NATIONAL INSTITUTE FOR RESEARCH IN NUCLEAR SCIENCE

GOVERNING BOARD

The ATLAS Computer Laboratory

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1.   Introduction

        The proposal to install a Ferranti ATLAS computer at Harwell
originated in a suggestion by the U.K.A.E.A. that, although they
could not yet justify an ATLAS for their exclusive use, there was
a good case for one to be ordered immediately for combined use by
the Authority, the Universities, N.I.R.N.S., and Government
Departments.   A Working Party appointed by the Minister for Science
endorsed this proposal, and asked the N.I.R.N.S. whether they would
be willing to accept formal responsibility for ownership and manage-
ment of the installation.   The Governing Board of N.I.R.N.S. agreed
on the following assumptions:

        (i) That no charge would be made to universities for
             any of the services provided.

        (ii) That cases would be made for other large computers
             for use by universities, and that these should,
             whenever possible, be located in the universities.

        The Board agreed that the computer should be located at the
Rutherford High Energy Laboratory at Harwell, on the assurance of
U.K.A.E.A. that experienced Authority staff could be made available
to operate it on behalf of the Institute.   They agreed to set up
a Computer Committee to manage the installation subject to the general
authority of the Board.

2.   The ATLAS Computer

        ATLAS is made by Ferranti Ltd., and is based on the work of
Professor Kilburn and his collaborators in the Computing Machine
Laboratory of the University of Manchester.   The first machine will
be installed in the Manchester laboratory by the end of 1961.

        The name refers to a computing system in which a central computer
is surrounded by a variable number of peripheral devices for information
storage, input and output.   The operating speed is very high - for
example the times for addition and multiplication are about 1 and 3.5
microsecond respectively - and the system design allows an installation
to be built up to almost any desired size.   The specification recommended
by the U.K.A.E.A., attached as Appendix I, provides for immediate-access
storage for 48,000 numbers on magnetic cores, 128,000 on magnetic drums,
16 magnetic tape units and ample input-output equipment, it would cost
£2.5 million and should be delivered in mid-1963.

3.   Objectives

        The object is to provide a computing service for a number of bodies
of whom the following are known at present:

        The U.K.A.E.A.

The British Universities, of whom it is assumed that
the Universities of Cambridge and London at least
will be major users.

N.I.R.N.S.

Government Scientific Establishments, of which so far only
the Meteorological Office has asked specifically for this
service.

The Institute were asked, when invited to accept responsibility
for the ATLAS, to ensure that the needs of these users were satisfied
within the capabilities of the computer, that work which could better
be done on available smaller computers would be turned away, and that
any spare capacity after these needs had been met would, if possible,
be sold commercially. The advice and assistance of the Authority
should be sought in selling any available time.

4. Organisation

Since the ATLAS will be used for only a part of its time for
work connected with nuclear science, we propose that it should be
placed in a special laboratory, linked only administratively with the
Rutherford High Energy Laboratory. There should be a head of the
ATLAS Laboratory, responsible to the Computer Committee who would be
the management committee, and he should be on the staff of N.I.R.N.S.
He could, of course, be seconded to N.I.R.N.S. from the Authority or
some other body.

The Laboratory will need to provide a complete service for data
preparation and for operation of the machine. It is assumed that
many users will write their own programmes but the Laboratory must
ensure that agreed sets of programming languages and input systems are
available and give instructions in their use. It must also be equipped
to make available mathematical advice and assistance to those users who
need them, especially in numerical analysis, and must keep in the
forefront of knowledge of programming and computational techniques,
computer applications and development, and numerical mathematics.

There may ultimately be three functional groups, each with a group
leader responsible to the head of the Laboratory:

(1) Machine Group:

Responsible for running the computer, data preparation,
operation of any data transmission links which may be
installed, record-keeping and provisioning the installation.
Maintenance engineers in this group should be provided on
contract by Ferranti.

(2) Computing Service Group:

Responsible for providing and modifying, when necessary,
the programming schemes, and operating systems, and the
educational and advisory services. Any writing of programmes
requested by users would be done in this group.

(3) Mathematics Group:

This group would make available a pool of mathematical
knowledge to be drawn on by members of the Computing Service
Group and by users of the Laboratory generally. It would
be concerned with advanced mathematical studies relevant to
numerical processes and to applications of the computer and
should have a good deal of freedom.

Administrative services (e.g. typing and clerical) should be provided through the Rutherford Laboratory. The Rutherford Laboratory should also look after financial arrangements, accommodation of visitors on extended visits, and laboratory services such as building maintenance supply of office equipment and furniture, etc.

5.   Staff requirements

It is estimated that the following staff will eventually be required for 3-shift operation:

	Head of Laboratory	Machine Group	Computing Service	Mathematics	Totals
Scientific	1	5	10-20	4	20-30
Clerical and Admin.	5	-	-	-	5
Operator		12-18	-	-	12-18
	6	17-23	10-20	4	37-47

The numbers of scientific staff under "Computing Service" and "Mathematics" are difficult to estimate. They will depend upon the nature and extent of the services required by users, and the compromise finally adopted between the extremes of "closed shop" and "open shop" operation of the Laboratory. These are matters with which the Computer Committee will wish to concern themselves.

The strength will be built up progressively, since the computer will not be delivered until 1963 and three-shift operation is unlikely to be needed immediately. The majority of the machine operators required should be available for transfer to N.I.R.N.S. from A.E.A. staff since the present intention is to dispose of the A.E.R.E. Mercury when the ATLAS is in operation.

A.E.R.E. will need to maintain a computing group for their own purposes and under their own control (not, of course, included in the Table), and therefore the scientific staff needed for ATLAS will not all be provided by transfer from A.E.R.E. However, sufficient key and supporting staff will be available to supervise commissioning and to help to initiate the service on behalf of N.I.R.N.S. About half a dozen of these experienced A.E.A. scientific staff could be made available full-time thereafter, to work under the direction of the head of the Laboratory. In addition, the experience and knowledge of the A.E.R.E. Computing Group, who will be using the A.E.A.'s share of ATLAS as their main resource, will be useful to the staff of the Laboratory and the other users. Nevertheless the Institute should progressively recruit their own staff to make up the balance of effort found necessary.

It is suggested that the majority of the Authority staff finally made available to work for N.I.R.N.S. should be offered transfer. The exception would be the very small number of senior staff, who could be seconded for a fixed period.

6.   Accommodation

A new building will be needed, and will have to include accommodation for visitors wishing to use the computer. Some members of the A.E.R.E. Computing Group will also need accommodation, but the Authority intend to accommodate the remainder inside A.E.R.E.

Appendix II gives a summary of the accommodation proposed in the A.E.A. specification, together with approximate cost estimates.

A site is proposed just outside the present perimeter of the Rutherford Laboratory, but convenient for the services of the Rutherford Laboratory (e.g. the restaurant) and also for the A.E.R.E. main library which is used by N.I.R.N.S. staff and visitors. In common with the rest of the Rutherford Laboratory there will be no security formalities.

7. Users' Committee

We recommend that there should be a Users' Committee to advise the head of the Laboratory. The members would be drawn from the user organisations on a representative basis, and should be persons closely concerned with the needs for the services of the Laboratory. They would concern themselves with the requirements of machine time and the type and extent of services to users. This Committee would be broadly analogous to the Visiting Committee of the Rutherford Laboratory, which advises the Director on the use of the accelerators.

8. Longer-term policy

On present plans, the Universities will be taking up at least half of the maximum total machine time of 150 hours per week. It is probable that within the next few years, one or more of the Universities will be proposing that there should be ATLAS machines in the Universities, to serve all departments. Should schemes of this type materialize, the ATLAS machine at the National Institute might not be so extensively used on University work. However, it is probable that the Authority will want more time, especially if the A.W.R.E. Stretch has been returned to I.B.M. It is also probable that more work for the ATLAS will originate within the Institute itself. There is sufficient flexibility in the proposals given in the present paper to enable adjustments to be made in a few years' time, should these seem desirable.

Appendix I

Specification of the Machine Installation

The installation will consist of a central computer containing all the arithmetical, logical and control circuits, surrounded by peripheral units for input, output and storage of information. To allow large-scale problems to be tackled efficiently one needs very large amounts of storage capacity; with ATLAS, as with almost all computers, three kinds of store are available:

(i)   magnetic cores, giving random access

(ii) magnetic drums, giving delayed but reasonably quick access
        and much cheaper than (i)

(iii) magnetic tapes, providing a backing store of slow access
        but virtually unlimited capacity.

There is also a feature which is special to ATLAS, a "fixed" store, of very rapid access, from which information can be read but into which a program cannot write; this will hold basic information which is common to all programs and need not be changed. It uses, for its own operations, a special core store referred to as the Subsidiary or Working Store. Physically the Fixed Store is made up of small ferrite rods inserted into a woven wire mesh.

The specification suggested for this installation is as follows; it has been arrived at after detailed consideration of the demands of typical large problems and of the need for a very efficient system of operation.

1.   Central computer, including 48K fixed store and 1K working store

2.   Core store, 48K

3.   Drum store: 4 drums of 24K each

4.   Magnetic tapes: 16 units

5.   Punched card input/output

6.   Second card input channel

7.   2 line printers (600 lines per minute)

In addition, there is a need for:

8.   Some means of handling IBM magnetic tape, to make it possible to
       interchange programs and data between ATLAS and the large IBM
       computers.

There may be a need for:

9.   A large-capacity random-access store such as a file-drum or
       disc-file

10. Extra working store, say a further 1024 words

11. A xeronic 3000 line-per-minute printer

Items 1–8 are being made the basis of a firm contract with Ferranti (there are of course other items such as power-supplies and tape-switching channels) and the possibility of a need for 9–11 has been made clear.

Accommodation for ATLAS proposed by the U.K.A.E.A.

A new building will be needed to house the computer, with its ancillary services, and the Laboratory staff.   The amount and type of accommodation needed is as follows:

(i)   Computer

Machine room	2000 sq.ft.	air-conditioned
Data preparation	1000 sq.ft	"
Card and tape store	300 sq.ft	"
Power supply	400 sq.ft.	
Maintenance engineers	500 sq.ft.	4200

(ii)   Operator staff

Operator's office (for 4)	250 sq.ft.	
Chief Operator	150 sq.ft.	
Clerk, records	150 sq.ft.	550

(iii)   Scientific staff, including
        visitors

Say, 60 at 120 sq.ft. each	7200

(iv)   Conference room   1000

                            Total ..   ..   ..   12950 sq.ft.

Allowing for corridors, toilet accommodation, etc., the gross area needed will be about 15,000 sq.ft.

Provision has been made for this in the estimates of costs given to the Treasury.