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To: Management Committee members

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NATIONAL INSTITUTE FOR RESEARCH IN NUCLEAR SCIENCE

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GOVERNING BOARD

PLA/A/04/2

BUILDINGS AT THE ELECTRON LABORATORY

by A. W. Merrison

I. Introduction.

This paper contains a statement of the present position of the planning and estimating of the buildings of the Electron Laboratory. It contains also a proposal that the Engineering Group of the U.K.A.E.A. should be asked to undertake the building and civil engineering work at the Electron Laboratory.

II. Planning and Estimating of the Buildings.

(a) Introduction.

The planning of the Daresbury site for the Electron Laboratory is almost complete, and a realistic cost estimate of the building and civil engineering of the project has now been made. This estimate is £1,666,000, excluding architects' and civil engineers' fees. A detailed breakdown of this figure is given in the Appendix.

The present estimate is, of course, higher than that made in the paper "A 4 GeV Electron Synchrotron" (NI/61/16, July 1961), and a comparison with the figures given in that paper is made in the Appendix. Part of the difference between the two estimates is due to the large increase in building costs (about 10%) since July 1961. The remaining difference is due to the greater cost of site services, in particular the cost of bringing services to the site (for which only a nominal allowance was made previously), and also for the greater provision which has had to be made for housing the ancillary equipment of the synchrotron.

(b) The Present Lay-out.

The geological structure at Daresbury appears to be satisfactory for the exacting foundation requirements for the electron synchrotron. More detailed knowledge of the site has still to be obtained and as soon as access is available work to this end will start. The site lay-out shown on the attached drawing has taken into account the best physical arrangement for future development, e.g. storage rings, and for the most economical development. The contours of the ground have been carefully considered in order to reduce the amount of excavation and levelling to a minimum. Even so, some 30,000 cubic yards of soil and rock will have to be moved.

(c) Buildings.

The buildings on the site can be conveniently broken down into a number of main groups :-

(1) Machine Buildings consisting of :

- (a) Magnet Ring Building.
- (b) Injector Building.
- (c) Electron Hall.
- (d) Transverse Building.
- (e) Equipment Buildings.

- (2) Services Buildings consisting of :
 - (a) Electric Supplies Building.
 - (b) High Voltage Compound.
 - (c) Water Cooling Supply Buildings.
 - (d) Boiler House Building.
- (3) Research Services Buildings consisting of :
 - (a) Ancillary Laboratory.
 - (b) Workshop.
 - (c) Stores.
 - (d) Control Room.
 - (e) Counting Rooms.
- (4) Laboratory and Office Buildings consisting of :
 - (a) Laboratories.
 - (b) Library.
 - (c) Common Room.
 - (d) Offices.
 - (e) Canteen.

In addition it is necessary to include two further groups :-

- (5) Permanent Site Services :
 - (a) Roads and Car Parks.
 - (b) Drainage and Sewage.
 - (c) Lighting.
 - (d) Fencing.
 - (e) Estate Works.
 - (f) Telephones.
 - (g) Caretaker's Residence.
- (6) Temporary Site Services :
 - (a) Temporary Electric Supply.
 - (b) Temporary Water Supply.
 - (c) Temporary Drainage and Sewage.
 - (d) Temporary Fencing.
 - (e) Temporary Bus Park.
 - (f) Site Construction Services.
 - (g) Payments for Electric Power & Water.

(1) Machine Buildings.

The magnet design has determined the physical size and shape of the Magnet Ring Building (1a) and its associated Injector Building (1b).

In setting out the surveying requirements necessary for the correct positioning of the magnets it became evident that with an approach rather different from the more orthodox one of constructing sighting tunnels for survey purposes, it was possible to obtain better facilities by constructing the so-called Transverse Building (1d).

Further development led to the conclusion that if this building were placed at right angles to the Electron Hall (1c) it would be possible to obtain a much desired experimental area inside the magnet ring. This also led to the conclusion that the electron synchrotron should pass through the Electron Hall without any fixed concrete shielding. This facility gives the maximum of flexibility in setting up experiments both inside and outside the magnet ring.

The Transverse Building houses all the radio frequency equipment in the south end. The north end is available for experimental purposes.

It was not considered unreasonable to use the areas between the inner wall of the Magnet Ring Building and the Transverse Building to construct an inexpensive structure referred to as the Equipment Buildings (1e). This exercise resulted therefore in providing excellent facilities for research and inexpensive buildings for housing equipment associated with the accelerator. In the 70 foot span Transverse Building there is a 15 ton crane with a hook height of 20 feet. The Electron Hall with a span of 110 feet has a 25 ton crane with a hook height of 25 feet.

(2) Services Buildings.

These follow the normal run of such buildings except that in the case of the Water Cooling Supply Building (2c) the primary water is pumped from the Bridgewater Canal and discharged into another section of the same canal about 1.5 miles away. This system dispenses with cooling towers which offend the planning authorities and are expensive.

In addition to the usual electrical equipment, the Electrical Supplies Building (2a) has adequate floor area to accommodate up to 4 M.W. of D.C. power for use elsewhere for experimental purposes.

(3) Research Services Buildings.

This group is directly associated with the research carried out in the Laboratory.. The machine Control Room (3d) and Counting Rooms (3e) follow well tried practice. The main feature of the block is the long frame building 60 feet wide by 180 feet long and served over its full length by a 10 ton, 20 foot hook height, crane. This open building is equally divided (but not partitioned) into three units. Nearest to the Electron Hall, and for obvious reasons, is the Ancillary Laboratory (3a). This is a large area for assembling and testing experimental equipment for use in the Electron Hall. Next to it is the Workshop (3b) with a resident staff of about 30. To this number should be added mobile groups working in different parts of the Laboratory. The last unit is the Stores (3c) which supplies the whole of the Laboratory.

(4) Laboratory and Office Building.

The main emphasis has been to provide adequate accommodation for the research groups planning experiments on the Synchrotron. There are ten spacious laboratories (4a) on the ground floor and these share several rooms in close proximity. These rooms may be used as smaller laboratories or even offices. A good sized Library (4b) and Common Room (4c) are provided. Experience in other laboratories has shown that considerable economies may be effected in keeping office accommodation down to reasonable sized modules. We have settled on a 12 foot standard module, with offices 12 feet deep (4a). Partitions will follow conventional practice: i.e. pot tiles and plaster. The whole of the First Floor is arranged in such a manner that the accommodation provided may be used for either small laboratories or office.

Detailed design for the Canteen (4e) has not yet been considered.

5) Permanent Site Services.

These are normal services required on a completed site.

(6) Temporary Site Services.

These are required for the duration of the construction period, and offer no particular problems.

(d) The Time Scale for Construction.

The design of the four groups of buildings is simple and offers no serious problem to a competent civil contractor. In drawing up a time scale emphasis has been placed in carrying out work in parallel. After internal site clearance and levelling it is proposed to commence work on Groups 1, 2 and 3 simultaneously and after a lapse of approximately 3 months work would start on Group 4. Groups 1 and 2 will take 21 months to complete. Group 3 will take 18 months and Group 4 12 months.

The phasing of the civil work has been arranged to enable assembly and testing of the synchrotron magnet units to start on site 12 months after the commencement of work on Group 1.

At present the methods to be used in planning and scheduling the work on site are under review and it is more than likely that the traditional bar line type of programme will be discarded in favour of the Critical Path Method (C.P.M.).

This method should help pinpoint difficulties well in advance and compress the duration of the project.

III. Supervision of the Building Work.

The initial planning of the buildings of the Electron Laboratory has been undertaken by the U.K.A.E.A. Engineering Group at Risley. We have now reached the point in this planning where it must be decided how the actual building work is to be supervised and who will do it. Much the most convenient solution to this problem, from the Institute's viewpoint, is to ask the U.K.A.E.A. Engineering Group to undertake this work. As the Board will recall, my principal doubts about adopting this solution have been on the question of adequate control of the design and of the expenditure on the project.

I have had a number of informal discussions with the Managing Director and other members of the Engineering Group and they have made the following proposals.

1. A permanent design team for the buildings should be established at Liverpool, and later Daresbury, to carry the principal responsibility for the sketch plan design and for liaison with specialists at Risley. The actual building work on the site would, of course, be supervised by a Resident Engineer in the normal way.
2. The Group works on a "no-profit no-loss" basis and is bound to recover actual costs. They would, however, put the building work in two classes: "Package type jobs for fairly self-contained units, e.g. stores buildings, which could be put out to a contractor on the basis of a specification. Engineering Group could prepare tender schemes and supervise contracts and construction. In the ordinary way, we would expect to recover fees of the order of 5% on such work. "Special purpose requirements on which the Group would provide a full consultancy service, covering design, inspection, supply and site supervision. The parts of

the project coming under this head have not yet been fully defined but we would expect them to require the services of civil, structural, mechanical and electrical engineering and architectural services on the design side. On a full consultancy service of this kind, we would expect to recover charges amounting to about 15%."

(These quotations are from a letter from Mr. G. R. Armstrong, Deputy Director, Administration and Accounts, Engineering Group.)

In addition to this, the Engineering Group is "prepared to second staff to the project where there was a reasonable prospect of two or more years full time employment and especially where you might wish to retain such staff permanently."

I am satisfied that these arrangements would enable the Electron Laboratory to maintain adequate control of the building programme. The fees which Risley propose seem to me reasonable for work of this nature. I have talked with outside architects and it seems certain that we could not get a substantially lower offer from private firms.

I ask the Board to accept the proposals of the U.K.A.E.A. Engineering Group and invite them to undertake the building work for the Electron Laboratory.

NATIONAL INSTITUTE FOR RESEARCH IN NUCLEAR SCIENCEGOVERNING BOARD

Estimate

21.3.63.

£

Construction Services.

1. Temporary Offices (Construction)	6,000
2. Temporary Fencing	2,000
Temporary Water Supplies	2,000
Temporary Electrics	21,000
3. Charges for Electricity and Water	<u>17,000</u>
	£48,000
	=====

Civils

1. Roads	38,000
2. Sewage	29,000
3. Domestic Water	13,000
4. Cooling Water	151,000
5. Temporary Drainage	2,000
6. Temporary Roads and Bus Park	<u>15,000</u>
	£248,000
	=====

Structurals

1. Magnet Tunnel	285,000
2. Injector Room	<u>56,000</u>
	£341,000
	=====

Architects

1. Laboratory and Office Block	185,000
2. Workshop	120,000
3. Control and Counting Rooms	30,000
4. Experimental Hall	145,000
5. Inner Experimental Hall and Equipment Room.	161,000
6. Power and Services Building :	
(a) Boiler House)	
(b) Demineralising Plant)	148,000
(c) Electrical Switchroom.)	
(d) Rectifier Room)	
7. Garage	5,000
8. Canteen	30,000
9. Estate Works	18,000
10. Permanent Site Fencing.	<u>2,000</u>
	£844,000
	=====

Electrical

1. Incoming supply and 33 KV Substation	60,000
2. 11 KV Substation Plant)	
3. Service Distribution System)	59,000
4. Telephone Exchange	7,000
5. Street Lighting	<u>5,000</u>
	£131,000
	=====

Estimate
21.3.63.

£

Other Services

1. Air Conditioning Plant and Ventilation of Magnet Tunnel	48,000
2. Compressor and Compressed Air Distribution.	4,000
3. Gas Supply	<u>2,000</u>
	£54,000
	=====

SUMMARY

Construction Services	48,000
Civil Engineering	248,000
Architects	844,000
Structural	341,000
Electrical	131,000
Other Services	<u>54,000</u>
	£1,666,000
	=====

Comparison of Estimates

	<u>Present</u>		<u>NI/61/16</u>
	£		£
<u>Site Services</u>			
Temporary services	48,000	Grand investigation	10,000
Civils	248,000	Opening up site	100,000
Estate works & fencing	20,000	Mechanical and	
Electrical	131,000	Electrical Site	
Other Services	<u>54,000</u>	Services	200,000
	£501,000	Roads & Car Park	<u>50,000</u>
	=====		£360,000
			=====
<u>Machine Buildings</u>			
Magnet Tunnel and		Magnet Building	350,000
Injector Room	341,000	Ancillary Building	80,000
Workshop, Control and		Generator House	50,000
Counting Rooms	150,000	Experimental Halls	<u>250,000</u>
Power & Services			£730,000
Building	148,000		=====
Experimental Halls and			
Equipment Room	<u>306,000</u>		
	£945,000		
	=====		
<u>Other Buildings</u>			
Laboratory & Office		Laboratory & Office	
Block	185,000	Block	280,000
Canteen	<u>30,000</u>	Canteen	<u>30,000</u>
	£215,000		£310,000
	=====		=====