

NATIONAL INSTITUTE FOR RESEARCH IN NUCLEAR SCIENCE
MAIN BUILDINGS FOR THE 7 GeV PROTON SYNCHROTRON

1. General Description

The object in designing the buildings has been to provide the minimum accommodation for the various functions consistent with satisfactory operation, and to achieve economical solutions of the special problems of shielding and stable magnet foundations. The magnet is to be housed in a concrete building with walls and roof of sufficient strength to support the necessary shielding, the bulk of which is provided by earth mounds. The roof thickness is 4 ft.-6 ins. of concrete and 10 ft. of earth, with provision for adding a further 10 ft. of earth over the magnet if this should be found necessary. The main shielding wall, separating the target area from the experimental area, is of concrete, 28 ft. thick, and with movable blocks up to a height of 12 ft. The experimental area is shielded on all sides, but not overhead, by earth banks. Internal beams are to be absorbed at the ends of long tunnels driven into the back wall of the experimental area, to give a "black body" effect in order to minimise radiation hazards. Shielding overhead, to avoid excessive "skyshine" radiation, will be provided at the targets where necessary. This solution retains flexibility and is far less costly than a fully shielded experimental area.

The contours of the site have been exploited to ensure that the most intense particle beams are driven into a hillside, and come to rest far underground.

A control room block contains those facilities essential to the remote operation of the machine, together with counting rooms, an experimental preparation area of 4,000 square feet, and accommodation for the operating crew. The motor alternator house and a laboratory and office block are located nearby and follow normal practice for such buildings.

2. Magnet Building

This has an internal diameter of **200 feet**, and a height to the crane hook of **18 feet**. These dimensions are adequate but not excessive. It is not economical to make a ring-shaped building of the required dimensions, and the centre of the ring is therefore roofed over. The space in the centre of the ring will be used for radiofrequency and other equipment.

Travelling cranes, of **30 tons** and **5 tons** capacity, cover the area. A small parasitic experimental room is attached, for experiments with weak beams and low background, and a further "bulge" houses the injector.

The magnet foundations have caused some difficulty, since borehole investigations have shown that the subsoil is not so good as was anticipated. Layers of hard chalk are interleaved with a relatively soft clay-like material to a depth of 200 feet or more. However, a system of rigid monolithic structures has been designed by Messrs. Herz and McLellan; this will satisfactorily support the magnet and roof structure within the tolerances specified by the Project Group, subject to a gradual general settlement which may amount to 2-3 inches over several years. We are satisfied that this settlement, as defined in Messrs. Herz and McLellan's report, can be accommodated in the accelerator design.

3. Experimental Area

There are two rooms, 31 ft. x 168 ft. and 61 ft. x 168 ft., separated only by a row of crane stanchions so that the rooms may be used separately or together as required. There are two 30 ton cranes, with a maximum hook height of 18 ft., and the floor is designed to withstand up to 10 units each of 200 tons weight distributed at random. Experiments may also be performed inside the magnet building, and here up to 6 units of 200 tons weight may be randomly distributed. Concrete blocks forming the main shielding wall under the shielding bridge, may be withdrawn on rails for alterations to the collimating arrangements. The beam height is 6 ft.-3 ins.

4. Control Block and Preparation Area

The control room is flanked by remote counting rooms, three in number and

2,000 square feet in total area. There are three offices for operating staff, a rest room and a small dark room. The preparation area is a hall 80 feet by 50 feet, with floor loading 2 tons per square foot and with a 20 ton overhead crane (18 feet maximum hook height). The whole building is ducted for cables, etc., and there is ready access to the accelerator.

5. Motor Alternator House

This is to house the magnet power supplies and auxiliary supplies for bending magnets, etc. The size and design will not be finally settled until discussions with possible contractors have been completed, but it is already clear that the building will have to be somewhat larger and more elaborate than that originally allowed for in the early estimates.

Although it is not yet possible to recommend a contractor for the magnet power supply, discussions with industry have shown that a system using phase-splitting transformers will have to be used. This requires additional space, and also the power supply building has to be split into two parts. Allowance for this has been made in the revised estimates submitted below.

6. Laboratory and Office Block

All the laboratories are on the ground floor, and offices etc., are on two floors above a part of the laboratory area. There are 5 large laboratory rooms, 32 feet wide and on a 12 foot module for length, with a total floor area of 8,700 square feet. One laboratory is for exceptionally heavy work, and is provided with an unloading gantry. All can be subdivided into smaller rooms; this will be necessary when nuclear physics work starts. For normal work in experimental physics, laboratory accommodation for a maximum of 60 will be available. The office space, which has to house engineering and administrative staff in addition to physicists, will accommodate a total of 44 in 15 single and 10 double offices, an engineering general office and a small drawing office. Altogether the building will house 60 experimental physicists and, say, 10 theorists and 13 engineers. There is a small colloquium or conference room and a small library. No accommodation is provided for any central National Institute administration, apart from what is required to run and use the 7 GeV accelerator, since this cannot be assessed at present. Extension would be possible.

A system of Boulton-Paul prefabricated wooden buildings will be available to the Institute, and was taken into account in planning laboratory and office accommodation. There will be a total of 6,500 square feet, which will initially house the design team but will be rather flexible as to the ratio of office to laboratory accommodation ultimately available. It could house, for example, 25 experimentalists and 13 theorists and/or engineers. Thus a grand total of 124 staff could be housed, not including industrial employees. This is believed to be about the right number for the 7 GeV machine, and may leave a little space for people planning further developments. An additional 2,500 square feet of similar accommodation could be provided later if needed, by replacing temporary huts which already exist on the site.

The Project Committee feel that the laboratory and office accommodation will be tight, but that it is not possible to make precise estimates of space requirements at this stage. Approval may be requested for more space later, when requirements are more accurately known.

7. Workshops

In the constructional stages, an existing local workshop in the linear accelerator building will be enlarged and used for both projects. Later, the Institute will need a larger mechanical workshop and an electrical workshop. It is difficult to predict the requirements in advance, and it is proposed eventually to build up workshops in an additional building which is the subject of a separate paper (N.I.(G.P.)(57) 6).

8. Cost estimate

The approved estimate, made in March 1957, was based upon preliminary work done by the New Works Division at Harwell during the design study stage. This was for a total of £1.9 million. Messrs. Merz and McLellan, together with the Industrial Group of the Atomic Energy Authority, have now produced more realistic

"intermediate estimates" based upon much more detailed work. These are summarised below:

	Building and Civil Engineering	Mechanical and Electrical	Plant and Equipment	Total
	£1,278,000 ¹	152,000	359,000	
		511,000		£1,789,000
Contingencies ²	118,000	47,000		165,000
CVC(2) ³	89,000	39,000		128,000
Consultants and specialists fees				140,000
Industrial Group fees				85,000
Furniture and fittings				30,000
GRAND TOTAL				£2,357,000

NOTES

1. This sum includes Messrs. Chivers' contract price of £1,018,715, together with the cost of minor contracts already placed, adjustments for the net cost of design changes approved since tenders were requested, and a sum of £100,000 considered necessary for special measures to meet the tight time programme.

2. The original estimate of £1.9 million approved by the Treasury contained no allowance for contingencies.

3. CVC(2) is a sum making allowance for possible variations in costs of labour and materials during the progress of the work, and is not normally included in estimates approved by the Treasury. It was not included in the approved £1.9 million.

4. No allowance was made in the original estimate for Industrial Group fees, since the Industrial Group was not then involved.

Therefore, in order to compare the "intermediate estimate" with the financially approved estimate of £1.9 million, we must deduct:

Contingencies	at	£165,000
CVC(2)	at	£128,000
Industrial Group fees	at	£ 85,000
		<u>£378,000</u>

This leaves £1,959,000 as the new estimate.

This is £100,000 less than the figure reported at the first meeting of the General Purposes Committee.

9. Present State

Tenders were received for the main building and civil engineering contract on 1st October, 1957, and the time programme requires the contract to be placed on 15th November, 1957. The Project Committee have considered the design of the buildings, on which the tender action has been based, and recommend its acceptance.

The Appendix to this paper reports the results of the tender action.

10. Recommendations

The Project Committee recommend:

(1) That a contract for the main building and civil engineering work be placed with Messrs. W. E. Chivers & Sons, Ltd., in the sum of £1,018,715, as defined in the Appendix to this paper.

(ii) That the estimate for the main buildings be amended to £1.96 million, computed as shown in this paper.

D. W. Fry
Chairman, Project Committee.

A.E.R.E., Harwell.
6th November, 1957.

7 GeV PROTON SYNCHROTRONMAIN CIVIL ENGINEERING CONTRACT

1. Tenders have been examined by Messrs. Merz and McLellan, who have submitted their report together with correspondence with Messrs. Chivers.
2. Messrs. Merz and McLellan recommend the acceptance of the lowest tender, that of Messrs. W. E. Chivers and Sons, Ltd., of Devizes, Wilts, amounting to £1,018,715 (one million, eighteen thousand, seven hundred and fifteen pounds).

I concur with this recommendation.
3. Special points arising from Messrs. Merz and McLellan's report are:
 - (i) The omission of a programme and craneage scheme from Messrs. Chivers' original tender has been rectified by:
 - (a) the submission of an acceptable programme and a statement of their general methods of construction.
 - (b) written agreement to adopt any reasonable construction methods required by the A.E.A.
 - (c) a statement that their tender figure includes for equipping the job with materials, plant and labour in order to complete the work to the programme in accordance with any reasonable request by the A.E.A.
 - (ii) Messrs. Chivers are not prepared to admit Sunday work except for Black Gang and Maintenance, but they still undertake to meet the programme and this is therefore acceptable.
 - (iii) The tender only includes for importation of 50% of tradesmen and steel fixers, and, should this percentage be exceeded, either their additional costs would be recoverable or they would undertake the responsibility for this importation for an additional lump sum payment of £31,062.

It is considered that the figure of 50% is low, but that the figure of £31,062 is more than adequate. It is therefore recommended that any extra importation should be paid for at cost, and a sum of £20,000 has been included in the estimates to allow for this.
 - (iv) In the tender documents it was made clear that no provision would be made for any camp or accommodation for housing labour, and that this was entirely the contractor's liability.

Messrs. Chivers, having been appointed Term Contractor at Harwell and having the use of Chilton Camp for that contract, have indicated that they intend to extend this camp to meet their needs for imported labour on the Proton Synchrotron contract.

This gives Messrs. Chivers an advantage over other contractors but the advantage is passed to the National Institute in the form of a very competitive tender.
4. In view of the foregoing I entirely concur with Messrs. Merz and McLellan's recommendation and I formally recommend Messrs. Chivers tender for acceptance, subject to the four provisos made in paragraph 17 of Messrs. Merz and McLellan's recommendation.

G. W. Dixon
Chief Architect, A.E.R.E.

6th November, 1957.