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NAFEC TECHNICAL LETTER REPORT

NA-78-43-LR

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DEMONSTRATION OF NAS EN ROUTE DUAL ALTITUDE SORT BOX SOFTWARE FIX TO MINIMIZE BEACON RING-AROUND TARGETS

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SEP 13 '78

by

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September 1978

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ABSTRACT

A demonstration of a software fix to reduce beacon ring-around targets was conducted at the National Aviation Facilities Experimental Center NAS En Route Stage A System Support Facility. This fix provided a dual altitude select capability, utilized the remote site to provide local radar overhead coverage, and maintained local site low altitude coverage. It is recommended that this fix be tested in an operational en route air traffic control environment which contains airways in the vicinity of a radar site.

DEMONSTRATION OF NAS EN ROUTE DUAL ALTITUDE SORT BOX SOFTWARE FIX

BACKGROUND

This effort was in response to a Systems Research and Development Service (SRDS) request to determine if any discriminates exist between actual and false beacon reports. The requirement was initiated by Air Traffic Service (AAT) through 9550 No. AT-500-16. Under Contract DOT-FA76WA-3815, the Computer Sciences Corporation (CSC) developed the Dual Altitude Sort Box Fix (Fix No. 2) in the form of an algorithm to the operating software of the National Aviation Facilities Experimental Center (NAFEC) NAS Stage A 9020 computer complex. The purpose of this fix was to minimize beacon ring-around targets and associated limited data blocks which consisted of repeated beacon codes and altitudes.

This fix was designed to function when double radar coverage existed near a radar site which was experiencing ring-around problems due to overflying aircraft operating on the airways overhead. This algorithm modification included the adaptation of the NAFEC Universal Data Set (UDS) in the Radar Input (RIN) subroutine of the NAS A3d2.3 program to represent the Las Vegas-Cedar City and the Indianapolis-London radar environments. In addition, a radar sort box table was included in the modification to provide a three-by-three (48 x 48 mile) sort box square area surrounding the local preferred site. If the selected altitude and beacon Mode C criteria were met, the high altitude site (supplemental remote site) designated in the table became the preferred site. The radar site which originated the target data was compared with the preferred site, and if a match existed, the targets were processed normally. However, if no match occurred, ring-around false targets were assumed which were eliminated from further RIN processing. A flow chart of algorithm No. 2 is shown in figure 1.

DATA COLLECTION

Beacon data in the form of digital tapes from candidate radar sites were received from the Los Angeles Center (Las Vegas radar) and the Indianapolis Center (Indianapolis radar). These tapes were reviewed to determine the worst case ring-around condition by use of hardware and software techniques. Conversion of the digital field tapes to input tapes on the 9020 computer were established by use of the Common Digitizer Record Program (CD-record, FAA-4006F). Identification and analysis of the worst case beacon ring-around problems were determined by generation of the Common Digitizer Data Reduction (COMDIG, FAA-4006B) and the Beacon False Target Analysis (BFTA, FAA-4306P) programs. Special discs, algorithm No. 2 program decks, along with Sim tapes (processed from CD record tapes) and algorithm No. 2 altitude selection patches operated in conjunction with the 9020 computer and the NAFEC NAS environment to show comparison between beacon ring-around data on the Plan View Display (PVD) consoles. A block diagram of the software configuration is shown in figure 2.

DEMONSTRATION

A demonstration of algorithm 2 was presented in May 1978 to AAT and SRDS representatives. The first portion of the demonstration was held in the NAFEC Display Recorder Lab wherein a playback of the NAS PVD recording on a modified Sangamo recorder showed extensive ring-around conditions. These ring-around conditions were comprised of 60 beacon false targets (Code 2527) recorded during a 45-scan period from Las Vegas data, and 26 beacon false targets (Code 7257) recorded during a nine-scan period from Indianapolis data. Additional playbacks of the same beacon data which presented the exact time period with the algorithm modification added, showed that 47 of 60 beacon false targets were eliminated from the Las Vegas data, and 25 of 26 beacon false targets were eliminated from the Indianapolis data. The reason 100 percent of the false targets were not inhibited was because the algorithm required a validated Mode C before the data would be processed. In the afternoon, a dynamic demonstration, including "hands on" at the PVD console controls, was presented in the NAS Lab. The same beacon codes, 2527 and 7257, were repeated. In addition, Las Vegas Code 3302 and Indianapolis Beacon Codes 6246 and 5617 were presented for ring-around comparison. Results of ring-around reduction derived from these added beacon codes, in addition to the forementioned, are shown in table 1.

RESULTS

For the five beacon targets presented, table 1 shows the total beacon false targets, the Mode C targets rejected, targets not rejected, the scan interval, and the percentage of beacon false targets eliminated. This detailed information was compiled from a COMDIG track box listing of the particular beacon codes which is available at NAFEC. A representative photograph of the ring-around beacon comparison data is shown in figure 3 which presents four tracked beacon targets. Of interest is Las Vegas beacon target Code 2527, ident OU12, fix out (upper) and ident IN12, fix in (lower). In summary, the algorithm is 100-percent effective for validated Mode C targets. Results from the five beacon ring-around targets selected (table 1) show that ring-around is significantly reduced by 80 to 90 percent. The difference from complete ring-around reduction is that nonvalidated Mode C targets are not processed by the algorithm. In addition, while the local site low altitude coverage is maintained, the algorithm permits remote site high altitude coverage when aircraft are positioned over the local site. Normally, targets in this area are lost as coverage is reduced to zero at beacon antenna pattern elevation angles in excess of 30 degrees.

Considering the significance of the dual altitude sort box fix as indicated above, it is recommended that this fix be thoroughly tested in a representative problem location (such as the Patrick-Tampa radar sites of the Miami ARTCC) before selective utilization may be considered for the NAS.

This demonstration was conducted under NAFEC Program Document 12-125, System Engineering Investigations and Applications; Subprogram 122-111, NAS Stage A Improvements, sponsored by ARD-110, Dr. J. Shannon, Subprogram Manager. Mr. George Apostolakis was the Program Manager. The project number was 122-111-310, False Target Discriminants. Further information may be obtained from Robert W. Delaney, Project Manager, ANA-170.

TABLE 1. PERCENTAGE OF BEACON RING-AROUND TARGET REDUCTION USING ALGORITHM #2

BEACON CODE	RADAR SITE	BEACON RING-AROUND TARGETS				TIME INTERVAL (SEC)	NUMBER SCANS
		TOTAL	REJECTED	NOT REJECTED*	PERCENT REJECTED		
2527	QAS	60	47	13	78.3	540	45.0
3302	QAS	54	42	12	77.8	392	32.7
7257	IND	26	25	1	96.2	101	10.5
6246	IND	18	16	2	88.9	96	10.0
5617	IND	16	14	2	87.5	60	6.2

*BEACON TARGETS WITHOUT VALIDATED MODE C

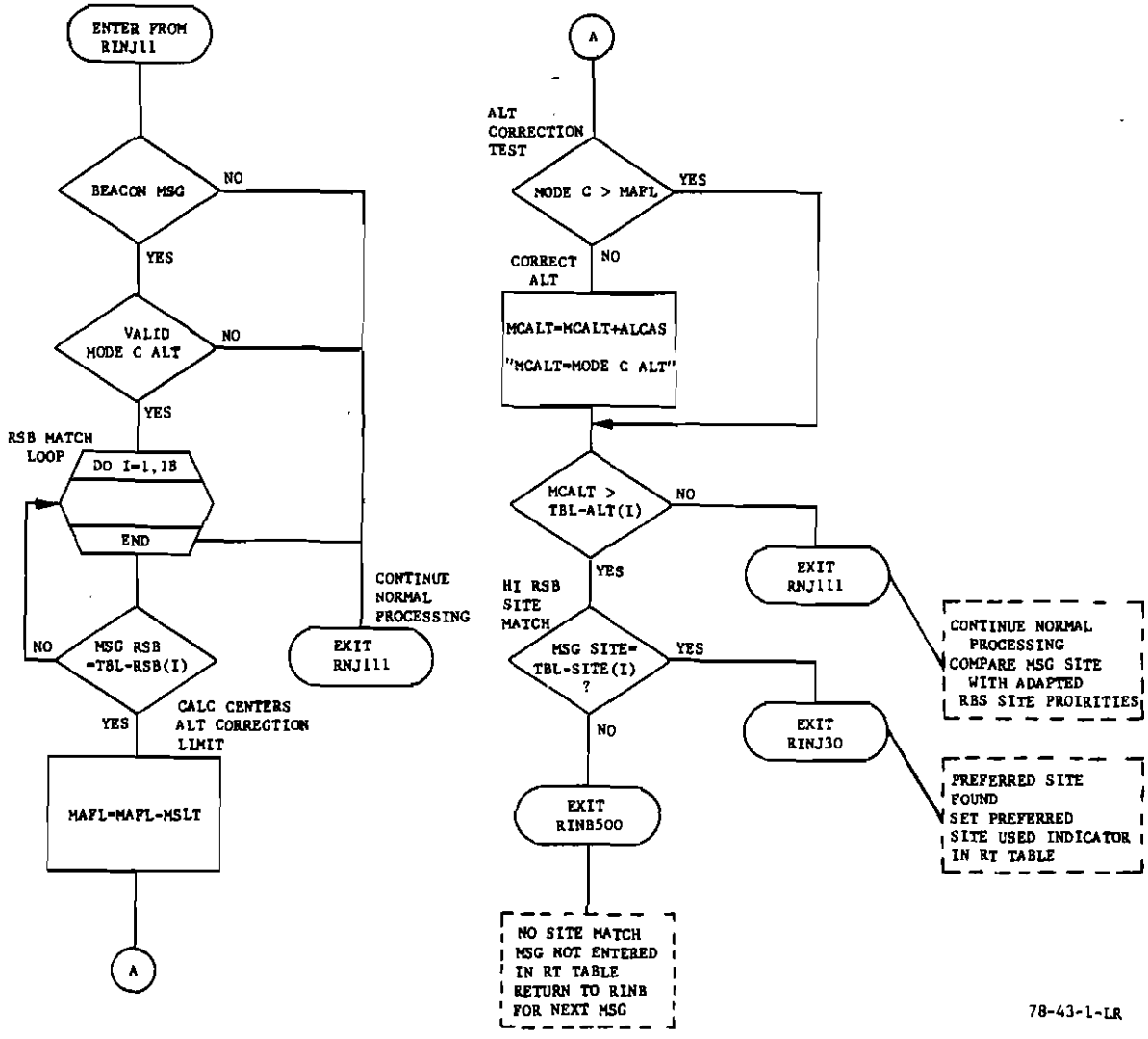

FIGURE 1. FLOW CHART OF FIX 2 - DUAL ALTITUDE SORT BOX

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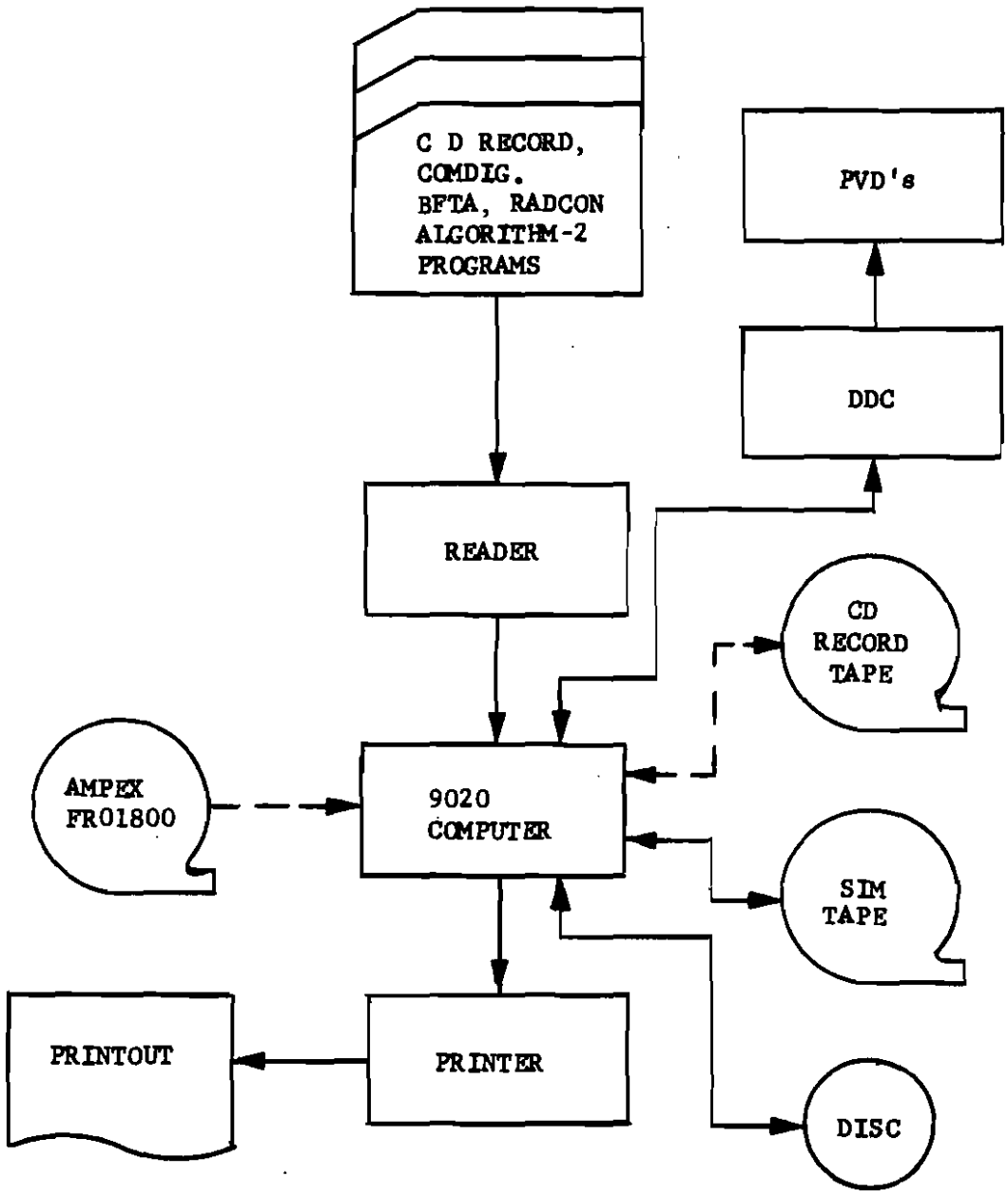

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FIGURE 2. BLOCK DIAGRAM FOR PROCESSING PROGRAMS AND DISPLAY OF BEACON DATA

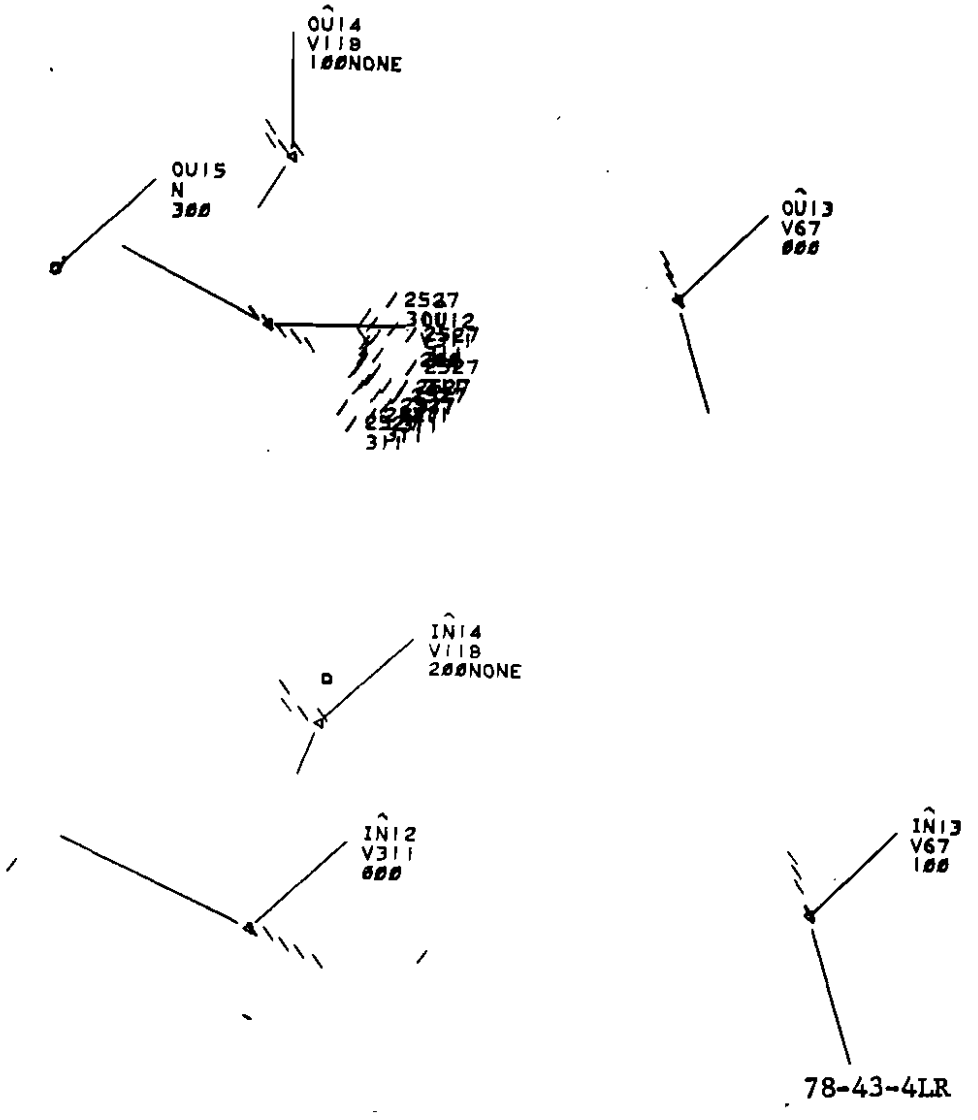

FIGURE 3. BEACON TRACKED TARGET CODE 2527, OU12 FIX OUT (UPPER), IN12 FIX IN (LOWER)

APPENDIX A
NA-78-43-LR

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