BUILDINGS FOR THE 7 GeV PROTON SYNCHROTRON

P.S.P.C. P/3

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 magnet room 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. External 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 Buildings

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 parasytic 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. Merz 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. I am satisfied that this settlement, as defined in Messrs. Merz and McLellan's report, can be accommodated in the accelerator design.

3. Experimental Area

There are two rooms, 81 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 20 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.

A small subsidiary room, 30 feet square, may be used for storing a large bubble chamber or other exceptionally heavy experimental apparatus. Adjacent to this is an associated plant room.

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 crew 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 settled until a contract is placed for the power supplies.

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 60 will be available. The office space, which has to house engineering and administrative staff in addition to physicists, will accommodate a total of 41 in 15 single and 10 double offices, an engineering general office and a small drawing office. From past experience, I estimate that 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.

7. Auxiliary Buildings

A system of Boulton-Paul prefabricated modern buildings will be available to the Institute, and was taken into account in planning laboratory and office accommodation. There will be a total of 5,500 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. They could house, for example, 25 experimentalists and 13 theorists and/or engineers. Thus a grand total of 127 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.

8. Workshops

In the constructional stages, an existing workshop in the linear accelerator building will be enlarged and used for both projects. It will house 18 mechanics. 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.

9. Cost estimates

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
	£1,454,000	144,600	304,700	£1,903,300
		449,300		£1,903,300
CVC(1)	70,000			1,973,300
Contingencies				194,200
CVC(2)				142,500
Consultants and specialists fees				105,000
Industrial Group fees				85,000
GRAND TOTAL				£2,500,000

NOTES

1. CVC(1) is a sum making allowance for the unusual conditions at Harwell, and is a standard provision in all building work at Harwell.

2. 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.

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

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 the following:

CVC(2)	at £142,500
½ Contingencies	at £194,200
Industrial Group	at £ 85,000
	£421,700

This leaves £2,078,300 as the new estimate, an increase of rather less than £200,000. Some of this increase is undoubtedly due to the difficulties in the magnet foundation problem.

10. Present State

Tenders were received for the main building and civil engineering contract on 1st October, and the programme calls for a contract to be placed on 15th November. Acceptance of a tender would mean acceptance of the present design and the present cost estimates. The programme is very tight, and lengthy delays would inevitably follow any major change.

11. Recommendation

I recommend that the estimate and design be accepted, for transmission from the Project Committee to the General Purposes Committee with a request for permission to place a contract.

T.G.P.

2.10.57