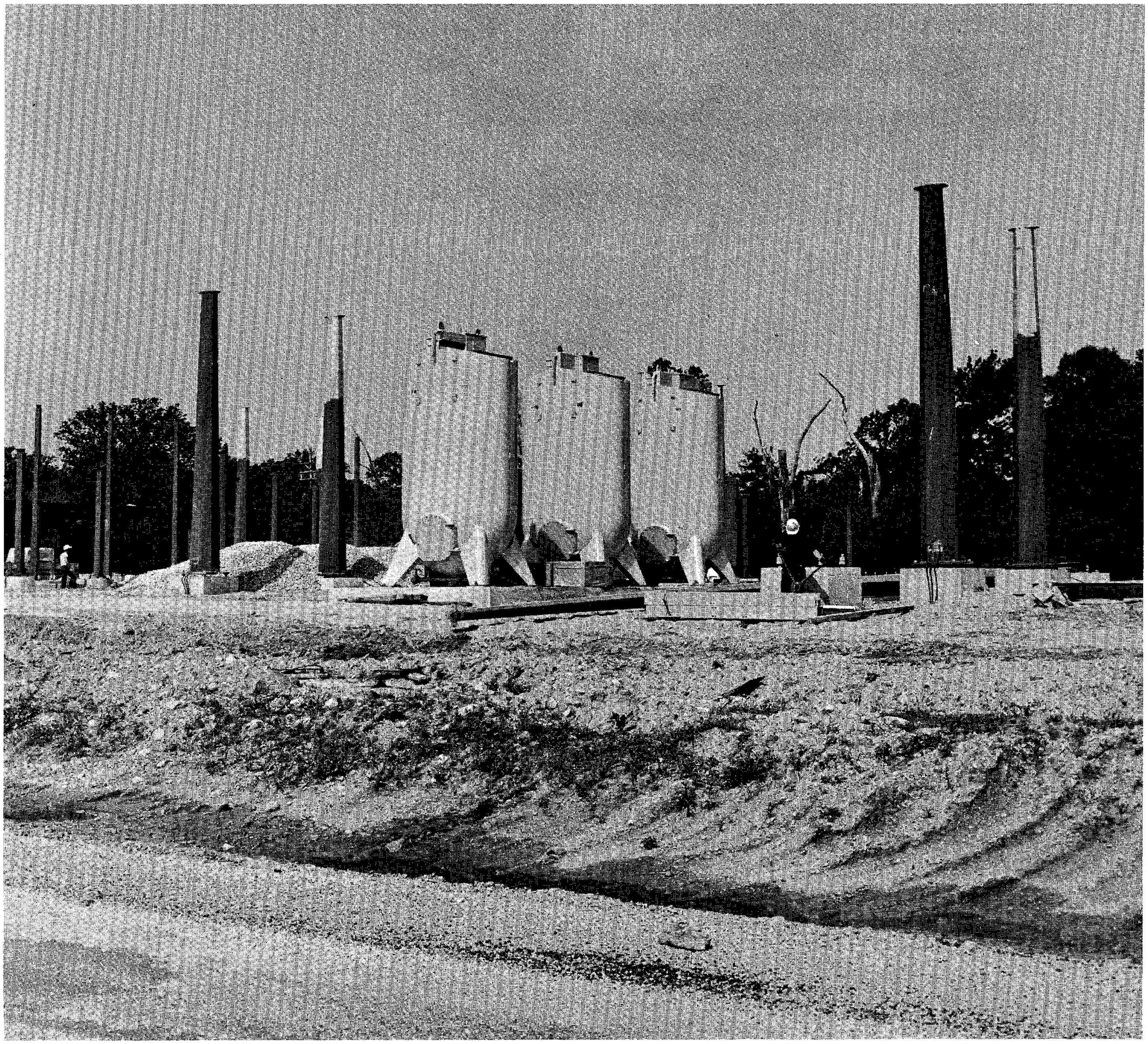
national accelerator laboratory

FERMILAB-NAL-042

MONTHLY REPORT OF ACTIVITIES

May 31, 1970



THE MASTER SUBSTATION

Operated by Universities Research Association Inc. Under Contract with the United States Atomic Energy Commission

Forthcoming Meetings at the Laboratory

June 3, 5	Professor of the Month--S. Treiman
June 22-July 24	Summer Study
Sept. 28-Oct. 2	Proton Linear Accelerator Conference

THE COVER: The cover is a recent photograph of the master sub-station, with the large oil circuit breakers in place.

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MONTHLY REPORT OF ACTIVITIES

F. T. Cole

May 31, 1970

Abstract: This report summarizes the activities of the National Accelerator Laboratory in May, 1970.

Linac

1. 10-MeV Operation. Beam tests were carried out during the first half of May, before Tank 2 was installed in its permanent position. A current of 100 milliamperes was achieved (without use of a prebuncher to aid capture). The ion-source geometry now used gives a higher heavy-ion contamination at low energy than in the earlier operation in the Village, but the growth in emittance through Tank 1 is now slightly smaller than before. The final emittances measured at 10 MeV are approximately the same as those found in the Village operation.

The beam-emittance detector used at 10 MeV is not applicable at higher energies, and a new non-destructive system has therefore been tested. The new system gives about the same phase-space area and ellipse orientation as the previous equipment, but does not give the detailed fine structure of the emittance. The results encourage us to rely on the new system at higher energies.

2. Fabrication. All 61 drift tubes have been installed in Tank 2 and tuning and adjustment of it are virtually complete. Only minor variations from the

calculated design fields were found, which gives confidence in the resonant post-coupler structure (new in this tank). The rf system for Tank 2 is operating at 4.5 megawatts.

Tank 3 was installed in the permanent building on May 18 and 16 of its 36 drift tubes have been installed since then. Its rf system is ready for power testing.

All sections of Tanks 4 and 5 have been delivered and are being prepared for installation.

Booster

One magnet module (two magnets on a girder) has been installed in its permanent position in the tunnel. The first ring magnet power supply has been installed, and initial tests have begun. Installation is also under way of components in the 200-MeV analysis and transport areas.

Main Accelerator

1. Production. Magnet assembly is now in progress in the first Industrial Building. Its interior is shown in Fig. 1. A total of 29 magnets has now been produced and the production rate is climbing toward the desired equilibrium. In particular, the West Chicago facility is producing 3 inner coils per day and when more tooling arrives, will reach the desired 4 per day rate.

Magnet measurements are also moving along. A long-term reproducibility over several weeks of $\pm 3\times 10^{-4}$ in measurements of effective length has been achieved. Between different magnets, the spread in effective length is less than 10^{-3}.

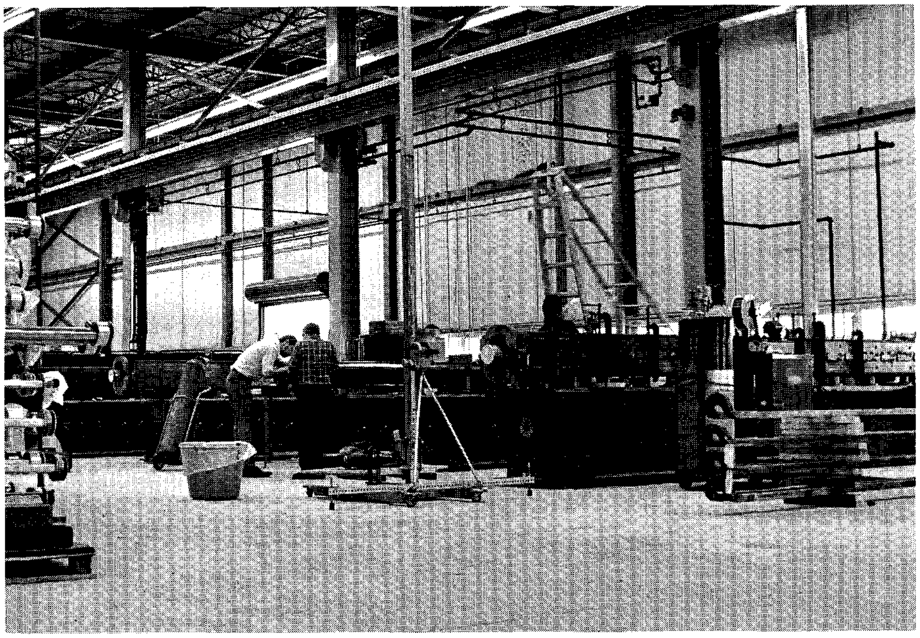

Fig. 1. Interior of the first Industrial Building. The ends of vacuum-chamber segments are at left. Completed magnets are at the right.

2. Installation. The magnet-handling vehicle has been moved into the tunnel.

Figure 2 shows this work in progress. Five bending magnets were placed in

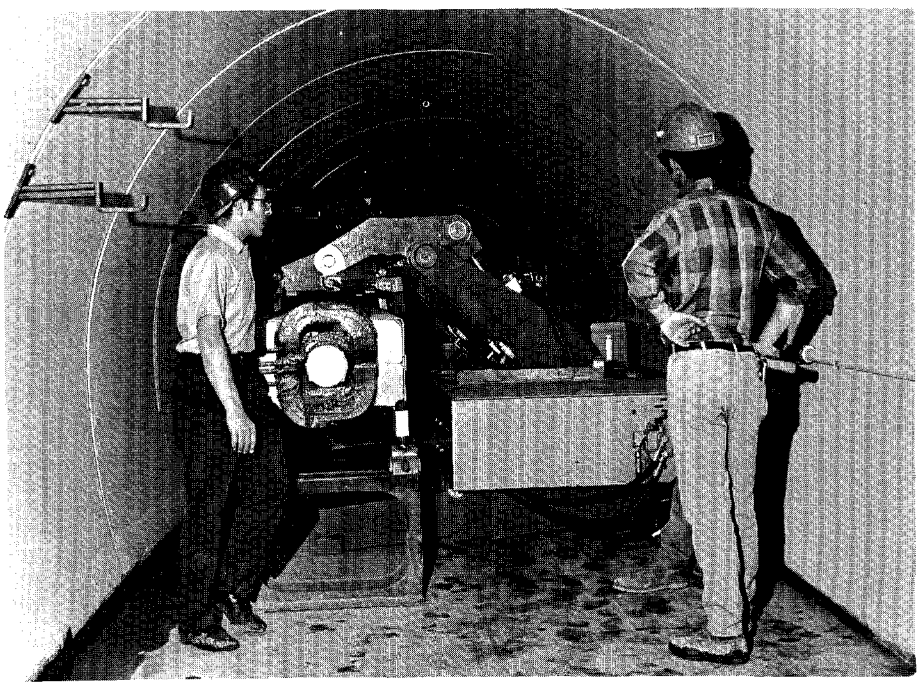

Fig. 2. The magnet-handling vehicle locating a magnet in the tunnel. Ernest Malamud is at the left.

the tunnel in May. Installation of power bus and water piping has also been started.

Radio Frequency

1. Booster Cavity. A prototype booster rf cavity and power amplifier system, shown in Fig. 3, has been operated at high power with the frequency sweeping over the full booster range of 30.06 to 52.81 MHz. Figure 4 shows oscilloscope traces of a typical 33.3 millisecond accelerating time. The waveforms shown are considered somewhat primitive; work is in progress to reduce the amplitude and phase variations.

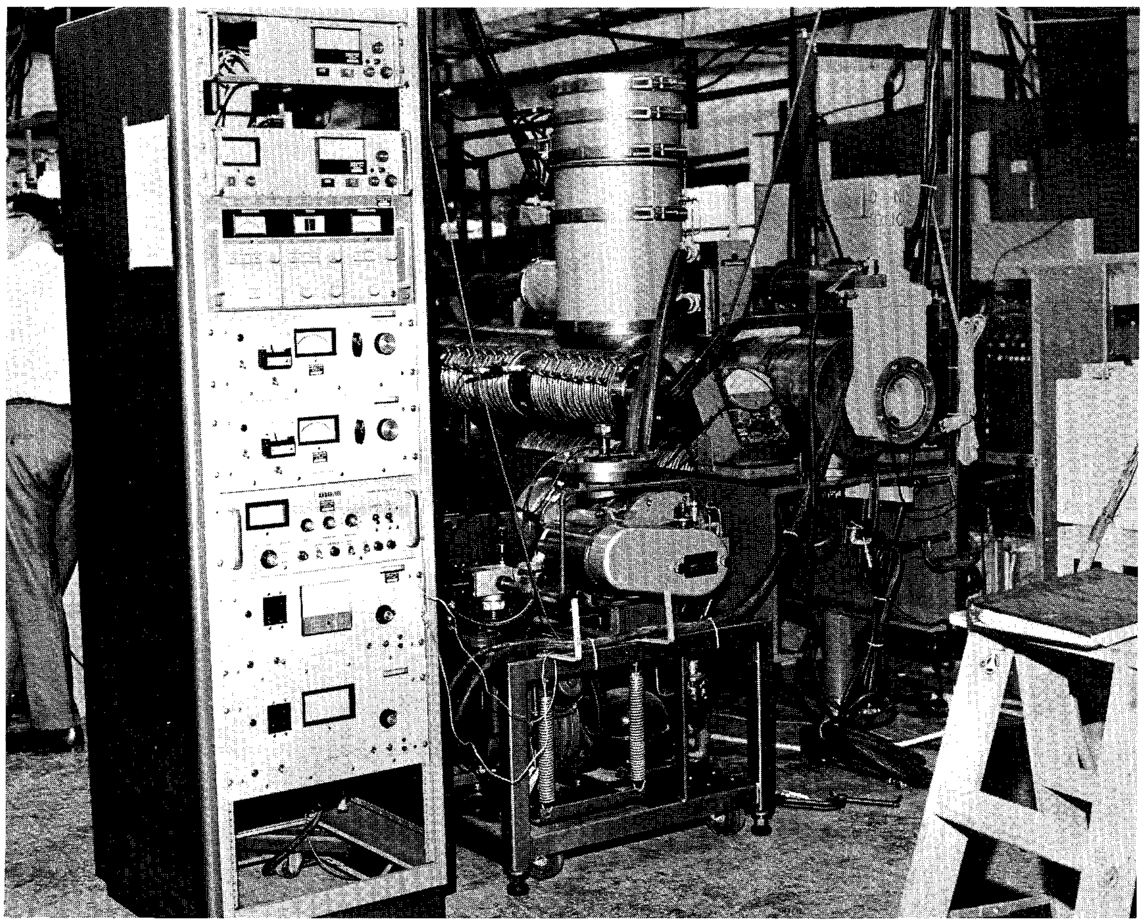

Fig. 3. Prototype Booster cavity. The end of the cavity is at the right. The power amplifier extends above the top of the cavity. The separate cylinders with cooling lines contain the ferrite rings.

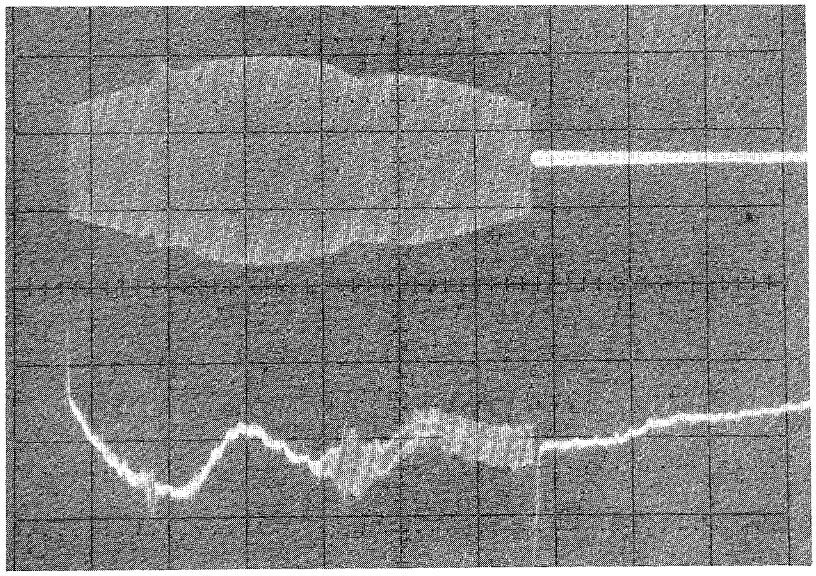

Fig. 4. Performance of the prototype Booster cavity. The upper trace is rf voltage. The lower trace is the error signal between the power-amplifier cathode and anode in the phase-locked loop.

The next two graphs concern the ferrite bias supply. Figure 5 exhibits

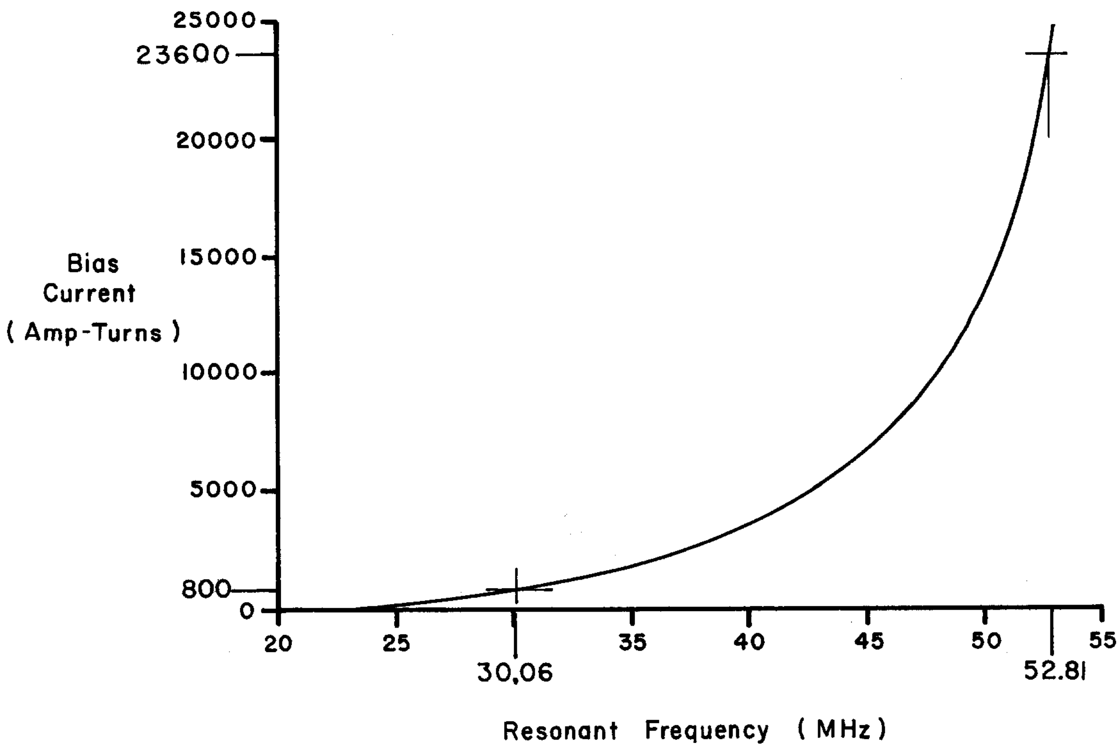

Fig. 5. Bias current vs resonant frequency.

the measured bias current required to tune the resonant frequency of the cavity; Fig. 6 shows the bias current as a function of time. In both cases, these curves are close to the predicted values.

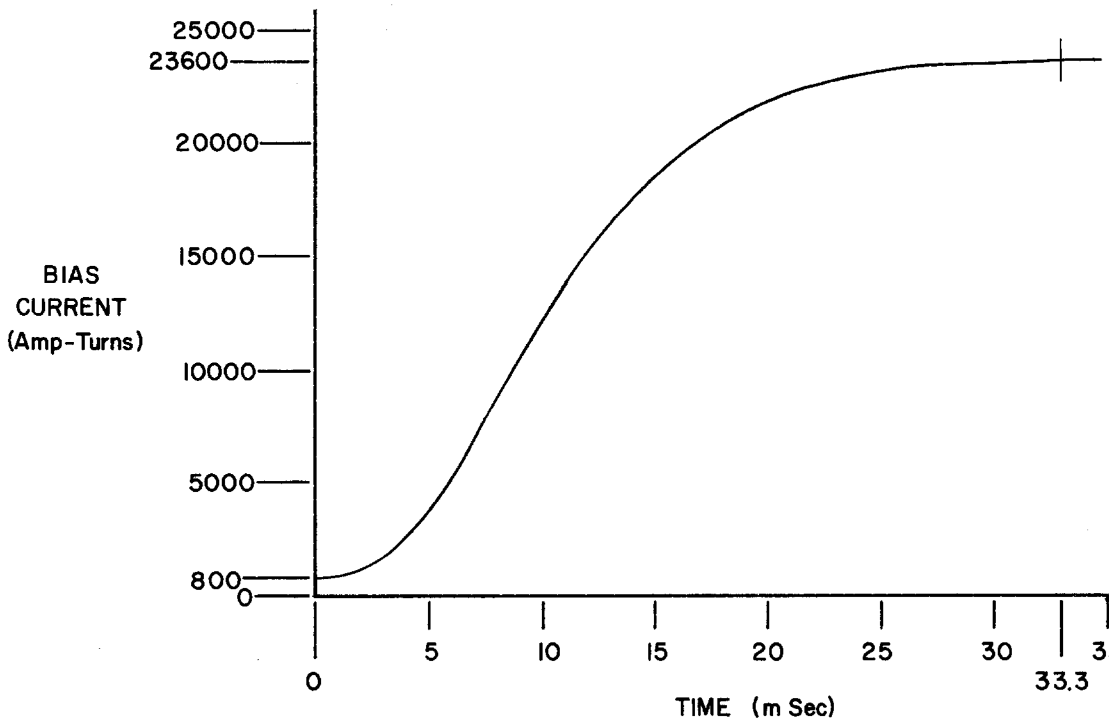

Fig. 6. Bias current vs time during the booster cycle.

These booster-cavity tests have yielded a great deal of valuable information. In particular, the process of ferrite-core selection to guard against premature onset of the high-flux loss phenomenon (the electron-spin mode mentioned in an earlier monthly report, NAL-33, Oct. 31, 1969) has been successful.

Beam Transfer

A model of a new type of fast-kicker magnet has been fabricated and is now being tested. Figure 7 shows this "strip-line" magnet together with the old "coaxial" design magnet. The new design, if successful, will produce a a much smaller and cheaper magnet with the same parameters.

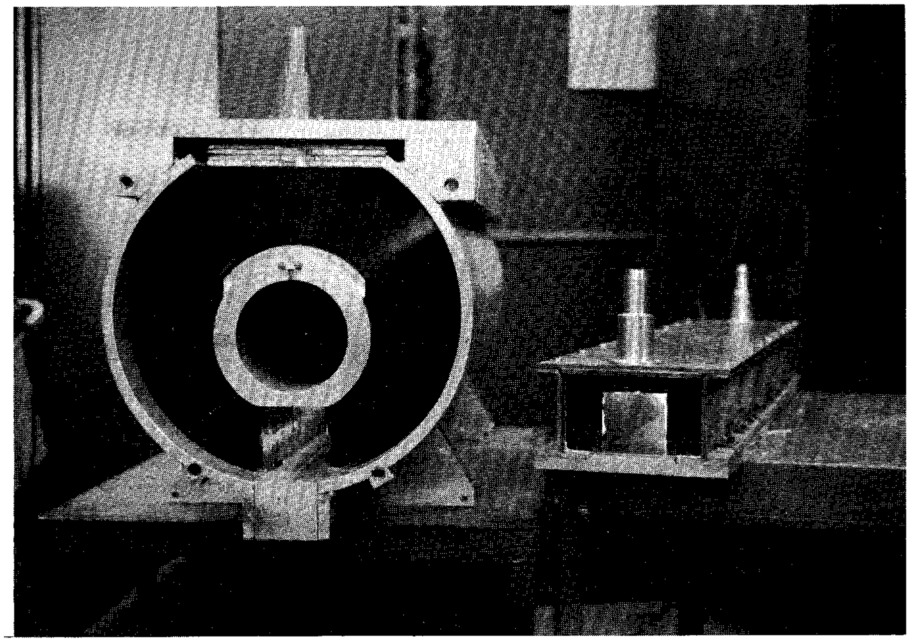

Fig. 7. Conventional ferrite-loaded coaxial fast-kicker magnet (left) and strip-line kicker.

In other work, electrode-shaping studies are being carried out on the electrostatic septum and a pulsed inflector magnet is being tested.

Experimental Facilities

Conceptual design of the target area for experimental-area 2 has been completed. This region, sketched in Fig. 8, contains the target proton-beam

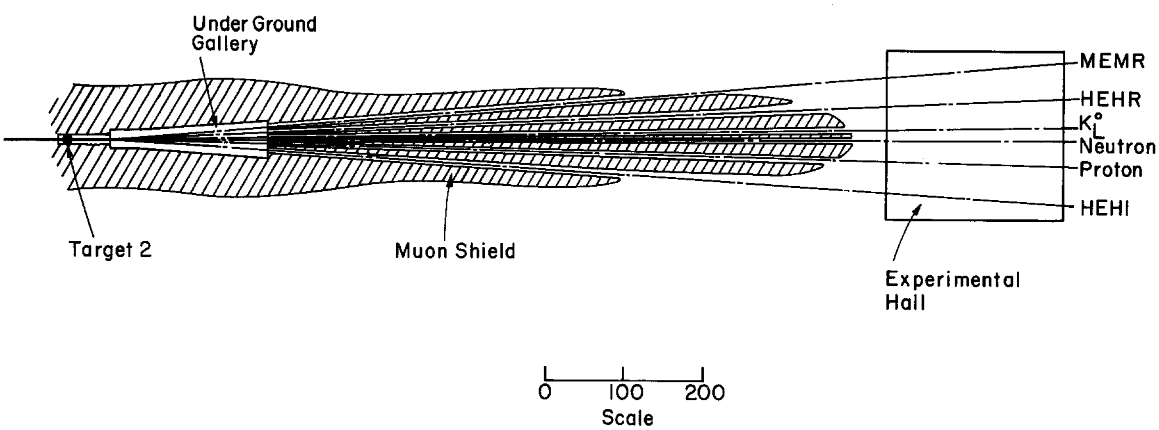

Fig. 8. Experimental-area 2.

stop, collimators in the secondary beams, and the first magnets in the secondary-beam line. These components are in a shielded enclosure. The target, beam stop, and collimators are mounted in the target box described in last month's report. The magnets are in a 220-ft long vault that tapers in width from 10 feet after the beam stop to 30 feet at the other end. At this point, the secondary beams are far enough apart that they can enter individual tunnels in the earth shield. The Experimental Hall shown in Fig. 8 is not yet designed.

There will be a service building adjacent to the target area to house power supplies, cooling, target-handling facilities, and general services for this area.

Construction

Work ground along close to schedule on construction, overcoming handicaps caused by extremely wet weather and a trucking strike. We cover some of the highlights below:

a. Booster. Power and water piping installation is complete. Approximately half of the vacuum line has also been installed. Work on cabling is also well under way. The contract is 94% complete.

b. Cross Gallery. Work is proceeding on the permanent control room and on finishing the remainder of the interior. The contract is 95% complete.

c. Central Utility Plant. There have been slight delays on installation of the building's siding. Equipment installation is on schedule, urged on by the necessity for providing cooling for Linac and Booster testing this summer. This contract is 28% complete. Figure 9 is a recent photograph.

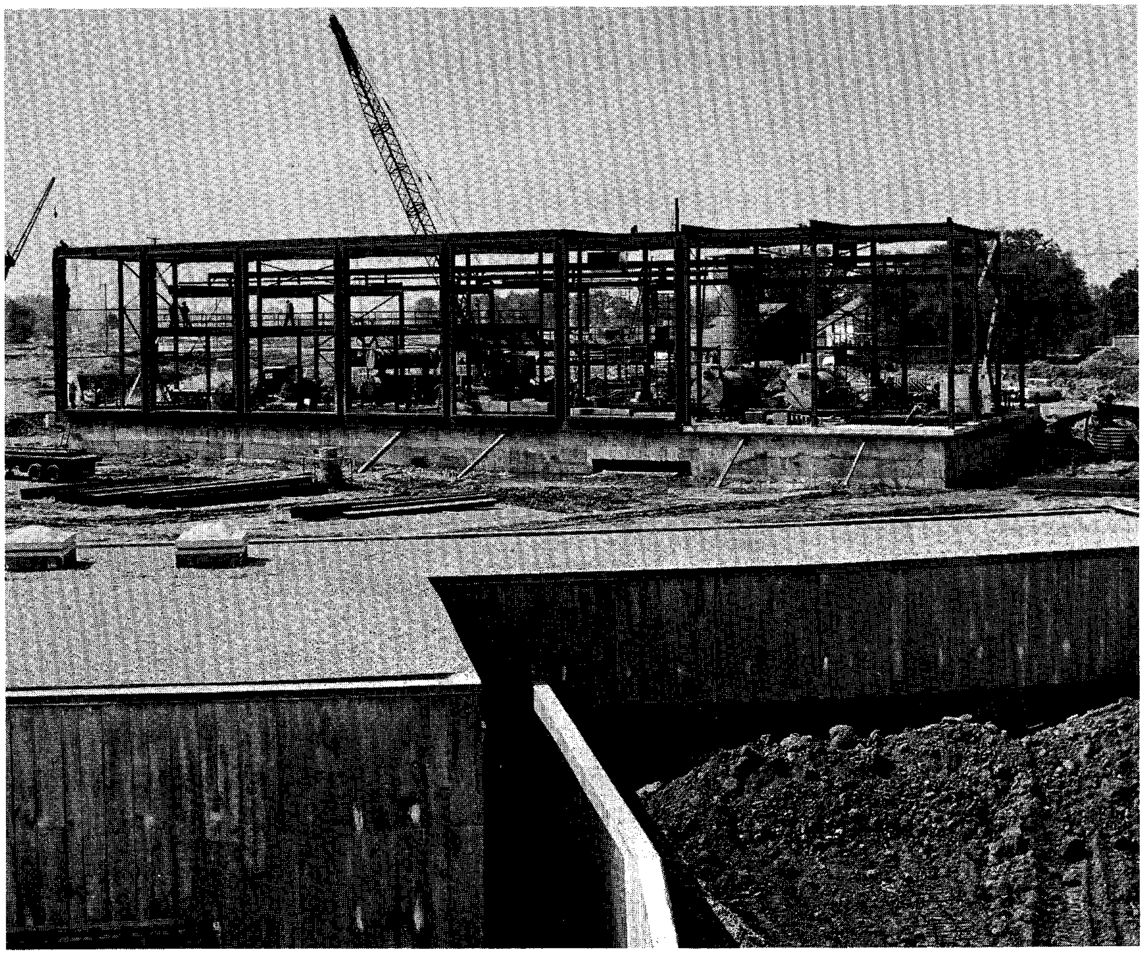

Fig. 9. The Central Utility Plant, seen over the Booster West Gallery. Boilers and chillers are being installed. Cooling nozzles can be seen projecting from the concrete base toward what will be the cooling pond.

d. Master Substation. The building is closed in and large equipment is being installed. The cover photograph shows this work. The contract is 44% complete.

e. Industrial Buildings. We are making considerable use of the first building. The second building is close to completion and area paving is under way. The contract is 88% complete.

f. Main Accelerator.

(i) Phase I. (First sixth of the tunnel) Virtually all the precast tunnel sections of the first one-sixth are in place and considerable backfilling has been done. We are making use of approximately 500 feet of the tunnel. We are also using the major vehicle access just south of the Transfer Hall, which is shown in Fig. 10. This contract is 72% complete.

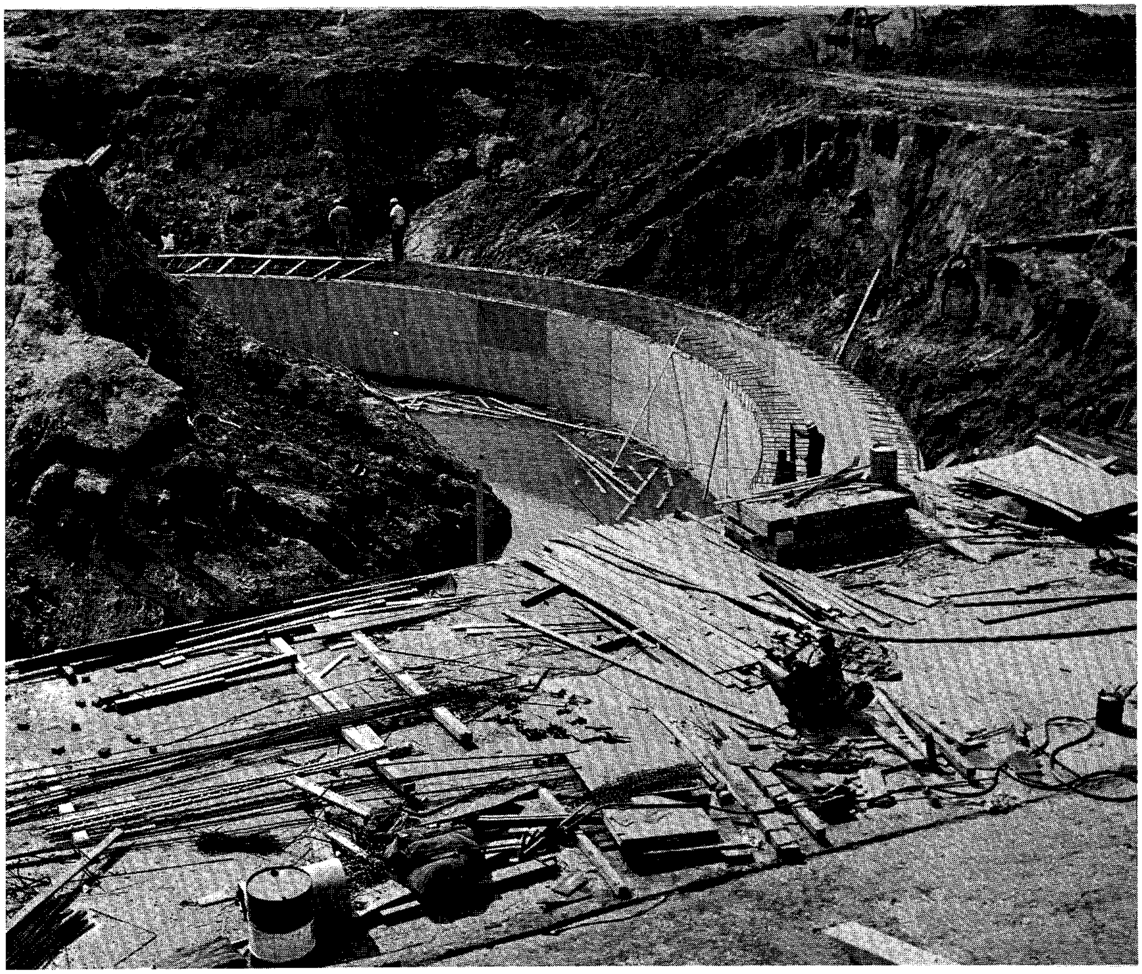

Fig. 10. Work on the Vehicle Access. The top of the Transfer Hall is in the background.

(ii) Phase II. (Five-sixths of the tunnel) More than 1.5 miles of excavation and approximately 1 mile of floor slab are completed. Placing of precast sections is now proceeding rapidly, as shown in Fig. 11. DUSAF has negotiated an incentive contract to give us early occupancy of the RF Building in long straight section F, which we need for our schedule, and excavation for this building is now under way. The entire contract is 20% complete.

Fig. 11. Tunnel work on the Phase II contract. This area is part of Super-period B. The Industrial Buildings can be seen in the background.

Fig. 12. Mack Hankerson looking suspiciously at a tree on Arbor Day (twice delayed by rain).