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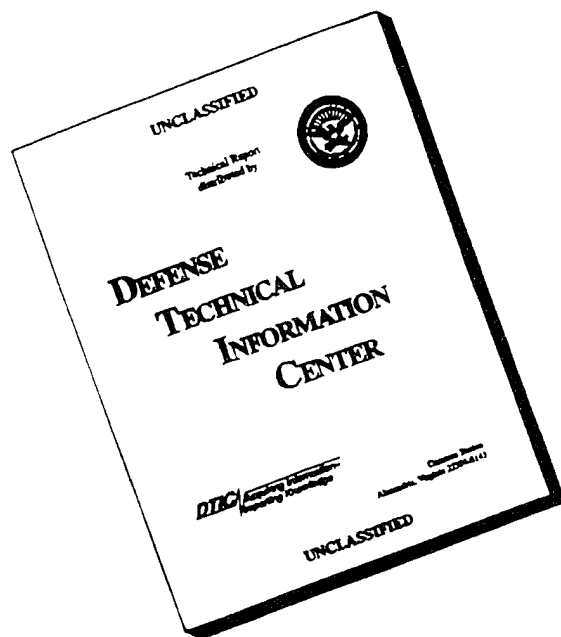
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LONG ARC LIGHTNING SIMULATOR

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AMEREM
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OPEN PUBLICATION

MAY 17 1996

Charles A. Greene
PUBLIC AFFAIRS OFFICE
NAVAL AIR SYSTEMS COMMAND
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OVERVIEW



1. MIL-STD-1757 Requirements
2. Design Criteria
3. Simulator Applications
4. Photos of Simulator
5. Summary

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1. Today I will discuss the requirements of MIL-STD-1757 as it refers to the Long Arc Lightning Simulator.

2. We will discuss our original design goals, uses for the simulator , and show some photographs of the simulator.



MIL-STD-1757 REQUIREMENTS



- Qualification Testing
- Waveform A, B & D
- Test Methods TO1 and TO 4

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1. For qualification testing, there are three voltage waveforms (A, B, & D) which represent the electric fields associated with a lightning strike.
2. Voltage waveforms A and D are used to test for possible dielectric puncture and other potential attachment points. This is known as test method TO1.
3. Voltage waveform B is used to test for streamers. This is referred to as Test Method TO4.



DESIGN CRITERIA



1. At Least 2.0 MegaVolt
2. Moveable
3. Plug-In Components
4. Pneumatic Adjustable Spark Gaps
5. Field Control Corona Rings
6. +/- Power Supply
7. Component Spacing Based and Creepage
12.7KV/IN.

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1. All parameters/goals were considered when simulator was designed. To save money and reduce life cycle costs, existing in house capacitor and materials were used where possible.

2. Simulator was designed to work in air, but possible to upgrade to a closed systems using SF₆ insulating gas. This would allow at least 3.0 MV on output.

3. Simulator design allows for removing stages for lower operating voltage and quick change out of capacitors to provide lower or higher energy in arc.



FINAL PRODUCT



1. Voltages Up To 2.4 MV
2. Erected Capacitance of Either 3.7 NF or 7.4 NF
3. $\approx$ 20 FT Tall
4. Easily Moved

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1. All design goals were achieved. Simulator is modular and easily reconfigured for the various waveforms.
2. The reliability has been extremely high, and the reliability issues associated with moving the system have not been a problem.



SIMULATOR APPLICATIONS



- Scale Model Testing
- To Determine Attachment Points
- To Determine Placement of Diverter Strips
- To Simulate Nearby Lightning
- To Determine Dielectric Strength of Materials
- To Evaluate Diverter Strip Design
- To Evaluate Flashover Characteristic of Coatings

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1. The Long Arc Lightning Simulator is a very versatile pulser for use during both the design and qualification of ground and air systems.
2. Among the more important applications ("Read from slide")



Photo of Long Arc

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1. The simulator is capable of providing an arc 3-4 meters.

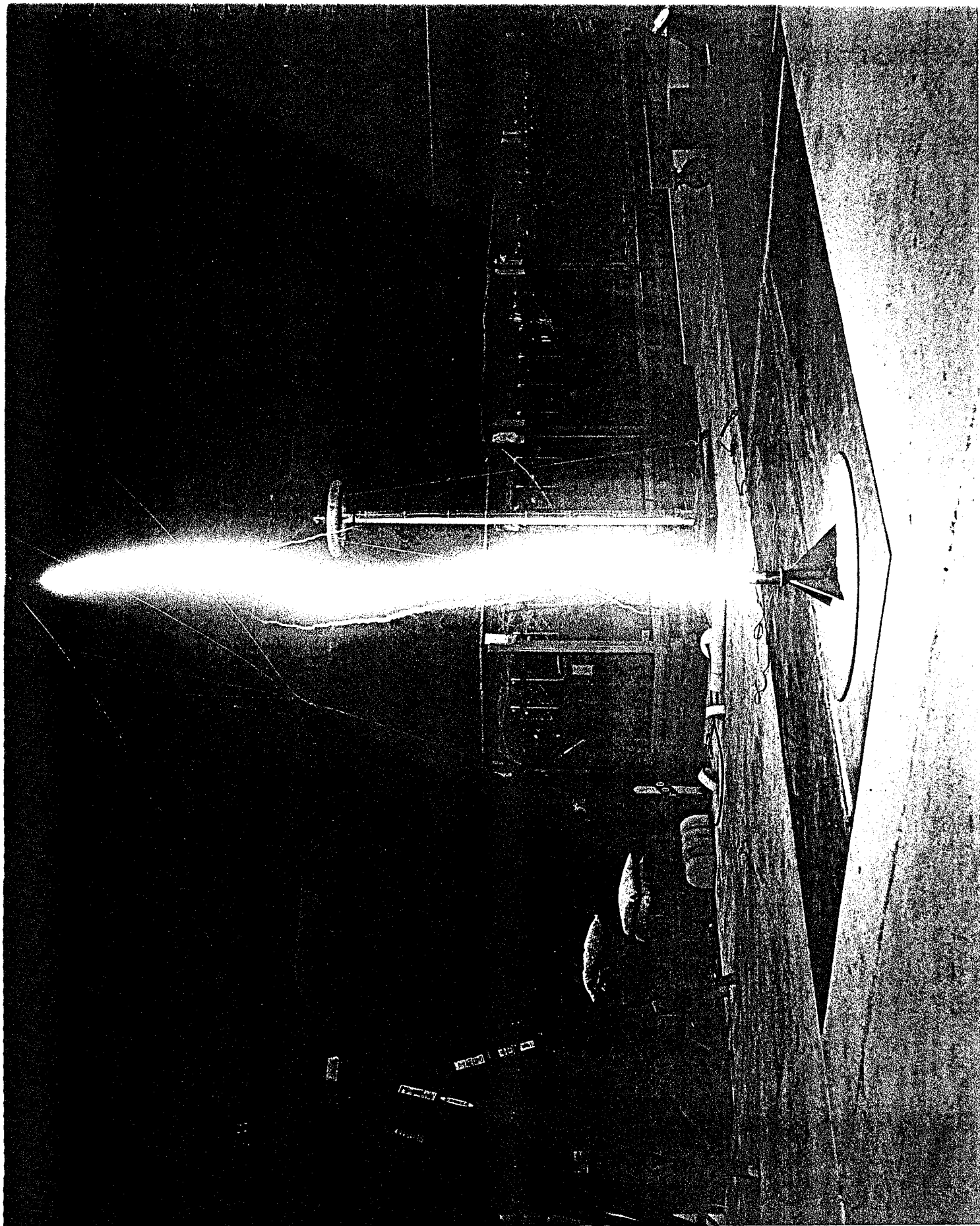




Photo of P-3 Model

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1. The simulator with it's Long Arc is capable of testing larger than normal test objects.



Photo of Radome

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1. The photograph here demonstrates effective diverter strip placement on a large Radome.

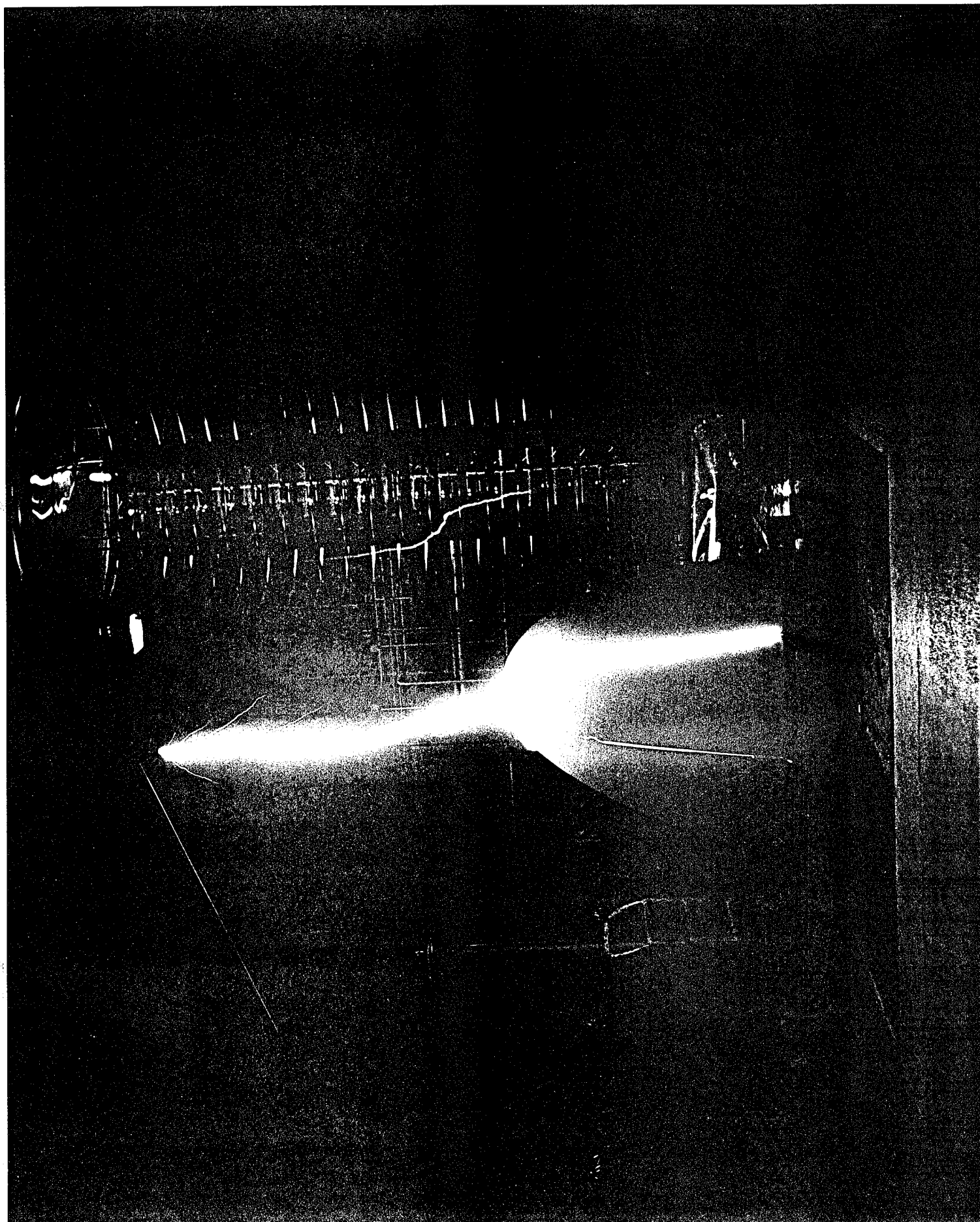




Photo of Simulator at Hangar Door

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1. For a nearly Lightning Test, it becomes necessary to relocate simulator to the hangar door.



Photo of DTSS with Arc

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1. This photo demonstrates an Arc being produced to generate a E and H field to simulate nearby lightning.
2. This test method is very popular with the U.S. Army, particularly with ground based systems.
3. The Navy is considering this test method on some systems.



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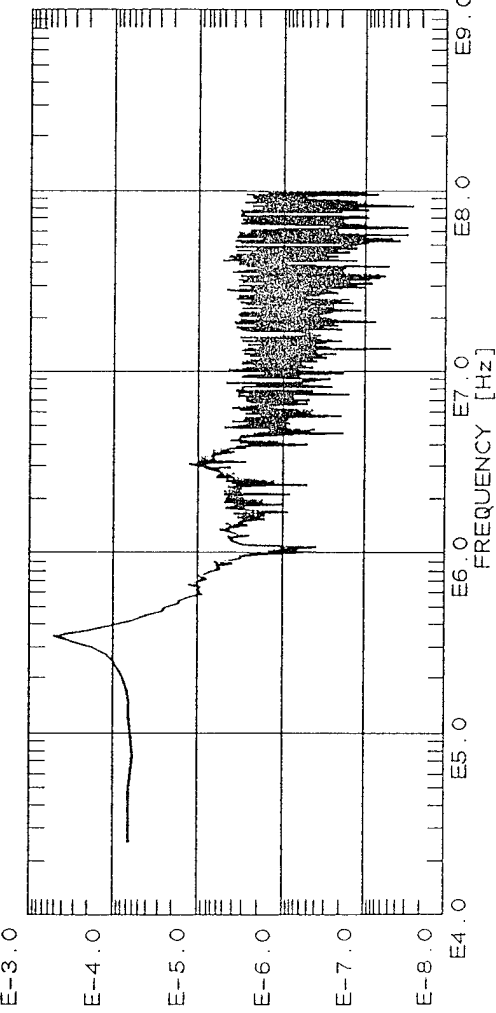
1. The pulser generates a vertically polarized electric field.
2. The fields inside the test volume were measured then the test object was placed in the volume.
3. For example: @ 11 meters we consider the 19 KV/m measured field to be the equivalent of a 50 percentile cloud to ground strike at 80 meters.

RHX30003 REPEAT 13, CORRECTED DATA

30-JAN-96 16:45:08

FILE: PDAS_DATA:RHX30003.013

MAGNITUDE [MV/Hz]



Test ID

Experiment Number

Pulse Number

Pulse Date

Ref Field [kV/m]

Rise Time [sec]

LONG ARC FM

2

151

25-JAN-1996 22:51:52

0.0000

0.0000

Measurement Type

Measurement Priority

Probe type

Probe Eu Conv. factor

Transmitter Gain [dB]

Total Scalar Gain

HX

A

MGL-2

12.60 E-09

-6

-56

Peak [MV]

Peak Time [sec]

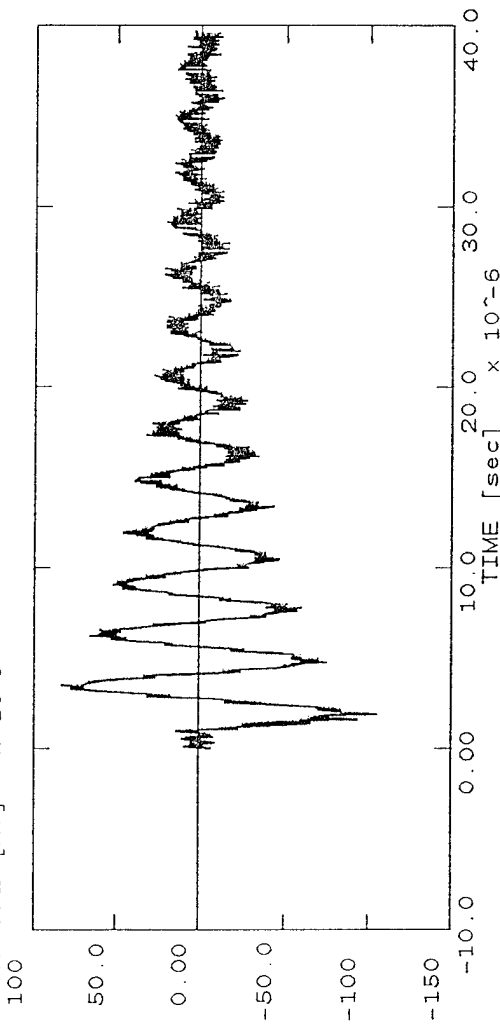
Signal/Noise Ratio [dB]

-104.8 A/m

1.924 E-06

27

AMPLITUDE [MV] x 10¹⁰



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SUMMARY



1. All Design Goals Were Exceeded
2. Actual Testing Has Shown That The Long Arc Lightning Simulator Is Fully Functional
3. Capability Is Available For Both Design Work and Qualification Testing

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1. (Brief from slide)