TOPIC 6

SYSTEM DIAGNOSIS AND QUALITY CONTROL

INTRODUCTION

As mentioned in previous topics, the primary function of a technical control operator is to provide and maintain reliable and stable communication links for the user. Using available testing equipment and proper system diagnosis is the backbone of this function.

GENERAL APPLICATIONS

The term *technical control* applies to both the function and the physical area.

The *function* is the coordination, operational control, and supervision of communications facilities, including the performance of tests and the restoration of service in accordance with the operational requirements and procedures.

The *physical area* is the space occupied by equipment and facilities that enables technical control personnel to perform these functions.

The Technical Control Facility (TCF) supervisor must be aware at all times of the status of the circuits and equipment operating within the facility. When trouble develops on a communications circuit, the TCF operators must apply their knowledge of equipment in the most logical manner possible to effect prompt circuit restoration.

SUPERVISION OF TRANSMISSION QUALITY

The TCF is responsible for circuit, equipment, and system tests to determine the operating condition of all circuits and equipment within the station, as well as all circuits passing through the station. Circuits that have deteriorated to the extent that service to the user is interrupted are removed from service. The technical controller then makes temporary substitution of facilities, if available. As a follow-up, report any equipment or components that are measured and found to be out of tolerance to the appropriate maintenance section. Routinely, the technical controller notifies maintenance personnel of any inactive circuits or equipment found to be below standards during the quality control tests. With this approach, all equipment and circuits can be maintained at a level of peak performance at all times.

EQUIPMENT SUBSTITUTION

When equipment failure occurs on operational circuits, technical control personnel must make equipment substitutions after removing defective items from service. User service can normally be restored quicker by equipment substitution than by trying to make immediate repairs on faulty equipment. Equipment substitution also provides the opportunity for maintenance, scheduled or unscheduled, that might otherwise be impractical because of operational requirements.

CIRCUIT ROUTING

During extended outages, individual circuits are rerouted over other facilities in accordance with their restoration priority. Every circuit is assigned a restoration priority in accordance with DCS policy. The TCF is responsible for restoring service with a minimum loss of operating time. The TCF will test, monitor, and observe outgoing and incoming circuits and channels, as necessary, to isolate and report troubles. Record all service interruptions, regardless of duration, in the master station log or the trouble and restoration records, as appropriate.

FAULT ISOLATION

Fault isolation is the process of determining the location of a trouble within a network, circuit, or transmission media carrying the circuit. The trouble could be in any of the transmitting facilities of one station, the receiving facilities of the adjacent station, the media connecting them, or a user's equipment that terminates the circuit.

Each TCF is responsible primarily for the receive side of all circuits at the installation.

If the circuit is not operating satisfactorily, the technical controller will analyze the circuit to determine the trouble. The technical controller at the receive station then proceeds as follows:

1. Coordinate with the distant technical controller to stop traffic and make tests to determine the quality of the circuit between the connected TCFs. If the circuit does not meet standards, restore service to the user either on a spare path or by preemption of a lower priority circuit when a spare path is not available.
2. If the path between the connected TCFs meets quality standards, analyze the circuit between their respective stations and the connected users to locate the trouble. Upon completion of circuit or equipment repairs, and when the circuit meets quality standards, restore normal service to the user.
3. When an interconnected circuit passes through a number of control centers, the technical controller in each center is responsible for the interconnections made. However, the technical controller in the center immediately serving the complaining user coordinates the activities in all centers involving that particular circuit.

The first step in fault isolation is to recognize that a problem exists. Trouble recognition may be a result of quality control testing, equipment sensors and alarms, user complaints, or any combination of these. Coordinated action to identify the location of the problem is initiated immediately by the operator recognizing the trouble.

NAVSECGRU and SPINTCOMM TCFs have many different types of equipment that perform identical functions, but they do not necessarily have the same electrical characteristics. Because these detailed differences exist, there are no universal fault isolation procedures to cover all possible installations. Each station develops local fault isolation procedures, based on the particular type of equipment installed in that station, the design capability of each link or system, patch panel and test point appearance, and test equipment availability. The procedures should contain appropriate diagrams indicating the test tone levels, impedance, operating levels, calculated noise, or Bit Error Rate (BER) specifications for each test point throughout the station. The procedures should clearly show those functions performed by TCF personnel and those accomplished by maintenance support elements. The TCF supervisor provides technical supervision for all fault isolation.

Each station has ready reference charts to assist personnel at the TCF in visualizing the possible reroute paths available. These records must be available to them for immediate reference. These reference charts should include circuit layout cards, block diagrams, and route maps. Additionally, circuit folders should be available to the watch, showing the required test level point, signal levels, group noise levels as derived from original Test and Acceptance (T&A), latest Technical Evaluation Program (TEP) or baseline data, BER, and allowable tolerances. Data recorded during the initial T&A of the system, the last major realignment, or the measurements made during a technical evaluation will be used as the standard against which fault isolation measurements are applied. The reference chart is normally prepared by the engineer who designed the link or who conducted the T&A. A copy of the chart, depicting the calculated idle channel noise versus the median receive signal level for each Voice Frequency (VF) group terminating in the station for Frequency-Division Multiplexing (FDM) and BER, is a valuable tool for the TCF and should be available.

Correct input and output signal levels must be maintained. A single-voice channel operating with excessive signal levels can disrupt the entire baseband. In fact, high levels can disrupt other links or systems through which that circuit is routed. A change in signal level at one point will affect the level at all subsequent points in the system. Signal level adjustments will not be made without complete coordination with all locations that can be affected. Equipment adjustments by the technical controllers will normally be limited to operational controls necessary for proper circuit operation (such as line current levels,

composite audio level, mode changes, channel reduction, and conditioning equipment).

REPAIR SERVICE

The technical controller is NOT responsible for performing repairs. The technical controller's initial responsibility is satisfied when he notifies the authorities and routes circuits to maintain service. However, good service to the user is not measured by how quickly the technical controller can restore service; it is measured by the infrequency of service interruption.

If there is a tight schedule of circuit on-line tests, the technical controller will have first-hand knowledge of circuits that are nearing the limits of tolerance. By taking preventive action, the technical controller can forestall trouble before it occurs and provide the best possible service to the users.

If the first indication of trouble is a complaint by the user, the technical controller may have failed in his duty. If the technical controller performs his duties well, he will be aware of developing problems before they occur and will take preventive actions. However, expect that equipment and circuit breakdowns will occur without notice. These incidents are not considered to be the fault of the circuit controller. The technical controller's final responsibility to the user is satisfied only when the user accepts the circuit and verifies that it meets requirements.

The technical controller performs many tasks in addition to the major duty of control. He is responsible, among other things, for adequacy and accuracy of operating records, for housekeeping in his work area, and for the maintenance of the patchcords and equipment used by the operator. However, none of these duties are as important as the single duty of providing reliable and secure service to the system users.

GUIDELINES

The following guidelines are for use in preparing local procedures and in determining the location of the equipment or medium causing service degradation. It may not be necessary, however, to take each step in the order listed. Depending on the trouble indications, some steps may be taken in a different sequence, combined with other steps, or even eliminated completely. When a problem is recognized, a controller's first question should be, "Does the problem affect only a single circuit or channel or user, or an entire group, digroup, or supergroup or set of users?" and then, "Is the circuit, group, digroup, or supergroup meeting the standards through my station?" The controller must then take the actions necessary to answer those questions. All steps should be taken in complete coordination with the other stations through which the service is routed and with the local maintenance section.

When the TCF discovers that a circuit or a multiplex group is not operating in the prescribed manner, appropriate in-service monitoring tests and checks will be performed to determine the extent of the fault and its general location. The TCF determines whether a single channel or an entire multiplexing group is affected. The goal is to locate and correct faults before service becomes unusable. TCF personnel must be aware of all circuit idiosyncrasies within a particular station, and of each circuit's end-to-end path. They must also have a working knowledge of station test equipment to ensure quick circuit restoration. Further information and guides to circuit fault isolation are in *DCS Technical Control*, volume II (*Procedures, Test Descriptions*), DCAC 310-70-1, supplement 1.

QUALITY CONTROL (QC)

To provide effective worldwide service to users of the DCS, each individual segment of the system must be operated and maintained at its specified operating level. The DCS concept for QC is to prevent interruption to user service by detecting and correcting adverse trends before user service is affected. Quality control is the function by which performance is measured and results compared against established standards. Optimum performance is achieved and maintained by thorough testing and analysis of those test results. An effective quality control program consists of scheduling prescribed tests, measuring specific parameters, comparing recorded measurements against applicable standards, analyzing trends, and directing corrective actions where indicated.

DCS TECHNICAL SCHEDULES

The DCS technical schedules are itemized listings of all the common services and circuit parameters. These DCS technical schedules apply to all U.S. Government-owned and -leased circuits within the DCS, with the exception of voice circuits on High-Frequency (HF) systems. DCAC 300-175-9, *DCS Operating-Maintenance Electrical*

Table 6-1.—DCS Circuit Parameter Code Cross-Reference

This table shows the old DCS circuit parameter codes and identifies the equivalent new codes.

NEW DCS PARAMETER CODE	OLD DCS PARAMETER CODE
C0	S0
C0	V1
C1	D2
C1	V2
C2	D1
C2	S1
C3 (Access Line)	S3 (Access)
CT (Trunk)	S3 (IST)
C4	S2
D1	HP
G1	Z1
G2	Z2
G3	Z3
J1	A1-A2
J2	A1-A9
J3	None
J4	None
M1	M1
M2	M2
M3	M3
N1	N1-3
R1	None
R2	None
R3	None
S1	None
S2	None
S3	None
S4	None
S5	None
W1	W1
X1	X1
X2	X2
Y1	Y1
Y2	Y2
Y3	Y3
Y4	None
Z4	Z-4
	(Analog/Digital)
Q1	C1/J1
Q2	C2/J1
Q3	M3/J1
Q4	M1/J1
Q5	C0/M1, J1
Q6	C0/J1
Q7	C2/J3

Performance Standards, describes the type of service provided by each circuit performance code and the required performance parameters. Table 6-1 shows the old DCS circuit parameter codes and identifies the equivalent new codes.

IN-SERVICE QUALITY CONTROL TESTING

In-service QC testing will be performed every 72 hours on the send signal levels of all active circuits by each servicing TCF. Normal user traffic signals and composite transmission levels are some of the parameters that can be measured without interruption of service and compared to levels normally found at the Transmission Level Point (TLP). Circuits should be monitored for abnormal conditions, taking care not to interrupt the data flow to the user.

The technical controller will analyze the test results to determine if corrective actions are required to bring the circuit within the DCS standards as specified in DCAC 300-175-9 or original T&A specifications. Level-sensitive equipment on the circuit path should not be adjusted using the user signal as a standard. The total circuit should be considered during the isolation of circuit problems during in-service QC testing. This may require rerouting the circuit, substituting equipment on the normal path, or obtaining a user release of service to take the circuit out of service for maintenance.

If the user cannot release the circuit because of traffic conditions or mission requirements, and states that the circuit is providing usable service, the technical controller will make arrangements with the user for release of the circuit as soon as traffic conditions or mission requirements permit.

The technical controller will advise appropriate maintenance elements and connected TCFs of the substandard condition of the circuit and of the projected downtime.

Table 6-2 contains the minimum test requirements. TCFs will develop detailed schedules for

Table 6-2.—Circuit Quality Control Test Schedule

	C0[2], C1[2, 3], C2, C4, M1-2, C3, CT, D1, M3					
	T&A	IN	OUT	T&A	IN	OUT
Transmission Level[4]	I	72		I	72	
Test Tone Level[5]	I		A	I		Q
Frequency Response	I		A	I		Q
Envelope Delay[6]	I		A	I		Q
Signal to C-Notched Noise Ratio	I		A	I		Q
Maximum Net Loss Variation	I		A	I		Q
Maximum Change in Audio Frequency	I		A	I		Q
C-Message Noise	I		A	I		Q
C-Notched Noise	I		A	I		Q
Impulse Noise	I		A	I		Q
Terminal Impedence	I		AR	I		AR
Data Transmission Level	I		AR	I		AR
Nonlinear Distortion[7]			AR			AR
Phase Jitter[7]			AR			AR
Gain Hits[7]			AR			AR
Phase Hits[7]			AR			AR
Drop Outs[7]			AR			AR
Gain Linearity at Input[7]			AR			AR
Signal to Quantizing Distortion[7]			AR			AR
Circuit Continuity[7]			AR			AR
Cross Modulation[7]			AR			AR
Maximum Operating Signal Level[7]			AR			AR
Peak to Average Ratio (PAR)	I		A	I		Q

Footnotes at end of table.

Table 6-2.—Circuit Quality Control Test Schedule (continued)

WIDEBAND CIRCUITS G1, G2, G3	G1, G2, G3 (WIDEBAND)		
		SERVICE	
	T&A	IN[8]	OUT[9]
Signal Plus Noise/Noise	I		SA
Impulse Noise	I		SA
Net Loss Variation	I		SA
Attenuation Line-up Loss[5]	I		SA
Envelope Delay			SA
Nominal Data Level	I	72	SA

GROUP BANDWIDTH X1, X2	X1, X2 (GROUP BANDWIDTH)		
		SERVICE	
	T&A	IN	OUT
Frequency Response	I		AR
Envelope Delay	I		AR
Amplitude Stability	I		AR
Maximum Frequency Offset	I		AR
Impedance	I		AR
Return Loss	I		AR
Interface Transmission Level Point	I		AR
Phase Jitter	I		AR
Random Noise Unweighted	I		AR
Impulse Noise	I		AR
Average Long-term Power	I		AR
Maximum Operating Signal Power	I		AR
Maximum Test Tone Power[5]	I		AR
Pilot Frequency	I	D	AR
Line-up Loss	I		AR

Footnotes at end of table.

Table 6-2.—Circuit Quality Control Test Schedule (continued)

		DIGITAL							
		S1, S2, S3, S4 S5, R1, R2, R3		J2, J3, J4, Z4		J1[12], Y1, Y2, Y3, Y4, W1		N1	
DIGITAL CIRCUITS	T&A	SERVICE IN	OUT	SERVICE IN	OUT	SERVICE IN	OUT	SERVICE IN	OUT
BIT Error Rate[10]	I		AR		Q		A		
% Error Free Sec	I		AR		Q		A		
Block Size	I		AR		Q		A		
Sync Time	I		AR		Q		A		
Interchange Differential Delay	I		AR		Q		A		
Loop Transport Delay	I		AR		Q		A		
Total Peak Telegraph Dist[11]	I							72	AR
Mark/Space BIAS Dist[10]	I								AR
Voltage Level	I								AR
Mark/Space Current Level	I								AR
Data Rate	I								AR
Data Signal Level	I							72	AR

Footnotes to Table 6-2, Circuit Quality Control Test Schedule

1. I = Initial Test and Acceptance (T&A) and new baseline data
   D = Daily
   72 = Every 72 hours
   W = Weekly
   M = Monthly
   Q = Quarterly
   A = Annually
   AR = As required
   SA = Semiannually

2. Quality control testing on single point-to-point voice circuits, regardless of the number of tandem systems traversed, will be conducted twice yearly.

3. C1 parameters will be used for out-of-service testing of spare unconditioned VF channels and circuits on analog systems unless otherwise specified.

4. Certain voice circuits use tone-on-while-idle supervisory signaling and will normally have a signal, with speech or tone, present. Measurements will be made at the monitor jack, as false rings will be caused by breaking the supervisory tone. The normal speech level is −12 VU with peaks to −6 VU at a 0 Transmission Level Point (TLP). The normal tone-on-while-idle signal level is −20dBm0.

5. Test tone measurements will be made before any other out-of-service test measurements. Test tone levels measured during scheduled out-of-service QC tests must be adjusted within plus or minus 1 dB of the level expected at the TLP where the measurement is made. Test tone level on circuits that traverse multiple links will be adjusted to within plus or minus 2 dB of the expected level.

6. Envelope delay distortion generally has little or no effect on narrowband VFCT operation (such as AN/FCC-19 and AN/FGC-67). TCFs may elect not to perform periodic delay distortion measurements on those circuits used exclusively for narrowband VFCT operations.

7. This test should be accomplished if other measured circuit parameters are within limits and troubles persist.

8. All 72-hour in-service QC checks will be conducted only on interswitch trunks.

9. Quarterly QC tests will be conducted only on WB circuits that have active circuit elements, such as amplifier-equalizer metallic circuits (short subscriber tails which do not require equalizers). Others will be tested on an "as required" basis.

10. Bias distortion and BER tests shall be performed on one spare part of each LSTDM system or AN/FCC-100 unit per radio day.

11. Normal day-to-day technical control actions may satisfy in-service requirements for active dc circuits. Spare dc circuits will be tested for total peak distortion at least once every 72 hours. Using a spare dc channel for reroute or establishing an on-call circuit may satisfy this requirement.

12. J1 circuits in support of jam-resistant secure communications will be out-of-service, quality control tested quarterly.

Table 6-2 is a list of test descriptions, as presented in DCAC 310-70-1, supplement 1, showing applicable parameter codes. Parameter codes are not applicable for all of the test descriptions. The list will be revised to include new parameter codes and test descriptions when they are developed.

Test description numbers are developed as follows:

TD	Indicates "Test Description"
TD-1	Indicates the first parameter (frequency response)
TD-1NB	Applies to narrowband VF (300-3400 Hz) channels
TD-1WB	Applies to wideband (0.01-50 kHz) channels
TD-1G	Applies to group (60-108 kHz) channels
TD-1SG	Applies to supergroup (312-552 kHz) channels
TD-1T	Applies to dc telegraph circuits
TD-1M	Applies to modem tests
TD-1D	Applies to digital tests
TD-1S	Applies to analog signaling tests
TD-1E	Applies to echo return loss tests

QC testing to satisfy these requirements. The TCF may increase the frequency of testing as necessary to ensure required standards are maintained. Test requirements may be satisfied by use of automatic measuring equipment that measures circuit parameters and provides a record copy of the readings or alarms when pre-set thresholds are exceeded.

Record, by exception only, in-service QC test results. If a user's signal level is not within DCA-specified standards, or if the circuit has an abnormal condition present, record circuit Command Channel Service Designator (CCSD), the signal level or an abnormal condition, and the corrective actions taken on an individual trouble or fault. Document accomplishment of in-service QCs in the Master Station Log (MSL).

OUT-OF-SERVICE QUALITY CONTROL TESTING

The designated Communications Control Office (CCO), in concert with the DCA area, schedules out-of-service QC testing on all circuits for which control responsibility has been assigned. Periodic out-of-service testing permits end-to-end realignment of circuits to meet applicable DCS circuit parameters. Out-of-service testing may require user release of the circuit. If service is to be maintained by pre-empting a lower priority user, notify the user of the circuit to be pre-empted beforehand. Selected out-of-service, and end-to-end tests, as determined by the TCF, are required after a transmission media failure when equipment or links are suspected of being faulty, and when deemed necessary by the TCF to ensure optimum operation of the DCS. Table 6-2 is intended as "minimum essential."

END-TO-END TESTING

End-to-end testing refers to the point nearest the user terminals at each end of the circuit where the capability exists to perform required testing. Often, this may be the servicing TCF or PTF. End-to-end testing for test and acceptance will be performed at the user terminal in all cases. The servicing TCFs or PTFs determine the point at which future end-to-end test measurements are made for each circuit.

End-to-end testing is performed on DCS circuits. However, when performance of the transmission media (hybrid analog and digital) cannot be determined by end-to-end testing (i.e., circuits interfacing with the channel-packing subsystem), segmented testing will be conducted. Segmented testing refers to separating the circuit into identifiable sections, such as tail segments, transoceanic segments, and Government-owned and -leased segments.

When tail segments between the TCF or PTF and the user cannot be readily tested on a scheduled basis, the user loop from the TCF or PTF will be tested to determine loop characteristics with the same test required for the circuit on an end-to-end basis. Data obtained from this test is retained in the circuit history file with T&A data for reference during subsequent tests or troubleshooting.

DCS users should operate with DCS TCFs or PTFs in the performance of T&A and scheduled or unscheduled circuit testing. The extent of user participation depends upon availability of test equipment and qualified personnel at the user location.

SEGMENTED CIRCUIT TESTING

The technical characteristics of transmission subsystems (hybrid analog and digital) preclude valid end-to-end circuit QC testing. Segmented testing of the transmission route and the circuit tail segments is necessary.

The CCO assigned to each circuit in the trunk will schedule periodic out-of-service QC tests for the tail segments between the end users and the TCFs or PTFs providing the channel-packed route.

If an alternate route is not available, trunk and circuit QC tests will be scheduled within the same time frame to reduce overall user circuit outage.

Periodic out-of-service QC tests on circuit tail segments terminating within, or adjacent to, the servicing TCF may not be necessary. However, if the servicing TCF suspects that the quality of the circuit tail segments is not within required specifications, QC tests for that segment should be scheduled. As a general rule, all circuit tail segments provided by commercial carriers and those extended off station should be scheduled for periodic QC testing. Quality control test schedules should be fully coordinated between the CCO and the distant and servicing TCF.

Digital circuits, whether or not designed with intermediate analog transmission media segments, will be tested end-to-end to meet parameters

specified in paragraph 2f of the TSO. An asterisk placed after the parameter code in paragraph 2f indicates that additional instructions for aligning the circuit path are provided in paragraph 5 of the TSO.

Analog circuits with intermediate digital segments that will not allow normal VF testing should be tested on a segment basis for the analog or digital parameters specified in the TSO. End-to-end BER testing is only required for initial installation. To minimize user disruption on circuits with multiple VF segments, the circuit CCO will schedule all segments and coordinate all out-of-service testing.

Analog circuits with intermediate digital segments that will pass VF test signals will continue to be tested in accordance with the QC test schedule.

Intermediate bridged trunks of analog circuits will be segment tested for the analog parameters specified in the TSO. End-to-end testing will be performed on initial installation during T&A. Subsequent end-to-end testing is required only when measured parameters of circuit segments under test are within parameters and troubles persist.

The TSO is the only vehicle that establishes the circuit parameter codes. Parameter codes are assigned each circuit to provide technical standards for testing or checking operational performance end-to-end. This parameter code will be used for testing analog, analog-digital, or digital circuits.

ORDER OF TESTING

The order of testing should be performed in a logical sequence, starting with the tests that find the majority of all circuit problems. Since most circuit problems are level- or noise-oriented, this is where testing should begin. Out-of-service QC testing should be performed in the following order:

1. Test tone level.
2. Idle channel noise or signal to C-notched noise ratio, depending on type of circuit.
3. Impulse noise (with holding tone).
4. Envelope delay (when applicable).
5. Frequency response.
6. All other required tests.

SATISFYING TESTING REQUIREMENTS

QC testing performed in accordance with other DCA and O&M programs, or complete realignment of a circuit as the result of a circuit outage (within 15 days of scheduled time), may satisfy the minimum requirements established in table 6-2. In such cases, it is not necessary to perform the same test measurements merely to satisfy the scheduled out-of-service tests (table 6-2), as long as the test results are documented in the circuit history folder.

TEST SCHEDULE FLEXIBILITY

Test schedules must be flexible enough to allow for non-availability of test equipment, circuit outages, and other situations. Failure to complete the circuit testing within 15 days of the scheduled testing date does not eliminate the responsibility to perform the circuit test.

RECORDING AND RETENTION OF TEST RESULTS

DD Form 1697 (Circuit Parameter Test Data), and DD Form 2097 (Voice Channel Impedance Graph) will be used to record T&A data for initial acceptance of service. These forms will be marked as initial T&A data. They will be maintained on file with the corresponding TSO in the circuit history folder for the life of the circuit or trunk. If T&A data are not available, the first-out-of-service QC will be recorded as the baseline test data.

Any time a circuit path changes or is materially altered and invalidates the T&A data, the CCO will initiate end-to-end testing to establish a new baseline for the circuit. Testing will include all tests required for T&A and will replace the original data.

DD Forms 1697 and 2097 will be used to record QC test data. All servicing TCFs and PTFs (closest TCF or PTF to each end-user) will retain on file, in the circuit history folder, all completed QC test data forms that reflect test data on the technical schedule circuit parameters designated in the TSO for all tests conducted during the last 12 months.

DD Forms 1697 and 2097 will not be forwarded to DCA or to O&M elements when scheduled or unscheduled QC testing is performed, unless the TCF is asked to do so for specific circuits and for specific periods of time.

TCFs may use a computer-driven product in place of the DD Forms 1697 or 2097, provided all the information required on the DD form is included in the substitute product.

REPORTING QUALITY CONTROL TESTING OUTAGES

All outages attributed to QC testing will be reported in accordance with current requirements established in DCAC 310-55-1, *Status Reporting for the Defense Communications System*.

Out-of-service QC testing is expected to be completed within 2 hours. When additional time to accomplish tests is justified, appropriate DOCC elements are authorized to allow 1 additional hour to complete the QC testing.

The time authorized to perform QC testing does not include time to correct deficiencies identified as a result of the testing. Minor adjustments may be made to circuits or equipment if the overall time for the outage does not exceed the authorized time.

When QC testing shows that a circuit does not meet the specified parameters and requires corrective action, the testing effort will be terminated. The circuit will be logged back "in" with the Reason For Outage (RFO) for an authorized outage. A new "out" report will then be submitted with the actual reason for outage (e.g., defective equipment). The *out* time will be the same as the previous *in* time. This will reflect continuous outage.

PERFORMANCE ANALYSIS

The DCAC 310-70-57, *DCS Quality Assurance Program* encompasses

> monitoring the operation of DCS transmission links using critical operating parameters as performance indicators,
>
> analyzing test data, and
>
> - developing performance trends.

Each TCF maintains a current copy of DCAC 310-70-57, and will be familiar with the procedures, methods, and practices.

TREND ANALYSIS

Government and commercial analysis of QC, quality assurance test data, and outage records is performed by the servicing TCF on as near a real-time basis as possible to identify degrading trends on all circuits. An aggressive trend analysis program may reveal specific systems or circuits where more frequent application of the QC program is warranted. It is the responsibility of the DCA areas and O&Ms to increase the QC time intervals on selected circuits to ensure maximum usage of minimum personnel and test equipment.

Use of in-service quality control test data is one way to identify degradation, since measurements can be taken and recorded without interrupting the user. Measurements of each quality control test are compared with measurement standards. If a deviation is noted, but the circuit is still providing satisfactory service, it should be flagged for closer scrutiny. One substandard measurement does not constitute a trend. If further changes are indicated after several measurements are taken, a degrading trend is evident and corrective action should be initiated.

Trend analysis should not be limited to QC test measurements. Trends can be detected from the outages over a given period of time. The length and frequency of outages can be an indication of a trend and should be considered in this analysis.

Trend analysis can determine whether large numbers of outages are occurring in the same time frame. This analysis should be performed if large numbers of outages are not reduced, despite repeated attempts to locate and correct the deficiency.

To simplify analysis, data may be transposed from worksheets to a line or bar graph or to some other management tool (such as a computer runoff) to give the history and to present

quality of a given circuit or channel at a glance. Comparison with all other channels of a particular group will indicate the general quality of the group.

Figures 6-1 through 6-4 are examples of typical graphs that may be used for trend analysis.

TEST AND ACCEPTANCE OF NEW EQUIPMENT

Integration of new equipment into a TCF is accomplished in some area of the world daily. To ensure technical and operational compatibility, the TCF chief will supervise an evaluation test of

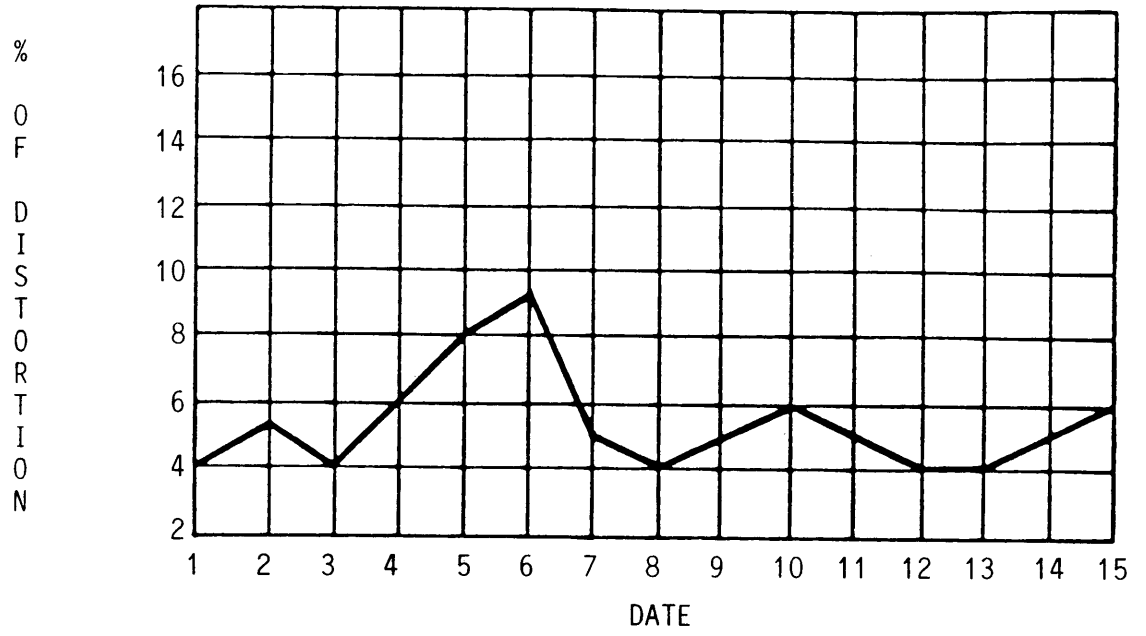

Figure 6-1.—Trending peak distortion.

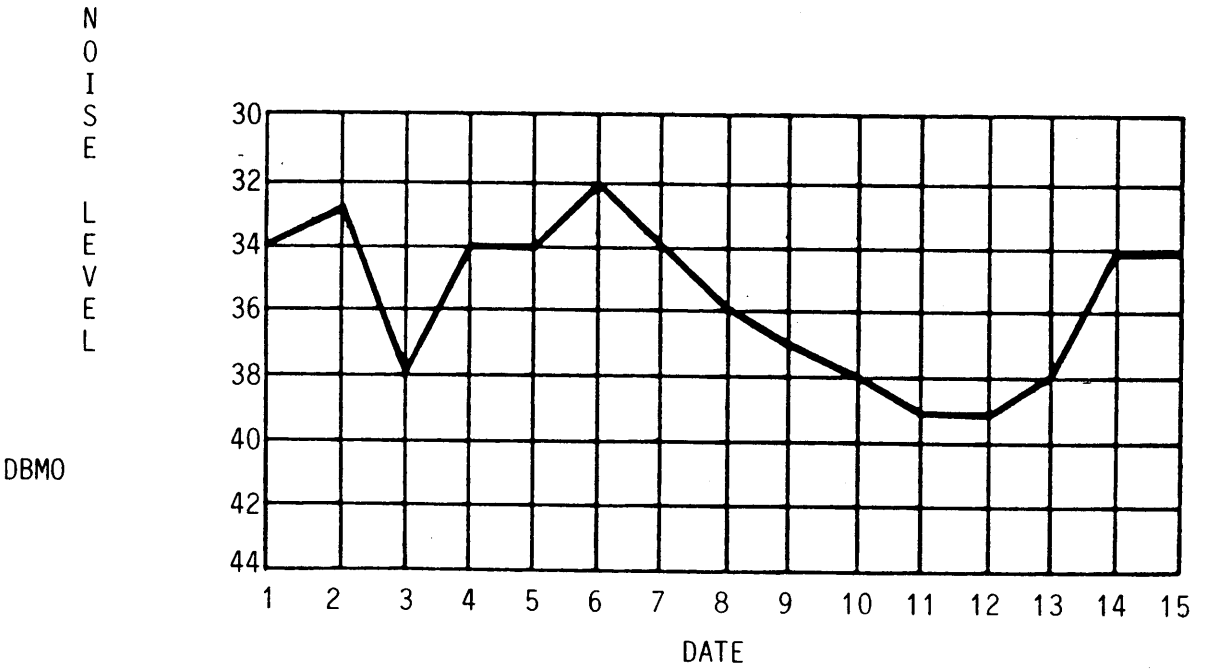

Figure 6-2.—Trending noise level.

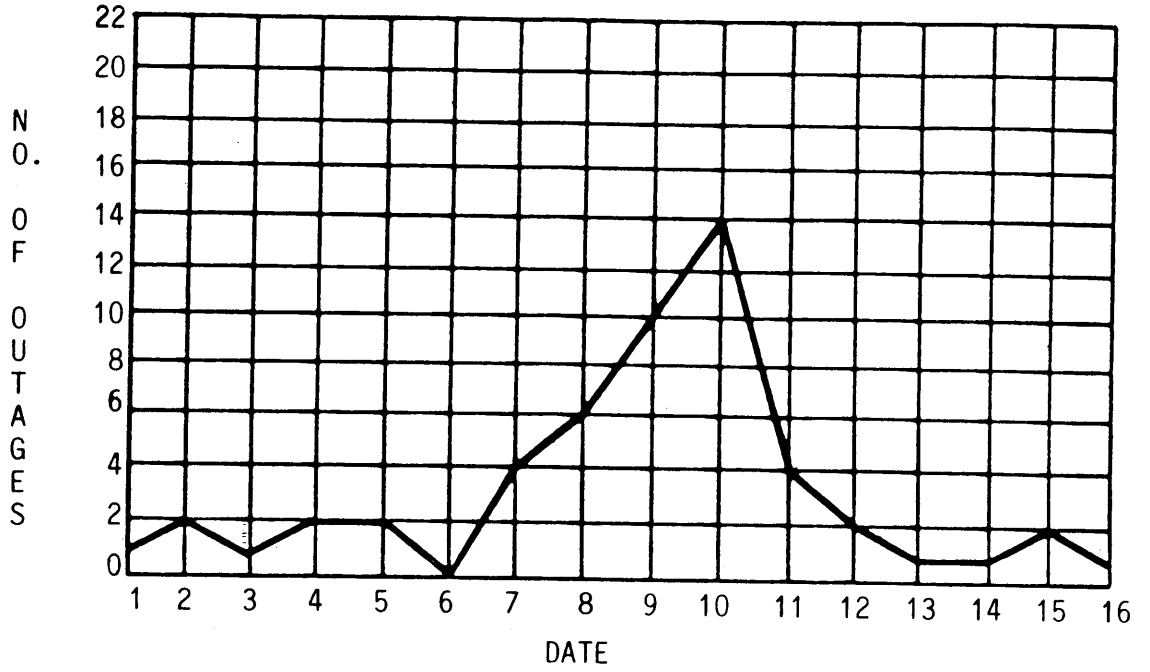

Figure 6-3.—Trending number of outages.

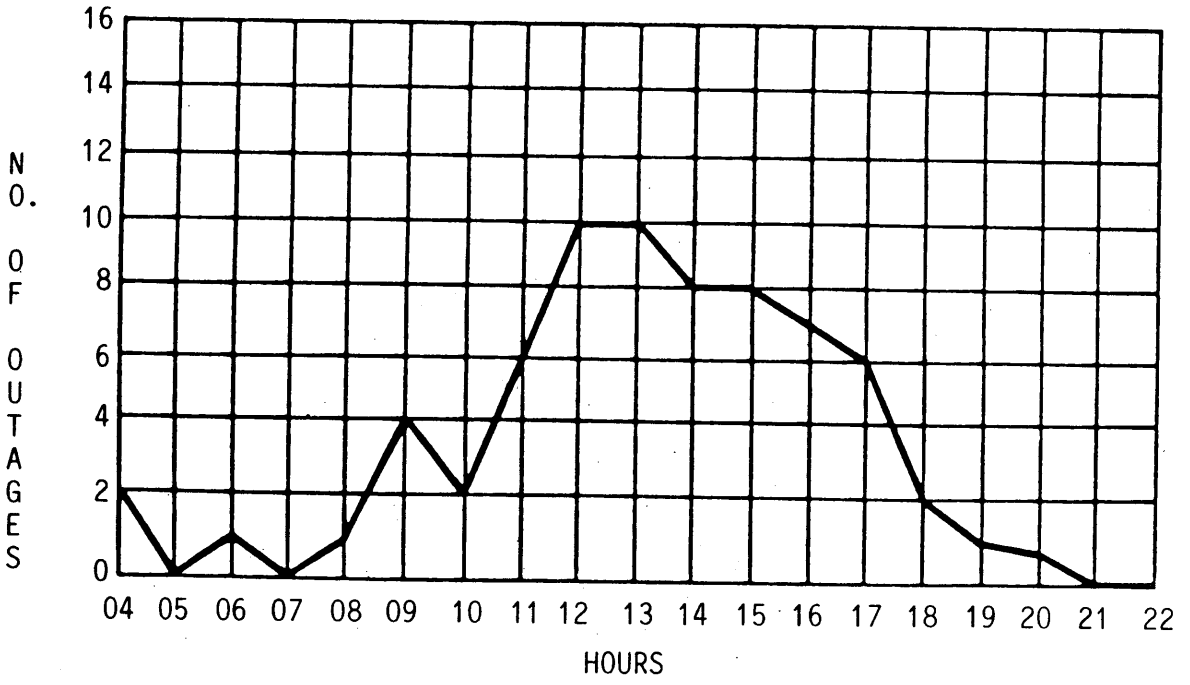

Figure 6-4.—Analysis of number of outages in relationship to the time of day.

equipment before it is placed on-line for traffic. This includes the following:

All quality control tests that are normally performed on the new item of equipment.

- Back-to-back and looped tests, as appropriate.
- Preparation of quality control [illegible] the new equipment.

Coordination with other stations, as required, concerning the addition of new equipment into the system.

- Testing of all circuits that require conditioning to ensure that the proper transmission parameters are maintained after the new installation.

- Coordination with all users prior to any cutover or testing regarding scheduling circuit outage.

- Maintenance of the TCF files for ready reference, and all test and acceptance data of the newly configured circuit.

QUALITY CONTROL AND PERFORMANCE MONITORING MANAGEMENT

QC and performance monitoring are the responsibilities of each technical controller. The technical control shift supervisor is responsible for ensuring that scheduled testing is performed. The shift supervisor advises the TCF chief of problem areas on circuits or systems that might require further testing. The importance of these programs cannot be overemphasized, as they are the primary means of reaching the basic objective—providing the best possible service to the DCS user.

Stations will prepare local instructions outlining procedures required for

- reporting substandard equipment to maintenance activities,

coordinating with users when their equipment is found to be out of tolerance, and

coordinating with commercial carriers when leased circuits are out of tolerance.

Stations will prepare QC checklists that reflect local requirements enabling technical controllers to test any equipment, circuits, or systems within the facility.

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