19.10.59.

Reference.....

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AP

Mr. P. W. Nunneley.

Purchase of Atlas.

I attach JDM's notes on the meeting held in your office on Monday 19th. I think they are quite a reasonable account of a very diffuse meeting!

DL.

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A meeting was held in Mr P.W. Mummery's office on 19 Oct 1959 to discuss what future computational facilities would be required by the Authority ~~Winfrith staff~~ for the solution of reactor physics problems. More specifically, it was discussed whether an Atlas computer would be required, assuming a 1963 delivery date. The meeting was attended by Dr G.N. Lance and representatives of HTRD and IPRB, viz ~~Dr. G.N. Lance~~ ~~Dr D.C.L.~~ Mr G.H. Kinchin, Dr D.C. Leslie, Mr. C.P. Gratton, Mr. J.G. Tyror, Mr. C.T. Chudley and Mr. J.D. Macdougall.

It had been previously agreed, in discussion between Mr. Mummery, Dr Howlett and Dr. Lance that the purchase of an Atlas computer was justified if it would either (1) result in a nett saving in the cost of nuclear power (i.e. a saving in nuclear power production cost in excess of the cost of the Atlas time employed in obtaining the saving), or (2) give a nett reduction in the cost of the reactor physics experimental research programme. ~~below that cost which would have been incurred had Atlas not been made available.~~ In addition there was a case for Atlas if (3) its use would enable solutions to be obtained to otherwise theoretically intractable safety problems which it is highly undesirable to investigate experimentally but for which answers are ~~required imperatively~~ urgently needed (the case might rest on Atlas computation being cheaper than Zoyo computation for such problems).

The meeting discussed the above three conditions, and arrived at the following conclusions:—

(1) It was felt that the use of Atlas could result in a definite saving in the cost of nuclear power, but that to make a numerical estimate of the saving to be expected was not very practicable at this stage. This use of Atlas was not discussed very extensively, as it was understood that Mr. Iliffe of the D+E group is looking into the savings that might be obtained. However two specific topics were mentioned. Firstly it was considered that a machine of the size (and speed) of Atlas was probably adequate to enable a survey to be made of the effect of fuel element shape on reactivity, thus enabling optimum fuel elements to be designed. Secondly, gagging problems were considered. At present, once a reactor is commissioned, the gagging pattern is effectively fixed. In order that a given reactor should be used as efficiently as possible, an optimum lifetime gagging pattern is required; on present generation computers it is possible to compute gagging patterns, but only with an undesirably small number of spatial points, to compute an optimum lifetime gagging pattern would however seem to be a reasonable problem to ask Atlas to solve. [Perhaps it should be noted that gagging problems may lie within the province of the C.E.G.B. rather than that of the Authority]

(2). It was also felt that the use of Atlas could reduce the amount of experimental reactor physics work below that which would otherwise be required. Theoretical reactor physics effort would not be reduced, but would be re-orientated to ensure the most efficient use of the computer, rather than being engaged in correlation of experiments using semi-empirical theories. Atlas would perform reactor physics calculations based primarily on nuclear physics data; it would however be necessary for this nuclear physics data to be supported by a certain amount of integral data from reactor physics experiments. Thus it was envisaged that for the efficient use of Atlas as a reactor physics tool, supporting nuclear and reactor physics experimental programmes would be required, the former to provide sufficiently accurate basic nuclear data on the materials used in reactors, and the latter to provide critical (i.e. crucial) experiments to confirm the Atlas computations. This would probably mean an increase in the nuclear physics programme and a decrease in the reactor physics programme; the exponential experiment programme would no longer be engaged on performing sufficient experiments to enable a semi-empirical theory to be formulated, but would be concerned in performing experiments on stacks specially arranged to test specific parts of the Atlas calculations, and this should involve a smaller amount of experimental work. [Mr. Kinchin was not in complete agreement with the above views]

* Insert here the (and fast) [illegible] given on p. 3.

That as large a machine as Atlas is required for reactor physics calculations is shown, for example, by the estimate that 4 hours of Atlas time would be required to obtain about 0.1 or 0.2% statistical accuracy in k_∞ in a Monte Carlo cell calculation. To perform a similar calculation on even the 7090 would clearly take an excessive amount of machine time.

(3) In the realm of safety, it was considered that Atlas might enable calculations of behaviour in fault conditions to be made for situations which could otherwise only be dealt with by experiments which would take a considerable risk of melting down, or even blowing up, a reactor. The difficulty is assessing the usefulness of Atlas in safety problems arises from the difficulty of specifying the equations which determine the behaviour of the reactor once physical changes start to take place in the reactor core; thus Atlas could be employed to survey reactor behaviour during reactor incidents up to the time (if any) at which

some physical change (such as melting of fuel elements, or ~~burning~~ incidence of fire) occurred in the reactor. ~~From~~ Such a survey would indeed be useful, but description of reactor behaviour after physical change occurs is often required; it was however felt that Atlas would be unable to cope with such situations, owing to the complexity of the phenomena involved. ~~However, the determination of the reactor state at the onset of physical change might enable non-reactive experime. However a combination of Atlas with non-reactive experiments might enable.~~ However it might be possible to replace (undesirable) reactive experiments in which physical changes occur, by a combination of Atlas with non-reactive experiments.

~~In conclusion~~ Two general comments ~~might~~ may be added. Firstly, it ~~seems worthwhile to observe that~~ Atlas has to perform very little more actual computation than (either) the 7014 or 7090 before ~~the cost per machine operation [i.e. the which is (opportunists) the same as~~ the cost per of a given calculation ~~becomes less that~~ performed on Atlas becomes less than the cost of the same calculation performed on either ~~the 7014 or 7090.~~ (of the other) machines. Secondly, if ~~an~~ a 7090 is rented for a period before the Atlas becomes available, it would be highly desirable for the Atlas programming system to be arranged to be compatible with that of the 7090.

To be inserted at the asterisk on page 2.

The vital point in justifying the purchase of an Atlas is therefore the demonstration that the saving on integral experiments outweighs the cost of Atlas time plus the increased outlay on basic experiments. The basic experiments will probably be the bigger item, but it can be argued that these experiments should be done even if the Authority does not buy an Atlas. If this is conceded, the case seems quite clear.