Session X. Airborne Doppler Radar / Industry

Status of Bendix Research
Daryal Kuntman, Bendix
DOPPLER WEATHER RADAR
WITH
PREDICTIVE WINDSHEAR DETECTION CAPABILITY

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OCTOBER 18, 1990
WE ARE...

A DIVISION OF ALLIED-SIGNAL AEROSPACE COMPANY WHICH IS A PART OF ALLIED-SIGNAL CORPORATION.

HAVE BEEN MANUFACTURING AIRBORNE WEATHER RADARS SINCE 1954.

HAVE THE MOST RADARS (OVER 35,000 DELIVERED) ON AIR TRANSPORT TYPE AIRCRAFT FLYING WORLDWIDE.

COMMITTED TO THE DEVELOPMENT OF AIRBORNE WEATHER RADAR WITH FORWARD LOOKING PREDICTIVE WINDSHEAR DETECTION CAPABILITY.
BENDIX/KING ATAD RADARS
IN CURRENT AIRLINE FLEETS

- RDR-1E: Magnetron transmitter not suitable for windshear detection.

- RDR-1F: Magnetron transmitter not suitable for windshear detection.

- RDR-4A: Latest generation solid-state transmitter fully coherent Doppler turbulence detection capability
RDR-4A FREQUENCY GENERATION

X-TAL OSCILLATOR

DIVIDER

MULTIPLIER

MULTIPLIER

MULTIPLIER

DIVIDER

POWER AMPLIFIER

IF

ANTENNA
PLAN

- TO ADD WINDSHEAR DETECTION CAPABILITY TO THE RDR-4A SYSTEM AS A MODIFICATION.

MODIFICATIONS

RECEIVER/TRANSMITTER:  - ADD WINDSHEAR DETECTION HARDWARE AND SOFTWARE
                       - ADD WINDSHEAR MODE CONTROL SOFTWARE
                       - ADD WINDSHEAR DATA TO THE OUTPUT BUSES

CONTROL PANEL:  ADD WINDSHEAR MODE SELECTION CAPABILITY

INDICATOR:  ADD WINDSHEAR DATA DISPLAY CAPABILITY

ANTENNA:  NO MODIFICATIONS REQUIRED
RDR-4A FUNCTIONAL BLOCK DIAGRAM
RDR-4A WITH WINDSHEAR DETECTION

CONTROL UNIT AND ONLINE DISPLAYS

TIMING CONTROL, AND MONITORING

DATA BUS

ANTENNA STABILIZATION PROCESSOR

ANTENNA DRIVE

429 CONTROL BUS

RF FRONT END

RF PREAMPLIFIER AND FIRST MIXER

RECEIVER

VIDEO AND DOPPLER PROCESSOR

TRANSMITTER

FREQUENCY SOURCES

WINDSHEAR PROCESSOR

VIDEO MEMORY

453 DISPLAY DATA BUS

ONLINE DISPLAYS

- MODIFIED MODULES

- NEWLY DESIGNED MODULES
## RDR-4A CHARACTERISTICS

<table>
<thead>
<tr>
<th></th>
<th>WEATHER AND MAP MODE</th>
<th>TURBULENCE DETECTION</th>
<th>WINDSHEAR DETECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TRANSMITTER PEAK POWER</strong></td>
<td>125 W (NOMINAL)</td>
<td></td>
<td></td>
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<tr>
<td><strong>PULSE WIDTH</strong></td>
<td>6 AND 18µSEC</td>
<td>6µSEC</td>
<td>2µSEC</td>
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<tr>
<td><strong>PRF</strong></td>
<td>380 Hz</td>
<td>1600 Hz</td>
<td>6000 Hz</td>
</tr>
<tr>
<td><strong>MAXIMUM RANGE</strong></td>
<td>320 NMILES</td>
<td>40 NMILES</td>
<td>10 NMILES</td>
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<tr>
<td><strong>OPERATING MODE</strong></td>
<td>PULSED COHERENT</td>
<td></td>
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<tr>
<td><strong>FREQUENCY</strong></td>
<td>9345 + 2 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SYSTEM NOISE FIGURE</strong></td>
<td>5 DB</td>
<td></td>
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<tr>
<td><strong>ANTENNA SCAN</strong></td>
<td>180°</td>
<td>40°</td>
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</tr>
<tr>
<td><strong>ANTENNA GAIN</strong></td>
<td>35 DB</td>
<td></td>
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<tr>
<td><strong>ANTENNA BEAMWIDTH</strong></td>
<td>3.3° ELEVATION</td>
<td>3.4° AZIMUTH</td>
<td></td>
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<tr>
<td><strong>TILT CONTROL</strong></td>
<td>± 15° MANUAL</td>
<td></td>
<td>AUTOMATIC</td>
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ISSUES

TECHNICAL:  - GROUND CLUTTER ELIMINATION
            - ESTABLISHMENT OF HAZARD THRESHOLDS
            - DEFINITION OF DISPLAY DATA BUS
              CHARACTERISTICS
            - SPECIFYING DATA INPUT REQUIREMENTS
            - DEFINITION OF FORM/FIT/FUNCTIONAL
              REQUIREMENTS (ARINC)

OPERATIONAL:  - MEANS OF SELECTING WINDSHEAR MODE
              - DISPLAY MEANS
              - AURAL ALERTS
              - INTERACTION WITH REACTIVE
                WINDSHEAR DETECTION SYSTEM

CERTIFICATION:  - ESTABLISHMENT OF A CERTIFICATION
                 CRITERIA SIMILAR TO THE REACTIVE
                 WINDSHEAR DETECTION SYSTEM
ESSENTIAL REQUIREMENTS FOR CERTIFICATION WITHOUT EXTENSIVE FLIGHT TESTS

- ESTABLISHMENT OF PERFORMANCE CRITERIA USING SIMULATED DATA (NASA)

- DEFINITION OF TEST MEANS USING SIMULATED SIGNAL INPUTS (NASA)

- MINIMUM OPERATIONAL REQUIREMENTS (RTCA)

- TSO (FAA)

- ADVISORY CIRCULAR FOR AIRWORTHINESS AND OPERATIONAL APPROVAL (FAA)