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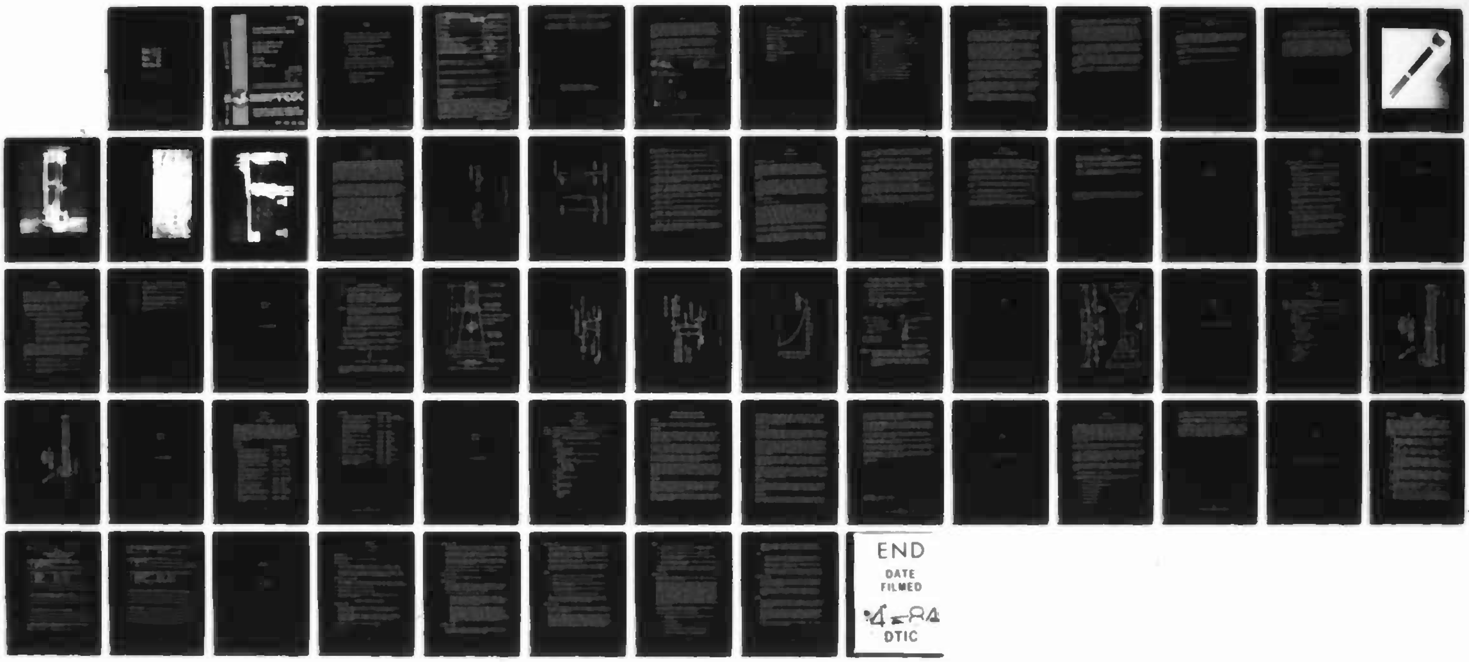

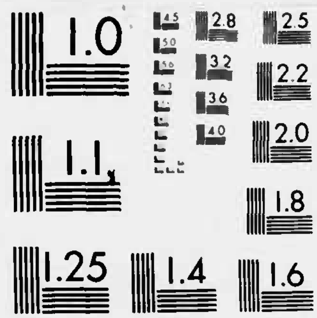

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Evaluation of Arctic Test of Tritium Radioluminescent Lighting

K.W. HAFF, J.A. TOMPKINS, F.N. CASE

OAK RIDGE NATIONAL LABORATORY
POST OFFICE BOX X
OAK RIDGE, TENNESSEE 37830

AUGUST 1983

FINAL REPORT
JANUARY - FEBRUARY 1983

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The arctic test of radioluminescent (RL) lighting was conducted to respond to the Alaskan Air Command (AAC) mission requirement for a self-sustaining airfield light system suitable for arctic deployment. The test showed durability and dependability of tritium lights. It also showed the system, as now designed, can support the operations of small, slow-moving type aircraft. For larger, faster-moving aircraft the lights offer only marginal performance and would have to be supported with other lighting aids to be totally acceptable.

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ERRATA - MARCH 1984

The following corrections are applicable to ESL-TR-82-35, "Evaluation of Arctic Test of Tritium Radioluminescent Lighting," August 1983.

Cover and DD Form 1473

Change Technical Report Number in upper right-hand corner of cover to read "ESL-TR-83-35." Change Report Number in Block 1 of DD Form 1473 to read "ESL-TR-83-35." These changes may be made with pen and ink

Engineering and Services Laboratory
Air Force Engineering and Services Center
Tyndall Air Force Base, Florida 32403

PREFACE

The work described in this report was performed by the Radioisotope Department, Operations Division, Oak Ridge National Laboratory, Post Office Box X, Oak Ridge, Tennessee, under Interagency Agreement 40-1127-80. The work was initiated at the request of the Air Force Engineering and Services Center, Engineering and Services Laboratory (AFESC/RDCS), Tyndall Air Force Base, Florida, and was performed between 12 January 1983 and 12 February 1983. The AFESC/RDCS project officers were Capt Frank J. Tustin, Jr. and Thomas C. Hardy.

This document was prepared under the sponsorship of the Air Force. Neither the United States Government nor any person acting on behalf of the United States Government assumes any liability resulting from the use of the information contained in this document, or warrants that such use be free from privately owned rights.

This report has been reviewed by the Public Affairs Office (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS it will be available to the general public, including foreign nationals.

This technical report has been reviewed and is approved for publication.

THOMAS C. HARDY, PE
Project Officer

ROBERT E. BRANDON
Deputy Director
Engineering and Services Laboratory

JOHN E. GOIN, Lt Col, USAF
Chief, Engineering Research Division

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SECTION I

INTRODUCTION

Radioluminescent (RL) lighting is light produced by impingement of radiation, generally a beta particle, onto a phosphor. The light may be visible or infrared, (IR) depending on the phosphor selected. RL lighting has been used in industry for clock dials, exit signs, and light standards in the photographic industry. Military applications include light-emitting paints for aircraft dial illumination, minefield markers, and gunsight illumination.

The Air Force is investigating alternate airfield lighting systems. In addition to electric power costs, current airfield lights use incandescent bulbs which require frequent maintenance and replacement, and wiring systems which are expensive to install and also require maintenance. The use of tritium RL lighting should greatly reduce maintenance costs. Mission planners desire a self-contained, lightweight system for tactical bare base employment which can be readily adapted to permanent airfields during periods of contingency. Remote Arctic air operations demand energy self-sufficient airfield lighting capable of enduring severe environmental extremes.

In 1979 an Air Force suggestion was submitted by the 1776th Civil Engineering Squadron, Andrews Air Force Base, Maryland, to construct runway distance and taxiway marker signs using tritium radioisotopes as a power source. The proposal advocated the use of tritium-filled, phosphor-lined glass tubes instead of incandescent bulbs and electric power for savings in airfield operation and maintenance costs.

A joint Department of Defense/Department of Energy (DOD/DOE) study group was formed to develop applications for defense nuclear waste radioisotopes as "alternate energy" lighting systems. This group, now known as DOD/DOE RL Technical Guidance Committee (TGC), has identified and demonstrated many military applications.

Tritium light fixtures were first demonstrated to the U.S. Air Force (USAF) by DOE's Oak Ridge National Laboratory (ORNL) during a July 15-17, 1980 demonstration at Andrews Air Force Base, Maryland. The demonstration was during night conditions and some observers reported visual sighting of up to 1 mile. However, more research was needed to improve brightness, color quality, light distribution, and safety.

Subsequently, joint Department of Energy/Engineering and Services Laboratory (DOE/ESL)-sponsored research at ORNL produced a report entitled, Testing of Tritium-Powered Runway Distance and Taxiway Markers.(1) Oak Ridge National Laboratory performed the initial evaluation tests on these RL signs, which included the evaluation of illumination intensity, discoloration, temperature, thermal shock, pressure, impact, vibration, immersion, rough handling, blowing sand, and service life tests.

The current program became known as PROJECT FIREFLY when tests of an improved RL fixture were conducted by ORNL at Bogue Marine Corps Auxiliary Landing Field (MCALF), North Carolina on September 14-18, 1981. These tests evaluated the product of joint DOE/ESL sponsored RL developments (2, 3) and showed that the new fixture was at least twice (228 percent) as bright as the original prototypes. During August 9-12, 1982, operational tests (OT&E) were performed at Bogue MCALF, ORNL, to evaluate a new tritium light fixture geometry redesigned to provide a significantly greater area of light emission.

Analysis of the program subsequent to these tests revealed that several areas required further engineering development. These improvements offer a high probability of producing a fixture to meet the requirements of several runway lighting applications. Some areas critical to achieving this goal formed the technical requirements of the Arctic Test.

The primary goal of the Arctic Operational Test was to evaluate the ability of RL lighting technology to satisfy the Alaska Air Command (HQ AAC) operational requirements. The secondary role of this test is to evaluate the feasibility of this lighting to reduce installation, operation, and maintenance of airfield lighting systems. A complete list of evaluation objectives is described in Appendix A.

The test was conducted during the JRX BRIM FROST '83. AAC and other users evaluated the operation in an Evaluation Review Board (ERB) following the exercise.

SECTION II

TEST PLAN, TEST PROCEDURE, AND EVALUATION PLAN

TEST PLAN

The Tritium Radioluminescent (RL) Lighting, Arctic Test Plan (ATP) was prepared and distributed by HQ, Air Force Engineering and Services Center (AFESC), Tyndall Air Force Base, Florida. This plan should be consulted for a detailed description of the tests, participants, test requirements, methodology, and responsibilities of participating organizations.

TEST PROCEDURE

The Test Procedure is taken from the Test Plan and is presented in Appendix B. The State of Alaska Test Plan and procedure is presented in Appendix C.

EVALUATION PLAN

The Arctic Test Evaluation Plan is taken from the Test Plan and is presented in Appendix D.

SECTION III

LIGHT WAND AND ALASKA FIXTURE DESCRIPTION

The tritium light wands consist of three individual Pyrex® light tubes, each containing 33 curies of tritium. The Pyrex® tubes are packaged inside a 1 1/2-inch diameter by 12 1/4-inch long polycarbonate tube which is sealed. Each unit has 9 inches of lighted tube over the 12 1/4-inch length (Figure 1).

Four light wands were contained in each Alaska-type fixture. The Alaska fixture consists of a 6-inch diameter by 14 1/4-inch long clear acrylic tube. The tube covers a 1 1/4-inch thick aluminum base which contains an O-ring seal and security screws for fastening the cover to the base. The light wands are set in a trapezoidal pattern on the base unit and fastened with 3/8-16 NC studs. This fixture (Figure 2) was placed atop a cone base assembly as described in the State of Alaska Test Plan (Appendix D). The airfield at Clear Creek, Alaska was set up as shown in the drawings in Appendix B and in Figure 3. The airfield lighting layout at Malemute Landing Field was similar, as seen in Figure 4.

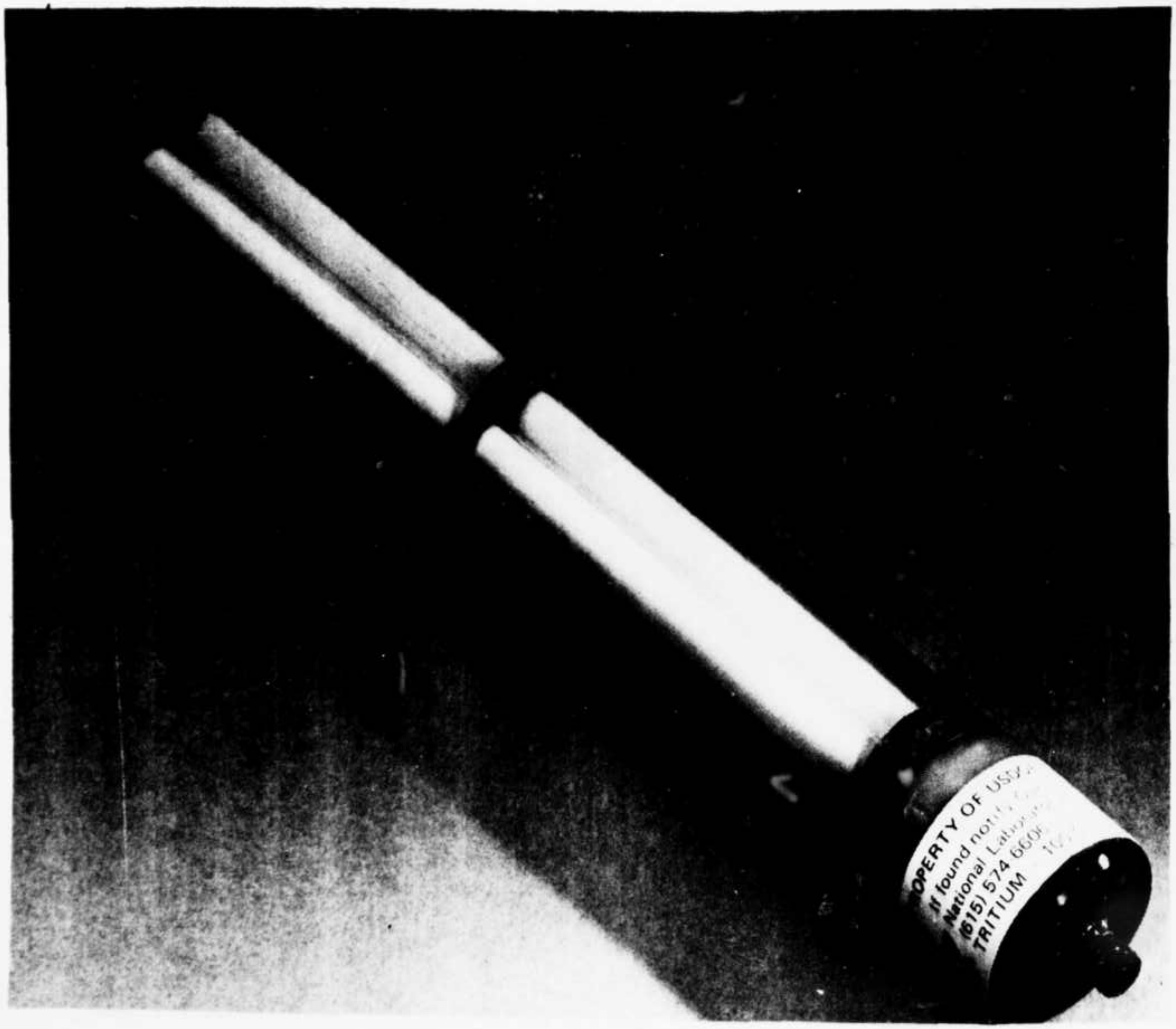

Figure 1. Individual Tritium Light Wand.

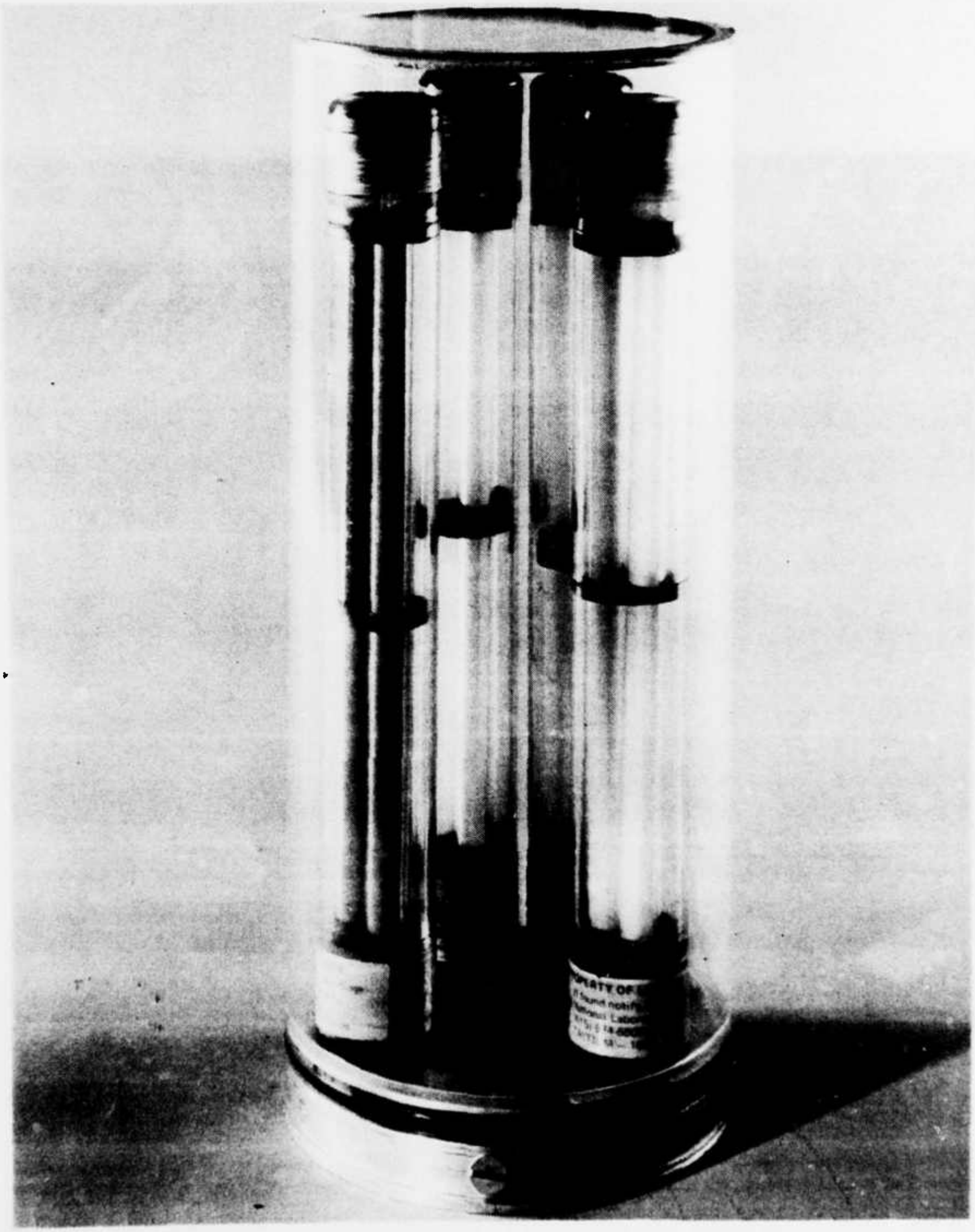

Figure 2. Tritium Light Wand Assembly Fixture for Runway Edge Marking.

Figure 3. VASI Panel System Used at Clear Creek AAF, Alaska.

Figure 4. Runway at Malemute Landing Zone, Ft. Richardson, Alaska.

SECTION IV

CONDUCT OF TESTS

On January 12, 1983, testing personnel departed McGhee-Tyson Air Force Base on an Alaskan Air National Guard C-130 transport, making an overnight stop near Spokane, Washington. Because of -40°F temperatures and heavy ice fog, the plane was diverted from Fairbanks International Airport to Eielson Air Force Base. Representatives of the State of Alaska Department of Transportation and Public Facilities (DOTPF) met the plane at the airfield with state trucks to transport the equipment to the storage site. Discussions were held with the Eielson Air Force Base Radiation Protection Officer (RPO) (also the Clear Creek RPO), who was concerned that no portable tritium sniffer was available and that he had only been informed of the arrival of the lights 6 hours previously. Permission was given to unload the equipment and the DOTPF people transported it to the storage site.

The lights remained in storage until January 16, 1983, when the visual approach slope indicator (VASI) panels and stands were taken to the Clear Creek Airfield by helicopter. The Clear Creek runway was 4000 feet long by 80 feet wide with packed snow, ice, and silt as the runway surface (runway headings 12-30). Two three-panel VAST sets (one infrared and one visible) were set up on the 12 end. Truncated traffic cones (Figure 2) with wooden disks mounted in the top were frozen to the runway at 150-foot intervals (Figure B-III-1, Appendix B).

On January 17, 1983, security screws were installed on arctic light fixture base units. Sixty lights were deployed at the Clear Creek airfield on the traffic cone bases. Actual deployment time was approximately 40 minutes, with two people and one vehicle. Setup time for traffic cones and VASI panels was approximately 1 hour each. Helicopter flights after dusk optimized the VASI configuration for aircraft use. Two VASI configurations, the Hat and the Bar, were tested (Figure 5), as well as a parallel and nonparallel runway alignment (Figure 6). The optimum configuration was the Hat, parallel to the runway. The front two panels were 116 feet from the rear panel, with a 10-foot separation between the edges of the two front light sets. The front lights were 6 feet (maximum height of an obstruction at 75 feet from the centerline of the runway per MAC regulations) above ground level at the top and the rear panel approximately 14 inches above ground level at the top.

January 18, 1983. Due to VASI array offset (75 feet from the centerline of the runway) final alignment with the airfield was not adequate for high-speed aircraft. As an experiment, the three VASI panels on the 12 end of the runway were deployed on the runway centerline at the 30 end of the field at 500 feet intervals away from the 30 threshold. These lights were configured as standard airfield lead-in lights and corrected the alignment problem.

January 22, 1983. The prevailing winds picked up to 10-15 knots and changed direction 180°. Almost all aircraft were landing on Runway 12. A

Figure 5. Two VASI Alignment Configurations.

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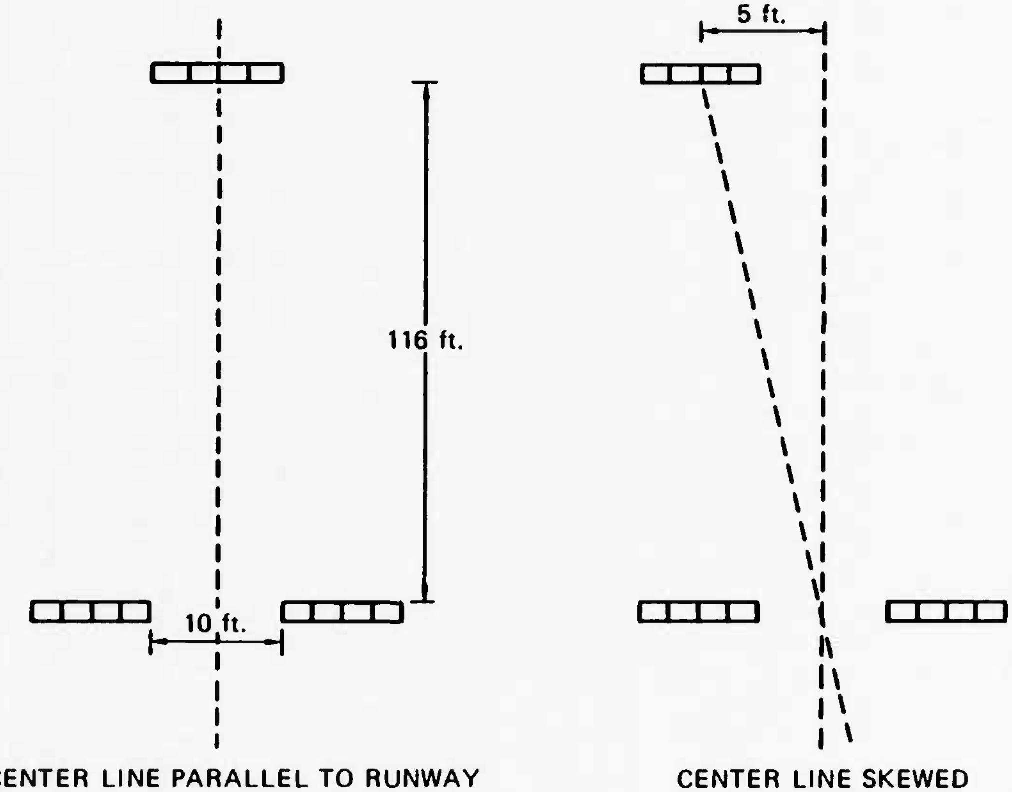

Figure 6. Parallel and Skewed VASI Layout.

decision was made by the group not to move the light array to see if the wind would shift again.

January 22, 1983. The light fixtures were cleaned (by wiping) to remove a layer of dirt and ice blown up by C-130 landings and takeoffs.

January 23, 1983. Two light fixtures were found blown over. The fixtures were reiced to the runway.

January 24, 1983. A briefing was given to the Ninth Infantry Helicopter Group (UH-60) on RL lights at Clear Creek.

January 25, 1983. All infrared wands were removed from 60 light fixtures at Clear Creek and visible wands were substituted.

January 27, 1983. More traffic cones with light fixtures had blown over due to sublimation of ice (average air temperature 10°F). The problem was eliminated by driving 12-inch timber spikes into the ground on opposite sides of the cone and wiring the cones to the spikes.

January 28, 1983. Prevailing wind direction was from the south; Runway 12 was being used. The decision to move the VASI system to the 12 end of the runway was made. Lead-in lights were not moved to the 12 end because of topographic considerations (a 50-foot dropoff on the 12 end).

February 1, 1983. The VASI panels, cones, and lights were removed from the airfield in 3 hours. The entire load of equipment was flown out as one load on board a UH-1 helicopter.

February 2, 1983. The lights were flown to Anchorage and stored at Kulis Air National Guard Base.

February 4, 1983. The cones, VASI panels, and wind tee were taken to Malemute Field (Ft. Richardson, Alaska) and deployed.

February 5, 1983. C-130 sorties were flown on lights by Alaska Air National Guard (AKANG). Approximately 20 landings and takeoffs were made using two aircraft and four crews. These were part of the State of Alaska series of tests.

February 6, 1983. Activities cancelled due to heavy snow.

February 7, 1983. Light aircraft landings and takeoffs were performed by Federal Aviation Agency (FAA) pilots and observers, as well as overflights by Air Force light (2 engine) aircraft and ANG helicopter flights. These were part of the State of Alaska series of tests.

SECTION V

DISCUSSION OF RESULTS

MAINTENANCE AND SAFETY

There were no problems identified with storing, shipping, handling, installing, or maintaining the tritium lights during the test. The fixtures were secured at designated positions along the runway by freezing in place. Several of the fixtures were overturned by C-130 prop blast but sustained no damage and were returned to service. Twelve-inch timber spikes were driven into the runway and the fixtures were wired down after the second occurrence of blow-over.

SECURITY

Prior to the BRIM FROST '83 test, much concern was raised about the tritium lights being removed, stolen, or vandalized. Because of the physical conditions at Clear Creek and limited security personnel available, it was decided that risk was within limits and this would be an undefined evaluation factor. Results in this area were totally satisfactory. Throughout the test period only one light was removed, retrieved immediately, and returned to service. This isolated case is insignificant when considering the large number of USAF and USA personnel involved at Clear Creek, the length of deployment, and lack of active security measures.

AIRCREW EVALUATION

1. Acquisition Range

a. Range at which pilots could visually acquire the tritium lights was considered a critical evaluation factor. Throughout the test, it was shown that acquisition range was highly dependent upon the level of light from external sources. Range decreased greatly with dawn and dusk or with a full moon and clear skies. Under ideal dark conditions, range varied from 1 to 2 miles and was dependent again on several factors. First, pilots of slower aircraft, such as helicopters, acquired the lights sooner than faster/larger aircraft such as the C-130. Also, range seemed to increase with increasing pilot familiarization with the tritium lights. Also, the lead-in and VASI panels were acquired sooner than the smaller runway edge lights, which was expected, considering the differences in light fixture frontal area.

b. The USA UH-60 pilots considered the tritium lights entirely satisfactory for their mission. They evaluated both visible and infrared (IR) lighting and rated both excellent.

c. O-2 pilot participation in the test was minimal. Consensus was that the tritium lights, in the present configuration, would be as acceptable as the alternative method of runway identification, Coleman-type fuel lanterns. Acquisition range, under ideal conditions, was 1 to 2 miles and tended to improve slightly with familiarity.

d. A-10 pilot participation in the test was minimal. Questionnaires received showed erratic aircrew responses which did not provide any meaningful information. A primary reason was undoubtedly due to pilot unfamiliarity with the tritium lights.

e. C-12 pilots acquired the tritium lights at 1 to 2 miles under ideal conditions. Range again improved with familiarity.

f. C-130 pilots tended not to acquire the lights as quickly as pilots of smaller, slower-moving aircraft. Even under best conditions they felt range was between 1/2 and 1 1/2 miles. This, again, is probably due to aircraft size and approach speed.

2. Runway Alignment. Most pilots felt the tritium lights provided useable alignment information from about 1 mile. This was considered satisfactory for slow-moving aircraft which would be afforded additional time for correction. Pilots of higher speed aircraft felt the tritium lights provided minimal time for alignment and forced go-arounds were a definite possibility.

3. VASI Lights. The tritium VASI system was a simple three-bar system. Acquisition range for most pilots was 1 to 1 1/2 miles. However, useable range (able to discern glide-slope deviation) was generally put at about one-half the acquisition range. Most pilots considered the VASI system, as configured for this test, a limited cross-check system rather than a total glide-slope guidance system.

4. Runway Landing Zone/Edge Lights. Only UH-60 and C-130 aircraft landed using the tritium light system and nearly all pilots considered them adequate for safe landing. O-2, A-10, and C-12 aircraft flew low approaches only, but these pilots felt a safe landing could have been made.

SECTION VI

CONCLUSIONS AND RECOMMENDATIONS

The test completed during BRIM FROST '83 showed the durability and dependability of the tritium lights. It also showed the system, as now designed, can probably support the operations of small, slow moving type aircraft. For larger, faster moving aircraft the lights offer only marginal performance and would have to be supported with other lighting aids to be totally acceptable.

The following recommendations are made for further development and testing of tritium RL lights for airport use.

1. The use of tritium runway lights, as presently designed, should be limited to supporting operations of small, slow moving aircraft like O-2's and helicopters.

2. Aircrews must have the opportunity to fly approaches to the tritium lights, in a controlled training environment, prior to any operational deployment.

3. Visual acquisition range must be improved by redesigning the lights and/or providing an additional location aid.

4. Further testing and evaluation is required to determine the feasibility of tritium lights to support A-10 or C-130 operations.

5. All aircraft pilots participating in RL light demonstrations and evaluations should be briefed beforehand by a pilot who has flown on the RL lighting system previously.

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NOTE TO READER: The Appendices and Annexes included with this report contain documents produced by various agencies involved. These documents have undergone minor editing for grammar, spelling and consistency, but remain unchanged in format and content.

APPENDIX A

EVALUATION OBJECTIVES

APPENDIX A

EVALUATION OBJECTIVES

1. Alaskan Air Command: (HQ AAC/DOOS)

   a. Evaluate the feasibility of storing, shipping, handling, installing, and maintaining RL fixtures for different Arctic applications.

   b. Evaluate the physical and environmental safety and security of RL lighting applicable in remote Arctic operations.

   c. Assess overall adequacy of the RL lighting system to recover a variety of aircraft in an Arctic environment.

   d. Estimate the maximum range at which the RL taxiway lighting fixtures can be acquired during night ground operations.

2. Military Airlift Command: (HQ MAC/XPQT)

   a. Estimate the distance from the runway that the VASI systems can be acquired and used effectively for approaches and landings.

   b. Estimate the maximum range at which the RL runway lighting system can be acquired during day and night air operations in VMC conditions.

   c. Assess the effectiveness of the RL lighting system for acquisition, alignment, approach, and ground operations.

3. Engineering and Services Laboratory: (HQ AFESC/RDCR)

   a. Evaluate the manpower and man-hours required to initially install and relocate the airfield lighting system as necessary to maintain a minimum operating strip (MOS) on any of the available airfield surfaces.

   b. To quickly relocate an MOS and to rapidly reduce nighttime detection of the runway, determine the most feasible method of covering and/or abandoning unwanted lighting.

   c. Quantify the degree RL lighting improves visibility over incandescent airfield lighting during adverse weather conditions.

APPENDIX B

TEST PROCEDURE

APPENDIX B

TEST PROCEDURE

1. Purpose. The purpose of this test is to evaluate several RL airfield applications for use in an Arctic environment during BRIM FROST '83. The field layout is depicted in the LIGHTING LAYOUT PLAN, Annex III. The Arctic Test Site (ATS) shall require 69 runway edge lights; 2 helipad lights (8 markers); and 3 VASI systems (9 VASI panels); and one wind Tee. Each VASI panel shall consist of 4 each 12-inch by 12-inch RL light panels.

2. Sequence of Events. The State of Alaska, Department of Transportation (AKDOT) personnel shall perform the site layout following the LIGHTING LAYOUT PLAN then install the fixture mounting cones for the runway/taxiway lights as depicted in Annex III.

The Alaska Air National Guard (AKANG) shall deploy a C-130 aircraft to transport the test team and equipment by the following schedule.

10-15 Jan 83	Prime BEEF installs auxiliary electroluminescent (EL) airfield light system at ATS.
11 Jan 83	Pick up personnel and fixtures at McGhee-Tyson Air National Guard Base (ANGB), Tennessee, and proceed to Andrews Air Force Base, Maryland, to remain overnight at Andrews AFB.
12 Jan 83	Pick up additional personnel and equipment at Andrews and proceed to a northwest Continental United States (CONUS) location for night stopover.
13 Jan 83	Proceed to Elmendorf AFB to pick up Arctic clothing, then continue to Fairbanks Airport, Alaska, to unload cargo and personnel before returning to Kulis ANGB Alaska.

The (AKARNG) shall provide two UH-1 helicopters and an aircrew to support the test team and to demonstrate the night vision equipment to interested pilots. The UH-1s shall transport the fixtures and personnel from Fairbanks to the ATS. Night vision demonstration requests shall be coordinated through the overall BRIM FROST coordinator, HQ AAC/DOOS. HQ AAC/DOOS shall provide the time of the installation and location of the ATS.

28 Jan 83	BRIM FROST Exercise to begin. All lights and panels will be in place during this period.
2 Feb 83	BRIM FROST Exercise to end. Team will proceed to test site to recover fixtures and panels.
3 Feb 83	AKANG will transport fixtures, panels, and personnel to Anchorage, Alaska.

4-10 Feb 83	Runway and VASI system evaluation by AKANG and AKDOT.
7-11 Feb 83	HQ AAC/ADO directs ERB at Elmendorf AFB, Alaska, with ESL and ORNL observers.
11 Feb 83	Remove lights and panels and prepare for shipment to CONUS.
12 Feb 83	AKANG will pick up personnel and equipment at Anchorage, Alaska to return to CONUS.
14 Feb 83	Stopover enroute at McGhee-Tyson ANGB to leave ORNL personnel and equipment.
14 Feb 83	Arrive Andrews AFB, Maryland. Test team returns to home stations.

APPENDIX B

ANNEX I

STATE OF ALASKA

CONE BASE BREAKAWAY TEST

CONE BASE BREAKAWAY TEST

1) Purpose: To determine the static load required to separate traffic cone R-L light support from cone base (Figure B-I-1).

2) Method: A truncated breakaway traffic cone prepared as per R-L light mounting base requirements was frozen to a plowed, frozen silt surface at the rear parking lot of the Duckering Building at 2:30 p.m. on January 3, 1983. Slowly increasing load was placed on the cone as shown in the diagram (Figure B-I-2).

An impact load was not attempted.

3) Results: The ambient temperature was -5°F. The cone-base assembly was left standing for 30 minutes to approach equilibrium temperature after snow and water had been packed around base to freeze to ground surface.

Three breakaway loads were applied. Each time the spring balance was read as the load increased slowly by hand. In each case the torque would induce a slight twisting of the cone in the base up to approximately 5° then the system would yield. At the yield point, the load was marked by two observers.

A) Cone broke loose from base and base separated from snow pack simultaneously at 26 pounds.

B) With cone base now secured by applying pressure with an observer's foot, the load was applied a second time. The breakaway force required was 29 pounds.

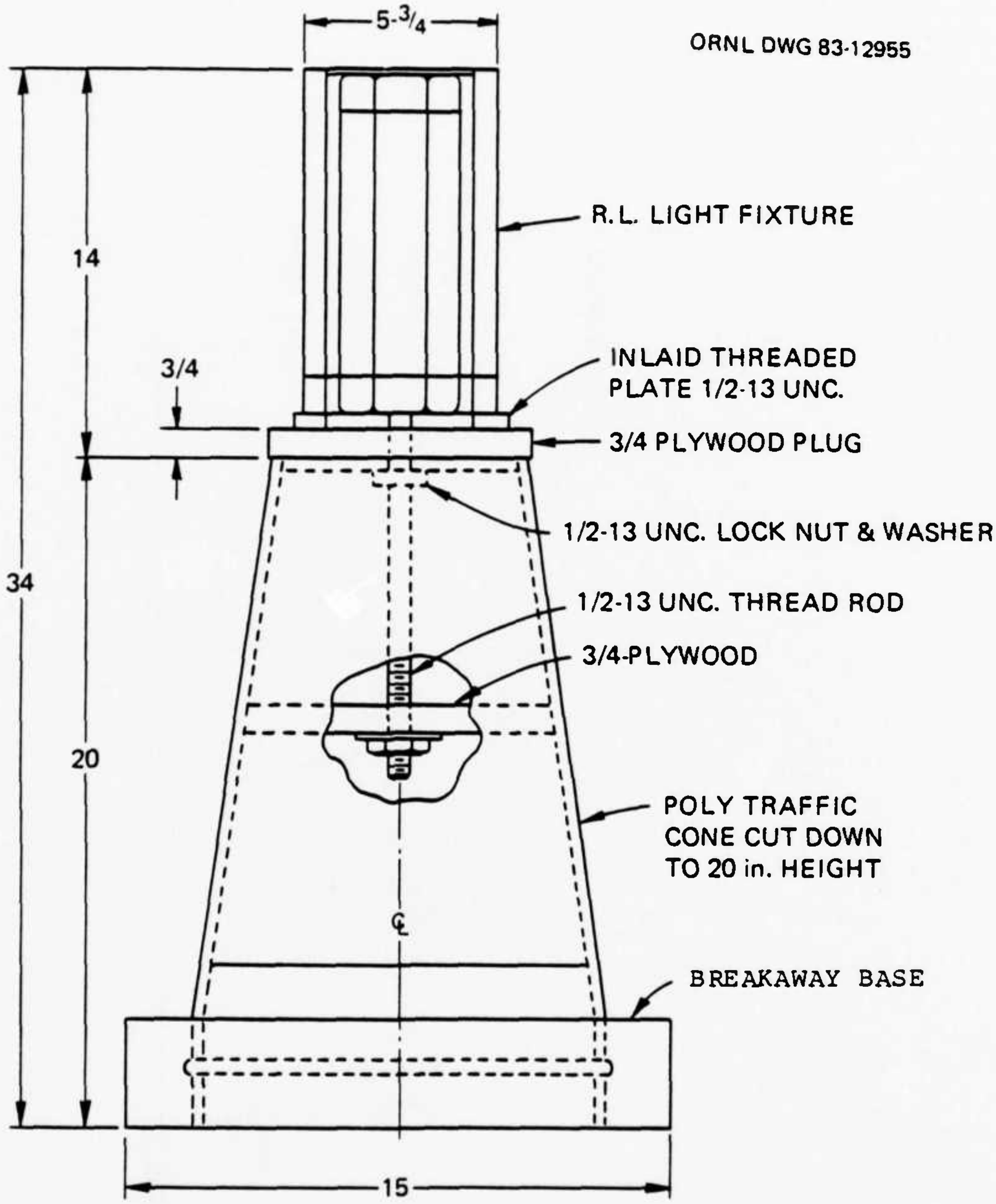
C) A third attempt was repeated as in "B" above. The breakaway occurred just as the scale reached its maximum extension at 30 pounds - estimate 31 pounds required.

4) Analysis of Results: Taking a simple average we can assume a typical breakaway force for a static load to be:

$$\begin{array}{r} 26 \\ 29 \\ \underline{+31} \\ 86 \end{array}$$

$$\text{Load average} = \frac{86}{3} = 28.66 = \underline{29\ \text{pounds}}$$

Using the geometry of the test and assuming a simple mechanical system shown below (Figure B-I-3), it is possible to plot the probable breakaway characteristics (Figure B-I-4) of the cone base assembly under static load conditions:



ELEVATION
R.L. LIGHT & BASE ASSEMBLY
SCALE: 3/16" = 1'

Figure B-I-1. Radioluminescent Light and Base Assembly.

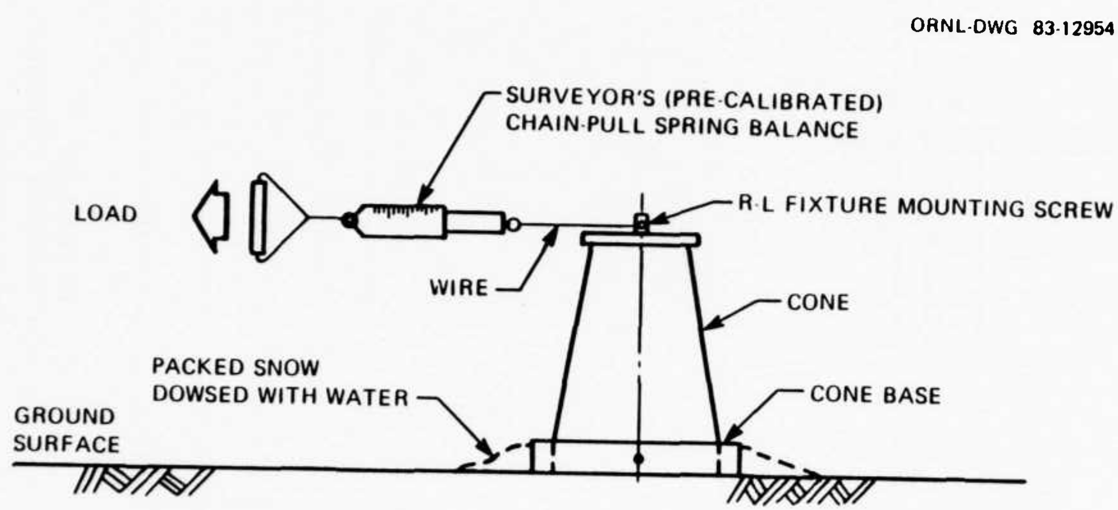


Figure B-I-2. Breakaway Cone Test Configuration.

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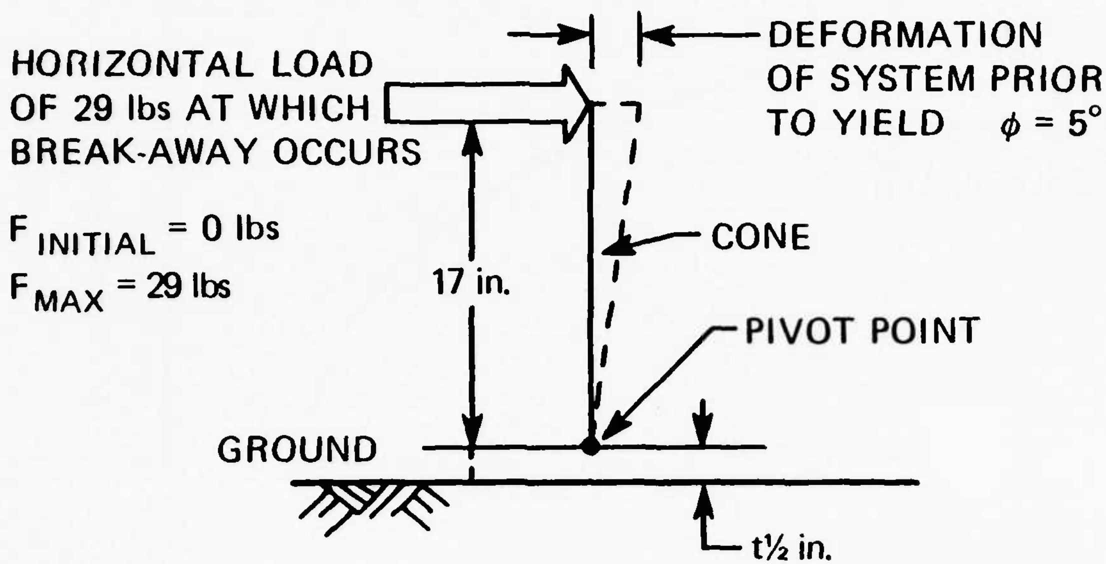

Figure B-I-3. Static Diagram of Test System.

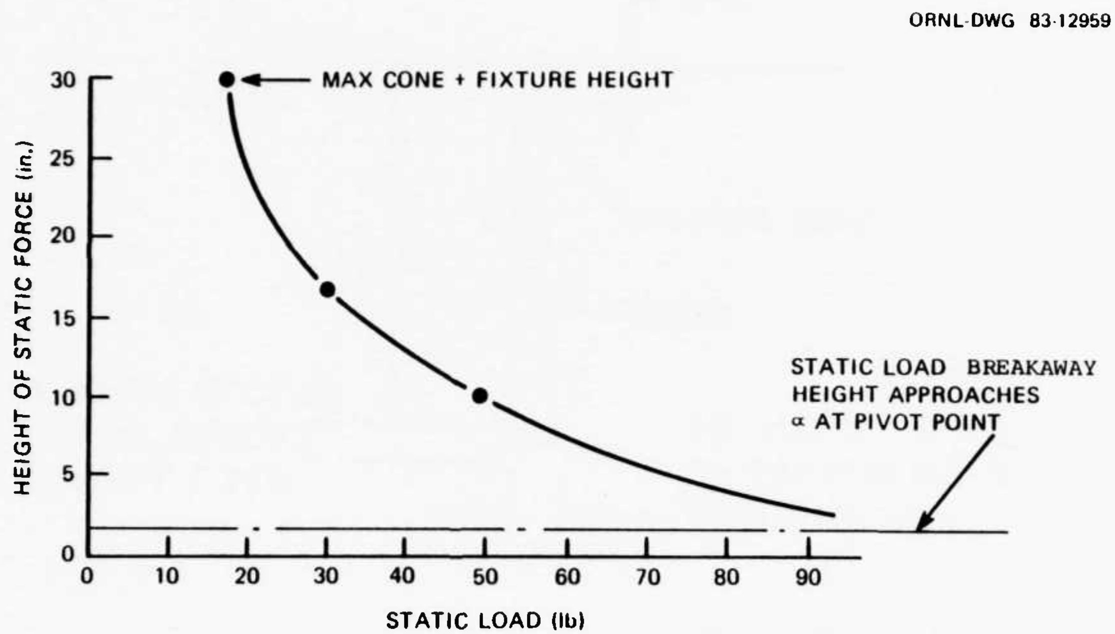

Figure B-I-4. Breakaway Characteristics of Cone Base Assembly.

This assumes that a moment of force of 41-foot pounds would be required to break away the cone about the pivot point.

We may approximate the eccentric impact load required to break away the cone using the static breakaway load if we make a few assumptions:

1) Assume that impact velocities are low (<100 fps).

2) Assume that the stress-strain relationships are linear. $(F_{ave} = 1/2\ F_{max})$

3) Assume that all the energy is used to break the cone away and none is lost in dynamic effects of heat or sound.

4) Energy - $\frac{(F_{max})\Delta}{2}$ (See Figure B-I-5)

ORNL-DWG 83-12956

Where Δ = Deflection

or for a torsional problem:

$E = (F_{max})(\text{Distance})(\emptyset)/2$

$E = (41\ \text{ft. lbs})(.0873\ \text{Rad.})/2$

$E = \frac{3.5779}{2}$ ft. lb.

$\boxed{E = 1.789\ \text{ft. lb.}}$

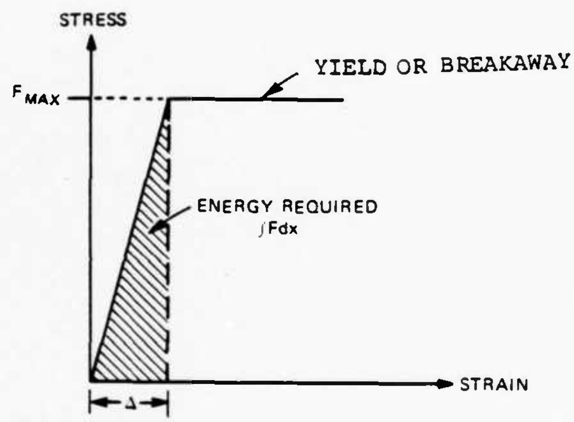

Figure B-I-5. Stress-Strain Diagram for Cone Breakaway

Conclusion: The criteria for shearing of light fixture support from permanent ground anchor was given in statement of work (JON: 20545046), "Tritium Runway Edge and Threshold Light-Cold Region Test," as less than 400 ft. lbs of impact energy in Paragraph 5.2.4.1.

By approximating the breakaway energy required from the static load we have determined an equivalent dynamic breakaway energy requirement of - 1.8 ft. lb which is only a tiny fraction of the above criteria.

APPENDIX B

ANNEX II

SITE PLAN

ORNL DWG 83 12957

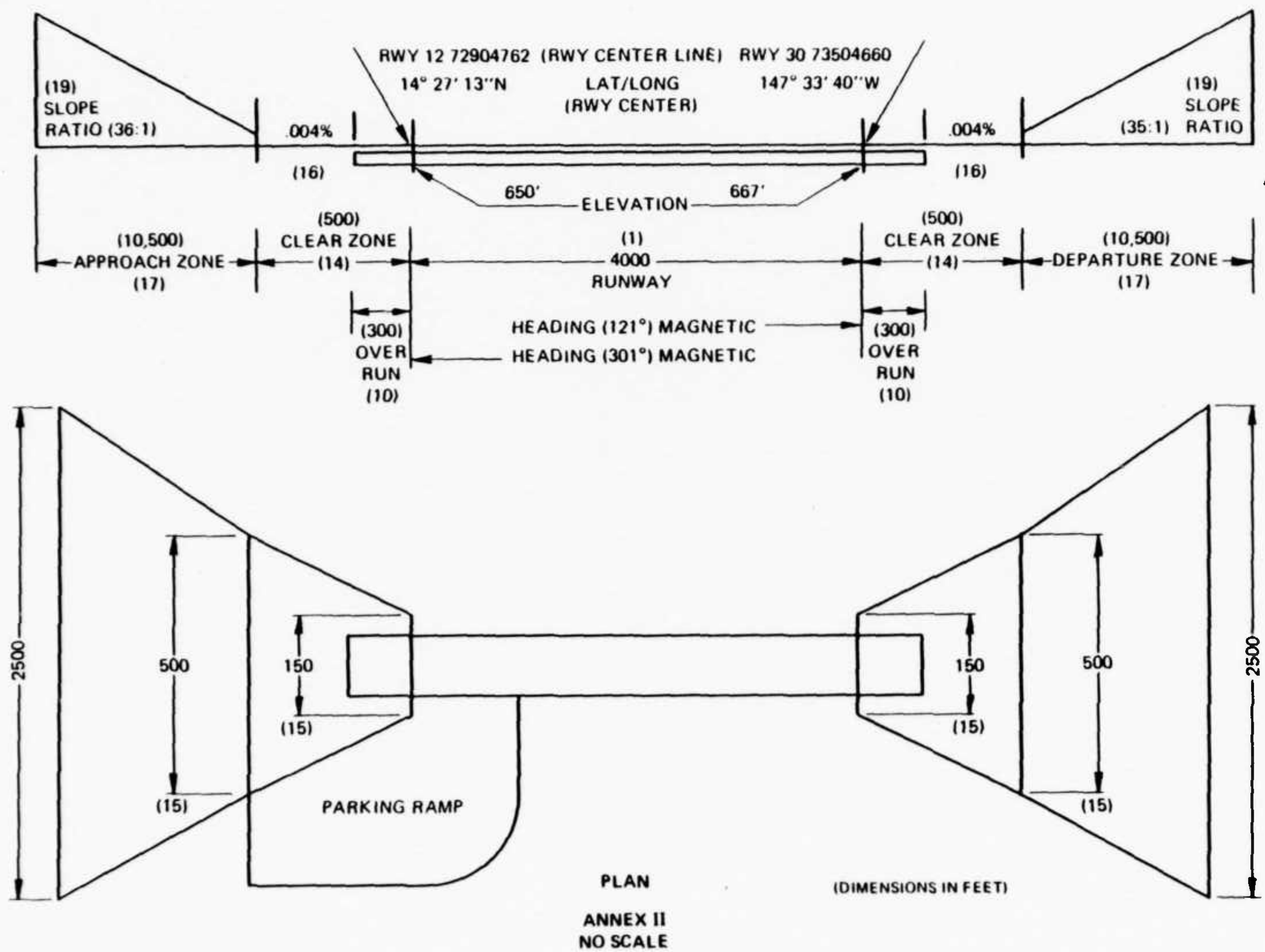

Figure B-II-1. Clear Creek AAF Site Plan Coordinates of Grid.

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APPENDIX B

ANNEX III

INSTALLATION BRIEFING PLAN

APPENDIX B

ANNEX III

INSTALLATION BRIEFING PLAN

(30 minutes)

TITLE: "Radioluminescent (RL) Light Handling"

AUDIENCE: Prime BEEF installation, fire protection, and disaster preparedness personnel, along with HQ AAC Radiological Protection Officers' (RPO) staff.

LOCATION: Arctic Test Site (ATS).

- PURPOSE: Explain and demonstrate safe installation of RL lighting fixtures.
- OVERVIEW
- INTRODUCTION: "Test and evaluation of new technology..."
- DESCRIPTION
  - -- What are RL lights?
  - -- How does it work?
  - -- Is it hazardous?
- GROUND OPERATIONS
  - -- Why use in Arctic?
  - -- Method(s) of deployment.
  - -- Physical security.
- SAFETY
  - -- In case of breakage: Reporting and Controlling.
  - -- Function of RPO.
- DEMONSTRATION
  - -- Site preparation.
  - -- Installation.
  - -- Alignment.
- SUMMARY: Q & A.

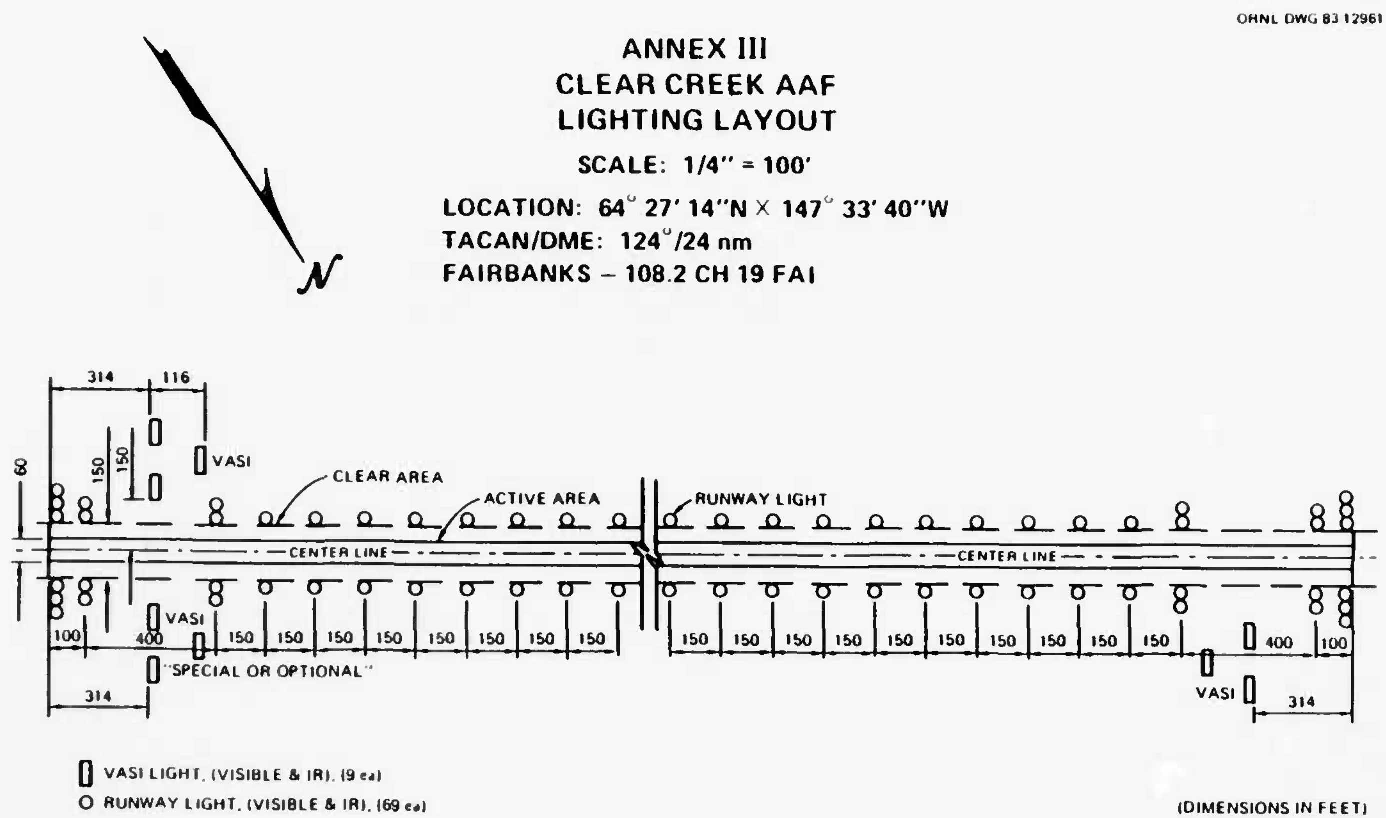

Figure B-III-1. ANNEX III - Clear Creek AAF Lighting Layout.

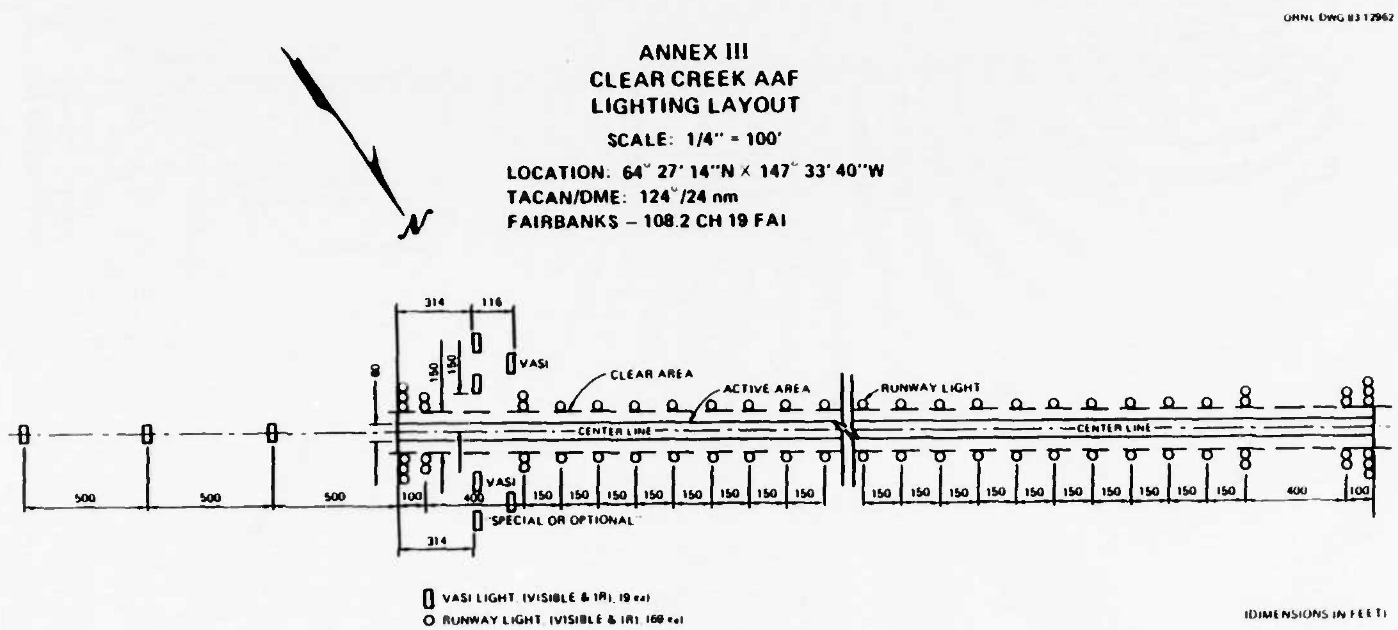

Figure B-III-2. ANNEX III - Clear Creek AAF Lighting Layout.

APPENDIX B

ANNEX IV

INSTALLATION PROCEDURE

APPENDIX B

ANNEX IV

INSTALLATION PROCEDURE

1. General. The mounting cones shall be installed prior to the deployment of the lighting fixtures. AKDOT shall survey the field and install the mounting cones. At the request of the BRIM FROST coordinator, the PROJECT FIREFLY team shall deliver the fixtures to the test site. Upon arrival of the team and fixtures the Prime BEEF team shall be instructed as to the proper care and installation of the fixtures by the FIREFLY team personnel. But, the VASI panel mounting frames shall not be installed until the team arrives to deliver and align the panels for specific glideslope angles.

2. Specific.

Step	Event	Responsibility
1.	Survey and spacing layout to follow the plan depicted in Annex III.	Action: AKDOT
2.	Securing fixture mounting bases to surface mounting bases will be gravel filled and frozen to ground.	Action: AKDOT
3.	Secure VASI panel mounting frames to surface, freeze in place.	Action: Prime BEEF Coord: Test Team
4.	Install VASI panels, bolt panels to frame.	Prime BEEF
5.	Install edge/taxiway lights, screw fixtures into mounting cones.	Action: Prime BEEF
6.	Install taxiway lights, screw fixture to mounting cone.	Action: Prime BEEF
7.	Install helipad lights, stake to ground.	Action: Prime BEEF Coord: Test Team
8.	Brief Prime BEEF personnel.	Action: AKDOT
9.	Distribute questionnaires.	Action: HQ AAC
10.	Collect questionnaires.	Action: HQ AAC
11.	Remove all fixtures and panels for relocation to State of Alaska test site.	Action: Prime BEEF Coord: Test Team
12.	Remove fixture bases and frames for relocation to State of Alaska test site.	Action: AKDOT Coord: Test Team

Step	Event	Responsibility	
13.	Transport all equipment and personnel to State of Alaska test site	Action: Coord:	AKANG & AKARNG Test Team & AKADOT
14.	Site survey and field layout at State of Alaska test site.	Action:	AKDOT
15.	Fill mounting bases with gravel, secure fixture mounting bases to surface and freeze to ground.	Action:	AKDOT
16.	Secure VASI frames, freeze to surface.	Action: Coord:	AKDOT Test Team
17.	Install VASI panels, bolt panels to frame.	Action: Coord:	AKDOT Test Team
18.	Install lights, screw fixture to mounting cone.	Action: Coord:	Test Team AKDOT
19.	Install helipad lights, stake to ground.	Action: Coord:	AKDOT Test Team
20.	Conduct State of Alaska evaluation.	Action:	AKDOT & RLTGC
21.	Remove lights and panels.	Action: Coord:	AKDOT Test Team
22.	Remove cones, bases and frames.	Action:	AKDOT
23.	Package all equipment for recovery.	Action:	AKDOT & Test Team
24.	Transport all personnel and equipment to CONUS.	Action:	AKANG

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APPENDIX B

ANNEX V

AIRCREW BRIEFING GUIDE

APPENDIX B

ANNEX V

AIRCREW BRIEFING GUIDE

(8-10 minutes)

TITLE: "Aircrew Evaluation of Radioluminescent (RL) Airfield Lighting"

AUDIENCE: All BRIM FROST forces.

LOCATIONS: Elmendorf AFB, Eielson AFB, and Ft.Wainwright AK.

- PURPOSE: Orient aircrews to RL lighting at Arctic Test Site (ATS), and explain RL lighting questionnaire.
- OVERVIEW
- INTRODUCTION: "Test and evaluation of a new technology..."
- DESCRIPTION
    - What are RL lights?
    - How does it work?
    - Is it hazardous?
    - Illustrate example(s): Display visible/IR wands.
- AIR OPERATIONS
    - Lighting Layout: ATS
    - NAV AIDS: Color, alignment, and sensitivity.
        - Wind Tee
        - VASI systems
        - Runway Lights
        - Taxiway Lights
    - Mission Particulars
- QUESTIONNAIRE
    - Review
    - Special Emphasis Items
    - Turn-in
- SAFETY
    - Target Fixation
    - Radiation Hazard
- SUMMARY
    - Air Operations
    - Questionnaire
    - Safety
    - Closure

BRIEFING HANDOUT FOR AIR OPERATIONS ON RADIOLUMINESCENT (RL) AIRFIELD LIGHTING

PURPOSE

Orient aircrews to RL airfield lighting applications before their evaluation during BRIM FROST '83 using the aircrew RL lighting questionnaire.

BACKGROUND

Radioluminescent (RL) lighting is defined as the use of radiation from radioisotopes in combination with phosphors to produce visible light. Radioluminescent lighting has been used in industry for clock dials, exit signs, and light standards in the photographic industry. The military has used light-emitting paints for aircraft dial illumination, minefield markers, and gunsight illumination.

In 1979, an Air Force Suggestion was submitted by the 1776 CES, Andrews AFB MD to construct runway distance and taxiway marker signs using tritium radioisotopes as a power source. The proposal advocated the use of tritium-filled, phosphor-lined glass tubes instead of incandescent bulbs and electric power for savings in airfield operation and maintenance costs.

A joint DOD/DOE study group was formed to develop applications for Defense Nuclear Waste radioisotopes as "alternative energy" lighting systems. This group, now known as DOD/DOE RL Technical Guidance Committee (TGC), has identified and demonstrated many military applications.

The current program became known as PROJECT FIREFLY when extensive tests of an improved RL fixture were conducted by Oak Ridge National Laboratory (ORNL) at Bogue MCALF NC on 14-16 Sep 81. These tests showed that the new fixture was at least twice as bright as the original prototypes. During 9-12 Aug 82 tests at Bogue MCALF, ORNL conducted a preliminary evaluation of a new tritium RL light fixture geometry redesigned to provide a significantly greater area of light emission.

DISCUSSION

Lights of various intensities and colors are necessary for airfield lighting. Some applications such as runway edge markers, taxiway markers, threshold markers, informational signs, and certain combat situations, may be served by lights of relatively low intensity. As potential candidates for these physical airfield applications, tritium (H-3) isotopes may offer several advantages over incandescent lighting.

However, tritium may have a few disadvantages compared to incandescent lights. RL lights operate as independent sources of light; they cannot be turned off and their intensity cannot be varied. The intensity of RL lighting is less than most incandescent lighting.

Environmentally, a single tritium RL tube is virtually benign, but in May 82 some adverse publicity occurred when several tubes were stolen from Ft. Rucker AL. The local media described the lights in the headlines as "...nuclear lighting which is derived from hydrogen bombs." The media buried their retraction in the newspaper several days later; the publicity was temporarily damaging to the local Army image.

AIR OPERATIONS

Because of the extreme and unique Arctic operational requirements, HQ AAC/CC has requested that these RL lights be tested in an actual mission situation where various aircraft can be deployed for a ground and aircrew evaluation. The configuration of the lighting systems will consist of VASI systems, runway/taxiway lights, inverted "Y" helipad lights, and a wind Tee.

The VASI panels will be seen at a much longer range than the runway edge lights and will allow the pilot to approach the runway before actually seeing the runway lights. As the approach continues it will become apparent that the VASI panels are actually separated and when the pilot keeps the panels separated he will be on the desired glide slope. The runway edge lights will become visible about the same time that the panel separation is observed. The VASI will be physically located at the end of the runway and will allow maximum light at the point of touchdown.

The runway edge lights will be mounted on cones which have reflector surfaces to highlight the edge of the runway when an aircraft is using landing lights. Each runway fixture will contain one IR light and three visible lights which for landing with night vision systems, or four visible lights for landing by visual flight rules (VFR).

The inverted "Y"s will operate in the IR range. Two members of the test team are qualified "IP"s for night vision equipment in UH-1 aircraft and will be available for flight demonstrations and questions on specific areas concerning night vision acquisition of the IR lights. The test team will provide eight AN/PVS-5 goggles, and the U.S. Army Night Vision Laboratory will provide two AN/ANVIS-6 goggles for demonstration purposes.

EVALUATION

All pilots will be given a questionnaire. It is imperative that each applicable item be answered to assess the current development of these lights. Do not pare the RL light sources to incandescent lighting, since RL lighting is likely to be deployed when it is impractical or unfeasible to provide incandescent lighting.

CONCLUSIONS

The technology is not completely matured. Further engineering development and advanced development will be required following the limited Arctic test this winter. Additional work will be required for a year-round design. Bare base installation techniques do not apply in permafrost. At a minimum, an extended Arctic test period will be required to integrate and evaluate long-term installation techniques. This testing must include several Spring thaws to verify the endurance of a yet untested anchoring system.

The RL LIGHT IS NOT HAZARDOUS, as long as the gas remains in the sealed glass tube. But a major, near-term obstacle to the routine operation of RL lighting is the NRC license. However, RL radioisotopes do not require NRC licensing, if DOE supervises testing and storage. During the Arctic test, ORNL will perform these responsibilities.

A specific airfield Notice-to-Airmen (NOTAM) and airfield lighting waiver required by AFM 88-14 must be arranged by the USAF/MAJCOM for each test location of an experimental lighting system.

RL LIGHTING - OFF LIMITS (i.e. NO BRIM FROST EXERCISE CAPTURE WILL BE PERMITTED BY THE DIRECTION OF THE COMMANDER, HQ AAC).

The unique appearance and operation of the lights make them highly pilferable. To avoid theft, and a media incident similar to the Ft Rucker example, physical security must be maintained during BRIM FROST.

AVOID TARGET FIXATION. Aircrews should use all available references to cross-check glide path position. Any tendency towards fixation on the VASI panels should be avoided by using other visual cues.

RECOMMENDATIONS

None.

Capt Tustin
HQ AFESC/RDCS, AUTOVON: 970-6280
Date: 28 Dec 82

APPENDIX C

ARCTIC TEST EVALUATION PLAN

APPENDIX C

ARCTIC TEST EVALUATION PLAN

1. Introduction. Subjective analyses of ground observations and aircrew questionnaires shall be the primary methods of data collection. The approved RL light questionnaire (ANNEX I) shall be briefed and distributed to participating flying organizations by HQ AAC/DOOS. Members of the team shall interview Prime BEEF and other ATS support personnel to interpret the success of ground operations. At the conclusion of BRIM FROST, HQ AAC/ADO shall direct an Evaluation Review Board (ERB) to make a written assessment of the overall operational effectiveness of RL lighting system under Arctic operations. ESL and ORNL shall observe the ERB critique to document the results and recommendations in the final evaluation report.

2. Method. The test team evaluation shall be completed in two parts to follow the ATP. ORNL shall perform all data reduction and analysis to document test results in the final evaluation report.

Part I - Visual Evaluation: Questionnaires shall be distributed to aircrew and ground observers as they review the exercise and again during daily preflight briefings. The aircrew's briefing on the purpose of the test shall include an example of a tritium-powered light fixture. The questionnaires can be returned by self-addressed mail to HQ AAC/DOOS. Those received by the end of BRIM FROST shall be reviewed by the ERB.

Part II - Physical Evaluation: ORNL shall collect, analyze, and condense the test team's observations, photographs, and witness interviews at the ATS. Preliminary findings shall be briefed at the ERB and presented in the final report.

3. Evaluation Objectives. (See APPENDIX A.)

4. Data Collection. The evaluation objectives shall be evaluated from the following sources collected by AAC, and the RL-TGC Test Team:

a. Aircrew Questionnaires.

b. Ground and Airborne Observations.

c. Individual Interviews.

d. Mission Debriefings.

e. Exercise Critique.

f. Evaluation Board.

g. Photographic Aids.

5. Analysis. The final report shall describe the RL airfield lighting actual system performance under Arctic conditions as determined by expert ground and aircrew observers (i.e., ERB), and other data collection techniques.

6. Conclusions/Recommendations. An overall assessment of the Arctic test and conclusions and recommendations shall be prepared by ORNL.

7. Documentation. ORNL shall prepare a final evaluation report. The final report shall be written in accordance with DID S-3591A. Submit two copies of draft final report within 30 days after completion of SOW, Section 5.4. Submit reproducible original within 60 days after receipt of sponsor's comments on the approval of drafts. Approving authority will be AFESC/RDCS. Reproducible original will be a "camera ready" copy, reference MIL-STD-847A, and shall be published as a joint AFESC/DOE technical report.

APPENDIX C

ANNEX I

AIR OPERATIONS

RADIOLUMINESCENT (RL) LIGHTING QUESTIONNAIRE

Observation
Date/Time(L):__________

APPENDIX C
ANNEX I
AIR OPERATIONS
RADIOLUMINESCENT (RL) LIGHTING QUESTIONNAIRE

Type Aircraft__________

OBJECTIVE: The Air Force is developing a new runway lighting system. These new lights use an RL light source instead of a standard incandescent bulb. The new lights use no electrical power and are expected to reduce O&M costs in Arctic regions. This airfield has been chosen to evaluate wind Tee, VASI, runway, and taxiway RL lighting applications. Your answers may determine if these lights will be installed at other Air Force installations.

INSTRUCTIONS: A questionnaire should be completed for each aircraft maneuver during all nighttime and any restricted daytime flying conditions. Please fill out the questionnaire and return to: HQ AAC/DOOS, Elmendorf AFB, AK 99506.

I. General:

A. Air Maneuver: Takeoff___Landing___Touch & Go___Low Approach___Fly-by___
B. Location Clear Creek AFB, or _______________ (Circle One)
C. Have you been to this airfield before? Yes ___ No ___
D. Were night vision goggles used: Yes(AN/PVS-5___, or AN/ANVIS-6___), or No___

II. Weather Conditions:

A. Daylight ___ Dusk ___ Night ___ Dawn ___
B. Sunny ___ Cloudy ___ Fog ___ Rain ___ Drizzle ___ Ice Fog ___ Snow ___
C. Moon: Full ___ Half ___ Quarter ___ None ___ Don't Know ___
D. Ceiling/Visibility: Height ___ft; Distance ___nm; Illumination ______%

III. VASI Landing System:

A. At what distance could you acquire the lights? ________nm
B. How was the distance measured? Radar ___ TACAN ___ CHART ___
C. At what distance did you distinguish individual VASI panels? __________nm
D. How would you rate the lights? (Rate only one, either visible or IR.)
Visible: Outstanding ___ Excellent ___ Satisfactory ___ Marginal ___ Unsat ___
IR(w/goggles) Outstanding ___ Excellent ___ Satisfactory ___ Marginal ___ Unsat ___

IV. Runway Edge Light:

A. At what distance could you acquire the lights? _________nm
B. How was the distance measured? Radar _____ TACAN _____ CHART _____
C. At what distance were the lights useable for runway alignment? _________nm
D. How would you rate the lights? (Rate only one, either visible or IR.)
Visible: Outstanding ___ Excellent ___ Satisfactory ___ Marginal ___ Unsat ___
IR:(w/goggles) Outstanding __ Excellent __ Satisfactory __ Marginal __ Unsat __

V. Taxiway Light:

A. At what distance could you see the lights? _________ft
B. At what distance were the lights useable for taxiway identification? ___ft
C. How would you rate the lights?
Outstanding ___ Excellent ___ Satisfactory ___ Marginal --- Unsat ___

VI. A. Comments: ____
____
____

B. Name: ______________________ Rank: __________
Base: ______________ Unit: __________ AUTOVON: __________

C. Please fold, staple, and return by mail. Thank you for your cooperation.

MAJCOM: ______________________ Aircraft: ______________________

NAME: ______________________

CRITIQUE

RADIOLUMINESCENT (RL) AIRFIELD LIGHTING

ARCTIC EVALUATION CONFERENCE

1. Were your MAJCOM's evaluation objectives satisfied?
(Discuss on a separate sheet of paper with the following headings):
   a. Critique Question _____
   b. Evaluation Objective _____
   c. Discussion: ______________________

____

2. Where did the test team fall short of satisfying your objectives?

a.	Planning	Yes _____	No _____
b.	Coordinating	Yes _____	No _____
c.	Fabricating	Yes _____	No _____
d.	Deploying	Yes _____	No _____
e.	Testing	Yes _____	No _____

(If Yes, please explain) ______________________

____

____

3. Was the questionnaire adequate for evaluation purposes?
Yes _____ No _____ (If No, please explain) ______________________

____

____

4. What improvements should be made to the questionnaire?

____

____

____

5. What do you feel is the minimum acquisition distance of the runway edge lights for effective use by your type aircraft?

General __________nm Tactical __________nm

6. What is the minimum acquisition distance required for the lights to be used safely for runway alignment by your type aircraft?

General ______________nm Tactical ______________nm

7. Have you ever flown against the lights? Yes _____ No _____
(If Yes, please explain.)

a. Where: ____

b. When: ____(Date/Time)

8. Prior to this conference had you ever seen the following ATP documents?

a. Final Test Plan (ATP) Yes _____ No _____
b. Aircrew Briefing Yes _____ No _____
c. Questionnaire Yes _____ No _____
d. RL Light Yes _____ No _____
e. Did you understand how the VASI system works?
   Yes _____ No _____

9. What is the most limiting factor about the current RL lighting system?

____

____

____

10. General Comments: ____

____

____

____

____

APPENDIX D

STATE OF ALASKA

TEST PLAN

APPENDIX D

STATE OF ALASKA

TEST PLAN

Evaluation of:

Radioluminescent (RL) Airfield Marking System

Location & Time:

1) At Clear Creek Strip (Interior Alaska) January 14 - February 3, 1983 (Part of Operation BRIM FROST, U.S. Military Arctic Training Exercise).

2) At Malemute Field (Ft. Richardson, Alaska) February 4 - February 8, 1983 (Alaska Air National Guard (AKANG) and Alaska Department of Transportation and Public Facilities (DOTPF) joint test and demonstration).

Equipment to be Evaluated:

1) Radioluminescent airfield edge lights with prototype fixture and portable base. (FIGURE B-I-1) [Same units used as taxiway and runway end identifiers.]

2) Radioluminescent portable (VASI) system

3) Radioluminescent airfield wind indicator

4) Night Vision equipment for use with radioluminescent lights in Arctic and Subarctic conditions.

Schedule & Description of Events

January 14, 1983

AKANG C-130 Transport will arrive at Fairbanks International Airport at approximately 1400 hours with cargo of RL lights, fixtures and ancillary equipment.

ADOTPF/Battelle personnel will meet C-130 and off-load test equipment to ground transportation. Equipment will then be taken to secure warm storage and assembly area at ADOTPF facility, 2301 Peger Road, Fairbanks, Alaska.

Assembly of RL wands and fixtures will commence.

Revised 1/5/83

January 15, 1983

ADOTPF/Battelle personnel will transport assembled RL light fixtures and ADOTPF supplied traffic cone base assemblies to Ft. Wainwright.

Alaska Army National Guard (AKARNG) helicopter will meet ADOTPF/Battelle personnel at Ft. Wainwright (time to be determined) to transport personnel and equipment to Clear Creek Strip.

ADOTPF/Battelle Personnel will freeze in-traffic cone bases, mount RL light fixtures, deploy ancillary equipment for test in accordance with Air Force/DOE specifications.

Photographic Documentation will be made of deployment operations.

AKARNG helicopter will return personnel to Ft. Wainwright.

January 16, 1983

DOE-USAF Alaska Air Command test schedule.

February 2, 1983

AKARNG helicopter or AKANG C-130 will meet ADOTPF/Battelle personnel at Ft. Wainwright (time to be determined) and airlift them to Clear Creek Strip where RL lights, bases, and ancillary test equipment will be retrieved and returned to Ft. Wainwright.

One of the following options will then occur.

1) Upon arrival at Ft. Wainwright with the C-130, the RL wand shipping container which remained in storage at ADOTPF Headquarters at 2301 Peger Road during the Clear Creek tests will be loaded aboard the aircraft and all test equipment will be transported to Kulis Air Guard Base in Anchorage.

2) Upon arrival at Ft. Wainwright with the AKARNG helicopter or AKANG C-130 the RL test fixtures and equipment will be off loaded by ADOT/Battelle personnel and taken by ground transport to the storage area at 2301 Peger Road. There the fixtures will be disassembled and the RL wands returned to their special shipping containers. All equipment will remain in storage awaiting rendezvous with AKANG C-130 at Fairbanks International Airport on February 3 or 4, when all equipment will be airlifted to Anchorage.

February 4, 1983

All equipment for testing will be stored in AKANG facilities at Kulis Air National Guard Base, where assembly of wands and fixtures will be accomplished by ADOTPF/Battelle/AKANG personnel.

February 5, 1983

Before noon, assembled test equipment will be transported to Malemute Field on Fort Richardson, using AKANG vehicles.

A timed deployment test of the entire RL airfield marking system will commence upon arrival at Malemute. Video tape documentation of deployment operation will be arranged, if possible.

Around 1600 hours, AKANG will begin test landings with C-130 aircraft at Malemute (AKANG to provide details).

Following fixed-wing tests, AKARNG helicopter tests will begin using inverted "Y" marking system and night vision equipment (AKARNG to provide details).

NOTE:

A) ADOTPF/Battelle personnel will assist with ground support.

B) AKANG will provide air-ground communications.

C) AKANG will provide detailed flight schedule and arrange air crew briefing and debriefing.

D) In case of bad weather on February 5, all activities will be postponed until February 6.

E) Crash and rescue support will be supplied by AKANG.

When all tests are concluded ADOTPF/Battelle/AKANG personnel will remove RL fixtures and cones and return to warm storage at Kulis. Cone bases will remain at landing zone overnight.

February 6, 1983

RL fixtures and cones will be deployed beginning around 1500 hours at Malemute. Any National Guard tests left uncompleted from the previous night will be carried out.

FAA Pilot (Ken Adams) will be briefed to fly and land light aircraft against RL system. Orientation takeoffs and landings will be flown. Pilot will be accompanied by pilot experienced with RL system. Recommend Major Hobbs, Alaska Air National Guard, and/or Major Everett, North Carolina Army National Guard. Enough landings and fly-bys will be flown to build confidence in pilot. ADOTPF Research and Battelle personnel will fly as passengers during these orientation flights.

NOTE:

A) FAA will supply civilian band air-ground communications,if required.

B) AKANG will supply firing range control communications.

C) Crash and rescue equipment may be required for civilian flights. If so, AKANG will supply.

D) Should weather prevent testing on February 6, the above activities will be postponed to February 7.

ADOTPF/Battelle/AKANG personnel will retrieve RL lights and cones and return them to secure storage area at Kulis. Bases will again be left overnight.

February 7, 1983

ADOTPF/Battelle/AKANG personnel will deploy RL lights and cones at Malemute Field around 1500 hours.

Demonstration flights will begin at dark, flown by a FAA pilot using chartered Cessna 206 aircraft or equivalent. Groups of about four people each will be picked up at "Bryant Army Airfield" and flown to Malemute Field where the pilot will make one fly-by then a landing. Passengers will disembark at Malemute for on-ground inspection and pilot will return to "Bryant Army Airfield" for another group. The pilot will return to Malemute for a fly-by and landing. The second group will then disembark for a ground inspection of the system and the first group will board the aircraft for a return to "Bryant Army Airfield." A third group will then be picked up and this process will repeat until all viewers have been cycled through. Fifteen to 30 viewers are expected. Each round trip is expected to take approximately 25 minutes.

A questionnaire will be given to each viewer to be completed and collected upon return to "Bryant Army Airfield".

Viewers will probably consist of the following.

1) Alaska Department of Transportation and Public Facilities personnel.

2) FAA personnel.

3) State Legislators.

4) Canadian Department of Transportation personnel.

5) Alaska Air Carriers Association representative.

Immediately following the tests (approximately 2200 hours) all RL lights and equipment, including cone bases, will be retrieved by ADOTPF/Battelle/AKANG personnel and returned to storage at Kulis Air Guard Base.

NOTE:

A) ADOTPF will supply civilian band air-ground communications if required, ground support at Malemute field and coordination of shuttle operation at Bryant Army Airfield.

B) AKANG will supply firing range control communication and crash-rescue equipment if required by FAA.

C) Should weather prevent testing on February 7 or if previous foul weather has caused other parts of the test schedule to slip, all events will be performed on the following day (February 8, 1983).

February 8, 1983

At 0900 hours, a debriefing will be held at Kulis Air National Guard Base OP's Theater, Building 8, for all interested parties concerning the tests for the purpose of answering questions and critiquing the RL system as demonstrated.

At approximately 1300 hours ADOTPF/Battelle/AKANG personnel will meet at Kulis Air Guard Base to disassemble RL light fixtures and ready all equipment for transport or storage (pending instructions from DOE).

NOTE:

Should weather conditions or some other contingency cause a cancellation of any of the events described above, a contingency test plan will be formulated with Allen Army Air Field and/or Ft. Yukon Airport used as alternate sites.

Within 60 days of the completion of the Malemute Field evaluation and test an informal report will be jointly published by the Alaska DOTPF, Battelle, and the Alaska Air National Guard, including a narrative recap of the test and discussing the impressions expressed by viewers on the appropriateness of the RL system for application in rural Alaska.

Attached is a copy of a test report on the breakaway characteristics of the traffic-cone base assembly.

DAT

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