PRACTICAL ROUTINE MAINTENANCE

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The topic, Practical Routine Maintenance, has been broken down into four basic catagories for discussion. The catagories have been placed in what I feel is their order of priority.

1. Equipment Selection
2. Personnel Training
3. Scheduling of Preventative Maintenance, Testing and Procedure
4. Record Keeping

This order of priority should not lead one to believe that, for example, Record Keeping is less important than Equipment Selection. Record Keeping, in normal system planning, is simply approached after Equipment Selection.

Equipment Selection

The major criteria for equipment selection is "cost versus performance". While this is extremely important in system planning, in far too many cases it over shadows two other very important considerations:

1. Dependability
2. Maintainability

Since the "performance" side of the equation in "cost versus performance" is generally derived from either Manufacturers Published Specifications or short term evaluations, the indicated savings of a good "cost versus performance" ratio can easily be offset by loss of subscriber revenue due to a low "mean time between failure" and increased maintenance cost.

This problem can be approached by enhancing the "performance evaluation" to include (1) a long time user inquiry as to failure ratios, major component involved in most common failures, average repair time, manufacturer repair turn-around time and cost; (2) service technicians practical evaluation of maintainability; (3) manufacturers statement as to units in service and warantee repair volume.

Consideration must also be given to future system up grading or improvements. Does the housing size and mechanical lay out of modules provide for future add on with out major changes? How many major changes has a manufacturer introduced during the normal life of a system? Have new generations of equipment totally obsoleted past generations?

Personnel Training

The most frequently missed step in the proper training of Service Personnel relates back to the previously discussed area, "Equipment Selection". In many situations the equipment is selected, ordered and delivered without the Service Technicians involvement. The selection process itself is a very valuable training tool.

Manufacturers provide service for the training of maintenance personnel. These services are available through seminars conducted in central locations throughout the country on a scheduled basis. The key to being apprised of seminars and other training services offered is to assure your place on the "mailing list".

Industry periodicals also provide a source for training. Many articles of a practical nature pertaining to system maintenance, testing techniques and trouble shooting tips are published. A great deal of these articles are written by System Service Technicians.

In the small systems (ie: one technician) training and information may be more difficult to obtain but it is not impossible. Most equipment manufacturers maintain toll free telephone numbers and are more than willing to answer questions whenever possible.

There are many technicians who have questions but do not ask them because they are afraid that the question will appear "dumb" or that the answer will be too obvious to others. Just remember that the only "dumb question is the one which is not asked!

In larger systems (ie: Chief Technicians and two or more service technicians) formal training programs can and should be set up. Such programs can be of your own invention tailored to serve the needs of the particular system or can be of fixed formats such as provided by correspondence schools.

In either the small or the large system "hands on experience" is the best teacher. A great deal of

care must be taken to properly plan times and tasks for this type of training as it can be the most costly in terms of subscriber revenue. Over estimating your own or others capabilities can be disastrous!

Scheduling Of Preventative Maintenance Testing And Procedures

Before discussing the scheduling of "Preventative Maintenance" let us first define it. "Intended or serving to ward off harm, disease, etc; a precautionary measure" is the dictionary definition. of the word "Preventative". Maintenance is "The act of maintaining" which is "to keep unimpaired and in proper condition".

From these dictionary definitions we can define "Preventative Maintenance" as those steps which we will take to insure unimpaired service to the system subscriber. The key word is unimpaired, which should indicate not only uninterrupted but also a high quality service. While it is true that customer tolerance to interruptions is very low and their reaction immediate, the corrective action is generally high priority and as long as the frequency of interruptions is low and the reasons valid, customer understanding and retention will be high. On the other hand, a gradual degrading of quality over a long period of time is as insidious as cancer. By the time the complaint is received, in as many as 50% of the cases, the customer has already decided to disconnect and has spread the word to friends and neighbors.

Any well planned Preventative Maintenance Schedule begins by listing the potential problems which could occur by priority and then evaluating the steps which can be taken to prevent their occurance. The following is such a list:

1. Service Interruption
   a) Power Failure
   b) Electronic Failure
   c) Discontinuity
   d) Cable Failure
   e) Drop System Failure

The evaluation of steps to be taken to prevent such interruptions would yield the following:

a) Headend stand-by power is a must as a power outage here would affect 100% of the subscribers. This can be accomplished by a gasoline generator or a battery/inverter configurations.

   Stand-by power at key line power supplies where large percentages of subscribers could be affected by a power outage. Long transportation runs should take first priority.

   Stand-by shelf generators should also be considered for smaller distribution areas.

   Remember in your evaluation that a power primary or secondary outage effecting the line power supply does not affect all subscriber houses.

b) This area requires that adequate system spares are on hand in good condition when needed. The most common problem here is that units are not returned or repaired on a regular basis thus depleting spares stock.

   In many cases, repairs are accomplished at the system level. Care should be taken that only manufacture recommended parts are used for repairs.

c) Two types of discontinuities are possible: 1) Those which come from poor installation practices resulting in "pull outs" due to thermal changes. These problems can be greatly reduced by proper training and follow-up inspection after all splicing. Key points for inspection should be center siezure tightness, connector tightness and weather proofing application. 2) Those which are caused by uncontrollable circumstances such as car/pole incidents, high wind or heavy loading conditions. For this type of outage it is imperative to have on hand the necessary equipment to effect the repairs to re-instate service. You should also have on hand a list of construction contractors who could, on short notice, react to emergencies beyond the scope of the system technical personnel.

d) Cable failure is uncommon as a normal failure, however, rodent damage, vandalism and other forms of breakage do occur. The best preventative action is to inspect the physical plant on a regular basis both from a mechanical viewpoint and the radiation of signals. The latter method is the preferred as it will point up small cracks in the sheath of the cable prior to a breakage occurring.

e) The best prevention of this type of failure is accomplished during the system planning stages. If your system will be subjected to high wind loading or heavy ice loading care must be taken in proper selection of drop cable and associated hardware. Remember, the drop system is as important as the cable system itself and can be the weakest link if not properly planned. Messangered drop cables are available for long drops and for use under the adverse conditions stated above.

2. System Performance
   a) Head End Equipment
   b) System Electronics
   c) System Interfaces
   d) System Passives
   e) Converter or In Home Devices

The above comprises the basic building blocks of the system which require periodic maintenance. In the following evaluation it is important to keep one thing in mind. The final determination of systam quality is made at the subscriber level. While system numbers (ie: beat ratios, noise, cross-modulation,etc.) are important tools to the technician for evaluating his system performance, the viewed picture is the final product which

must be delivered and maintained!

a) The Maintenance routine must begin with a physical inspection of the tower installation. It is not necessary to climb the tower for each inspection, although periodic close inspection should be made of connectors, weather proofing and mounting hardware. The normal inspection can be made from the ground with a good pair of binoculars (the power of which is determined by the tower height). The inspection should begin with the most obvious faults, broken antenna elements, unsecured electronic or passive devices, unsecured down leads, loose or broken wench lines and general condition of tower structure and associated guy wires. A few moments should be taken during the close inspection to boldly mark the antenna mounting interfaces with paint to enable the technician to determine proper position during ground inspections (CATV antenna configurations are generally of a relatively narrow beam width and a few degrees of movement can cause signal degradation.) Search antenna rotation should also be checked during all inspections to insure operation when needed.

   After completion of the inspection of the tower installation, an inclosure inspection should be performed to evaluate general condition, noting any required repairs. This must include environmental control devices such as heaters and air-conditioners.

   If stand-by powering devices are installed, check them for proper operation. In the case of a gasoline driven generator, start it and allow it to run during the balance of the maintenance routine at the head end.

   To start the electrical evaluation, all input and output levels are to be checked, comparing them against the levels recorded at the initial system set up. Adjustments should be made to the output levels of all devices as needed to return them to the initial levels. Remember, devices which require frequent or excessive adjustment are probably leaning toward failure. Do not wait until it fails, take action to correct the deficiency at once!

   The next step in the Head End evaluation is to inspect the picture quality. In many cases this is performed in a rather loose fashion, not being critical. Since this evaluation is essentially what the subscriber is doing on a daily basis, it should recieve adequate time and consideration. All impairments must be recorded when viewed and investigated as to cause and cure. Electrical properties such as multipath ghosting, co-channel, off air beats and head end generated beats, noise levels, AGC/AFC control windows and frequency stability must also be tested on a less frequent basis.

b, c & d) These areas can be checked by two simple tests 1.) Picture quality as viewed by the subscriber at pre-selected key system location and additional random locations. The quality evaluation should be augmented with recorded levels at the pre-selected key locations. 2.) System radiation testing as covered in the NCTA publication "Signal Leakage and Interference Control". Locations for this test should be random throughout the system to include trunk, feeder and drop locations and should be changed for each test period.

   On a less frequent basis, the major system parameters should be tested in detail. As a minimum, frequency vs. gain (both narrow and wide band), signal to noise ratios, carrier to cross-modulation and low frequency components (60 and 120 cycle) must be checked and recorded. For more complex systems, group delay, differencial gain and phase, echo and ingress testing may be added to the list.

e) The subscriber drop system is basically a physical inspection for worn drop cable, loose connectors, staples entering the shield and mounting hardware such as ground blocks and clamps. This inspection can be quickly made during the testing of b, c & d above.

In scheduling test periods remember that the first year of operation is the most critical. The first impression of the subscriber is the most lasting. It is for this reason that I suggest more frequent testing during this period.

For the sake of simplicity, I shall refer to testing and inspections, other than major parameter measurements, as "mini tests" and those which involve large amounts of equipment and time as "maxi tests". The following might be the basis for a 5 year plan of scheduled maintenance:

Year	Mini	Maxi
1	52	4
2	26	3
3	13	2
4	13	2
5	13	2

At the close of each year, an evaluation of the program effectivness should be made and the schedule adjusted accordingly.

There are many test methods for maxi testing, using various cost reletive equipment packages which are industry accepted as yielding valid results. The methods for your particular system should be selected according to cost, technician competence and availability (you may choose to rent test equipment on an as needed basis, thus rental availability is very important.) Once methods are selected they must not be varied test period to test period. Variations in methods of testing may yield variations in results which are not comparable to previous tests performed.

Record Keeping

Through this paper various areas of inspection and testing have been referred to, with the intent to "satisfy the subscriber" with a full time quality product. All of these steps are in vain if five years from now you are unable to establish their effectivness.

The most important record, other than that of payment, is the "Service Call Record". If it is properly thought out and filled out, the SCR will tell you the cost of service calls and the weak points of the system causing this cost. The SCR should include:

1. Date and time initiated
2. Basic complaint
3. Customer name and account number
4. Date and time given to technician
5. Technicians report of failure
   a) Fine Tuning
   b) Set Problem
   c) Drop Failure
   d) Distribution System Failure
   e) Trunk Failure
   f) Power Interruption
   g) Head End Failure
   h) Other
6. Corrective action taken
7. Date and time completed
8. Customer signature

At the end of each week a consolidation should be made showing:

1. Total number of SCR's
2. Total of each type of failure and percentage of total SCR's
3. Total time expended
4. Disconnects due to service problems

This report can be a valuable tool to management. For example if 50% of the service calls involve fine tuning of TV sets, he may choose to send out information bulletins to the subscriber base for training purposes, thereby reducing service cost in this area and applying it to the preventative maintenance area.

Records of both mini and maxi test results and dates should be consolidated on a running spread sheet for direct comparison purposes. This record will show up degredation trends at a glance.

Remember, also, that test equipment requires maintenance and calibration. Records of this must also be kept.

When laying out your record keeping program, first establish your objectives and then devise your forms to provide the desired information in an easy to read format. Cumbersome, long and complicated forms very seldom get filled out completely or properly. Use basic catagories and "check blocks" where ever practical.

Summary

The topic of Practical Routine Maintenance is a very broad one and can be very "dry", but is very important to the success or failure of a CATV system. In the practical world a satisfied customer is a paying customer, thus I have invented a new formula, for those who like equations,

$$PM + PA = SS$$

"Preventative Maintenance plus Positive Action equals Satisfied Subscribers" which is the entire point of this paper.