NATIONAL ACCELERATOR LABORATORY

MONTHLY REPORT OF ACTIVITIES

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This is the first of a series of monthly reports summarizing the status of the work of the National Accelerator Laboratory. This first report will cover developments since the publication of the Design Report in January.

General

1. Authorization hearings were held before the Joint Committee on Atomic Energy on February 21, 1968. Dr. Wilson described the plans and designs of the Laboratory*.

2. The present plan of the Laboratory is that the Village of Weston will be utilized for office, laboratory, and shop space during construction. The Laboratory business office is already occupying several houses. The linac section is occupying three houses for offices and construction of an 8,000 sq ft laboratory building for linac work is almost complete. Another house is being used and a 4,500 sq ft inflatable building is being constructed for model-magnet and vacuum testing. Other temporary buildings will be constructed for use by other sections. We plan to move into the village as rapidly as is feasible and it is planned that the entire technical staff will be located there by October.

The Laboratory staff totals 132 people as of April 1. Of these, 47 are physicists and engineers.

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*Note added in proof -- The AEC authorization bill has been passed by both houses of Congress.

Conventional Facilities

Design effort has been somewhat concentrated on architecture in order to push toward decisions needed for next year's construction.

As a result of "Architecture Month," beginning February 19, we have fixed the positions and levels of the main ring, the booster, the linac, and the EPB on the site. We have also determined the approximate position and junctions within the "foot print" of the high-rise building. A particularly dramatic concept of the building has been suggested by the architects--a building of triangular cross-section that leans and is partly supported by an external core that intersects the building near the top. This building will be given further detailed study until April 15 in order to clarify the problems that will arise for a specific building. We will then make a choice as to whether we should develop an entirely new design concept.

In addition, the positions of the accelerator buildings on the site have been fixed and are being suitably memorialized (on paper) by DUSAF.

A site coordinate system has been adopted. It is described in technical specification TS-1.

Theory

The theory section is working with the component sections in design of the lattices (see main ring below) and in digital computation of magnetic fields.

Space-charge effects at transition energy and at full energy are being studied. It is of interest that neutralized space-charge defocusing is rather

large. In addition, the negative-mass longitudinal space-charge effect will also affect debunching for extraction and targeting.

The DCT-2000 remote-terminal link to the NYU CDC-6600 is now in operation. Efforts are being made to translate programs for the IBM-360 at ANL. A data link will be installed later.

Main Ring

1. Lattice. Injection from the booster will take place into the long straight section from which the proton beam is to be extracted. This replaces the injection into a medium straight section described in the Design Report. The medium straight sections have been relocated in cell 13 of the superperiod, chosen for optimum beam-scraper positions, and now two magnets are omitted in each, rather than three.

The parameters of the main-ring lattice have been frozen except for a possible small change in length of the long straight-section quadrupoles. A note giving these parameters is in preparation.

2. Model Magnet Program. Tooling and materials for construction of a pair of 3-ft model magnets have been ordered. The lamination die is under construction in the vendor's shop and part of the steel sheet for the laminations has been delivered. Coils are on order and the copper has been delivered to the fabricator. The stacking fixture from LRL has been delivered to the EBWR building at Argonne where the models will be fabricated and the large magnet stacking experiments will be performed. The design of coils for a quadrupole model was started.

3. Mechanical Design. Effort has concentrated on studies of the techniques of fabricating the 20 ft long magnets, including the mounting of the coils, and the problems of carrying the water and power to them. Simplifications seem to be possible, lowering costs and improving reliability. Present thinking on the water pipe bus system is to have all joints, water cooling as well as electrical, welded. An analysis of the field shape requirements for the magnets has shown that the magnet profile design (reported by the theory group) is close to satisfying the criteria.

4. Power Supplies. An analysis of the transmission-line modes of the magnet ring has shown that a problem exists, but that it is not too serious. A curious result is that the perturbation of the beam due to this effect is essentially independent of the relative phases of the power supplies. A proposed system for an "off-line" local energy-storage system seems promising. Its cost would be more than offset by a reduction of the cost of substations.

5. Plans for the Coming Month. The LRL core stacking fixture will have its modifications completed to adapt it for stacking NAL magnet cores. The lamination die will be finished at about the end of the month, and the coils will be available soon afterwards. The instrumentation for preliminary model measurements will be gathered together and tested. Meetings with all of the major steel suppliers are being scheduled for discussions of the basis for specifying the magnet steel.

Booster

1. Booster Injection Energy. A reexamination of 150 MeV injection into the booster was carried out in collaboration with the linac section. It was concluded that there is no cost reduction as compared with 200 MeV injection and the linac energy is fixed at 200 MeV.

2. Booster Lattice. Work is being carried out on the booster lattice design, including straight-section lengths and auxiliary magnets.

3. Plans for the Coming Month. The booster lattice will be frozen. Materials will be ordered for two 3-ft magnet models. Design work on a power supply for full-scale magnet prototypes will be completed. Work on low-level rf, kicker, and septum magnets will be continued. Work will continue on linac-to-booster beam transport.

Linac

1. The possibility of a 90^{o} bend in the linac was considered. It was concluded that it would be entirely possible to make such a bend, but that it would not aid the architectural arrangements.

2. Model Program. The "scaled-frequency" model of a linac cavity has undergone electrical measurements. Post couplers have been added to stabilize the structure and further measurements will be made. A 3-ft model to test cavity mechanical features has been constructed. Two NAL people have gone to Brookhaven to work on cooperative fabrication of quadrupoles.

3. Plans for the Coming Month. An immediate objective is to build and test as a design prototype a 10 MeV linac in the temporary building at Weston. Mechanical-design work on the 10 MeV cavity will be completed in April, so that bids can be solicited on rolling and machining the cavity. Design work will continue on other mechanical features of the 10 MeV cavity, using the 3-ft mechanical model for tests. Development work is also in progress on high-gradient columns and emittance-measuring devices.

RF

1. Main Ring. Modes are being investigated in a model cavity at LRL. A ferrite-investigation program is being carried out.

2. Booster. Changes in the design of the booster rf cavity are under consideration. These changes would make a slimmer cavity using less ferrite. The possibility of changing the location of the power-amplifier tube from the booster ring enclosure to the equipment gallery is also being studied.

3. Plans for the Coming Month. The development program will continue at LRL. The entire rf program will move here during the summer.

Radiation Physics

1. The linac shielding has been specified, including penetrations.

2. Earth shielding over the accelerator enclosure has been specified.

3. Calculations of muon energy loss, neutron transport and other aspects has been initiated.

4. Plans for the Coming Month. An experiment to measure neutron fluxes in a labyrinth has been proposed at the Princeton-Pennsylvania Accelerator. Preliminary runs will be carried out. Work will also continue on the calculations in (3) above.

Research Facilities

1. Preparations are being made for the 1968 Summer Study on experimental areas, facilities, and equipment, to be held at Aspen, Colorado.

2. Development work on shielding in target stations and experimental areas is being carried out, including calculations of muon range-energy and straggling curves.

3. An experiment is being planned at the Brookhaven AGS to measure production cross-sections for various particles and different momenta and angles. It is hoped that this experiment will be performed in late 1968 and that it will provide much more data for extrapolation to 200 BeV proton energy.