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MODELING OF THE PAN AMERICAN AIRLINE'S HANGAR AT JFK AIRPORT RUNWAY 13R

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BACKGROUND

In preparation for the microwave landing system (MLS) demonstration scheduled at JFK airport, runway 13R, in October 1989, personnel from the Federal Avaition Administration Technical Center (FAATC) made an in-person survey to evaluate the site configuration for a 3.0° "CANARSIE" approach. This study identified the Pan American Airlines hangar's corrugated roof as a possible source of signal interference for the elevation antenna. MLS math modeling personnel performed preliminary modeling to predict the magnitude of signal disruption that might be expected from the Pan Am hangar. Two flightpaths were modeled: the 3.0° "CANARSIE" approach which will be used for the October demonstration and a 6.0° straight-in approach designed to traverse the region of maximum multipath as determined from the intersection of the specular reflection from the midpoint of the hangar's roof plate and the centerline of the runway. Both flightpaths were simulated with a dwell gate receiver and with a split gate receiver. The results of this preliminary modeling, presented below, predict no out-of-tolerance signal interference for any of the simulations performed.

DISCUSSION

A map of the airport scenario is presented in figure 1. The Pan Am hangar roof was modeled as two scattering building plates, both parallel to the runway centerline and tilted away from the centerline at angles of 17.2° (lower plate) and 29.3° (upper plate) respectively. The lower plate extends 37 feet from its bottom elevation of 29 feet (msl); the upper plate extends 35 feet from its bottom elevation of 64 feet (msl). The 3.0° and 6.0° approaches were modeled as segmented flightpaths using the coordinates given in table 1 and table 2 respectively. The simulation used the Bendix test bed transmitters, a 2° azimuth scanning from -40° to +40°, a 1.5° elevation scanning from .0° to 20°, and an omnidirectional DME/P.

The propagation model (BMLST) predicted no multipath effects from either scattering plate for the 3.0° CANARSIE approach for the azimuth, elevation, or DME/P. Using a split gate and a dwell gate receiver (as simulated by BMLSR), no out-of-tolerance errors resulted with this scenario as illustrated by the PFE filtered error plots for the elevation system given in figures 2 and 3 respectively. Similar results were obtained from the azimuth system. The maximum multipath level simulated for the DME/P was 54 decibels below the direct beam. Although DME/P simluation is not available in BMLSR at this time, no significant errors are anticipated due to this low multipath level.

The 6.0° approach was designed to penetrate the area of greatest multipath as determined from the intersection of the runway centerline and the specular reflection of the elevation system from the lower roof plate. The math model shows multipath from the lower plate for the elevation system at 1.5 nautical miles from threshold as can be seen in figure 4. However, the

separation angle between the multipath and direct signals is greater than two beam widths and therefore should not create problems for the receiver (see figure 5). The PFE and CMN filtered error plots confirm that this multipath will not cause out-of-tolerance errors with either a split gate or a dwell gate receiver. These results are illustrated in figures 6 to 9. No significant multipath was predicted for either the azimuth or DME/P systems.

CONCLUSION

Preliminary modeling of the Pan Am hangar with the 3.0° CANARSIE approach to JFK runway 13R shows no multipath interference. Modeling with a 6.0° approach designed to penetrate the area of greatest possible multipath does show interference from the lower roof plate of the hangar on the elevation signal. However, the separation angle between this multipath and the direct signal is great enough to avoid problems at the receiver. We can conclude, therefore, that the configuration used for modeling this scenario will not cause multipath problems for the demonstration at JFK airport.

TABLE 1. FLIGHTPATH COORDINATES FOR 3.0° APPROACH

##	X	Y	Z
01	26454.53	22258.23	1503.04
02	29507.36	19194.71	1503.04
03	29872.13	18794.48	1503.04
04	30199.82	18363.36	1503.04
05	30487.82	17904.77	1503.04
06	30733.84	17422.37	1503.04
07	30935.94	16919.98	1503.04
08	31092.50	16401.58	1503.04
09	31202.29	15871.31	1503.04
10	31264.42	15333.37	1503.04
11	31278.42	14792.03	1503.04
12	31264.75	14062.73	1503.04
13	31264.75	14062.73	1503.04
14	31258.73	10936.03	1343.96
15	31233.71	10397.40	1315.97
16	31160.92	9863.17	1287.05
17	31040.93	9337.57	1257.42
18	30874.70	8824.74	1227.31
19	30663.53	8328.73	1196.97
20	30409.10	7853.47	1166.63
21	30113.40	7402.70	1136.53
22	29778.79	6979.98	1106.91
23	29407.89	6588.65	1078.01
24	24335.18	1692.44	705.86
25	23948.06	1349.47	678.15
26	23533.14	1040.78	649.75
27	23093.43	768.62	620.87
28	22632.11	534.97	591.72
29	22152.55	341.52	562.52
30	21658.23	189.68	533.48
31	21152.74	80.55	504.80
32	20639.75	14.92	476.70
33	20122.99	-6.72	449.38
34	11968.0	0.00	26.00
35	11000.0	0.00	26.00

TABLE 2. FLIGHTPATH COORDINATES FOR 6.0° APPROACH

##	X	Y	Z
01	26000.0	0.0	1485.2
02	11968.0	0.0	26.0

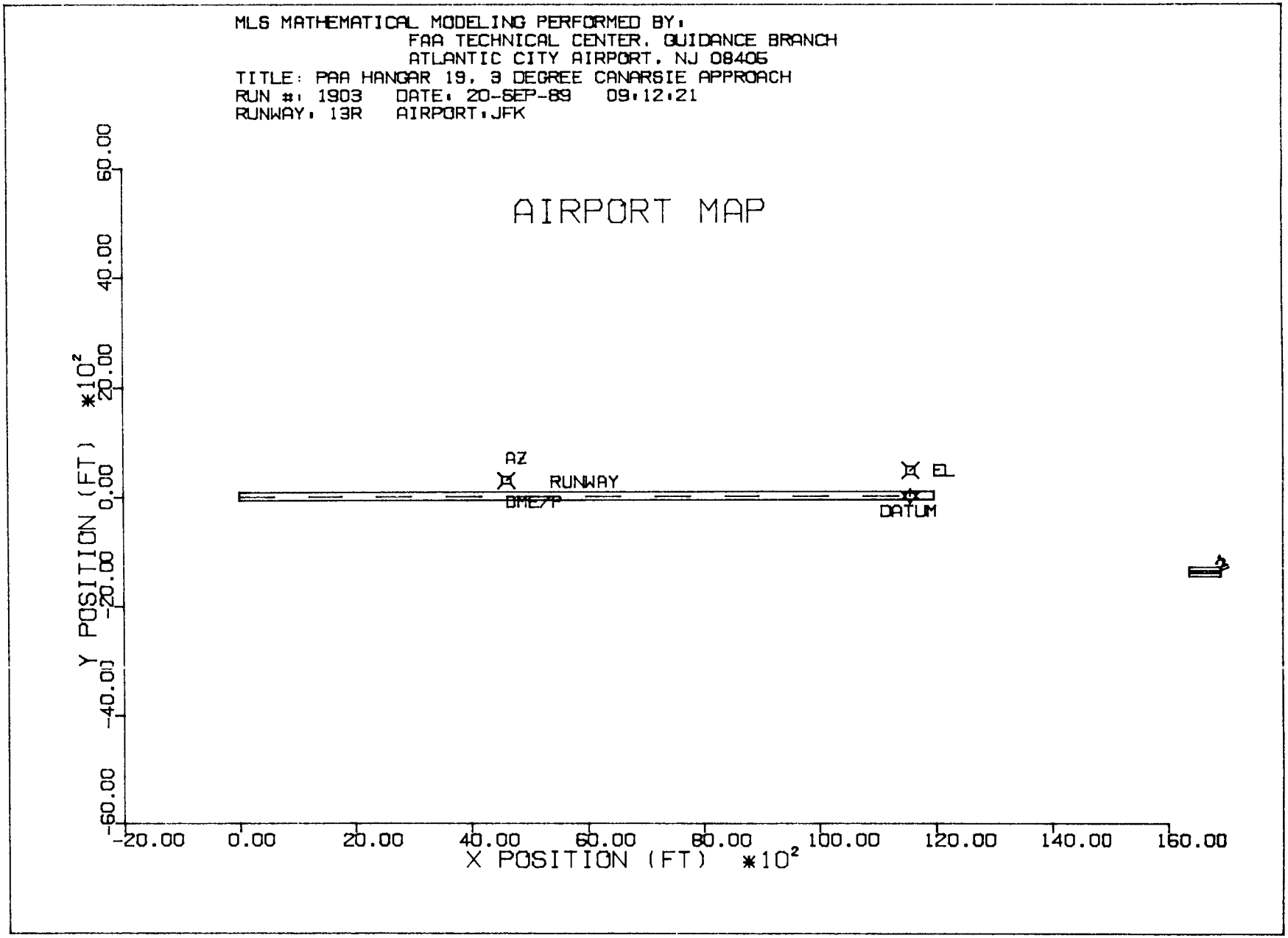

FIGURE 1. SCENARIO MAP

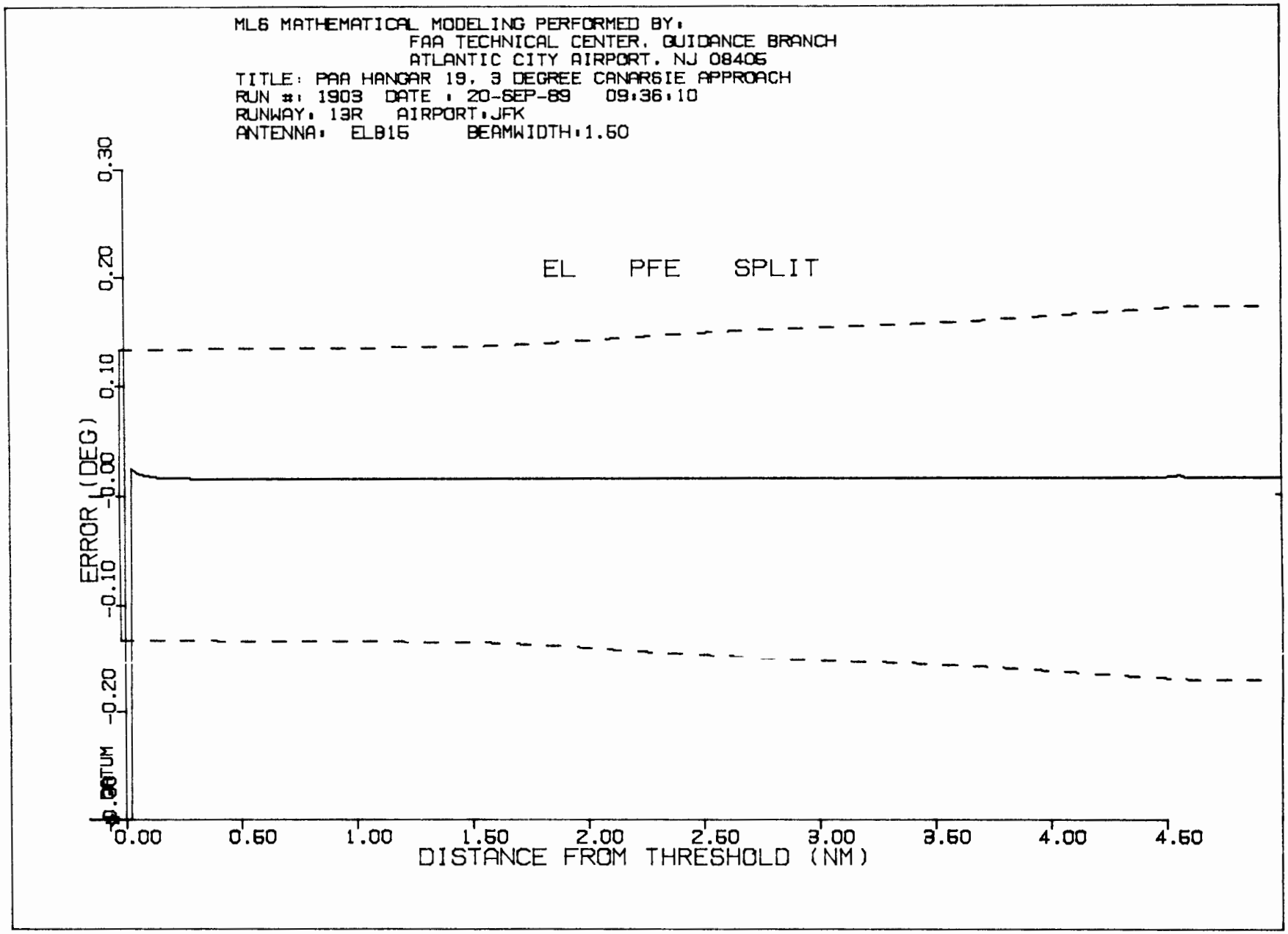

FIGURE 2. ELEVATION SYSTEM PFE, 3.0 DEGREE APPROACH, SPLIT GATE RECEIVER

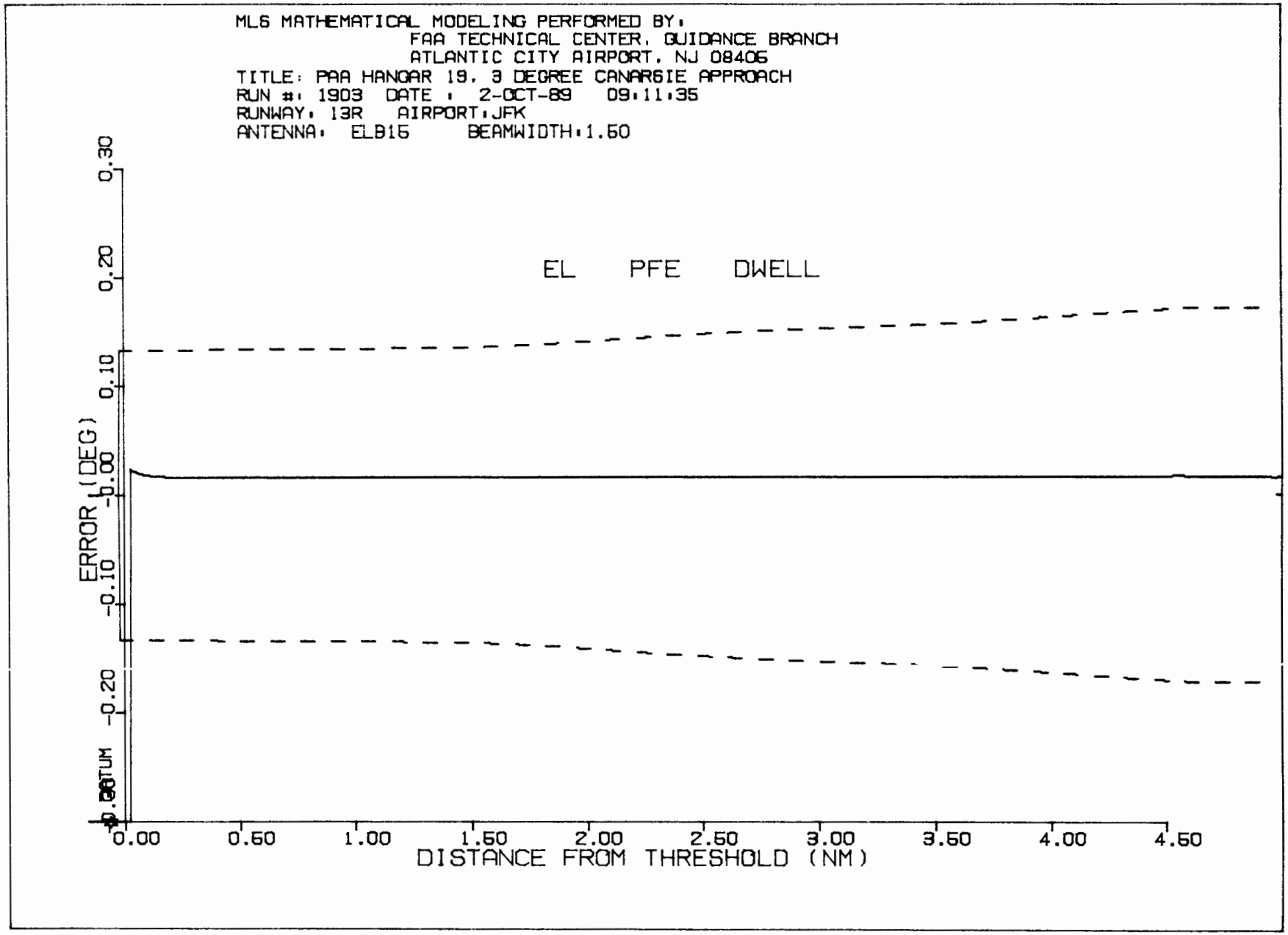

FIGURE 3. ELEVATION SYSTEM PFE, 3.0 DEGREE APPROACH, DWELL GATE RECEIVER

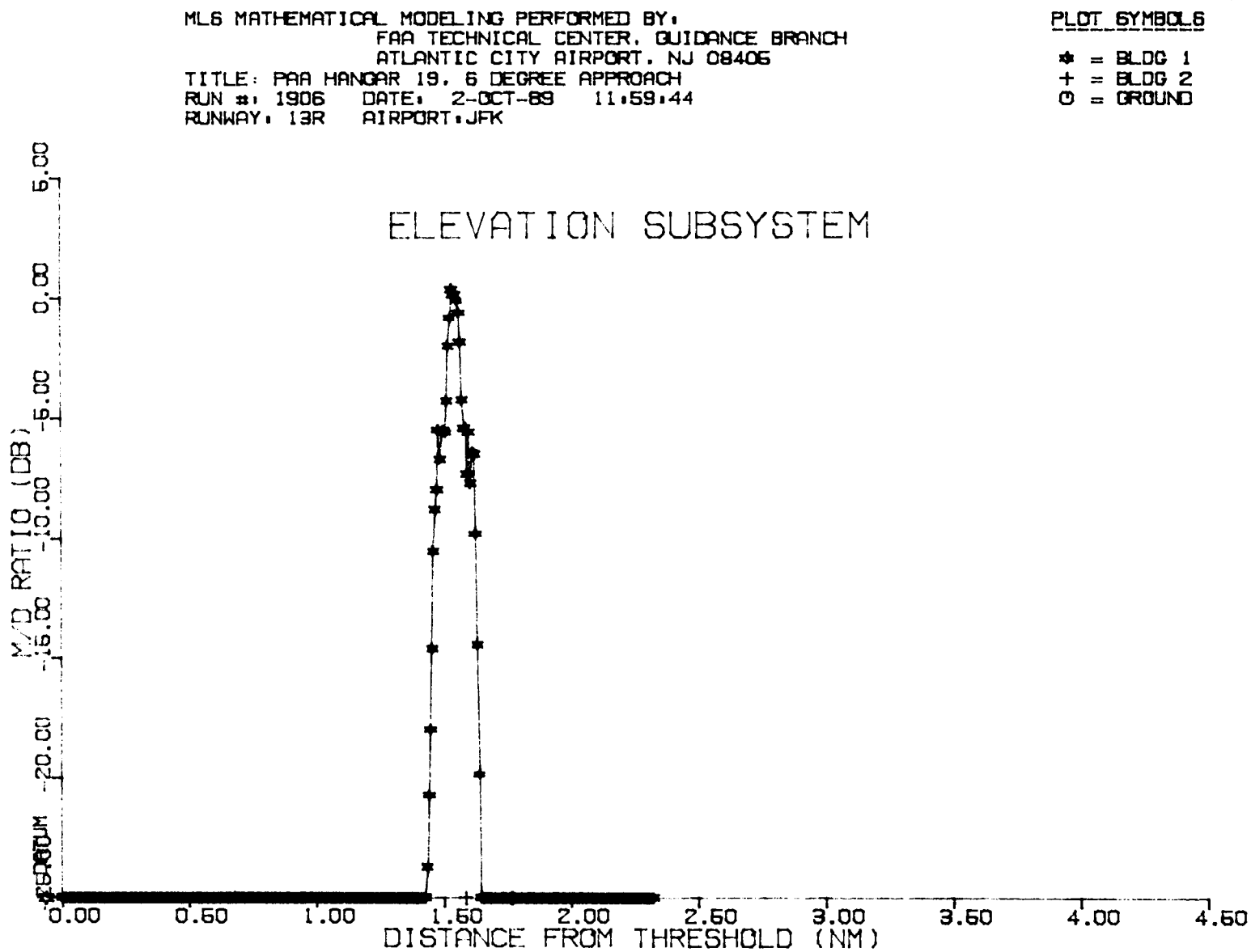

FIGURE 4. ELEVATION SYSTEM MULTIPATH/DIRECT RATIO, 6.0 DEGREE APPROACH

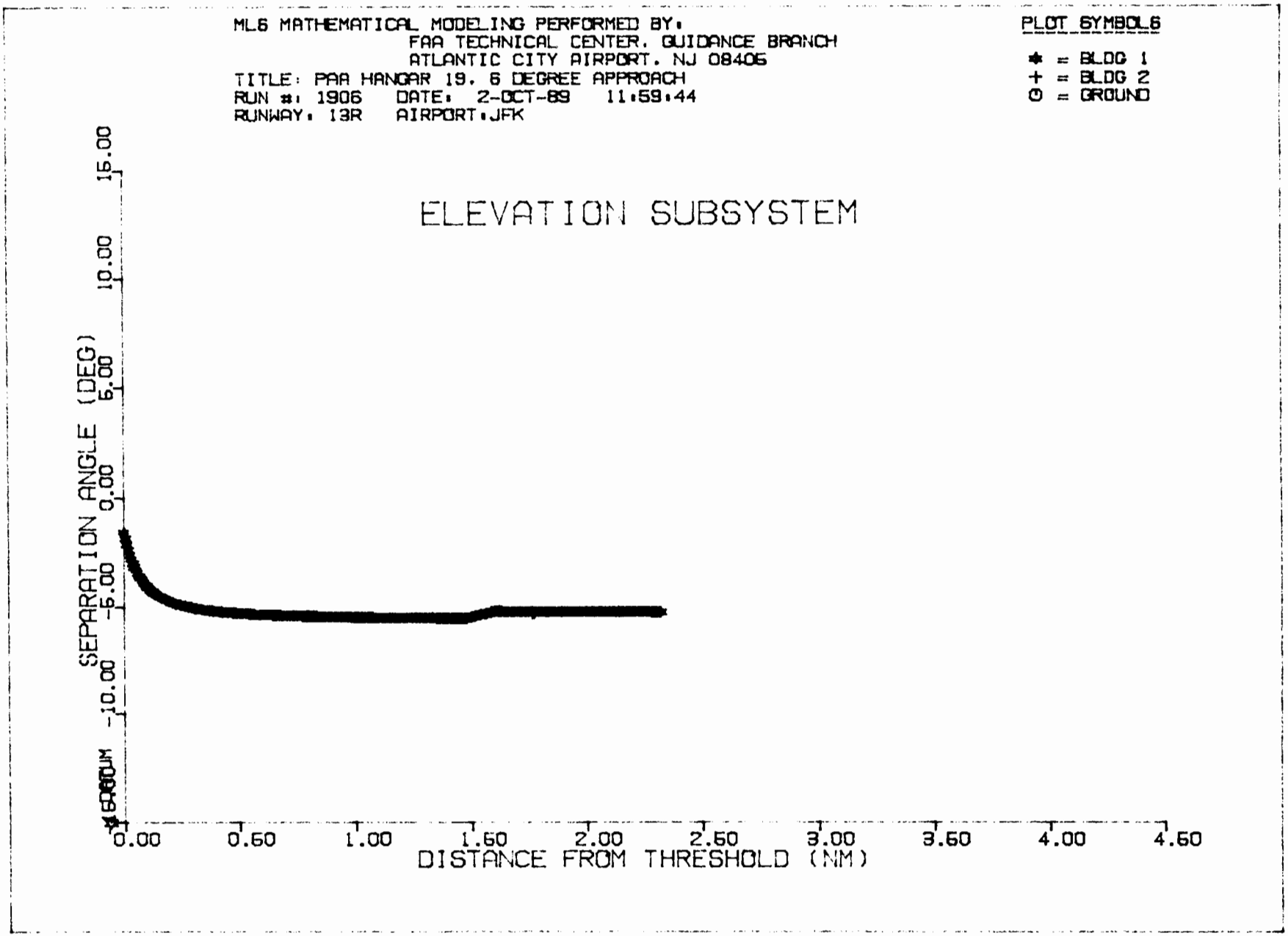

FIGURE 5. ELEVATION SYSTEM SEPARATION ANGLE, 6.0 DEGREE APPROACH

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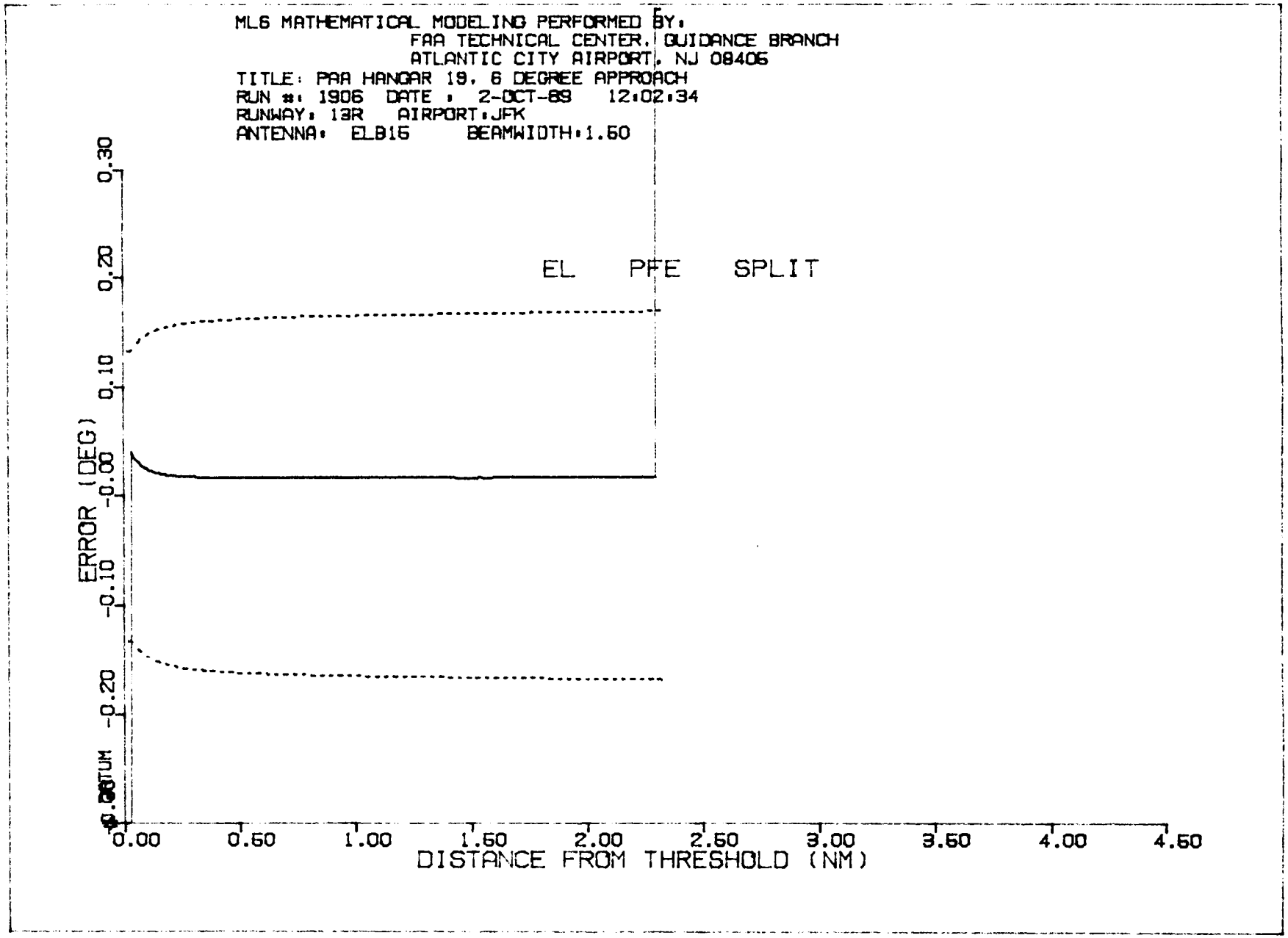

FIGURE 6. ELEVATION SYSTEM PFE, 6.0 DEGREE APPROACH, SPLIT GATE RECEIVER

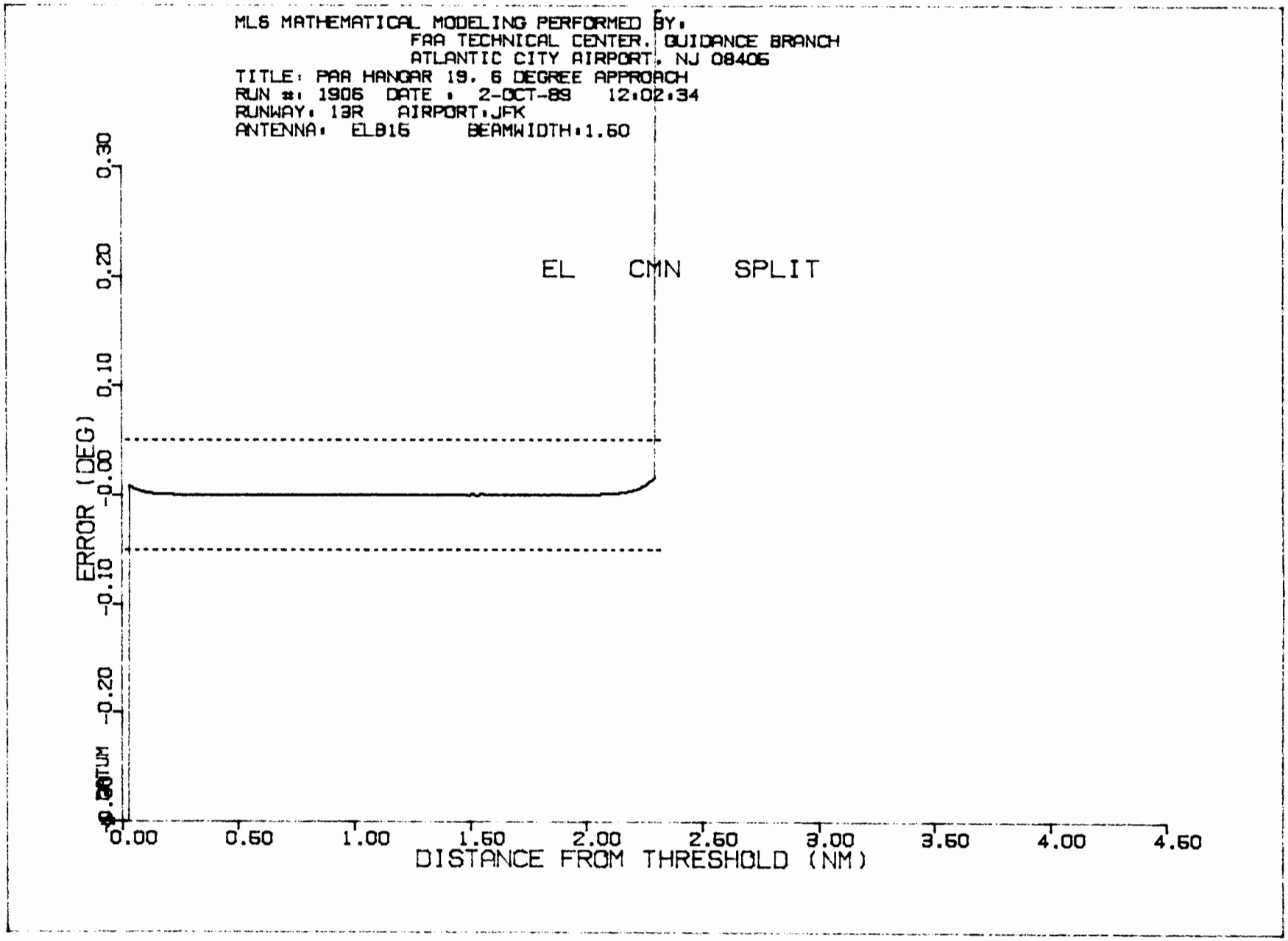

FIGURE 7. ELEVATION SYSTEM CMN, 6.0 DEGREE APPROACH, SPLIT GATE RECEIVER

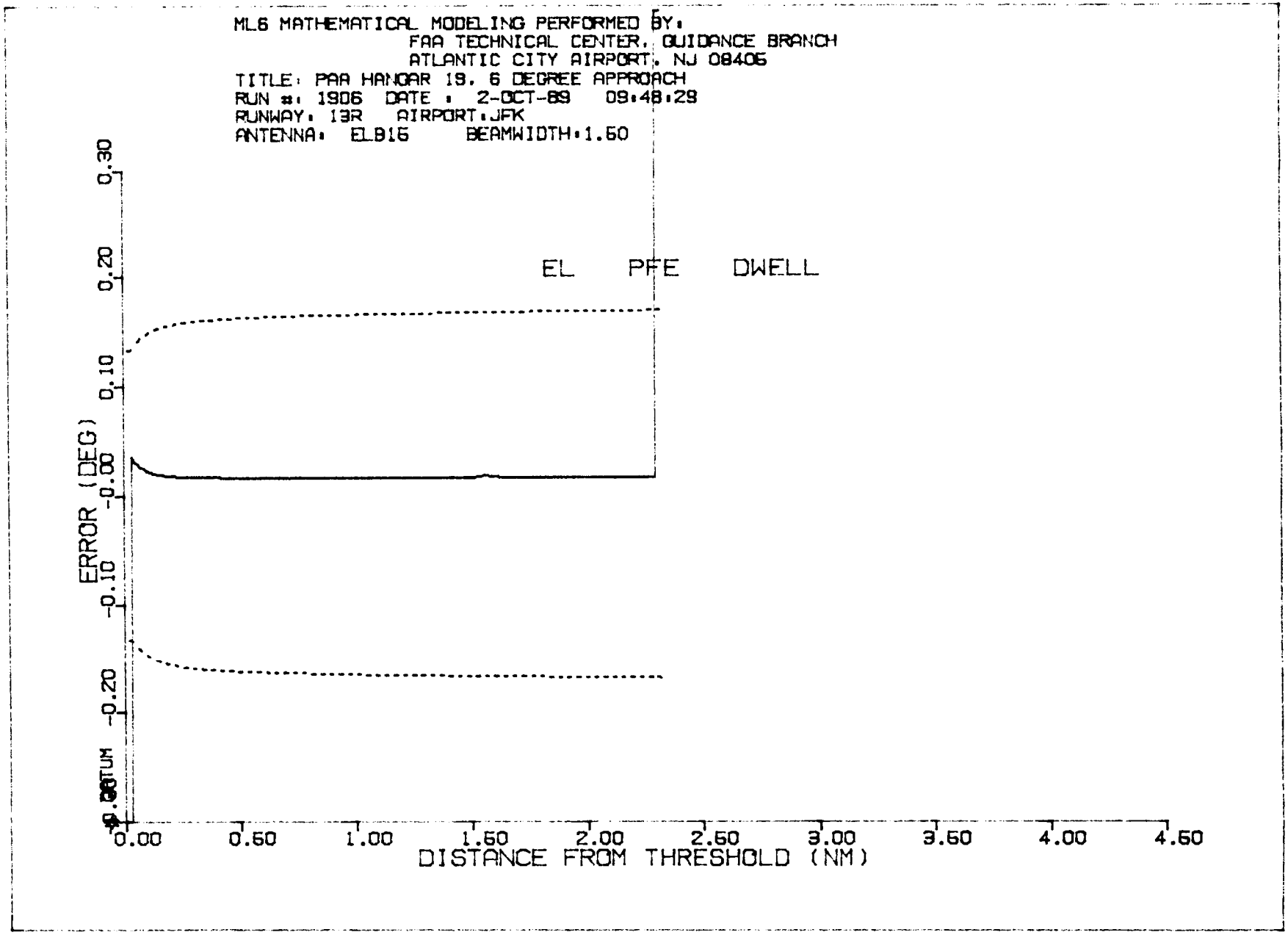

FIGURE 8. ELEVATION SYSTEM PFE, 6.0 DEGREE APPROACH, DWELL GATE RECEIVER

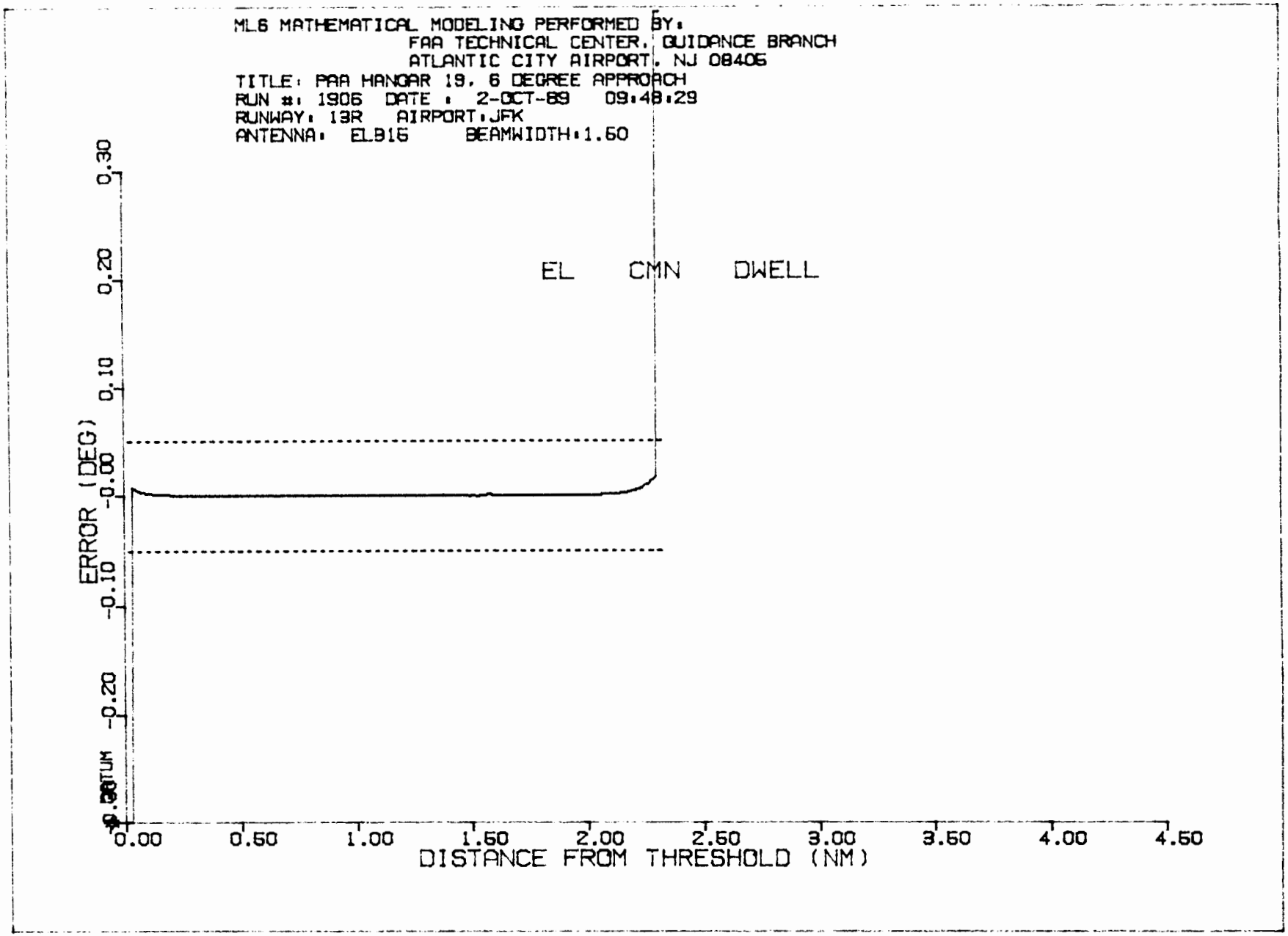

FIGURE 9. ELEVATION SYSTEM CMN, 6.0 DEGREE APPROACH, DWELL GATE RECEIVER