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PROGRESS REPORT

PERIOD OF 1 SEPTEMBER 1965 TO 30 SEPTEMBER 1965

CONTRACT NUMBER AF33(600)40280

10 November 1965

BY

WESTINGHOUSE ELECTRIC CORPORATION

AEROSPACE DIVISION

P. O. Box 746, Baltimore, Maryland 21203

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A F-101 FLIGHT TEST

FLIGHT TESTS

Four missions were flown in September, producing data of the Wallops Island, Philadelphia, and Washington-Baltimore areas. Specific information on all four flights is tabulated in Appendix A.

Flight 184 was planned as the first of a series of flights simulating altitude and radar conditions of the Field Flight Test. However, after the F-101 was airborne, ground control would allow a maximum altitude of only 35,000 feet and the flight was of no use for altitude comparison. The second flight of this series, flown the same day over the same path at 20,000 feet, was unsuccessful because of a transmitter TWT failure.

The target area for the repeat flights for high altitude simulation was shifted from Philadelphia to Washington-Baltimore on flight 186 because of sonic noise considerations.

TABLE I
F-101 Program Summary
September 1965

Flights Scheduled		12
Flights Accomplished		4
Productive Radar Flights	3	
No Results-Transmitter TWT Failure	1	
Flights Cancelled		8
Weather	3	
Target Area Clearance	1	
Aircraft Problems	1	
Recorder	1	
Transmitter	1	
Receiver	1	

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An intermittent random striping or fading of video recorded on the primary film was noted, similar to the problem experienced in late spring of 1964. Since the deliverable receiver used on this one flight is suspected of being the cause, the breadboard receiver will be installed for the next flight.

Shortly after the end of the radar run on flight 186, a left engine fire warning indication was observed. Post-flight checks revealed an insulating blanket located between the engine and fire warning sensors had been punctured and insulating material displaced. The aircraft has been grounded since the flight, awaiting replacement of the blanket.

DFT operation was checked on flight 183. Up to 15 db attenuation was inserted in the DFT IF amplifier with no noticeable effect on tracker operation. The improvement in DFT operation is due to replacement of a defective transistor in the Frequency Generator as described in the August progress report.

MODIFICATIONS AND GROUND TESTS

Transmitter

The transmitter failure of flight 185 was caused by a grid-to-cathode short within the TWT. This tube was replaced.

Internal arcing of the new TWT caused an overload of diodes in the TWT filament voltage switching circuit. This circuit was modified to switch the diodes out of the circuit prior to the application of the TWT high voltage.

Voltage can now be applied to the vac-ion pump of the TWT during periods of transmitter inactivity to maintain its vacuum without applying full high voltage.

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Transmitter servo lock-up has been improved by molding an external control into a pigmy connector and eliminating the connector cable. The deliverable transmitters have always had this improvement.

Receiver

A defective stalo in the breadboard receiver was discovered prior to flight 186. Receiver 003 was installed in the aircraft. Although ground checks were satisfactory, the striping noted on flight 186 may have been caused by this receiver. After replacing a defective tube and relay, the breadboard receiver was re-installed in the F-101 for the next flight.

Recorder

Film is normally free to slide from side to side over the film take-up roller. However, several days exposure to high humidity caused film to stick to rubber rollers and eventually creep over the roller flanges. This problem was corrected by replacing the rubber take-up roller with an aluminum roller.

After performing the 10-flight recorder adjustment and inspection procedure per T-Spec 787137, the electronics package was modified for 4 kc sweep operation in preparation for the flight simulating field conditions.

KA-45A Camera

The KA-45A was returned to the manufacturer for investigation of the shutter malfunction. No difficulty was noted. Since being returned to Westinghouse, the camera has not operated properly and is still being checked in the laboratory.

Instrumentation

While the aircraft is grounded for the fire warning problems, several instrumentation channels are being calibrated.

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B FIELD FLIGHT TEST

A proposal was submitted in anticipation of the reactivation of the Field Flight Test. Supplementing this proposal is a request for replenishment of spares as they are used and for additional test equipment to test the parametric amplifier now being added to the systems.

C SYSTEM

RECORDER

With the completion of the extensive modifications to the electronic package, all three recorders are now operational. However, the first package used vector boards for initial testing. These will be replaced with printed circuit boards as used on the later two units after Recorder 005 is removed from the F-101 next month.

An Automatic Bias Control (ABC) was included in each of the recorders when delivered by Itek. Because the circuit has been extremely noisy, erratic, and narrow in dynamic range, the ABC has never been operated closed loop to control the average light output of the cathode ray tube, but used only as a CRT light monitor for the failure circuit.

Several months ago, the film gamma was increased to improve overall recorder signal linearity. This reduced the required grid drive to only 10-20 volts peak-to-peak, causing two conditions which dictated improvements to the ABC:

1. Small variations in grid bias or CRT characteristics now cause a significant change in light output and the operating point on the bias-transmission curve.

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2. The more critical recorder set-up makes pre-flight checks all the more important. The present check is a three-point bias check of film density, which requires developing and analyzing the film before correcting set-up. This undesirable time lag should be reduced.

Several changes have been tried on one recorder to improve the ABC performance:

1. The light sensor increased in area by a factor of 7 and placed more advantageously, making a large improvement in the circuit signal/noise ratio
2. Input impedance to the ABC amplifier reduced from 10K to 1 K ohms providing the proper impedance match for the light sensor with improved stability and reduced noise.
3. Input circuit tuned to the system PRF giving somewhat greater gain.
4. Circuitry changed to allow switching from open loop (light meter operation) to closed loop (ABC) operation without requiring a change in the bias adjustment.

Preliminary tests show the circuit to work well in closed loop. A means of adjusting the CRT light output operating point is being developed. Eventually these improvements will be incorporated in all three recorders.

AUTOMATIC GAIN CONTROL

A flyable breadboard of the AGC was built and installed but not connected in the F-101. Flight testing is delayed until sufficient time is available to check out the AGC performance in the receiver.

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TRANSMITTER

Based on the experience with the F-101 tests, three modifications have been designed for the transmitter and are to be incorporated in all three units. These are:

1. Redesign of the TWT filament voltage switching circuit to improve reliability. TWT's are subject to internal arcs under normal operation because of manufacturing imperfections and outgassing. In the past, this arcing has caused some failures in the filament switching circuitry. Simplification of this circuitry, with one component change, has eliminated the failures due to arcing with no change in function.
2. Addition of an external method of applying voltage to the TWT vac-ion pump when the transmitter is charged with SF_6. Adding two high voltage diodes and using a spare BNC connector on the transmitter shell allow the TWT to be vacuum pumped without applying high voltage to the CFA. The vac-ion pump is normally operated full-time when the transmitter is in Run.
3. Addition of a TWT overload circuit to prevent loss of circuit components in the TWT power supply and modulator when an overload occurs. With this change, either a TWT or CFA overload will shut off the transmitter and be indicated by the CFA failure light on the Control Panel. This overload circuit was deemed necessary because a TWT failure in the F-101 transmitter caused the Phase C power supply fuse to blow, which in turn caused the two transmitter heat exchanger blowers, running on only two phases, to overheat and fail.

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LOW NOISE RECEIVER PRE-AMPLIFIER

The parametric amplifiers for the two deliverable units are being assembled now.

ANTENNA

The heat-pressure life test on three array sticks bonded with I-40 resin was discontinued after 600 hours at 550°F and 30 psig internal pressure. The three sticks were then packed in dry ice for three periods of 8 hours each. No leakage was detected from any of the sticks either during or after the test.

During the continuous heat pressure test, large bubbles developed on one stick and small bubbles on another. Examination of the bond area showed that a residue of resin remained on both the fabric and the metal stick surface, thus indicating a resin deterioration. Based on these tests, life expectancy of the seal is 500 to 600 hours at 550°F and 30 psig with no degradation at -65°F.

Bonding of the array sticks for Antenna 002 is complete on five of the six modules. All sticks will undergo a heat-pressure check at 550°F for 8 hours before assembly to the module. Completion of Antenna 002 is planned for 1 November 1965.

The feasibility of electron beam welding the joint between the array stick and the manifolds was discussed at Westinghouse Atomic Power Division. The complexity of the job evidently prevents the use of welding in this application. No further investigation is planned.

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The report on the bonding study at Westinghouse Research Labs was released as technical memorandum STM-172 "Polyimide Impregnated Glass Cloth Bonded to Nickel Surfaces for High Temperature, Gas Tight Seals".

D SPARES

After adding four transmitter spares items (two blowers, one motor, and an "O" ring), Amendment 11 to the system spares exhibit has been closed and prepared for submission for negotiation. The last of the spares for Ground Support Equipment was delivered in September. Status of spares is summarized:

	Items Shipped in September	Items Open	Per Cent Complete
System	0	17	99
Basic list plus first 10 amendments	0	8	99
Amendment 11	0	9	36
Ground Support Equipment	1	0	100

E CORRELATOR OPERATION

In addition to the regular flight support, some flight film was recorrelated to give optimum focus at particular areas of interest. Flight 182 was rerun to obtain the optimum position of the output slit system.

On the Detail Correlator, the tank platen assembly was interchanged with the unit located at Itek, which includes a pump and fluid filter system. The film now used in the Linhof camera back for making exposures on the Detail Correlator is Type 2475, the same as used in the Correlator except for the 70 mm width.

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F CORRELATOR MECHANICAL REVIEW

As a result of the Correlator design investigation, five modifications are being proposed to improve the Correlator performance. These are:

1. a new input slit mount to reduce stray light at the output film plane
2. installation of a liquid filter to reduce scattering of light due to dirt in the liquid gate
3. polishing of scratched lenses to eliminate stray light due to scratched surfaces
4. procuring new platen glasses to allow repolishing the platens on a rotation basis
5. new rainbow filters with the proper slope to reduce azimuth resolution errors when processing film from 22,500 foot altitude flights.

In addition, a film cleaner to reduce scattering of light due to dust on the input film was justified by the study. This cleaner was quoted as part of the normal maintenance costs of the correlator.

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APPENDIX A

FLIGHT NO.	183	184	185
DATE	9-3-65	9-8-65	9-8-65
ALTITUDE	20000	35000	20000
AREA			
PURPOSES	To evaluate DFT operation and obtain radar map of Wallops Island missile launching site.	High altitude simulation flight over Philadelphia, Pa.	High altitude simulation flight over Philadelphia, Pa.
SIGNIFICANT SYSTEM CHANGES	Repaired LO circuitry for video and DFT.	None	None
RESULTS	Map is best from 1/4 to 1/2 range. Contrast & resolution are good. Some targets less than 20 ft. Shadows are fairly clean. Low density bands correspond to DFT tracking errors. Instrumentation information for determining offset frequency in error.	On far range strip map is best from near edge to 3/4 range. Resolution is not the best, contrast is fair. Elementary dots are elongated as much as 3 to 1 and change in direction from vertical to 2 o'clock. Drift was 2°left. Antenna was pulled around by accelerometer integrator. Suspect roll table. Density bands not as contrasty.	TWT failed. No data.

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FLIGHT NO.	186		
DATE	9-21-65		
ALTITUDE	40000		
AREA			
PURPOSES	High altitude flight over Washington, D.C. and Baltimore, Md.		
SIGNIFICANT SYSTEM CHANGES	New transmitter TWT; receiver package changed.		
RESULTS	Stripes on primary of .04 to .12 sec. duration, not always uniform over range. May be caused by Stalo instability. In best areas resolution and contrast is good. Map is faced from edge to 1/3 range of BNI.		

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