N88-17629

FORWARD LOOKING WIND SHEAR DETECTION

STATUS REPORT 10/22/87

BACKGROUND

- INERTIAL AND INTEGRATED AVIONICS SYSTEMS
- ELECTRO-OPTICAL SURVEILLANCE SYSTEMS
- HUGHES AIRCRAFT SENSOR EXPERTISE

CURRENT OBJECTIVES

- ASSESS BASIC FEASIBILITY OF PASSIVE INFRARED (IR) INTEGRATED SYSTEMS SOLUTION TO EARLY DETECTION OF HAZARDOUS, LOW-ALTITUDE WIND SHEAR

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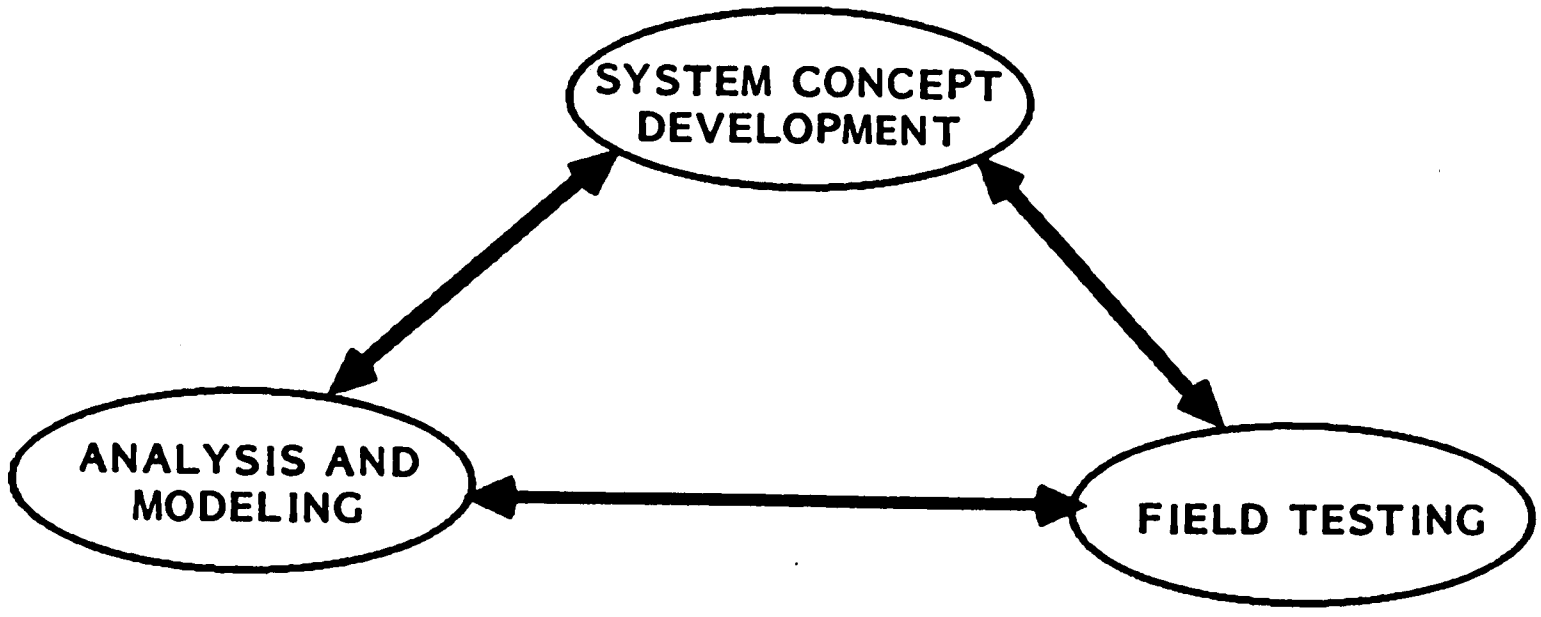
FEASIBILITY ASSESSMENT APPROACH



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SYSTEM CONCEPT DEVELOPMENT

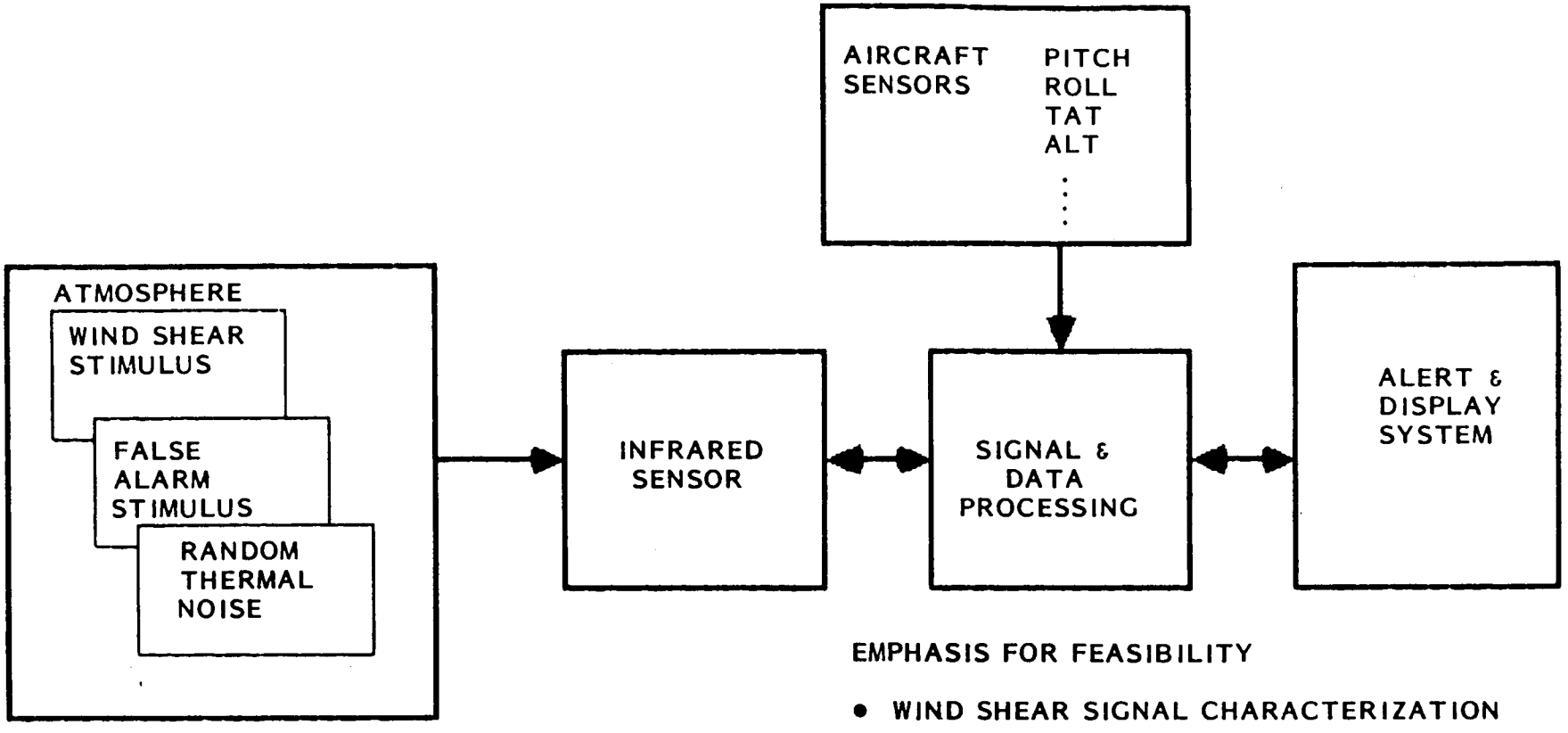
PHILOSOPHY

- INTEGRATED SYSTEMS SOLUTION REQUIRED - NOT STANDALONE IR SENSOR.
- WIDE FIELD OF VIEW COVERAGE - MULTIPLE RESOLUTION ELEMENTS TO PERMIT MORE RAPID DETECTION, TARGET LOCATION & INTENSITY ASSESSMENT, AND NOISE REJECTION.
- MODELING OF ATMOSPHERE TO PROVIDE CALIBRATION OF PARAMETERS.
- ADAPTIVE THRESHOLD SENSITIVITY DEPENDENT ON ATMOSPHERIC CONDITIONS.

GOALS

- MINIMUM 20 SECONDS WARNING FOR MICROBURSTS.
- 60° (OR GREATER) HORIZONTAL FIELD OF VIEW.
- ASSESSMENT OF TARGET RANGE, HEADING & SEVERITY.
- STAGED LEVEL OF OPERATION & ALERTS.
  - SAFE
  - CAUTION
  - WARNING
- MINIMUM FALSE ALARM RATE
- RELIABLE, AFFORDABLE, MAINTAINABLE

ANALYSIS/MODELING



EMPHASIS FOR FEASIBILITY

- WIND SHEAR SIGNAL CHARACTERIZATION
- FALSE ALARM DEFINITION
- RANDOM/BACKGROUND NOISE ASSESSMENT
- SENSOR REQUIREMENTS
- DISCRIMINATION ALGORITHMS

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ANALYSIS/MODELING

- SIGNAL CHARACTERIZATION

  SUBJECTS

  - HAZARD AND SCALE DEFINITION
  - THREAT INTENSITY
  - UNIQUE IR SIGNATURES/CUES
  - SIGNAL TO NOISE RATIOS
  - FEASIBLE OPERATING RANGES
  - RESOLUTION REQUIREMENTS
  - MICROBURST DRIVING FORCES
  - ATMOSPHERIC STABILITY INDICATORS

  SOURCES

  - EXISTING MICROBURST DATA
  - COMPUTER MODEL SIMULATIONS
  - SCIENTIFIC LITERATURE
  - ATMOSPHERIC EXPERTS
  - EXPERIMENTAL FIELD TESTS

- NOISE ENVIRONMENT AND POTENTIAL FALSE ALARM SOURCES

  - RANDOM TEMPERATURE FLUCTUATIONS (UNCORRELATED)
  - SPATIAL AND TEMPORAL TEMPERATURE FLUCTUATIONS
  - RAIN, DRIZZLE, FOG
  - CLOUDS AND ATMOSPHERIC HOLES BETWEEN CLOUDS
  - THERMAL PLUMES (HEAT ISLANDS)
  - FIELD OF VIEW STABILITY
  - STABILITY OF ABSORPTION AND SCATTERING
  - ENTRANCE WINDOW CONTAMINATION AND INTEGRITY
  - HARD TARGETS (AIRCRAFT/OBJECTS IN FOV)
  - TURBULENCE WAKES
  - SMOKE AND POLLUTANTS
  - INVERSIONS, DENSITY WAVES
  - SOLAR EFFECTS

ANALYSIS/MODELING (CONTINUED)

- SENSOR AND SIGNAL PROCESSING
  - OPERATING WAVELENGTHS
  - DETECTOR TYPES & CONFIGURATION
  - SCANNING MECHANISMS
  - STABILIZATION REQUIREMENTS
  - CALIBRATION TECHNIQUES
  - STIMULUS EVALUATION/CLASSIFICATION
  - FALSE ALARM DISCRIMINATION/MANAGEMENT
  - SENSITIVITY (SIGNAL TO NOISE ENVIRONMENT)
  - SIGNAL ENHANCEMENT/NOISE REJECTION
  - RANGE AND SEVERITY EVALUATION TECHNIQUES
  - ATMOSPHERIC DATA ASSESSMENT
  - INTEGRATION OF EXTERNAL SENSOR DATA
  - IMAGE CONSTRUCTION & PROCESSING
- AIRCRAFT AND OPERATOR INTERFACE
  - CONTROLS & ACTIVATION SEQUENCES
  - EXTERNAL INPUTS
  - WARNING & DISPLAY APPROACHES
  - SENSOR DATA SOURCES & PROCESSING

FIELD TEST PROGRAM

OBJECTIVES

- TEST SENSING TECHNIQUES AND SIGNAL PROCESSING ALGORITHMS
- MEASURE AND EVALUATE BACKGROUND NOISE AND SPATIAL/ TEMPORAL VARIATIONS
- VERIFY SIGNAL CHARACTERISTICS/SIGNATURES
- INVESTIGATE PROPOSED WAVELENGTH RESPONSES AND STABILITY
- CHARACTERIZE DIFFERENT ATMOSPHERES (DRY, HUMID, MARINE, ETC.)

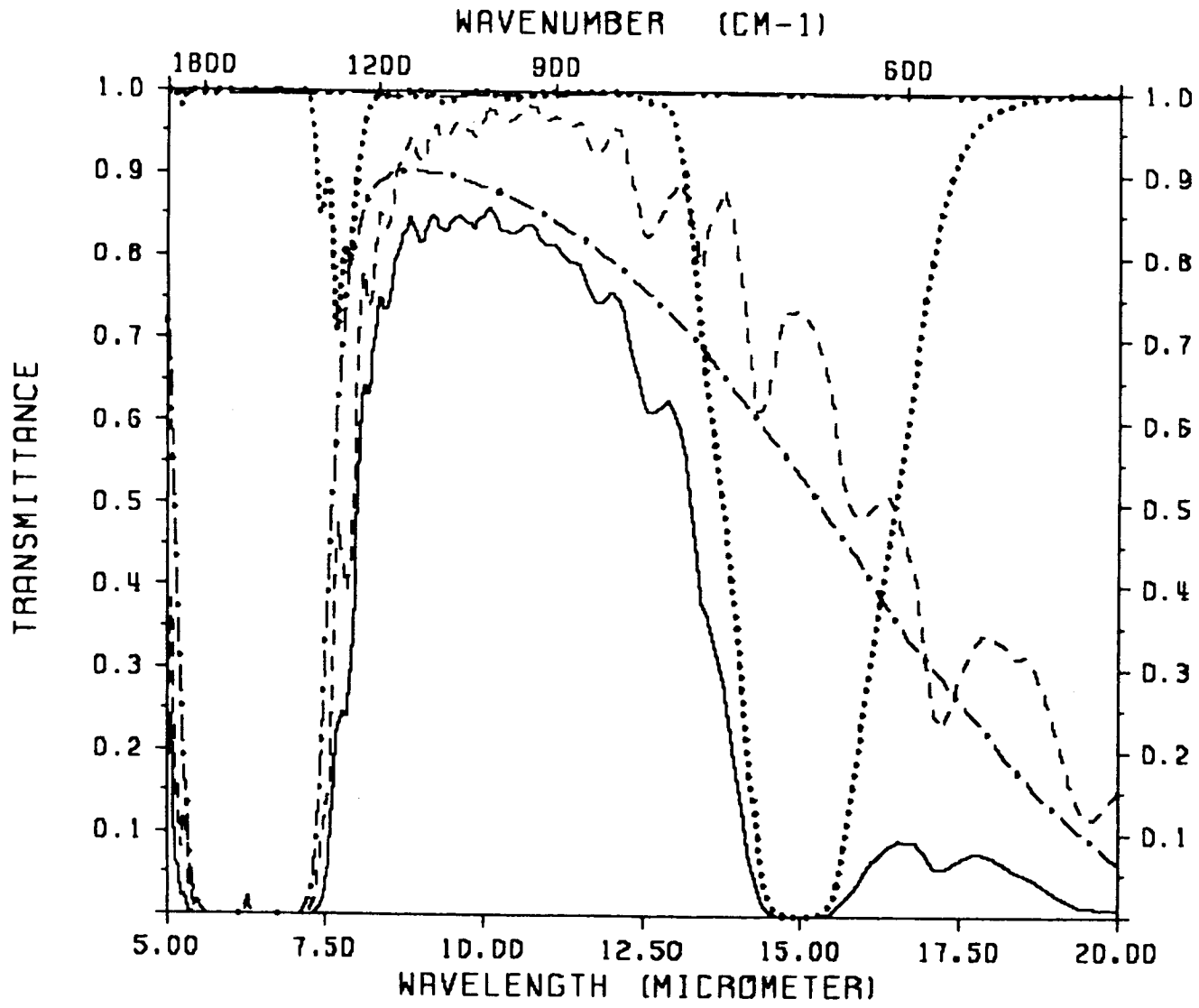
TEST CONFIGURATION AND LOCATIONS

- ARRAY OF FIVE SENSORS (THREE IMAGING, TWO RADIOMETRIC)
  - VISIBLE TV CAMERA WITH AUTO-IRIS
  - PYROELECTRIC VIDICON THERMAL IMAGING SYSTEM (8-20 MICRONS)
  - CRYOGENICALLY COOLED HgCdTe FLIR IMAGING SYSTEM (8-14 MICRONS)
  - DUAL PRT-5 RADIOMETERS WITH MULTIPLE BANDPASS FILTERS
- VIDEO AND DIGITAL RECORDING SYSTEMS WITH TIME CODE GENERATOR
- METEROLOGICAL DATA INPUTS
- DATA COLLECTED IN COLORADO, ALABAMA, AND FLORIDA

PRELIMINARY RESULTS AND CONCLUSIONS

- BACKGROUND NOISE QUANTIFIED - APPEARS MANAGEABLE
- SIGNAL EFFECTS RECORDED - INCLUDING DRY MICROBURST
- NUMBER OF FALSE ALARMS SOURCES IDENTIFIED & ASSESSED
- PROPOSED OPERATING WAVELENGTHS, PROCESSING SCHEMES, & ALGORITHMS EVALUATED
- NO SHOW STOPPERS ENCOUNTERED
- FALSE ALARM DISCRIMINATION NOT TRIVIAL
- INTEGRATED SYSTEMS SOLUTION NECESSARY - NOT STANDALONE
- MORE QUANTITATIVE TESTING REQUIRED

TYPICAL PC-TRAN MODEL OUTPUT



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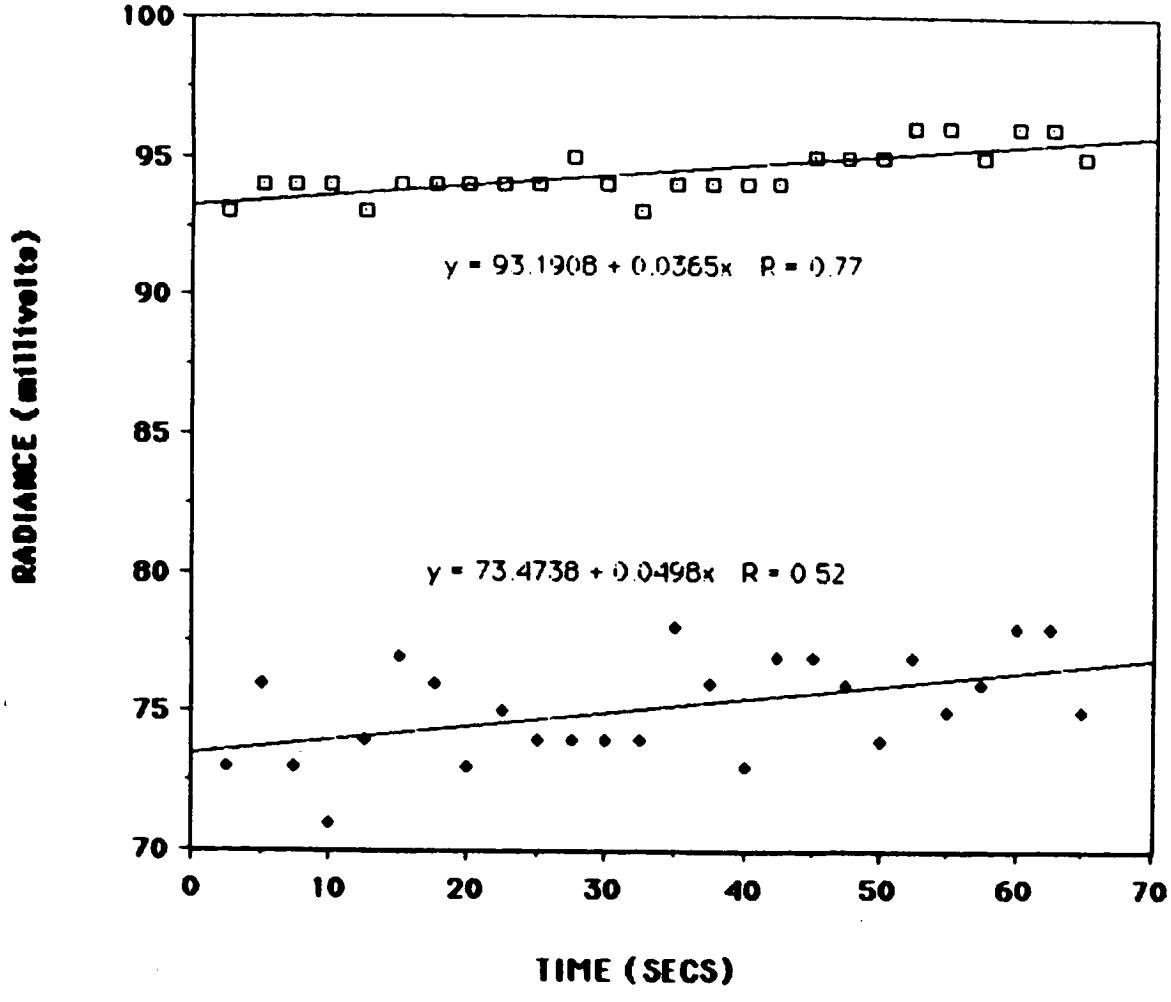
TYPICAL RADIANCE FLUCTUATIONS (NOISE) vs TIME



FAR FIELD

std dev = .902 mv

NEAR FIELD

std dev = 1.848 mv

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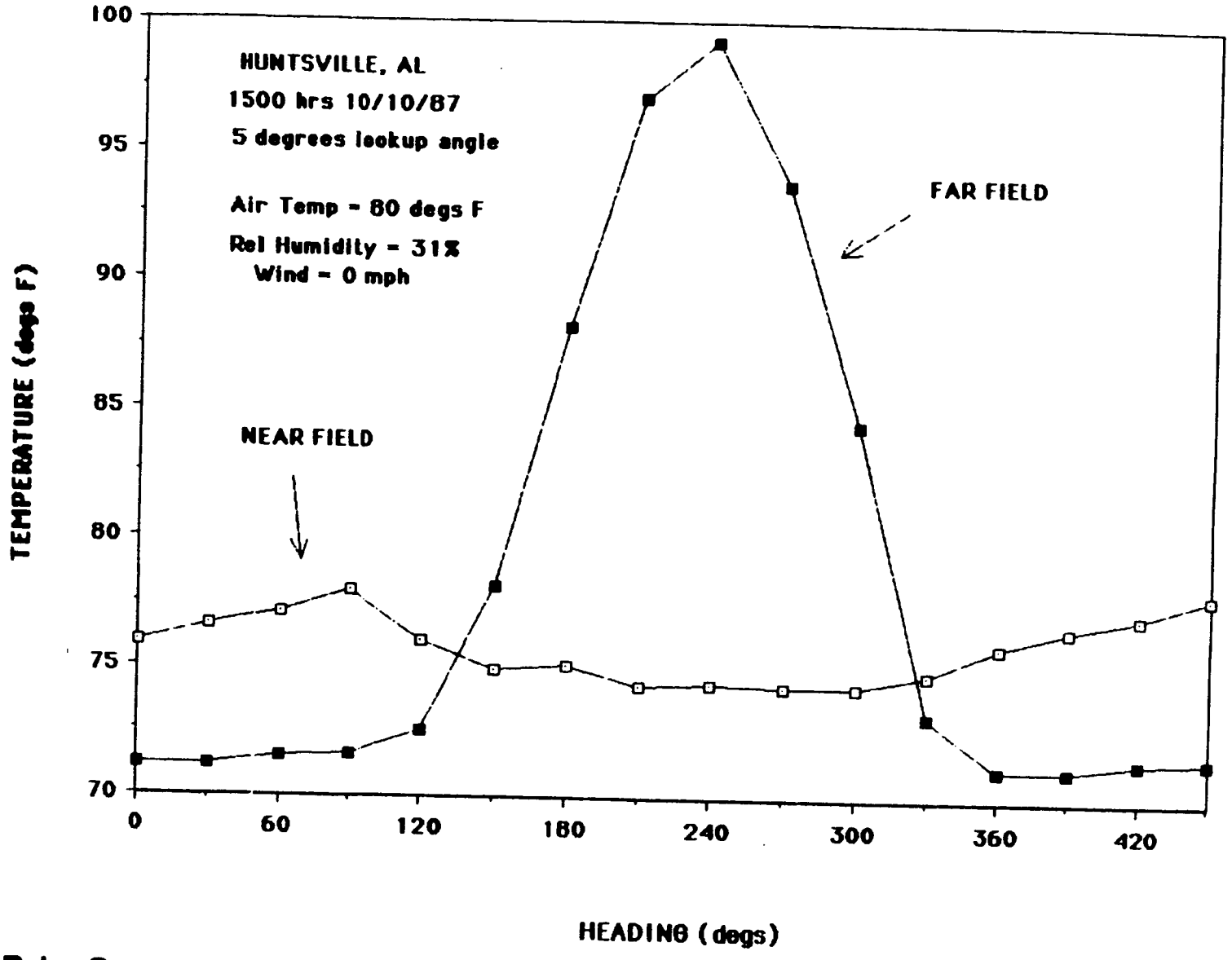
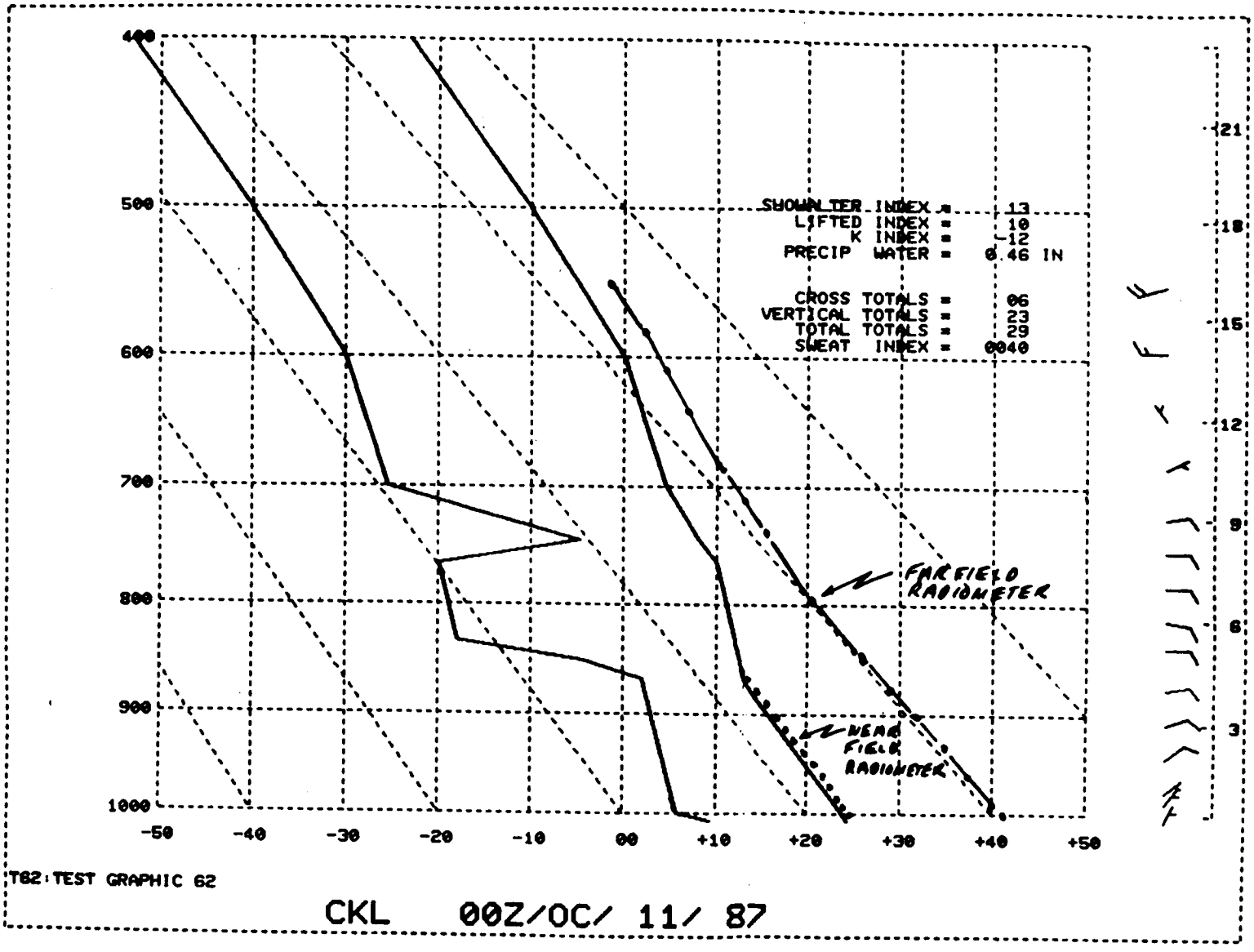


COMPARISON OF RADIOMETRIC TEMPERATURES WITH SOUNDING DATA 10/10/87



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