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Evaluation of Procurement Procedures for Acquiring the Closed Circuit Television System

Research Report 2923-1

Cooperative Research Program

TEXAS TRANSPORTATION INSTITUTE
THE TEXAS A&M UNIVERSITY SYSTEM
COLLEGE STATION, TEXAS

TEXAS DEPARTMENT OF TRANSPORTATION

in cooperation with the
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16. Abstract

A closed circuit television leased contract incorporates system components from field camera to the display monitor from a public utility company that includes equipment, installation, and maintenance. Installation time was 75 calendar days of which incomplete preconstruction work hindered progress. Camera and communications tests were all successful.

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EVALUATION OF PROCUREMENT PROCEDURES FOR ACQUIRING THE CLOSED CIRCUIT TELEVISION SYSTEM

by

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Sponsored by the
Texas Department of Transportation

December 1995

TEXAS TRANSPORTATION INSTITUTE
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IMPLEMENTATION STATEMENT

The project proposes to evaluate the Closed Circuit Television (CCTV) traffic monitoring system, which the Texas Department of Transportation (TxDOT) is leasing from a private utility company, Phonoscope, Inc., of Houston, Texas. This procedure for acquiring the video signals by leasing, rather than purchasing, is being evaluated because of the short time period required for implementation. Private industry has fiber optic transmission systems in place in various areas of the metropolitan area. The Astrodome monitoring system proposal required an operational system within 75 days after award of the contract.

DISCLAIMER

The contents of this report reflect the views of the author who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Texas Department of Transportation (TxDOT). This report does not constitute a standard, specification, or regulation. It is not intended for construction, bidding, or permit purposes.

ACKNOWLEDGMENT

Research study 7-2923 required this report as conducted by Texas Transportation Institute (TTI) and sponsored by Texas Department of Transportation (TxDOT) in cooperation with the U.S. Department of Transportation, Federal Highway Work Administration (FHWA).

Acknowledgment is given to the efforts of Ted Heyn of T&J Electronics (subcontractor of the cameras, video multiplexors, and testing criteria) and Phonoscope personnel (construction and maintenance) for providing background literature and information. Appreciation is given to the TxDOT personnel of the Interim Traffic Management Center (ITMC) staff under Carlton Allen's direction for their assistance in recording the maintenance activities. Finally, TxDOT's Houston District and FHWA are commended for providing the resources through State and Federal Priority Corridors Program.

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SUMMARY

The Congestion Mitigation and Air Quality (CMAQ) Improvement Program and the Priority Corridors Program of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 under the guidance of FHWA enabled the Houston District of TxDOT to apply for funding to support this project. The Houston District prepared specifications for competitive bidding which required a leased video system of ten (10) video cameras placed at designated sites near the Astrodome area of Houston and provided fiber optic cable for transmitting the video signals to the Interim Traffic Management Center (ITMC). The construction time specified 75 calendar days. However, the actual construction time exceeded 75 days, due to delays in preconstruction work that was the responsibility of TxDOT.

The testing procedures for camera and communication performance standards provided the opportunity to take advantage of the National Television Standards Committee (NTSC) signal generator wave forms. All system components met specifications.

Phonoscope's performance after the acceptance of the system has been poor. Communicating by telephone or regular mail has been delayed apparently by a loss of personnel by the vendor. Follow up on work, related to problems observed and reported, has not been received in a timely manner.

Recommendations to enhance the TxDOT specifications should include information concerning premature leased equipment cancellation and camera modifications without cable plant expansion. The contract should have additional sections that clarify the positions of TxDOT and the vendor.

INTRODUCTION

The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 embodies the renewal of the United States surface transportation programs to address the changing needs for America's future. There are eight titled programs that denote the Act's comprehensive coverage. These programs are:

I. Surface Transportation (related to highways);
II. Highway Safety;
III. Federal Transit Act Amendments of 1991;
IV. Motor Carrier Act of 1991;
V. Intermodal Transportation;
VI. Research;
VII. Air Transportation; and
VIII. Extension of Highway-Related Taxes and Highway Trust Funds.

Within the Surface Transportation title, generally administered by FHWA, funding exists for a number of different programs, one of which is the Congestion Mitigation and Air Quality (CMAQ) Improvement Program. CMAQ directs funds towards transportation projects in Clean Air Act Amendments (CAAA) non-attainment areas for ozone and carbon monoxide (1).

Houston meets the attainment requirements for all criteria air pollutants specified in the CAAA except for ozone. The Houston-Galveston severe ozone non-attainment area includes eight counties. The CAAA requires a 15 percent reduction in volatile organic compound (VOC) emissions, adjusted for growth, between 1990 and 1996, and full compliance with the ozone standard by 2007 (2).

The National Ambient Air Quality Standard requires that hourly ozone concentrations not exceed 0.12 parts per million (ppm) during more than one day per year over a three-year period. The number of days when the Houston area exceeded the ozone standard declined from seventy-one in 1988 to thirty-nine in 1993 (3). The fourth highest concentration recorded during the three-year 1987 to 1989 period was 0.22 ppm, which places Houston in the severe ozone non-attainment category by the CAAA (4).

Under the research title of ISTEA, the Intelligent Vehicle-Highway Systems Act (IVHS) provides for a Priority Corridors Program. The Priority Corridors Program provides funding for operational tests of new and emerging technologies under "real world" conditions. Between the CMAQ and Priority Corridors Programs, the funding provided for the five-year lease of the CCTV cameras and fiber optic communications equipment.

LEASING AGENDA

The process that the Houston District of TxDOT was to follow to secure the leasing of the Video System began when TxDOT management availed itself of CMAQ and Priority Corridors funding through contact with the United State Department of Transportation. The Houston District created the specifications and made application for approval and funding through TxDOT's Traffic Operations Division (TOD) in Austin. The Austin Division submitted the required documentation and secured the approval and funding for the five-year lease of video system around the Astrodome Stadium in Houston, Texas (Figures 1 and 2).

From the TxDOT TOD group, the approval process required submittal to the General Service Division (GSD), which conducts the contracting. GSD reviewed TxDOT specifications, conducted the advertising for bids, and hosted a pre-bidders conference. Several potential contractors and subcontractors attended the conference. Few questions asked concerned the communications medium (fiber optics). Many questions at the conference concerned component items issues, i.e., NTSC color camera, lens, camera housing, etc. These questions revealed that the camera lens specified was no longer available. Rather than take exceptions, GSD required specifications modifications and a new bid package developed.

The lens specification changed to reflect the present equipment availability. Potential vendors received a revised bid package. This process required six months. Appendix A presents the new specifications, as sent to the bidders. The specifications are functional in nature, but address specific items where TxDOT had determined that minimum standards should be enforced in order to receive a quality video system. Several utility companies [Houston Lighting and Power Company (HL&P), Southwestern Bell, American Telephone and Telegraph Company (AT&T), Teleport Communications Group Inc., and Phonoscope] that have fiber networks in the Houston area attended the pre-bidders conference. All companies received the second bid package information mailouts, but only one company, Phonoscope, filed a bid response. The other firms officially submitted "no bid." Phonoscope's bid was higher than the Engineer's estimate. Phonoscope submitted a written response justifying the bid overage. The Engineer's estimate was

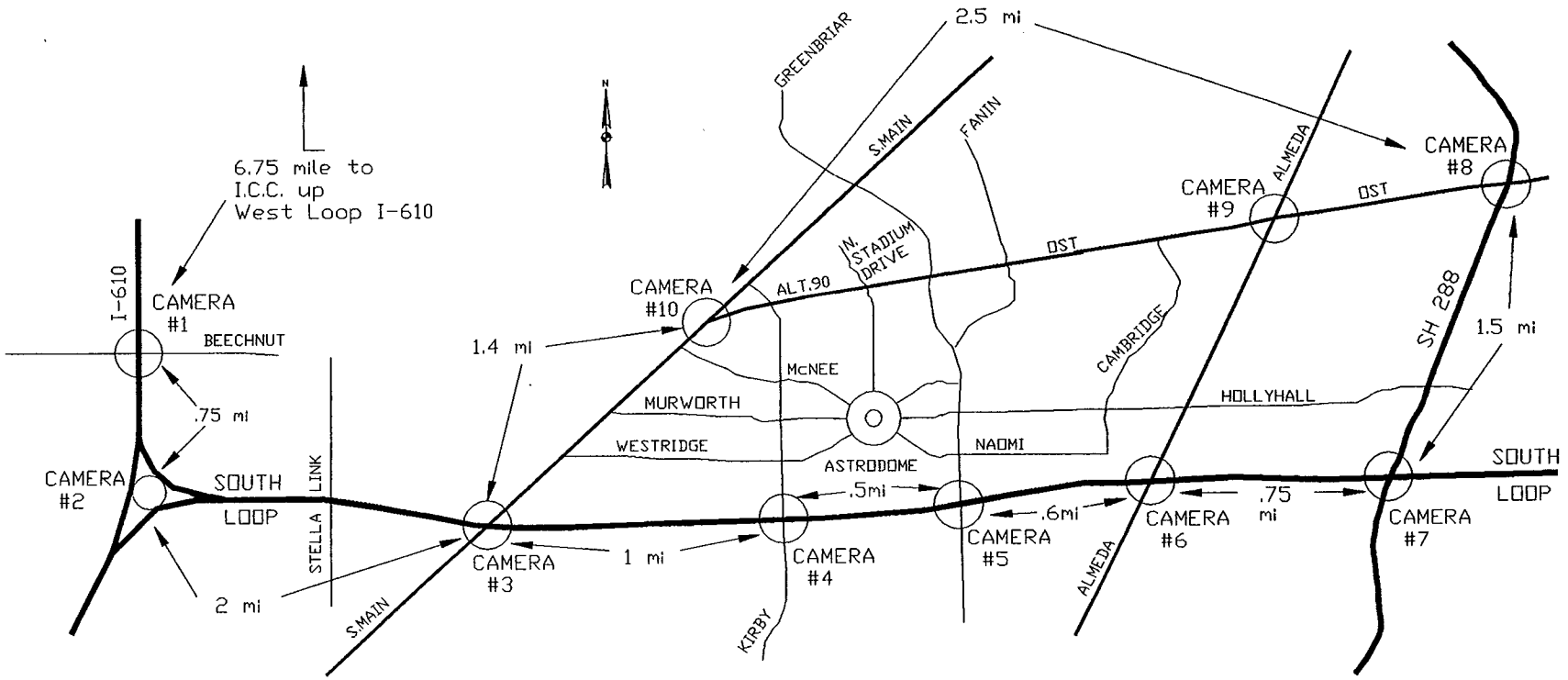

Figure 1. CCTV Camera Locations

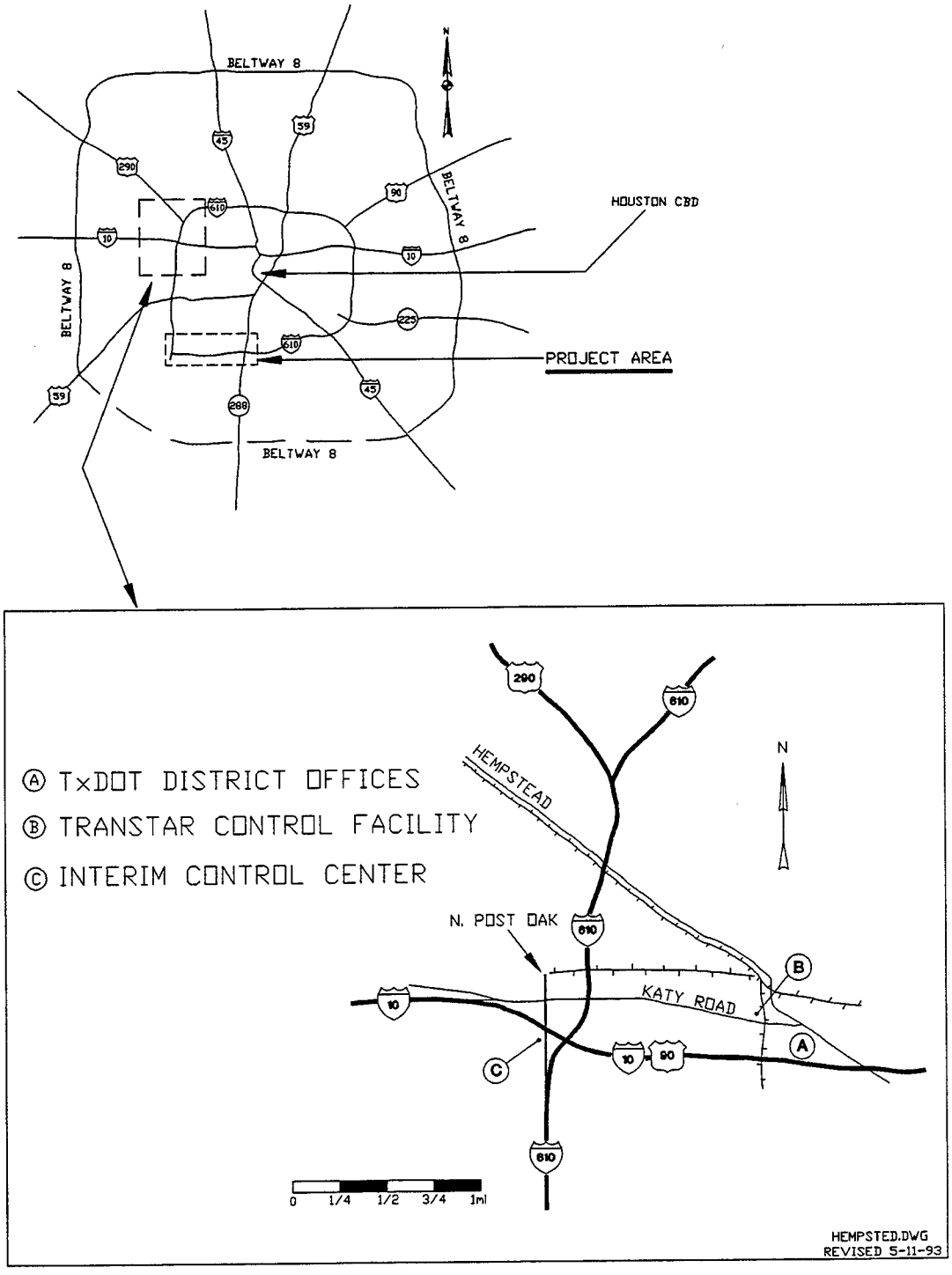

Figure 2. Project, ITMC, and TranStar Central Locations

created 18 months prior to the bid. Phonoscope applied inflation factors to operational and maintenance costs over the five-year period to reconcile the difference. Phonoscope was awarded the contract.

TxDOT's Houston District had four basic options in implementing the CCTV camera system on the major roadways around the Astrodome complex. The options in all cases include the fiber cable plant vendors participating in leasing fiber or fibers plus communication services.

Option 1: TxDOT could purchase all hardware (cameras, communications, monitors, etc.) for the field sites and the receiving site at the ITMC, along with TxDOT doing the installation and maintenance for all equipment, excluding the fiber plant.

Option 2: TxDOT could purchase the equipment and conduct the installation of the equipment, as in Option 1, but contract the maintenance to an outside contractor.

Option 3: TxDOT could purchase the equipment as in Options 1 and 2 but contract for the installation and maintenance to outside sources.

Option 4: TxDOT could contract (lease) the entire hardware system and contract (lease) the installation and maintenance to an outside source(s).

Option 1 is feasible but practically impossible because TxDOT does not have the technical personnel needed to install and maintain the video equipment. In addition, the time required for TxDOT to do this installation would exceed the required implementation time of several weeks. Therefore, for Options 1, 2, and 3, TxDOT would possibly have to execute two separate contracts to provide the installation and maintenance for the proposed system along with the leased fibers contract. Option 4 was the feasible choice with the fiber cable plan vendor becoming the installer, maintainer, and provider of the video equipment as well as the fibers for communications. Under this arrangement, TxDOT was able to conserve capital funds and spread the cost over a five-year period. This enabled TxDOT to arrange funding from CMAQ as well as from the Priority

Corridors Program. But the most important selection factor was that the fiber cable provider could install and interconnect all field facilities to the ITMC in the 75-day implementation period. This installation time could never have been realized within the normal TxDOT construction schedules.

The positioning of the fiber cable vendor as the installer, maintainer, and provider of the video system eliminates the interface questions normally associated where different systems must connect and operate correctly. Public information monitoring can now be provided by the private sector utilizing capital investments and proven technology. TxDOT will be able to learn first hand from the maintenance practices of a private utility company. TxDOT can formulate maintenance schedules and procedures based on the experiences over the five-year period. TxDOT can, before the contract expires, terminate the lease or shift the cameras to other priority corridor roadways. TxDOT will not have to maintain aging equipment nor deal with antiquated equipment at the contract closure.

CONSTRUCTION PROCEDURES

The specification included the following statement: *Part VII Installation Requirements, 2.1 Field Installation: The vendor shall submit a work plan to TxDOT within 10 days of contract award which delineates field site installation schedules. TxDOT shall require traffic control plans where frontage roads or city streets are blocked longer than 15 continuous minutes. Lane blockage of more than 30 continuous minutes shall require TxDOT approval.*

TxDOT expected Phonoscope to abide by these specifications. Different residency departments of TxDOT's Houston District reported that Phonoscope or it subcontractors blocked traffic lanes in the general vicinity of the associated areas where Phonoscope's fiber optic cables were being installed. In each case, TxDOT requested removal of the lane blocking equipment. In fact, work site violations were reported in sections of the city totally removed from any fiber installations dealing with the Astrodome CCTV monitoring. It is unknown whether these violations were reported because of the Astrodome construction contract or abnormal traffic control plan violations.

The fiber field construction and installation work execution was attacked with more zealous effort than normally experienced by TxDOT. The 75-day implementation time was actually met by the fiber optics installations, but not met by the overall work effort. Setting the 75-day construction time represented both good and bad features: good in that the system implementation would take a relatively (to the normal two-year surveillance, communications, and control construction) short-time period and bad in that the contractor had to take liberties with the present traffic control plan rules and regulations.

TxDOT has experienced a long history of utility companies not following rules set forth for lane closures. The utilities (HL&P, Entex, Southwestern Bell, etc., plus City and County) only provide minimal barricades, signing, etc., for protection of their workers and do not meet the standards of TxDOT.

Because of several factors (delay in letting contract, inherent capabilities for work through existing maintenance contract, etc.), TxDOT decided to have several of the planned construction items completed by TxDOT forces and a contractor on an existing maintenance contract. For instance, TxDOT provided an installed AC power pole and meter at the ROW line. TxDOT's work included connecting the meter pole to the camera pole (or sign structure). The camera pole base and pole were installed with a pole-mounted cabinet sized for the camera and fiber optics equipment including power surge components. The described TxDOT work was completed three or four months before the Phonoscope field work took effect. Once Phonoscope began installation of the roadside equipment cabinet, several items were found missing. The missing items were, in part, 1) AC power underground service incomplete; 2) power surge components missing; 3) power service breakers missing; and 4) various connectors/bolts/nuts, etc., missing. While some items were mostly minor, the missing or incomplete equipment and AC power at each site caused delays in the completion of the project. The 75-day installation period may have overemphasized the importance of the incomplete installations. The corrections to the missing AC power required the most (last-minute) effort on the part of TxDOT and the power company.

The fiber optic transceivers (transmitter at one end and receiver at the other) required the longest lead time (six weeks) of equipment ordered. The fiber optic equipment tested did not meet the signal strength budget, and thus, was sent back to the factory for adjustment. The adjustment, which corrected the low power, took three-plus weeks. While the transceivers were being corrected, the camera tests as required in the contract were conducted and all camera equipment passed the requirements test.

Upon completion of the AC power delivery problems that TxDOT and the power company corrected, the leased field equipment was ready for operation. The lease equipment required is shown in Figure 3. As shown in Figure 4, the separation of the monitor rack and the switcher controls exceeds 45 meters (15 feet) and a right angle to each other. This created a most awkward positioning situation for the person conducting camera control functioning. A person would have to look to the left while manipulating a joy stick and buttons for the camera selected on the right.

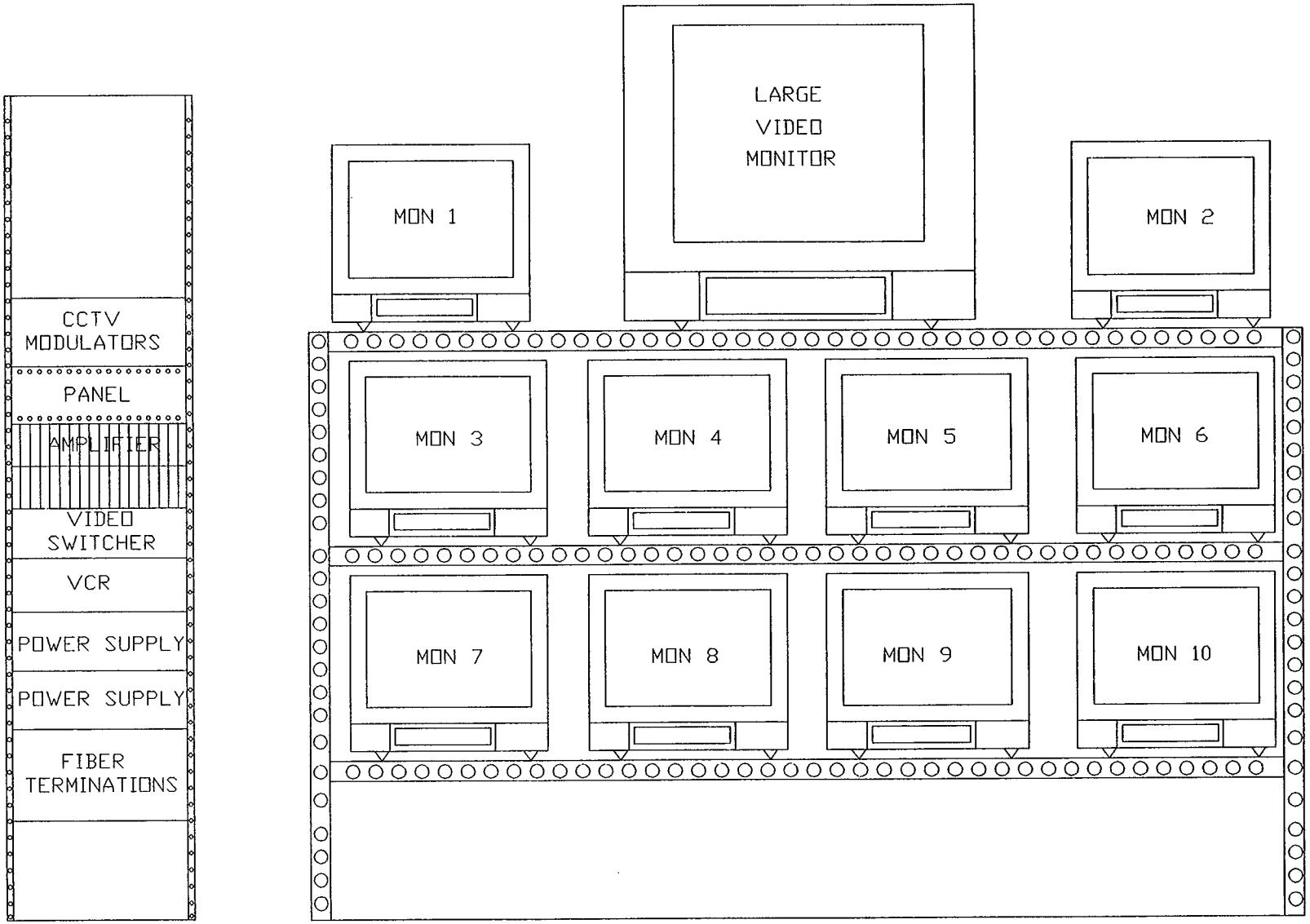

Figure 3. Leased Equipment Stationed in ITMC

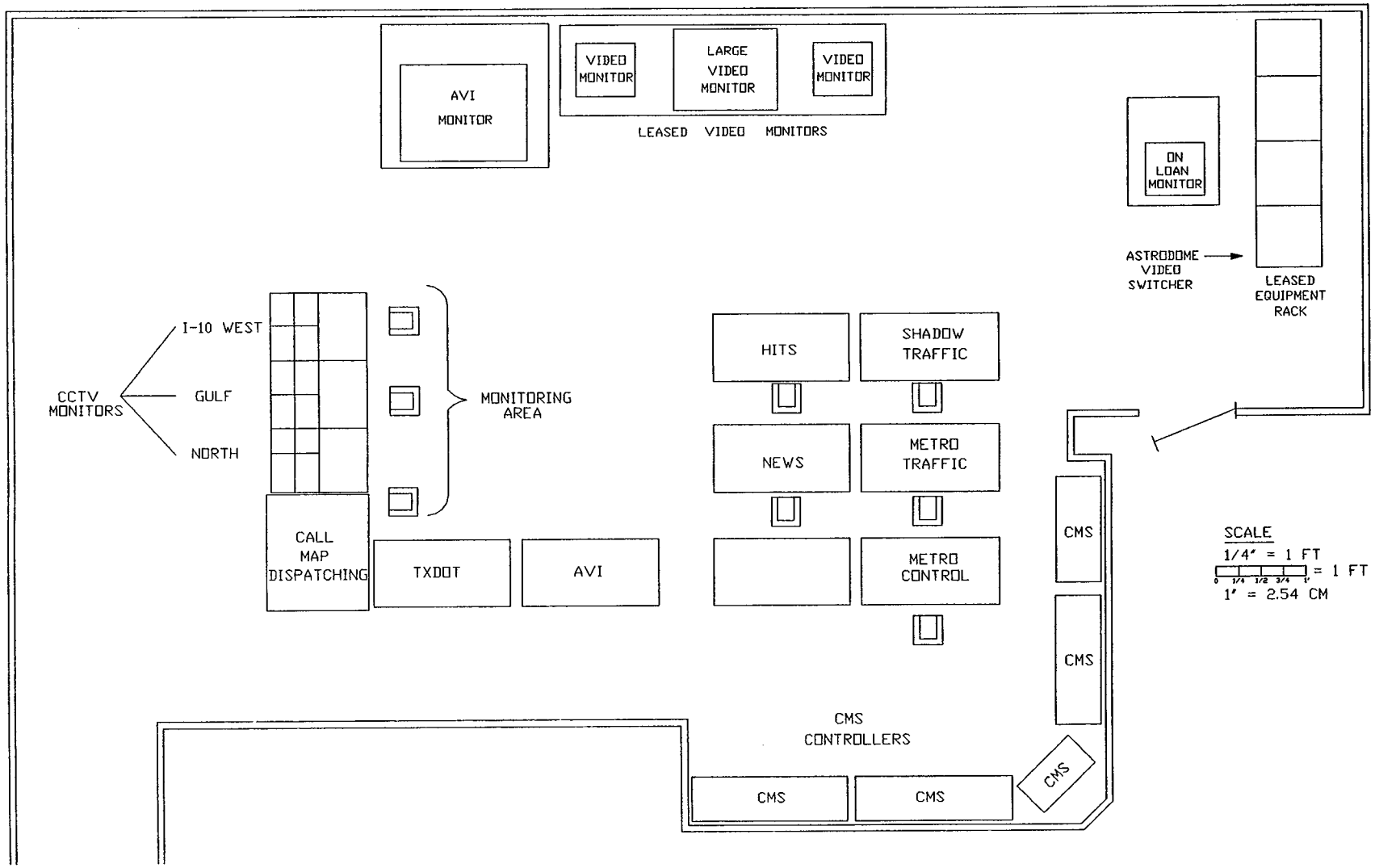

Figure 4. Leased Equipment Positioning in ITMC

This situation could have been solved by a remote control panel which could enable a person to sit directly in front of the monitors and observe the camera control functions. The ITMC location is temporary and thus the remote control panel's inclusion excluded. Instead, the subcontractor temporarily loaned a small monitor to the ITMC. This monitor connects to one of the six switcher outputs. Thus, the person can switch any camera into the rack side monitor and perform all camera control functions while observing the camera function results on the small monitor screen. Additionally, the video scenes in the assigned monitor in the monitor rack reflects changes as directed by the camera control functions. The entire functional diagram is shown in Figure 5.

After the acceptance testing, there were various cases of small item conditions requiring calibration, redefining, or replacement. In one case, the fiber in the cabinet at the base of the camera pole snapped. Phonoscope reconnected the fiber ends, and the video signal once again arrived at the ITMC.

The final functional diagrams for the field site and the ITMC installation are shown in Figure 5.

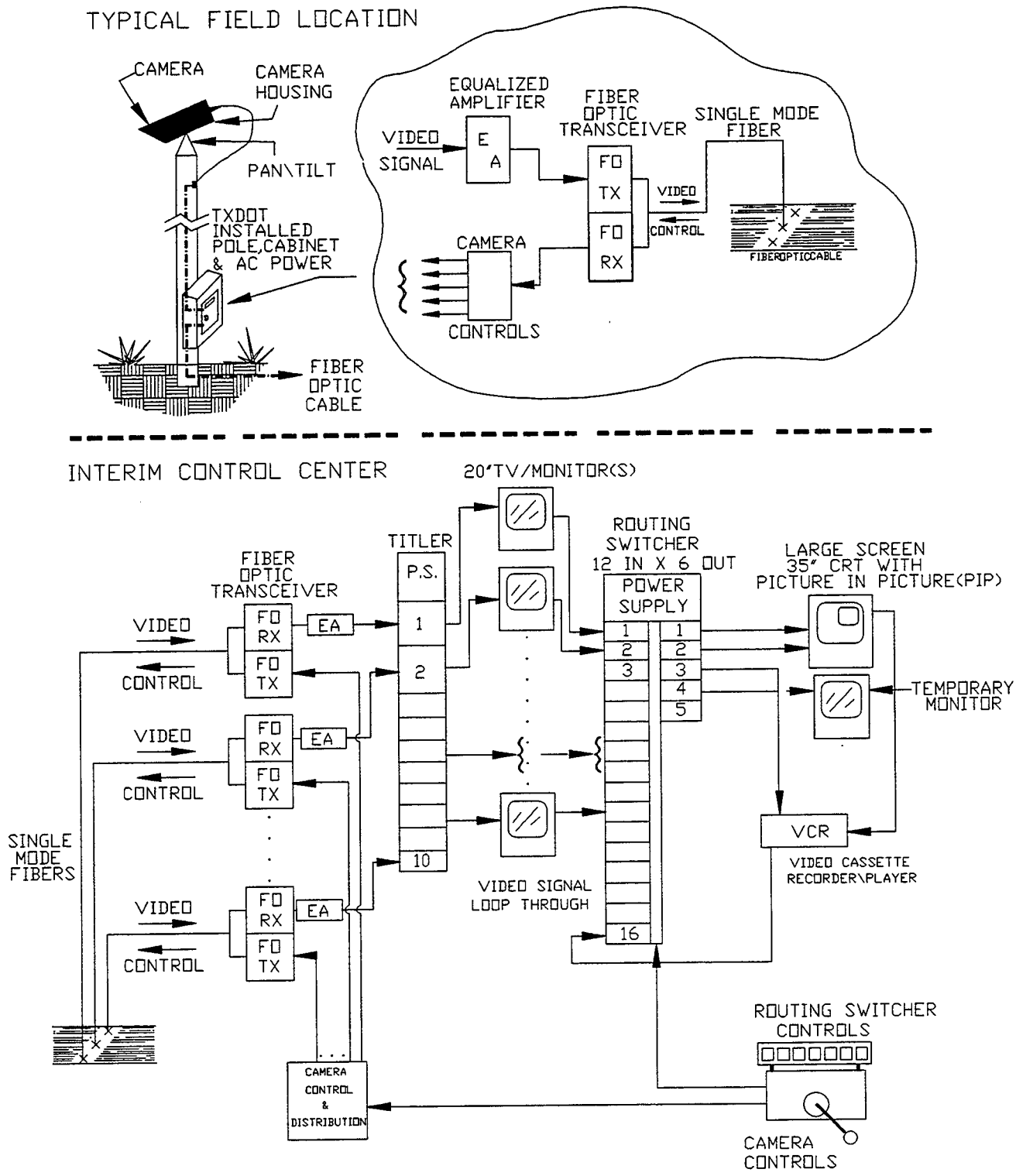

Figure 5. Video and Camera Controls Functional Systems Deployment

REQUIREMENT TESTING

At the conception of the project, there was always the question of quality of the fiber optic transmission capabilities. Also, there needed to be a way to test the video signal at the field site and the video signal after it had transversed the communications network, providing a measure of the communications system. Therefore, the testing requirements stated:

1.0 *END TO END SYSTEM TESTS*

1.1 *The vendor shall test the system prior to the acceptance of the system by TxDOT and at various times during the lease period to verify the performance of system. Two separate tests shall be conducted to measure the performance: a test at the field installation to measure the output of the video camera, and a test at the ITMC to measure the output of the video system. These tests are outlined in the following sections with recommendations for performance measures.*

1.2 *During the installation of the system, all 10 camera locations shall pass both tests prior to the acceptance of the total system by TxDOT.*

1.3 *During the lease period, TxDOT will request tests to be conducted a minimum of one time per year. If one or more camera positions do not pass the tests, the vendor shall have five working days to restore the system to acceptable levels.*

1.4 *If after five days, one or more camera positions do not pass the tests, the TxDOT will suspend lease payments for the total system until the total system meets the required levels of operation.*

2.0 *CAMERA TEST*

2.1 *Prior to installation the vendor shall perform all tests necessary to verify that the camera equipment meets the specification. After the system has been installed, but before the acceptance by TxDOT for initiating operations under the terms of the lease, the vendor shall conduct an end to*

end test for each camera. The vendor shall provide all of the equipment and materials necessary to conduct the test, which shall include coaxial cable approximately equal to the length of the camera pole and a 20-inch test monitor. The camera test shall be conducted with the monitor connected to the downstream side of the equalization amplifier located in the cabinet. EIA Standardized Resolution and Registration Test Charts shall be placed in front of the cameras in the prescribed manner at the field site, and the resultant video signals shall be measured and recorded at the field site on the test monitor.

2.2 *If the field results of each tested item are greater than or within minus 10 percent of the camera specifications, the camera shall be accepted. If the field results of each tested item fall below the minus 10 percent level, the vendor shall be required to adjust the camera and circuit components to achieve the allowable level or to replace the equipment.*

3.0 *SYSTEM TEST*

3.1 *After the Camera Test has been successfully completed, the vendor shall connect the camera to the fiber optic system and transmit the signals to the television monitor at the ITMC. No other ITMC video equipment–such as titlers, switchers, large screen monitors–shall be connected in the system unless directed by TxDOT. The results of the EIA Standardized Resolution and Registration Test Charts shall be recorded from the television monitor in the ITMC.*

3.2 *The allowable deviation from the results of each item measured in the field in the Camera Test is 5 percent. If the office results deviate from the field results by more than 5 percent, the vendor shall be required to make the necessary adjustments to the equipment or the system design to achieve the 5 percent level.*

The EIA Standardized Resolution and Registration charts (see Appendix B) provided camera tests criteria in controlled lighting conditions. The camera test required each camera's output connected to approximately 15 meters (50 feet) of coaxial cable simulating field conditions between camera output and transceiving input. A high quality monitor (800 lines of resolution) received the camera's video signal. Phonoscope and TxDOT representatives observed the images on the monitor of the individual charts placed in the required light intensity levels.

The resolution chart provided the means to determine the lines of resolution. The camera specifications were given at 450 horizontal lines, but only one of the cameras achieved this rating. For the most part, 420 to 425 lines could be most definitely seen with the human eye. Any image with more lines would have had the person guessing. The CCTV monitors provide 430 horizontal lines of resolution. If the camera passes more resolution than the monitor can take, the remaining lines will be disregarded. This means that the intended monitor will have the capacity to exhibit all video information from the 450 lines of resolution. Some lines of resolution will be lost.

The remaining patterns on the resolution and registration standards used parallel lines, circles, and squares. Any aberrations should be most apparent near the edges and corners of the scene. Several cameras had patterns in the edges and corners of the scene that were questionable, but these instances were not reproducible and, thus, deemed not to be relevant. In summary, the camera test, using the human eye for measuring signal pattern deviations, passed.

In addition to using the two chart patterns as evaluation tools, a cathode ray tube (CRT) wave form monitor provided an input port (channel A) for one camera's video signal per test. Channel B of the same wave form monitor contains the input video signal from a national television standard of codes (NTSC) generator. By switching between the camera signal and the standard signal, the sync, luminance, and color burst were evaluated and recorded. Table 1 provides the results of both visual and standard video wave form evaluations for each camera.

Table 1. TxDOT P151C37 Camera Test and Acceptance					
Date: 9/28/1994				Observer: Musa Misleh	
Camera S/N Lens S/N	10042 160982	Resolution Luminance	450 lines 100 IRE	Sync Color Burst	-42 IRE -20/+20 IRE
Camera S/N Lens S/N	13615 161040	Resolution Luminance	420 lines 100 IRE	Sync Color Burst	-42 IRE -20/+20 IRE
Camera S/N Lens S/N	13607 161011	Resolution Luminance	425 lines 98 IRE	Sync Color Burst	-42 IRE -20/+20 IRE
Camera S/N Lens S/N	13612 161360	Resolution Luminance	440 lines 100 IRE	Sync Color Burst	-42 IRE -20/+20 IRE
Camera S/N Lens S/N	13606 161063	Resolution Luminance	420 lines 102 IRE	Sync Color Burst	-42 IRE -20/+20 IRE
Camera S/N Lens S/N	13597 161390	Resolution Luminance	425 lines 100 IRE	Sync Color Burst	-42 IRE -20/+20 IRE
Camera S/N Lens S/N	13599 158102	Resolution Luminance	430 lines 100 IRE	Sync Color Burst	-42 IRE -20/+20 IRE
Camera S/N Lens S/N	13618 161010	Resolution Luminance	420 lines 100 IRE	Sync Color Burst	-42 IRE -20/+20 IRE
Camera S/N Lens S/N	13594 161398	Resolution Luminance	425 lines 100 IRE	Sync Color Burst	-42 IRE -20/+20 IRE
Camera S/N Lens S/N	13617 161014	Resolution Luminance	420 lines 100 IRE	Sync Color Burst	-42 IRE -20/+20 IRE

The above observations meet the criteria of the specification and are accepted by: Musa Misleh, TxDOT Representative; C.M. Painter, Operations Manager, Phonoscope.

The camera test was conducted on September 28, 1994. The overall system test was completed December 14, 1995. The intentions of the specifications were to use the Resolution and Registration charts at each camera site where Phonoscope's work van would house the test charts under controlled lightings. Proposals from Phonoscope and the subcontractor for the camera installations strongly suggested not to attempt this process. The use of a bucket truck to reach the camera was the major problem. If this procedure were executed in a yearly fashion, the costs for the bucket truck alone would be substantial. For instance, the weekly rate of $1,500 for the bucket truck or $325 per day would be applicable. Therefore, a much simpler and direct approach was taken.

At each camera site, the fiber optic transmitter accepted a test generator signal. A single mode "home run" fiber connects the transmitter at each camera site to the receiver at the ITMC.

The routing was not the most direct but, as a general rule, had to provide an eighteen (18) dB loss budget (which is the budget for the fiber optic transceivers). The high resolution monitor displayed the received generator signal. The results of NTSC generator tests are shown in Table 2. The technical aspects of each pattern are represented in Appendix B.

Table 2. TxDOT P1537C End to End Test and Final Acceptance (December 14, 1994)

	Fiber Optic Transmission and Camera Functions								
	NTSC Generator						Camera		
	Multi Burst IRE	Five Step IRE	Color Burst IRE	Sync Pulse IRE	Flat Field IRE	Color Bars IRE	Sync Pulse IRE	Color Burst IRE	Scene Avg IRE
Beechnut on IH 610 West Cam/SN 13594	70	+20, -40	±20	-40	+100	✓	38	+20, -18	ok 110 10
S. Post Oak/IH 610 Interchange Cam/SN 13599	70	+20, -39	±20	-40	+100	✓	38	+20, -18	ok 110 10
S. Main on IH 610 S Loop Cam/SN 13597	70	+20, -39	±20	-39	+100	✓	37	±20	ok 110 10
Kirby on IH 610 S Loop Cam/SN 13618	70	+20, -39	±21 ±20	-39	+100	✓	37	±20	ok 110 10
Fannin on IH 610 S Loop Cam/SN 13606	70	+20, -39	±20	-40	+100	✓	38	±19	ok 110 10
Almeda on IH 610 S Loop Cam/SN 13617	70	+20, -40	±20	-39	+100	✓	38	±19	ok 110 10
SH 288 within Interchange with IH 610 S Loop Cam/SN 13612	70	+20, -39	±20	-39	+100	✓	37	±19	ok 110 10
OST on SH 288 Cam/SN 10042	70	+20, -39	±20	-39	+100	✓	38	±19	ok 110 10
OST at Almeda Cam/SN 13615	70	+20, -39	±20	-40	+100	✓	37	±20	ok 110 10
OST at S Main Cam/SN 13607	70	+20, -39	±20	-39	+100	✓	37	±19	ok 110 10

The above observations indicate acceptable operation and meet the criteria of the specification: Musa Misleh, TxDOT Representative; C.M. Painter, Phonoscope Representative.

The fiber optic transceiving equipment at the field site provided video signaling transmission at 1310 nanometers (NM) to the ITMC and the other transceiving (receiver) device. The camera control functions were input to the ITMC transceiver device and transmitted at 1500 NM over the same single mode fiber used for the video. At the field site, the transceiver (receiver at 1500 NM) transformed optical to electrical coding for the camera control functions. Therefore, the acceptance tests for the camera control functions were to exercise each function and observe the reactions via the video image changes. Table 3 contains the test results of all camera function executions.

Table 3. TxDOT P15137C End to End Camera Controls Test and Final Acceptance

Location	Pan and Tilt Functions			Lens Functions			Comments	
	Pan	Tilt	Presets	Zoom	Focus	Presets		
Beechnut on IH 610 West	✓	✓	✓	✓	✓	✓	Iris Override	✓
S Post Oak IH 610 Interchange	✓	✓	✓	✓	✓	✓	Iris Override	✓
Kirby on IH 610 S Loop	✓	✓	✓	✓	✓	✓	Iris Override	✓
Fannin on IH 610 S Loop	✓	✓	✓	✓	✓	✓	Iris Override	✓
Almeda on IH 610 S Loop	✓	✓	✓	✓	✓	✓	Iris Override	✓
SH 288 Within Interchange with IH 610 S Loop	✓	✓	✓	✓	✓	✓	Iris Override	✓
OST on SH 288	✓	✓	✓	✓	✓	✓	Iris Override	✓
OST at Almeda	✓	✓	✓	✓	✓	✓	Iris Override	✓
OST at S Main	✓	✓	✓	✓	✓	✓	Iris Override	✓

The above observations indicate acceptable operation and meet the criteria of the specification: Musa Misleh, TxDOT Representative; C.M. Painter, Phonoscope Representative.

CONTRACTOR REVIEW

Phonoscope is a privately owned Texas Corporation utility and licensed with the Public Utilities Commission to do business in the State of Texas. The company has been active since 1957 and totally committed to fiber networks from 1989. At present, the company has over 1,329 kilometers (826 air miles) of fiber installed, with up to 8 kilometers (5 miles) of fiber installed each work day. At present, the two busiest segments of the fiber cable plant provide multichannel television feeds for apartment complexes and high-speed data communication networks in self-healing rings for the business community. Figure 6 depicts the areas within the Houston Metropolitan area where Phonoscope fiber is available.

Phonoscope, in its first video services lease to TxDOT, may not have approached the construction stage in the manner expected by TxDOT. TxDOT requires traffic control plans because of liability and traffic engineering applications issues. Furthermore, TxDOT fully expects traffic control plans to be filed and followed. TxDOT could have stopped construction work by Phonoscope if it had so desired but chose not to stop the work activities.

The non-filing of monthly operations and maintenance records are a general pattern of not having a Phonoscope official permanently assigned to the TxDOT account. The basic business conducted in the company may not have constant monitoring of each particular account. Soon after the construction and testing phases completion, the operations manager for Phonoscope resigned. Phonoscope did not provide an operations manual as required. Phonoscope provided a maintenance login call sheet. ITMC personnel log all maintenance calls. Up to the end of July 1995, Phonoscope had not provided any monthly summary reports of the system performance. Contract statements required Phonoscope to provide, as a minimum, a monthly maintenance report. Not only could TxDOT better understand what is happening to the system performance of the leased system with this report, TxDOT could be projecting performance criteria for its own fiber optic plant based on the Phonoscope plant.

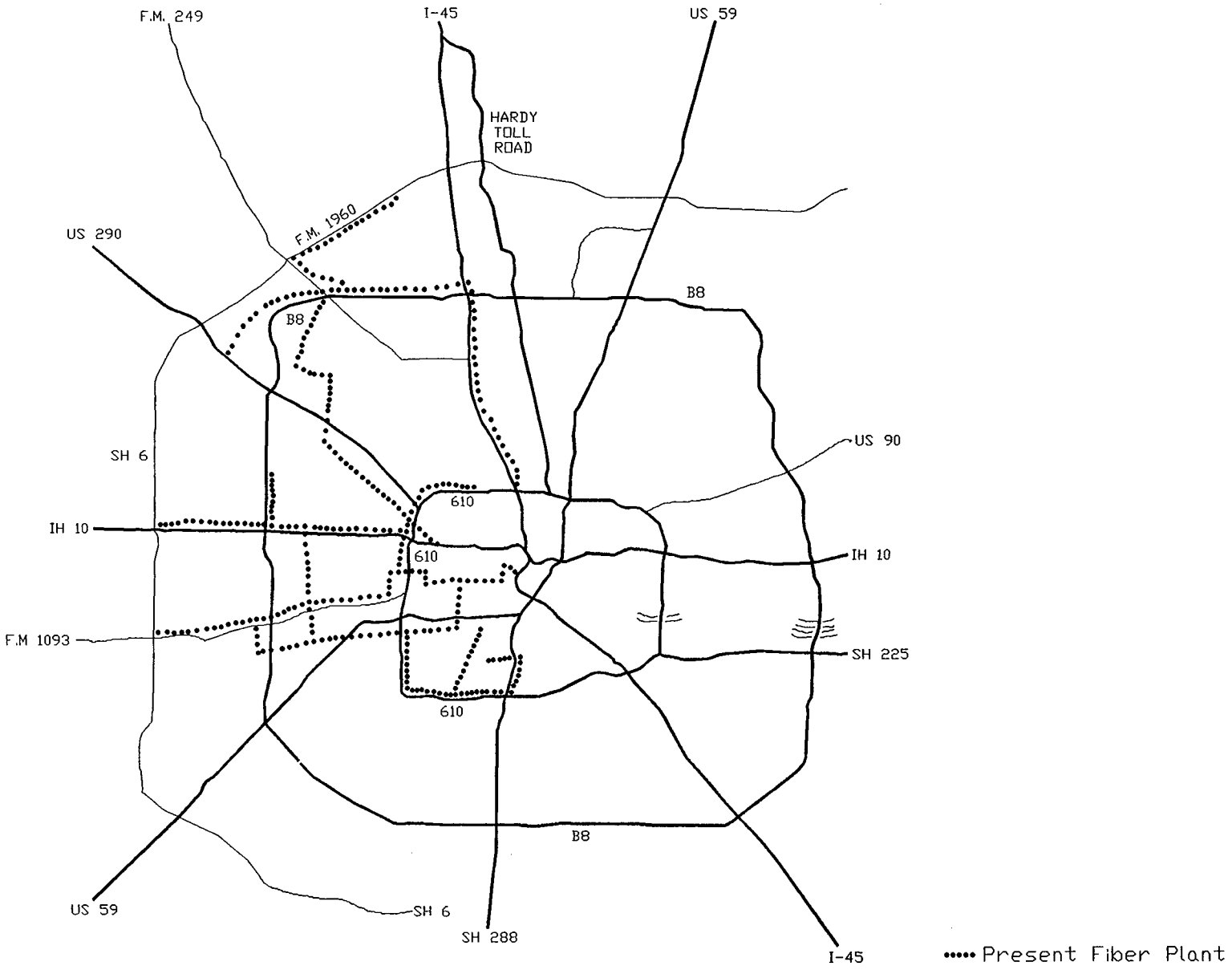

Figure 6. Phonoscope Fiber Network

The following operation conception appears to be in force. Phonoscope's loss of the Operations Manager created a problem area that prohibited anyone in Phonoscope (above the field technicians) from solving problems. Phonoscope management did not delegate the responsibility for problem solving to anyone else. Therefore, when a TxDOT question required a rapid and responsible answer, no one at Phonoscope was in or no one returned voice mail messages.

The beneficial aspects of this project that Phonoscope provided were: 1) the current state of the art in communication technologies (fiber, fiber optic transceivers, etc.); 2) lease of total video system, communications, and maintenance; and 3) total implementation (planning, advertising, bidding, selections, award, construction, acceptance) time of less than 200 calendar days.

TxDOT REVIEW

TxDOT administered this project from the conception without securing input from the operations staff that would operate the leased system. As such, several problem items were not addressed before implementation, i.e., camera stops misplacement, a camera location modified, ITMC remote controller required, etc. Once the equipment submittal was accepted and installed, modifications would have created an extra cost in which TxDOT chose not to participate.

TxDOT did insure that the vendor of the leased system produce responsive maintenance on a weekday service call. While not requiring 24 hours, seven days a week maintenance operations, the responsiveness of the weekday call indicated whether TxDOT's applications were of importance such that Phonoscope would actively respond. Not only was maintenance an issue, but the total area of how Phonoscope responded to operations of TxDOT's leased system was a larger issue. TxDOT needed to develop relationships with the private sector where problems were solved quickly to TxDOT's satisfaction. The problem for the private sector was how to win the job and then manage the TxDOT maintenance while still making a profit. Phonoscope needed to modify the standard approaches to fulfilling maintenance of the leased system, i.e., make TxDOT more aware of recurring problems that could be traced to an ITMC design or operation malfunction.

The TxDOT Operations group may have had higher expectations of how the overall video system was to function. Also the TxDOT Management may have just expected Operations to make the video system work regardless of the limitations delivered with the leased system. These limitations included, as a minimum: 1) camera controls are 25 feet away from "the other" control panels; 2) video monitors at right angles to "the other" video monitor banks; 3) city street scenes are different from freeway traffic scenes; 4) operations group are "tuned" to operating only freeway conditions because freeway operations are the primary responsibility for personnel; and 5) special events (i.e., Houston Livestock Show and Rodeo) requires funding and manpower resources outside the present operations group's work schedules. With the increased freeway coverage, as provided with the leased video system, Management expected that Operations would make do.

During the normal weekday activities, the leased video system was viewed by Operations staff more than all of the other freeway segments. This was because each field camera in the leased video system had a dedicated video monitor at the ITMC whereas in the other freeway segments, one monitor served multiple cameras. While the Operations staff may seem to have ignored the leased video system, the actual "video scans" (an observer scans the freeway scene looking for stopped motion) occurred more often than for the average camera scene for the other freeway segments. Also, the large bank of video monitors offered more visual targets than the smaller video monitors used in displaying the other freeway segments.

REVIEW COMMENTS AND PROPOSED MODIFICATIONS

The following statements suggest TxDOT Management, Design, Construction, and Operations groups insure that future leased video services provide the optimum value for the contracted services.

Future camera location selections for generating the visual information should film from a bucket truck to insure all responsible parties are provided review of the site selection through actual visual scenes. With the advantages offered by telephoto zoom lens, the possibilities of optimum camera placement over normal lens camera placement is often enhanced.

TxDOT's inspection of each camera pole installation insures that the standards in the specifications are met.

TxDOT's inspection of primary power drop to the camera pole cabinet insures that the conduit, connectors, and power service meters all meet or exceed specifications.

Each camera pole cabinet's inspection insures that the required components, i.e., cabinet itself, circuit breakers, brackets, connectors, panels, etc., meet or exceed specifications.

Any and every metal pole extension welded to the top of sign structure supports requires inspection insuring each and every specification adherence.

All the field work needed to erect a camera pole, whether ground or aerial installed, requires inspection on all phases to insure that it meets or exceeds TxDOT specifications.

All TxDOT parties require responsible specification reviews.

The video camera and communication system over fiber acceptance criteria requires total restructure and added strength of the specifications. The NTSC signal generator standards for the camera and communications tests adaption is definitely needed. Also, inclusion of other fiber optic signalization tests is warranted.

The specifications expansion should clarify those issues where TxDOT expectations/vendor responses differ. Detailing the expectation/response criteria to the required degree enhances interpretation similarities.

TxDOT, in future specifications, should delineate premature lease termination without excessive buyout costs. For a number of reasons (i.e., TxDOT surveillance, communications, and control completed along the same route, funding modifications or cancellations, leased services determined to not fulfill expectations, etc.), TxDOT may have to terminate the lease and, as such, should have a clear understanding with the lessor concerning the lease termination and cost. The language should have monetary equations dealing with the current age of equipment, replacement cost, used equipment values, initial labor costs, current return on money, inflation rate, loss of income, etc. The cancellation process negotiation must occur prior to contract signing establishing costs or procedures.

The catalog purchasing procedures have been in effect for two-plus years. Under the guidelines issued by the General Services Commission (GSC), any legitimate company doing business in Texas can prepare "a catalog" of pricing for basic equipment/services. GSC must approve all catalogs. Once accepted, TxDOT agencies can secure the basic equipment/services offered by this company. If and when the items in the catalog become outdated, incomplete, or need updating, an addendum can be made to the original document. While the catalog price is contractible, the actual pricing can become a negotiation of equipment/services and accommodation changes between the State and company.

The attempt by the State is to use the catalog to receive the "best value" and not necessarily the lowest bid. The District is responsible for verifying that the equipment/services serve the intended functions. Therefore, the catalog procedures would enable the leasing of equipment/services in which the TxDOT District could negotiate the very best value from several companies. In fact, TxDOT can purchase the design, specifications development, and even the acceptance testing expertise through the catalog. In this manner, TxDOT does not have to retain the expertise level technical personnel normally required. Even inspection criteria and inspection itself can become catalog items. TxDOT would have to maintain control of the project through quality management practices.

REFERENCES

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2. Munnich, L.W., DeCramer, G., Campbell, C., Rohde, B., Hatlum, D.V., and Douma, F., *IVHS and the Environment–New Models for Federal, State, and Local Cooperation in the Application of Advanced Transportation Systems for Environmental Improvements in Urban Areas–Final Report*, Humphrey Institute of Public Affairs, University of Minnesota, March 1995.
3. Duncan, Norman E., *Houston and the 1990 Revisions to the Clean Air Act*, Publication 93-09, University of Houston, Center for Public Policy, March 1993, p. 5.
4. Remarks by Richard Flannery, Texas Natural Resources Conservation Commission, at the IVHS and the Environment Consultation, Houston, Texas, November 5, 1993.

APPENDIX A.

SPECIFICATIONS FOR A

CLOSED CIRCUIT TELEVISION (CCTV) SYSTEM

TEXAS DEPARTMENT OF TRANSPORTATION

SPECIFICATIONS FOR A CLOSED CIRCUIT TELEVISION SYSTEM

on

IH 610 SOUTH LOOP FREEWAY AND ARTERIAL STREETS SERVING THE ASTRODOME AREA

for

MONITORING TRAFFIC OPERATIONS DURING PEAK PERIODS OF COMMUTER TRAFFIC AND SPECIAL EVENTS

HOUSTON, TEXAS

February, 1994

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INTRODUCTION

The Texas Department of Transportation (TxDOT) proposes to implement a Closed Circuit Television (CCTV) System for the purpose of monitoring traffic operations on the freeways and arterial streets serving the Astrodome area in Houston, Texas. The CCTV system shall utilize a fiber optic communication network provided by the vendor on a lease basis. The video signals shall be transmitted to the TxDOT Interim Control Center (ICC) and will be used by traffic management personnel from TxDOT, METRO, the City of Houston, and Harris County to alleviate traffic congestion caused by commuter travel and special events at the Astrodome.

BACKGROUND AND SIGNIFICANCE OF WORK

The TxDOT's Houston District has established an ICC located at 701 North Post Oak, Suite 439, Houston, Texas, for managing traffic systems and responding to traffic incidents. The ICC is manned by representatives of various transportation agencies involved with local traffic management and enforcement activities. The major element that makes the ICC beneficial and productive is real time traffic and roadway information. Information will be provided to the ICC through the monitoring of traffic sensors, automatic vehicle identification and location systems, and closed circuit television. The use of the private sector data and video transmission systems offers the opportunity to expand the monitoring process to many more streets and freeways in a shorter time period without impacting the design and implementation schedule of Houston's on-going Computerized Transportation Management System (CTMS) program.

OBJECTIVE OF PROJECT

The objective of this project is to develop a traffic monitoring system using CCTV technology employing leased private fiber optic transmission lines. The video signals shall be transmitted to the ICC for use by traffic management personnel.

TEXAS DEPARTMENT OF TRANSPORTATION
DIVISION OF EQUIPMENT AND PROCUREMENT

SPECIFICATION NO.
TxDOT 840-80-40120
REVISED: FEBRUARY 1994

CLOSED CIRCUIT TELEVISION SYSTEM

PART I
GENERAL CLAUSES AND CONDITIONS

1.0 The equipment furnished under this specification shall be the latest improved model in current production as offered to commercial trade, and shall be of quality workmanship and material. The bidder represents that all equipment offered under this specification shall be new. USED, SHOPWORN, DEMONSTRATOR, PROTOTYPE, OR DISCONTINUED MODELS ARE NOT ACCEPTABLE.

2.0 Bidder should submit with the bid the latest printed literature and detailed specifications on equipment the bidder proposes to furnish. This literature is for informational purposes only. Technical and standard published literature submitted will be used to determine compliance with all relevant specifications contained in the Invitation for Bid.

3.0 All parts not specifically mentioned which are necessary for the system to be complete and ready for operation or which are normally furnished as standard equipment shall be furnished by the lessor. All parts shall conform in strength, quality and workmanship to the accepted standards of the industry.

4.0 The system provided shall meet or exceed all Federal and State of Texas safety, health, lighting and noise regulations and standards in effect and applicable to equipment furnished at the time of manufacture.

5.0 It is the intent of this department to purchase goods, equipment and services having the least adverse environmental impact, within the constraints of statutory purchasing requirements, departmental need, availability, and sound economical considerations. Suggested changes and environmental enhancements for possible inclusion in future revisions of this specification are encouraged.

Part II
SPECIFICATIONS

1.0 SCOPE: The Texas Department of Transportation (TxDOT) publishes this specification for the installation, operation and maintenance of a Closed Circuit Television (CCTV) System for purpose of monitoring traffic operations on the freeways and arterial streets serving the Astrodome area in Houston, Texas. The CCTV system shall utilize a fiber optic communication network provided by the vendor on a lease basis. The video signal shall be transmitted to the TxDOT Interim Control Center (ICC) and will be used by traffic management personnel from TxDOT, METRO, the City of Houston, and Harris County to alleviate traffic congestion caused by commuter travel and special events at the Astrodome.

2.0 SYSTEM REQUIREMENTS:

2.1 The vendor shall install and provide service for a CCTV traffic monitoring system according to this specification.

2.2 TxDOT will lease the video service from the vendor at a set monthly rate for a period of 5 years (60 months). The monthly payments will begin after the System Tests, Part V have been successfully completed and the system has been accepted by TxDOT.

2.3 The vendor shall install CCTV cameras at the ten locations specified in Part III and shown in Figure 1. TxDOT will provide exact CCTV field equipment locations and install the camera poles, cabinets, foundations, and electrical power connections to the pole-mounted cabinets.

2.4 The vendor shall provide and install all CCTV central and field equipment according to this specification. A functional system block diagram is shown in Figure 2.

2.5 The vendor shall provide sufficient fibers in the communications plant to transmit the video signals from each of the ten field sites to the ICC for simultaneous presentation on ten separate video monitors. The end to end video signals shall meet the requirements in Part IV, Special Specification 3.

2.6 The vendor shall provide a large screen monitor with associated VCR and switch matrix for switching any signal into the larger monitor or into the VCR according to Part IV, Special Specification 4.

2.7 The vendor shall install the necessary fiber optic cable from the Post Oak right-of-way to the ICC. The conduit from the Post Oak right-of-way to the ICC is existing.

2.8 TxDOT will operate the CCTV system from the ICC and will pay for the power consumption for the CCTV equipment.

2.9 The vendor shall maintain all elements of the CCTV system that the vendor installs for the duration of the five-year lease period according to Part V.

2.10 The vendor shall relocate the CCTV Central Equipment from the ICC to the permanent Central Control Facility (CCF) located at 6922 Old Katy Road, Houston, Tx., sometime during the five-year lease period, as directed by TxDOT. See Figure 3.

2.10.1 The vendor shall supply all materials and manpower necessary to relocate the CCTV equipment to the CCF, including all fiber optic cable, transmissions equipment, camera control hardware, monitors, switchers, VCR, and all other equipment installed under this purchase order.

2.10.2 TxDOT will provide the conduit necessary to install the fiber optic cable only on the CCF property. All other easement access shall be the vendor's responsibility. TxDOT will provide sufficient space in the CCF for the vendor to install all of the relocated equipment.

2.10.3 The vendor shall have 45 calendar days from notice, from the engineer, to proceed, to have all fibers installed and terminated at the CCF. The vendor shall have two workdays to remove and reinstall all equipment in the CCF and place all ten camera signals in operation. The vendor shall continue to receive full payment of the lease during the two workdays of non-functional camera operation. If the CCTV system is non-functional for more than two workdays, the lease payments will be suspended until the vendor has the video system reconnected and fully operational. Whenever time is suspended, the vendor shall receive payment for only the operational days during the monthly pay period. The lease shall remain for the five-year period with suspension time added at the end.

3.0 COMPETENCY OF BIDDER

3.1 The bidder shall satisfy all of the following requirements in order to be eligible to be considered for award of this purchase order. The bidder or their subcontractors shall have:

3.1.1 Installed and operated at least two fiber-optic based communications networks.

3.1.2 Provided or is currently providing maintenance and operational support for at least two similar fiber optic systems.

3.1.3 Installed at least two centrally-operated closed circuit television surveillance systems equal to or greater than that defined within this project.

3.1.4 Provided or is currently providing maintenance and operational support for at least two similar CCTV systems.

3.2 The Bidder shall prepare and submit with the bid a statement that addresses all of the requirements stated above. Information on systems installation shall include specific systems, locations, and dates for beginning and completion of the project. Statements shall include the name, telephone number, and address of a representative of the organization that owns and operates the referenced system. Statements shall also include the name and project history of individuals on staff that will perform the work defined within this project.

3.3 Failure to submit, with the bid, all of the required information requested herein will be cause for rejection of the bid.

3.4 Negative responses will be grounds for rejection of the bid.

4.0 INSURANCE: Prior to the beginning of work, the vendor shall complete and submit to the TxDOT representative shown on the face of the purchase order, the TxDOT Form 20.102, within thirty (30) days subsequent to award of the order, showing evidence of general liability and workman's compensation insurance. Insurance shall remain in effect during the full term of this purchase order. The TxDOT will allow deductible policies, however the vendor is responsible for payment of the deductible amount.

PART III
SYSTEM DESIGN — CAMERA LOCATIONS

1.0 GENERAL REQUIREMENTS: The area to be monitored by the CCTV system is bounded by the IH 610 West Loop, IH 610 South Loop, South Main Street and Almeda (see Figure 1). The approximate locations have been defined by the intersection designations in Figure 1, and more exact locations are described in 2.0, below. The descriptions in 2.0 give further information on the fields of view expected from each camera. Final locations have been determined by TxDOT and all field equipment to be supplied by TxDOT has been installed.

2.0 CAMERA LOCATIONS:

2.1 Camera Site 1: Beechnut on IH 610 West Loop

2.1.1 The camera shall be mounted on the east side of IH 610, using a 55 foot pole placed near the freeway main lanes. The following fields of view are possible:

- West Loop main lanes to Bellaire.
- West Loop main lanes to South Post Oak Interchange.
- West Loop frontage road, east side.
- West Loop frontage road, west side, with possible blockage near the intersection by the freeway main lanes.
- Meyerland Parking area used by METRO for shuttle service.

2.2 Camera Site 2: South Post Oak/IH 610 Interchange

2.2.1 The camera shall be mounted on the east side of the Park and Ride Facility between the IH 610 eastbound lanes and the South Post Oak Connector. The camera shall be mounted on a 55 foot pole with the following fields of view:

- The Park and Ride Facility.
- South Loop main lanes to Stella Link.
- South Post Oak Connectors to South Loop.
- The South Loop frontage roads east of the interchange.
- South Post Oak to West Bellfort intersection.

2.3 Camera Site 3: South Main on IH 610 South Loop

2.3.1 The camera shall be mounted on the south side of IH 610 and east of South Main on top of a freeway sign support adjacent to the freeway main lanes. Fields of view are:

- South Loop main lanes to Stella Link.
- South Loop main lanes to Kirby.
- South Loop frontage road, south side to Buffalo Speedway/Kirby.
- South Loop frontage road, north side to Kirby with some restrictions near Main Street.
- South Main to Murworth.
- South Main to Willowbend.

2.4 Camera Site 4: Kirby on IH 610 South Loop

2.4.1 The camera shall be mounted on the south side of IH 610 and east of Kirby on top of a freeway sign support adjacent to the freeway main lanes. Fields of view are:

- South Loop main lanes to Buffalo Speedway.
- South Loop main lanes to Astroworld pedestrian bridge.
- South Loop frontage road, south side — Buffalo Speedway to Astroworld pedestrian bridge.
- South Loop frontage road, north side — Buffalo Speedway to Astroworld pedestrian bridge with some restriction near Kirby intersection.
- Kirby to McNee with restrictions near freeway.
- Kirby to West Bellfort.
- Dome parking area, southwest quadrant.

2.5 Camera Site 5: Fannin on IH 610 South Loop

2.5.1 The camera shall be mounted on the north side of IH 610 and west of Fannin on top of a freeway sign support adjacent to the freeway mainlanes. Fields of view are:

- South Loop main lanes to Almeda.
- South Loop main lanes to Astroworld pedestrian bridge.
- South Loop frontage road, south side — Astroworld pedestrian bridge to Fannin entrance ramp.
- South Loop frontage road, north side — Fannin exit ramp to Astroworld pedestrian bridge.
- Fannin to Holly Hall.
- Dome parking area, southeast quadrant.
- South entrance to Dome parking area.

2.6 Camera Site 6: Almeda on IH 610 South Loop

2.6.1 The camera shall be mounted on the north side of IH 610 and west of Almeda on top of a freeway sign support adjacent to the freeway main lanes. Fields of view are:

- South Loop main lanes to SH 288 interchange.
- South Loop main lanes to Fannin.
- South Loop frontage road, south side to Fannin.
- South Loop frontage road, north side to Fannin.
- Almeda to OST.
- Almeda to East Bellfort with restriction near freeway.

2.7 Camera Site 7: SH 288 within interchange with IH 610 South Loop

2.7.1 The camera shall be mounted on a 55 foot pole on the North side of IH 610 adjacent to the ramp from southbound SH 288 ramp to eastbound IH 610 with good line of sight northward up SH 288. Fields of view are:

- SH 288 to Holly Hall.
- Connector ramps on the north side of the SH 288 interchange.
- SH 288 south to Holmes Rd., with restrictions caused by the IH 610 connector ramps.

2.8 Camera Site 8: OST on SH 288

2.8.1 The camera shall be mounted on the northeast side of SH 288 at OST using a 55 foot pole placed near the freeway main lanes with good line of sight westward out OST. Fields of view are:

- SH 288 main lanes to Holly Hall.
- SH 288 main lanes to McGregor.
- OST to Almeda.
- OST to Tierwester.

2.9 Camera Site 9: OST at Almeda

2.9.1 The camera shall be mounted on the north side of OST and Almeda using a 55 foot pole position in the median. Fields of view are:

- OST to SH 288.
- OST to Fannin/Greenbriar.
- Almeda to Holly Hall.
- Almeda to Holcomb Boulevard.

2.10 Camera Site 10: OST at South Main

2.10.1 The camera shall be mounted on the north side of OST and east side of South Main on a 55 foot pole. Fields of view are:

- OST to Fannin.
- South Main to Murworth.
- South Main north to South Braeswood.
- Kirby to McNee.

PART IV
CCTV SPECIFICATIONS
(Refer to Figure 2 for Functional System Design)

SPECIAL SPECIFICATION 1
CAMERA POLE STRUCTURE

1.0 SCOPE: This specification shall govern the design, fabrication, delivery, and installation of existing camera pole structures. The design conforms to the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals with Interim Specifications thereto and with additional interpretations as applied by TxDOT. The poles will be provided by and installed by TxDOT. The specifications are provided herein for the vendor's information only with regard to the vendor's responsibility for installing the camera and field equipment on the pole and in the cabinet.

2.0 MATERIALS

2.1 General: This specification and instructions in the referenced plans and drawings constitute the only acceptable design for the assemblies. Fabrication and welding shall be in accordance with the item "Steel Structures" of the Standard Specifications and with Department Bulletin C-5. All welded joints shall develop the full required strength of the member. All materials furnished, assembled, fabricated or installed under this item shall be new, corrosion resistant and in strict accordance with the details shown on the plans and in the specifications.

2.2 Shop Prints: Prints of the shop drawings showing the fabrication and erection details for each support including the CCTV cabinet and mounting details will be provided for the vendor's review. Each sheet has a title in the lower right corner which includes the sheet index data shown in the lower right corner of the project plans, names of the fabricator and contractor, and sheet numbering.

3.0 ANCHOR BOLTS

3.1 Anchor bolts conform to the requirements in the Standard Drawings and comply with the requirements of ASTM A36 if 1 inch or less in diameter and if greater than 1 inch diameter with the requirements of ASTM A193-B7 or A687, or if designated A36M55 with the requirements of the Special Specification "Medium-Strength, Mild Steel Anchor Bolts." Dimensions are based on the foundation size required for the column lengths and local design wind speed.

3.2 The anchor bolts have the standard nut anchorage. Nuts comply with the requirements of ASTM A563 Grade A or better, heavy hex. Washers comply with the requirements of the item "Structural Bolting" of the Standard Specifications.

3.4 Two circular steel templates are provided for each assembly. The lower nut is tack welded to the lower template. The upper template stays in place until the concrete has achieved its initial set.

3.5 The upper 14 inches of all anchor bolts are galvanized or painted with 2 coats of a zinc-rich coating containing a minimum of 95 percent zinc and meeting Federal Specification DOD-P-21035A. Exposed nuts are galvanized or coated with the same zinc-rich paint. Washers are galvanized.

3.6 Threads for anchor bolts are rolled or cut threads of unified coarse thread series except for ASTM A193-B7 bolts which shall be 8 pitch thread series. If rolled, the diameter of the unthreaded portion is not less than the minimum pitch diameter nor more than the maximum major diameter of the threads. Threads have Class 2 fit tolerances. Galvanized nuts are tapped after galvanizing.

3.7 Threads of anchor bolts are coated with pipe joint compound prior to installation of upper nuts when erecting pole. After poles are plumbed and in permanent alignment, the exposed upper threads of painted bolts are cleaned and an additional coating of the zinc-rich paint is applied to seal the bolt thread-nut joint.

4.0 POLES

4.1 The shaft for the pole may be round or octagonal and is tapered. Circumferential welds, other than at the ends of the shafts, are not permitted. The exterior of longitudinal seam welds are ground or otherwise smoothed to the same appearance as other shaft surfaces. Longitudinal seam welds for pole sections have 60 percent minimum penetration or longitudinal seam welds have complete penetration when within 6 inches of circumferential base welds. A maximum of two longitudinal seam welds are made in pole sections. Low hydrogen electrodes, or the equivalent in wire and flux for automatic welding, are required for all welds. Preheat is required for welding pole to the base plate in accordance with Department Bulletin C-5.

4.2 Material for pole shafts conform to the requirements in the Standard Drawings and comply with the requirements of ASTM A570 Grade 50, or A572 Grade 50, or A670 grade 50, or A595 Grade A, or if designated A36M50 with the requirements of the Special Specification "High-Strength, Structural Steel for Sign, Signal, and Luminaire Support Structures". Material supplied under the A570 Grade 50 or A595 Grade A specifications meet their associated chemical and bend test requirements with the further stipulation that the materials meet a minimum yield of 50 ksi and a minimum elongation of 18 percent in 8 inches or 23 percent in 2 inches prior to brake or tube forming operations. A570 Grade 50 material in thicknesses up to 5/16 inch is acceptable providing it meets the above-stated chemical, bend test, yield, and elongation requirements. A595 Grade A material which can be shown by tests to have a minimum of 50 ksi yield adjacent to base welds after fabrication is acceptable.

4.3 Mill test reports and/or laboratory test certifications will be provided to show that the materials conform to these requirements.

4.4 A metal cap at the top of all poles is secured using galvanized or stainless steel set screws.

4.5 A 1/2 inch thick 10 inch diameter round steel plate is provided on the top of each pole for camera mounting.

5.0 FINISH

5.1 The camera pole is galvanized.

5.2 All sheared or cut edges and all other exposed edges to be painted or galvanized are rounded or chamfered to an approximate 1/16 inch.

5.3 Hot-Dip Galvanizing: Camera poles required to be hot-dip galvanized are designed so as to provide proper filling, venting, and draining during the cleaning and galvanizing operations. All parts, with the exception of the lower portion of the anchor bolts, nut anchorages, and the top and bottom templates, are hot-dip galvanized after fabrication in accordance with ASTM A123. All screws, nuts, bolts, washers, shims, and the upper portion of the anchor bolts if galvanized are in conformance with the specifications of ASTM A153, Class C or D, unless otherwise specified. All nuts are tapped after galvanizing.

6.0 CCTV CABINET: The cabinets shall house the CCTV field equipment described in Special Specification 2. The cabinet will be provided with fully wired back panels, with all the necessary terminal boards, wiring, harnesses, connectors, and attachment hardware for each cabinet location. All terminals and panel facilities are placed on the lower portion of the cabinet walls below all shelves. Each cabinet will be provided complete with all internal components, back, and side panels, terminal strips, harnesses, and connectors as well as all mounting hardware necessary to provide for installation of equipment as described in this specification. All cabinets are identical in size, shape, and quality throughout the entire project. In addition, the cabinets are equipped internally as specified herein. Each cabinet, as a minimum, is supplied with the following:

- Adjustable shelves, as required.
- Backpanel.
- Surge protection.
- Terminal strips.
- Interconnect harnesses with connectors.
- Jack for field telephone.
- "Door Open" connection to back panel.
- All necessary installation and mounting hardware.

6.1 Electrical Requirements

6.1.1 Backpanel: This panel includes the following components:

6.1.1.1 Circuit Breakers: The circuit breakers are approved and listed by Underwriters Laboratories. The operating mechanism is enclosed and the switches are marked to indicate whether it is in the closed or open position. Contacts are silver alloy enclosed in an arc quenching chamber. Each cabinet has a single pole, 20 amp circuit breaker. Circuit breaker is unaffected by ambient temperature range, relative humidity, applied power, shock, and vibration range specified in Section 2, "Environmental Standards and Test Procedures" of NEMA TS1-1989. Circuit breaker has an interrupt capacity of 5,000 amperes and insulation resistance of 100 megs at 500 VDC.

6.1.1.2 Power Line Surge Protection: Power line surge protectors are provided and installed as described below.

6.1.1.2.1 One surge protector is a three electrode gas tube type and has the following ratings:

- Impulse Breakdown: Less than 1,000 volts in less than 0.1 microseconds at 10 Kilovolts/microseconds.
- Standby Current: Less than one milliampere.
- Striking Voltage: Limit any voltage greater than 212 volts dc.
- Capable of withstanding 15 pulses of peak current, each of which will rise in 8 microseconds and fall in 20 microseconds to one half the peak voltage, at 3 minute intervals. Peak current rating shall be 20,000 amperes. The surge protector shall utilize both metal oxide varistors and silicon avalanche diodes to protect against transients having a single surge energy level up to 70 joules, voltage transients up to 6 kv, and current transients up to 6 ka. Protection shall be provided for line to neutral, line to ground and neutral to ground terminals.

6.1.1.2.2 The protectors have the following ratings:

- Recurrent peak voltage 212 volts.
- Energy rating minimum 120 joules.
- Power dissipation — average 0.85 watt.
- Peak current for pulses for less than 6 microseconds 20,000 amperes.
- Standby current less than 1 milliampere.

6.1.1.3 Power Cable Input Junction Terminals: Power distribution blocks suitable for use as a power feed and junction points for two and three wire circuits are provided. The line side of each circuit is capable of handling two size 1/0 AWG conductors. The AC neutral and equipment ground wiring is electrically isolated from the line wiring by an insulation resistance of at least 10 megohums when measured at the AC neutral. The AC neutral and equipment grounding wiring is color coded white and green respectively.

6.1.2 Wiring

6.1.2.1 All cabinet wiring is identified by the use of insulated pre-printed sleeving slipped over the wire before attachment of the lug or making the connection. The wire markers carry this legend in plain words with sufficient details so that a translating sheet is not required.

6.1.2.2 All wires are cut to the proper length before assembly. No wires are doubled back to take up slack. Harnesses to connectors are covered with "Chinese Finger" woven braid or braided. Cables are secured with nylon cable clamps.

6.1.2.3 Service loops are provided to facilitate removal and replacement of assemblies, panels and modules.

6.1.2.4 All wiring containing line voltage AC are routed and bundled separately and/or shielded from all low voltage, i.e., control circuits. All conductors and live terminals or parts, which could be hazardous to maintenance personnel, are covered with suitable insulating material.

6.1.2.5 All conductors used on the cabinet wiring are No. 22 AWG or larger with a minimum of 19 strands. Conductors conform to MIL SPEC MIL-W-168780, Type B or D. The insulation has a minimum thickness of 10 MILS. All wiring containing line voltage is a minimum size of No. 14 AWG.

6.1.3 Terminal Strips

6.1.3.1 Terminal strips located on the backpanel are accessible to the extent that it is not necessary to remove the electronic equipment from the cabinet to make an inspection or connection.

6.1.3.2 Terminal blocks are two position, multiple pole barrier type. Shorting bars are provided in each of the positions provided along with an integral marking strip. Terminal blocks are arranged so that they shall not upset the entrance, training and connection of incoming field conductors. All terminals are suitably identified by legends permanently affixed and attached to the terminal blocks. Not more than three conductors are brought to any one terminal screw. No electrically energized components or connectors extend beyond the protection afforded by the barriers. All terminal blocks are located below the shelves. Terminals used for field connections secure conductors by means of a No. 10-32 nickel or cadmium plated brass binder head screw. Terminals used for interwiring connections, but not for field connections, secure conductors by means of a No. 5-32 nickel plated brass binder head screw.

6.1.3.3 As a minimum, all connections to and from the electronic equipment terminate to an interwiring type block. These blocks act as intermediate connection points for all electronic equipment input/output.

6.1.4 Cabinet Internal Grounding: The cabinet internal ground consists of one or more ground bus-bars permanently affixed to the cabinet and connected to the grounding electrode. Bare stranded No. 6 AWG copper wire is used between bus-bars and between the bus-bar and grounding electrode. Each copper ground bus-bar has a minimum of 20 connector points, each capable of securing at least 1 number 10 AWG conductor. AC neutral and equipment ground wiring return to these bus-bars.

6.2 Mechanical Requirements

6.2.1 Size and Construction

6.1.2.1 The cabinets are clean-cut in design and appearance and have the following minimum dimensions:

- DEPTH 15 inches
- WIDTH 20 inches
- HEIGHT 36 inches

6.2.1.2 All cabinets are constructed of welded sheet aluminum with a minimum thickness of one-eighth inch. No wood, wood fiber product, or flammable products are allowed in the cabinet. The cabinet structure is effectively sealed to prevent the entry of rain, dust, and dirt.

6.2.1.3 All exterior seams for cabinet and doors are continuously welded. All edges are filed to a radius of 0.03125 inch minimum.

6.2.1.4 Cabinets conform to the requirements of ASTM designation B209 for 5052-H32 aluminum sheet.

6.2.1.5 Welding on aluminum cabinets is done by the gas metal arc (MIG) or gas tungsten arc (TIG) process using bare aluminum welding electrodes. Electrodes conform to the requirements of the American Welding Society (AWS) A5.10 for ER5356 aluminum alloy bare welding electrodes.

6.2.1.6 Procedures, welding machines and welding machine operators for welding on aluminum are qualified in accordance with the requirements of AWS B3.0, "Welding Procedures and Performance Qualification" and to the practices recommended in AWS C5.6.

6.1.2.7 The surfaces on each aluminum cabinet conform to the requirements of Military Specification MIL-A-8625C ("Anodic Coatings for Aluminum and Aluminum Alloys") for a Type II, Class I coating, except that the anodic coating has a minimum thickness of 0.0007 inch and a minimum coating weight of 27 milligrams per square inch. Prior to applying the anodic coating, the cabinets are cleaned and etched. The anodic coating is sealed in a 5 percent aqueous solution of nickel acetate (ph of 5.0 to 6.5) for 15 minutes at 208 to 212 degrees F (97.8 to 100 degrees C).

6.2.2 Ventilation: The cabinet is provided with vent openings to allow convection cooling of electronic components. The vent opening is located on the lower portion of the cabinet side and is covered fully on the inside with a commercially available disposable three layer graded type filter. There is no opening on the top portion of the cabinet roof.

6.2.3 Exterior Finish: The aluminum is carefully smoothed and the exterior left in its unpainted natural color.

6.2.4 Serial Number: The cabinet is provided with a five-digit serial number unique to the manufacturer and this five-digit serial number is preceded by an assigned two-letter manufacturer's code. The entire identification code and number is either stamped on a metal plate which is riveted to the cabinet, stamped directly on the cabinet, or engraved on a metalized mylar plate that is epoxied to the cabinet on the upper right hand cabinet side wall.

6.2.5 Shelves: Adjustable shelves are provided in each cabinet as required to support the equipment as specified in the plans. Shelf adjustment is at 2 inch intervals in the vertical position. The shelves are removable and capable of supporting the electronic equipment. There is a minimum of 1 inch between the read and front edge of the shelf and the back inside wall and door of the cabinet respectively to allow room for the equipment cables.

6.2.6 Mounting Hardware: All cabinets are furnished with the appropriate mounting plates, anchor bolts, and any other necessary hardware to mount the cabinet on the camera pole structure. Cabinet mounting plates are welded to the pole. Banding of cabinet or mounting plates is not permitted. The cabinet is designed for pole mounting and is reinforced at points of attachment to the pole.

6.2.7 Door

6.2.7.1 The cabinet door is sturdy and torsionally rigid. The door substantially covers the full area of the front of the cabinet and is attached by a minimum of two heavy duty hinges.

6.2.7.2 The hinges utilize stainless steel hinge pins. The hinge and door assembly are of sufficient strength to withstand a 50 pound per vertical foot of door height load supplied vertically to the outer edge of the door. There is no deformation or impairment of the door, locking mechanism or door seal when the load is removed.

6.2.7.3 Each cabinet door is provided with a No. 2 Corbin lock. Two keys for the tumbler lock are provided for each cabinet. The cabinet door is provided with a catch mechanism to hold the door open at 2 positions; 90 degrees, plus or minus 10 degrees, and 180 degrees plus or minus 10 degrees. Both the door and door stop mechanism are of sufficient strength to withstand a simulated wind load of 5 pounds per square foot of door area applied to both inside and outside surfaces without failure, permanent deformation, or compromising of door position. The cabinets do not have auxiliary police doors.

6.2.7.4 A gasket is provided to act as a permanent and weather resistant seal at the cabinet door facing. The gasket material is a non-absorbent material and maintains its resiliency after long term exposure to the outdoor environment. The gasket has a minimum thickness of three-eighths inch. The gasket is located in a channel provided for this purpose either on the cabinet or on the door. An "L" bracket is acceptable in lieu of this channel if the gasket is fitted snugly against the bracket to insure a uniformly dust and weather resistant seal around the entire door facing.

6.3 Surge Protection: Protector and Cabinet Configuration.

6.3.1 All ungrounded conductor wires entering or leaving the cabinet are provided with surge protectors. The conductor leads and the surge protector leads are kept as short as possible with all conductor bends formed to the maximum possible radius. The protector units are located as near as possible (6 inches) to the entry or exit point, and as far as possible from any electrical equipment. The protector ground lead is connected directly to the ground bus.

6.3.2 The surge protector utilized for AC power does not dissipate any energy and does not provide any series impedance during standby operation. The unit returns to its non-shunting mode after the passage of any surge and does not allow the shunting of AC power.

6.4 Environmental Design Requirements: The camera pole and CCTV cabinet meets all functional requirements during and after subjection to any combination of the following requirements:

6.4.1 Ambient temperature range of 0 to 122 degrees F (17.8 to 50 degrees C).

6.4.2 Temperature shock not to exceed 30 degrees F (1.1 degrees C) per hour, during which the relative humidity shall not exceed 95 percent.

6.4.3 Relative humidity range not to exceed 95 percent over the temperature range of 40 to 110 degrees F (4.4 to 43.3 degrees C).

6.4.4 Moisture condensation on all surfaces caused by temperature changes.

7.0 CONSTRUCTION METHODS

7.1 General: The equipment, design, and construction utilize the latest available techniques with a minimum number of different parts, subassemblies, circuits, cards, and modules to maximize standardization and commonality. The equipment is designed for ease of maintenance. All component parts are readily accessible for inspection and maintenance. The only tools and test instruments required for maintenance by maintenance personnel are simple hand held tools, basic meters and oscilloscopes.

7.2 Mechanical Components

7.2.1 All external screws, nuts, and locking washers are stainless steel. No self tapping screws are used unless specifically approved by the engineer.

7.2.2 All parts are made of corrosion resistant material, such as plastic, stainless steel, aluminum or brass.

7.2.3 All materials used in construction are resistant to fungus growth and moisture deterioration.

7.2.4 Dissimilar metals are separated by an inert dielectric material.

SPECIAL SPECIFICATION 2
CCTV FIELD EQUIPMENT

1.0 DESCRIPTION: This specification shall govern for the furnishing and installation of Closed Circuit Television (CCTV) field equipment in designated field locations and equipment cabinets as detailed in Special Specification 1.

2.0 MATERIALS

2.1 General Requirements: All materials furnished, assembled, fabricated or installed under this item shall be new, corrosion resistant and in strict accordance with the details shown in the specifications.

2.1.1 The CCTV Field Equipment to be furnished by the vendor shall include, but not be limited to the following:

- Video camera unit.
- Camera lens, filter, control circuit, and accessories.
- Camera housing (environmentally controlled).
- Heavy duty pan and tilt unit.
- Camera controller.
- Camera control panel for local controls.
- Video and camera control cable harness and connectors.
- Equipment for accommodating presets.
- All necessary coaxial, control, and power cables.

2.2 Functional Requirements: The CCTV Field Equipment together with the CCTV central equipment in the Interim Control Center (ICC) will form a complete CCTV system which shall meet the following requirements:

2.2.1 The CCTV Field Equipment shall have 525 lines per frame, interlaced 2:1, per EIA-170 Standard. The system limiting resolution shall conform to NTSC standards. The system shall provide clear, low-bloom and low-lag video pictures under all conditions from bright sunlight to night time scene illumination of 1.8 footcandle (fc.) (AGC on). Sensitivity measurement shall be referenced to the illumination at the camera faceplate at a color temperature of 3200 degrees K with camera AGC on if required. The camera shall produce at least 80 percent video at the specified scene illumination level. Color quality shall be maintained by a continuous through the lens automatic white balance for color temperatures from 3200 K to 5500 K.

2.2.2 All field equipment installed shall be operational in all weather conditions and shall withstand a wind load of 100 mph without permanent damage to mechanical and electrical equipment.

2.2.3 Equipment used shall be identical at each field location and shall be completely interchangeable.

2.3 Electrical and Mechanical Requirements

2.3.1 Video Camera Unit: All video cameras shall be of solid state design, and shall meet the following requirements:

2.3.1.1 Image pickup device: one-half inch solid state color CCD.

2.3.1.2 Pickup device blemishes: When viewing a uniform white field, there shall be no blemishes for any iris opening producing any signal level between 7.5 and 100 IRE.

2.3.1.3 Sensitivity: The camera shall maintain full p-p video with 2 fc., 3200 degrees K incandescent illumination on the image device face plate.

2.3.1.4 Resolution: 350 lines vertical and 430 lines horizontal, measures per EIA-170 Standard.

2.3.1.5 Over exposure protection: The camera shall not sustain any permanent damage when pointed directly at strong light sources, including the sun.

2.3.1.6 Peak-white clipping circuits: The camera shall have an adjustable peak white clipper circuit to limit the output of any highlights to a present level. The white clip level shall be set to limit the signal to 100 IRE.

2.3.1.7 Sync generator: The camera shall have an internal sync generator which shall conform to the EIA-170 Standards.

2.3.1.8 Video signal format: EIA-170 Standard, video output 1 Volt p-p composite.

2.3.1.9 Output impedance: 75 Ohms plus or minus 5 percent.

2.3.1.10 Aspect ratio: 4:3.

2.3.1.11 Geometric Distortion: Less than 2 percent.

2.3.1.12 Signal to noise ratio: 47 dB minimum (AGC off).

2.3.1.13 Images shall have a minimum of 510 (H) X 490 (V) pixels.

2.3.1.14 Automatic light compensation: The video output shall be maintained with at least 80 percent video light level from bright sunlight to nighttime scene illumination.

2.3.1.15 Lens mount shall be standard 16 mm "C" or "CS" mount.

2.3.2 Camera Accessories

2.3.2.1 The vendor shall provide with each camera an f/1.8 glass multi-coated zoom lens. The lens shall have focal length variable from 11 mm to 110 mm.

2.3.2.2 Motorized automatic iris control with manual override shall be provided with each lens.

2.3.2.3 The camera shall have a minimum effective aperture range of f/1.8 to f/22. The lens shall have a minimum Transmission Factor of T800.

2.3.2.4 The lens shall be equipped for remote control of zoom, focus, and iris operations. Mechanical or electrical means shall be provided to protect the motors from overrunning in extreme positions. Lens mount shall be the standard 16 mm C or CS mount and compatible with the camera. The lens shall be capable of both auto iris and remote manual iris operation.

2.3.2.5 Equalizing amplifiers shall be placed between each camera and the corresponding fiber optic transmitter. The amplifier shall be located in the CCTV field cabinet. Each amplifier shall be adjusted at the time of installation to compensate for DC and high frequency coax losses between the camera and the fiber optic transmitter. Each amplifier shall have static discharge protection and ground loop isolation devices connected to both its input and output. Each amplifier shall have a separate output brought out to a female BNC jack for monitoring purposes. Loading of the monitoring output shall not affect the signal level at the other output.

2.3.3 Camera Housing

2.3.3.1 The vendor shall furnish and install a water proof, dustproof, and lockable enclosure for each camera.

2.3.3.2 Except for the viewing window, the enclosure shall be constructed of anodized aluminum of a least 0.063 inch thickness.

2.3.3.3 The housing shall be equipped with a heater and a window defroster. The turn-on point of the thermostat shall be 40 degrees F (4.5 degrees C). The heater shall provide 35 watts minimum heating power.

2.3.3.4 A circulation blower and thermostat shall be furnished and installed in each housing. The turn-on point of the thermostat shall be 90 degrees F (32.2 degrees C). Air shall be drawn into the housing through a filter which shall be externally replaceable. The fan shall operate at 120 VAC, 60 Hz, and consume no more than 19 watts power.

2.3.3.5 The viewing window shall be constructed in such a way that unrestricted camera views can be obtained at all camera and lens positions.

2.3.3.6 A sun visor shall be provided in the front of the housing.

2.3.3.7 Cables and harness shall enter at the rear and/or the bottom of the housing, with gaskets at entry points to prevent moisture entry.

2.3.3.8 A sun shield shall be provided to shield the entire housing from direct sunlight. It shall be constructed to allow the free passage of air between the housing and the shield, but shall not form a "sail" to place an excessive load on the pan/tilt unit in high winds.

2.3.4 Pan-Tilt Unit

2.3.4.1 The vendor shall furnish and install a heavy duty, anodized aluminum weather-proof pan-and-tilt unit at each camera site on top of the camera pole. The vendor shall provide any mounting adapter and/or attachment required to install the pan-and-tilt unit. The mounting for the camera housing and the pan-and-tilt unit shall withstand 100 mph wind loading.

2.3.4.2 The unit shall provide vertical movement of plus or minus 90 degrees and horizontal movement of 350 degrees. Tilt speed shall be in the range of 3 to 4 degrees per second and the pan speed shall be 5 to 6 degrees per second. The unit shall be capable of simultaneous pan and tilt movements.

2.3.4.3 The unit shall have a load rating compatible with that of the camera housing, camera and all cabling under wind conditions of 100 mph and acceleration/deceleration conditions specified. The vendor shall provide analyses of the loading on the pan-and-tilt assembly based on the above criteria.

2.3.4.4 Drive motors shall be capable of instantaneous reversing and shall have overload protection.

2.3.4.5 Braking shall be provided in both pan and tilt movements to enable fast stop and reversal and to prevent drifting.

2.3.4.6 Limit switches or stops shall be provided to limit the range of vertical and horizontal movements, which shall be adjustable individually. The camera shall be mounted in such a way that the camera line of sight is at the center line of the desired field of view when the camera is at the mid-point of its mechanical motion. The field of view of each camera and the limit settings of its vertical and horizontal movements will be provided by TxDOT prior to installation.

2.3.4.6 The pan-and-tilt unit shall have seals and gaskets to protect the motors, gears, and cables. Seals and gaskets shall be resistant to ozone, ultraviolet radiation, and other pollutants inherent to all local environmental conditions.

2.3.5 Camera Controller: The vendor shall furnish and install in the pole cabinet at each camera site a camera controller to locally control the camera, pan/tilt and lens functions. As an alternate, the vendor may provide a portable camera controller to be approved by TxDOT. The controller shall decode the digital signals from the camera control fiber optic transceiver and transform the appropriate drive signals for each camera, pan/tilt and lens mechanisms. The camera controller shall meet the following specific requirements:

2.3.5.1 Camera remote control functions: The unit shall provide, as a minimum, control and drive circuits for the following functions.

- Pan Left
- Pan Right
- Tilt Up
- Tilt Down
- Zoom In
- Zoom Out
- Focus Near
- Focus Far
- Iris Override
- Iris Open
- Iris Close
- Pan/Tilt Position Reset
- Camera Power (Latching)
- One Auxiliary Output

2.3.5.2 Controller Address: Each unit shall have a unique address which is changeable by any one of the three following methods: changing connector harnesses, switch settings or plug-in modules. The unit shall respond to the central command if and only if it is addressed.

2.3.5.3 Power Supplies: All power supplies required to operate the camera, pan/tilt, and lens movements shall be included with the controller.

2.3.5.4 Control Panel: A control panel with pan/tilt and lens functions described above shall be provided to control the camera, pan/tilt unit, and lens motions locally. The control panel shall be mounted inside the cabinet where the controller is housed.

2.3.5.5 Communications Interface: Camera control signals, data exchange protocol, and timing shall be compatible at each camera site with the master controller in the ICC. Each camera control data shall include a camera identifier. The camera controller connectors and harness shall be provided to connect to the camera control's fiber optic transceiver. Complete hardware interface and protocol description shall be supplied by the vendor to TxDOT as part of the required documentation (paragraph 2.5).

2.3.5.6 Power Input: 115 plus or minus 20 VAC, 60 plus or minus 3 Hz, 80 watts maximum.

2.3.5.7 Packaging: The controller shall be packaged in an enclosure with size not exceeding the dimension of the pole cabinet and fabricated of anodized aluminum of at least one-sixteenth inch thickness.

2.3.5.8 Connectors: All connectors and wiring shall be provided and installed by the vendor. Connectors shall be used for connections at the control unit and at the camera, lens, and pan/tilt mechanisms. All connector pins and mating connectors shall be gold plated.

2.3.6 Surge Protection: The camera installation shall meet the following requirements:

- Pole mounting adapter — electrically bonded to pole.
- Pan/tilt mechanism — electrically bonded to adapter.
- Camera ground strap — No. 6 AWG braided conductor to connect enclosure to pole mounting adapter.

2.3.6.1 Surge Protector Cabinet: A weatherproof, ventilated equipment type cabinet will have been installed by TxDOT with a lockable door at the bottom of the pole to house protective devices. If space is available, the vendor may install protective devices inside the camera enclosure and pan/tilt unit instead of the top cabinet with the approval of TxDOT. Each conductor (including return conductors) shall be protected by the appropriate surge protector described in 2.3.6.2, below.

2.3.6.2 Power and Control Cable Surge Protectors: Surge protectors as specified in the Special Specification 1 "CCTV Cabinets" shall be installed in each CCTV field equipment cabinet described in 2.3.6.1 for each power conductor and each control conductor.

2.3.7 Power Requirements

2.3.7.1 The CCTV field equipment shall meet all of its specified requirements when the input power is 115 VAC plus or minus 20 VAC, 60 Hz plus or minus 3 Hz. The maximum power required, including the heater and the blower, shall not exceed 400 watts.

2.3.7.2 The equipment operations shall not be affected by transient voltages, surges, and sags normally experienced on commercial power lines. The vendor shall check the local power service to determine if any special design is needed for the equipment and the vendor shall provide the items needed in the special design.

2.3.8 Primary Input Power Interruption: The CCTV field equipment shall meet all the requirements in Section 2.1.4 "Power Interruption" of the National Electrical Manufacturers Association (NEMA) Standard TS1-1989 for Traffic Control System, latest revision.

2.3.9 Power Service Transients: The CCTV field equipment shall meet the requirements of Sec. 2.1.6, "Transients, Power Service" of the NEMA Standard TS1-1989, latest revision.

2.3.10 Wiring

2.3.10.1 All wiring shall meet the requirements of the National Electric Code. All wires shall be cut to proper length before assembly. No wire shall be doubled-back to take up slack. Wires shall be neatly laced into cable with nylon lacing or plastic straps. Cables shall be secured with clamps. Service loops shall be provided at all connections.

2.3.10.2 Coaxial cable between the camera and the surge protector at the base of the camera pole shall be of the RG-59 type with a stranded center conductor. Coaxial cable from the surge protector to the fiber optic transmitter shall be of the RG-11 type with 100 percent shield coverage. All coaxial cable shall have a cellular polyethylene dielectric. All coaxial cable and connectors shall be furnished and installed by the vendor.

2.3.11 Transient Suppression: All DC relays, solenoids, and holding coils shall have diodes across the coals for transient suppression.

2.3.12 Power Service Protection: The equipment shall contain readily accessible, manually resettable or replaceable circuit protection devices (such as circuit breakers or fuses) for equipment and power source protection. Circuit breakers or fuses shall be provided and sized such that no wire, component, connector, PC board or assembly shall be subjected to sustained current in excess of their respective design limits upon the failure of any single circuit element or wiring.

2.3.13 Fail Safe Provision: The equipment shall be designed such that the failures of the equipment shall not cause the failure of any other unit of equipment.

2.3.14 Modular Design: The CCTV field equipment shall be modular in design such that major portions may be readily replaced in the field. Modules and assemblies shall be clearly identified with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance.

2.3.15 Connectors and Harness: All external connections shall be made by means of connectors. The connectors shall be keyed to preclude improper hookups. All wires to and from the connectors shall be color coded and/or appropriately marked. All pins and mating connectors shall be gold plated. Connectors utilizing solder type connections shall have each soldered connection covered by a piece of heat shrink tubing securely shrunk to insure that it protects the connection.

2.4 Environmental Design Requirements: The equipment shall meet all its specified requirements during and after subjection to any combination of the following conditions.

2.4.1 Ambient temperature range of 0 to 122 degrees F (17.8 to 50 degrees C).

2.4.2 Temperature shock not to exceed 30 degrees F (1.1 degrees C) per hour, during which the relative humidity shall not exceed 95 percent.

2.4.3 Relative humidity range not to exceed 95 percent over the temperature range of 40 to 110 degrees F (4.4 to 43.3 degrees C).

2.4.4 Moisture condensation on all surfaces caused by temperature changes.

2.5 Documentation Requirements: Two complete sets of operation and maintenance manuals shall be provided. The manuals shall, as a minimum, include the following:

2.5.1 Complete and accurate schematic diagrams.

2.5.2 Complete installation procedures.

2.5.3 Complete performance specifications (functional, electrical, mechanical, and environmental) on the unit.

2.5.4 Complete parts list including names of vendors for parts not identified by universal part numbers such as JEDEC, RETMA, or EIA.

SPECIAL SPECIFICATION 3
VIDEO AND CAMERA CONTROL FIBER OPTIC TRANSMISSION EQUIPMENT

1.0 DESCRIPTION: This specification shall govern the furnishing and installation of the Video and Camera Control Fiber Optic Transmission Equipment in designated equipment cabinets in the field and in the Interim Control Center (ICC) as directed by the TxDOT.

2.0 MATERIAL

2.1 General Requirements: All materials furnished, assembled, fabricated or installed under this item shall be new, corrosion resistant and in strict accordance with the details in the specifications.

2.2 Functional Requirements

2.2.1 Video Fiber Optic Transceivers

2.2.1.1 The video fiber optic transmitter-receiver system shall provide a video link to transmit the video signal from the individual camera locations to the ICC.

2.2.1.2 The video fiber optic transmitter shall generate optical signals modulated by the video signal from the video camera output in the form of pulse frequency modulation.

2.2.1.3 The video fiber optic receiver shall detect the optical signal and shall convert it to video signal.

2.2.1.4 The operating optical wavelength shall be in the 1300 nanometer (nm) range.

2.2.2 Camera Control

2.2.2.1 The camera control fiber optic transmitter and receiver system shall provide an optical link to transmit camera control signals from the ICC to each camera location over the same fiber that carries the video signal.

2.2.2.2 The camera control signals shall generate optical signals modulated by the camera control functions in the form of frequency modulation.

2.2.2.3 The camera control fiber optic receiver shall detect the optical signal and convert it to camera control signals.

2.2.2.4 The operating optical wavelength shall be in the 1550 nm range.

2.2.2.5 All the camera control and video fiber optic transmitters and receivers shall be from the same manufacturer.

2.3 Electrical/Optical Requirements

2.3.1 Transmitter Inputs

2.3.1.1 Transmitter video input shall be 75 Ohms nominal, 1.4 Volt peak-to-peak maximum between sync tip to 100 percent white level.

2.3.1.2 Transmitter camera control input shall be 120 Ohms nominal, .5 volt to 3.0 volt peak-to-peak.

2.3.2 Transmitting Device

2.3.2.1 The video transmitting device shall be a light-emitting diode (LED) which shall have a mean time between failures (MTBF) of 100,000 hours at 122 degrees F (50 degrees C).

2.3.2.2 The camera control transmitting device shall be a LED which shall have a MTBF of 100,000 hours at 122 degrees F (50 degrees C).

2.3.3 Transmitter Outputs

2.3.3.1 The video transmitter and receiver optical output power to (8-10)/125 microns single mode glass fiber at a wavelength in the 1300 nm range shall be sufficient to accommodate a link loss budget of 15 dB or more.

2.3.3.2 The camera control transmitter and receiver optical output power to 8.3/125 microns single mode glass fiber at a wavelength in the 1500 nm range shall be sufficient to accommodate a link loss budget of 12 dB or more.

2.3.3.3 Once design is tested and approved, the optical coupled power value and tolerance will become incorporated as part of this specification for the purpose of acceptance tests.

2.3.4 Optical Detector

2.3.4.1 The video optical detector of the receiver shall be a PIN type.
2.3.4.2 The camera control optical detector of the receiver shall be a PIN type.

2.3.5 Receiver Optical Input

2.3.5.1 The video receiver input shall have a minimum sensitivity of 15 dB below the transmitter output level and operate within the parameters of this specification.

2.3.5.2 The camera control receiver input shall have a minimum sensitivity of 12 dB below the transmitter output level and operate within the parameters of this specification.

2.3.5.3 Once design is tested and approved, the receiver sensitivity value and tolerance shall be incorporated as a part of this specification for the purpose of acceptance tests.

2.3.6 Receiver Automatic Gain Control

2.3.6.1 The video receiver shall have automatic gain control (AGC) circuitry to provide the receiver with the required dynamic range from transmitter-repeater, or repeater-transmitter spacing of 1 to 15 dB.

2.3.6.2 The camera control receiver shall have AGC circuitry to provide the receiver with the required dynamic range from transmitter to receiver spacing of 1 to 11 dB.

2.3.6.3 The above dynamic range requirements may be accomplished with external optical attenuators with the approval of TxDOT.

2.3.7 Receiver Output

2.3.7.1 The video receiver output shall be 75 Ohms nominal, 1.4 volt maximum peak-to-peak between sync tip and 100 percent white level.

2.3.7.2 The camera control receiver output shall be 120 Ohms nominal, 2 volt peak-to-peak.

2.3.8 Modulation

2.3.8.1 The video modulation shall be pulse frequency modulation.

2.3.8.2 The camera control modulation shall be pulse frequency modulation.

2.3.9 Signal to Noise Ratio

2.3.9.1 The video system signal to noise ratio (SNR), measured as peak-to-peak white to blanking, to rms noise (ppwb/rms) in a .5 to 4.5 MHz bandwidth, shall be better than 50 dB.

2.3.9.2 The camera control system shall have an error rate of 10 to the (-9) power or less.

2.3.10 Linearity: The video system linearity shall be better than 1 percent.

2.3.11 Tilt: The video system tilt shall be less than 2 percent.

2.3.12 Differential Phase: The video system differential phase shall be less than 1.0 degrees at 10 percent to 90 percent average picture level (APL).

2.3.13 Differential Gain: The video system differential gain shall be less than 2 percent at 10 percent to 90 percent average picture level (APL).

2.3.14 Frequency Response

2.3.14.1 The video system frequency response shall be plus or minus 0.1 dB, 10 Hz to 0.5 MHz; plus or minus 0.2 dB, 0.5 MHz to 4.2 Mhz.

2.3.15 Optical Fiber Compatibility: Optical fiber compatibility shall be (8-10)/125 micron single mode glass fiber.

2.3.16 Power Requirements

2.3.16.1 Transceivers shall operate from 115 VAC plus or minus 20 VAC and shall not draw more than 5 watts of power each.

2.3.16.2 The equipment operation shall not be affected by transient voltages, surges, and sags normally experienced on commercial power lines. The vendor shall check the local power service to determine if any special design is needed for the equipment. The extra cost, if required, shall be included in the bid of this item.

2.3.17 Surge Protection: Surge protectors as specified in Special Specification 1 shall be installed in the equipment cabinet for the coaxial cable connection to the video camera.

2.3.18 Power Service Transients: The equipment shall meet the requirements of Sec. 2.1.6, "Transients, Power Service" of the NEMA Standard TS-1-1989, latest revision.

2.3.19 Wiring: All wiring shall meet the requirements of the National Electric Code. All wires shall be cut to proper length. Cable slacks shall be provided to facilitate removal and replacement of assemblies, panels, and modules. No wire shall be doubled back to take up slack. Wires shall be neatly laced into cable with nylon lacing or plastic straps. Cables shall be secured with clamps.

2.3.20 Transient Suppression: All DC relays, solenoids, and holding coils shall have diodes across the coils for transient suppression.

2.3.21 Power Service Protection: The equipment shall contain readily accessible, manually resettable or replaceable circuit protection devices (such as circuit breakers or fuses) for equipment and power source protection.

2.3.22 Fail Safe Provision: The equipment shall be designed such that the failure of the equipment shall not cause the failure of any other unit of equipment.

2.4 Mechanical Requirements

2.4.1 Modular Design

2.4.1.1 The equipment shall be modular in design such that major portions may be readily replaced in the field.

2.4.1.2 Modules of unlike functions shall be mechanically keyed to prevent insertion into the wrong socket or connector.

2.4.1.3 All modules and assemblies shall be clearly identified with name, model number, serial number, and any other pertinent information required to facilitate equipment maintenance.

2.4.2 Connectors and Harness

2.4.2.1 All external connections shall be made by means of connectors. The connectors shall be keyed to preclude improper hookups. All wires to and from the connectors shall be color coded and/or appropriately marked.

2.4.2.2 The video system input and output connectors shall be BNC type.

2.4.2.3 The camera control system input and output connectors shall be 6-pin screw terminals.

2.4.2.4 Optical input and output connectors shall be SMA or ST type with stainless steel housing and ceramic ferrule.

2.4.2.5 Connecting harness of appropriate length and terminated with matching connectors shall be provided for interconnection with the video cameras, video switcher, and the fiber optic network.

2.5 Environmental Design Requirements: The equipment shall meet all its specified requirements during and after subjection to any combination of the following requirements.

2.5.1 Ambient temperature range of 0 to 120 degrees F (17.8 to 60 degrees C).

2.5.2 Relative humidity from 0 to 95 percent.

SPECIAL SPECIFICATION 4
CCTV CENTRAL EQUIPMENT

1.0 DESCRIPTION: This specification shall govern for the furnishing and installation of Closed Circuit Television (CCTV) Central Equipment in the Interim Control Center (ICC).

2.0 MATERIALS: All materials furnished, assembled, fabricated or installed under this item shall be new, corrosion resistant and in strict accordance with the details shown on the plans and in the specifications.

3.0 FUNCTIONAL REQUIREMENTS

3.1 The vendor shall furnish and install CCTV central equipment in the ICC to control the video cameras in the field and the video signals in the ICC.

3.1.1 The CCTV central equipment shall include, but not be limited to, the following equipment:

- ten each 20 inch video monitors (color)
- one large screen 35 inch video monitor (color)
- control panel
- camera controller
- video switcher
- video character generator/titler
- fiber optic video and camera control transceivers
- power supplies, connectors, harness, and accessories
- video cassette recorder (VCR) and twelve (12) new blank tapes

3.1.2 The video and camera control fiber optic transceiver shall decode the incoming video optical signal into an electronic signal for distribution to ICC video functions (Figure 2).

3.1.3 The camera functions to be controlled by the central camera controller shall be as described in Special Specification 2, "CCTV Field Equipment."

3.1.4 The camera controller shall encode the camera control commands from the control panel switches to digital form, for transmission to the camera controllers in the field via the video and camera control fiber optic transceivers.

3.1.5 The video switcher shall provide the capability of selecting any one of the video signals for display on a single large screen monitor, for recording on a video cassette recorder (VCR) or transmitting to the open vacant ports.

3.1.6 The camera controller and the video switcher may be one integral unit housed in the same case.

3.2 Control Panel

3.2.1 The control panel shall have switches for all cameras, pan/tilt, and lens functions described in Special Specification 2, "CCTV Field Equipment." A numeric keypad shall be provided for camera selections. A two-digit numeric display shall be provided to indicate the camera selection. Switches shall also be provided to program and select a preset position for each of the cameras. All switches shall be momentary type except the pan/tilt switches which may be in the form of a joystick. A lock type on/off switch shall be provided to control the power to the controller. Four sets of keys shall be provided with the unit. All switch legends shall be clearly marked on the panel.

3.2.2 The control panel shall also have switches and/or a keypad to control the video switcher to select up to 16 video input signals as output to any of the existing ports. A two-digit numeric display shall be provided to indicate the video signal selection.

3.2.3 The control panel may be one integral unit with self-contained power supplies or shall draw its power from either the camera controller or the video switcher.

3.3 Camera Controller

3.3.1 The camera controller shall provide the electronics to encode the switch actuation, to translate to digital commands and to append address bits for the particular camera being controlled. The controller shall retain the preset positions of all cameras when power is removed. The preset positions shall be changeable by operating the control panel switches. The controller shall also provide switch scanning, switch debouncing and interlock functions so that conflicting commands such as simultaneous pan-left and pan-right will not be transmitted to the camera in the field. Response time of the switches (the time between the actuation of a switch and the occurrence of the resulting actions) shall not exceed 0.5 seconds.

3.3.2 The controller shall control every camera in the field one camera at a time.

3.3.3 The camera controller shall be a microprocessor-based design and shall generate digital codes compatible with the field controllers.

3.3.4 The controller shall provide an RS-232D port capable of implementing any control panel function from a future external computer or through a remote communications link. This interface port may be the same as the interface port on the video switcher. All interface and protocol information shall be provided to TxDOT by the vendor with the required system documentation.

3.4 Video Switcher: The video switcher shall have a minimum of twelve (12) inputs and six (6) outputs and shall be compatible with the control panel(s) described in para. 3.1 above. Video switcher outputs will go to the large screen monitor and the CCTV VCR recorder. The video switcher shall be provided with an RS-232D port to enable future control by an external computer or communications link. This interface port may be the same as the interface port on the camera controller. All interface and protocol information shall be provided to TxDOT by the vendor with the required system documentation.

3.4.1 Each output shall be capable of being switched to any single input without affecting the state of any other output. The switcher shall only change states during the vertical interval. The video switcher shall also meet the following electrical requirements:

- Input impedance: High impedance looping, terminated by an external BNC 75 Ohm, 1 percent terminator.
- Output impedance: 75 Ohms, nominal.
- Frequency response: DC to 10 MHz, plus or minus 0.5 dB.
- Gain: unity.
- Crosstalk: less than 40 dB down.

3.4.2 Character Generator/Titler: The character generator/titler may have the capability of integrating all functions within an integral unit. The character generator/titler shall have the following minimum characteristics:

- Display all upper case letters, numbers, and punctuation characters with a minimum of 2 character sizes between 7 and 56 scan lines with the smallest legible font size to be determined by TxDOT.
- All characters shall be white with a level between 70 percent and 100 percent with gray matte black border edges on all characters.
- The character generator/titler shall automatically "pass through" video in case of equipment or power failure.
- The character generator/titler shall have the capability of inserting self generated time and date information at any position on the screen.

3.5 Video Monitors

3.5.1 Station Monitors: Ten 20-inch (measured diagonally) color video monitors shall be provided in the ICC, one for each field camera provided. Each monitor shall feature a loop through capability. The monitors shall be of solid state design, with the exception of the picture tube, and shall meet the following requirements:

- Video input: EIA 170 standard, black negative polarity, composite signal, BNC connector, termination selectable between high impedance loop through or 75 Ohms.
- Resolution: 350 lines vertical, 450 lines horizontal, measured per EIA-170 standard.
- Geometric distortion: two percent maximum.
- Gray scale: Capable of displaying 10 discernible shades of gray.
- Scanning: 2:1 interlaced, 525 lines/frame, 30 frames per second per EIA-170 standard, scanning rate 60 Hz vertical, and 15,750 Hz horizontal.
- Control Functions: Front panel controls: Power on/off, contrast, brightness, horizontal hold (if used), vertical hold (if used), color (chroma), and hue (tint or phase).
- Integral means shall be provided for degaussing, either automatically at power-up, or manually by means of an external pushbutton.

3.5.2 System Monitor: One large screen 35-inch (measured diagonally) color video monitor shall be provided in the ICC. The monitor shall be connected to the switcher output side to receive inputs from any of the twelve (12) switcher inputs. The large screen video monitor shall meet the following requirements:

- The screen shall have, as a minimum, a 35 inch (measured diagonally) full square tinted picture tube.
- The monitor shall have Picture-in-a-Picture (PIP) electronics that may be engaged or disengaged.
- Horizontal resolution: minimum of 750 lines.
- Two video inputs with BNC connectors.
- The vendor shall provide a remote wireless control unit to include as a minimum the control of the PIP operation, the on/off operation, and an automatic link that interconnects to the video cassette recorder.

3.6 CCTV Video Cassette Recorder (VCR): The vendor shall furnish a single front loading VHS recorder for recording and playing real time color video, and 12 new, unused VHS tapes. The ICC operator or supervisor shall be able to exercise full control over this recorder from his or her operating position, including record, play, stop, rewind, fast-forward, input video source selection and output video to the video routing switcher. The VCR unit shall meet the following requirements:

- VHS format with recording and playback speeds SP, LP, EP.
- Video signal to noise ratio better than 44 dB.
- Equipped with a remote wireless control unit.

3.7 Wiring and Connectors

3.7.1 Coaxial cable used for making video connections between devices in the ICC shall be of the RG-59 type with a nominal impedance of 73 to 75 Ohms. All cable shall have a polyethylene dielectric with copper braid shield having a minimum of 95 percent shield coverage and not greater than 3.4 dB attenuation per 100 feet at 100 MHz.

3.7.2 Video connectors shall be the BNC die crimp type. Coax braid shall be neatly trimmed before crimping the connector to insure no possibility of contact between braid and inner connector. There shall be no nicks in the center conductor. Crimps shall be mechanically secure and made in such a way that no braid is left exposed or protrudes from the connector. The center pin shall be gold plated and shall be installed with the tip of the center pin flush with the front edge of the connector.

3.7.3 All wiring shall meet the requirements of the National Electric Code. All wires shall be cut to proper length before assembly. No wires shall be doubled back to take up slack. Wires shall be neatly laced into cable with nylon lacing or plastic straps. Cables shall be secured with clamps. Cable slack shall be provided to facilitate removal and replacement of assemblies, panels, and modules.

4.0 POWER REQUIREMENTS

4.1 The CCTV central equipment shall meet all of its specified requirements when the input power is 115 plus or minus 20 VAC, 60 plus or minus 3 Hz. The maximum power required shall not exceed 600 Watts.

4.2 The equipment operations shall not be affected by transient voltages, surges, and sags normally experienced on commercial power lines. It is the vendor's responsibility to check the local power service to determine if any special design is needed for the equipment. The extra cost, if required, shall be included in the bid price of this item.

PART V
TESTING

1.0 END TO END SYSTEM TESTS

1.1 The vendor shall test the system prior to the acceptance of the system by TxDOT and at various times during the lease period to verify the performance of the system. Two separate tests shall be conducted to measure the performance: a test at the field installation to measure the output of the video camera, and a test at the ICC to measure the output of the video system. These tests are outlined in the following sections with recommendations for performance measures.

1.2 During the installation of the system, all ten camera locations shall pass both tests prior to the acceptance of the total system by TxDOT.

1.3 During the lease period, TxDOT will request tests to be conducted a minimum of one time per year. If one or more camera positions do not pass the tests, the vendor shall have five working days to restore the system to acceptable levels.

1.4 If after five days, one or more camera positions do not pass the tests, the TxDOT will suspend lease payments for the total system until the total system meets the required levels of operation.

2.0 CAMERA TEST

2.1 Prior to installation the vendor shall perform all tests necessary to verify that the camera equipment meets the specification. After the system has been installed, but before the acceptance by TxDOT for initiating operations under the terms of the lease, the vendor shall conduct an end to end test for each camera. The vendor shall provide all of the equipment and materials necessary to conduct the test, which shall include coaxial cable approximately equal to the length of the camera pole and a 20 inch test monitor. The camera test shall be conducted with the monitor connected to the downstream side of the equalization amplifier located in the cabinet. EIA Standardized Resolution and Registration Test Charts shall be placed in front of the cameras in the prescribed manner at the field site, and the resultant video signals shall be measured and recorded at the field site on the test monitor.

2.2 If the field results of each tested item are greater than, or within minus 10 percent of the camera specifications, the camera shall be accepted. If the field results of each tested item fall below the minus 10 percent level, the vendor shall be required to adjust the camera and circuit components to achieve the allowable level, or to replace the equipment.

3.0 SYSTEM TEST

3.1 After the Camera Test has been successfully completed, the vendor shall connect the camera to the fiber optic system and transmit the signals to the television monitor at the ICC. No other ICC video equipment — such as titlers, switchers, large screen monitors — shall be connected in the system unless directed by TxDOT. The results of the EIA Standardized Resolution and Registration Test Charts shall be recorded from the television monitor in the ICC.

3.2 The allowable deviation from the results of each item measured in the field in the Camera Test is 5 percent. If the office results deviate from the field results by more than 5 percent, the vendor shall be required to make the necessary adjustments to the equipment or the system design to achieve the 5 percent level.

4.0 SUSPENSION OF LEASE: TxDOT will notify the vendor in writing if the performance of the system is not acceptable. If the vendor does not take corrective action(s) to produce acceptable results within five working days, TxDOT may suspend lease payments of all leased services until acceptable performance is resumed.

5.0 RESUMPTION OF SUSPENDED LEASE: TxDOT shall only pay for the number of fully operational days each month. Any suspended time shall be added to the end of the five-year lease period. The vendor shall prepare and submit to TxDOT each month a written statement that denotes the number of fully operational days.

PART VI
MAINTENANCE REQUIREMENTS

1.0 GENERAL REQUIREMENTS: The vendor shall provide all maintenance activities on the leased video system covered under this purchase order for the duration of the 5-year lease period. The vendor shall provide monthly reports detailing problems detected, problems repaired, equipment replaced, cost estimate, and man-hours of service rendered. Since the Interim Control Center (ICC) may not be operated 24 hours per day, the vendor shall provide a list of simple procedures that may be used by the TxDOT assigned operator to start up/close down active operations of camera video signals and camera functions.

2.0 TIME OF MAINTENANCE: The vendor shall conduct maintenance activities between 8:00 a.m. and 5:00 p.m. on weekdays. All other maintenance activities that fall outside the prior time boundaries shall be coordinated with TxDOT for approval before such activities begin. The vendor shall provide and maintain a maintenance log at the ICC for documentation as to calls, service, and status. The vendor shall respond to non-scheduled maintenance calls within four hours on a weekday.

3.0 SCHEDULED MAINTENANCE: The vendor shall notify TxDOT in writing at least one weekday in advance of scheduled maintenance activities on the system. TxDOT shall cooperate with the vendor's request except in the following conditions:

3.1 If incident response activities occur that require both camera and control functions to be used in a moment's notice.

3.2 If special event or road maintenance activities require continuous monitoring functions.

4.0 NON-SCHEDULED MAINTENANCE: Shall be conducted by the vendor in an orderly and efficient manner such that the total system down time is minimal.

PART VII
INSTALLATION REQUIREMENTS

1.0 DESCRIPTION: This specification shall govern the installation schedules of the field and central equipment.

2.0 TOTAL INSTALLATION: The vendor shall have seventy-five (75) calendar days in which to install all fiber, all CCTV field equipment and all Central equipment.

2.1 Field Installation: The vendor shall submit a work plan to TxDOT within ten days of contract award which delineates field site installation schedules. TxDOT shall require traffic control plans where frontage roads or city streets are blocked longer than 15 continuous minutes. Lane blockages of more than 30 continuous minutes shall require TxDOT approval.

2.2 Central Installation: The vendor shall notify TxDOT three days prior to installing fiber from the North Post Oak Street ROW line to the fourth floor at 701 North Post Oak address known as the ICC. All other central installations shall be scheduled: 1) five days in advance; and 2) Monday through Friday, 8:00 a.m. until 5:00 p.m.

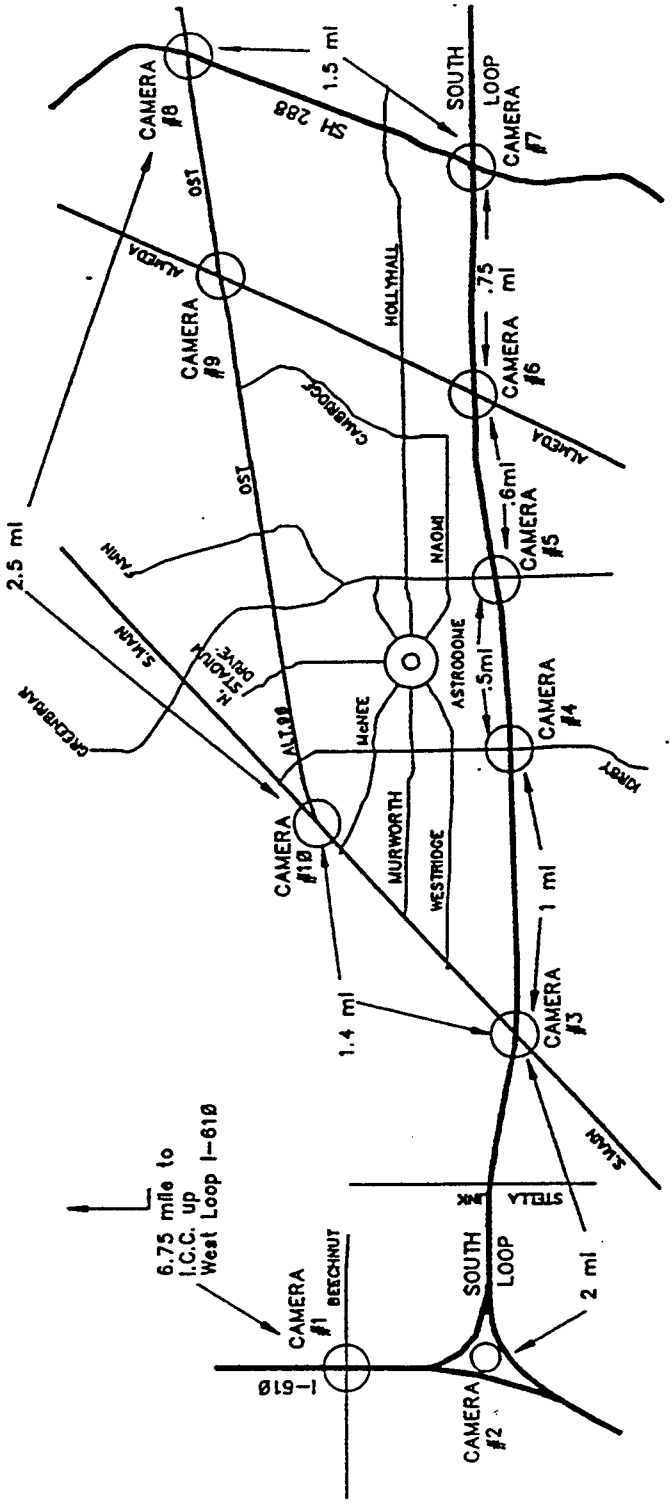


FIGURE 1: CCTV CAMERA LOCATIONS

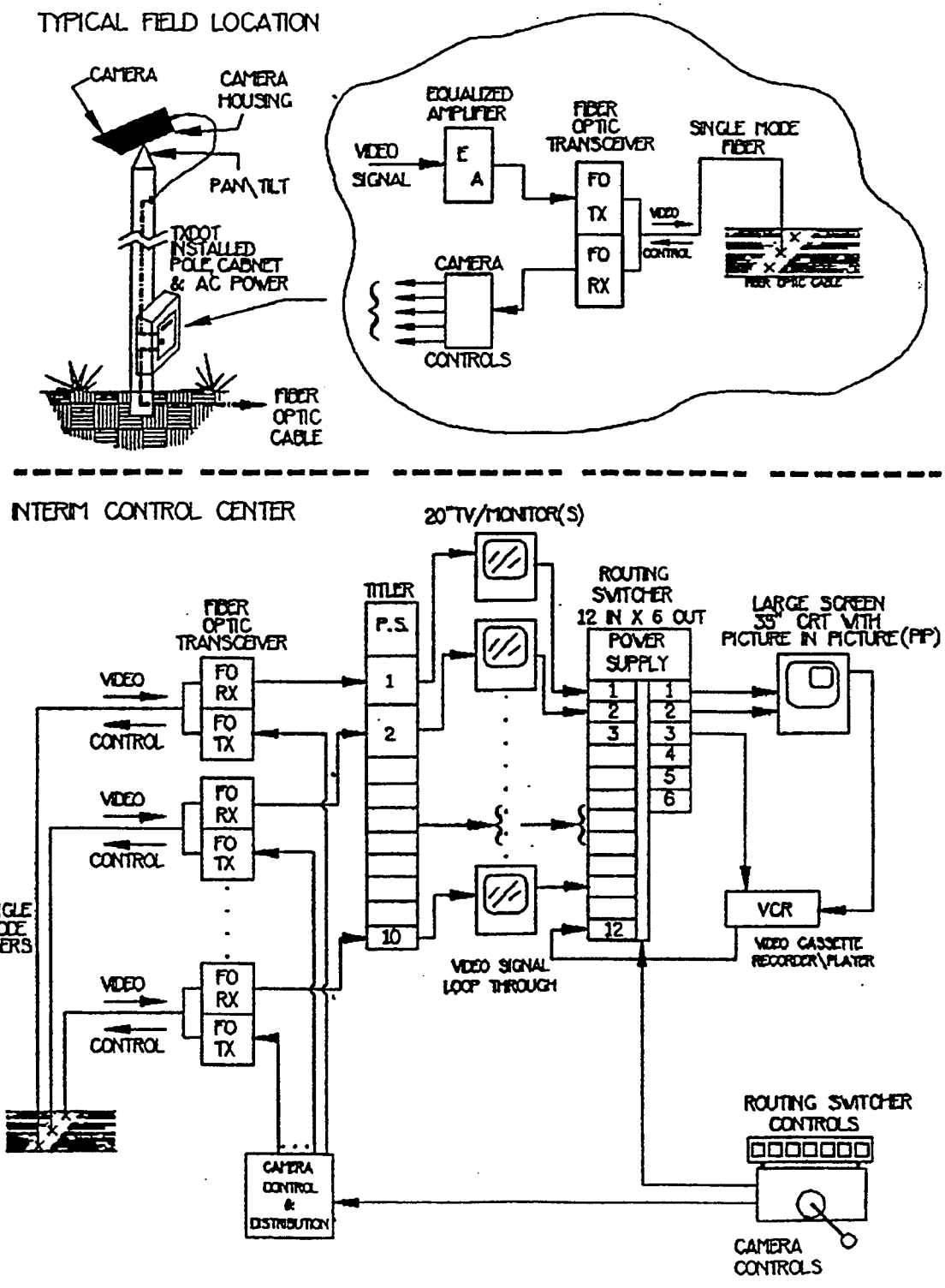


FIGURE 2. VIDEO AND CAMERA CONTROLS FUNCTIONAL SYSTEMS DEPLOYMENT

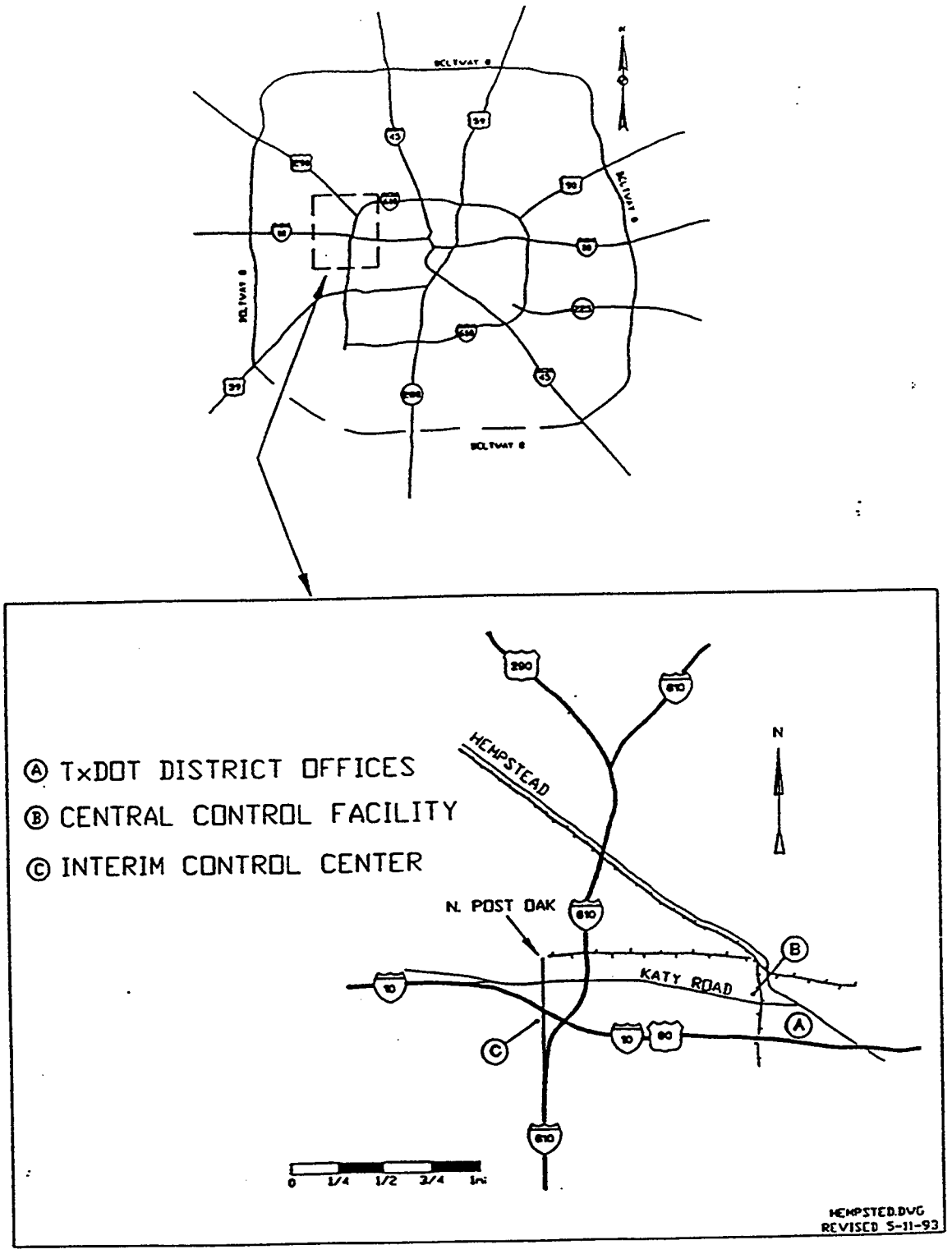
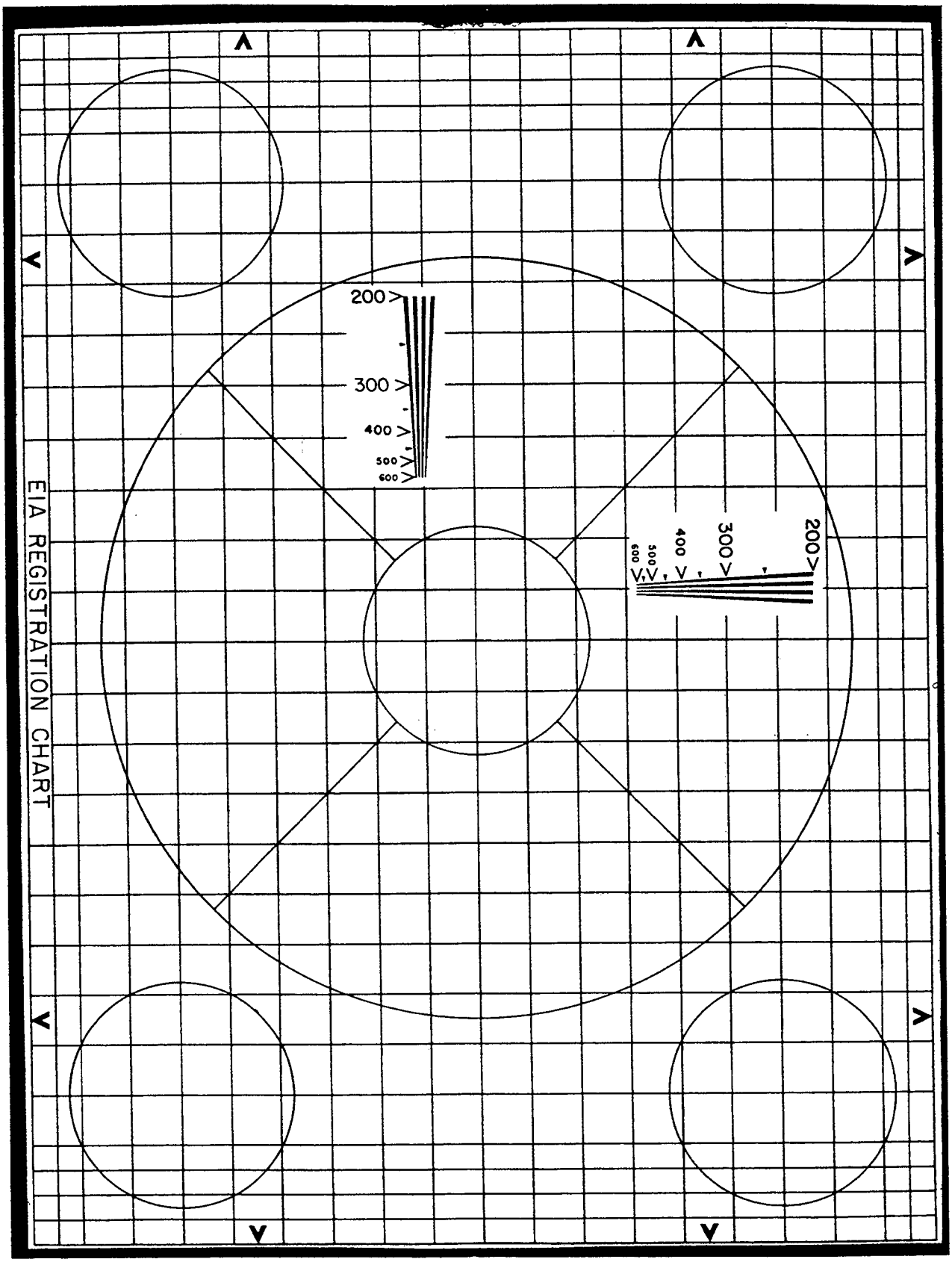


FIGURE 3. ICC AND CCF LOCATIONS

APPENDIX B.
EIA STANDARDIZED CHARTS, RESOLUTION, AND REGISTRATION


EIA REGISTRATION CHART
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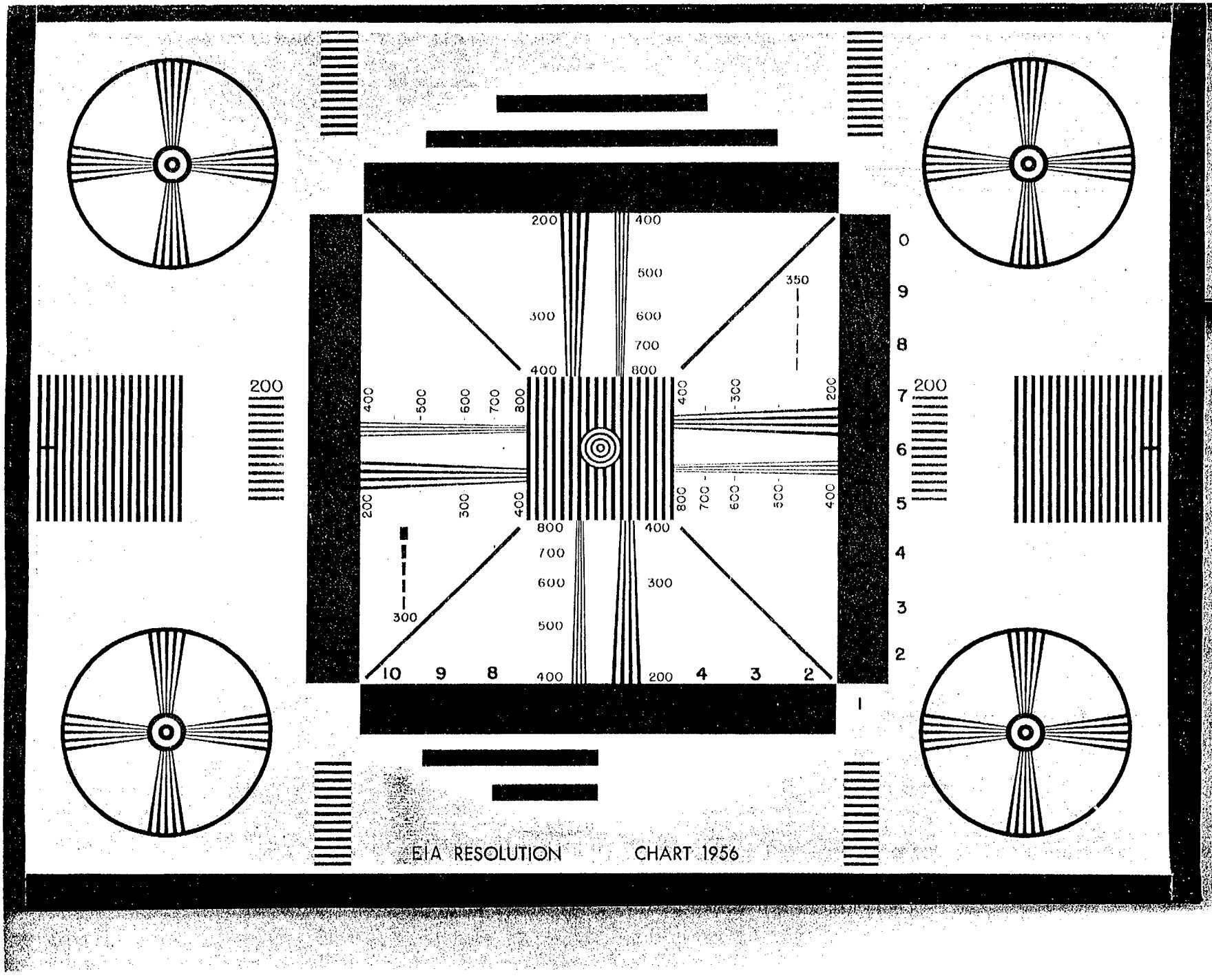
400
500
600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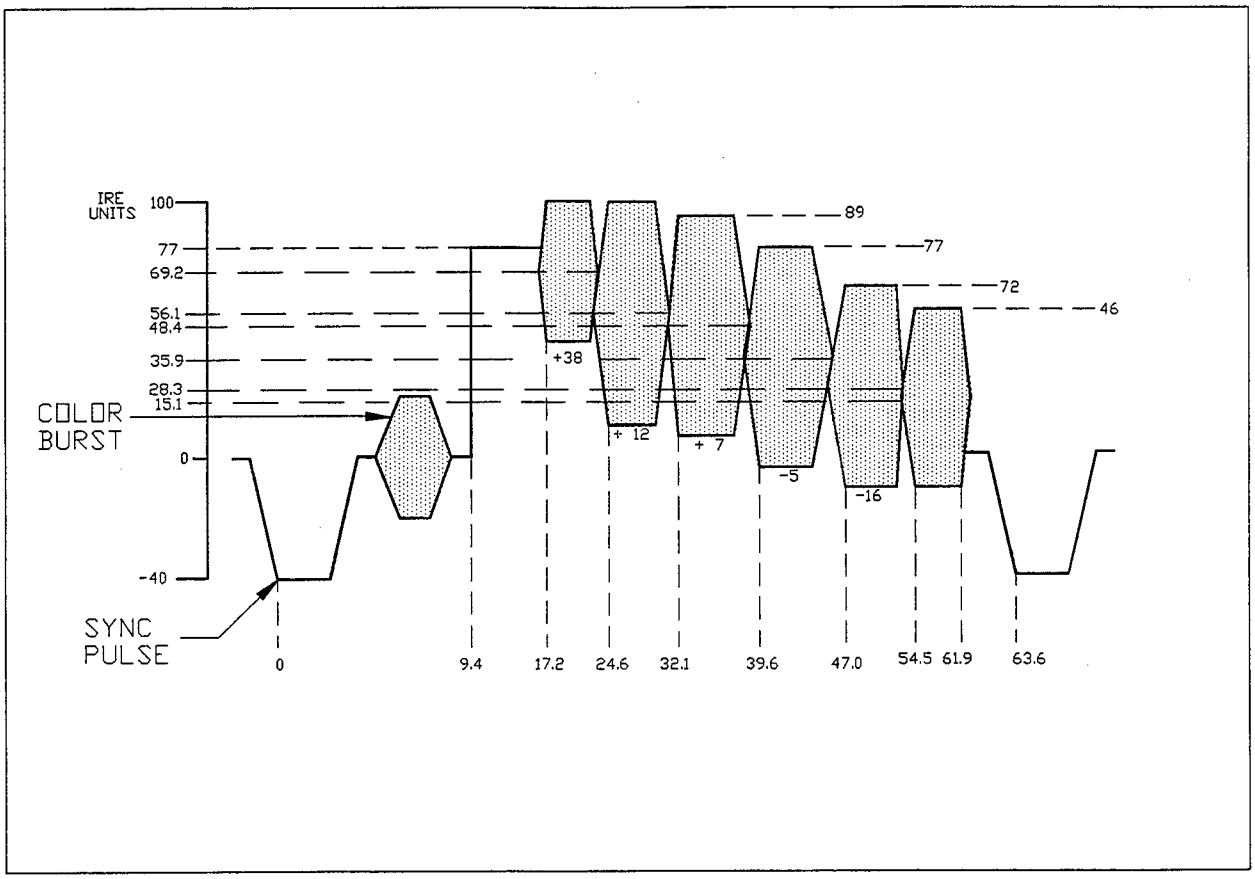
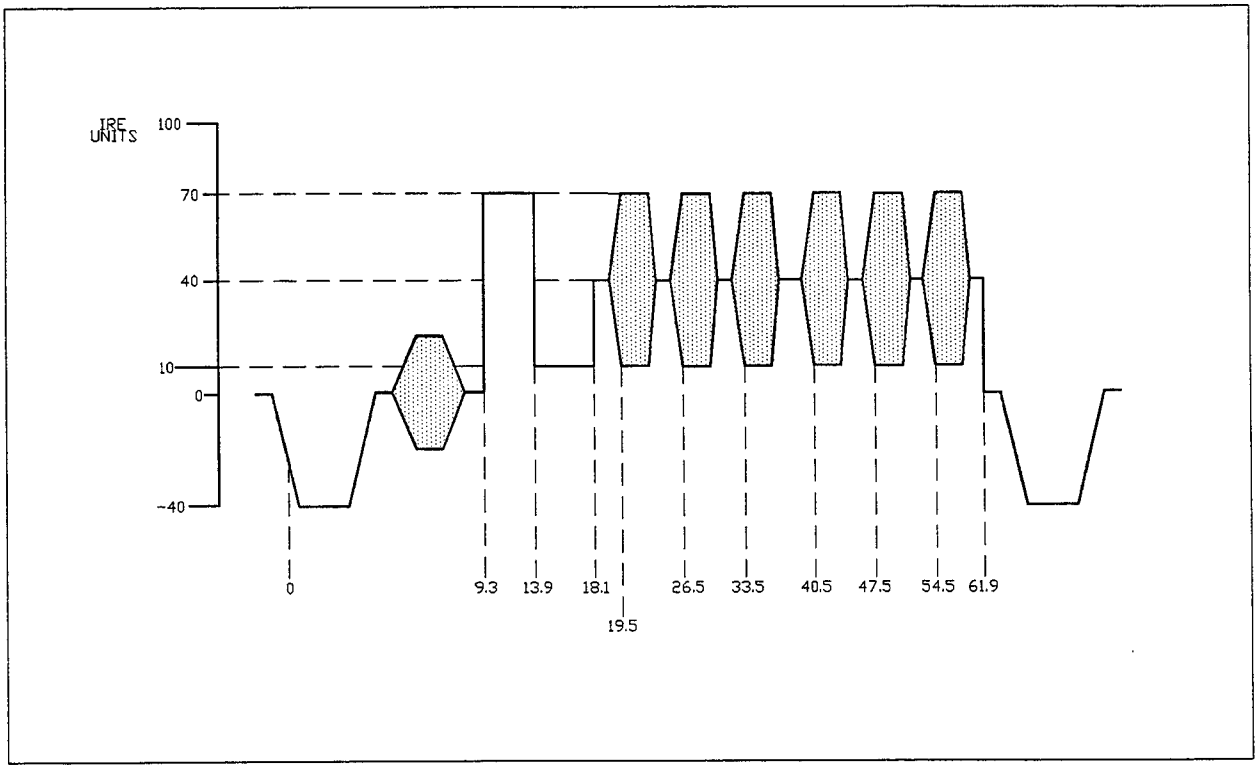
EIA RESOLUTION CHART 1956

APPENDIX C.

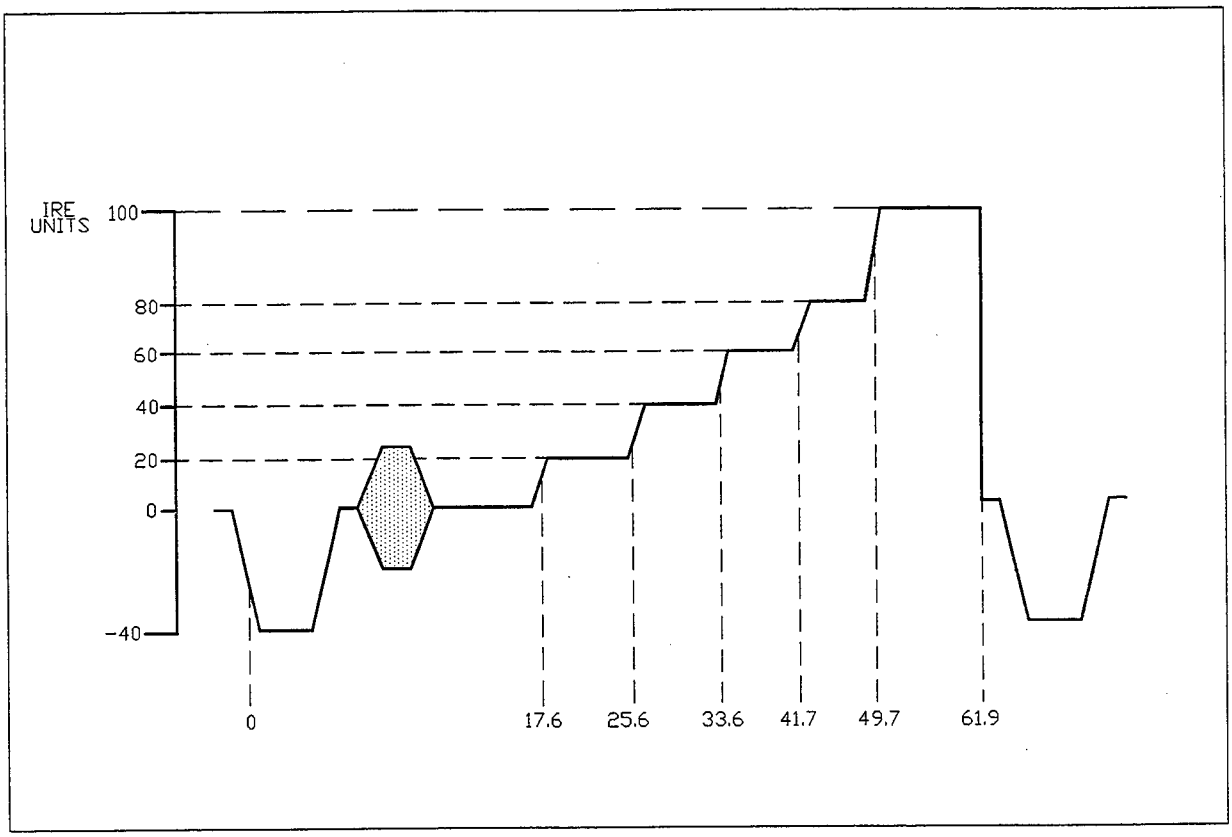
NTSC SIGNAL GENERATOR WAVE FORMS



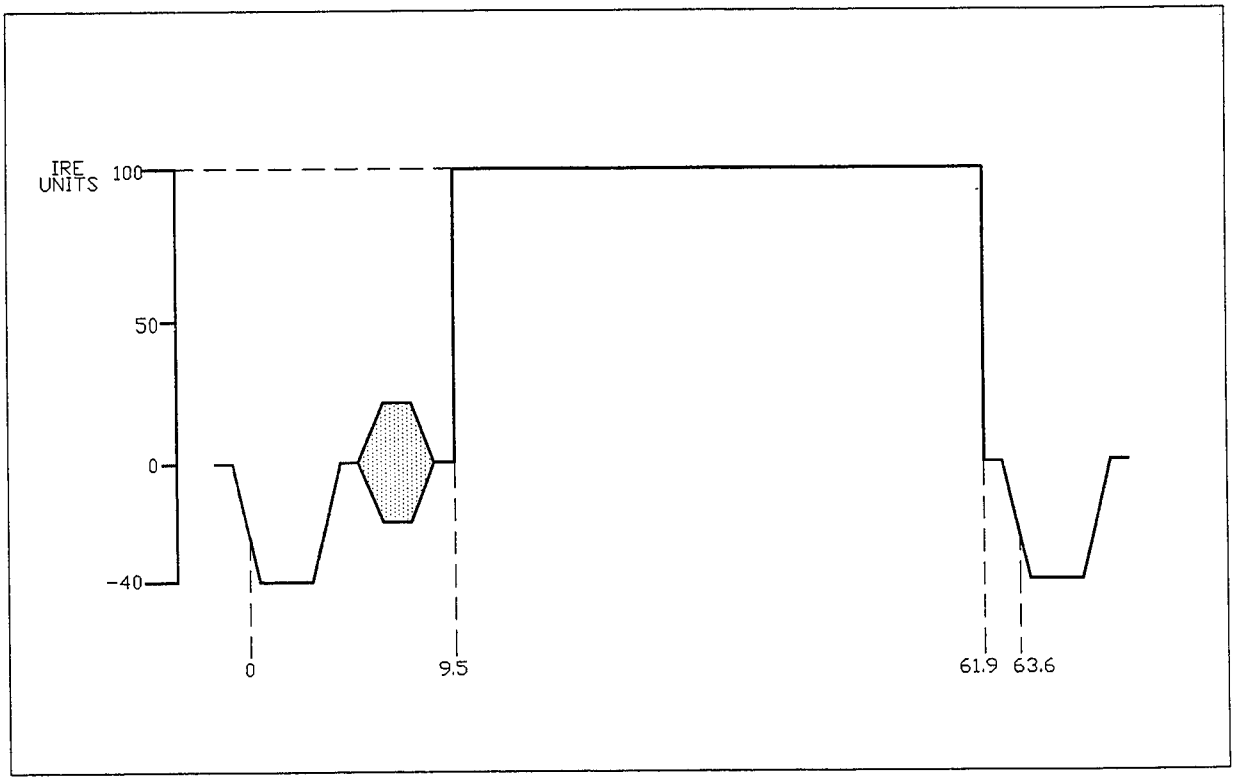
Color Bars fit SMPTE BARS. (SAME AS EIA COLOR BARS.)



Multiburst



5 Step Staircase



100 Flat Field