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Evaluation of Radar Light Guns in the Washington National Airport IFR Room

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by

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EVALUATION OF RADAR LIGHT GUNS IN THE WASHINGTON NATIONAL AIRPORT IFR ROOM

SUMMARY

This report covers a limited operational evaluation of two new radar light guns in the IFR room of the control tower at the Washington National Airport. The light guns were installed at the two approach control positions to permit one controller to identify a target on the other controller's radar indicator by placing an enlarged "blip" adjacent to a selected target.

The tests indicated that the light guns are not beneficial for improving coordination between two approach controllers who are seated side by side. In general, Washington tower personnel were of the opinion that the light guns required more time in the process of target identification than present verbal and manual techniques. They did not use the light guns during heavy traffic periods. Tower personnel believe that the light guns should assist in radar hand-offs to the Air Route Traffic Control Center.

INTRODUCTION

A previous test of a U. S. Air Force radar light gun in the IFR room of the La Guardia Airport control tower had indicated that such a device might be useful for coordination between radar approach controllers. Certain improvements in the light gun design and construction were indicated desirable in this test. Two new light guns incorporating the desired design changes were built at the FAA Technical Development Center, along with the necessary video amplifiers and timing circuits. This report describes a limited operational test of these new light guns between the two approach control positions in the IFR room of the control tower at the Washington National Airport. The light guns were installed August 13, and removed September 16, 1958.

CONTROLLER COORDINATION AND WORKLOAD

The two radar approach controllers in the IFR room of the Washington tower are seated side by side. Coordination between these controllers is necessary in arranging the proper spacing and sequencing of successive aircraft on the final approach path. This coordination is accomplished in two ways:

1. Verbal. One controller who has an aircraft on radar approach advises the other approach controller of the distance and bearing of the aircraft from a known fix which appears on the video map, together with the observed track of the target.

2. Verbal and Manual. The controller reaches over and points out the target with a pencil or his finger on the adjacent controller's radar scope, and gives him a brief verbal description of the target position.

At the beginning of the test period, data were gathered to obtain a representative sample of the workload involved in IFR radar approach control coordination. Stop-watch measurements were made of the coordination time required, and, simultaneously, the number of flights under control was recorded. It was planned to make subsequent measurements after the controllers had gained some experience in using the radar light guns as a coordination aid to determine whether there was a reduction in coordination time.

Data were recorded prior to use of the light guns for twenty-three 15-minute intervals. During the entire period, the ceiling generally was 800 to 900 feet overcast, with visibility 4 to 6 miles. A total of 141 aircraft were worked by the approach controllers with a minimum of 2 aircraft and a maximum of 10 aircraft per 15-minute period. The average number of aircraft under radar control during a 15-minute period was 6.1

The coordination time required between the two approach controllers varied from 1 to 9 seconds. In one instance, coordination required 14 seconds for a missed approach to Andrews Air Force Base (AFB). The average coordination time was 3.1 seconds.

There was no correlation between the number of times coordination was accomplished between the approach controllers and the number of aircraft under control simultaneously. There was a marked difference in the number of times coordination was accomplished and length of time per coordination, depending upon the controller's experience. For twelve 15-minute periods, controllers in a training status worked 64 aircraft, coordinating 21 times, for an average of 4.47 seconds per coordination and 0.32 coordination per aircraft. This included the missed approach to Andrews AFB, which required 14 seconds of coordination. For eleven 15-minute periods, controllers with 2 years or more experience worked 77 aircraft, coordinating 102 times for an average of 2.88 seconds per coordination and 1.32 coordinations per aircraft.

There was no radical change in the weather conditions during the two periods, but traffic volume increased slightly during the latter period. However, during the first period when trainees worked the arriving aircraft, an average of 5.33 aircraft were handled every 15 minutes; whereas during the second period, when more experienced controllers worked the arriving aircraft, an average of 7.0 aircraft were handled every 15 minutes. It will be noted that the controllers having greater experience coordinated 60 per cent more per aircraft than the trainees.

OPERATION WITH LIGHT GUN

Controllers were instructed in the operation of the radar light gun and in its use as a coordination aid in identifying radar targets on an adjacent radar scope. Also, supervisors were familiarized with the procedure for rapid changeover to bypass the light gun circuits. This feature was incorporated as a means of assuring that the light gun circuits would not cause any interruption of radar service.

It was planned that controllers would familiarize themselves with the operation and application of this equipment in the IFR room, and after a two-week period, additional measurements would be made similar to those made previously. During this two-week period, the light guns functioned satisfactorily, with the exception of a minor repair made necessary by the dislodgment of a mirror in the optical system of one gun. A modification in mounting technique corrected this fault.

To use the light gun, the controller places the muzzle of the gun against the filter over the scope and aims it at the radar target. See Fig. 1. As the trigger is pulled back to the first detent, a small crossmark is projected by means of a built-in lamp onto the face of the scope. By placing this light marker over the desired target, positive aiming is accomplished. The trigger is then pulled through the remaining travel, the aiming light goes off, and as the radar scan passes over the target, a photomultiplier tube in the gun and associated video and timing circuits are activated. The result is a bright, rectangular blip written on the scope electronically, approximately 1/2 to 3 miles beyond the range of the selected target. See Fig. 2. This marker is visible on both radar indicators used by the approach controllers.

A previous evaluation of the Air Force light gun in the La Guardia tower IFR room indicated the need for improved optical resolution. The new light gun was designed to permit selection of targets in close proximity to each other, so that they could be identified individually. However, in resolving this problem, another manifested itself. As the controller depressed the trigger through the final stage of aiming the possibility of "pulling" the gun off target was increased. This required waiting an additional antenna-scan period before reidentification could be attempted. The resultant loss in time (a 4.6-second delay at a 13-rpm antenna-scan rate) was considered intolerable when compared to other forms of coordination and identification now in use at the Washington tower.

TEST RESULTS

After a period of 4 weeks, the Washington tower was revisited. By this time, the controllers felt that the light gun was not desirable for coordination between the two approach control positions.

With a hand microphone in one hand and a pencil in the other, controllers are reluctant to relinquish either, even temporarily, to pick up the light gun. Proximity of the radar scopes permits easy access to them so that targets can be pointed out with the pencil. In addition, aiming of the light gun requires considerable concentration which detracts from observing the over-all picture.

Washington tower control personnel stated that it is necessary for one controller to call the other controller's attention to a hand-off or identification verbally, regardless of the coordination method used. The sudden appearance of the bright square or blip behind the radar target was not considered sufficient to handle the necessary coordination adequately. A request for identification of targets has to be made, or offered, and the idiomatic phraseology developed from long experience served their purpose more than adequately. Although a large majority of Washington tower personnel believed that the concept of identifying radar targets from one scope on another by the use of a radar light gun had merit, its application between side-by-side approach control positions was not considered necessary or desirable.

It was of no advantage to take additional measurements pertaining to coordination after the two-week familiarization period had expired, because operations personnel did not use the equipment during heavy traffic conditions.

CONCLUSIONS

Many applications of the radar light guns may be made in varied environments. The apparent inability of the radar light gun to improve coordination between the Washington tower radar approach controllers should be considered in light of the close physical relationship of the controllers. They are located side by side, and manual and verbal coordination has been refined over a long period of experience to the point where the introduction of an instrument to accomplish this is unacceptable. Therefore, the determination of the success or failure of the radar light guns as a coordination device would be dependent on the further evaluation tests in other environments and applications.

Use of the radar light gun in environments which prohibit side-by-side controller coordination should be tried. A possible application of the radar light gun is in identifying radar targets from tower to center in radar departure operations. An evaluation of the radar light guns in an IFR room environment such as at La Guardia Airport, where the B position is located between the two radar approach controllers and coordination is limited only to verbal comment, is suggested. McChord RAPCON personnel who have seen the light guns feel that they would be quite useful between the radar "pickup" position and the "pattern" controller, and an evaluation at this facility also

is suggested. Meanwhile, an evaluation of a radar target-marking device between the Indianapolis Airport control tower and the Indianapolis Air Route Traffic Control Center is planned, with both facilities using scan-converted TV radar displays. The construction and technical features of the light gun will be described in a forthcoming report.

FIG. 1 CONTROLLER IDENTIFYING RADAR TARGET THROUGH USE OF RADAR LIGHT GUN

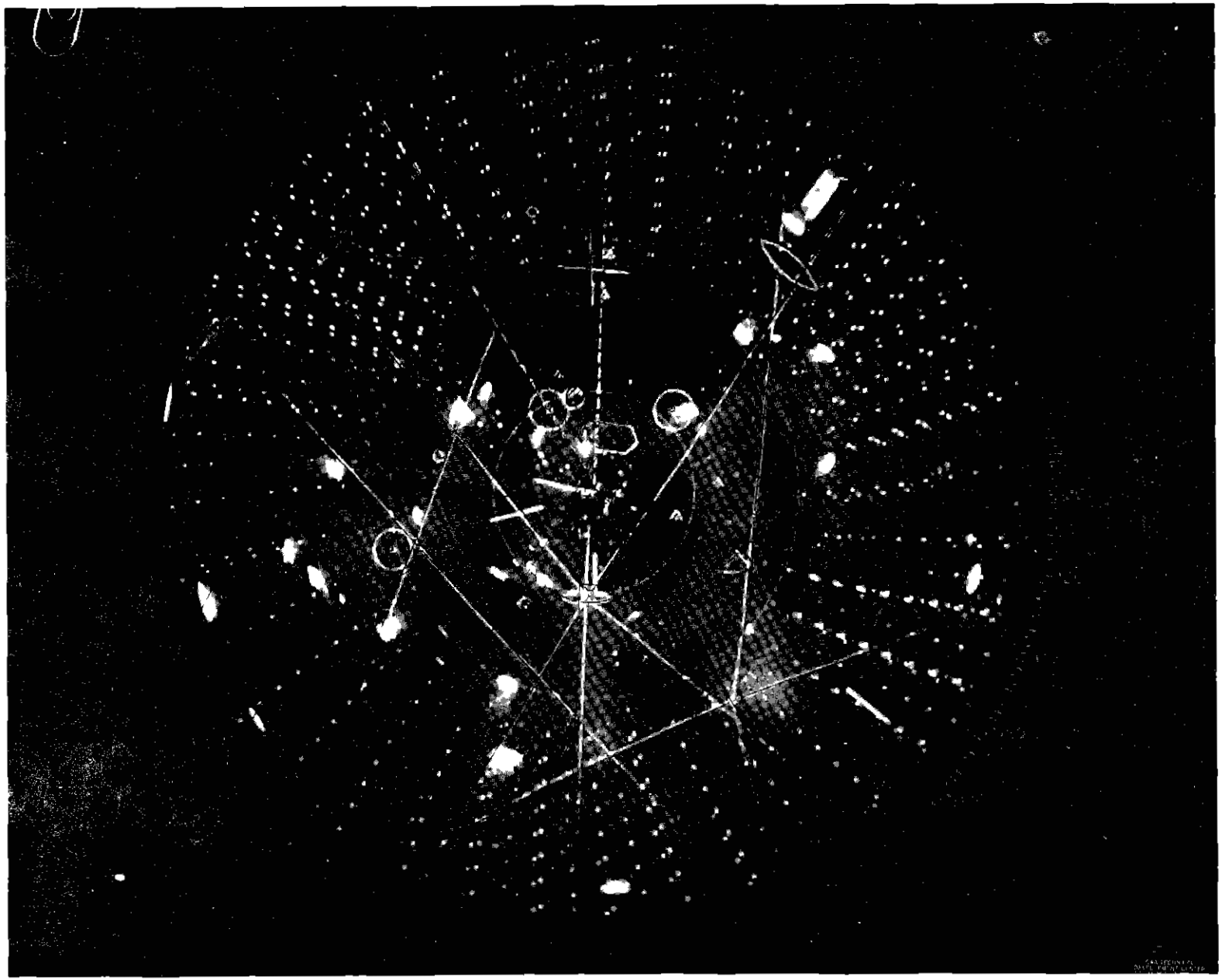

FIG. 2 IDENTIFYING "BLIP" BEHIND RADAR TARGET