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REPORT ON THE INSTALLATION AND TESTING OF INFUSE

Prepared by DS

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Report on the Installation and Testing of INFUSE

1. Introduction

In December 1955 the Department of Supply, through Telecommunications Group, Weapons Research Establishment, accepted responsibility for the installation and "de-bugging" of INFUSE. To this end the writer was attached to DSB for the two years beginning in May 1957. This report has been prepared at the conclusion of the attachment.

2. History

INFUSE is the outcome of a policy decision taken in 1951. At that time G.C.H.Q. had in mind the construction of a flexible cryptanalytic machine following broadly the logical system of the successful war-time COLOSSUS and ROBINSON machines. The new machine was later called COLOROB. This machine was put forward as the most suitable machine for DSB's requirements, although a firm decision to purchase it was not made until November 1954. INFUSE is the DSB version of COLOROB from which it differs only in detail.

In November 1952 two officers of the Department of Supply were attached to G.C.H.Q. to assist in the design, development and construction of COLOROB. They returned to Australia in August 1955, before the machine was ready for testing.

The shipment of INFUSE began early in 1957 and was completed in December of the same year.

3. Construction of INFUSE and Testing of Chassis prior to Shipment

Some INFUSE chassis were wired at G.C.H.Q. and the others were built under contract by A.T.& E. Ltd. at Liverpool. The two magnetic drums and their special heads, and the high speed tape readers were supplied by Ferranti Ltd.

The two suites of racks (24 in all) were constructed by Hassett and Harper Ltd. They were first put together at Cheltenham when the various parts were marked to ensure easy reassembly. Special racks for the Wostat rectifiers were built: these made better use of the limited space available at DSB. All cable ducting was prefabricated at Cheltenham so that very little workshop effort was required during final assembly.

Although chassis were tested at G.C.H.Q. before despatch, the machine as a whole was not completely out of the development stage at the time of shipment.

4. Installation

Mechanical assembly and wiring of racks and power supplies commenced on 13 August 1957 and proceeded smoothly to its conclusion in November. A total staff of three with occasional workshop assistance was engaged on this work. The thorough preparation and provision of drawings and wiring schedules by G.C.H.Q. did much to speed this phase. Mention should also be made of the assistance received from the DSB purchasing staff who were called on frequently to obtain small items at short notice.

Testing and Fault Correction

5. The first chassis was tested on 11 December 1957. Testing of chassis was mainly carried out by the programming staff while the technical staff attended to the faults they found.

A program to produce Hagelin Key (JOEY) was run on 17 January 1958. This required the output but did not involve the magnetic drum or tape input system.

During February the magnetic drum and its associated equipment were wired in and checked. A check was also made on the spare drum. During testing a 3328 digit synchronising track was damaged: it was subsequently rewritten on a different track.

At this stage the testing of a programmed multiplier showed up a design defect which, although not serious, has proved a nuisance. The original design provided for the use of 20 logical gates plugged in series but tests showed that only 10 can safely be used. This trouble is inherent in the design and cannot be remedied cheaply.

The air-conditioning plant was installed by the contractors during March 1958. This work was carried out smoothly and the plant has continued to operate satisfactorily.

From April 1958 to December 1958 the following programs were run:

JIM (repeat search)

BORONIA (width count)

BUNYIP (calculation of theoretical cypher letter frequencies)

GELATINE [redacted]

CRADLE (message setting by crib-dragging)

These programs were primarily intended to check the machine but they also performed useful work. BORONIA was used to prove the feasibility of open wiring for plugboards.

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Experience with the machine over this period, and advice from G.C.H.Q. resulted in a number of minor modifications. Some difficulty was experienced with the tape to drum input system, the output and the modular adders and subtractors: this is not surprising as the input and output are complex and the modular adders were built and tested in a hurry. Troubles in the input system were cleared by the provision of a regulated +150 volt supply, and a number of changes were made to the output. The modular adders and subtractors are not yet completely reliable. A good deal of trouble has occurred with chassis containing trigger circuits: a minor circuit modification suggested by G.C.H.Q. has brought their reliability to an accepted standard.

The CRADLE program (which uses about 80% of available chassis) was regarded as an acceptance test. This program was run in December 1958, and responsibility for day to day maintenance passed to DSB on 1 January 1959.

6. Development

Quick changes of program will not be possible until INFUSE is fitted with plugboards. A prototype has been built for 3 at the 24 racks and has proved satisfactory. In the INFUSE plugboard system all inputs and outputs previously plugged by coaxial cable are brought out on the backs of the chassis on miniature connectors which are connected to the plugboard by open wires. This system not only makes possible quick program changes but should speed fault finding by improving access to the chassis. Approval for construction of the system was obtained in November 1958 but no progress has since been made.

Some thought has been given to the provision of two core stores each with a capacity of 1024 6-bit words. These will be logically similar to those provided on COLOROB, but will probably differ in circuitry. As suitable development and construction facilities are not available at DSB., this work will probably have to be done on contract.

7. Maintenance

Adequate accommodation and test equipment have been provided. Spares are held for all essential major items of equipment, and satisfactory stocks of other spares are available.

The maintenance staff is headed by Mr R. Bailey (Eng.Gr.III) who is responsible to the Senior Engineer. Other members of the staff are

Mr J.D. Singleton	(STO.1)
Mr R.J. Robson	(TO.1)
Mr R. Wolstenholme	(Tech.)

Singleton spent 6 months in U.K. on COLOROB, and, with Robson, has been on the INFUSE staff since installation began.

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A staff of this size when fully trained should be adequate for maintenance alone. However, some time must be diverted to development and minor construction work (e.g. the prototype plugboard), thereby lowering the standard of maintenance. In a small project it is neither desirable nor practicable to separate the development and maintenance staff, so an increase in staff is essential if the current development plans are to be effected in a reasonable time.

Fault-finding on INFUSE can be difficult and time consuming. Very close co-operation between programming and engineering staff is necessary and it is desirable that the latter should have a knowledge of programming fundamentals. A training course for this purpose has been instituted.

8. Concluding Remarks

The installation and testing of INFUSE are considered complete. This does not mean, of course, that the peak has been reached in either efficiency or performance. On the contrary there are still defects to be remedied and improvements to be effected, and, indeed, the potential of the machine cannot be exploited until the plugboard system is installed and working satisfactorily. Every effort should be made to have this work completed as soon as possible.

The reliability of most chassis is satisfactory. Minor modifications and careful and intelligent maintenance should bring the whole machine to the same standard. "De-bugging" is made difficult by the poor access to chassis caused by the coaxial cables used for the front panel plugging. The plugboards will leave the front faces completely clear and an appreciable reduction in the time required for removing machine faults is to be expected.

9. Acknowledgements

The writer is indebted to all members of M23 group at G.C.H.Q. for the careful preparation of equipment and documents, and for their continuing help and advice.

The assistance received from all departments of DSB left nothing to be desired, but special mention must be made of the efforts of Mr J.D. Singleton and Mr R.J. Robson.

E.T. ROBINSON
7 May 1959