THE TECHNICAL PERFORMANCE REVIEW,

WHAT NEEDS TO BE DONE ?

Patrick K. McDonough

United Cable Television Corporation

DEFINITION OF SYSTEM AUDIT

ABSTRACT

This paper will consider the technical audit function in light of current system operational requirements. A checklist will be the result of a review of technical topics including CLI, frequency accuracy, picture quality, system response, plant physical condition, service call analysis and preventative maintenance.

AIM

The aim of a system audit is to provide management with a tool that accurately defines the operational status of a CATV system. In large MSO's corporate management is often out of touch with the day to day operations of each system. They need to have a source of information about each system that will enable them to make responsible decisions regarding the systems. This is especially true when considering major capital expenditure items such as rebuilds or upgrades. A good system audit will present an accurate overview of the physical condition and operating status of the plant.

The second aim of a system audit program is to maintain a set of records on each system so that periodic comparisons can be performed. The result of this analysis can help identify trends in operation that may need to be corrected or that may be applied to other systems to help them operate more efficiently. The system records can be kept in notebooks for easy reference or can be summarized, by system, in a computerized data base. Whatever filing system is used, the information should be easily accessible, regularly updated and be retained in a format that is applicable to the end user.

PROGRAM GOALS

The goals of an audit program are to provide the above noted information to management in a clear and concise format. In order to do this correctly, the system technical audit must be performed by a qualified outside party. The resulting audit report should present an unbiased view of the system, uncolored by any personal interest on the part of the auditor. Since the auditor has no interest in the system, he can be as critical or as laudatory as is required by the circumstances.

It is also important that an outside party examine the system because it is often true that someone who is very close to the system will not see problems that may be quite obvious to someone else. It is critical to the long term validity of the program that this view be maintained. Otherwise, the resulting reports will end up being useless in so far as real information is concerned.

REPORTING REQUIREMENTS

In general, the reporting requirements are fairly simple. The audit should result in a detailed formal report of the system operating environment. In addition, there may be an executive summary which provides an overview of the highlights of the detail report. These reports should be written in clear, concise English with a minimum amount of jargon.

For long term records, maintained in whichever department that is responsible for the audit program, the system test sheets, photographs and other acquired data should also be retained along with the final reports. This provides a handy reference if any questions arise regarding the results. The system book is also used to prepare for the next audit in that particular system. For instance, if the last audit turned up the information that a system was having difficulty maintaining system response, then that issue will become a focus area for the next audit.

It is our standard practice to hold an exit review of the audit results with system management before the auditor leaves the system. This practice minimizes the amount of disagreement which could arise later when the report is issued and gives the system a chance to correct any errors made by the auditor. It is also common practice to send the system a rough draft of the audit report and allow them the opportunity to respond to the findings. For instance, if the auditor states that the system needs to increase the amount of preventative maintenance being done, the system can indicate what steps are being contemplated to correct the problem. The system may also dispute a result entirely if they feel the auditor is mistaken. In either case, management has a complete picture of the system.

The technical audit may be incorporated into an operational audit report if both of these functions are performed concurrently. In this case, the operational auditor will normally be resposible for the final draft of the technical portion of the report. All of the acquired data should in any case be retained, as noted above, for future reference.

PHYSICAL PLANT TESTS

TESTPOINTS

Depending on the size and geography of the system, test points are selected so as to reflect the worst case amplifier cascades. The normal practice is to randomly select two or three locations at the extremities of each major trunk run. Separate headend or hub areas are treated independently with each area being fully tested.

The test point is usally the last tap in the feeder line. If at all possible, it is advantageous to perform the tests in a subscriber's home. Although this is becoming more difficult to do, it has the advantage of allowing the auditor to see the system as it is percieved by the subscriber. The auditor can also ask the customer about the service and any difficulties they may have encountered. The resulting information will paint a much truer picture of the system than many technical tests can.

In real life though, it is not always practical to try and gain access to the subscribers dwelling. In these cases, a long piece of drop cable should be used as the test lead to approximate conditions at the subscriber set. The test cable, approximately 150 feet in length, should be of the same type and size of cable being used in the system. The auditor should sweep the cable prior to using it to verify attenuation and response characteristics.

TEST EQUIPMENT

The auditor carries his own set of test equipment. This is done for a number of reasons. First, each system does not always have have all of the gear necessary to perform the full range of tests that are done. Second, the use of dedicated equipment assures repeatable results from system to system. For the sake of accurate long term comparative analysis, dedicated equipment is required to insure that results are valid. Third, there is the remote possibility that the system's equipment is out of calibration or otherwise faulty. If the system is unaware of this condition it could result in incorrect headend or amplifier levels being used, leading to increased problems throughout the plant. Independent equipment can identify this problem and the auditor may be able to use his test gear to do a rough calibration of the system equipment.

The actual test equipment used will vary depending on budget limitations, personal preferences and the physical requirement that the gear needs to be transported to each test location. A balance must be achieved between having too much equipment to move and having too little to get the job done correctly.

Because test gear is expensive and because it is necessary to maintain calibration, the use of very good shipping cases is called for. There are a number of commercially available cases which will serve this purpose quite well. For the best balance between protection and flexibility, the use of custom designed and built cases should be considered. Custom cases can maximize the amount of equipment available and help keep shipping costs down to a manageable level. Whichever route is taken, shipping cases should be of the highest quality to provide the maximum amount of protection and long term service.

Test equipment should also be of the best quality to insure the type of results that are required of a solid audit program. A list of the test equipment used in the author's systems is shown below.

1. A good quality portable spectrum analyzer, such as the HP 8590A. This is an automated, menu driven analyzer designed specifically for CATV usage.

2. A good quality field strength meter such as the Wavetek SAM IIIE.

3. A portable frequency counter, preferably one with an oven controlled crystal and accuracy rated to one part per million over a ten MegaHertz range.

4. A good quality handheld DVM with Amp. probe.

5. A set of tunable bandpass filters of adequate frequencies to cover the system being tested.

6. A tunable dipole antenna and preamp.

7. A data recording device, either a polaroid camera or a laptop computer and printer.

8. Quality shipping cases sufficient to encase all of the equipment.

9. An assortment of connectors, jumpers adaptors, etc.

The list above is not all-inclusive and can obviously be modified to meet the specific needs of the systems being tested.

A trend in the type of equipment which is currently available is the prominence of computer interfaceable gear. Both the spectrum analyzer and the field strength meter listed above can be connected to and driven by a computer. This can greatly speed up the acquisition of levels and can automate the performance of system test procedures. The use of a computer will allow the auditor to visit a higher number of test points in the same amount of time and thus get a much more comprehensive view of the system.

TESTS

Within the context of a modern CATV system, there are numerous concerns about picture quality and plant reliability that are more important every day. This is due to increased competition from alternate entertainment forms and the looming development of both fiber optic technology and the potential of enhanced NTSC delivery systems. There is also increased pressure from governmental bodies in response to a percieved increase in reception problems on the part of subscribers. This is mainly due, in reality, to unhappiness because of rate increases. Whatever the reason, there is a need for improvements in the overall operating efficiency of the systems to retain subscribers in a competitive environment.

To this end, the technical auditor must be aware of the latest requirements for quality operation within the system. Today, this means a full working knowlege of CLI and leakage specifications; headend frequency accuracy requirements and possible future demands on the system for additional channel carriage and the necessary technology to accomplish this.

The tests to be run on the plant should be comprehensive enough to allow management to make informed decisions based on accurate information on the system. The following tests will provide a solid overview of system operation and will provide the basis for future operational analysis.

1. LEVELS--A complete set of levels should be taken at every test point. This should include both video and audio carriers and a representative sampling of FM caariers. It is also a good idea to measure any data carriers present on the system. A field strength meter connected to a computer can read and record all of these levels in a matter of only several minutes. The data obtained can be stored on a disk for future retrieval or printed out immediately.

2. PICTURE QUALITY--A subjective evaluation of each channel on the system is made using a good quality TV and an appropriate converter where necessary. Picture quality is judged using a TASO rating system. The TASO system in use in the author's systems consists of the following ratings: 1=Excellent; 2=Good; 3=Fair; 4=Poor; 5=Barely Viewable; 6=Unviewable. Picture quality should rate at least a 2 or better on the TASO codes to be acceptable. Special attention should be given to the stability and overall quality of descrambled signals to assure the best possible reception.

3. CTB--The use of an automated test set, like the above noted spectrum analyzer, can make tests like composite triple beat practical in every day situations. All that is needed is an unused channel or a channel that can be turned off without any customer complaints.

4. CROSSMOD--Like CTB, this test can be routinely run in any system. Also like CTB, Crossmod is becoming a more important technical issue in the era of HDTV and other enhanced transmission systems.

5.CARRIER to NOISE--This test is probably the most informative of any that can be performed on an ongoing basis in any system. Noise is the base measurement that defines the overall quality of any operating plant. This parameter is also becoming more critical with the advent of enhanced picture standards.

6. HUM MODULATION--This test is not critical but is performed as a matter of course. It can provide the auditor with a key to how well and how often preventative maintenance is being done.

7. LEAKAGE--RF leakage should be monitored throughout the series of tests in the system via a truck mounted reciever, such as the Cuckoo or Sniffer units. When possible, a proof type test should be performed at the test point using a tunable dipole antenna. This test is currently among the most important than can be done in any system. Careful documentation of the results of

this test should be retained by the auditor and the system.

8. SWEPT FREQUENCY RESPONSE--The response of the system is an important consideration in overall picture quality. This test also reveals a good deal about the status of the maintenance program.

In addition to these objective tests, there are a number of physical inspections that should occur in the plant. These include visual inspections of the amplifier housings, cable, connectors, lashing wire, pole hardware and so on. In underground plant, the pedestals should be checked for integrity and vaults inpected for excessive water retention. The condition of shrink boots and other protective devices should be confirmed. System grounding, as well as drop grounds, should also be thoroughly inspected in all areas of the plant.

Power supplies require their own set of inspections, especially if they are standby types and use batteries. These tests should note whether the supply is properly installed and grounded, if the housing is correctly ventilated, if the batteries are connected correctly and if the charger and other parts are operative. If possible, a standby supply should be exercised to make sure it will operate in the event of a power outage.

HEADEND TESTS

The headend is assuming a role of major importance in the regulatory environment today. There is renewed emphasis on the accuracy of frequency assignments used in CATV, which must be maintained in the headend. As has always been the case, the ultimate quality of the system is determined by headend performance so particular importance should be given to the quality of the signals at this location.

The headend tests follow the same general pattern as the system tests. All video and audio carrier levels should be read and recorded, including all FM carriers and data carriers. A subjective picture quality test is done using the TASO codes noted previously. A set of CTB, X-MOD, C/N, Hum Modulation and a sweep response are done at the headend output for reference. All of these test results are recorded in the same format as the system tests for easy comparison.

In addition to the standard RF tests, the headend should also be tested at baseband video. Incoming signals should be subjected, at a minimum, to a video Signal to Noise test. If a video test set, such as the VM-700 from Tektronix, is available, a whole set of video tests can be performed quickly and with excellent accuracy. Incoming RF signals should be examined both before and after headend processing to ensure that no unacceptable distortion or noise is being introduced.

All video gear, such as VDA's, should be checked for 1 volt P/P output. Audio signals should be tested for depth of modulation along with the video waveform. A subjective test of audio quality should be performed on all audio signals including FM channels and especially on stereo encoded TV audio channels.

The headend facility should be checked for neatness and indications of regular maintenance activity. All wiring should be inspected to make sure each wire is in good condition, with connectors properly tightened and is installed so as to be reliable. AC outlets should be adequate for the facility and no doubling up on outlets should be allowed. The entire headend should be properly grounded, along with the tower, earth stations and antenna feed lines.

To insure reliability, the auditor needs to check the status of the standby power supply. This device should be exercised to prove emergency operation. Heating, air conditioning and fire alarm systems should also be checked to make sure they are operational.

Along with the headend, any addressable equipment should be inspected and tested. The important thing in looking at this gear is to treat it as a system rather than a bunch of discrete parts. The addressable computer should be exercised to communicate with each controllable headend piece, such as scramblers, and return communication verified. The computer's power conditioner should be checked to confirm proper connection. If the computer has a dial-in modem it should be disconnected unless it is in use. The area around the computer should be neat and clean and anti-static devices in place. Spare data tapes or disks should be available. The auditor should also make a note of access to the computer, which should be limited to authoized personnel. Passwords, if used, should be checked for the last time they were changed.

Along this same line, any return data carriers in the system must be tested as well. Each return trunk should be checked individually and the combined signal tested also. The minimum tests on return signals should be a Carrier to Noise and RF levels. It is also very helpful to confirm two-way converter operation and exercise the remote box functions.

Headend pieces should be tested for accurate output frequency and to confirm that the proper frequency off-set is being utilized. The output of the comb generator, if one is in use, should also be read with a frequency counter and levels verified.

While at the headend, a thorough check of the tower and antennas should be made. Overall tower condition should be noted as well as the status of the paint and beacons. Antenna downleads should be visually inspected for good condition, ice fall protection and proper installation. Tower grounding should be verified. If the tower is guyed, the tension on the guy wires should be noted.

Earth stations should be inspected for proper installation, that waveguide plumbing is neatly installed and that the LNA/LNB's are secure. Grounding should be verified as well. Power leads should be checked and all connectors inspected for corrosion. If a pressurization system is in place for the waveguides, this should be checked as being operational and the dessicant in good condition.

The headend facility should be checked for overall cleanliness and safety. Wiring should be neat and all inputs/outputs labled to indicate source or destination. Test equipment should be calibrated and in good operating condition. Spares should be properly stored and there should be no defective equipment laying around.

DOCUMENATION

A major part of the audit will be concerned not only with the physical tests but also with the record keeping used in the system. How the system documents its own activities and problems will tell the auditor a good deal about the depth of commitment to the maintenance program, CLI program and so forth. A system that is sloppy in record keeping habits can be assumed to be sloppy in doing the actual work as well.

A full inspection of the system's records is called for. This should include a check of all required operating licenses for two-way radios (FCC form 574-L), fixed earth stations (FCC form 488), microwave radio station license (FCC form 469), CATV relay service (CARS Band-FCC form 371-A), Common Carrier microwave radio station authorization (FCC form 462-C) and the tower aeronautical study (FAA form 7460-1). The system must also have a copy of their most current FCC form 325 and a current copy of the FCC rules.

Other documentation which ought to be on hand includes the system maintenance log, headend maintenance log, leakage logs (this is very important), up to date system design maps, headend rack and electronics diagrams, the latest proof of performance test results, power supply maintenance log and equipment manuals for all the equipment used in the system.

The auditor should compare the results listed in the system and headend maintenance logs with the results of the on-site audit tests. Obvious discrepancies should be noted and questioned. The main point in this area is that the auditor needs to evaluate the effectiveness of whatever maintenance or repair plans the system is utilizing. A system may have a great preventative maintenance plan on paper, scheduled out correctly and designed to cover every system amplifier twice a year, but if the plan is not implemented correctly or the system doesn't allocate enough personnel and equipment to the effort it will never work. This is especially true for CLI. The auditor must be aware of not only the presence of a viable plan but should confirm the effectiveness of the plan and the commitment of the system's management to seeing it through the long run.

RESULTS

The end result of the audit review, besides the formal report to management, is a concise, accurate technical summary of the system. The hard copies of the test results provide a yearly record of system performance, which is useful in a number of ways as decisions regarding the future of the system arise. The auditor must be unbiased in the approach to testing and completely honest in reporting the results. Otherwise the results would not be valid and would be of little practical value.

Shown below are samples of the level recording/TASO rating sheets which are used in the author's systems. Also shown are samples of automated test results done in an operating system. Lastly, an audit checklist is shown which provides a listing of the salient points to cover during the technical system audit.

ACKNOWLEGEMENTS

The author wishes to extend his thanks to Rey Johnson and David Glasgow, both Corporate Field Engineers at United Cable TV Corp. for their assistance in devising the the test procedures, automated testing methods and forms which have been developed over the past several years. Ralph Gillespie of United of Colorado has been responsible for writing the computer programs that make the automated testing work as intended.

CABLE TELEVISION CORPORATE TECHNICAL REVIEW

Test Site # ______________ System: ______________ Area: ______________
Review Date: ______________ Address: ______________ AMPS Deep: ______________
Time: ______________ am/pm ______________ Billed Service: ______________
Const. Type: ______________ Sub Name: ______________ Tap Value: ______________
Test Point Type: ______________ Drop Length: ______________ FSM Used: ______________
Spect. Analyzer: ______________ TV Used: ______________
Converter: ______________

CHNL.	LEVELS Picture	Audio	S/N	C/N	TASO	PICTURE COMMENTS	OTHER COMMENTS
2							
3							
4							
5							
6							
106.5							
A-1							
A14							
B15							
C16							
D17							
E18							
F19							
G20							
H21							
I22							
7							
8							
9							
10							
11							
12							
13							
J23							
K24							
L25							
M26							
N27							
O28							
P29							
Q30							
R31							
S32							
T33							
U34							
V35							
W36							
AA37							
BB38							
CC39							
DD40							
EE41							
FF42							

OVERALL: LAST MAINTENANCE DATE:
Service Call Prepared? Yes/No Results: ______________
General Comments: ______________

Signatures: General Manager: ______________ Corp. Eng. ______________
Chief Technician: ______________
TASO Quality 1=Excellent 2=Good 3=Fair 4=Poor 5=Barely Viewable 6=Unviewable

CABLE TELEVISION CORPORATE TECHNICAL REVIEW

Test Site # ______________ System: ______________ Area: ______________
Review Date: ______________ Address: ______________ AMPS Deep: ______________
Time: ______________ am/pm ______________ Billed Service: ______________
Const. Type: ______________ Sub Name: ______________ Tap Value: ______________
Test Point Type: ______________ Drop Length: ______________ FSM Used: ______________
Spect. Analyzer: ______________ TV Used: ______________

CHNL.	LEVELS Picture	Audio	S/N	C/N	TASO	PICTURE COMMENTS	OTHER COMMENTS
GG43							
HH44							
II45							
JJ46							
KK47							
LL48							
MM49							
NN50							
OO51							
PP52							
QQ53							
RR62							
SS63							
TT64							
UU65							
VV66							
WW67							
XX68							
YY69							
ZZ70							
71							
72							
73							
74							
75							
76							
77							
78							
79							
80							
81							
82							
83							
84							
85							
86							

OVERALL: LAST MAINTENANCE DATE:
Service Call Prepared? Yes/No Results: ______________
General Comments: ______________

Signatures: General Manager: ______________ Corp. Eng. ______________
Chief Technician: ______________
TASO Quality 1=Excellent 2=Good 3=Fair 4=Poor 5=Barely Viewable 6=Unviewable

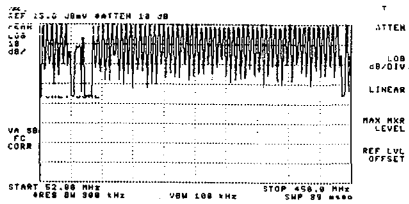
TESTPOINT NUMBER 01 READINGS

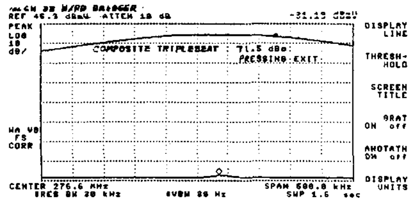
DATE: 01-10-1989 TIME: 12:08 P.M.

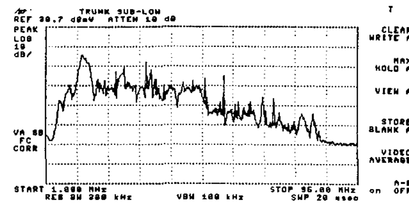
TESTPOINT LOCATON:
READINGS TAKEN BY:

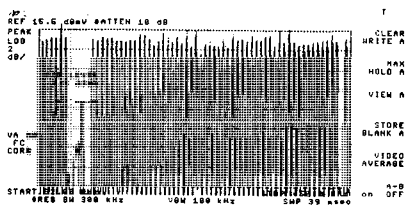
METER BATTERY READING: 15 VOLTS
AMBIENT TEMPERATURE: 73 DEGREES FAHRENHEIT
ATTENUATOR SETTING: 5 TO 15 dBmV
SYSTEM HUM READING WAS: .3 % @ 73.96 Mhz
SYSTEM CARRIER/NOISE WAS: 44.5 dB @ 73.96 Mhz

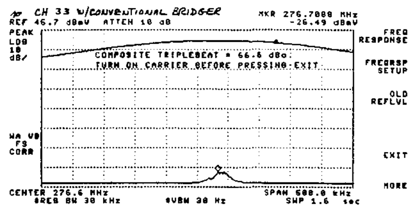
CHANNEL	VIDEO FREQ (MHZ)	LEVEL (dBmV)	AUDIO FREQ (MHZ)	LEVEL (dBmV)
2	54	9.7	58.5	-6.4
3	60	9.7	64.5	-6.4
4	66	10.0	70.5	-6.1
X-PRESS	72.6	-8.9	0	0
5	78	10.3	82.5	-6.7
6	84	10	88.5	-6.4
FM	96.1	-5.3	0	0
FM	97.9	-6.0	0	0
FM	101.9	-5.0	0	0
FM	102.3	-5.2	0	0
FM	102.7	-8.5	0	0
FM	103.1	-6.8	0	0
FM	105.5	-5.0	0	0
FM	106.5	-7.6	0	0
FM	107.1	-6.0	0	0
FM	107.9	-5.7	0	0
DATA	108.5	2.0	0	0
SNIFFER	109.275	5.8	0	0
DATA	114	-9.2	0	0
TEST CARRIER	118.5	-12.0	0	0
14(A)	120	10.3	124.5	-5.8
15(B)	126	10.0	130.5	-6.1
16(C)	132	10.0	136.5	-7.3
17(D)	138	6.7	142.5	-11.2
18(E)	144	7.6	148.5	-6.1
19(F)	150	9.1	154.5	-3.9
20(G)	156	10.0	160.5	-7
21(H)	162	9.4	166.5	-7
22(I)	168	9.1	172.5	-6.7
7	174	9.1	178.5	-7.3
8	180	9.4	184.5	-7
9	186	9.7	190.5	-6.7
10	192	10.0	196.5	-6.4
11	198	10.0	202.5	-7
12	204	9.1	208.5	-7
13	210	9.7	214.5	-6.7
23(J)	216	9.7	220.5	-6.7
24(K)	222	9.7	226.5	-6.7
25(L)	228	9.4	232.5	-7.3
26(M)	234	9.1	238.5	-7
27(N)	240	9.4	244.5	-6.4
28(O)	246	15.7	250.5	-6.4
29(P)	252	9.7	256.5	-6.4
30(Q)	258	9.4	262.5	-6.4
31(R)	264	9.4	268.5	-7
32(S)	270	9.7	274.5	-7
33(T)	276	9.7	280.5	-7
34(U)	282	8.8	286.5	-7
35(V)	288	8.8	292.5	-7
36(W)	294	9.4	298.5	-6.7
37(AA)	300	7.6	304.5	-6.7
38(BB)	306	9.7	310.5	-7
39(CC)	312	10.3	316.5	-7.6
40(DD)	318	7.6	322.5	-8.2
41(EE)	324	8.8	328.5	-7.6
42(FF)	330	9.4	334.5	-7
43(GG)	336	9.7	340.5	-5.1
44(HH)	342	8.8	346.5	-7.6
45(II)	348	8.8	352.5	-7.6
46(JJ)	354	9.4	358.5	-7.3
47(KK)	360	8.8	364.5	-7.9
48(LL)	366	7.9	370.5	-7
49(MM)	372	8.2	376.5	-7.3
50(NN)	378	8.2	382.5	-8.5
51(OO)	384	8.8	388.5	-7.6
52(PP)	390	8.2	394.5	-7.6
53(QQ)	396	8.5	400.5	-7.6

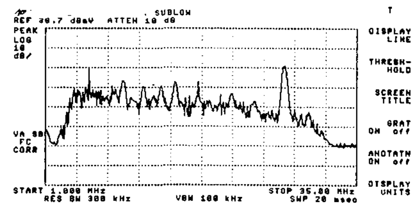


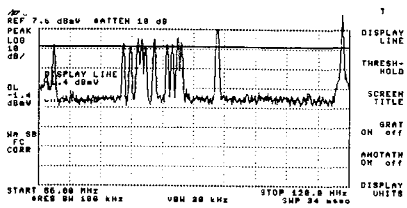


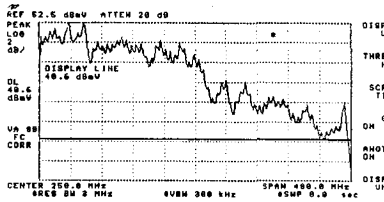


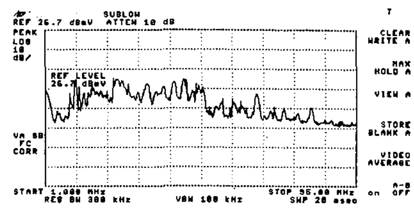


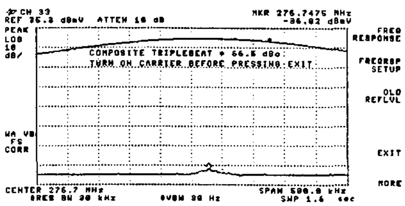


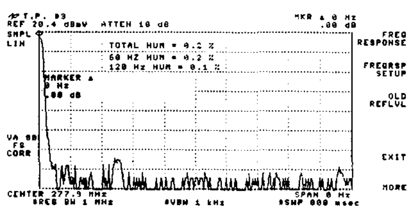


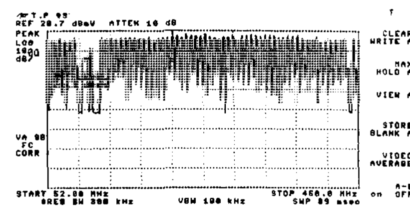


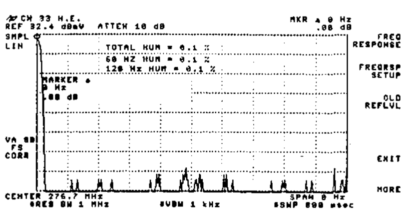


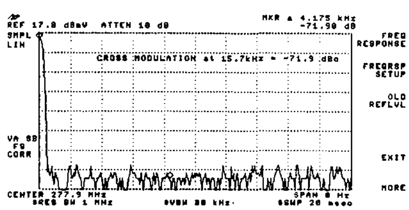


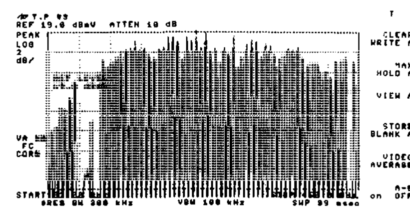


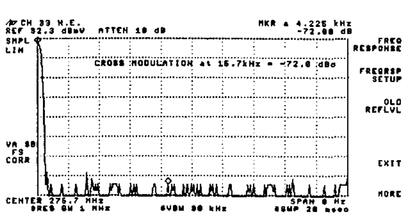


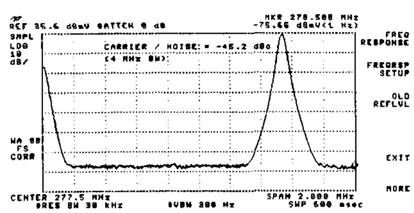


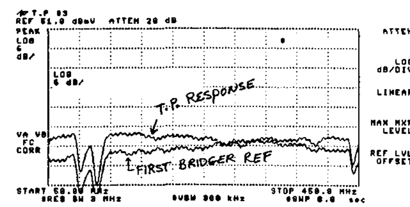


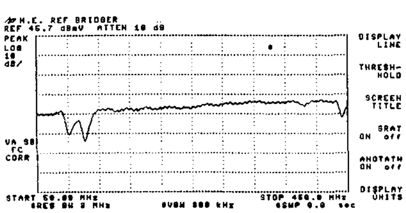


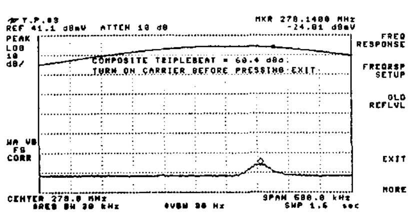


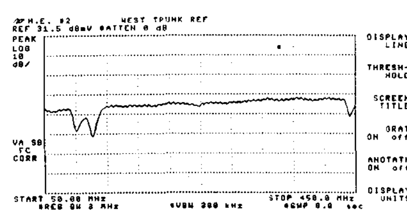





T.P. RESPONSE
FIRST BRIDGER REF







AUDIT CHECK LIST

HEADEND

- _____ Headend drawings current?
  - _____ 1. Electronic Diagram
  - _____ 2. Rack Diagram
- _____ Headend Maint. Log (last date ________)
- _____ Tower Condition:
  - _____ Paint _____ Structural Analysis
  - _____ Lights _____ Downguy Tension
  - _____ Ground _____ Antenna Leads Protected from Falling Ice
  - _____ Downleads neat
  - _____ Date of Last Tower Inspection
- _____ Earth station, LNA security, Waveguide plumbing, power leads, grounding.
- _____ Defective equipment sent in for repair.
- _____ Rack wiring neat and labeled.
- _____ Standby power generator?
  - _____ Check oil and water
  - _____ Exercise generator
  - _____ Check log book for exercise time
- _____ Serial numbers and calib. dates of HE test equipment
- _____ Check linearity of system sweep equipment, record response
- _____ Record HE test point attenuation
  - _____ 1. Video levels
  - _____ 2. Audio levels
  - _____ 3. Leakage XMTR and data carrier levels.
  - _____ 4. FM carrier levels.
  - _____ 5. Record HE response.
  - _____ 6. Record CTB, XMD, HUM, C/N.
  - _____ 7. Note beats on spectrum analyzer.
- _____ Check off-air signal inputs (TV)
  - _____ Check off-air FM inputs
- _____ Confirm 1 Volt P/P levels on all modulator inputs from MW or Sat.
- _____ Noise:
  - _____ 1. S/N tests of Sat/MW signals.
  - _____ 2. C/N tests of entire HE.
- _____ Picture quality check (TASO) input ch's.
  - _____ 1. Off-air input/output quality.
  - _____ 2. MW/Sat. input/output quality.
- _____ Frequency offset:
  - _____ 1. Phaselock generator model.
  - _____ 2. Frequency stability (± 1 Hz HRC/ ± 5 KHz Std.)
- _____ Picture quality check (TASO) all ch's.
  - _____ Check quality at HE output
  - _____ Check quality at any intersystem cross connects (if applicable).
  - _____ Note any visible impairment to pictures (ghosts, smearing, co-channel, Xmod, noise, beats).
  - _____ Note effectiveness of scrambling (if used).
  - _____ Note any impairment to descrambled channel.

SYSTEM TEST POINTS

- _____ Check standby power supplies, batteries, connections, ventilation, excercise.
- _____ Standby PS maintenance prog./log.
- _____ Record system levels, all amplifiers.
- _____ Record video levels.
- _____ Record audio levels.
- _____ Record pilot carrier levels.
- _____ Record leakage, data carrier levels.
- _____ Record/compare sweep response.
- _____ Check picture quality (TASO)
- _____ Record CTB, XMD, C/N. HUM.
- _____ Check drop, correct cable ('D', 'X', etc.), grounding, proper installation, connectors correct, tagged.
- _____ Visually inspect housings, cable, connectors, lashing wire, pedestal.
- _____ Record all RF leaks detected by Rcvr. Note intensity of leak, whether legal.