SUBJECT: RESULTS OF THE SYSTEM TESTS PERFORMED ON THE AN/FSQ-7 (XD-1) DURING OCTOBER 1955

To: N. H. Taylor

From: J. D. Crane

Approved: A. O'Brien

Date: 2 December 1955

Abstract: System tests were performed on the display system and the GFI element in XD-1 during October 1955.

The following equipment was included in display tests:
- DD, RD, and TD drum fields
- Semi-automatic camera system
- Digital display and situation display generator frames
- Display manual test facilities and display console #168

The character selection line drivers, the character positioning line drivers, and all power cathode followers that drive lines to consoles were not given an adequate test because the full compliment of display consoles was not available.

The following equipment was included in the GFI tests:
- GFI fields on the LOG drum
- Mapper consoles and mapper counter frame (GFI)
- SDV receivers were not included in GFI tests.

Reliability figures for the central computer and the drum system show that the computer was able to perform its assigned tasks about 85 to 90% of the time. Interruptions occurred every three to twelve hours, depending on the mode of computer operation.

Precision resistors and the Y type diodes in the GFI equipment are the only components which showed excessive failure rates. Extensive work is being done to correct these situations.

The display system and GFI element were able to perform all of the operations specified in the system test specifications.
1.0 Introduction

The third group of tests in a series of system tests to be performed on the AN/FSQ-7 (XD-1) was conducted during the month of October, 1955. These tests consisted of six demonstration runs and a survey of the performance of the central computer, magnetic tapes, and magnetic drums. Three of the demonstration runs exercised GFI equipment and the three remaining runs were on display equipment.

1.1 Demonstration Runs

Display test demonstration runs were performed on 4, 6, and 13 October 1955; GFI was demonstrated on 11, 18, and 20 October 1955. Air Force and MIT representatives attended all the demonstrations, and test operations were controlled by IBM engineers.

1.2 Performance Records

Records of equipment performance were compiled for the month of October. Basic data for this analysis were taken from logbook summaries issued by IBM. Component failures in GFI and display areas are included in this report; other reliability studies for GFI and display during October were omitted because of the nature of the equipment and its use during the month.

2.0 Equipment Submitted for Acceptance

A list of equipment and instructions included in the test are presented in "System Test Plans for Display System", by Messrs. W. E. Triest and H. L. Kurkjian, and "XD-1 System Test Procedure for GFI Element", by Mr. H. J. Rottici.

The following list of equipment is presented in this report to furnish the reader with an over-all view of the equipment being tested:

1. Mapper consoles (GFI)
2. GFI fields on the LOG drum
3. Mapper counter frame (GFI)
4. DD, RD, and TD drum fields
5. Display manual test facilities
6. Digital display generator frame
7. Situation display generator frame
8. Semi-automatic camera system
9. Display console (#168)

The SDV receivers were not included in the GFI tests.

The character selection and character positioning line drivers were not given an adequate test because the full compliment of display consoles was not available.
3.0 Results of Acceptance Test Demonstration Runs

Six demonstration runs were performed to show that the equipment listed in section 2 of this report was able to perform the functions required for acceptance.

3.1 Logical Completeness

The equipment was able to perform all of the specified logical functions. It was noted, however, that a true count of missing azimuths is not obtained with the present GFI logic. This false indication results when the speed of the console drums allows normal azimuth pulses to be counted as spurious pulses. Both spurious and missing azimuths use the same analog counter so the normal azimuths for this condition appear as missing azimuths.

The digital display drum field is read using a precessing scheme that is not compatible with the interleave mode of writing on drums. A study of this situation was made by Mr. R. D. Buzzard of MIT and it was recommended that this system should remain as is because programming means allow efficient use of the equipment as it now exists.

3.2 Physical Completeness

All of the equipment was delivered and installed. It was noted, however, that some minor mechanical inadequacies or deficiencies exist (see Table I).

<table>
<thead>
<tr>
<th>TABLE I</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINOR MECHANICAL DEFICIENCIES AND OMISSION ON XD-1</td>
</tr>
</tbody>
</table>

A. Marking and Labeling not Completed
   1. Unit numbers on GFI mapper consoles and display consoles.
   2. The indicators on the MCD frames for the GFI element.
   3. AC - DC meter designs on frame 25.

B. Temporary Arrangements (redesign of these units or circuits is in progress).
   3. Analogue circuitry.

C. Miscellaneous
   1. Paint trays missing in GFI mapper consoles.
   2. Air conditioning indicators on the frames are not operative.
3.3 Reliability During Display Demonstration Runs

During the display demonstrations, two malfunctions were noted in the display equipment: a relay in the +90 volt supply line failed to short out a resistor used for surge suppression and an open wire in module N of Frame 25 caused a display malfunction.

The central computer stopped once for some unexplained reason during the second test run while program DDS 03 was being run.

3.4 Reliability During GFI Demonstration Runs

All of the features demonstrated during the GFI tests worked correctly. It was noted, however, that missing and/or spurious information was causing undesirable operation.

During the first demonstration, "on the spot" repair of a broken wire, a wiring error, and replacement of a faulty plug-in unit eliminated the condition of repeated failures in two of the three faulty channels. Occasional failures in several other channels persisted throughout the demonstration.

The only instances of failure during the second demonstration occurred when a faulty circuit breaker blew; this happened several times.

During the third demonstration run, the GFI equipment was tested at three speeds -- 2, 6, and 10 rpm. It was necessary to optimize the system when changing from 2 to 10 rpm and from 10 to 6 rpm; this is not an equipment fault. Adjustments were made on the intensity (channel 12 only) and the north correction circuitry (channel 8 only). After these adjustments were made, a few failures were noted; these occurred at "North" time and were caused by transients from relay switching. This condition is not tolerable and is being investigated by IBM.

4.0 XD-1 Performance During October 1955

The XD-1 logbook entries were kept by IBM engineers for the period including 1-28 October. These records were used as the source material for preparing this study of computer performance.

4.1 XD-1 Activity During October 1955

From 2 October through 29 October, the 422 hours of assigned XD-1 time were used for the following purposes:
4.2 Equipment Included in Records

All of the equipment included in the first two system tests (Phases I and II) are included in the reliability study.

Component failures in the GFI and display equipments are included in the component failures listed in the explained failure graph on figure 2. Records of system failures and lost time attributable to GFI and display were not included in this report because these units have been used with the computer in such a way that records of their system reliability are not meaningful for the month of October.

4.3 Results of the Reliability Study

A comparison of the results of XD-1 reliability studies for the period including 13 June through 29 October 1955 is included in Figs. I, II, and III. The mean good-time between failures improved slightly and the percentage of useful assigned time dropped eight percent since the last evaluation. It should be noted that over 75% of the lost time during this test period was caused by bad solder connections, broken wires, uncammed plug-in units, etc. Most of these lost time incidents can be attributed to modifications or installations. Modifications made to accommodate the additional auxiliary magnetic drums and installation of frame covers constituted the major portion of XD-1 installations and modifications affecting the equipment under study. If lost time resulting from these causes were omitted, over 95% of the assigned computer time would have been useful.

The Y type diode failures in the GFI element (see Fig. 2) and precision resistors in all areas were the only excessive component failures. Precision resistors have been noted previously and work is being done to correct this situation. Diode failures in the GFI equipment are also being investigated.
5.0 Margins and Margin History

One set of margins on display and GFI have been taken and any low margins were improved during frame testing. A complete set of margins with the GFI frames installed as part of the system is being taken during the month of November. Margins on display will be taken after changes in the analogue circuitry have been made. Results of this margin checking will be issued as a supplement to this memorandum.

6.0 Summary

Results of the demonstration runs on GFI equipment and display generation equipment (including magnetic drums associated with the GFI and display frames) showed that their operation was satisfactory for this state of their development; however, the intermittent operation of the GFI equipment requires further attention.

A survey of the performance of both the central computer and magnetic drums for the month of October showed that the computer operated correctly about 85 - 90% of the time and errors occurred every three hours. Modifications and installations were responsible for 75% of the lost time.

6.1 Components

One-percent precision resistors continue to be the principle component failure category for the central computer and drums. The "Y" diodes in the GFI intensification circuitry have shown excessive failure rates. The suspected cause of these failures is the diodes' environment; this aspect is being investigated.

6.2 Voltage Margins

The first set of margins for the equipment under test appeared satisfactory; however, more margin check data will be taken during November and December. The results will be published as a supplement to this memorandum.

6.3 Physical Deficiencies

This report points out deficiencies other than those which have been corrected or have been scheduled to be corrected.
Drawings Attached

A-75692-1
A-75693-1
A-75694-1

Distribution List

MIT
* J. W. Forrester
* R. R. Everett
* S. H. Dodd
* N. H. Taylor
* C. R. Wieser
* E. E. McVicar
* H. I. Rundquist
* E. S. Rich
* Group 62 Staff
* Group 64 Staff
* Systems Office (1)

IBM at Lexington
* R. W. Bottomley
* R. E. Butler
* J. F. Mills
* R. W. Shur
* E. J. Raser
* W. J. Mitchell (40 copies)

IBM at Poughkeepsie
* M. M. Astaahan
* T. A. Burke
* R. F. Crago
* E. H. Goldman
* W. L. Jackman
* H. L. Kurkjian
* J. MacDonllul
* G. B. McCuller
* L. R. Walters
* A. E. Quick
* A. Schiff

ADES at Lexington
* F. Ong
* D. Doherty
* S. Hayes

BTL at Lexington
* G. Clement

AFRQCR at Poughkeepsie
* G. B. Moross

LPO
* Lt. F. G. Camp
* Lt. H. C. Kreide
* W. Smith
* C. Segerstrom
* W. Zimmer
* Lt. Col. R. S. LaMontagne

* Recipient of complete Memo
PERCENTAGE OF USEFUL ASSIGNED TIME

MEAN GOOD-TIME BETWEEN FAILURES OR INTERRUPTIONS

TOTAL ASSIGNED TIME (WEEKLY AVERAGE)

EQUIPMENT INCLUDED IN RELIABILITY STUDIES

CENTRAL COMPUTER

CENTRAL COMPUTER, MAGNETIC TAPES AND MAGNETIC DRUMS

13 JUNE 14 JULY 22 AUG. 2 OCT. 29 OCT.

FIG. 1
AN/FSQ-7 (XD-1) RELIABILITY, 13 JUNE 1955-29 OCTOBER 1955
FIG. 2
EXPLAINED FAILURES IN AN/FSQ-7 (XD-1),
13 JUNE 1955 - 29 OCTOBER 1955
FIG. 3
UNEXPLAINED FAILURES IN AN/FSQ-7 (XD-I),
13 JUNE 1955 - 29 OCTOBER 1955