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TECHNICAL DEVELOPMENT REPORT NO. 385

DYNAMIC SIMULATION TESTS OF SEVERAL TRAFFIC CONTROL SYSTEMS FOR THE JACKSONVILLE AREA

FOR LIMITED DISTRIBUTION

by

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February 1959

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TECHNICAL DEVELOPMENT CENTER
INDIANAPOLIS, INDIANA

FEDERAL AVIATION AGENCY

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DYNAMIC SIMULATION TESTS OF SEVERAL TRAFFIC CONTROL SYSTEMS FOR THE JACKSONVILLE AREA

SUMMARY

This report describes simulation tests of the existing method and several proposed methods of controlling IFR traffic in the Jacksonville, Fla., metropolitan area

All tests were conducted through the use of the dynamic air traffic control simulator at the Federal Aviation Agency's Technical Development Center at Indianapolis, Ind. Tests indicated that, with a slight change in the present traffic routing, feeder fixes other than those presently in use should be adopted A revised system using new feeder fixes is recommended Such a system, using existing available navigational facilities and one new VOR, was developed and studied with minimum relocation of present clearance limit fixes. An additional method of routing northeast-bound flights departing from Jacksonville Municipal Airport was developed.

A concept of a common IFR room to serve the Jacksonville Municipal and Mayport Airports also was tested The common IFR room concept appeared feasible when applied to this area.

INTRODUCTION

Early in 1958, the CAA Office of Air Traffic Control requested the Technical Development Center (TDC) to conduct a simulation study of the Jacksonville, Fla , area Preliminary discussions for the Jacksonville simulation were held at a meeting in August 1958 in which TDC and Region 2 personnel participated

In November 1958, two TDC airways operations specialists spent several days in the Jacksonville area observing traffic operations, gathering background material for this study, and discussing the proposed test program with Jacksonville traffic control personnel and Jacksonville Navy personnel Discussions were held on the present and anticipated future problems of the area, and of the assumptions to be made during the simulation tests. The general assumptions under which the simulation tests were conducted were

1 The holding airspace area, as defined in TSO-N20A, would be increased 50 per cent in width, as shown in Fig. 1.

2. Airway structure would be based only on VHF navigational aids

3 Flights entering area R-161 landing at Navy-Jacksonville would do so in level flight All necessary altitude changes within R-161 would be controlled by Navy-Jacksonville approach control

4. Direct air/ground communications would be used between control facilities and all flights.

5. Adequate radar coverage would exist throughout the area simulated.

6 Civil jet aircraft would be controlled in a conventional manner unless approach delays were excessive Holding at 20,000 feet and above would be employed only if delays were excessive

7. A proposed letter of agreement, which was to become effective in January 1959, would be used as the general guide for these simulation studies. See Appendix A

8. Because of the physical layout of the airport, and the geographical features adjacent thereto, it is not feasible to relocate the present instrument landing system (ILS) Therefore, for the purposes of this study, all instrument approaches and departures at the Jacksonville Municipal Airport would be made to the northeast.

9. Since consideration presently is being given to establishing corridors for Navy operations from Navy-Cecil and Navy-Jacksonville airports, these proposed corridors would be honored during all simulation studies

The two specialists from TDC spent several days observing traffic control at the Jacksonville Air Route Traffic Control (ARTC) Center and other control facilities in the Jacksonville area. It was decided at the November meeting to formulate the following objectives for these simulation tests:

1 The first phase would be a study of the present system, based on the revised Center/Tower letter of agreement The major change from existing procedures would be that propeller-driven (prop) aircraft departing from the Navy-Jacksonville Airport would be handled by Jacksonville departure control

2. The second phase of this study would incorporate a navigational facility located west of the Jacksonville Airport identified as Dinsmore The Dinsmore VOR would serve as a primary feeder fix, provide transition routes, and establish additional intersections Table I lists location identifiers used in these studies

3 Possible improvement of terminal area arrival and departure routes, terminal area holding fixes, including those used as inbound clearance limits or for high-altitude holding, terminal area feeder fixes, terminal area approach aids, preferential en route structures, and preferential en route navigational aids, would be investigated

Simulation tests were commenced on December 5, 1958, and concluded on December 18, 1958 A total of 20 test runs were made in which approximately 1,600 flights were simulated.

EVALUATION METHODS

Measurements

Traffic delays, airport acceptance rates, and communication data were obtained during the simulation tests and were used as a means of determining the merits or weaknesses of the various systems tested.

Because of the limited time available for these tests, terminal and en route studies were conducted simultaneously. The ARTC Center controllers who participated were personnel from the Jacksonville ARTC Center who had received little or no training in radar vectoring or radar control prior to this program Although the terminal area personnel were experienced radar controllers, several experimental test runs were conducted to give all personnel an opportunity to acquaint themselves with the equipment and procedures used in these tests

Arrival delays were computed by comparing the theoretical time at which each aircraft should be over the outer marker on final approach, assuming that no other traffic was involved, with the actual time of such aircraft over the outer marker. These data are summarized in Fig. 2 Controller contacts and communications time were recorded by automatic equipment These data are presented in Fig 3

Controller Opinion

At the conclusion of the test studies, a critique was held, and the opinions and recommendations expressed by the controllers who had participated in the tests were used to a large extent in the final evaluation of the results of the tests and the recommendations derived therefrom

Traffic Sample

Flight progress strips of recent, moderately busy days were obtained from the Jacksonville ARTC Center and the Jacksonville tower facilities These strips were analyzed for use in determining the distribution of traffic utilizing the various airways in the area. The density of the traffic simulated was approximately 100 per cent greater than that indicated in the analyzed operations The traffic sample used in the test consisted of 74 aircraft operating during a 1-hour period However, approximately 90 minutes was required to simulate all flights to conclusion.

TEST PROCEDURES

Systems Tested

Three basic systems were tested· (1) present system, Figs. 4 and 5, (2) the Dinsmore system, Figs 6 and 7, and (3) the St. Mary's system, Figs 8 and 9. Tests of the present system and the Dinsmore system were conducted using rules and restrictions as set forth in the new Center/Tower letter of agreement, effective sometime in January 1959 Slight deviations from the letter of agreement were made during tests of the St Mary's system

The Dinsmore system is a variation of the present system, using a proposed VOR facility identified as Dinsmore This VOR is located 12 1/2 nautical miles (nm) west of the Jacksonville VOR on the 272° radial of the Jacksonville VOR. In the planning and development of this system, cognizance had to be taken of the location of the Jacksonville Airport and the ILS serving it, with respect to restricted area R-161. Because of the extremely limited area for spacing aircraft while under radar control, the Dinsmore site was selected as the most nearly ideal position for a feeder fix. The Bryceville intersection was relocated from its position in the present system, 20 nm from the Jacksonville VOR, to a point 30 1/2 nm from the Jacksonville VOR to permit simultaneous holding at Dinsmore and Bryceville

The introduction of the Dinsmore VOR in the Dinsmore system also required the elimination of Callahan as a clearance limit, since the holding patterns at Dinsmore and Callahan overlapped Therefore, the Hilliard intersection was used as the clearance limit for Jacksonville arrivals from the northwest

This system utilized the same route structure and the same restrictions as in the present system In addition, several tests were conducted which deviated slightly from the proposed letter of agreement. This deviation allowed the approach control facility to use altitudes of 5,000 feet and below, whereas the present letter of agreement limits approach control to the use of 4,000 feet altitude and below.

The St. Mary's system, which is a further development of the present and the Dinsmore systems, also was tested The following major changes were introduced in the St. Mary's system

1 En route traffic over the Jacksonville terminal area in the present and Dinsmore systems was rerouted during tests of the St Mary's system, bypassing Jacksonville to the east on proposed Victor Airway 1 from Daytona Beach to Savannah. In addition, some northwestbound traffic, which of necessity must proceed over Jacksonville, was rerouted via Victor Airway 3-E, Victor 51, whereas such traffic now uses Victor Airway 3/51 in the present system

2 All inbound traffic landing at Jacksonville Airport used Victor Airway 3 instead of Victor Airway 3-E as in previous systems tested. Inbound aircraft proceeded from Brunswick via a relocated airway, designated Victor Airway 3-W, to the St. Mary's intersection. The St Mary's intersection is formed by the 027° radial of Dinsmore and the 333° radial of the Jacksonville VOR. The Shiloh feeder fix was relocated from its location on Victor Airway 3-E to a position on Victor Airway 3, and is formed by the 158° radial of Jacksonville and the 120° radial of the Dinsmore VOR. Jacksonville arrivals from the northwest were routed from over Alma, via Victor Airway 5-W, to the relocated Hilliard intersection. The Hilliard intersection in this system is formed by the 315° radial of Dinsmore and the 232° radial of the Brunswick VOR

3. The Waverly 348° departure route via Brunswick was discontinued. Northeastbound departures instead were routed via Victor Airway 3-E to Clinch intersection where routing continued on Victor Airway 3-E over Sea Island or, alternately, proceeded from Clinch via the 173° radial of Brunswick to Victor Airway 3

4. Military jets were descended en route in this system and were cleared by the ARTC Center to the lowest available altitude at Dinsmore. This was done to eliminate the use of a teardrop penetration pattern east of Jacksonville. This penetration interfered with traffic on bypass airway Victor 1.

Traffic Samples.

Two traffic samples were compiled. Traffic sample I was designed to study the present and Dinsmore systems. Traffic sample II, with the same distribution of traffic as sample I, was designed to test the St. Mary's system. The routings of aircraft in Sample II were revised as necessary to coincide with the route structure of the St Mary's system. The distribution of traffic in these samples is shown in Table II.

Equipment.

Approach control utilized two simulated ASR scopes, as shown in Fig 10. One was used for Jacksonville approach control, one for Jacksonville, Mayport, and Navy-Jacksonville departure control. Two superimposed panoramic radar display (SPANRAD) units were used for en route control, as shown in Figs. 11 and 12

PRESENT SYSTEM

The present system, shown in Figs. 4 and 5, was tested with two terminal radar controllers, four ARTC Center controllers, and four data positions

The approach controller vectored all arrivals from the perimeter feeder fixes to the final approach course for landing The departure controller cleared and vectored all departures from Jacksonville, Mayport, and Navy-Jacksonville Airports until they were released to the north or south Center radar departure controller.

The Center control area was divided geographically by an east-west line over the Jacksonville outer marker All airspace north of the east-west dividing line was controlled by two north Center radar controllers, one arrival and one departure controller In addition, individual north and south Center ANC, or nonradar, controllers worked all en route aircraft for radio position reports The ANC controllers made all initial radio contacts and descended inbound aircraft to the lowest available altitude prior to release to the Center radar arrival controllers In addition, they were responsible for the departure aircraft during climb-to-cruising altitudes after release by Center departure radar

In the early tests of the present system, all Center control was conducted from one SPANRAD and two ANC flight progress sectors, which were patterned after existing sectors in the Jacksonville ARTC Center. Center control was predicated on a north radar departure and a north radar arrival controller Similar control positions were simulated for the south portion of the area on the same SPANRAD.

Because of the heavy workload and congestion observed in the early tests conducted from a single SPANRAD, subsequent tests were made using two SPANRAD's, with the north controllers operating from one display and the south controllers operating from the other. Each SPANRAD unit was furnished with interphone, air/ground communication facilities, and direct Tower/Center hand-off circuits.

Departing aircraft were assigned altitudes in accordance with direction of flight. Blocked altitudes were simulated at appropriate fixes and departure tunneling was used. ARTC radar target markers for departure traffic carried flight identity, altitude assigned and requested, and a fix identifier to indicate the route of flight or clearance limit. Departures were issued short-range clearances to an altitude and fix that would allow an uninterrupted climb while being handed off from Tower to Center radar.

Blocked altitudes were simulated for arrival traffic which was fed into the holding fixes and released to approach control in a realistic manner. SPANRAD target markers also were used by the radar arrival controllers These markers carried flight identity, route, altitude, type, and clearance limit.

Clearance Limits

Inbound aircraft from the northwest were cleared to the Callahan intersection; inbound aircraft from the west were cleared to the Bryceville intersection; from the northeast, arrivals were cleared to the Clinch intersection, and arrivals from the south were routed via Victor Airway 5-E and were cleared to the Shiloh intersection

Westbound departures were cleared via the "swamp departure" to Taylor; traffic to destinations northwest, through northeast of Jacksonville, were cleared on Victor Airway 5-E to Baxley; flights destined to Savannah and Brunswick were cleared via the Waverly departure to Brunswick, and southbound departures were cleared to Roy via Victor Airway 267

Jacksonville Approach Control Area

The control boundaries were as defined in the Jacksonville Center/Tower letter of agreement The Jacksonville approach controller vectored aircraft to final approach course from the four feeder fixes mentioned previously, namely, Callahan, Bryceville, Clinch, and Shiloh One radar arrival controller vectored all landing traffic from these four fixes for a front-course ILS approach to the Jacksonville Airport. Approaches were made from southwest to northeast during tests of all systems, inasmuch as the present ILS serving the Jacksonville Airport is not usable for back-course approaches. Approach control was allowed the use of all altitudes through 4,000 feet within their control jurisdiction.

Arrivals

The ARTC Center cleared all arrivals to the four feeder fixes at altitudes of 4,000 feet and above, with release points as indicated:

Clearance Limit		Release Point	
Bryceville	(BYE)	Moniac	(MO)
Callahan	(CA)	Hilliard	(HL)
Clinch	(CH)	Cumberland	(CU)
Shiloh	(SO)	Atlantic	(AT)

Since the highest altitude available for use by approach control was 4,000 feet, all arrivals left the feeder fixes at or below that altitude Aircraft holding at the perimeter fixes above 4,000 feet were required to descend to the 4,000-foot level in the holding pattern before being vectored to the final approach course

Arrivals on approach vectors maintained an altitude of 4,000 feet until established within a descent area, defined in this study as that airspace bounded on the south by a line originating 3 nm north of the north edge of R-161, on the west by an arc connecting the line 3 nm north of the edge of R-161, through Bryceville, and terminating on Victor Airway 5/51 northeast of Callahan; and on the east by a 180°-360° line tangential to the northeast edge of Jacksonville Airport, between R-161 and the inbound extension of the Jacksonville 318° radial

Arrivals from Clinch intersection maintained 3,500 feet altitude until they were past the 318° radial of Jacksonville VOR, and 2,500 feet until they were past the 272° radial of Jacksonville. Arrivals from over Callahan descended to 2,500 feet after leaving the Callahan holding pattern, and maintained that altitude until they were past the 272° radial of Jacksonville. Arrivals holding at Shiloh departed the holding pattern at 4,000 feet, which was maintained until they were clear of Victor Airway 267. Aircraft vectored from Bryceville were not restricted on descent below 4,000 feet other than by traffic being vectored from the other three feeder fixes Arrival radar vector patterns are illustrated clearly in Fig. 4 An aircraft spacing chart, shown in Table III, was readily available for the controller's use, and was provided to assist him in maintaining optimum separation between successive aircraft on radar vector to the outer marker.

Arrivals landing at Navy-Jacksonville Airport were cleared to the Cecil VOR facility at the altitude specified by Navy-Jacksonville approach control The minimum altitude for such arrivals was 5,000 feet, and the ARTC Center retained control of Navy-Jacksonville arrivals until aircraft were established within the airspace of R-161.

Mayport arrivals were cleared by Jacksonville approach control to the Mayport H facility at 2,500 feet, from which point an ADF circling approach was conducted

Departures.

Unrestricted departure routes were used for all directions of traffic with the exception of southbound flights, which utilized Victor Airway 267 and were integrated with southbound over-traffic destined to Orlando. All departure traffic simulated in this area was controlled by one departure radar controller West departures utilized a "swamp departure" via Victor Airway 22-N on the 288° radial of Jacksonville and the 237° radial of Brunswick VOR to the Taylor intersection These departures maintained 1,500 feet until handed off to the north Center departure radar controller

Northbound and northwestbound departures were cleared via preferential routing, Victor Airway 5-E, and were restricted to altitudes of 2,500 feet until radar hand-off

Departures destined to Brunswick and Savannah were cleared via the "Waverly departure," the 348° radial of Jacksonville and the 237° radial of Brunswick to the Brunswick VOR facility These departures were restricted to an altitude of 2,500 feet until radar hand-off was accomplished.

Southbound departures were routed via Victor Airway 267 and were required to cross the Blue Jacket intersection at an altitude of at least 3,000 feet or above because of the 2,000-foot corridor reserved for Navy operations between R-161 and W-158. This corridor is shown in Figs. 5, 7, and 9.

All radar hand-offs between Tower and Center were accomplished 15 nm from the Jacksonville VOR facility for westbound, northbound, and northeastbound departures Fifteen-mile reference marks were etched on the radar overlays to assist control personnel in making this transfer of control responsibility Radar hand-offs of southbound departures were accomplished at the Blue Jacket intersection.

DINSMORE SYSTEM

Tests of the Dinsmore system, shown in Figs. 6 and 7, were conducted using traffic sample I.

Equipment and Controllers.

The same equipment arrangement and division of control area were used in the Dinsmore system tests as were utilized in studies of the present system

Clearance Limits.

Clearance limits in these tests were the same as those used in previous tests except that the location of Bryceville was altered and Hilliard was used as a perimeter feeder fix instead of Callahan.

Departures.

All departure routes and departure restrictions used in the present system were retained in tests of the Dinsmore system.

Arrivals.

The principal difference between the Dinsmore system and the present system was the addition of a VOR facility at Dinsmore

Approaches were conducted in a manner similar to those in the present system except that the radar approach controller regulated the flow of traffic by a choice of two methods. Radar vectors to the final approach course were made directly from the perimeter fixes as in the present system. However, as the density of arrival traffic increased, the approach controller recleared aircraft from any of the four feeder fixes to the Dinsmore VOR, from which point radar vectors were started

The use of Dinsmore as a terminal feeder fix enabled the approach controller to vector only as many aircraft as his capabilities allowed, without causing any en route delays at the perimeter fixes during traffic build-ups The addition of Dinsmore enabled the arriving pilot to proceed beyond the perimeter fix by his own navigation to a close-in feeder fix before it became necessary for the approach controller to assume full radar control.

ST. MARY'S SYSTEM

The St Mary's system is illustrated in Figs. 8 and 9 All equipment arrangement, division of control area, and the personnel used in this study were the same as described in the present and Dinsmore systems

Clearance Limits.

Hilliard and Bryceville continued to serve as feeder fixes for traffic from the northwest and west. Arrival traffic from the south was rerouted from Daytona Beach via Victor Airway 3 instead of Victor Airway 3-E, as in the Dinsmore and present systems. Shiloh continued to be used as a clearance limit, but was relocated on Victor Airway 3, which was the intersection formed by the 158° radial of Jacksonville and the 120° radial of the Dinsmore VOR. The arrival routing change and the relocation of Shiloh were effected in order to separate Jacksonville arrivals from over-traffic after passing Daytona Beach, thereby providing more expeditious descent into the holding pattern at Shiloh

Another change affecting arrival control was the establishment of the St. Mary's intersection, formed by the 027° radial of Dinsmore and the 333° radial of Jacksonville In this study, Jacksonville arrivals from the north and northeast were rerouted at Savannah and were cleared over Brunswick via the relocated airway, designated as Victor Airway 3-W, to the St. Mary's intersection.

Arrivals.

Transitions were made, as in the Dinsmore system, with radar vectors direct from the four perimeter fixes to the final approach course, or, at the discretion of approach control, arrivals proceeded by their own navigation directly to Dinsmore. From this point, radar vectors were conducted to the final approach course.

Departures.

Departure routes and restrictions within the terminal area remained the same as in previous studies except that Victor Airway 3-E was used for northeastbound departures. This routing replaced the "Waverly departure" used in the present and Dinsmore systems.

COMMON IFR ROOM

Limited time prevented any exhaustive studies of a common IFR room concept as it might apply to the Jacksonville area. However, several tests of the St Mary's system only were made with all control facilities operating from a common IFR room.

Control during these studies was exercised from two SPANRAD units and two ANC sectors The Tower and Center departure controllers worked at one SPANRAD and the Tower and Center arrival controllers operated from a second SPANRAD. The two SPANRAD's were located within about 10 feet of each other, with the two ANC sectors situated between the two SPANRAD's, as illustrated in Fig. 13. All sectors were furnished with adequate interphone and air/ground communications. Coordination between the en route controllers and the terminal arrival and departure controllers was effected by direct conversation

TEST RESULTS

Present System.

The approach controller using the present system, shown in Fig 4, was hampered in maintaining a steady, well-spaced flow of traffic during radar vector operations from the perimeter fixes. The proximity of restricted area R-161 to the Jacksonville Airport greatly reduced the radar maneuvering area to the east to such an extent as to preclude the use of a right turn-in to the final approach course. Therefore, for the most efficient operations, it was necessary to vector aircraft from Shiloh to the middle marker, across the ILS course, with a left turn-in from the area west of the airport to the final approach course. Also, as the traffic density increased, arrivals at Shiloh were, in most instances, neglected in favor of the arrivals cleared to Clinch, Callahan, and Bryceville. This resulted from the fact that Clinch, Callahan, and Bryceville were concentrated in one geographic area. As the traffic increased, the radar approach controller was compelled to pull off traffic at these fixes in order to utilize the relatively small vector area west of the localizer course to maintain a steady flow to the approach gate. Whenever the Shiloh arrival was favored in the approach sequence, additional delays were incurred by aircraft holding at Callahan and Clinch because of the inability of the Shiloh arrival to maneuver with a right turn-in.

Westbound departures from Mayport Airport presented a minor problem to the terminal radar departure controller Such departures were required to climb to 2,500 feet in order to provide separation from aircraft which might be executing a missed approach at Jacksonville. After clearing the missed-approach path, the Mayport departure then was descended to 1,500 feet to provide separation with aircraft on arrival radar vectors to the final approach course This descent to 1,500 feet could be eliminated only by proper coordination between the radar departure and arrival controllers, contingent upon the availability of the 2,500-foot level within the terminal area

Departures from Navy-Jacksonville Airport did not present any appreciable control problems during these tests In all instances, west- and northbound departures were routed via the Sunbeam intersection and the Jacksonville VOR. The Bryceville departure, as set forth in the Center/Tower letter of agreement, was not used because of the arriving traffic operating in the area west of Jacksonville and the inherent coordination difficulties. The Tower/Center hand-off operations were conducted in a routine manner. Navy departures are illustrated in Figs. 14 and 15

Center functions in this system were conducted without any appreciable difficulty until such time as delays were encountered at Shiloh.

Dinsmore System

The Dinsmore system provided several features which do not exist in the present system The use of the Dinsmore VOR as a terminal aid gave the terminal arrival radar controller much greater latitude for spacing and vectoring. The approach controller workload was greatly reduced.

A steady flow of traffic was maintained with a smaller number of aircraft in the vector pattern The Dinsmore VOR allowed the approach controller to vector directly from the perimeter fixes or, as traffic dictated, aircraft could be recleared to Dinsmore before radar vectoring began Such transition to Dinsmore was conducted by the pilot on his own navigation, allowing the approach controller extra time for target identification, space maneuvering, and strip marking.

In addition, the availability of Dinsmore for Shiloh arrivals eliminated the vector problem encountered in tests of the present system in which all Shiloh traffic required special attention during the maneuver from the clearance limit to the west quadrant of the final approach course. By reclearing all Shiloh arrivals to Dinsmore before they entered the vector problem, all traffic was placed in approximately the same geographical area on the approach controller's scope, and concentration on target identification was simplified It was noted during these tests, however, that Shiloh arrivals continued to receive secondary consideration to those aircraft arriving from the north and northwest as they do in the present system

Considerable workload relief was obtained for the approach controller by allowing him the use of altitudes up to and including 5,000 feet instead of only 4,000 feet, as set forth in the Center/Tower letter of agreement. Center and Tower departure procedures did not vary from those used in the present system As shown in Fig. 3, the number of controller/pilot radio contacts was less in this system than in the present system

Arrival delays during tests of this system were greater than those recorded in tests of the present system These are depicted in Fig 2.

St. Mary's System

Modification of the Dinsmore system produced the St. Mary's system. In an effort to segregate en route, arrival, and departure traffic, the St. Mary's system provided an off-shore bypass airway to the east, designated as Victor Airway 1. Victor Airway 1 also contributed to the increased operating efficiency of arrival and departure traffic at Jacksonville by minimizing the amount of traffic on Victor Airway 3 which, by necessity, had to pass over Jacksonville. This left Victor Airway 267 available as an unrestricted departure route southbound The small number of aircraft overflying Jacksonville were routed via Victor Airway 3-E and Victor 51. This change of routing from the Dinsmore system made possible the preferential inbound airway Victor 3 from Daytona Beach for Jacksonville landing traffic. As a result of this routing change, it was necessary to relocate the Shiloh intersection from its position on Victor Airway 3-E to an adjacent position on Victor Airway 3.

In tests of this system, Clinch was not used as an arrival clearance limit Instead, arrival traffic entered the Jacksonville area on Victor Airway 3 and was cleared by the ARTC Center from over Brunswick to the new intersection identified as St Mary's. Transition from Brunswick to St Mary's was accomplished on the proposed Victor Airway 3-W from Brunswick to Dinsmore. The use of St. Mary's as a clearance limit instead of Clinch reduced the approach controller's area of concentration and provided cleaner and more expeditious radar vector paths to the final approach course from the north and northeast

By moving the arrival traffic from Victor Airway 3-E to Victor Airway 3-W, departure problems were practically eliminated for northeastbound flights by establishing a preferential unrestricted departure route on Victor Airway 3-E The use of Victor 3-E also provided the departure controller with an additional routing for flights destined north or northeast of Savannah Navy departures were simplified by the use of the unrestricted climb area north of Jacksonville between the Mayport homer and Sea Island. Center workload was reduced by the elimination of the confliction area over Jacksonville on Victor Airway 3 which had existed in the present and Dinsmore systems. In addition, northeast departures were simplified by the establishment of Victor Airway 3-E as a preferential departure route. As shown in Figs 3 and 4, communications contacts, communications time, and length of arrival delays were less in this system than in either the present or Dinsmore systems

CONCLUSIONS

Present System.

Tests indicated that the current IFR traffic volume now operating at Jacksonville can be handled adequately with the present system. However, as increased traffic was simulated with this system, it became apparent that the greatest problems to be solved concerned the arrival traffic at the perimeter fixes of Shiloh and Clinch. The radar vector path from Clinch to the final spacing area demanded the controller's attention for long periods of time. This affected directly the controller's handling of aircraft at other perimeter fixes by increasing the holding delays and the average approach interval.

The limited maneuvering area available to the approach controller in the area east of the ILS localizer course necessitated clearing arrivals from Shiloh intersection via the ILS middle marker to the vector area located west of the airport. These arrivals, under radar control, then were headed directly toward the flow of arrivals from Callahan and Bryceville. Such inherent conflictions were added to the already difficult spacing problem confronting the radar approach controller.

Arrival operations could be vastly improved by a more extensive use of the Bryceville intersection Such improvement could be accomplished by rerouting present Tampa-Jacksonville flights via Taylor and Victor Airway 22 Furthermore, considerable relief could be gained for the approach controller during peak periods by clearing Shiloh arrivals to Bryceville for radar vectoring to the final approach course. The procedure of clearing arrivals from the south to Bryceville would place the aircraft in a more favorable position for the approach controller's functions. In addition, the ARTC Center would have additional altitudes available on Victor 3 for en route aircraft over Jacksonville

The additional control duties placed upon the Center and Tower personnel by placing Navy-Jacksonville departure operations under their control, as set forth in the Center/Tower letter of agreement, had no adverse effect upon the over-all movement of traffic in the Jacksonville terminal area. These procedures improved the utilization of available airspace by allowing the ARTC Center to handle such departures as though they actually were departing Jacksonville Airport. It was no longer mandatory that Navy departures climb to cruising altitude within restricted area R-161 before proceeding on course to destination.

Dinsmore System.

Tower and Center departure procedures in this system were the same as those used in the present system. Departure delays recorded during tests of this system were considerably less than those noted in the present system studies This was a direct result of the added radar experience gained by the control personnel during each successive simulation run. Added familiarity with the simulation equipment also resulted in improved over-all operations during tests of the Dinsmore system.

The use of the Dinsmore VOR as a terminal aid reduced the approach control workload by allowing flights to proceed closer to the airport by their own navigation, thereby reducing the length of the radar vector path. The advantage of this type of operation became more pronounced as the traffic volume increased.

Although the controller/pilot contacts were less and delays greater in this system than in the present system, the controllers were of the opinion that the added delays were the result of inexperience with the feeder-type operation.

St. Mary's System

The location of the St Mary's intersection and the establishment of Victor Airway 3-W as an arrival route greatly reduced controller workload by reducing the approach controller's scope-scanning area This procedure allowed the approach controller much greater flexibility in his operations

In this system, the reversal of arrival and departure routes north and northeast of Jacksonville accomplished several purposes. By changing Victor Airway 3-E, as used in the present and Dinsmore systems, from an arrival route to a departure route, both Tower and Center personnel were provided an additional departure route for aircraft destined for points north and northeast of Savannah In the two previous systems tested, all such departures were limited to the use of Victor Airway 5-E via Tarboro Northeast departure routing on Victor Airway 3-E also eliminated any crossover of departure and arrival paths within the terminal area.

The advantages gained by routing departures on Victor Airway 3-E, however, were not without some disadvantages Simulation tests showed that no difficulty was encountered between Victor 3-E departures and Victor 1 en route traffic at Sea Island. Controller personnel, however, were of the opinion that, in actual practice under conditions of heavy load and high temperatures, it might not be possible for these departures to climb to high altitudes by the time they crossed Sea Island It is felt, though, that the advantages gained in this instance outweigh the minor climb difficulty which might exist at Sea Island.

The rerouting of Jacksonville over-traffic on Victor Airway 1 greatly reduced radar target congestion and simplified terminal target identification Clear-channel arrival routings existed except on Victor Airway 22, which permitted military jet aircraft to make normal descents en route, thereby eliminating the need of jet penetrations over the terminal area

The common IFR room concept for this area was tested only with the St Mary's system The limited tests conducted indicated that the common IFR room appears feasible when applied to this area However, more extensive tests should be conducted before any definite conclusions can be reached It was indicated during these tests that the common IFR room practically eliminated all Center/Tower coordination and permitted better utilization of available airspace Because of the limited number of tests conducted in this study, arrival delays and communication data were not compiled.

The proposed 2,000-foot corridor for Navy operations between R-161 and W-158, tested in all three systems, created additional control duties for the Jacksonville departure controller The control personnel also indicated that aircraft departing via Runway 12 at Jacksonville Municipal Airport often would be unable to cross the Blue Jacket intersection at 3,000 feet unless the aircraft were vectored off course.

RECOMMENDATIONS

It is recommended that.

1 A VOR facility be installed on Victor Airway 5-E between Jacksonville, Fla , and Macon, Ga., to permit use of lower en route altitudes along this departure route.

2 Preferential routings be published and more extensive use be made of Victor Airway 157, west of Jacksonville, for both en route and terminal traffic Tampa-Jacksonville traffic should be routed via Taylor in order to alleviate some of the congestion now existing southeast of Jacksonville.

3. A VOR facility be installed at or near the location used in the Dinsmore system

4 A Victor Airway be designated between the Daytona Beach VOR and the Sea Island intersection Note· Airspace action presently is pending.

5. When traffic conditions dictate, a preferential route structure similar to the St Mary's system be adopted

6. Consideration be given to future simulation study of the common IFR room concept as applied to the Jacksonville area

TABLE I

LOCATION IDENTIFIERS

ADW	Andrews AFB
AMG	Alma
ATL	Atlanta, Ga
AM	Amelia
AT	Atlantic
BJ	Blue Jacket
BK	Blackshear
BL	Bolen
BN	Bunnell
BOF	Bolling AFB, Washington, D C
BYE	Bryceville
CA	Callahan
CB	Colesburg
CH	Clinch
CK	Croaker
CS	Cabins
CU	Cumberland
CHS	Charleston, S C.
CLT	Charlotte, N C
CTY	Cross City, Fla
DIN	Dinsmore VOR
DAB	Daytona Beach
DCA	Washington National Airport
EWR	Newark, N. J.
FK	Folkston
FLL	Fort Lauderdale
GNV	Gainesville, Fla.
GRL	Greenville, S. C.
GRE	Donaldson AFB, Greenville, S C
HL	Hilliard
HST	Homestead
IAG	Niagara Falls
IDL	Idlewild, N Y.
JAX	Jacksonville, Fla
LGA	La Guardia, N. Y
LCK	Lockbourne AFB, Columbus Ohio
MCN	Macon, Ga
MDW	Chicago Midway
MIA	Miami, Fla
MSY	New Orleans, La.
MPT	Mayport
MO	Moniac
MP	Swamp
MR	Marion
NGU	Norfolk NAS
NHK	Patuxent River, Md., NAS
NIG	Miami Marine Base
NIP	Navy Jacksonville (Mainside)
NKT	Cherry Point, N C.
NRJ	Sanford, Fla., NAAS
NP	Neptune
ORF	Norfolk, Va.
ORL	Orlando, Fla.
PBI	West Palm Beach, Fla.
PQS	Pinecastle AFB, Orlando, Fla.
RDU	Raleigh, N. C.
RY	Roy
SBU	Sunbeam
SSI	Brunswick
SVN	Savannah
SI	Sea Island
SJ	St. John's
SM	St Mary's
SN	Shand
SO	Shiloh
TLH	Tallahassee, Fla
TPA	Tampa, Fla.
TR	Tarboro
TY	Taylor
VPS	Valpariso
YL	Yulee

TABLE II

DISTRIBUTION OF FLIGHTS IN THE TRAFFIC SAMPLES

Airport	No. of Arrivals Per Hour		No. of Departures Per Hour		Total Operations Per Hour	
	Jet	Prop	Jet	Prop	Jet	Prop
Jacksonville	4	18	3	17	7	35
Jacksonville Navy		6		5		11
Mayport		1		2		3
	4	25	3	24	7	49
En Route Over-Traffic						18

TABLE III

OPTIMUM AIRCRAFT SPACING - JACKSONVILLE METROPOLITAN ILS

Aircraft Sequence No. 1	No 2	Outer Marker Separation (miles)
S	M	5.1
S	F	5.5
S	J	6 6
M	S	3 1
M	F	4.5
M	J	5.8
F	S	3.0
F	M	3 5
F	J	5 2
J	S	3 0
J	M	3.0
J	F	3.0
Same Type		4 0

Aircraft Category	Approximate Approach Speed (mph)	(knots)
S - Slow	120	104
M - Medium	140	122
F - Fast	150	130
J - Jet	180	156

APPENDIX A

November 4, 1958

JOINT JACKSONVILLE CENTER AND JACKSONVILLE TOWER AGREEMENT

SUBJECT: Approach Control

EFFECTIVE

The following agreement between the Jacksonville Center and the Jacksonville Tower, covering Approach Control Service, is supplementary to the procedures contained in the ANC/PCAT MANOP, and the U S Standard Manual of Radar Air Traffic Control Procedures. This letter cancels and supersedes Letter of Agreement dated January 2, 1957

I. GENERAL

The Jacksonville Approach Control Airspace shall include all of the airspace up to and including 3,000 feet MSL, bounded by the inbound clearance limits listed in Section II, including the holding pattern airspace areas, and the outbound release points listed in Section III, and shall include all the airspace up to and including 4,000 feet MSL, within the holding pattern airspace areas for the Jacksonville LFR, VOR, and LMM The Center shall not clear aircraft through the Jacksonville Approach Control Airspace below 5,000 feet, nor shall Approach Control clear aircraft from the clearance limit to the primary Approach NAVAID above 4,000 feet without prior coordination.

II INBOUND CONTROL

The Center shall clear inbound aircraft to the clearance limit at the lowest available altitude, 4,000 feet or above. Aircraft will be released to Jacksonville Approach Control at the release fix for the clearance limit.

FROM OR OVER	VIA	CLEARANCE LIMIT	RELEASE FIX
Alma	V51W	Callahan	Hilliard
Taylor	V22	Bryceville	Moniac
Orlando/Daytona Beach	V3E	Shiloh	Atlantic
Savannah/Brunswick	V3E	Clinch	Cumberland
Gateway	CA1153	St John's	St. John's

Whenever possible, direct route inbound flights will be rerouted into the Jacksonville Approach Control Airspace via one of the preferred routes

Military jet aircraft normally will be cleared to the Jacksonville VORTAC or LF range at altitudes 20,000 feet or above, and released to

Approach Control over the clearance limit or at a specified time. Approach Control will, when clearing the flight for penetration, specify a standard jet penetration, or coordinate an alternate penetration with the Center

III DEPARTURE CONTROL

Departing aircraft will normally be routed to or over the following fixes as listed below:

TO OR OVER	VIA	CLEARANCE LIMIT	RELEASE FIX
SSI/SAV	V3W	SSI	Waverly
CHS/MCN	V5E	Baxley	Colesburg
AMG	V51E	AMG	Colesburg
TLH	*V22N	Taylor	Toledo

*Until such time as V22N is designated and published, these flights will be cleared as follows. DRCT Swamp, via JAX 288 Radial, DRCT Taylor, via SSI 237 Radial

DAB/ORL	V267/V267E	Roy	Shand

The Jacksonville Center will normally issue clearance to a short range clearance limit at or below 6,000 feet.

All aircraft departing the Jacksonville Terminal Area on a departure route, as listed under Paragraph III, will be held to an altitude under Approach Control jurisdiction until at least 15 miles from the Jacksonville VORTAC. Departures will normally be released to the Center leaving an altitude level of 1,000 feet below assigned altitude for the clearance limit, but in no case prior to 15 miles from Jacksonville VORTAC. Radar separation may be utilized by radar departure control to establish the outbound aircraft at the altitude, and on the appropriate departure route as assigned by the center. When radar is used in lieu of an altitude restriction, radar departure control will apply radar separation as outlined in the U. S Standard Manual of Radar Air Traffic Control Procedures

IV. NAS JACKSONVILLE DEPARTURE CONTROL

See Annex "B" for NAS Jacksonville Departure Control

V MISCELLANEOUS PROCEDURES

Deviation from the procedures outlined in these instructions may be made only after coordination which completely establishes responsibilities in each case. See Annex "A" for additional information on holding fixes, arrival and departure routes.

CHIEF, Jacksonville Center

CHIEF, Jacksonville Tower

JOINT JACKSONVILLE CENTER, JACKSONVILLE TOWER, AND NAS JACKSONVILLE AGREEMENT

Annex "B"

VI. NAS JACKSONVILLE DEPARTURES

NIP Operations will file all flight plans on conventional (prop) type aircraft departing NIP with the Jacksonville Center.

NIP Tower will request the departure clearance on the flights outlined above from the Jacksonville Center.

Jacksonville Center will issue a departure clearance in accordance with Part III, Departure Control.

NIP Tower will then request departure clearance from the Jacksonville Tower, giving an abbreviated flight plan as follows:

a. Identification numbers.
b. Type of aircraft.
c Route of flight and altitude, as given by the Jacksonville Center.

Jacksonville Tower will clear departures as follows: To Bryceville, Blue Jacket or Sunbeam, at 3,000 feet or below, then via appropriate departure route

Jacksonville Tower will utilize the procedures as outlined in Section III, Departure Control, after the flight has departed Restricted Area 161.

No (prop) type aircraft will be cleared to depart under IFR conditions, utilizing these procedures, unless direct communications can be established with both the Jacksonville Center and Jacksonville Departure Control.

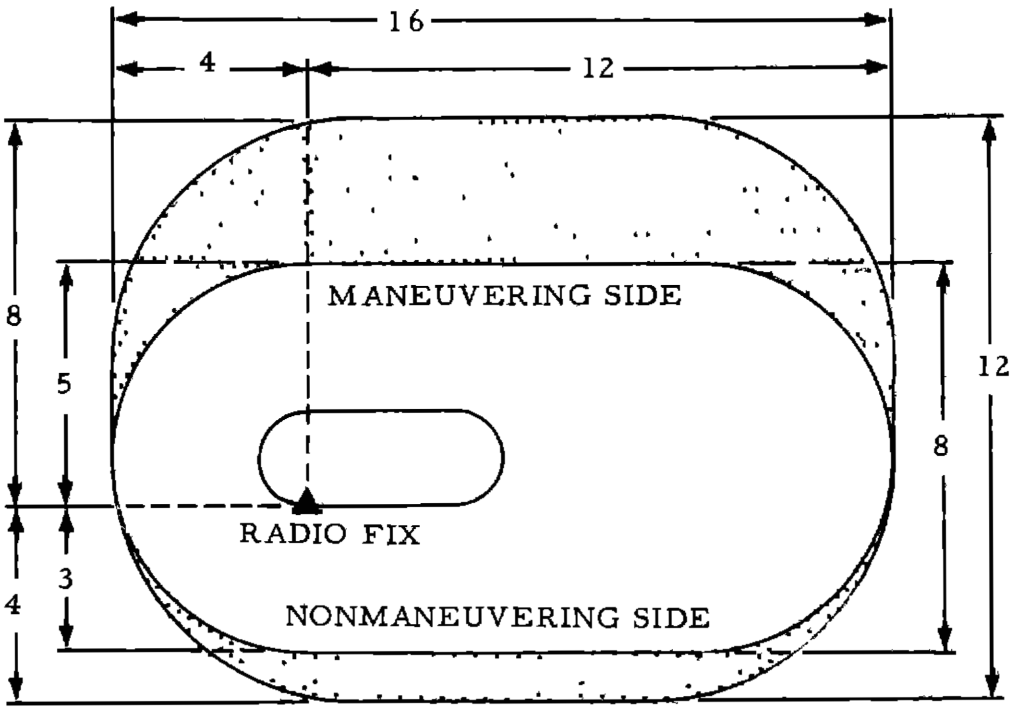
NAS Jacksonville will be responsible for preparing suitable charts to define the departure procedures.

Competent military authority will be responsible for the separation of aircraft departing NIP while the aircraft are operating within R-161.

CHIEF, Jacksonville Center

CHIEF, Jacksonville Tower

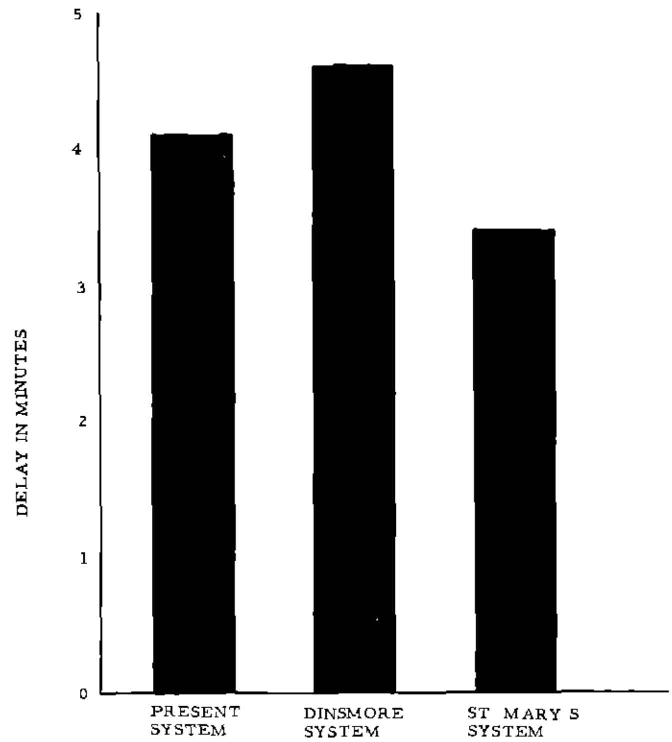
Commanding Officer, NAS
Jacksonville, Florida



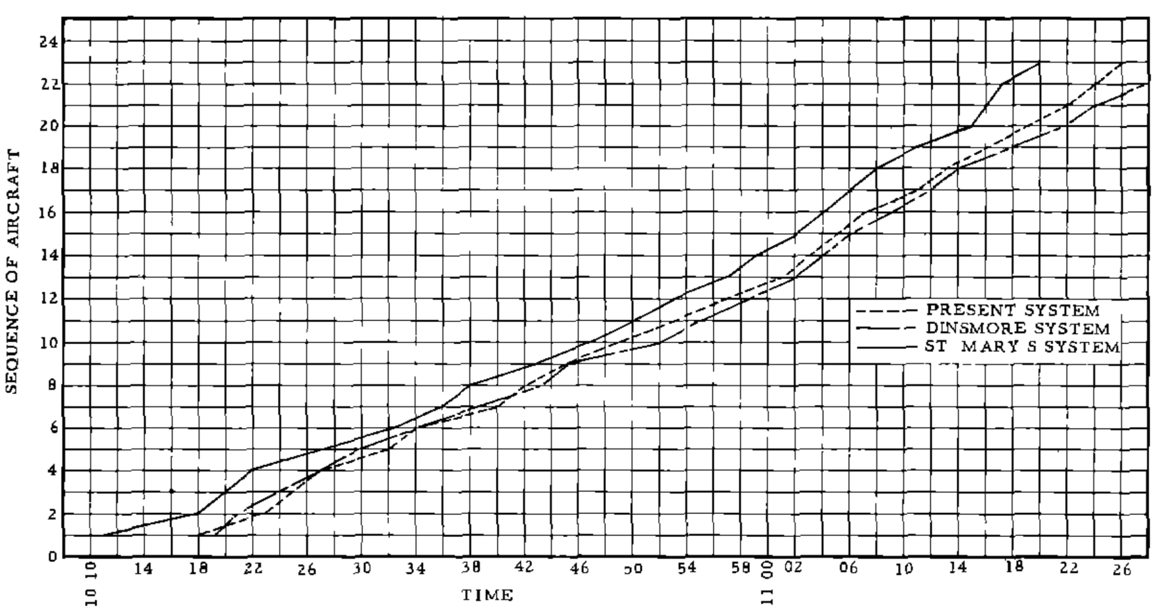
INDICATES INCREASE IN HOLDING PATTERN AIRSPACE AREA ASSUMED FOR JACKSONVILLE SIMULATION TESTS

ALL DIMENSIONS IN STATUTE MILES

FIG. 1 TSO-N20A HOLDING PATTERN AIRSPACE AREA

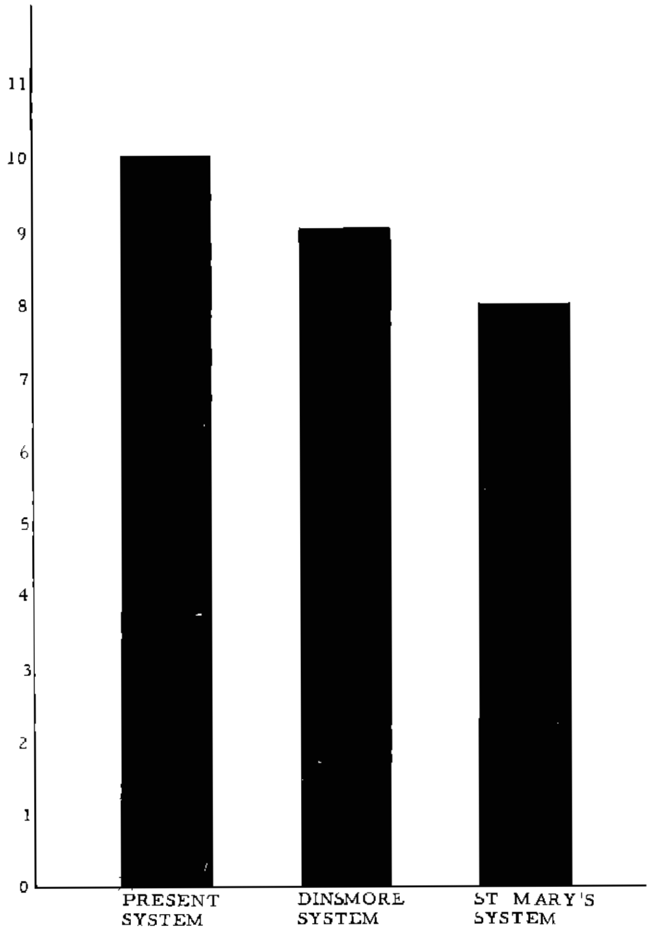


AVERAGE DELAY PER AIRCRAFT

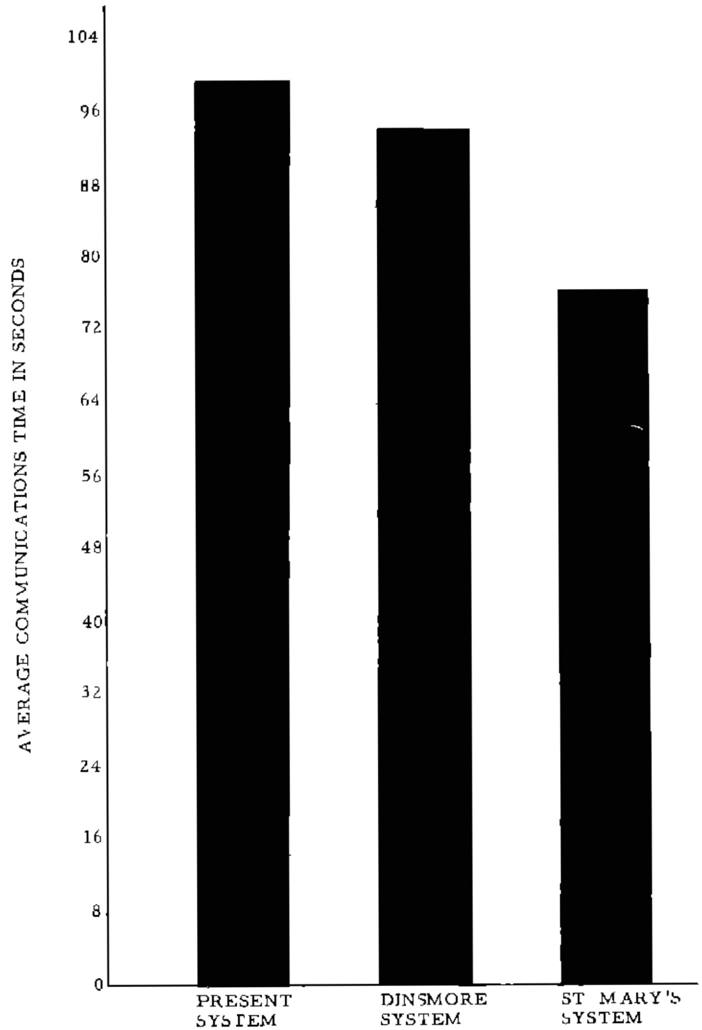


AVERAGE TIME OF AIRCRAFT OVER OUTER MARKER

FIG 2 AIRCRAFT ARRIVAL DELAY DATA



AVERAGE CONTROLLER CONTACTS PER AIRCRAFT



AVERAGE COMMUNICATIONS TIME PER AIRCRAFT

FIG 3 CONTROLLER CONTACTS AND COMMUNICATIONS DATA

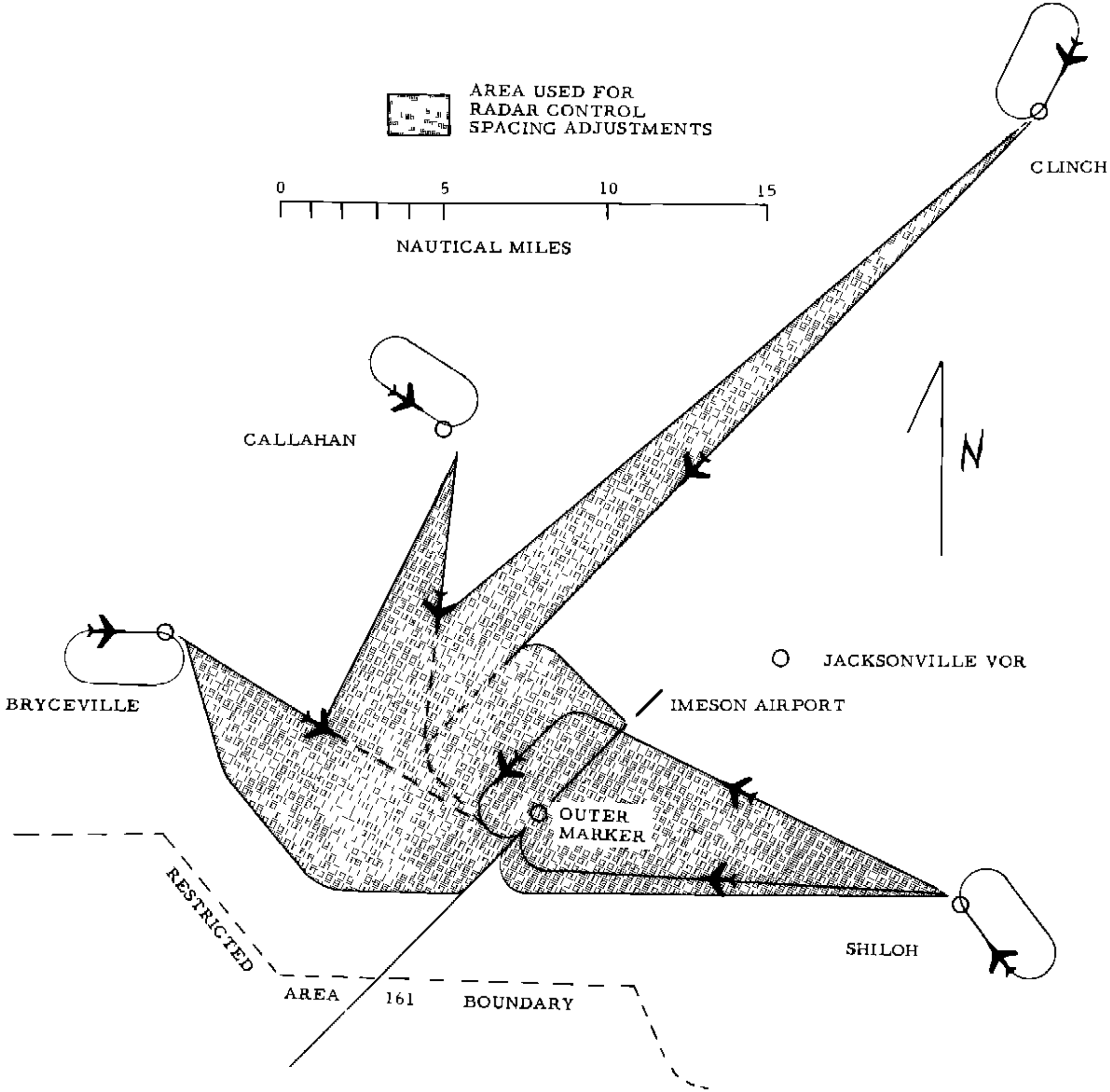


FIG 4 ARRIVAL ROUTES AND VECTOR PATTERNS - PRESENT SYSTEM

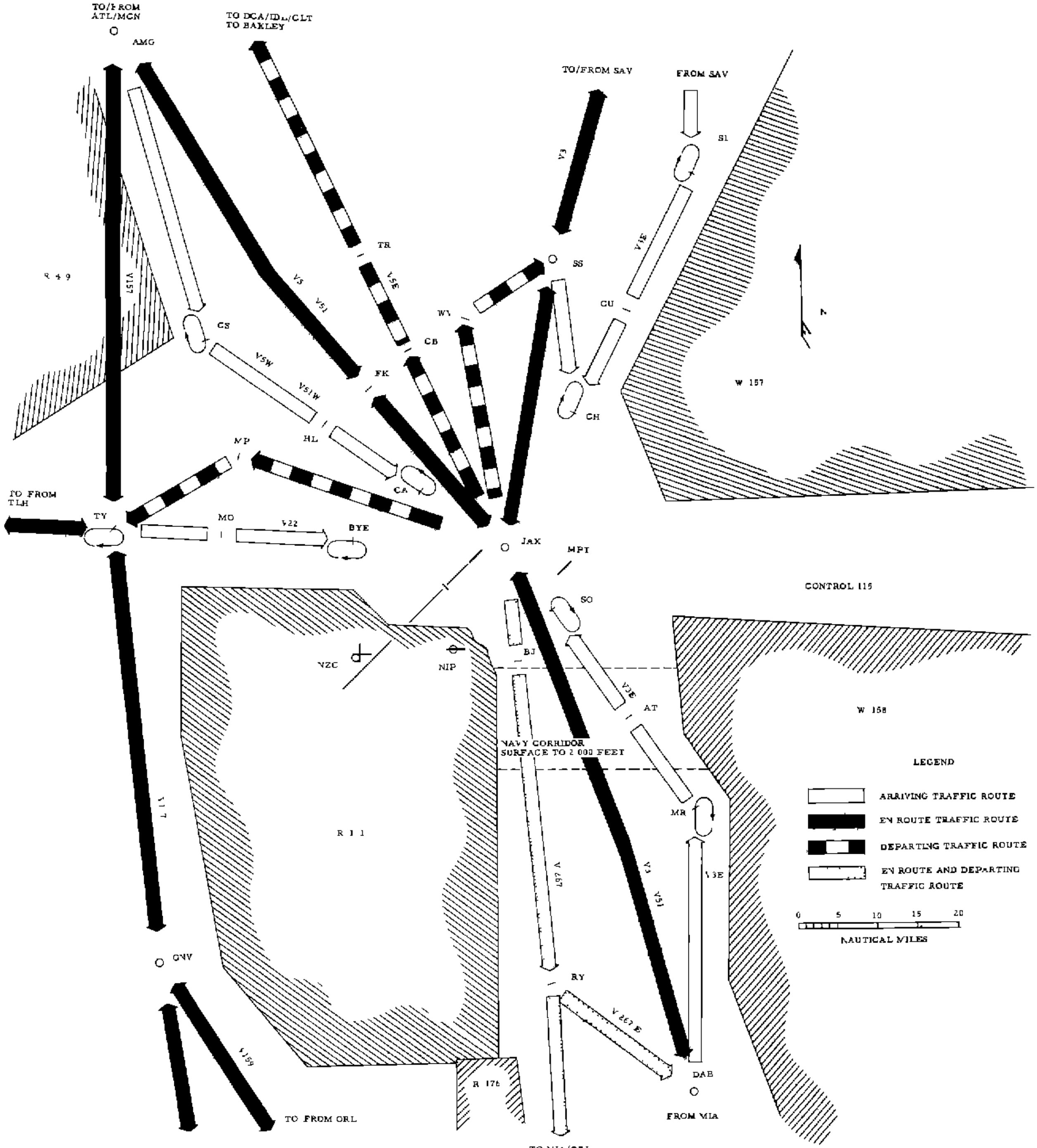


FIG 5 ROUTE STRUCTURE PRESENT SYSTEM

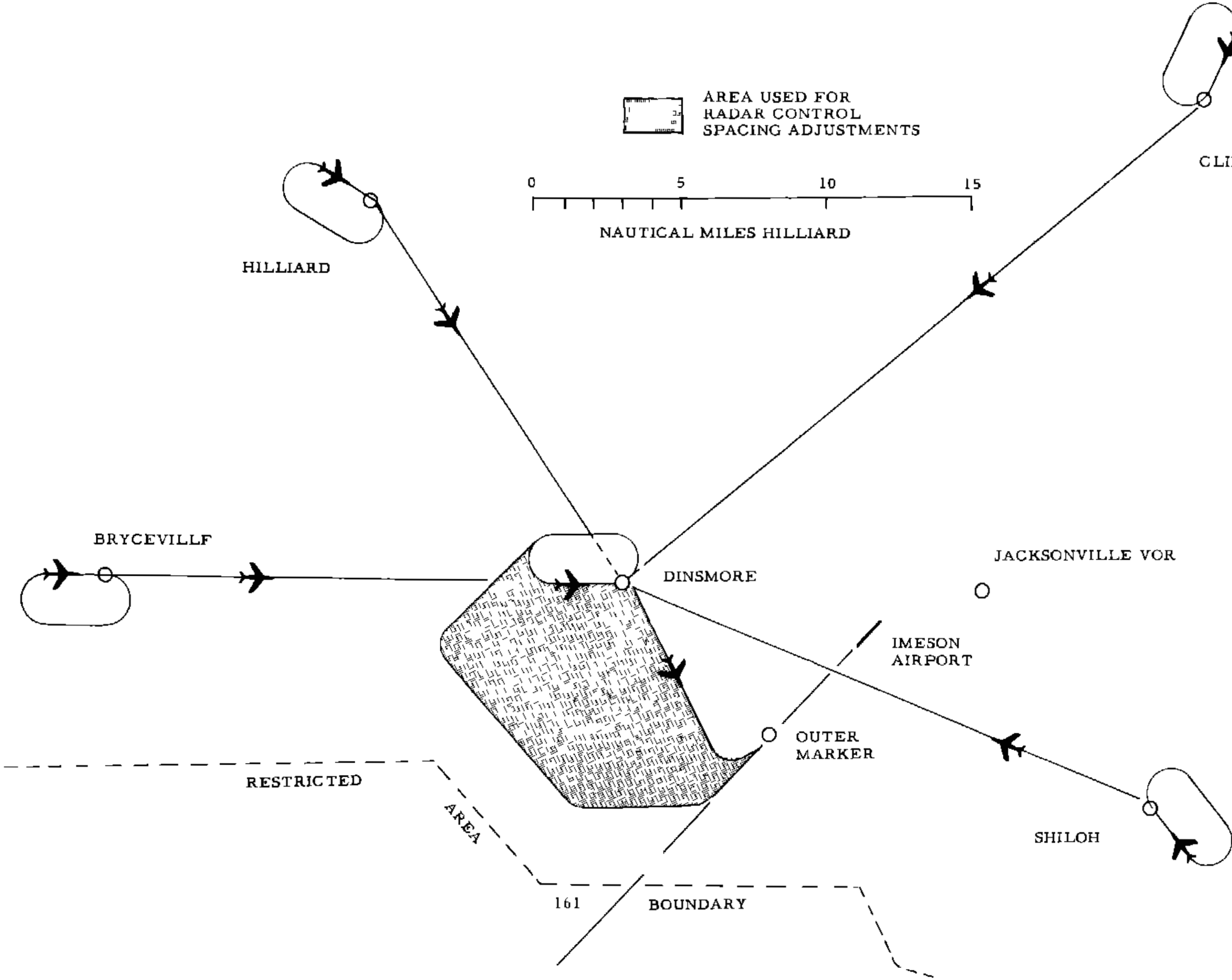


FIG 6 ARRIVAL ROUTES AND VECTOR PATTERNS - DINSMORE SYSTEM

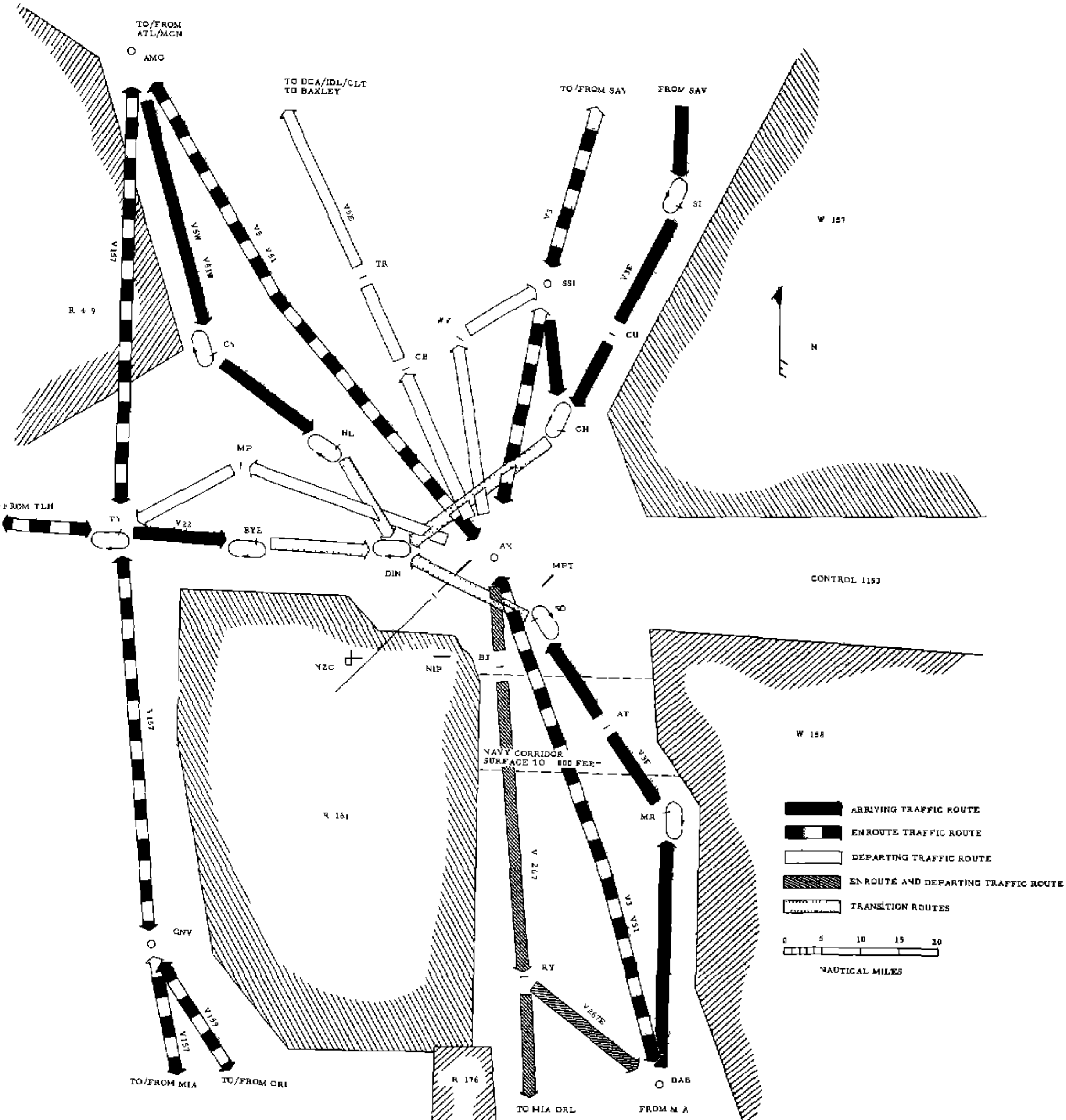


FIG 7 ROUTE STRUCTURE DINSMORE SYSTEM

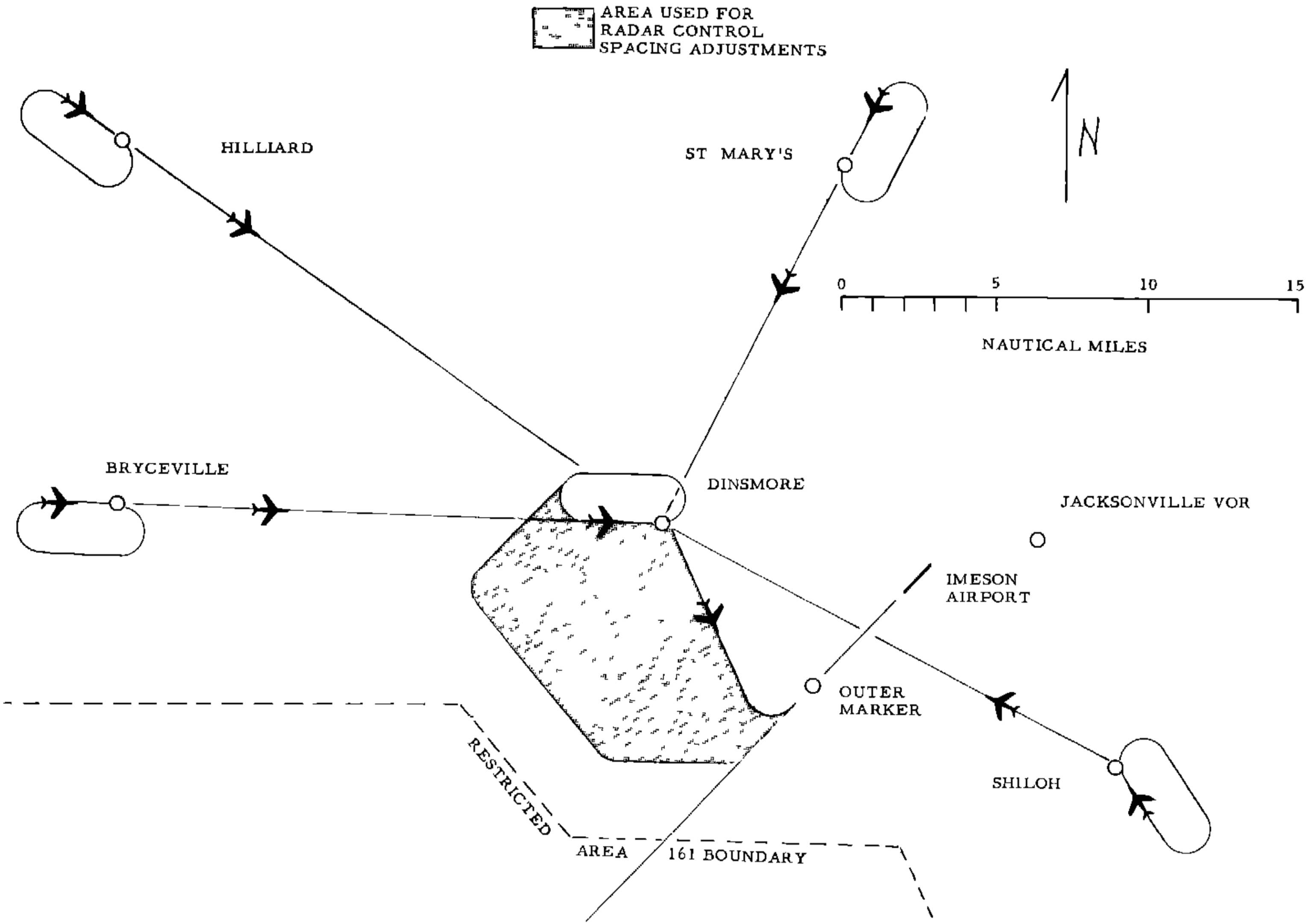


FIG 8 ARRIVAL ROUTES AND VECTOR PATTERNS - ST MARY'S SYSTEM

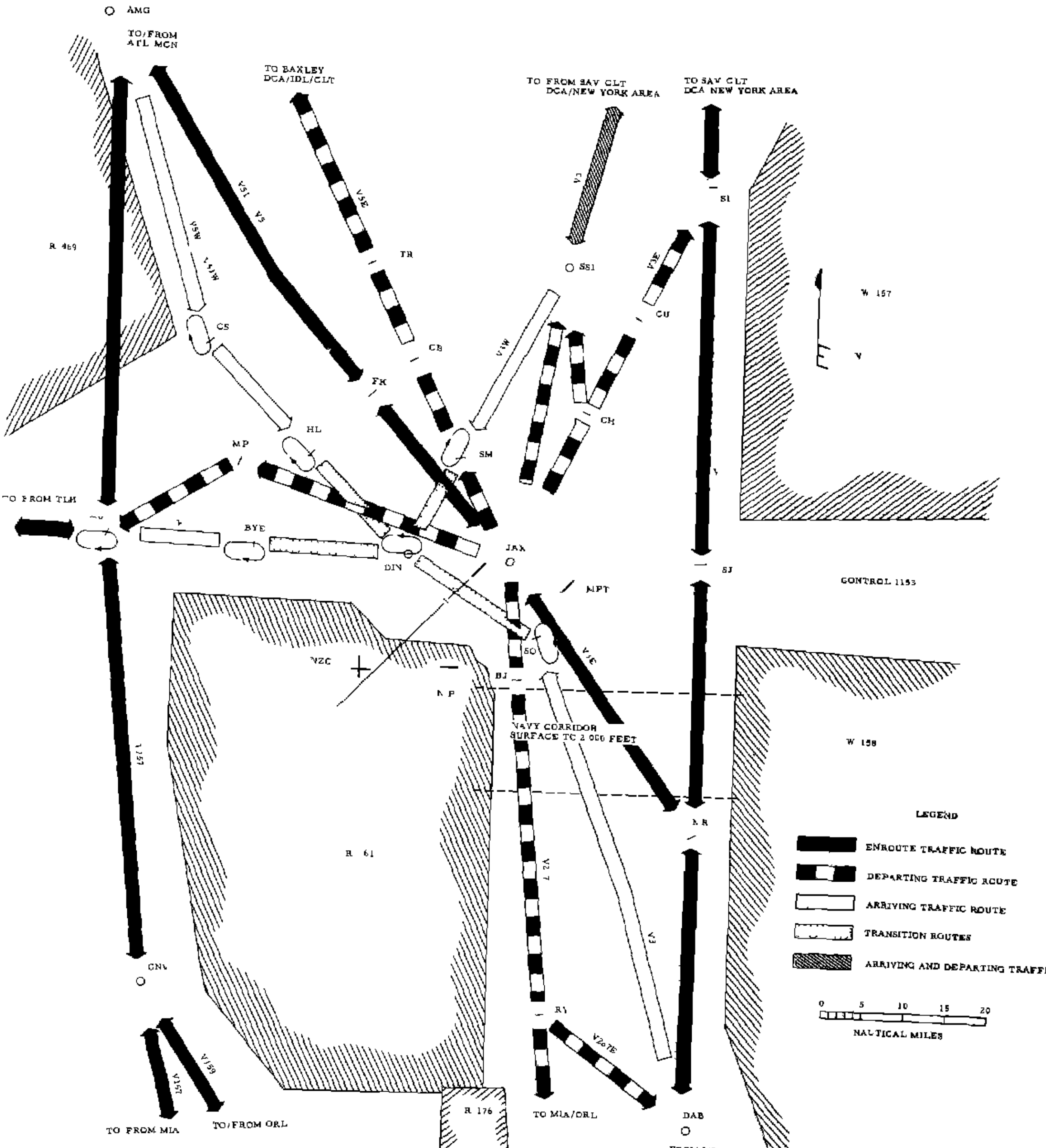


FIG 9 ROUTE STRUCTURE ST MARY S SYSTEM

FIG 10 JACKSONVILLE APPROACH CONTROL

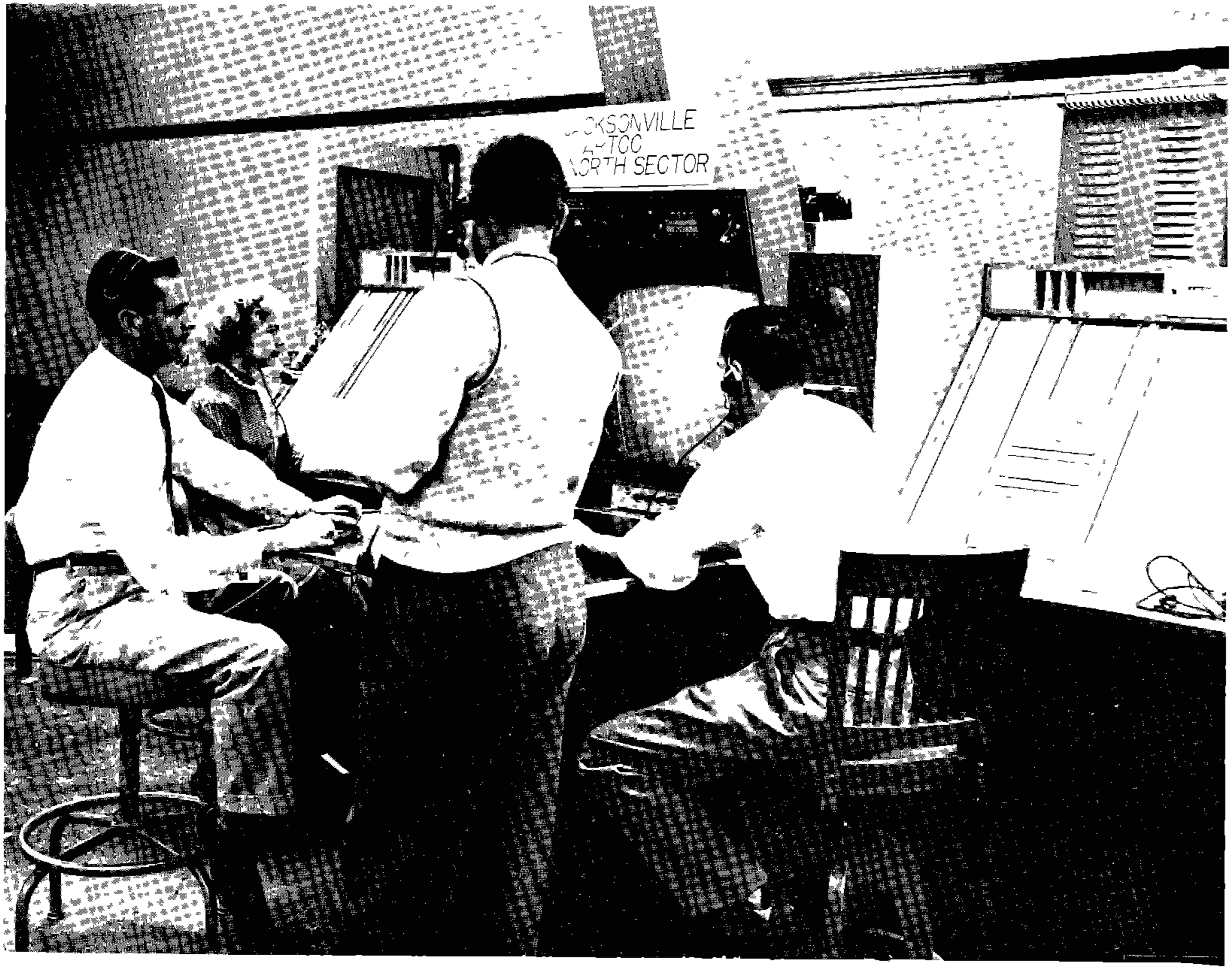


FIG 11 ARTC NORTH RADAR SECTOR

FIG 12 ARTC SOUTH RADAR SECTOR

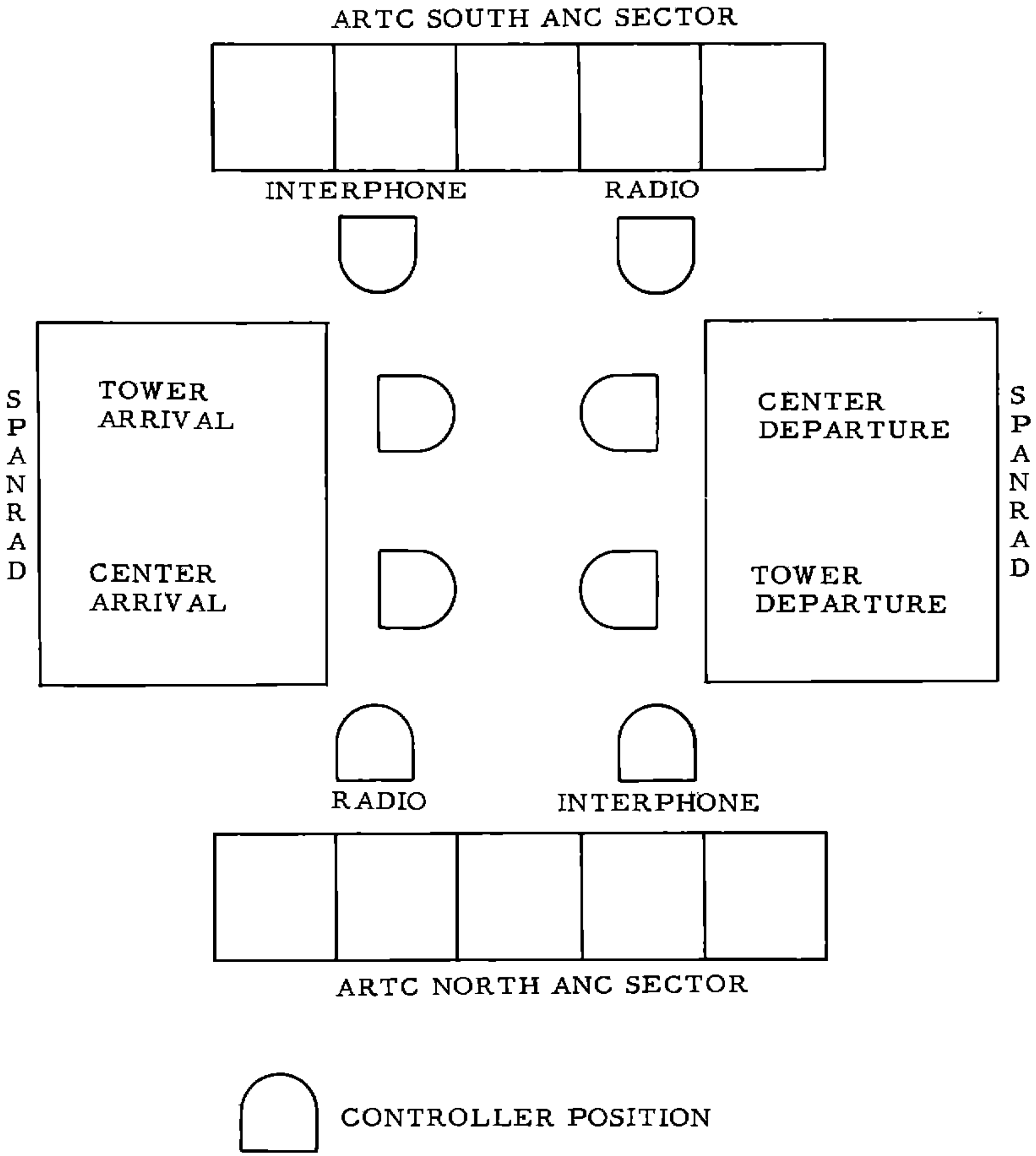


FIG. 13 COMMON IFR ROOM EQUIPMENT ARRANGEMENT

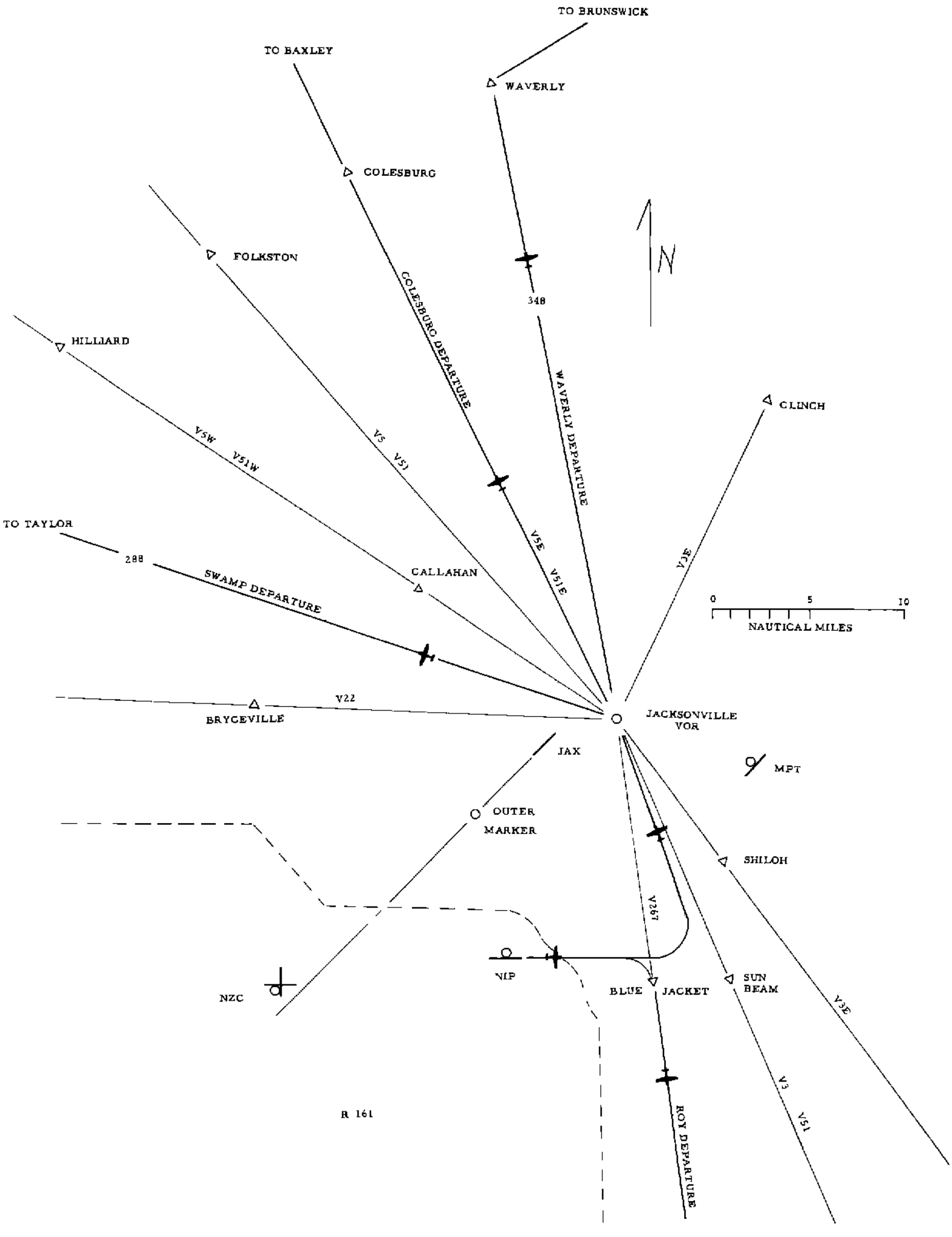


FIG 14 NAVY JACKSONVILLE DEPARTURE ROUTES - PRESENT AND DINSMORE SYSTEMS

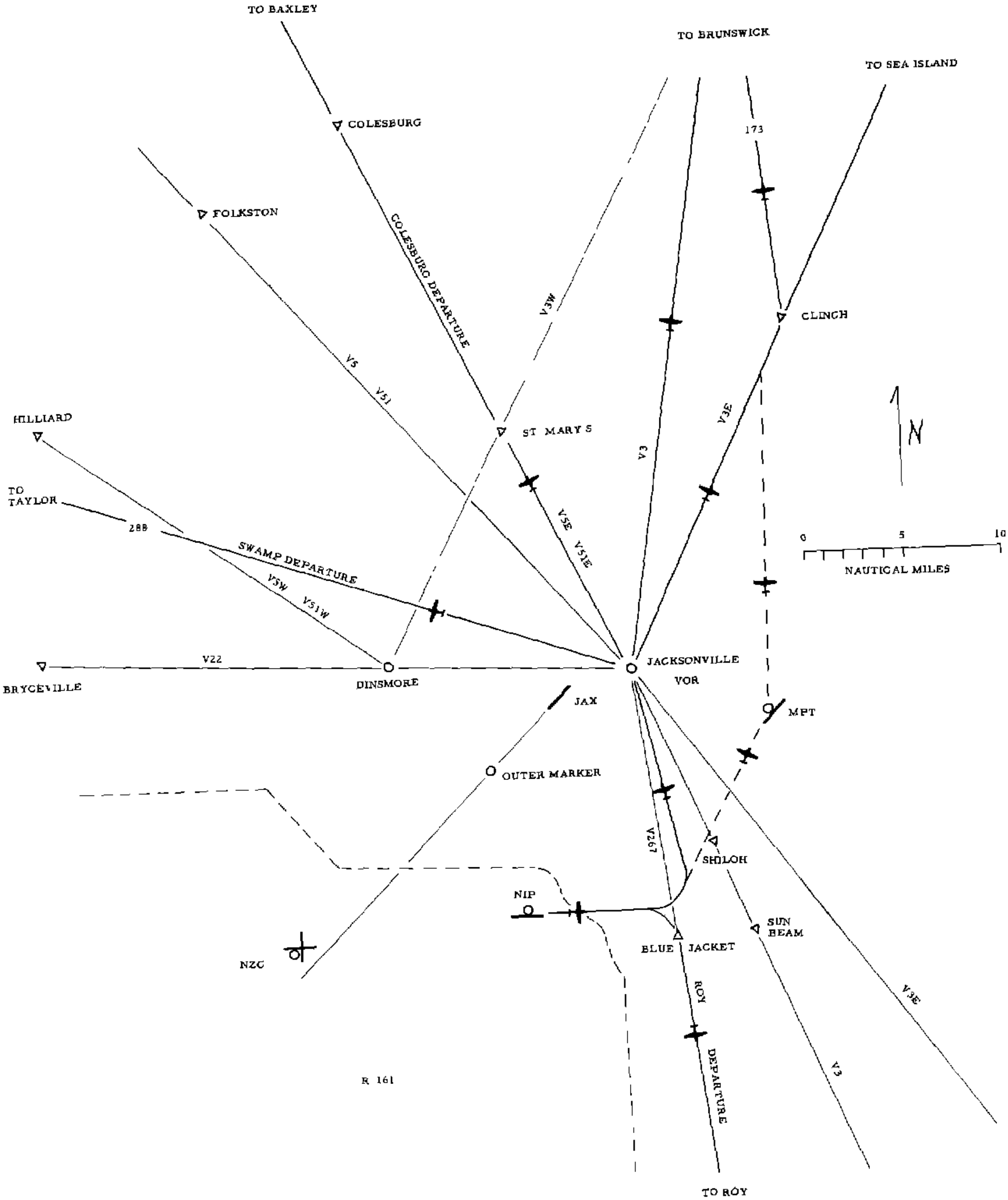


FIG 15 NAVY JACKSONVILLE DEPARTURE ROUTES - ST MARY S SYSTEM