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LIGHTNING TRACKING SYSTEM EVALUATION.(U)
AUG 79 R L JOHNSON

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Electrical Storm Warning	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This is a progress report summarizing technical progress on (1) verification of performance of the lightning position and tracking system (LPATS) developed by Atlantic Science Corporation, and (2) a side-by-side performance comparison of the LPATS device with the lightning location system developed by Lightning Location and Protection Incorporated (LLP).

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ELECTROMAGNETICS DIVISION

22 August 1979

TO: Scientific Officer
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Attention: Mr. James H. Hughes

FROM: Southwest Research Institute
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SUBJECT: Progress Report
Contract N00014-79-C-0223

PERIOD COVERED: 1 May 1979 - 13 July 1979

This report summarizes technical progress on the Lightning Tracking System Evaluation under Contract N00014-79-C-0223 during the reporting period. The objectives of the subject contract were: (1) to verify the performance of the lightning position and tracking system (LPATS) developed by Atlantic Science Corporation, and (2) to conduct a side-by-side performance comparison of the LPATS device with the lightning location system developed by Lightning Location and Protection Incorporated (LLP).

Both systems employ crossed loop direction finders to determine angle of arrival at separated sites and compute the intersection of the lines of bearing at a centralized computer for lightning position estimation. Both systems rely upon a cloud-to-ground waveform recognition algorithm to determine angle of arrival on the initial portion of the return stroke, thereby avoiding horizontal polarization errors known to exist in crossed loop direction finders. Significant differences in the systems are: (1) the LPATS system uses a third antenna site to enhance location accuracy along the baseline of antenna pairs, while (2) the LLP system uses flat plate E-Field antennas co-located with the crossed loops for waveform analysis in resolving ambiguities.



SAN ANTONIO, HOUSTON, TEXAS, AND WASHINGTON, D. C.

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I. WORK ACCOMPLISHED

A. Installation

Deployment of system antennas is shown in the attached map of Kennedy Space Center (KSC). The LLP sensors were located at (1) Block house 43 and (2) at the slide wire site near pad 39A. Two of the LPATS antennas were co-located with the LLP sensors and the third antenna was located at Tico Airport.

On 3 May 1979, Southern Bell Telephone Company was requested by SwRI to install data modems connecting the remote sites to the central processors in the SwRI trailer located at the FCA1 site. This work was to be completed on or before 31 May so that tests could begin on 1 June 1979 and conclude on 13 July 1979. The SwRI trailer was placed on the FCA1 site on 24 May 1979 and departed KSC on 13 July 1979.

B. Task I - Verification of LPATS Performance

Verification of LPATS performance was completed on 26 June 1979. Modem installation was scheduled with Southern Bell to begin on 29 May 1979 and complete by 1 June 1979. Actual completion date of installation by Southern Bell was 15 June 1979. Deployment by Atlantic Science Corporation of LPATS commenced on 14 June 1979 and was completed on 26 June 1979.

During the afternoon of 26 June 1979, 1700 EDT, an isolated convective cell developed within a triangular area bounded by Melbourne, St. Cloud and Cocoa Beach, Florida. This cell was located 22-25 miles distant from the SwRI trailer and was the only discernible echo on the CCAFS AWS radar. Using the LPATS CRT display, the storm center was qualitatively located by the recording of 50-60 lightning events in agreement with the radar data. The operating software at this time did not report individual flash location data to the line printer; thus requiring a subsequent modification to provide this capability for comparison testing with the LLP system.

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Based upon the observations made during this experiment, it was determined that the LPATS system had the capability to detect and track lightning events.

C. Task II - Side-by-Side Comparison Test

The LLP system was installed and operational on 15 June 1979, however, a failure in the telephone modems was observed on 16 June 1979 and corrected on 21 June 1979. Since 84 percent of the thunderstorm activity observed during the test period occurred after 21 June, the LLP system was operational during 18 thunderstorm events for an aggregate of 36 hours of attended data acquisition.

During the period 27 June 1979 through 8 July 1979, the LPATS system was undergoing software development to incorporate line printer output. Updated software implementing the line printer output was installed on 8 July. Additional enhancements provided were refinements to the CRT map display and a circle drawn about developing or active storm cells as determined from the LPATS measured data. Four thunderstorm events were observed while the LPATS system was operational, comprising an aggregate of 8 hours of data acquisition. During this period approximately 250 lightning event locations were reported.

The total period of data acquisition during the KSC experiment was 43 hours under the purview of U. S. Bureau of Mines Contract J0387207. The side-by-side comparison was active during the final 19 percent of the concurrent Bureau of Mines test.

The ground truth data consists of approximately 100 cloud-to-ground lightning strikes observed by personnel in the O and C Building and 9 ground strike locations recorded by the SwRI optical lightning location system. The archive film of the Daytona Beach NWS radar is being acquired from Asheville, N. C., for correlative analysis.

D. Task III - Report

The data base referenced above will be used to assess comparative system performance in terms of: (1) location accuracy, (2) recognition of cloud-to-ground lightning events, (3) false alarm rate and (4) failure to alarm rate. Data reduction and final report generation will begin upon receipt of second increment funding approval scheduled for 1 October 1979.

E. Cost and Schedule

The comparison test was completed in accordance with the originally planned schedule. Anticipated cost to complete remains unchanged. Although the amount of LPATS and LLP concurrent data is less than originally expected, effort to reduce this data will exceed the original estimates due to the significantly greater volume of visual sightings reported by two observers during the experiment.

II. WORK ANTICIPATED

A. Task I

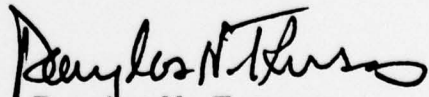
Verification of LPATS system performance is complete and no further effort is anticipated with regard to this task.

B. Task II

Comparison of test data and ground truth information is proceeding on a time available basis pending delivery of the NWS radar data.

C. Task III

The scheduled period of data analysis will begin on 1 October 1979 and terminate on 30 November 1979, based on receipt of increment funding approved 1 October 1979.



Douglas N. Travers
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att.

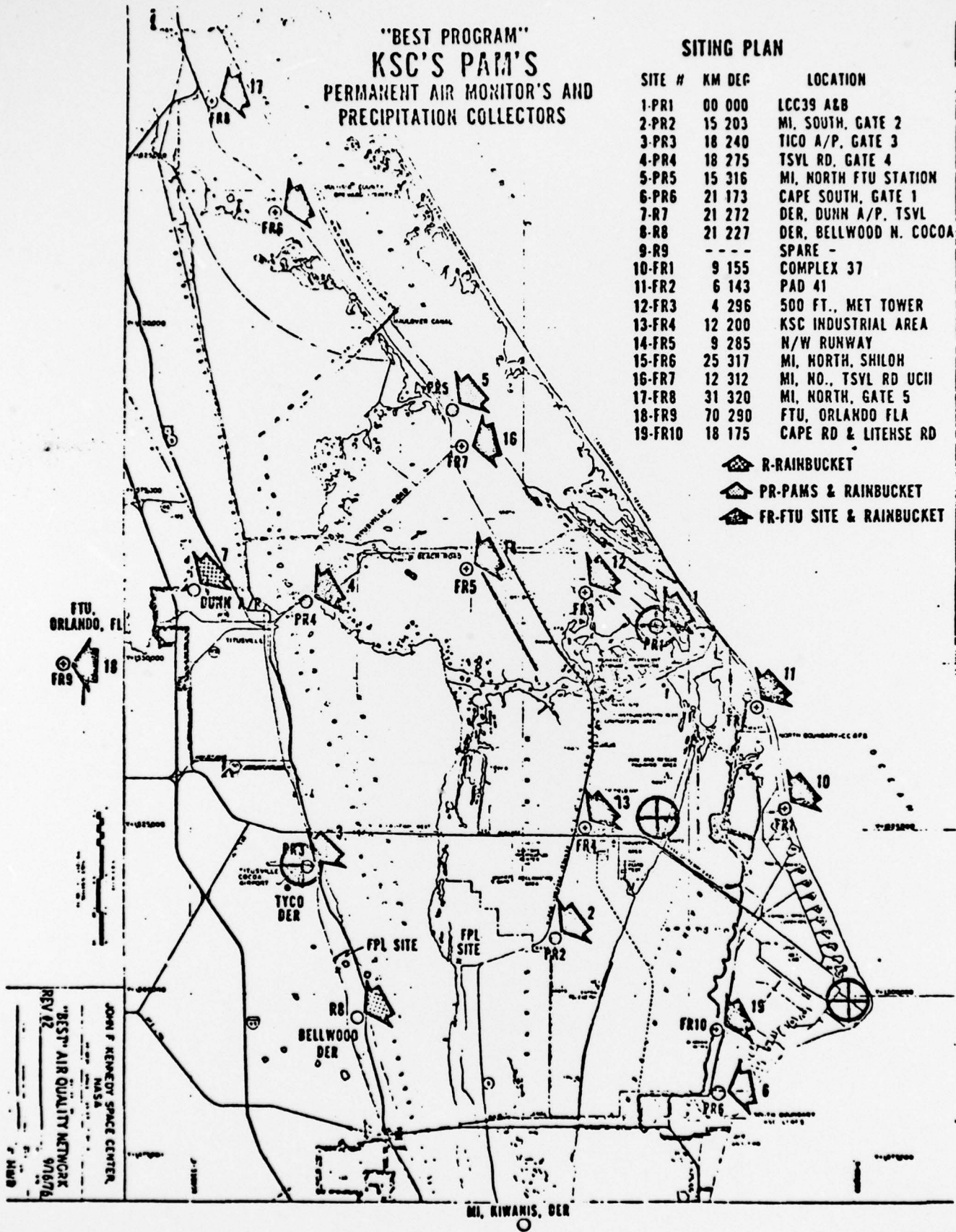
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Enclosure 1, Contract
Dr. D. R. Fitzgerald
Capt. Jim Lyon

**"BEST PROGRAM"
KSC'S PAM'S
PERMANENT AIR MONITOR'S AND
PRECIPITATION COLLECTORS**

SITING PLAN

SITE #	KM DEG	LOCATION
1-PR1	00 000	LCC39 A&B
2-PR2	15 203	MI, SOUTH, GATE 2
3-PR3	18 240	TICO A/P, GATE 3
4-PR4	18 275	TSVL RD, GATE 4
5-PR5	15 316	MI, NORTH FTU STATION
6-PR6	21 173	CAPE SOUTH, GATE 1
7-R7	21 272	DER, DUNN A/P, TSVL
8-R8	21 227	DER, BELLWOOD N. COCOA
9-R9	---	SPARE -
10-FR1	9 155	COMPLEX 37
11-FR2	6 143	PAD 41
12-FR3	4 296	500 FT., MET TOWER
13-FR4	12 200	KSC INDUSTRIAL AREA
14-FR5	9 285	N/W RUNWAY
15-FR6	25 317	MI, NORTH, SHILOH
16-FR7	12 312	MI, NO., TSVL RD UCII
17-FR8	31 320	MI, NORTH, GATE 5
18-FR9	70 290	FTU, ORLANDO FLA
19-FR10	18 175	CAPE RD & LITENSE RD

-  R-RAINBUCKET
-  PR-PAMs & RAINBUCKET
-  FR-FTU SITE & RAINBUCKET



FTU, ORLANDO, FL

FR9

DUNN A/P

PR4

TYCO DER

FPL SITE

FPL SITE

BELLWOOD DER

MI, KIWANIS, DER

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