681E+02	.9480E+03	-.4785E+00	-.1470E+03	.9313E+01
.5100E+01	.8238E+01	-.3034E+01	-.2747E+05	.4509E+03	.3386E+02	.9527E+03	-.4941E+00	-.1480E+03	.9462E+01
.5200E+01	.8238E+01	-.3045E+01	-.2747E+05	.4511E+03	.4032E+02	.9568E+03	-.5140E+00	-.1490E+03	.9606E+01
.5300E+01	.8238E+01	-.3055E+01	-.2747E+05	.4512E+03	.4616E+02	.9603E+03	-.5386E+00	-.1499E+03	.9746E+01
.5400E+01	.8237E+01	-.3064E+01	-.2746E+05	.4513E+03	.5136E+02	.9634E+03	-.5684E+00	-.1507E+03	.9881E+01
.5500E+01	.8237E+01	-.3072E+01	-.2746E+05	.4514E+03	.5594E+02	.9660E+03	-.6035E+00	-.1515E+03	.1001E+02
.5600E+01	.8237E+01	-.3078E+01	-.2746E+05	.4515E+03	.5989E+02	.9683E+03	-.6436E+00	-.1522E+03	.1014E+02
.5700E+01	.8236E+01	-.3084E+01	-.2746E+05	.4516E+03	.6325E+02	.9703E+03	-.6893E+00	-.1529E+03	.1026E+02
.5800E+01	.8236E+01	-.3089E+01	-.2746E+05	.4517E+03	.6604E+02	.9720E+03	-.7398E+00	-.1535E+03	.1038E+02
.5900E+01	.8236E+01	-.3093E+01	-.2746E+05	.4519E+03	.6830E+02	.9735E+03	-.7947E+00	-.1541E+03	.1049E+02
.6000E+01	.8236E+01	-.3097E+01	-.2746E+05	.4522E+03	.7007E+02	.9748E+03	-.8539E+00	-.1547E+03	.1059E+02
.6100E+01	.8235E+01	-.3100E+01	-.2746E+05	.4525E+03	.7139E+02	.9759E+03	-.9160E+00	-.1552E+03	.1070E+02
.6200E+01	.8235E+01	-.3103E+01	-.2746E+05	.4529E+03	.7230E+02	.9770E+03	-.9831E+00	-.1557E+03	.1079E+02
.6300E+01	.8235E+01	-.3106E+01	-.2746E+05	.4533E+03	.7286E+02	.9779E+03	-.1052E+01	-.1562E+03	.1089E+02
.6400E+01	.8235E+01	-.3109E+01	-.2746E+05	.4538E+03	.7310E+02	.9787E+03	-.1123E+01	-.1567E+03	.1098E+02
.6500E+01	.8235E+01	-.3111E+01	-.2746E+05	.4543E+03	.7308E+02	.9795E+03	-.1196E+01	-.1571E+03	.1106E+02
.6600E+01	.8234E+01	-.3113E+01	-.2745E+05	.4549E+03	.7283E+02	.9802E+03	-.1271E+01	-.1575E+03	.1114E+02
.6700E+01	.8234E+01	-.3116E+01	-.2745E+05	.4555E+03	.7240E+02	.9808E+03	-.1346E+01	-.1579E+03	.1122E+02
.6800E+01	.8234E+01	-.3118E+01	-.2745E+05	.4562E+03	.7182E+02	.9815E+03	-.1422E+01	-.1582E+03	.1129E+02
.6900E+01	.8234E+01	-.3120E+01	-.2745E+05	.4568E+03	.7114E+02	.9821E+03	-.1497E+01	-.1586E+03	.1136E+02
.7000E+01	.8234E+01	-.3122E+01	-.2745E+05	.4575E+03	.7038E+02	.9828E+03	-.1573E+01	-.1589E+03	.1142E+02
.7100E+01	.8234E+01	-.3124E+01	-.2745E+05	.4582E+03	.6957E+02	.9834E+03	-.1647E+01	-.1592E+03	.1148E+02
.7200E+01	.8234E+01	-.3126E+01	-.2745E+05	.4589E+03	.6874E+02	.9840E+03	-.1721E+01	-.1595E+03	.1154E+02
.7300E+01	.8234E+01	-.3129E+01	-.2745E+05	.4596E+03	.6791E+02	.9847E+03	-.1793E+01	-.1598E+03	.1159E+02
.7400E+01	.8233E+01	-.3131E+01	-.2745E+05	.4603E+03	.6710E+02	.9853E+03	-.1864E+01	-.1601E+03	.1165E+02
.7500E+01	.8233E+01	-.3133E+01	-.2745E+05	.4609E+03	.6632E+02	.9859E+03	-.1934E+01	-.1603E+03	.1169E+02
.7600E+01	.8233E+01	-.3135E+01	-.2745E+05	.4616E+03	.6560E+02	.9866E+03	-.2001E+01	-.1606E+03	.1174E+02
.7700E+01	.8233E+01	-.3137E+01	-.2745E+05	.4622E+03	.6493E+02	.9872E+03	-.2067E+01	-.1608E+03	.1178E+02
.7800E+01	.8233E+01	-.3139E+01	-.2745E+05	.4629E+03	.6433E+02	.9878E+03	-.2131E+01	-.1610E+03	.1182E+02
.7900E+01	.8233E+01	-.3142E+01	-.2745E+05	.4635E+03	.6379E+02	.9885E+03	-.2193E+01	-.1612E+03	.1186E+02
.8000E+01	.8233E+01	-.3144E+01	-.2745E+05	.4640E+03	.6333E+02	.9891E+03	-.2253E+01	-.1614E+03	.1190E+02
.8100E+01	.8233E+01	-.3146E+01	-.2745E+05	.4646E+03	.6295E+02	.9898E+03	-.2311E+01	-.1616E+03	.1193E+02
.8200E+01	.8233E+01	-.3148E+01	-.2745E+05	.4651E+03	.6263E+02	.9904E+03	-.2366E+01	-.1618E+03	.1197E+02
.8300E+01	.8233E+01	-.3150E+01	-.2745E+05	.4656E+03	.6239E+02	.9910E+03	-.2422E+01	-.1619E+03	.1200E+02
.8400E+01	.8233E+01	-.3152E+01	-.2745E+05	.4661E+03	.6221E+02	.9917E+03	-.2475E+01	-.1621E+03	.1203E+02
.8500E+01	.8233E+01	-.3154E+01	-.2745E+05	.4665E+03	.6210E+02	.9923E+03	-.2526E+01	-.1622E+03	.1205E+02
.8600E+01	.8233E+01	-.3156E+01	-.2745E+05	.4669E+03	.6204E+02	.9929E+03	-.2575E+01	-.1624E+03	.1208E+02
.8700E+01	.8233E+01	-.3158E+01	-.2745E+05	.4673E+03	.6204E+02	.9935E+03	-.2623E+01	-.1625E+03	.1211E+02
.8800E+01	.8232E+01	-.3160E+01	-.2745E+05	.4677E+03	.6208E+02	.9941E+03	-.2669E+01	-.1626E+03	.1213E+02
.8900E+01	.8232E+01	-.3161E+01	-.2745E+05	.4680E+03	.6217E+02	.9946E+03	-.2714E+01	-.1628E+03	.1215E+02
.9000E+01	.8232E+01	-.3163E+01	-.2745E+05	.4683E+03	.6229E+02	.9952E+03	-.2756E+01	-.1629E+03	.1217E+02
.9100E+01	.8232E+01	-.3165E+01	-.2745E+05	.4686E+03	.6244E+02	.9957E+03	-.2801E+01	-.1630E+03	.1219E+02
.9200E+01	.8232E+01	-.3166E+01	-.2745E+05	.4689E+03	.6261E+02	.9962E+03	-.2842E+01	-.1631E+03	.1221E+02
.9300E+01	.8232E+01	-.3168E+01	-.2745E+05	.4692E+03	.6280E+02	.9967E+03	-.2883E+01	-.1632E+03	.1223E+02
.9400E+01	.8232E+01	-.3169E+01	-.2745E+05	.4694E+03	.6301E+02	.9972E+03	-.2923E+01	-.1633E+03	.1225E+02
.9500E+01	.8232E+01	-.3171E+01	-.2745E+05	.4696E+03	.6322E+02	.9977E+03	-.2962E+01	-.1634E+03	.1227E+02
.9600E+01	.8232E+01	-.3172E+01	-.2745E+05	.4698E+03	.6344E+02	.9981E+03	-.3000E+01	-.1635E+03	.1228E+02
.9700E+01	.8232E+01	-.3174E+01	-.2745E+05	.4700E+03	.6365E+02	.9986E+03	-.3037E+01	-.1635E+03	.1230E+02
.9800E+01	.8232E+01	-.3175E+01	-.2745E+05	.4702E+03	.6387E+02	.9990E+03	-.3074E+01	-.1636E+03	.1231E+02
.9900E+01	.8232E+01	-.3176E+01	-.2745E+05	.4704E+03	.6408E+02	.9994E+03	-.3111E+01	-.1637E+03	.1233E+02
.9980E+01	.8232E+01	-.3177E+01	-.2745E+05	.4705E+03	.6424E+02	.9997E+03	-.3140E+01	-.1638E+03	.1234E+02

TIME	LRAM	MRAM	NRAM	XAERO	YAERO	ZAERO	LAERO	MAERO	NAERO
.1000E+00	0.	.1442E+01	0.	-.3299E-06	0.	-.1652E-01	0.	.6544E-04	0.
.2000E+00	0.	.2266E+01	0.	-.8291E-06	0.	-.2374E-01	0.	.1508E-03	0.
.3000E+00	0.	.2554E+01	0.	-.1370E-05	0.	-.2819E-01	0.	.1859E-03	0.
.4000E+00	0.	.2447E+01	0.	-.1848E-05	0.	-.3117E-01	0.	.1643E-03	0.
.5000E+00	0.	.2080E+01	0.	-.2198E-05	0.	-.3340E-01	0.	.1028E-03	0.
.6000E+00	0.	.1562E+01	0.	-.2400E-05	0.	-.3539E-01	0.	.2081E-04	0.
.7000E+00	0.	.9782E+00	0.	-.2457E-05	0.	-.3748E-01	0.	-.6629E-04	0.
.8000E+00	0.	.3876E+00	0.	-.2378E-05	0.	-.3985E-01	0.	-.1483E-03	0.

Gas Coupled System Hover Time History (Continued)

Step Input Of Roll Control

.9000E+00	0.	-.1725E+01	0.	-.2172E-05	0.	-.4254E-01	0.	-.2182E-03	0.
.1000E+01	0.	-.6010E+01	0.	-.1852E-05	-.6144E-07	-.4554E-01	.8073E-05	-.2701E-03	.4680E-06
.1100E+01	-.6837E+02	-.1557E+02	-.2460E+02	.5123E-05	-.2997E-01	-.8067E-01	-.1194E+00	-.1423E-01	-.3228E-03
.1200E+01	-.1175E+03	-.2770E+02	-.4315E+02	.7235E-04	-.3527E+01	-.1522E+00	-.1286E+01	-.4872E-01	-.1568E+00
.1300E+01	-.1397E+03	-.2661E+02	-.5602E+02	.2202E-03	-.1218E+02	-.2131E+00	-.3981E+01	-.6715E-01	-.7847E+00
.1400E+01	-.1460E+03	-.1597E+02	-.6902E+02	.4679E-03	-.3115E+02	-.3305E+00	-.9631E+01	-.6531E-01	-.1986E+01
.1500E+01	-.1407E+03	-.4496E+01	-.8403E+02	.7770E-03	-.6147E+02	-.5353E+00	-.1882E+02	-.3039E-01	-.3863E+01
.1600E+01	-.1306E+03	.2396E+01	-.1029E+03	.9775E-03	-.9846E+02	-.8021E+00	-.2949E+02	.3339E-01	-.6007E+01
.1700E+01	-.1186E+03	.5333E+01	-.1260E+03	.8233E-03	-.1387E+03	-.1114E+01	-.4118E+02	.1136E+00	-.8349E+01
.1800E+01	-.1069E+03	.6492E+01	-.1530E+03	.5100E-03	-.1822E+03	-.1461E+01	-.5365E+02	.2140E+00	-.1067E+02
.1900E+01	-.9646E+02	.6348E+01	-.1833E+03	-.3593E-03	-.2287E+03	-.1832E+01	-.6680E+02	.3479E+00	-.1301E+02
.2000E+01	-.8766E+02	.6729E+01	-.2162E+03	-.1772E-02	-.2770E+03	-.2215E+01	-.8032E+02	.5210E+00	-.1527E+02
.2100E+01	-.8356E+02	.6050E+01	-.2508E+03	-.3785E-02	-.3233E+03	-.2603E+01	-.9399E+02	.7279E+00	-.1740E+02
.2200E+01	-.7925E+02	.4723E+01	-.2866E+03	-.6407E-02	-.3757E+03	-.2989E+01	-.1076E+03	.9550E+00	-.1936E+02
.2300E+01	-.7174E+02	.3506E+01	-.3228E+03	-.9622E-02	-.4250E+03	-.3370E+01	-.1212E+03	.1207E+01	-.2114E+02
.2400E+01	-.6997E+02	.3071E+01	-.3589E+03	-.1342E-01	-.4736E+03	-.3738E+01	-.1346E+03	.1486E+01	-.2274E+02
.2500E+01	-.6936E+02	.2522E+01	-.3940E+03	-.1777E-01	-.5211E+03	-.4092E+01	-.1477E+03	.1772E+01	-.2414E+02
.2600E+01	-.6949E+02	.1360E+01	-.4294E+03	-.2256E-01	-.5672E+03	-.4433E+01	-.1604E+03	.2039E+01	-.2535E+02
.2700E+01	-.7014E+02	-.6231E+00	-.4630E+03	-.2773E-01	-.6114E+03	-.4759E+01	-.1725E+03	.2273E+01	-.2639E+02
.2800E+01	-.7109E+02	-.4065E+01	-.4953E+03	-.3307E-01	-.6535E+03	-.5072E+01	-.1840E+03	.2438E+01	-.2725E+02
.2900E+01	-.7214E+02	-.9586E+01	-.5262E+03	-.3833E-01	-.6933E+03	-.5375E+01	-.1948E+03	.2493E+01	-.2795E+02
.3000E+01	-.7310E+02	-.1611E+02	-.5554E+03	-.4328E-01	-.7305E+03	-.5668E+01	-.2049E+03	.2466E+01	-.2852E+02
.3100E+01	-.7425E+02	-.2253E+02	-.5829E+03	-.4790E-01	-.7650E+03	-.5946E+01	-.2142E+03	.2470E+01	-.2898E+02
.3200E+01	-.7580E+02	-.2906E+02	-.6087E+03	-.5206E-01	-.7972E+03	-.6215E+01	-.2230E+03	.2399E+01	-.2933E+02
.3300E+01	-.7833E+02	-.3493E+02	-.6331E+03	-.5561E-01	-.8271E+03	-.6468E+01	-.2313E+03	.2321E+01	-.2962E+02
.3400E+01	-.8147E+02	-.4013E+02	-.6560E+03	-.5853E-01	-.8546E+03	-.6702E+01	-.2390E+03	.2248E+01	-.2985E+02
.3500E+01	-.8493E+02	-.4431E+02	-.6773E+03	-.6085E-01	-.8799E+03	-.6919E+01	-.2461E+03	.2211E+01	-.3003E+02
.3600E+01	-.8846E+02	-.4637E+02	-.6970E+03	-.6271E-01	-.9031E+03	-.7115E+01	-.2528E+03	.2255E+01	-.3018E+02
.3700E+01	-.9185E+02	-.4830E+02	-.7153E+03	-.6431E-01	-.9243E+03	-.7287E+01	-.2588E+03	.2380E+01	-.3029E+02
.3800E+01	-.9497E+02	-.4886E+02	-.7321E+03	-.6579E-01	-.9437E+03	-.7437E+01	-.2644E+03	.2555E+01	-.3037E+02
.3900E+01	-.9779E+02	-.4914E+02	-.7477E+03	-.6721E-01	-.9614E+03	-.7571E+01	-.2695E+03	.2747E+01	-.3041E+02
.4000E+01	-.1004E+03	-.4937E+02	-.7622E+03	-.6862E-01	-.9777E+03	-.7692E+01	-.2742E+03	.2939E+01	-.3043E+02
.4100E+01	-.1027E+03	-.4959E+02	-.7757E+03	-.7001E-01	-.9927E+03	-.7801E+01	-.2785E+03	.3124E+01	-.3043E+02
.4200E+01	-.1049E+03	-.4984E+02	-.7881E+03	-.7143E-01	-.1007E+04	-.7902E+01	-.2824E+03	.3302E+01	-.3041E+02
.4300E+01	-.1070E+03	-.5011E+02	-.7997E+03	-.7283E-01	-.1019E+04	-.7994E+01	-.2861E+03	.3471E+01	-.3039E+02
.4400E+01	-.1089E+03	-.5043E+02	-.8105E+03	-.7423E-01	-.1031E+04	-.8078E+01	-.2894E+03	.3631E+01	-.3035E+02
.4500E+01	-.1107E+03	-.5091E+02	-.8206E+03	-.7565E-01	-.1042E+04	-.8156E+01	-.2925E+03	.3780E+01	-.3031E+02
.4600E+01	-.1124E+03	-.5129E+02	-.8300E+03	-.7706E-01	-.1052E+04	-.8228E+01	-.2954E+03	.3916E+01	-.3026E+02
.4700E+01	-.1139E+03	-.5175E+02	-.8387E+03	-.7847E-01	-.1061E+04	-.8295E+01	-.2980E+03	.4040E+01	-.3020E+02
.4800E+01	-.1153E+03	-.5231E+02	-.8468E+03	-.7986E-01	-.1069E+04	-.8357E+01	-.3005E+03	.4152E+01	-.3014E+02
.4900E+01	-.1167E+03	-.5291E+02	-.8545E+03	-.8123E-01	-.1077E+04	-.8415E+01	-.3028E+03	.4252E+01	-.3008E+02
.5000E+01	-.1179E+03	-.5356E+02	-.8616E+03	-.8257E-01	-.1085E+04	-.8470E+01	-.3049E+03	.4342E+01	-.3002E+02
.5100E+01	-.1190E+03	-.5424E+02	-.8682E+03	-.8389E-01	-.1091E+04	-.8520E+01	-.3069E+03	.4421E+01	-.2995E+02
.5200E+01	-.1201E+03	-.5495E+02	-.8744E+03	-.8516E-01	-.1098E+04	-.8568E+01	-.3087E+03	.4491E+01	-.2989E+02
.5300E+01	-.1211E+03	-.5569E+02	-.8802E+03	-.8639E-01	-.1104E+04	-.8613E+01	-.3104E+03	.4552E+01	-.2982E+02
.5400E+01	-.1220E+03	-.5644E+02	-.8857E+03	-.8758E-01	-.1109E+04	-.8656E+01	-.3120E+03	.4604E+01	-.2976E+02
.5500E+01	-.1228E+03	-.5720E+02	-.8908E+03	-.8873E-01	-.1114E+04	-.8695E+01	-.3135E+03	.4651E+01	-.2970E+02
.5600E+01	-.1236E+03	-.5796E+02	-.8956E+03	-.8984E-01	-.1119E+04	-.8734E+01	-.3149E+03	.4691E+01	-.2964E+02
.5700E+01	-.1243E+03	-.5872E+02	-.9001E+03	-.9089E-01	-.1124E+04	-.8771E+01	-.3162E+03	.4725E+01	-.2958E+02
.5800E+01	-.1249E+03	-.5947E+02	-.9044E+03	-.9189E-01	-.1128E+04	-.8805E+01	-.3174E+03	.4755E+01	-.2953E+02
.5900E+01	-.1255E+03	-.6020E+02	-.9083E+03	-.9282E-01	-.1132E+04	-.8838E+01	-.3185E+03	.4780E+01	-.2947E+02
.6000E+01	-.1261E+03	-.6092E+02	-.9121E+03	-.9369E-01	-.1136E+04	-.8869E+01	-.3196E+03	.4802E+01	-.2942E+02
.6100E+01	-.1266E+03	-.6161E+02	-.9156E+03	-.9451E-01	-.1139E+04	-.8898E+01	-.3206E+03	.4821E+01	-.2937E+02
.6200E+01	-.1271E+03	-.6228E+02	-.9190E+03	-.9527E-01	-.1143E+04	-.8926E+01	-.3216E+03	.4837E+01	-.2932E+02
.6300E+01	-.1275E+03	-.6292E+02	-.9221E+03	-.9598E-01	-.1146E+04	-.8953E+01	-.3225E+03	.4851E+01	-.2928E+02
.6400E+01	-.1280E+03	-.6353E+02	-.9250E+03	-.9663E-01	-.1149E+04	-.8979E+01	-.3233E+03	.4864E+01	-.2923E+02
.6500E+01	-.1283E+03	-.6411E+02	-.9278E+03	-.9722E-01	-.1152E+04	-.9003E+01	-.3241E+03	.4876E+01	-.2919E+02
.6600E+01	-.1287E+03	-.6465E+02	-.9305E+03	-.9777E-01	-.1154E+04	-.9026E+01	-.3249E+03	.4887E+01	-.2916E+02
.6700E+01	-.1290E+03	-.6516E+02	-.9329E+03	-.9827E-01	-.1157E+04	-.9048E+01	-.3256E+03	.4897E+01	-.2912E+02
.6800E+01	-.1294E+03	-.6564E+02	-.9353E+03	-.9872E-01	-.1159E+04	-.9069E+01	-.3263E+03	.4907E+01	-.2908E+02
.6900E+01	-.1297E+03	-.6608E+02	-.9375E+03	-.9914E-01	-.1162E+04	-.9088E+01	-.3269E+03	.4917E+01	-.2905E+02
.7000E+01	-.1299E+03	-.6649E+02	-.9396E+03	-.9951E-01	-.1164E+04	-.9107E+01	-.3275E+03	.4927E+01	-.2901E+02
.7100E+01	-.1302E+03	-.6687E+02	-.9416E+03	-.9985E-01	-.1166E+04	-.9125E+01	-.3281E+03	.4937E+01	-.2898E+02
.7200E+01	-.1304E+03	-.6722E+02	-.9434E+03	-.1002E+00	-.1168E+04	-.9141E+01	-.3286E+03	.4948E+01	-.2895E+02
.7300E+01	-.1307E+03	-.6754E+02	-.9452E+03	-.1004E+00	-.1170E+04	-.9157E+01	-.3291E+03	.4958E+01	-.2893E+02

Gas Coupled System Hover Time History (Continued)

Step Input Of Roll Control

.7400E+01	-.1309E+03	-.6784E+02	-.9469E+03	-.1007E+00	-.1171E+04	-.9172E+01	-.3296E+03	.4969E+01	-.2890E+02
.7500E+01	-.1311E+03	-.6810E+02	-.9485E+03	-.1009E+00	-.1173E+04	-.9186E+01	-.3301E+03	.4980E+01	-.2887E+02
.7600E+01	-.1313E+03	-.6834E+02	-.9500E+03	-.1011E+00	-.1175E+04	-.9200E+01	-.3305E+03	.4992E+01	-.2885E+02
.7700E+01	-.1315E+03	-.6856E+02	-.9514E+03	-.1013E+00	-.1176E+04	-.9212E+01	-.3309E+03	.5004E+01	-.2883E+02
.7800E+01	-.1317E+03	-.6876E+02	-.9527E+03	-.1015E+00	-.1177E+04	-.9224E+01	-.3313E+03	.5016E+01	-.2880E+02
.7900E+01	-.1318E+03	-.6894E+02	-.9540E+03	-.1016E+00	-.1179E+04	-.9236E+01	-.3317E+03	.5028E+01	-.2878E+02
.8000E+01	-.1320E+03	-.6910E+02	-.9552E+03	-.1018E+00	-.1180E+04	-.9246E+01	-.3321E+03	.5041E+01	-.2876E+02
.8100E+01	-.1322E+03	-.6925E+02	-.9563E+03	-.1019E+00	-.1181E+04	-.9256E+01	-.3324E+03	.5053E+01	-.2874E+02
.8200E+01	-.1323E+03	-.6938E+02	-.9574E+03	-.1020E+00	-.1182E+04	-.9266E+01	-.3327E+03	.5065E+01	-.2873E+02
.8300E+01	-.1324E+03	-.6950E+02	-.9584E+03	-.1021E+00	-.1183E+04	-.9275E+01	-.3330E+03	.5077E+01	-.2871E+02
.8400E+01	-.1326E+03	-.6961E+02	-.9594E+03	-.1023E+00	-.1184E+04	-.9283E+01	-.3333E+03	.5089E+01	-.2869E+02
.8500E+01	-.1327E+03	-.6971E+02	-.9603E+03	-.1024E+00	-.1185E+04	-.9291E+01	-.3336E+03	.5101E+01	-.2867E+02
.8600E+01	-.1328E+03	-.6980E+02	-.9612E+03	-.1025E+00	-.1186E+04	-.9299E+01	-.3338E+03	.5113E+01	-.2866E+02
.8700E+01	-.1329E+03	-.6988E+02	-.9620E+03	-.1026E+00	-.1187E+04	-.9306E+01	-.3341E+03	.5124E+01	-.2864E+02
.8800E+01	-.1330E+03	-.6996E+02	-.9628E+03	-.1027E+00	-.1188E+04	-.9313E+01	-.3343E+03	.5135E+01	-.2863E+02
.8900E+01	-.1331E+03	-.7003E+02	-.9635E+03	-.1028E+00	-.1189E+04	-.9319E+01	-.3345E+03	.5146E+01	-.2862E+02
.9000E+01	-.1332E+03	-.7010E+02	-.9643E+03	-.1028E+00	-.1190E+04	-.9325E+01	-.3347E+03	.5156E+01	-.2860E+02
.9100E+01	-.1333E+03	-.7016E+02	-.9649E+03	-.1029E+00	-.1190E+04	-.9331E+01	-.3349E+03	.5166E+01	-.2859E+02
.9200E+01	-.1334E+03	-.7021E+02	-.9656E+03	-.1030E+00	-.1191E+04	-.9336E+01	-.3351E+03	.5176E+01	-.2858E+02
.9300E+01	-.1335E+03	-.7027E+02	-.9662E+03	-.1031E+00	-.1192E+04	-.9341E+01	-.3353E+03	.5185E+01	-.2856E+02
.9400E+01	-.1336E+03	-.7032E+02	-.9668E+03	-.1032E+00	-.1192E+04	-.9346E+01	-.3355E+03	.5193E+01	-.2855E+02
.9500E+01	-.1337E+03	-.7037E+02	-.9673E+03	-.1033E+00	-.1193E+04	-.9351E+01	-.3357E+03	.5202E+01	-.2854E+02
.9600E+01	-.1338E+03	-.7041E+02	-.9679E+03	-.1034E+00	-.1193E+04	-.9356E+01	-.3358E+03	.5209E+01	-.2853E+02
.9700E+01	-.1338E+03	-.7046E+02	-.9684E+03	-.1035E+00	-.1194E+04	-.9360E+01	-.3360E+03	.5217E+01	-.2852E+02
.9800E+01	-.1339E+03	-.7050E+02	-.9689E+03	-.1035E+00	-.1194E+04	-.9364E+01	-.3361E+03	.5223E+01	-.2851E+02
.9900E+01	-.1340E+03	-.7054E+02	-.9693E+03	-.1036E+00	-.1195E+04	-.9368E+01	-.3362E+03	.5230E+01	-.2850E+02
.9980E+01	-.1340E+03	-.7057E+02	-.9697E+03	-.1037E+00	-.1195E+04	-.9371E+01	-.3363E+03	.5235E+01	-.2849E+02

TIME	XB	YB	ZB	LB	MB	NB	PDEG	QDEG	RDEG
.1000E+00	.1721E+02	0.	-.2746E+05	0.	-.2659E+02	0.	0.	-.3593E-02	0.
.2000E+00	.1641E+02	0.	-.2747E+05	0.	-.8364E+01	0.	0.	-.5125E-02	0.
.3000E+00	.8533E+01	0.	-.2747E+05	0.	.7785E+01	0.	0.	-.4765E-02	0.
.4000E+00	.7985E+01	0.	-.2748E+05	0.	.1793E+02	0.	0.	-.3091E-02	0.
.5000E+00	.7798E+01	0.	-.2748E+05	0.	.2272E+02	0.	0.	-.7281E-03	0.
.6000E+00	.7709E+01	0.	-.2748E+05	0.	.2315E+02	0.	0.	.1814E-02	0.
.7000E+00	.7647E+01	0.	-.2749E+05	0.	.2061E+02	0.	0.	.4167E-02	0.
.8000E+00	.7594E+01	0.	-.2749E+05	0.	.1634E+02	0.	0.	.6102E-02	0.
.9000E+00	.7543E+01	0.	-.2749E+05	0.	.1129E+02	0.	0.	.7534E-02	0.
.1000E+01	.7483E+01	.1740E-02	-.2745E+05	.1847E+04	.3730E+03	-.1051E-02	.2102E+00	.2372E-01	.8019E-02
.1100E+01	.7523E+01	-.1679E+01	-.2725E+05	.6470E+04	.1944E+04	-.1335E+03	.2252E+01	.2234E+00	.7889E-01
.1200E+01	.7694E+01	-.6693E+01	-.2737E+05	.2994E+04	.7239E+03	-.2659E+03	.3441E+01	.3485E+00	.1023E+00
.1300E+01	.7853E+01	-.1721E+02	-.2752E+05	.1071E+04	-.6472E+03	-.3061E+03	.3876E+01	.3187E+00	.9394E-01
.1400E+01	.8000E+01	-.3894E+02	-.2760E+05	-.2658E+03	-.1373E+04	-.2986E+03	.3914E+01	.1862E+00	.6872E-01
.1500E+01	.8162E+01	-.7267E+02	-.2757E+05	-.1065E+04	-.1007E+04	-.2639E+03	.3650E+01	.6069E-01	.3488E-01
.1600E+01	.8384E+01	-.1140E+03	-.2751E+05	-.1413E+04	-.5293E+03	-.2196E+03	.3254E+01	-.1287E-01	-.6408E-04
.1700E+01	.8646E+01	-.1592E+03	-.2743E+05	-.1535E+04	-.2603E+03	-.1750E+03	.2803E+01	-.4933E-01	-.3315E-01
.1800E+01	.8917E+01	-.2033E+03	-.2748E+05	-.1501E+04	-.1909E+03	-.1343E+03	.2351E+01	-.7229E-01	-.6259E-01
.1900E+01	.9172E+01	-.2610E+03	-.2749E+05	-.1389E+04	-.1948E+03	-.9949E+02	.1926E+01	-.9401E-01	-.8803E-01
.2000E+01	.9400E+01	-.3158E+03	-.2750E+05	-.1247E+04	-.1910E+03	-.7076E+02	.1542E+01	-.1157E+00	-.1092E+00
.2100E+01	.9596E+01	-.3714E+03	-.2750E+05	-.1097E+04	-.1588E+03	-.4792E+02	.1202E+01	-.1348E+00	-.1267E+00
.2200E+01	.9756E+01	-.4275E+03	-.2750E+05	-.9255E+03	-.1183E+03	-.2910E+02	.9114E+00	-.1489E+00	-.1405E+00
.2300E+01	.9873E+01	-.4834E+03	-.2749E+05	-.7435E+03	-.1284E+03	-.1526E+02	.6745E+00	-.1628E+00	-.1511E+00
.2400E+01	.9945E+01	-.5385E+03	-.2748E+05	-.5973E+03	-.1180E+03	-.5225E+01	.4650E+00	-.1765E+00	-.1589E+00
.2500E+01	.9971E+01	-.5924E+03	-.2747E+05	-.4966E+03	-.6284E+02	.2529E+01	.3293E+00	-.1856E+00	-.1648E+00
.2600E+01	.9953E+01	-.6446E+03	-.2746E+05	-.4230E+03	.1133E+02	.9260E+01	.1975E+00	-.1869E+00	-.1692E+00
.2700E+01	.9890E+01	-.6947E+03	-.2746E+05	-.3627E+03	.9223E+02	.1556E+02	.8490E-01	-.1797E+00	-.1722E+00
.2800E+01	.9787E+01	-.7425E+03	-.2747E+05	-.3268E+03	.2368E+03	.2184E+02	-.1473E-01	-.1589E+00	-.1744E+00
.2900E+01	.9655E+01	-.7876E+03	-.2748E+05	-.3029E+03	.3567E+03	.2842E+02	-.1061E+00	-.1230E+00	-.1756E+00
.3000E+01	.9494E+01	-.8298E+03	-.2749E+05	-.2855E+03	.3357E+03	.3545E+02	-.1928E+00	-.8482E-01	-.1761E+00
.3100E+01	.9303E+01	-.8691E+03	-.2749E+05	-.2312E+03	.3457E+03	.4230E+02	-.2663E+00	-.4857E-01	-.1755E+00
.3200E+01	.9102E+01	-.9057E+03	-.2749E+05	-.1350E+03	.3526E+03	.4804E+02	-.3159E+00	-.9164E-02	-.1735E+00
.3300E+01	.8899E+01	-.9398E+03	-.2748E+05	-.3131E+02	.3050E+03	.5173E+02	-.3329E+00	.2569E-01	-.1698E+00
.3400E+01	.8704E+01	-.9711E+03	-.2748E+05	.3278E+02	.2565E+03	.5365E+02	-.3278E+00	.5569E-01	-.1651E+00

Gas Coupled System Hover Time History (Continued)

Step Input Of Roll Control

.3500E+01	.8522E+01	[illegible]	-.2749E+05	.7332E+02	.1538E+03	.6465E+02	-.3068E+00	.7630E-01	-.1597E+00
.3600E+01	.8357E+01	-.1026E+04	-.2749E+05	.8957E+02	.3325E+02	.6530E+02	-.2824E+00	.8383E-01	-.1540E+00
.3700E+01	.8212E+01	-.1051E+04	-.2749E+05	.8654E+02	-.5128E+02	.5605E+02	-.2555E+00	.8072E-01	-.1482E+00
.3800E+01	.8089E+01	-.1073E+04	-.2749E+05	.7545E+02	-.8923E+02	.5709E+02	-.2314E+00	.7198E-01	-.1425E+00
.3900E+01	.7989E+01	-.1093E+04	-.2749E+05	.6493E+02	-.9798E+02	.5836E+02	-.2106E+00	.6148E-01	-.1366E+00
.4000E+01	.7911E+01	-.1112E+04	-.2749E+05	.5791E+02	-.9575E+02	.5966E+02	-.1922E+00	.5095E-01	-.1313E+00
.4100E+01	.7851E+01	-.1129E+04	-.2748E+05	.5365E+02	-.9113E+02	.6080E+02	-.1752E+00	.4086E-01	-.1252E+00
.4200E+01	.7807E+01	-.1145E+04	-.2748E+05	.5059E+02	-.8568E+02	.6167E+02	-.1592E+00	.3134E-01	-.1194E+00
.4300E+01	.7775E+01	-.1159E+04	-.2748E+05	.4782E+02	-.7697E+02	.6220E+02	-.1441E+00	.2253E-01	-.1136E+00
.4400E+01	.7752E+01	-.1173E+04	-.2748E+05	.4504E+02	-.7099E+02	.6237E+02	-.1298E+00	.1449E-01	-.1077E+00
.4500E+01	.7735E+01	-.1185E+04	-.2748E+05	.4221E+02	-.6232E+02	.6218E+02	-.1163E+00	.7412E-02	-.1019E+00
.4600E+01	.7723E+01	-.1197E+04	-.2748E+05	.3937E+02	-.5356E+02	.6164E+02	-.1036E+00	.1286E-02	-.9618E-01
.4700E+01	.7713E+01	-.1207E+04	-.2747E+05	.3651E+02	-.4508E+02	.6077E+02	-.9184E-01	-.3904E-02	-.9055E-01
.4800E+01	.7703E+01	-.1217E+04	-.2747E+05	.3362E+02	-.3731E+02	.5959E+02	-.8053E-01	-.8204E-02	-.8505E-01
.4900E+01	.7692E+01	-.1226E+04	-.2747E+05	.3072E+02	-.2944E+02	.5814E+02	-.7085E-01	-.1165E-01	-.7969E-01
.5000E+01	.7678E+01	-.1235E+04	-.2747E+05	.2784E+02	-.2240E+02	.5645E+02	-.6172E-01	-.1432E-01	-.7451E-01
.5100E+01	.7660E+01	-.1243E+04	-.2747E+05	.2503E+02	-.1596E+02	.5454E+02	-.5342E-01	-.1627E-01	-.6951E-01
.5200E+01	.7639E+01	-.1250E+04	-.2747E+05	.2233E+02	-.1014E+02	.5247E+02	-.4596E-01	-.1766E-01	-.6472E-01
.5300E+01	.7613E+01	-.1257E+04	-.2746E+05	.1975E+02	-.4921E+01	.5025E+02	-.3922E-01	-.1826E-01	-.6014E-01
.5400E+01	.7581E+01	-.1263E+04	-.2746E+05	.1733E+02	-.4741E+00	.4793E+02	-.3338E-01	-.1845E-01	-.5579E-01
.5500E+01	.7545E+01	-.1269E+04	-.2746E+05	.1509E+02	.3387E+01	.4552E+02	-.2819E-01	-.1820E-01	-.5167E-01
.5600E+01	.7503E+01	-.1275E+04	-.2746E+05	.1302E+02	.6621E+01	.4307E+02	-.2364E-01	-.1758E-01	-.4778E-01
.5700E+01	.7456E+01	-.1280E+04	-.2746E+05	.1113E+02	.9255E+01	.4060E+02	-.1971E-01	-.1665E-01	-.4412E-01
.5800E+01	.7404E+01	-.1285E+04	-.2746E+05	.9408E+01	.1133E+02	.3813E+02	-.1633E-01	-.1547E-01	-.4069E-01
.5900E+01	.7341E+01	-.1289E+04	-.2746E+05	.7864E+01	.1288E+02	.3560E+02	-.1345E-01	-.1411E-01	-.3749E-01
.6000E+01	.7288E+01	-.1294E+04	-.2745E+05	.6489E+01	.1395E+02	.3328E+02	-.1102E-01	-.1262E-01	-.3451E-01
.6100E+01	.7224E+01	-.1298E+04	-.2746E+05	.5279E+01	.1459E+02	.3094E+02	-.8987E-02	-.1104E-01	-.3175E-01
.6200E+01	.7157E+01	-.1302E+04	-.2746E+05	.4223E+01	.1486E+02	.2868E+02	-.7310E-02	-.9419E-02	-.2919E-01
.6300E+01	.7087E+01	-.1305E+04	-.2745E+05	.3313E+01	.1479E+02	.2650E+02	-.5941E-02	-.7797E-02	-.2684E-01
.6400E+01	.7015E+01	-.1309E+04	-.2745E+05	.2537E+01	.1444E+02	.2441E+02	-.4839E-02	-.6205E-02	-.2467E-01
.6500E+01	.6941E+01	-.1312E+04	-.2745E+05	.1883E+01	.1385E+02	.2243E+02	-.3963E-02	-.4670E-02	-.2266E-01
.6600E+01	.6866E+01	-.1315E+04	-.2745E+05	.1342E+01	.1307E+02	.2055E+02	-.3280E-02	-.3214E-02	-.2086E-01
.6700E+01	.6790E+01	-.1318E+04	-.2745E+05	.9005E+00	.1213E+02	.1879E+02	-.2755E-02	-.1856E-02	-.1921E-01
.6800E+01	.6714E+01	-.1321E+04	-.2745E+05	.5483E+00	.1109E+02	.1713E+02	-.2364E-02	-.6081E-03	-.1769E-01
.6900E+01	.6637E+01	-.1323E+04	-.2745E+05	.2745E+00	.9972E+01	.1559E+02	-.2076E-02	.5194E-03	-.1632E-01
.7000E+01	.6562E+01	-.1326E+04	-.2745E+05	.6887E-01	.8809E+01	.1416E+02	-.1875E-02	.1521E-02	-.1508E-01
.7100E+01	.6487E+01	-.1328E+04	-.2745E+05	-.7836E-01	.7631E+01	.1284E+02	-.1736E-02	.2394E-02	-.1395E-01
.7200E+01	.6413E+01	-.1330E+04	-.2745E+05	-.1761E+00	.6462E+01	.1163E+02	-.1649E-02	.3139E-02	-.1293E-01
.7300E+01	.6340E+01	-.1333E+04	-.2745E+05	-.2328E+00	.5323E+01	.1052E+02	-.1587E-02	.3758E-02	-.1200E-01
.7400E+01	.6265E+01	-.1335E+04	-.2745E+05	-.2559E+00	.4231E+01	.9505E+01	-.1550E-02	.4256E-02	-.1117E-01
.7500E+01	.6199E+01	-.1336E+04	-.2745E+05	-.2523E+00	.3232E+01	.8585E+01	-.1526E-02	.4644E-02	-.1042E-01
.7600E+01	.6131E+01	-.1338E+04	-.2745E+05	-.2281E+00	.2245E+01	.7752E+01	-.1503E-02	.4916E-02	-.9738E-02
.7700E+01	.6065E+01	-.1340E+04	-.2745E+05	-.1887E+00	.1369E+01	.7001E+01	-.1483E-02	.5094E-02	-.9122E-02
.7800E+01	.6001E+01	-.1342E+04	-.2745E+05	-.1389E+00	.5790E+00	.6328E+01	-.1455E-02	.5182E-02	-.8569E-02
.7900E+01	.5938E+01	-.1343E+04	-.2745E+05	-.8253E-01	-.1217E+00	.5725E+01	-.1418E-02	.5192E-02	-.8066E-02
.8000E+01	.5877E+01	-.1345E+04	-.2745E+05	-.2316E-01	-.7323E+00	.5187E+01	-.1369E-02	.5131E-02	-.7611E-02
.8100E+01	.5820E+01	-.1346E+04	-.2745E+05	.3642E-01	-.1254E+01	.4710E+01	-.1309E-02	.5013E-02	-.7197E-02
.8200E+01	.5763E+01	-.1347E+04	-.2745E+05	.9391E-01	-.1688E+01	.4287E+01	-.1236E-02	.4839E-02	-.6826E-02
.8300E+01	.5709E+01	-.1348E+04	-.2745E+05	.1475E+00	-.2044E+01	.3914E+01	-.1151E-02	.4627E-02	-.6475E-02
.8400E+01	.5656E+01	-.1350E+04	-.2745E+05	.1958E+00	-.2313E+01	.3585E+01	-.1056E-02	.4383E-02	-.6159E-02
.8500E+01	.5605E+01	-.1351E+04	-.2745E+05	.2379E+00	-.2513E+01	.3296E+01	-.9504E-03	.4114E-02	-.5866E-02
.8600E+01	.5555E+01	-.1352E+04	-.2745E+05	.2731E+00	-.2647E+01	.3043E+01	-.8370E-03	.3829E-02	-.5595E-02
.8700E+01	.5507E+01	-.1353E+04	-.2745E+05	.3011E+00	-.2721E+01	.2821E+01	-.7173E-03	.3533E-02	-.5335E-02
.8800E+01	.5461E+01	-.1354E+04	-.2745E+05	.3217E+00	-.2742E+01	.2627E+01	-.5931E-03	.3234E-02	-.5117E-02
.8900E+01	.5415E+01	-.1355E+04	-.2745E+05	.3353E+00	-.2716E+01	.2456E+01	-.4662E-03	.2936E-02	-.4900E-02
.9000E+01	.5372E+01	-.1356E+04	-.2745E+05	.3420E+00	-.2655E+01	.2308E+01	-.3385E-03	.2644E-02	-.4695E-02
.9100E+01	.5329E+01	-.1356E+04	-.2745E+05	.3422E+00	-.2552E+01	.2177E+01	-.2118E-03	.2361E-02	-.4502E-02
.9200E+01	.5287E+01	-.1357E+04	-.2745E+05	.3366E+00	-.2426E+01	.2062E+01	-.8749E-04	.2092E-02	-.4326E-02
.9300E+01	.5248E+01	-.1358E+04	-.2744E+05	.3258E+00	-.2280E+01	.1960E+01	.3283E-04	.1837E-02	-.4146E-02
.9400E+01	.5208E+01	-.1359E+04	-.2744E+05	.3104E+00	-.2118E+01	.1870E+01	.1479E-03	.1600E-02	-.3981E-02
.9500E+01	.5167E+01	-.1359E+04	-.2744E+05	.2912E+00	-.1945E+01	.1789E+01	.2566E-03	.1382E-02	-.3823E-02
.9600E+01	.5129E+01	-.1360E+04	-.2744E+05	.2687E+00	-.1766E+01	.1716E+01	.3581E-03	.1183E-02	-.3672E-02
.9700E+01	.5091E+01	-.1361E+04	-.2744E+05	.2438E+00	-.1586E+01	.1649E+01	.4517E-03	.1004E-02	-.3526E-02
.9800E+01	.5054E+01	-.1361E+04	-.2744E+05	.2170E+00	-.1406E+01	.1588E+01	.5367E-03	.8441E-03	-.3387E-02
.9900E+01	.5018E+01	-.1362E+04	-.2744E+05	.1891E+00	-.1231E+01	.1531E+01	.6129E-03	.7037E-03	-.3252E-02

Gas Coupled System Hover Time History (Continued)

Step Input Of Roll Control

.9960E+01	.4989E+01	-.1362E+04	-.2744E+05	.1662E+00	-.1096E+01	.1489E+01	.6673E-03	-.6049E-03	-.3149E-02
TIME	PHI	THA	PSI	X	Y	H	STLATP	STLONF	PEDALF
.1000E+00	0.	-.1480E-03	0.	.3696E-03	0.	.5000E+02	0.	.4557E-02	0.
.2000E+00	0.	-.5007E-03	0.	.9019E-03	0.	.5000E+02	0.	.4655E-02	0.
.3000E+00	0.	-.1079E-02	0.	.1557E-02	0.	.5000E+02	0.	.4693E-02	0.
.4000E+00	0.	-.1511E-02	0.	.2317E-02	0.	.5000E+02	0.	.4676E-02	0.
.5000E+00	0.	-.1751E-02	0.	.3179E-02	0.	.5000E+02	0.	.4620E-02	0.
.6000E+00	0.	-.1748E-02	0.	.4143E-02	0.	.5000E+02	0.	.4537E-02	0.
.7000E+00	0.	-.1493E-02	0.	.5205E-02	0.	.5000E+02	0.	.4441E-02	0.
.8000E+00	0.	-.1016E-02	0.	.6365E-02	0.	.5000E+02	0.	.4341E-02	0.
.9000E+00	0.	-.3597E-03	0.	.7619E-02	0.	.5000E+02	0.	.4245E-02	0.
.1000E+01	0.	.4139E-03	0.	.8962E-02	0.	.5000E+02	0.	.4157E-02	0.
.1100E+01	.8721E-01	.8036E-02	.3227E-02	.1038E-01	.5941E-04	.5000E+02	.2011E+00	-.2520E-02	-.6102E-04
.1200E+01	.3533E+00	.3574E-01	.1221E-01	.1181E-01	.6841E-03	.4999E+02	.1283E+00	-.9836E-02	-.3476E-02
.1300E+01	.7112E+00	.7047E-01	.2265E-01	.1309E-01	.3995E-02	.4999E+02	.6344E-01	-.1242E-01	-.5261E-02
.1400E+01	.1133E+01	.9860E-01	.3181E-01	.1403E-01	.1130E-01	.4998E+02	.2162E-01	-.1054E-01	-.5412E-02
.1500E+01	.1487E+01	.1130E+00	.3800E-01	.1449E-01	.2472E-01	.4998E+02	-.5482E-02	-.7221E-02	-.4697E-02
.1600E+01	.1841E+01	.1165E+00	.4053E-01	.1441E-01	.4595E-01	.4998E+02	-.1994E-01	-.4948E-02	-.3432E-02
.1700E+01	.2153E+01	.1140E+00	.3943E-01	.1376E-01	.7643E-01	.4998E+02	-.2716E-01	-.3719E-02	-.1959E-02
.1800E+01	.2419E+01	.1085E+00	.3498E-01	.1258E-01	.1173E+00	.4998E+02	-.2971E-01	-.2874E-02	-.4187E-03
.1900E+01	.2641E+01	.1010E+00	.2758E-01	.1089E-01	.1695E+00	.4998E+02	-.2944E-01	-.1947E-02	.1101E-02
.2000E+01	.2822E+01	.9137E-01	.1764E-01	.8751E-02	.2334E+00	.4997E+02	-.2762E-01	-.8333E-03	.2553E-02
.2100E+01	.2966E+01	.7979E-01	.5573E-02	.6220E-02	.3098E+00	.4997E+02	-.2497E-01	.3928E-03	.3922E-02
.2200E+01	.3077E+01	.6657E-01	-.8248E-02	.3367E-02	.3981E+00	.4997E+02	-.2186E-01	.1603E-02	.5207E-02
.2300E+01	.3161E+01	.5218E-01	-.2345E-01	.2745E-03	.4988E+00	.4997E+02	-.1864E-01	.2911E-02	.6450E-02
.2400E+01	.3222E+01	.3525E-01	-.3972E-01	-.2971E-02	.6116E+00	.4997E+02	-.1587E-01	.4384E-02	.7512E-02
.2500E+01	.3266E+01	.1922E-01	-.5679E-01	-.6276E-02	.7360E+00	.4997E+02	-.1366E-01	.5859E-02	.8536E-02
.2600E+01	.3295E+01	.1553E-02	-.7445E-01	-.9541E-02	.8717E+00	.4997E+02	-.1179E-01	.7202E-02	.9580E-02
.2700E+01	.3311E+01	-.1597E-01	-.9250E-01	-.1266E-01	.1018E+01	.4996E+02	-.9941E-02	.8302E-02	.1042E-01
.2800E+01	.3317E+01	-.3240E-01	-.1103E+00	-.1554E-01	.1175E+01	.4996E+02	-.8027E-02	.8938E-02	.1130E-01
.2900E+01	.3312E+01	-.4625E-01	-.1291E+00	-.1809E-01	.1342E+01	.4996E+02	-.5915E-02	.8926E-02	.1215E-01
.3000E+01	.3293E+01	-.5633E-01	-.1473E+00	-.2024E-01	.1518E+01	.4996E+02	-.3440E-02	.8499E-02	.1297E-01
.3100E+01	.3277E+01	-.6275E-01	-.1653E+00	-.2193E-01	.1703E+01	.4996E+02	-.4469E-03	.7936E-02	.1376E-01
.3200E+01	.3249E+01	-.6540E-01	-.1830E+00	-.2313E-01	.1895E+01	.4995E+02	.2793E-02	.7051E-02	.1451E-01
.3300E+01	.3217E+01	-.6427E-01	-.2002E+00	-.2363E-01	.2096E+01	.4995E+02	.5771E-02	.5932E-02	.1518E-01
.3400E+01	.3184E+01	-.5982E-01	-.2168E+00	-.2405E-01	.2303E+01	.4995E+02	.7823E-02	.4785E-02	.1577E-01
.3500E+01	.3151E+01	-.5266E-01	-.2328E+00	-.2382E-01	.2517E+01	.4995E+02	.9107E-02	.3712E-02	.1630E-01
.3600E+01	.3121E+01	-.4387E-01	-.2481E+00	-.2318E-01	.2736E+01	.4995E+02	.9801E-02	.2943E-02	.1678E-01
.3700E+01	.3094E+01	-.3472E-01	-.2629E+00	-.2218E-01	.2961E+01	.4995E+02	.1010E-01	.2518E-02	.1722E-01
.3800E+01	.3069E+01	-.2612E-01	-.2771E+00	-.2098E-01	.3191E+01	.4995E+02	.1023E-01	.2329E-02	.1763E-01
.3900E+01	.3047E+01	-.1849E-01	-.2908E+00	-.1932E-01	.3426E+01	.4995E+02	.1033E-01	.2261E-02	.1802E-01
.4000E+01	.3026E+01	-.1135E-01	-.3040E+00	-.1755E-01	.3665E+01	.4995E+02	.1052E-01	.2252E-02	.1838E-01
.4100E+01	.3007E+01	-.6480E-02	-.3166E+00	-.1560E-01	.3908E+01	.4995E+02	.1072E-01	.2282E-02	.1872E-01
.4200E+01	.2991E+01	-.2391E-02	-.3288E+00	-.1351E-01	.4154E+01	.4995E+02	.1091E-01	.2346E-02	.1903E-01
.4300E+01	.2975E+01	.1421E-02	-.3404E+00	-.1131E-01	.4404E+01	.4995E+02	.1108E-01	.2439E-02	.1933E-01
.4400E+01	.2961E+01	.4011E-02	-.3514E+00	-.9003E-02	.4657E+01	.4995E+02	.1123E-01	.2555E-02	.1958E-01
.4500E+01	.2948E+01	.5777E-02	-.3619E+00	-.6614E-02	.4913E+01	.4995E+02	.1134E-01	.2686E-02	.1981E-01
.4600E+01	.2937E+01	.6842E-02	-.3719E+00	-.4152E-02	.5171E+01	.4995E+02	.1144E-01	.2828E-02	.2002E-01
.4700E+01	.2927E+01	.7292E-02	-.3814E+00	-.1622E-02	.5432E+01	.4995E+02	.1150E-01	.2975E-02	.2021E-01
.4800E+01	.2918E+01	.7221E-02	-.3903E+00	.9726E-03	.5695E+01	.4996E+02	.1155E-01	.3128E-02	.2037E-01
.4900E+01	.2910E+01	.6716E-02	-.3986E+00	.3631E-02	.5960E+01	.4996E+02	.1158E-01	.3279E-02	.2051E-01
.5000E+01	.2904E+01	.5865E-02	-.4065E+00	.6357E-02	.6227E+01	.4996E+02	.1158E-01	.3429E-02	.2064E-01
.5100E+01	.2898E+01	.4742E-02	-.4139E+00	.9154E-02	.6496E+01	.4997E+02	.1158E-01	.3575E-02	.2076E-01
.5200E+01	.2893E+01	.3418E-02	-.4207E+00	.1203E-01	.6767E+01	.4997E+02	.1156E-01	.3714E-02	.2086E-01
.5300E+01	.2888E+01	.1960E-02	-.4272E+00	.1499E-01	.7039E+01	.4997E+02	.1154E-01	.3846E-02	.2095E-01
.5400E+01	.2884E+01	.4234E-03	-.4331E+00	.1803E-01	.7313E+01	.4998E+02	.1151E-01	.3970E-02	.2102E-01
.5500E+01	.2881E+01	-.1140E-02	-.4387E+00	.2118E-01	.7588E+01	.4998E+02	.1148E-01	.4084E-02	.2108E-01
.5600E+01	.2879E+01	-.2685E-02	-.4438E+00	.2443E-01	.7865E+01	.4998E+02	.1146E-01	.4188E-02	.2114E-01
.5700E+01	.2876E+01	-.4183E-02	-.4486E+00	.2780E-01	.8142E+01	.4999E+02	.1142E-01	.4283E-02	.2119E-01
.5800E+01	.2875E+01	-.5536E-02	-.4529E+00	.3129E-01	.8421E+01	.5000E+02	.1139E-01	.4366E-02	.2126E-01
.5900E+01	.2873E+01	-.6902E-02	-.4570E+00	.3490E-01	.8701E+01	.5000E+02	.1137E-01	.4440E-02	.2130E-01
.6000E+01	.2872E+01	-.8034E-02	-.4607E+00	.3866E-01	.8982E+01	.5001E+02	.1135E-01	.4504E-02	.2132E-01

Gas Coupled System Hover Time History (Continued)

Step Input Of Roll Control

TIME	STLAT	STLON	PEDAL	AILERON	STAB	RUDDER	THV1	THV2	THV3
.6100E+01	.2871E+01	-.9123E-02	-.4641E+00	.4254E-01	.9264E+01	.5002E+02	.1133E-01	.4658E-02	.2135E-01
.6200E+01	.2870E+01	-.1003E-01	-.4673E+00	.4658E-01	.9547E+01	.5002E+02	.1131E-01	.4664E-02	.2137E-01
.6300E+01	.2868E+01	-.1078E-01	-.4702E+00	.5076E-01	.9831E+01	.5003E+02	.1130E-01	.4641E-02	.2139E-01
.6400E+01	.2868E+01	-.1138E-01	-.4723E+00	.5509E-01	.1012E+02	.5003E+02	.1129E-01	.4670E-02	.2141E-01
.6500E+01	.2868E+01	-.1183E-01	-.4752E+00	.5958E-01	.1040E+02	.5004E+02	.1129E-01	.4692E-02	.2143E-01
.6600E+01	.2868E+01	-.1214E-01	-.4775E+00	.6422E-01	.1069E+02	.5005E+02	.1128E-01	.4708E-02	.2144E-01
.6700E+01	.2867E+01	-.1232E-01	-.4795E+00	.6901E-01	.1097E+02	.5005E+02	.1129E-01	.4719E-02	.2146E-01
.6800E+01	.2867E+01	-.1237E-01	-.4814E+00	.7396E-01	.1126E+02	.5006E+02	.1129E-01	.4725E-02	.2147E-01
.6900E+01	.2867E+01	-.1231E-01	-.4831E+00	.7906E-01	.1155E+02	.5006E+02	.1130E-01	.4726E-02	.2149E-01
.7000E+01	.2867E+01	-.1215E-01	-.4847E+00	.8431E-01	.1184E+02	.5007E+02	.1131E-01	.4725E-02	.2150E-01
.7100E+01	.2867E+01	-.1190E-01	-.4862E+00	.8971E-01	.1213E+02	.5008E+02	.1132E-01	.4720E-02	.2151E-01
.7200E+01	.2866E+01	-.1157E-01	-.4875E+00	.9525E-01	.1242E+02	.5008E+02	.1133E-01	.4714E-02	.2153E-01
.7300E+01	.2866E+01	-.1117E-01	-.4888E+00	.1009E+00	.1271E+02	.5009E+02	.1134E-01	.4705E-02	.2154E-01
.7400E+01	.2866E+01	-.1072E-01	-.4899E+00	.1068E+00	.1300E+02	.5010E+02	.1136E-01	.4696E-02	.2156E-01
.7500E+01	.2866E+01	-.1023E-01	-.4910E+00	.1127E+00	.1329E+02	.5010E+02	.1138E-01	.4686E-02	.2157E-01
.7600E+01	.2866E+01	-.9715E-02	-.4920E+00	.1188E+00	.1358E+02	.5011E+02	.1139E-01	.4676E-02	.2158E-01
.7700E+01	.2866E+01	-.9161E-02	-.4929E+00	.1251E+00	.1387E+02	.5012E+02	.1141E-01	.4665E-02	.2160E-01
.7800E+01	.2865E+01	-.8604E-02	-.4938E+00	.1314E+00	.1416E+02	.5012E+02	.1143E-01	.4655E-02	.2161E-01
.7900E+01	.2865E+01	-.8044E-02	-.4946E+00	.1379E+00	.1446E+02	.5013E+02	.1145E-01	.4646E-02	.2163E-01
.8000E+01	.2865E+01	-.7487E-02	-.4954E+00	.1445E+00	.1475E+02	.5014E+02	.1146E-01	.4637E-02	.2164E-01
.8100E+01	.2865E+01	-.6940E-02	-.4961E+00	.1512E+00	.1504E+02	.5014E+02	.1148E-01	.4629E-02	.2166E-01
.8200E+01	.2865E+01	-.6405E-02	-.4968E+00	.1580E+00	.1534E+02	.5015E+02	.1150E-01	.4622E-02	.2167E-01
.8300E+01	.2865E+01	-.5890E-02	-.4974E+00	.1649E+00	.1563E+02	.5016E+02	.1151E-01	.4616E-02	.2168E-01
.8400E+01	.2865E+01	-.5412E-02	-.4980E+00	.1720E+00	.1593E+02	.5016E+02	.1153E-01	.4612E-02	.2170E-01
.8500E+01	.2865E+01	-.4951E-02	-.4986E+00	.1791E+00	.1622E+02	.5017E+02	.1154E-01	.4608E-02	.2171E-01
.8600E+01	.2864E+01	-.4520E-02	-.4992E+00	.1863E+00	.1652E+02	.5018E+02	.1155E-01	.4605E-02	.2172E-01
.8700E+01	.2864E+01	-.4119E-02	-.4997E+00	.1936E+00	.1681E+02	.5018E+02	.1157E-01	.4603E-02	.2174E-01
.8800E+01	.2864E+01	-.3748E-02	-.5002E+00	.2010E+00	.1711E+02	.5019E+02	.1158E-01	.4603E-02	.2175E-01
.8900E+01	.2864E+01	-.3405E-02	-.5007E+00	.2085E+00	.1740E+02	.5020E+02	.1159E-01	.4603E-02	.2176E-01
.9000E+01	.2864E+01	-.3101E-02	-.5012E+00	.2160E+00	.1770E+02	.5021E+02	.1160E-01	.4604E-02	.2177E-01
.9100E+01	.2864E+01	-.2822E-02	-.5016E+00	.2237E+00	.1799E+02	.5021E+02	.1161E-01	.4605E-02	.2179E-01
.9200E+01	.2864E+01	-.2572E-02	-.5021E+00	.2314E+00	.1829E+02	.5022E+02	.1162E-01	.4607E-02	.2180E-01
.9300E+01	.2864E+01	-.2350E-02	-.5025E+00	.2392E+00	.1859E+02	.5023E+02	.1162E-01	.4610E-02	.2181E-01
.9400E+01	.2864E+01	-.2153E-02	-.5029E+00	.2471E+00	.1888E+02	.5024E+02	.1163E-01	.4613E-02	.2182E-01
.9500E+01	.2864E+01	-.1980E-02	-.5033E+00	.2551E+00	.1918E+02	.5024E+02	.1164E-01	.4617E-02	.2183E-01
.9600E+01	.2864E+01	-.1829E-02	-.5036E+00	.2631E+00	.1948E+02	.5025E+02	.1164E-01	.4621E-02	.2184E-01
.9700E+01	.2864E+01	-.1698E-02	-.5040E+00	.2712E+00	.1977E+02	.5026E+02	.1165E-01	.4625E-02	.2185E-01
.9800E+01	.2864E+01	-.1585E-02	-.5043E+00	.2794E+00	.2007E+02	.5027E+02	.1165E-01	.4629E-02	.2186E-01
.9900E+01	.2864E+01	-.1489E-02	-.5047E+00	.2876E+00	.2037E+02	.5027E+02	.1166E-01	.4633E-02	.2187E-01
.9980E+01	.2864E+01	-.1422E-02	-.5049E+00	.2942E+00	.2061E+02	.5028E+02	.1166E-01	.4637E-02	.2187E-01

TIME	STLAT	STLON	PEDAL	AILERON	STAB	RUDDER	THV1	THV2	THV3
.1000E+00	0.	0.	0.	0.	-.1356E+00	0.	.1446E+00	.1446E+00	0.
.2000E+00	0.	0.	0.	0.	-.1389E+00	0.	.1482E+00	.1482E+00	0.
.3000E+00	0.	0.	0.	0.	-.1406E+00	0.	.1500E+00	.1500E+00	0.
.4000E+00	0.	0.	0.	0.	-.1406E+00	0.	.1499E+00	.1499E+00	0.
.5000E+00	0.	0.	0.	0.	-.1392E+00	0.	.1485E+00	.1485E+00	0.
.6000E+00	0.	0.	0.	0.	-.1369E+00	0.	.1460E+00	.1460E+00	0.
.7000E+00	0.	0.	0.	0.	-.1341E+00	0.	.1430E+00	.1430E+00	0.
.8000E+00	0.	0.	0.	0.	-.1311E+00	0.	.1399E+00	.1399E+00	0.
.9000E+00	0.	0.	0.	0.	-.1282E+00	0.	.1367E+00	.1367E+00	0.
.1000E+01	.9999E-01	0.	0.	.1207E+01	-.1255E+00	0.	.1191E+00	.1513E+01	.2358E+01
.1100E+01	.9999E-01	0.	0.	.4610E+01	.1159E-02	.6351E-01	.1527E-01	.5589E+01	.9211E+01
.1200E+01	.9999E-01	0.	0.	.2419E+01	.2381E+00	.1365E+00	0.	.2994E+01	.5195E+01
.1300E+01	.9999E-01	0.	0.	.9841E+00	.3617E+00	.1566E+00	0.	.1217E+01	.2563E+01
.1400E+01	.9999E-01	0.	0.	.4651E-01	.3419E+00	.1455E+00	.5627E-01	.1143E+00	.8688E+00
.1500E+01	.9999E-01	0.	0.	-.4930E+00	.2451E+00	.1145E+00	.6045E+00	0.	.1390E+01
.1600E+01	.9999E-01	0.	0.	-.7639E+00	.1659E+00	.7347E-01	.9453E+00	0.	.1804E+01
.1700E+01	.9999E-01	0.	0.	-.8772E+00	.1209E+00	.2866E-01	.1088E+01	0.	.1955E+01
.1800E+01	.9999E-01	0.	0.	-.8904E+00	.9366E-01	-.1679E-01	.1102E+01	0.	.1936E+01
.1900E+01	.9999E-01	0.	0.	-.8476E+00	.6719E-01	-.6090E-01	.1049E+01	0.	.1837E+01
.2000E+01	.9999E-01	0.	0.	-.7744E+00	.3540E-01	-.1028E+00	.9586E+00	0.	.1605E+01
.2100E+01	.9999E-01	0.	0.	-.6844E+00	-.6191E-03	-.1423E+00	.8510E+00	.4176E-02	.1374E+01

Gas Coupled System Hover Time History (Continued)

Step Input Of Roll Control

.2200E+01	.9999E-01	0.	0.	-.5877E+00	-.3721E-01	-.1793E+00	.7626E+00	.3964E-01	.1168E+01
.2300E+01	.9999E-01	0.	0.	-.4996E+00	-.7511E-01	-.2137E+00	.6910E+00	.8312E-01	.9869E+00
.2400E+01	.9999E-01	0.	0.	-.4290E+00	-.1180E+00	-.2453E+00	.6467E+00	.1259E+00	.8413E+00
.2500E+01	.9999E-01	0.	0.	-.3705E+00	-.1629E+00	-.2750E+00	.6201E+00	.1738E+00	.7209E+00
.2600E+01	.9999E-01	0.	0.	-.3150E+00	-.2046E+00	-.3032E+00	.5954E+00	.2182E+00	.6188E+00
.2700E+01	.9999E-01	0.	0.	-.2582E+00	-.2398E+00	-.3302E+00	.5628E+00	.2558E+00	.3630E-01
.2800E+01	.9999E-01	0.	0.	-.1972E+00	-.2644E+00	-.3561E+00	.5184E+00	.2820E+00	0.
.2900E+01	.9999E-01	0.	0.	-.1264E+00	-.2696E+00	-.3811E+00	.4371E+00	.2876E+00	0.
.3000E+01	.9999E-01	0.	0.	-.4150E-01	-.2594E+00	-.4053E+00	.3264E+00	.2762E+00	0.
.3100E+01	.9999E-01	0.	0.	.5465E-01	-.2438E+00	-.4283E+00	.2601E+00	.3253E+00	0.
.3200E+01	.9999E-01	0.	0.	.1480E+00	-.2191E+00	-.4496E+00	.2337E+00	.4122E+00	0.
.3300E+01	.9999E-01	0.	0.	.2187E+00	-.1878E+00	-.4685E+00	.2003E+00	.4626E+00	.9120E-01
.3400E+01	.9999E-01	0.	0.	.2633E+00	-.1540E+00	-.4852E+00	.1643E+00	.4819E+00	.5137E+00
.3500E+01	.9999E-01	0.	0.	.2890E+00	-.1215E+00	-.5001E+00	.1285E+00	.4791E+00	.5665E+00
.3600E+01	.9999E-01	0.	0.	.3010E+00	-.9434E-01	-.5137E+00	.1006E+00	.4673E+00	.5926E+00
.3700E+01	.9999E-01	0.	0.	.3060E+00	-.7865E-01	-.5264E+00	.8389E-01	.4578E+00	.6040E+00
.3800E+01	.9999E-01	0.	0.	.3095E+00	-.7117E-01	-.5382E+00	.7562E-01	.4544E+00	.6117E+00
.3900E+01	.9999E-01	0.	0.	.3141E+00	-.6826E-01	-.5494E+00	.7281E-01	.4572E+00	.6213E+00
.4000E+01	.9999E-01	0.	0.	.3197E+00	-.6754E-01	-.5598E+00	.7205E-01	.4634E+00	.6322E+00
.4100E+01	.9999E-01	0.	0.	.3256E+00	-.6810E-01	-.5694E+00	.7264E-01	.4711E+00	.6437E+00
.4200E+01	.9999E-01	0.	0.	.3309E+00	-.6971E-01	-.5782E+00	.7436E-01	.4793E+00	.6542E+00
.4300E+01	.9999E-01	0.	0.	.3355E+00	-.7226E-01	-.5861E+00	.7708E-01	.4875E+00	.6636E+00
.4400E+01	.9999E-01	0.	0.	.3393E+00	-.7555E-01	-.5933E+00	.8059E-01	.4954E+00	.6701E+00
.4500E+01	.9999E-01	0.	0.	.3423E+00	-.7937E-01	-.5998E+00	.8467E-01	.5028E+00	.6755E+00
.4600E+01	.9999E-01	0.	0.	.3445E+00	-.8355E-01	-.6056E+00	.8912E-01	.5097E+00	.6795E+00
.4700E+01	.9999E-01	0.	0.	.3461E+00	-.8794E-01	-.6108E+00	.9381E-01	.5160E+00	.6821E+00
.4800E+01	.9999E-01	0.	0.	.3471E+00	-.9246E-01	-.6153E+00	.9863E-01	.5217E+00	.6835E+00
.4900E+01	.9999E-01	0.	0.	.3476E+00	-.9702E-01	-.6193E+00	.1035E+00	.5268E+00	.6839E+00
.5000E+01	.9999E-01	0.	0.	.3476E+00	-.1015E+00	-.6229E+00	.1082E+00	.5314E+00	.6835E+00
.5100E+01	.9999E-01	0.	0.	.3474E+00	-.1059E+00	-.6260E+00	.1130E+00	.5355E+00	.6825E+00
.5200E+01	.9999E-01	0.	0.	.3469E+00	-.1102E+00	-.6287E+00	.1175E+00	.5391E+00	.6811E+00
.5300E+01	.9999E-01	0.	0.	.3462E+00	-.1142E+00	-.6310E+00	.1218E+00	.5423E+00	.6793E+00
.5400E+01	.9999E-01	0.	0.	.3454E+00	-.1180E+00	-.6330E+00	.1259E+00	.5452E+00	.6773E+00
.5500E+01	.9999E-01	0.	0.	.3446E+00	-.1215E+00	-.6348E+00	.1296E+00	.5476E+00	.6752E+00
.5600E+01	.9999E-01	0.	0.	.3437E+00	-.1247E+00	-.6363E+00	.1331E+00	.5498E+00	.6731E+00
.5700E+01	.9999E-01	0.	0.	.3429E+00	-.1277E+00	-.6376E+00	.1362E+00	.5516E+00	.6711E+00
.5800E+01	.9999E-01	0.	0.	.3420E+00	-.1303E+00	-.6388E+00	.1389E+00	.5532E+00	.6692E+00
.5900E+01	.9999E-01	0.	0.	.3413E+00	-.1326E+00	-.6398E+00	.1414E+00	.5546E+00	.6674E+00
.6000E+01	.9999E-01	0.	0.	.3406E+00	-.1346E+00	-.6406E+00	.1435E+00	.5557E+00	.6659E+00
.6100E+01	.9999E-01	0.	0.	.3400E+00	-.1363E+00	-.6414E+00	.1454E+00	.5567E+00	.6645E+00
.6200E+01	.9999E-01	0.	0.	.3395E+00	-.1377E+00	-.6421E+00	.1469E+00	.5576E+00	.6634E+00
.6300E+01	.9999E-01	0.	0.	.3391E+00	-.1389E+00	-.6427E+00	.1482E+00	.5583E+00	.6625E+00
.6400E+01	.9999E-01	0.	0.	.3388E+00	-.1398E+00	-.6432E+00	.1492E+00	.5589E+00	.6619E+00
.6500E+01	.9999E-01	0.	0.	.3386E+00	-.1406E+00	-.6437E+00	.1500E+00	.5594E+00	.6614E+00
.6600E+01	.9999E-01	0.	0.	.3385E+00	-.1411E+00	-.6442E+00	.1505E+00	.5598E+00	.6611E+00
.6700E+01	.9999E-01	0.	0.	.3386E+00	-.1415E+00	-.6447E+00	.1509E+00	.5602E+00	.6611E+00
.6800E+01	.9999E-01	0.	0.	.3387E+00	-.1417E+00	-.6451E+00	.1511E+00	.5605E+00	.6613E+00
.6900E+01	.9999E-01	0.	0.	.3388E+00	-.1418E+00	-.6456E+00	.1512E+00	.5608E+00	.6617E+00
.7000E+01	.9999E-01	0.	0.	.3391E+00	-.1418E+00	-.6460E+00	.1512E+00	.5611E+00	.6622E+00
.7100E+01	.9999E-01	0.	0.	.3394E+00	-.1417E+00	-.6464E+00	.1511E+00	.5614E+00	.6628E+00
.7200E+01	.9999E-01	0.	0.	.3398E+00	-.1415E+00	-.6468E+00	.1509E+00	.5617E+00	.6635E+00
.7300E+01	.9999E-01	0.	0.	.3402E+00	-.1412E+00	-.6472E+00	.1507E+00	.5619E+00	.6644E+00
.7400E+01	.9999E-01	0.	0.	.3407E+00	-.1410E+00	-.6477E+00	.1504E+00	.5622E+00	.6653E+00
.7500E+01	.9999E-01	0.	0.	.3411E+00	-.1407E+00	-.6481E+00	.1500E+00	.5625E+00	.6663E+00
.7600E+01	.9999E-01	0.	0.	.3416E+00	-.1404E+00	-.6485E+00	.1497E+00	.5628E+00	.6673E+00
.7700E+01	.9999E-01	0.	0.	.3422E+00	-.1401E+00	-.6490E+00	.1494E+00	.5631E+00	.6683E+00
.7800E+01	.9999E-01	0.	0.	.3427E+00	-.1397E+00	-.6494E+00	.1491E+00	.5634E+00	.6694E+00
.7900E+01	.9999E-01	0.	0.	.3432E+00	-.1395E+00	-.6498E+00	.1488E+00	.5638E+00	.6704E+00
.8000E+01	.9999E-01	0.	0.	.3437E+00	-.1392E+00	-.6502E+00	.1485E+00	.5642E+00	.6715E+00
.8100E+01	.9999E-01	0.	0.	.3442E+00	-.1389E+00	-.6507E+00	.1482E+00	.5645E+00	.6725E+00
.8200E+01	.9999E-01	0.	0.	.3447E+00	-.1387E+00	-.6511E+00	.1480E+00	.5649E+00	.6735E+00
.8300E+01	.9999E-01	0.	0.	.3452E+00	-.1385E+00	-.6515E+00	.1478E+00	.5653E+00	.6744E+00
.8400E+01	.9999E-01	0.	0.	.3456E+00	-.1384E+00	-.6519E+00	.1476E+00	.5657E+00	.6753E+00
.8500E+01	.9999E-01	0.	0.	.3461E+00	-.1383E+00	-.6523E+00	.1475E+00	.5661E+00	.6762E+00
.8600E+01	.9999E-01	0.	0.	.3465E+00	-.1382E+00	-.6527E+00	.1474E+00	.5665E+00	.6770E+00

Gas Coupled System Hover Time History (Continued)

Step Input Of Roll Control

.8700E+01	.9999E-01	0.	0.	.3469E+00	-.1381E+00	-.6531E+00	.1473E+00	.5669E+00	.6777E+00
.8800E+01	.9999E-01	0.	0.	.3472E+00	-.1381E+00	-.6535E+00	.1473E+00	.5673E+00	.6784E+00
.8900E+01	.9999E-01	0.	0.	.3475E+00	-.1381E+00	-.6539E+00	.1473E+00	.5677E+00	.6791E+00
.9000E+01	.9999E-01	0.	0.	.3479E+00	-.1381E+00	-.6543E+00	.1473E+00	.5681E+00	.6797E+00
.9100E+01	.9999E-01	0.	0.	.3481E+00	-.1381E+00	-.6546E+00	.1473E+00	.5685E+00	.6802E+00
.9200E+01	.9999E-01	0.	0.	.3484E+00	-.1382E+00	-.6550E+00	.1474E+00	.5688E+00	.6807E+00
.9300E+01	.9999E-01	0.	0.	.3486E+00	-.1383E+00	-.6553E+00	.1475E+00	.5692E+00	.6812E+00
.9400E+01	.9999E-01	0.	0.	.3488E+00	-.1384E+00	-.6556E+00	.1476E+00	.5695E+00	.6816E+00
.9500E+01	.9999E-01	0.	0.	.3490E+00	-.1385E+00	-.6559E+00	.1477E+00	.5699E+00	.6821E+00
.9600E+01	.9999E-01	0.	0.	.3492E+00	-.1386E+00	-.6562E+00	.1478E+00	.5702E+00	.6823E+00
.9700E+01	.9999E-01	0.	0.	.3494E+00	-.1387E+00	-.6565E+00	.1480E+00	.5705E+00	.6826E+00
.9800E+01	.9999E-01	0.	0.	.3495E+00	-.1388E+00	-.6568E+00	.1481E+00	.5708E+00	.6829E+00
.9900E+01	.9999E-01	0.	0.	.3497E+00	-.1390E+00	-.6571E+00	.1482E+00	.5711E+00	.6831E+00
.9980E+01	.9999E-01	0.	0.	.3498E+00	-.1391E+00	-.6573E+00	.1483E+00	.5713E+00	.6833E+00

TIME	SIG1	SIG2	SIG3	GAM1	GAM2	GAM3
.1000E+00	.1008E+02	.1008E+02	.9998E+01	0.	0.	0.
.2000E+00	.1008E+02	.1008E+02	.9996E+01	0.	0.	0.
.3000E+00	.1008E+02	.1008E+02	.9995E+01	0.	0.	0.
.4000E+00	.1008E+02	.1008E+02	.9997E+01	0.	0.	0.
.5000E+00	.1008E+02	.1008E+02	.9999E+01	0.	0.	0.
.6000E+00	.1008E+02	.1008E+02	.1000E+02	0.	0.	0.
.7000E+00	.1008E+02	.1008E+02	.1000E+02	0.	0.	0.
.8000E+00	.1008E+02	.1008E+02	.1000E+02	0.	0.	0.
.9000E+00	.1007E+02	.1007E+02	.1000E+02	0.	0.	0.
.1000E+01	.9196E+01	.1143E+02	.1001E+02	.6102E-04	.6102E-04	-.1220E-03
.1100E+01	.7186E+01	.1533E+02	.1009E+02	.1217E-01	.1217E-01	-.2433E-01
.1200E+01	.9441E+01	.1282E+02	.1019E+02	.2449E-01	.2449E-01	-.4899E-01
.1300E+01	.1056E+02	.1115E+02	.1023E+02	.2728E-01	.2728E-01	-.5456E-01
.1400E+01	.1112E+02	.9386E+01	.1021E+02	.2483E-01	.2483E-01	-.4966E-01
.1500E+01	.1148E+02	.9592E+01	.1015E+02	.1918E-01	.1918E-01	-.3837E-01
.1600E+01	.1154E+02	.9546E+01	.1010E+02	.1205E-01	.1205E-01	-.2410E-01
.1700E+01	.1149E+02	.9612E+01	.1007E+02	.4459E-02	.4459E-02	-.8818E-02
.1800E+01	.1137E+02	.9724E+01	.1006E+02	-.3247E-02	-.3247E-02	.6493E-02
.1900E+01	.1123E+02	.9843E+01	.1004E+02	-.1062E-01	-.1062E-01	.2124E-01
.2000E+01	.1107E+02	.9951E+01	.1002E+02	-.1759E-01	-.1759E-01	.3519E-01
.2100E+01	.1092E+02	.1004E+02	.1000E+02	-.2414E-01	-.2414E-01	.4828E-01
.2200E+01	.1079E+02	.1013E+02	.9977E+01	-.3027E-01	-.3027E-01	.6053E-01
.2300E+01	.1069E+02	.1019E+02	.9956E+01	-.3594E-01	-.3594E-01	.7187E-01
.2400E+01	.1061E+02	.1024E+02	.9939E+01	-.4117E-01	-.4117E-01	.8234E-01
.2500E+01	.1056E+02	.1027E+02	.9924E+01	-.4607E-01	-.4607E-01	.9215E-01
.2600E+01	.1051E+02	.1030E+02	.9916E+01	-.5074E-01	-.5074E-01	.1015E+00
.2700E+01	.1045E+02	.1032E+02	.9915E+01	-.5521E-01	-.5521E-01	.1104E+00
.2800E+01	.1039E+02	.1033E+02	.9922E+01	-.5950E-01	-.5950E-01	.1190E+00
.2900E+01	.1031E+02	.1033E+02	.9941E+01	-.6363E-01	-.6363E-01	.1273E+00
.3000E+01	.1025E+02	.1028E+02	.9965E+01	-.6761E-01	-.6761E-01	.1352E+00
.3100E+01	.1014E+02	.1030E+02	.9980E+01	-.7140E-01	-.7140E-01	.1428E+00
.3200E+01	.1010E+02	.1036E+02	.1001E+02	-.7490E-01	-.7490E-01	.1498E+00
.3300E+01	.1002E+02	.1041E+02	.1003E+02	-.7800E-01	-.7800E-01	.1560E+00
.3400E+01	.9984E+01	.1043E+02	.1004E+02	-.8075E-01	-.8075E-01	.1615E+00
.3500E+01	.9964E+01	.1043E+02	.1005E+02	-.8321E-01	-.8321E-01	.1664E+00
.3600E+01	.9961E+01	.1042E+02	.1006E+02	-.8547E-01	-.8547E-01	.1709E+00
.3700E+01	.9969E+01	.1041E+02	.1005E+02	-.8756E-01	-.8756E-01	.1751E+00
.3800E+01	.9981E+01	.1041E+02	.1004E+02	-.8953E-01	-.8953E-01	.1791E+00
.3900E+01	.9991E+01	.1041E+02	.1003E+02	-.9139E-01	-.9139E-01	.1828E+00
.4000E+01	.9999E+01	.1042E+02	.1002E+02	-.9312E-01	-.9312E-01	.1862E+00
.4100E+01	.1001E+02	.1042E+02	.1002E+02	-.9472E-01	-.9472E-01	.1894E+00
.4200E+01	.1001E+02	.1043E+02	.1001E+02	-.9618E-01	-.9618E-01	.1924E+00
.4300E+01	.1002E+02	.1043E+02	.1001E+02	-.9751E-01	-.9751E-01	.1950E+00
.4400E+01	.1002E+02	.1044E+02	.1000E+02	-.9870E-01	-.9870E-01	.1974E+00
.4500E+01	.1003E+02	.1044E+02	.9999E+01	-.9978E-01	-.9978E-01	.1996E+00
.4600E+01	.1004E+02	.1045E+02	.9996E+01	-.1007E+00	-.1007E+00	.2015E+00
.4700E+01	.1004E+02	.1045E+02	.9994E+01	-.1016E+00	-.1016E+00	.2032E+00

Gas Coupled System Hover Time History (Continued)

Step Input Of Roll Control

.4800E+01	.1005E+02	.1046E+02	.9993E+01	-.1024E+00	-.1024E+00	.2047E+00
.4900E+01	.1006E+02	.1046E+02	.9991E+01	-.1030E+00	-.1030E+00	.2061E+00
.5000E+01	.1006E+02	.1046E+02	.9991E+01	-.1036E+00	-.1036E+00	.2072E+00
.5100E+01	.1006E+02	.1047E+02	.9990E+01	-.1041E+00	-.1041E+00	.2083E+00
.5200E+01	.1006E+02	.1047E+02	.9990E+01	-.1046E+00	-.1046E+00	.2092E+00
.5300E+01	.1007E+02	.1047E+02	.9990E+01	-.1050E+00	-.1050E+00	.2099E+00
.5400E+01	.1007E+02	.1047E+02	.9990E+01	-.1053E+00	-.1053E+00	.2106E+00
.5500E+01	.1007E+02	.1047E+02	.9990E+01	-.1056E+00	-.1056E+00	.2112E+00
.5600E+01	.1007E+02	.1047E+02	.9991E+01	-.1059E+00	-.1059E+00	.2117E+00
.5700E+01	.1007E+02	.1047E+02	.9991E+01	-.1061E+00	-.1061E+00	.2122E+00
.5800E+01	.1008E+02	.1047E+02	.9992E+01	-.1063E+00	-.1063E+00	.2125E+00
.5900E+01	.1008E+02	.1047E+02	.9993E+01	-.1064E+00	-.1064E+00	.2129E+00
.6000E+01	.1008E+02	.1047E+02	.9993E+01	-.1066E+00	-.1066E+00	.2132E+00
.6100E+01	.1008E+02	.1047E+02	.9994E+01	-.1067E+00	-.1067E+00	.2134E+00
.6200E+01	.1008E+02	.1047E+02	.9995E+01	-.1068E+00	-.1068E+00	.2136E+00
.6300E+01	.1008E+02	.1047E+02	.9995E+01	-.1069E+00	-.1069E+00	.2138E+00
.6400E+01	.1008E+02	.1047E+02	.9996E+01	-.1070E+00	-.1070E+00	.2140E+00
.6500E+01	.1008E+02	.1047E+02	.9997E+01	-.1071E+00	-.1071E+00	.2142E+00
.6600E+01	.1008E+02	.1047E+02	.9997E+01	-.1072E+00	-.1072E+00	.2144E+00
.6700E+01	.1008E+02	.1047E+02	.9998E+01	-.1073E+00	-.1073E+00	.2145E+00
.6800E+01	.1008E+02	.1048E+02	.9998E+01	-.1073E+00	-.1073E+00	.2147E+00
.6900E+01	.1008E+02	.1048E+02	.9999E+01	-.1074E+00	-.1074E+00	.2148E+00
.7000E+01	.1008E+02	.1048E+02	.9999E+01	-.1075E+00	-.1075E+00	.2149E+00
.7100E+01	.1008E+02	.1048E+02	.9999E+01	-.1075E+00	-.1075E+00	.2151E+00
.7200E+01	.1008E+02	.1048E+02	.1000E+02	-.1076E+00	-.1076E+00	.2152E+00
.7300E+01	.1008E+02	.1048E+02	.1000E+02	-.1077E+00	-.1077E+00	.2154E+00
.7400E+01	.1007E+02	.1048E+02	.1000E+02	-.1078E+00	-.1078E+00	.2155E+00
.7500E+01	.1007E+02	.1048E+02	.1000E+02	-.1078E+00	-.1078E+00	.2157E+00
.7600E+01	.1007E+02	.1048E+02	.1000E+02	-.1079E+00	-.1079E+00	.2158E+00
.7700E+01	.1007E+02	.1048E+02	.1000E+02	-.1080E+00	-.1080E+00	.2159E+00
.7800E+01	.1007E+02	.1048E+02	.1000E+02	-.1080E+00	-.1080E+00	.2161E+00
.7900E+01	.1007E+02	.1048E+02	.1000E+02	-.1081E+00	-.1081E+00	.2162E+00
.8000E+01	.1007E+02	.1048E+02	.1000E+02	-.1082E+00	-.1082E+00	.2164E+00
.8100E+01	.1007E+02	.1048E+02	.1000E+02	-.1083E+00	-.1083E+00	.2165E+00
.8200E+01	.1007E+02	.1048E+02	.1000E+02	-.1083E+00	-.1083E+00	.2166E+00
.8300E+01	.1007E+02	.1048E+02	.1000E+02	-.1084E+00	-.1084E+00	.2168E+00
.8400E+01	.1007E+02	.1048E+02	.1000E+02	-.1085E+00	-.1085E+00	.2169E+00
.8500E+01	.1007E+02	.1048E+02	.1000E+02	-.1085E+00	-.1085E+00	.2171E+00
.8600E+01	.1007E+02	.1048E+02	.1000E+02	-.1086E+00	-.1086E+00	.2172E+00
.8700E+01	.1007E+02	.1048E+02	.1000E+02	-.1087E+00	-.1087E+00	.2173E+00
.8800E+01	.1007E+02	.1048E+02	.1000E+02	-.1087E+00	-.1087E+00	.2175E+00
.8900E+01	.1007E+02	.1048E+02	.1000E+02	-.1088E+00	-.1088E+00	.2176E+00
.9000E+01	.1007E+02	.1048E+02	.1000E+02	-.1089E+00	-.1089E+00	.2177E+00
.9100E+01	.1007E+02	.1048E+02	.1000E+02	-.1089E+00	-.1089E+00	.2178E+00
.9200E+01	.1007E+02	.1048E+02	.1000E+02	-.1090E+00	-.1090E+00	.2179E+00
.9300E+01	.1007E+02	.1048E+02	.1000E+02	-.1090E+00	-.1090E+00	.2180E+00
.9400E+01	.1007E+02	.1049E+02	.1000E+02	-.1091E+00	-.1091E+00	.2182E+00
.9500E+01	.1007E+02	.1049E+02	.1000E+02	-.1091E+00	-.1091E+00	.2183E+00
.9600E+01	.1007E+02	.1049E+02	.1000E+02	-.1092E+00	-.1092E+00	.2184E+00
.9700E+01	.1007E+02	.1049E+02	.1000E+02	-.1092E+00	-.1092E+00	.2184E+00
.9800E+01	.1007E+02	.1049E+02	.1000E+02	-.1093E+00	-.1093E+00	.2185E+00
.9900E+01	.1007E+02	.1049E+02	.1000E+02	-.1093E+00	-.1093E+00	.2186E+00
.9980E+01	.1007E+02	.1049E+02	.1000E+02	-.1093E+00	-.1093E+00	.2187E+00