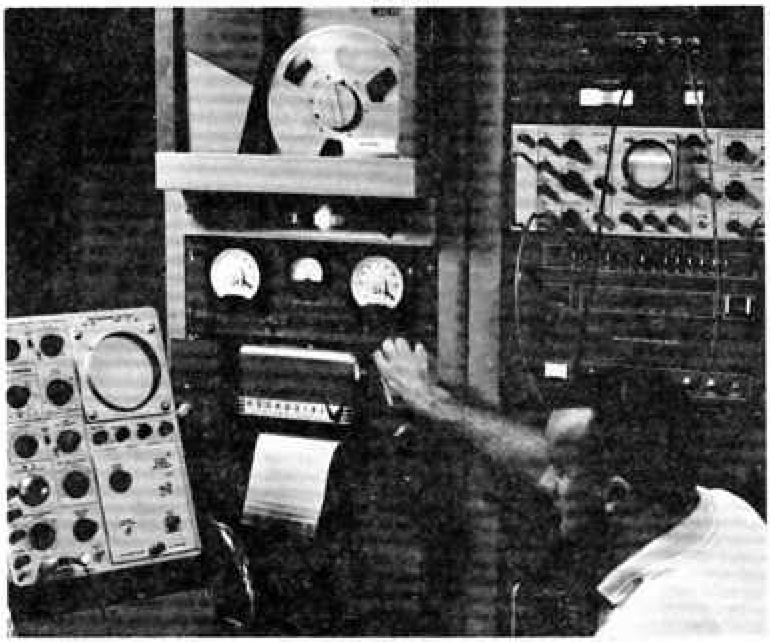
1962



Technician Paul Karkeck operates an altimeter surface station on the ship Twin Falls Victory

1963

ABOVE — ARIS I Ship's Instrumentation Manager (SIM) Samuel L. Candler is shown working at the radar console during a test. BELOW — Don L. Ely, ARIS II SIM, checks the target trajectory plotter. Candler and Ely head up RCA personnel aboard the two ARIS vessels.

1963

Graham Walker at the telemetry control console of the General Arnold.

Ernie Gagne (foreground) and Don Crawford.

Manning the radar console on the General Arnold are (left to right) Charles Demming, Charles Whitetree and James Fennell.

Meal time on the General Vandenberg.

1965 Coastal Crusader & Sword Knot

Charlie Brown, Dix Compton at communications console.

Terry Hood (standing), Bill Cooksey in receiving room.

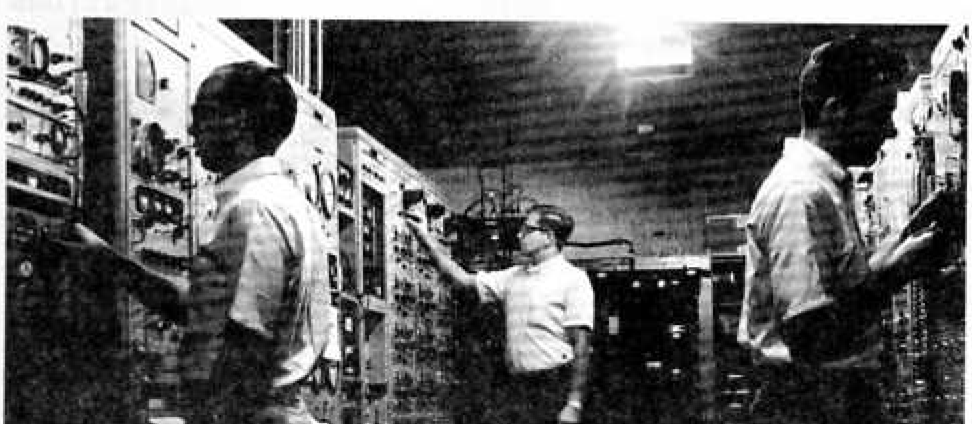
1972

Dwight A. Collier with the Redstone in the background.

1967

Reunion At Alameda

The USNS Arnold joins the Vandenberg at dockside, the first meeting of the two ships in almost three years. Exchanging greetings from the rails, (in photo below) are MTP crew members.



Twin Falls

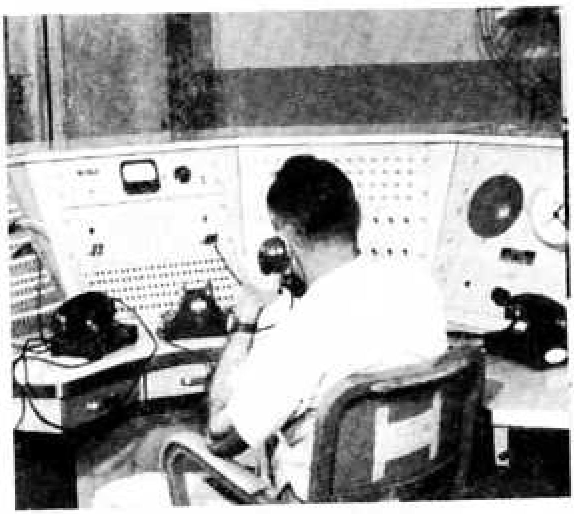
MTP technicians stand by to support a Polaris test. Chief Technician, Henry Janicki (center), checks out telemetry receivers. Technicians Dan Chapman (left) and Henry Bishop follow countdown

Communications

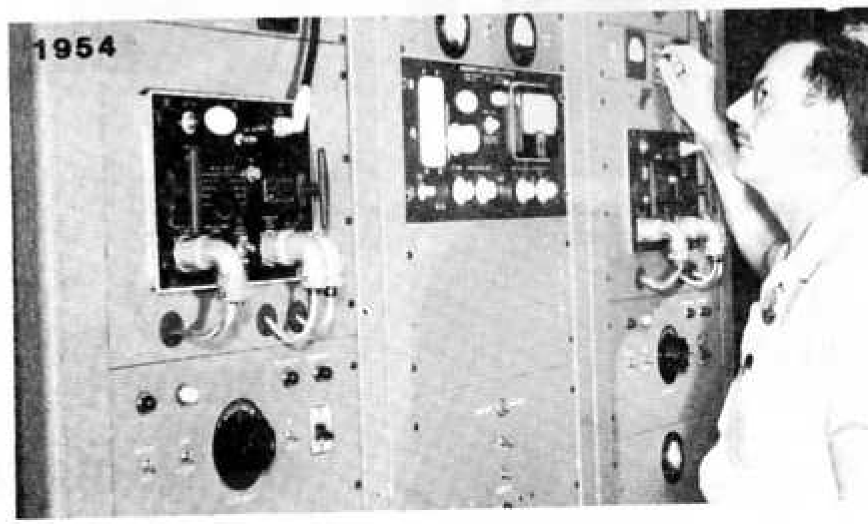
In 1919, when the original charter of the Radio Corporation of America was adopted, the document stressed the company's emphasis on communications.

Today that fulfillment of the original charter is nowhere better exemplified than at Cape Canaveral and the Eastern Test Range.

In 1953, with only a few personnel, RCA assumed responsibility for operating and maintaining communications on the Atlantic Missile Range. Contact between Cape Canaveral and the only downrange station at GBI was solely dependent upon high frequency radio. A green phone system was in operation, but the submarine cable, MOPS system, HF sideband and VHF/UHF were to come later with RCA providing the engineering and expertise that made them possible.



MONITORING AND NET CONTROL CONSOLE



VHF GROUND RADIO EQUIPMENT for missile destruction and control.

The lifeline of the Range is its extensive and complex communications system. This system ranges from a 5000 line automatic dial telephone system at Cape Canaveral to a complex intercommunication network comprising over 4000 stations.

Downrange, as far as Antigua, the backbone of communications is the submarine cable system. This cable network between tracking stations provides multiplie voice channels as well as channels for transmission of teletype, tracking and timing data. Ground/air and shore/ship contact is provided from each station over high-frequency, very-high-frequency and ultra-high-frequency radio systems. Ten 45-kilkowatt single-sideband terminals, utilizing high-gain rhombic antennas, provide highly reliable communications over the long hops to Antigua and Ascension.

An extensive interstation communications network connects each range station with each other and the outside world. A high degree of flexibility and reliability is achieved by using undersea cable, high frequency and microwave radio, communications satellites and various landline links.

RCA communications personnel maintain and provide a net control for all stations during operations, guard designated frequencies, operate a central tape recording system that can record 100 channels for up to 24 hours, provide on-site technical support during missile tests and operate a 24 hour comm center that provides continuous teletype and cryptographic communications by submarine cable and radio to all range stations and other selected agencies.

Today, point-to-point radio links between major stations primarily use the 45-kW transmitters and antennas. The tri-nested rhombic antennas are designed for directional radiation in specific frequency bands and fixed in azimuth. Line-of-sight uhf and vhf radio is normally used in ground-to-air, air-to-air, air-to-ground, ship-to-air, and air-to-ship communication. Transmissions normally consist of administrative/operational test support coordination, using simplex voice channels. Transmissions are either unified S-band (2200-2300 MHz) or vhf. The vhf capability is simplex up- or down-link using one AN/ARC-34, 100-W transceiver and four vhf crossed-dipoles mounted in the telemetry dome. For unmanned launch operations, uhf, vhf, or hf is used. Ships can be configured to obtain secure communications. For manned launch operations, the unified S-band system is also used. Low-power hf single sideband transceivers are located at each station for contingency communications during disasters such as hurricanes.

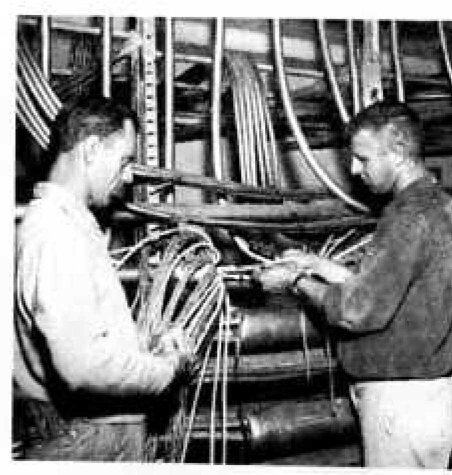
The USNS Redstone and CCAFS have installed WSC-3 UHF satellite terminals, used in conjunction with the WSC-3 terminal installed aboard the USNS Range Sentinel and at Norfolk.

The Range's Ascension Island station is equipped with an AN/GSC-39 Defense Satellite Communications System satellite terminal. Thc CONUS end of the satellite circuit terminates at Northwest, near Norfolk. Four voice plus two data circuits are extended by landline to CCAFS.

CCAFS is the communications focal point for all Range circuits, Range User nets, and domestic commercial carrier interconnect to all other Government agencies. Antigua is the nodal point for the Caribbean area. Ascension is the net control station for ship and aircraft operations in the Atlantic, Africa, and Indian Ocean areas. Antigua and Ascension have complete manual and semiautomatic Range communication control center capabilities. One digital microwave system interconnects CCAFS and PAFB with 504 voice channels; 120 channels of the 504 are extended from CCAFS to Malabar and there are 72 channels between Malabar and CCAFS. Audio recorders at CCAFS and downrange stations record selected voice channels during operation support. CCAFS can now record 160 voice channels simultaneously at 15 to 16 inches/second. The Digital Network Switch (DNS) located at CCAFS provides a store and forward processing capability. Several intercommunications systems extend through the mainland and downrange instrumentation and operational control sites. The primary systems are the Green Phone and the Transistorized Operations Phone System (TOPs). The Green Phone system is a direct line ringdown system that allows rapid communication between instrumentation supervisors (or Range Users) and operating personnel.

1961

A. H. McDowell (standing), Leader, Cape Canaveral Communications Center, observes teletype operators C. E. Park, E. H. Conz, and W. M. Johnson as they send messages to down range areas.



Range station wire technicians W. L. Andrus (left) and G. R. Wisman splice cable at the Cape Canaveral North Terminal Cable Building.

John Blalock (left) and Billy Morefield

John T. McCabe
Cape Wire Communications

Cecil Nelin (foreground), RCA's Communications Manager at San Sal makes an entry in the log during an operation as N. C. Tucker, Manager of RCA Instrumentation, leans forward to watch the missile's progress

MTP's electronic shops are also constructing some of the equipment that will be used on Gemini. Here technician M. D. Hernandez assembles a Gemini communications switching panel. Looking on is Al Waits, who designed the device, of Communications Engineering.

Bill Seay

John Varn, Arthur Hensley, Joe Falgione, Larry Mims in Cape Center

Patrick Leader Melba Backus

Gene Smith mans Osborne console.

Technicians at their stations in Transmitter Bldg.

1968 Malabar

Vic DeRosa inspects the Microwave

Jay P. Morgan (seated), R. F. Ferguson set-up equipment.

35 Years Of Radars At The ETR

When MTP was put in charge of the Range Instrumentation in January 1954, it dealt not only with the operational aspects of this responsibility but also started an unexpectedly long era of progress and creative developments for the benefit of the Range and its customers. In the radar part of the instrumentation, these efforts have culminated in the most advanced Test Range radar chain of the U. S. and a reputation for top capabilities and data quality.

MTP's accomplishments in this area were made possible by the competence of its team, the motivation and dedication of many individuals, and the cooperation with the agencies managing and utilizing the ETR. The expertise of the MTP/Pan Am teams in performing major "in-house" modernizations throughout the years produced substantial improvements of capabilities while achieving enormous cost savings to the taxpayer.

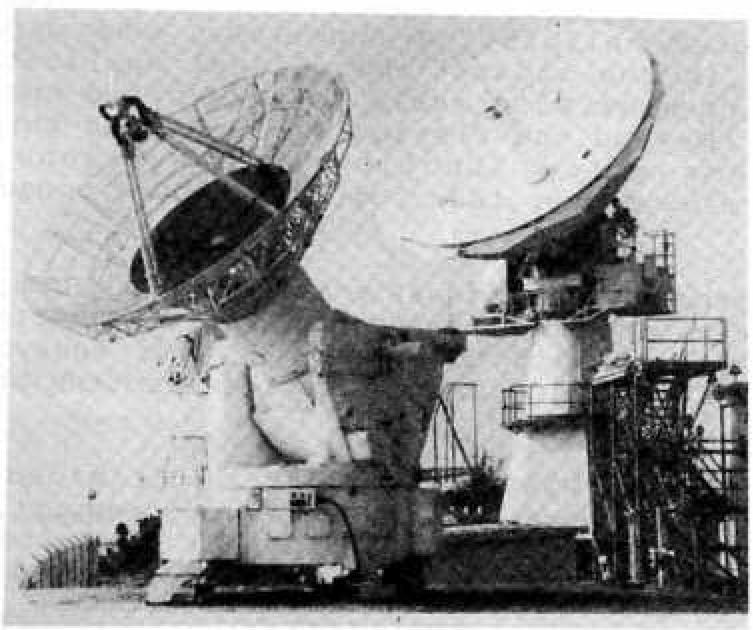
By the start of MTP at the ETR, there were a series of Mod I S-Band radars - slightly modified WW II SCR-584's with a poor-man's data system, the WLAMC Data Box. The targets tracked were Matadors, Bomarcs, Snarks and the first ballistic missiles, the Redstones. Data were processed manually on Monroe and Friden calculators, with boresight camera films helping to achieve acceptable angle data quality. The first digital electronic computer - the FLAC - was in a phase of trials and checkout. Beginning in 1955, the MOD Is were replaced by the Reeves - developed MOD II radars which were an outgrowth of the MSQ-1 guidance radar for the Matador missile and incorporated many innovations peculiar to Test Range missile tracking as well as an "operator-friendly" console, the layout of which employed various MTP suggestions. Initiated by MTP, mobile Mod I and Mod II radars explored the utility of the PAFB, Vero Beach and Jupiter sites as a means for reducing flame attenuation/interference effects through less sensitive radar-to-missile aspect angles. The Mod IIs participated heavily well into the 60's and were, together with the Reeves Verlort radars at other sites, major supporters of the Mercury and Gemini manned spaceflight programs. MTP contributed various innovations, including solutions for the teething problems of the Giannini punch tape data recording system, the beacon sequencing technique allowing uninterrupted station-to-station handover operation, calibration methods for improved accuracy, and the first evaluations of target radar cross-section.

1954

Mod II S-Band Radar atop Central Control (The CPS-5 Search Radar in background).

A dramatic step forward took place in 1957 when RCA placed the first C-Band monopulse instrumentation radar, the FPS-16 XN-1, at Patrick AFB for support of the Navy's Vanguard program. The more than 10-fold improvement in angle performance and other features quickly raised the importance of this radar so that launch agencies in several cases would rather postpone a missile launch than to forego the FPS-16 support! This prototype and its brother, the XN-2 at GBI, were the first Test Range sets which accomplished skin track of the Sputnik II satellite in December 1958. It was only logical that FPS-16 radars were installed at the major ETR stations and other Test Ranges in the following years and also became part of the Spaceflight tracking network.

The progress of the U.S. missile programs led in 1962 to the RCA development of the high-performance FPQ-6/TPQ-18 (MIPIR) radar which as expressly designed to satisfy the tracking and metric demand of long range missile and space vehicle support operations. The first system was accepted at PAFB with the turnkey ceremony on 5 June 1963. These radars replaced the FPS-16s (except at CCAFS) in the following years and remained the backbone of the Range's radar instrumentation to this day.



FPS-16 XN-1 and FPQ-6
at the PAFB Beach Site, 1962
before removal of the XN-1.

As early as 1965 the ETR MIPIRs debuted as part of the ADCOM Spacetrack Network because of their outstanding data quality, and are still in this 24-hour service at Antigua and Ascension Island.

The years since introduction of the MIPIRs brought about two major milestones leading to extensive modifications and modernizations:

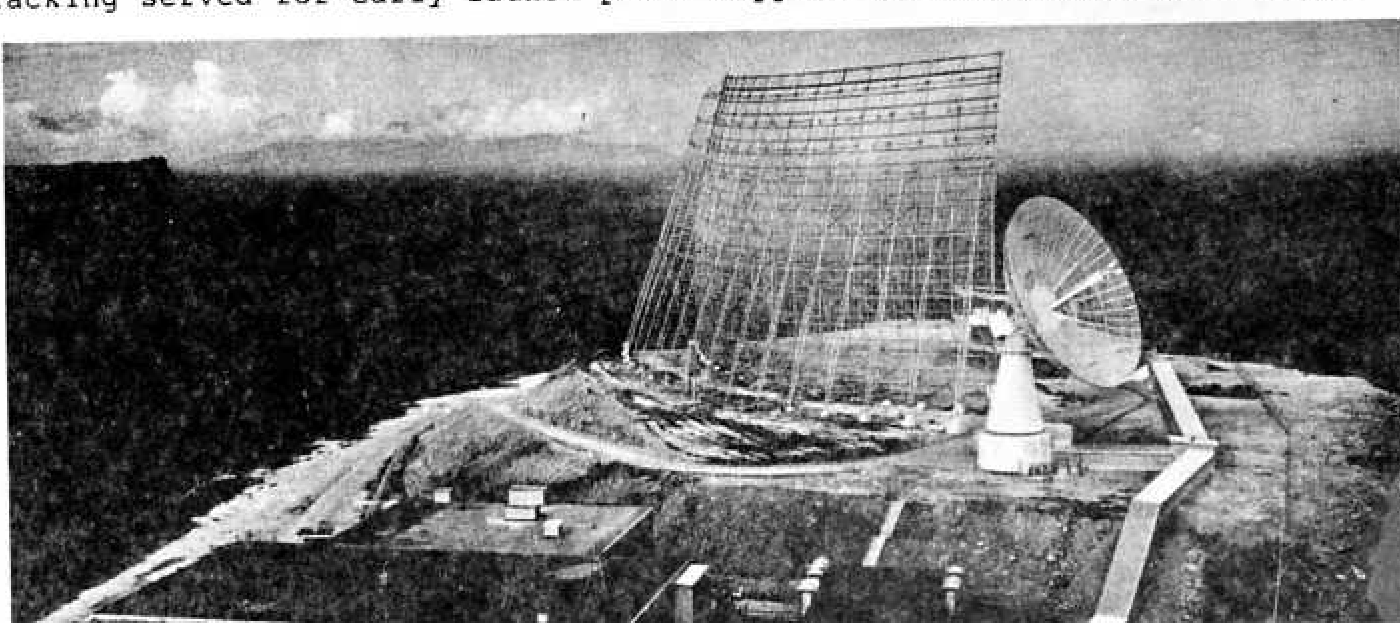
1. The advances in solid-state technology led to conversion of all tube-equipped radar subsystems - except the transmitter - to solid state circuitry, reducing equipment size, power and cooling requirements, and failure rates. These conversions, including the engineering of the new digital range tracker, receiver, and electric antenna drive were designed and performed as part of the radar modernization program at the ETR by the Range Contractor's Engineering Team.

2. The probably most significant advancement was reached when special ARPA R&D requirements in the late 60's called for real-time radar accuracies with total errors below 0.1 mil during echo track of satellites, and led ultimately to the marriage between the radar hardware and on-site high-capacity digital computers in what is generally called the computer-directed (On-Axis) tracking technique. With a firm goal imposed, a team of the brightest Range Contractor mathematicians, programmers and engineers developed the prototype FPQ-13 at the PAFB Range Measurement Laboratory, and its successful completion in the early 70's led to the conversion of all ETR MIPIRs to On-Axis radars in the 1974 Range Modernization Project. This phase of instrumentation evolution also led to the permanent formation of Instrumentation Programming as the counterpart of Metric Engineering.

The addition of fast large-memory on-site digital computers offered avenues long sought by operations planners, engineers and analysts, and became an object of intense challenge to the software designers. From the initial program performing the tracking control, the current radar software has grown to embody about 150 programs and subroutines to support the radars' tracking tasks, perform elaborate automated calibration functions, and execute numerous auxiliary tasks needed in the radars' operational application, including complex procedures which otherwise would have required special mechanical or analog equipment. Beyond the flexibility achieved through computer control, these systems allow functional innovations and modifications by software programming rather than costly and time consuming hardware changes.

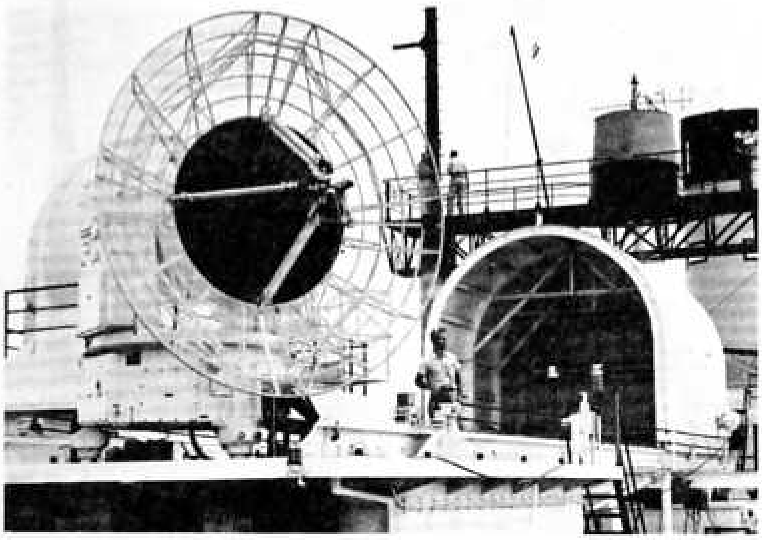
A second major modernization program in the mid-80's included the computer changeout (Sigma 5 to SEL 32/27) with attendant programming, introduction of the Adaptive Mode Switch (AMS) Console which controls all radar subsystems via microprocessors, and a series of other innovations in the electronics and data systems.

In the 60's and early 70's, the huge FPS-43 UHF radar at Trinidad was operated on behalf of the Navy missile program and in Spacetrack support, and at the Cape two Mod IV (Nike Ajax) X-Band radars equipped with infra-red tracking served for early launch phase support of Minuteman silo firings.



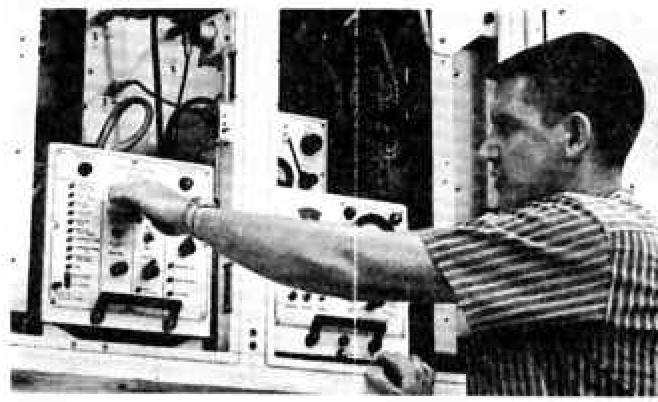
Big eyes of the Trinidad Station. The Atlantic Missile Range's 165-foot high scanner and 84-foot dish face northwestward across the Carribean. The mountains of Venezuela are in the left background. At the upper left between Venezuela and Trinidad is the Island of Monos.

In addition to land-based radars, the ETR has operated shipborne radars on a series of instrumentation platforms, beginning with the USNS Twin Falls Victory and followed by the USNS Vandenberg and Arnold, the USNS Redstone and, finally, the USNS Observation Island. These systems were and are employed for a variety of special support in areas inaccessible to fixed instrumentation in both the Atlantic and Pacific Oceans since the early 60's, and MTP activities dealt with the operational as well as extensive engineering tasks.



The FPS-16 radar antenna mounted on the Twin Falls Victory

1962



Technician Billy Morefield checks out the RF preamplifiers

When the Range's radar inventory needed to be increased to meet new support requirements, the TPQ-18 "Frankenstein" was engineered as a replacement for the Station 12 TPQ-18 (which was relocated to the Kwajalein Range) and used a deactivated TTR pedestal and a previously damaged but locally refurbished MIPIR antenna. This radar now operates at Ascension Island together with the greatly modernized former TTR, now FPQ-15. Finally, the need for easily mobile radars led to engineering of two MCBRs built on Nike-Hercules pedestals with FPS-16 antennas and trailerized Electronics/Control vans. These two radars have found extensive use in substituting for down-time radars and, most prominently, for tracking support from locations favoring early acquisition of missile launches. One of these radars, when located near the Shuttle landing strip at KSC, has tracked the landing Shuttle down to the "Weight on Wheels" part of the mission!

The progress of the radars as data gathering instrumentation was accompanied by MTP in the areas of Data Transmission, metric and video Data Processing, Signature Analysis, Systems Evaluation and radar Performance and Accuracy Analysis. In the latter, the Radar Accuracy Monitoring Program (RAMP) using satellites as tracking targets was developed in the late-60's and serves, with the aid of the Central Computer Complex, for regular accuracy checking of the ETR radar chain. Because of its efficiency and capabilities, this program processes the data of the entire U. S. Spaceflight radar network on behalf of NASA during operations before and during each Shuttle flight.

Last but not least to be voiced with the history of the ETR radars are the know-how and collective experience of the personnel in all areas of MTP who joined and grew with the project for many years and account to a great part for the reputation gained in this field of ETR support. Witness that the crews at the individual ETR radars proudly represent combined experiences anywhere between about 60 and over 120 manyears in their chosen profession!