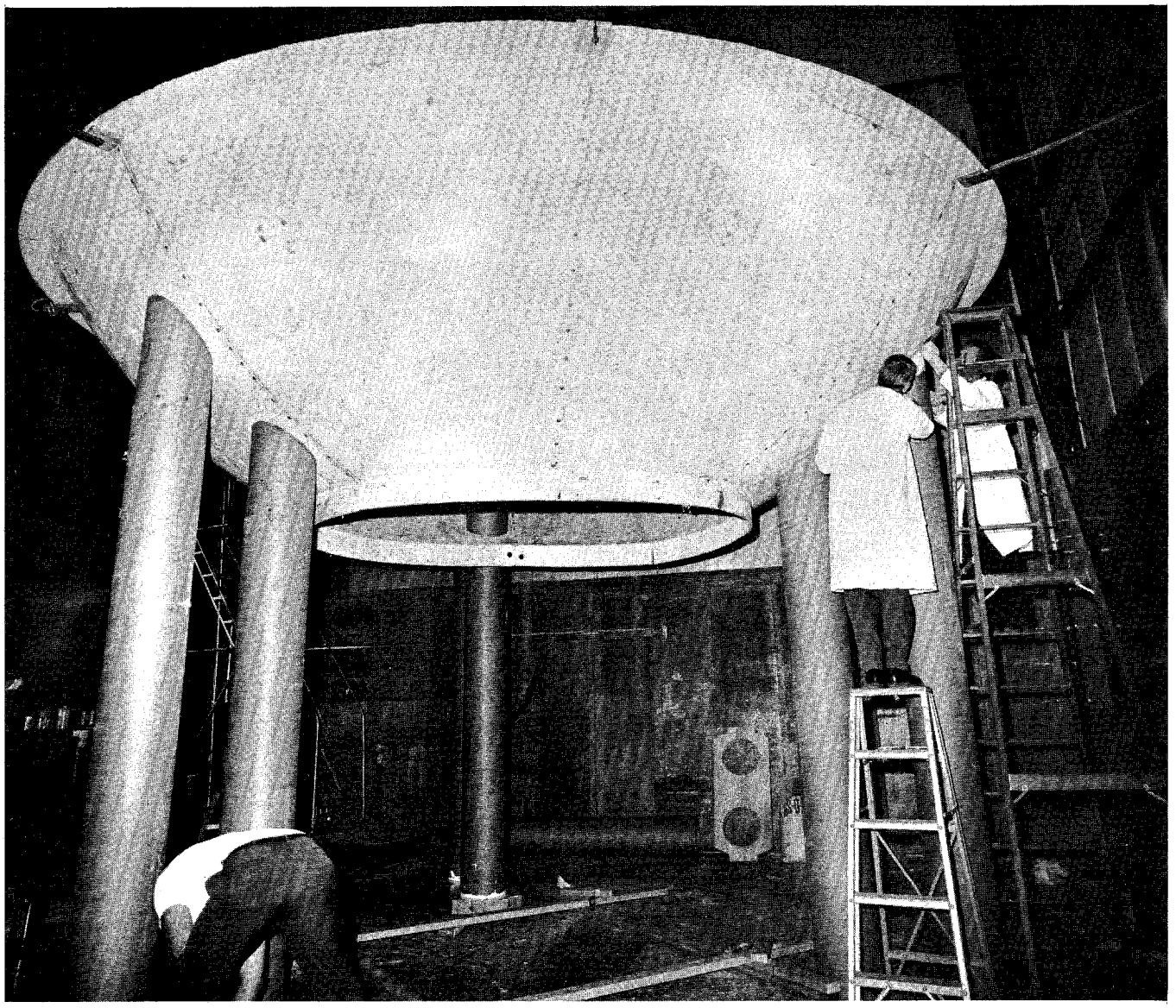
national accelerator laboratory FERMILAB-NAL-046

MONTHLY REPORT OF ACTIVITIES

August 31, 1970



FULL-SCALE MOCKUP OF THE 15-FOOT BUBBLE CHAMBER

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MONTHLY REPORT OF ACTIVITIES

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August 31, 1970

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

Experimental Facilities

1. Fifteen-Foot Bubble Chamber. Design and construction of the 15-foot bubble chamber are moving along. The effort is centered in the former Linac Laboratory building in the Village.

A vacuum-chamber design and fabrication contract has been let. In connection with the vacuum chamber, a full-scale mockup, shown on the cover, is being built to verify piping and equipment layouts. Field assembly of the final vacuum system is scheduled for February, 1971.

Work is also getting under way on the superconducting magnet system for the 15-foot chamber, which is being built by Argonne National Laboratory, and on the expansion system, which is being built by the Stanford Linear Accelerator Center.

2. Program Committee. The Laboratory's Program Advisory Committee met for an intensive week in Aspen. A communication describing the results of the meeting has been sent to all members of the Users Organization. The following paragraph is taken from that communication:

> "The general plans for experimental beams in Areas 1 and 2 were favorably reviewed at the meeting. The following are some specific recommendations that developed from the discussions:

a. That both broad-band and monochromatic neutrino beams be available in Area 1 and that NAL investigate the question of whether the broad-band beam is to be quadrupole focused or horn focused.

b. That the design and construction of a high-intensity muon beam in Area 1 be pursued.

c. That there is no urgency in starting work on a conventional rf separator, but that the Laboratory study how to apply its resources to accelerate the development of superconducting rf separators; that in the meantime, an unseparated charged particle beam to the 15-foot bubble chamber should be provided.

d. That a tagged π^+ beam be available in the charged-particle beam of Area 1.

e. That the Laboratory continue construction of the spherical 15-foot bubble chamber; that at the same time, the LRL group be encouraged to pursue the development of the proposed quantometer they have proposed. That at a later time, this development can be reviewed and, if promising, consideration can be given to modification of the chamber or to the construction of a new chamber body. That the development of track-sensitive hydrogen targets imbedded in a neon mixture should also be pursued.

f. That development of electronic neutrino detector installations be encouraged and that space for this be allowed behind the bubble chamber in the Area 1 layout.

g. That a small bubble chamber be made available at the time accelerated beams are first available for experiments.

h. That NAL study the possibilities of a target station in a future experimental area using a transmission target in the full intensity proton beams. The Laboratory will study the possibility of producing charged-particle beams for the bubble chamber from this target.

i. That NAL pursue the design of a high-energy tagged photon beam.

j. That NAL examine the future availability of test beams in the experimental areas."

The Committee also reviewed the individual proposals submitted to the Laboratory. Their recommendations have been reviewed and letters are

being sent to each of the proposers informing them of the decision on their proposals.

The Program Advisory Committee will meet again on December 11 and 12 at the Laboratory.

An appendix to this report brings the list of proposals submitted up to date.

3. Summer Study. The work of the 1970 Summer Study was concentrated on the experiments proposed and their relation to the experimental facilities planned at the Laboratory. The discussions centered on physics comparison and compilation of the parameters to be measured. These data were used to work out equipment and space requirements, which are being used in the further design work on experimental facilities.

The absence of a second neutral beam in Area 2 was brought up in the study. One of the groups proposed a neutral beam at 8 milliradians, which would give two neutral and four charged beams in Area 2.

There was also considerable study of the need for a longer muon shield in Area 1 because of the increase in energy to 500 BeV. This and the other subjects are discussed at length in the Proceedings now being prepared.

Construction

1. Work on Existing Contracts.

a. Main Accelerator. The Phase I contract (first sixth) is 94% complete. The Laboratory has taken occupancy of the entire tunnel and two of the service buildings that are part of this contract and will take the remaining service buildings in September. Some of this work is shown in Fig. 1.

The Phase II contract is 47% completed. The excavation is done almost

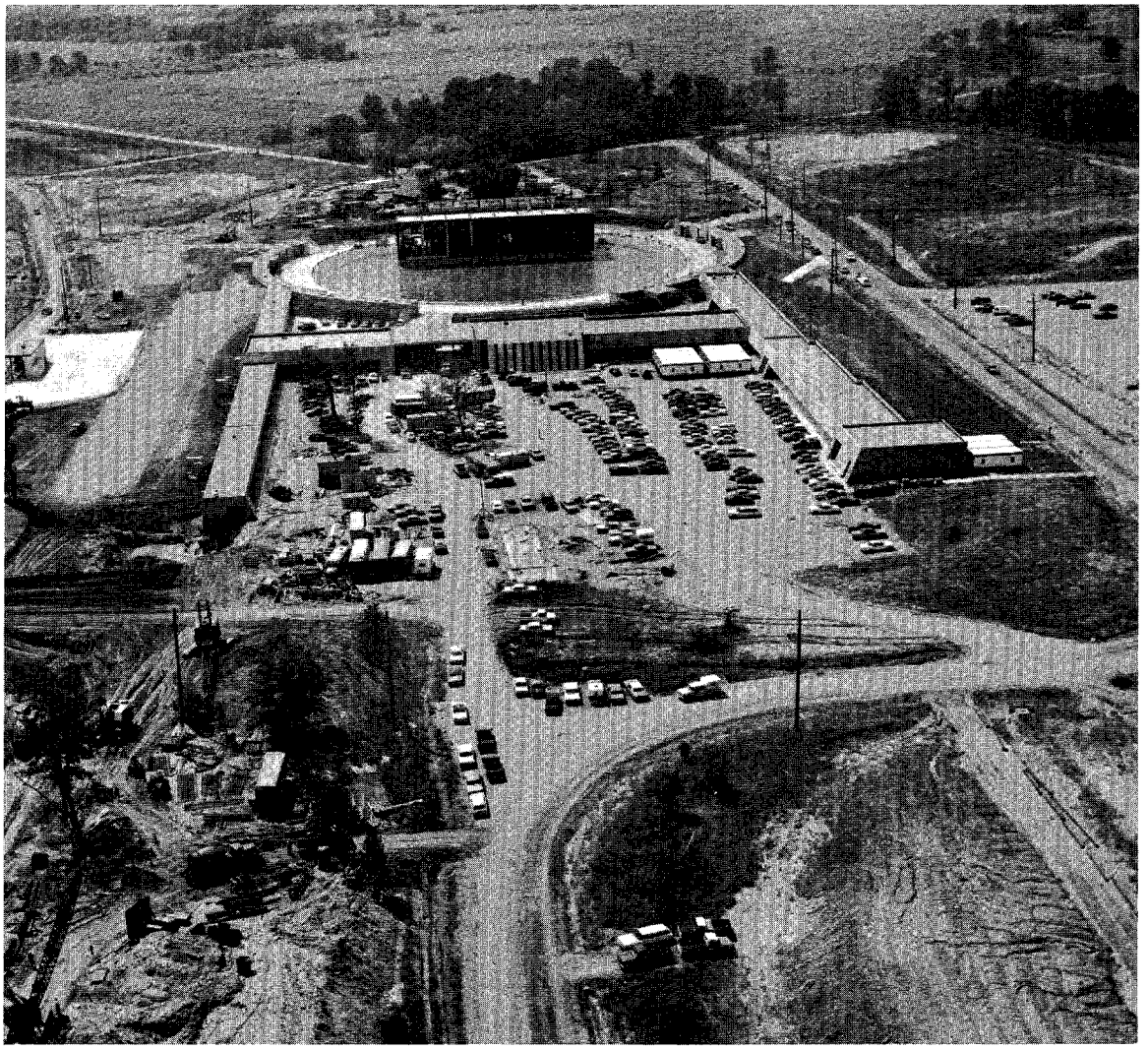

Fig. 1. An aerial view of the Injection Area. The Central Utility Plant and Booster Pond are behind the Cross Gallery. The Transfer Hall and Main Ring, now covered with earth shielding, are at the left. The Transfer Galleries are above them. The Proton Beam Line excavation extends toward the bottom of the photograph from the Transfer Hall.

all the way to the RF Building in Straight Section F, and the floor slab is right behind. Tunnel sections have now been placed more than halfway around from the Transfer Hall. Figures 2 and 3 show this work. The lower part of the RF Building is almost finished, as can be seen in Figs. 4 and 5.

Backfilling has been done through Superperiod B. Work is also going on on the Service Buildings and the Second Major Vehicle Access, which is

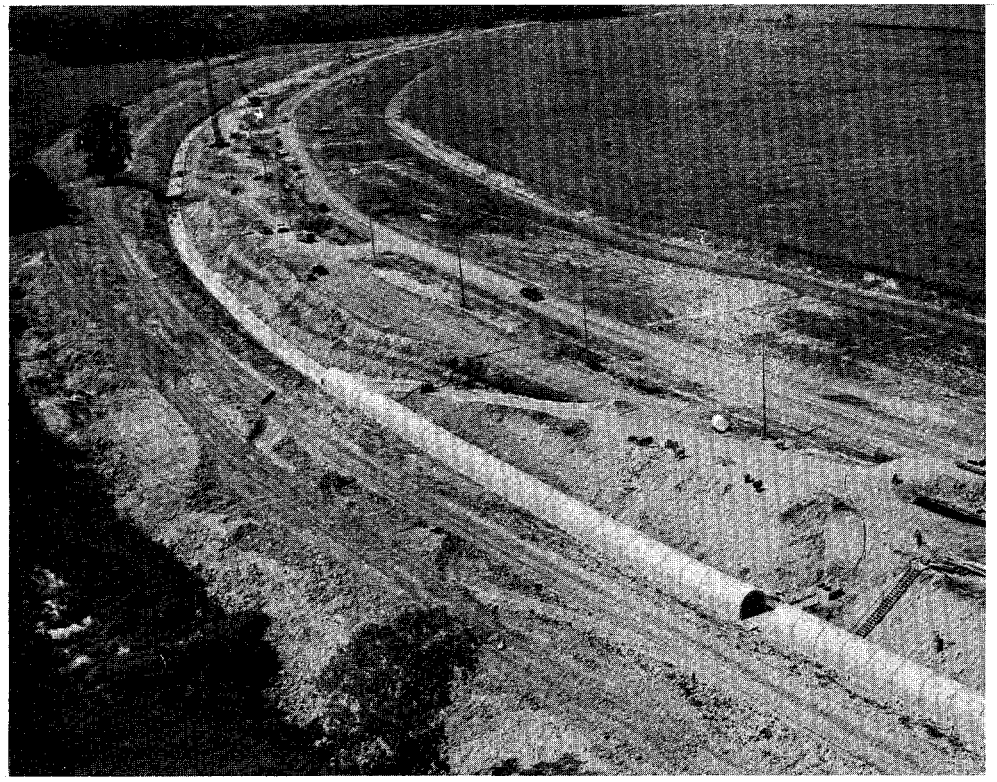

Fig. 2. Progress on the Main Ring from the air. This is the southernmost portion of the ring. The RF Building is beyond the grove of trees at the top.

Fig. 3. Progress on the Main Ring from the ground.

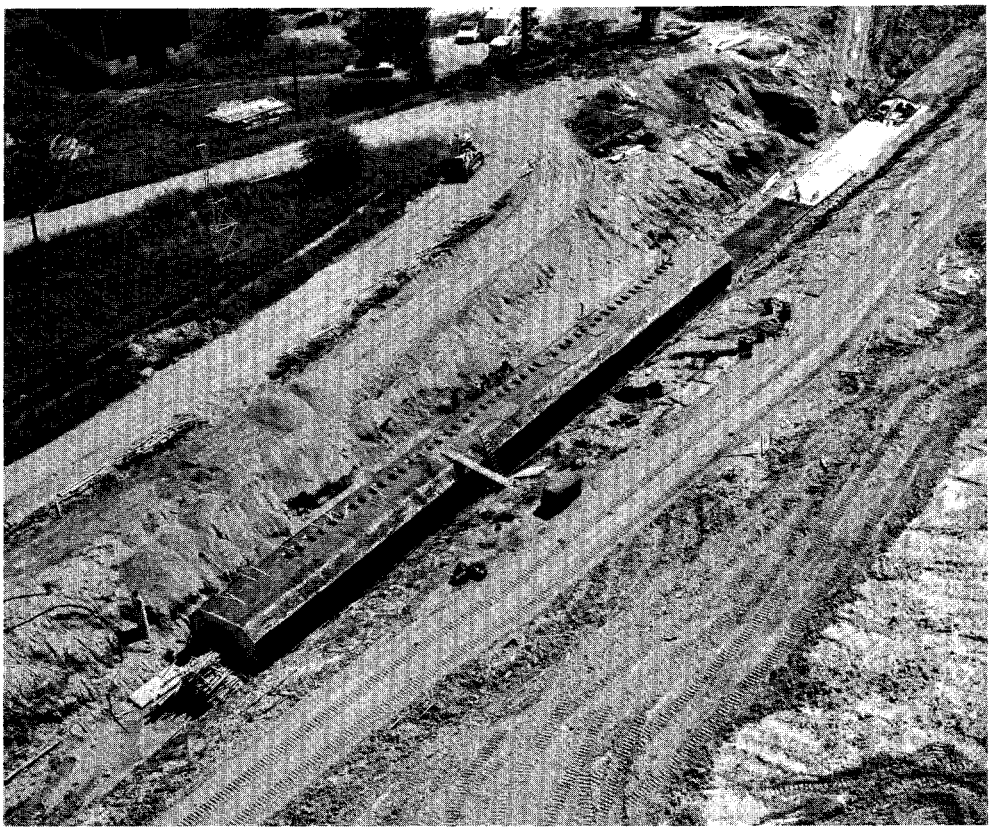

Fig. 4. The RF Building from the air. The holes in the roof will be penetrations for equipment leading to the upper part of the building.

Fig. 5. The RF Building from the ground.

shown in Fig. 6. The Laboratory has taken occupancy of the tunnel part of Superperiod B and some of C.

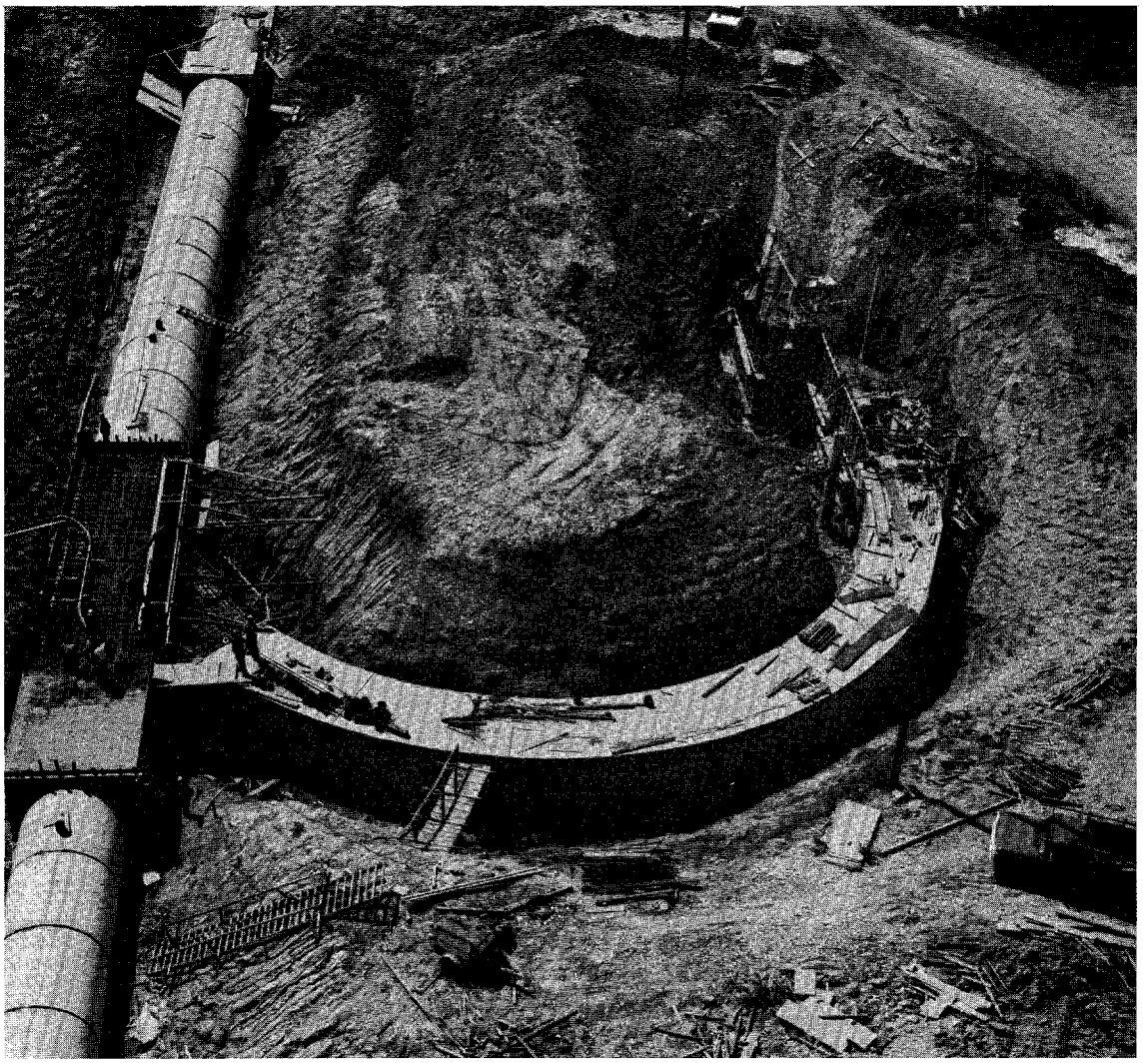

Fig. 6. An aerial view of work on the second Major Vehicle Access.

b. Master Substation and Power Line. The Master Substation is 83% complete. The major items lacking are the 345-kV transformers, the first of which is scheduled for delivery in early October. The right-of-way is being cleared for the 345-kV power line from the northeast corner of the site to the Master Substation. This contract is 20% complete.

c. Central Utility Plant. The Booster pond is filled, as can be seen in Fig. 1. Equipment installation is continuing in the Utility Plant itself, which will soon begin to supply low-conductivity cooling water to the Linac and Booster. The contract is 72% complete.

d. Proton Beam Enclosure. This contract is still largely involved in excavation and is 8% complete. Work near the Main Ring was shown in Fig. 1. Work near the Master Substation is shown in Fig. 7.

Fig. 7. Excavation for the Proton Beam Line near the Master Substation.

e. Cross Gallery. The Cross Gallery is almost completely occupied and in heavy use by the Laboratory, but construction work has been continuing on the permanent Control Room. The Laboratory took occupancy in August,

and installation of control-computer equipment in the lower level was begun. This lower level is shown in Fig. 8.

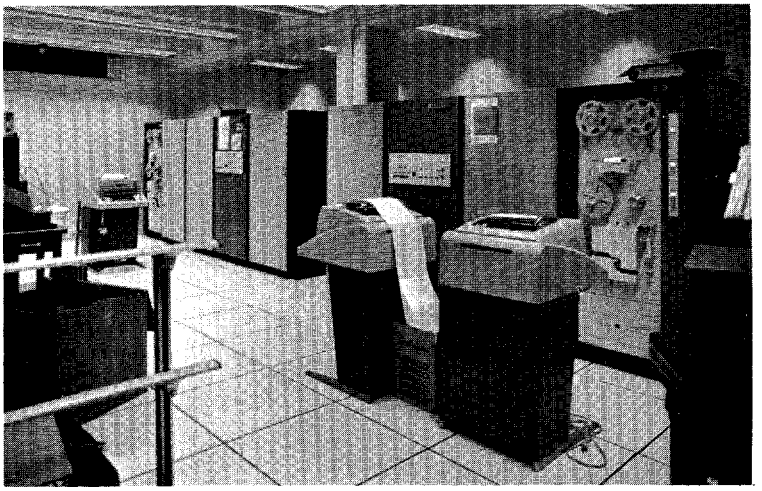

Fig. 8. Control-computer equipment in the lower level of the permanent control room.

f. New Contracts. Notice to proceed has been issued to Walsh Bros. Inc. for Phase I of the Central Laboratory. This contract is for $1.9 million. The Phase I contract includes the ground floor of the building and is scheduled for completion on May 1, 1971 (with some earlier partial occupancies). Phase II, the remainder of the Central Laboratory, is scheduled to start being constructed in February, 1971.

Linac

1. 66-MeV Operation. The first three tanks were operated on evening shifts until August 22, when Tank 4 was moved into its final position. It was not possible to complete tuning up these tanks in the time available, so that this work will be continued as part of the 139-MeV beam studies in October. The main effort was to reduce beam losses in the first three tanks. Improvements in the polarity of the quadrupole windings made it possible to reduce the losses in Tanks 2 and 3 to levels so low that they could not be measured. The

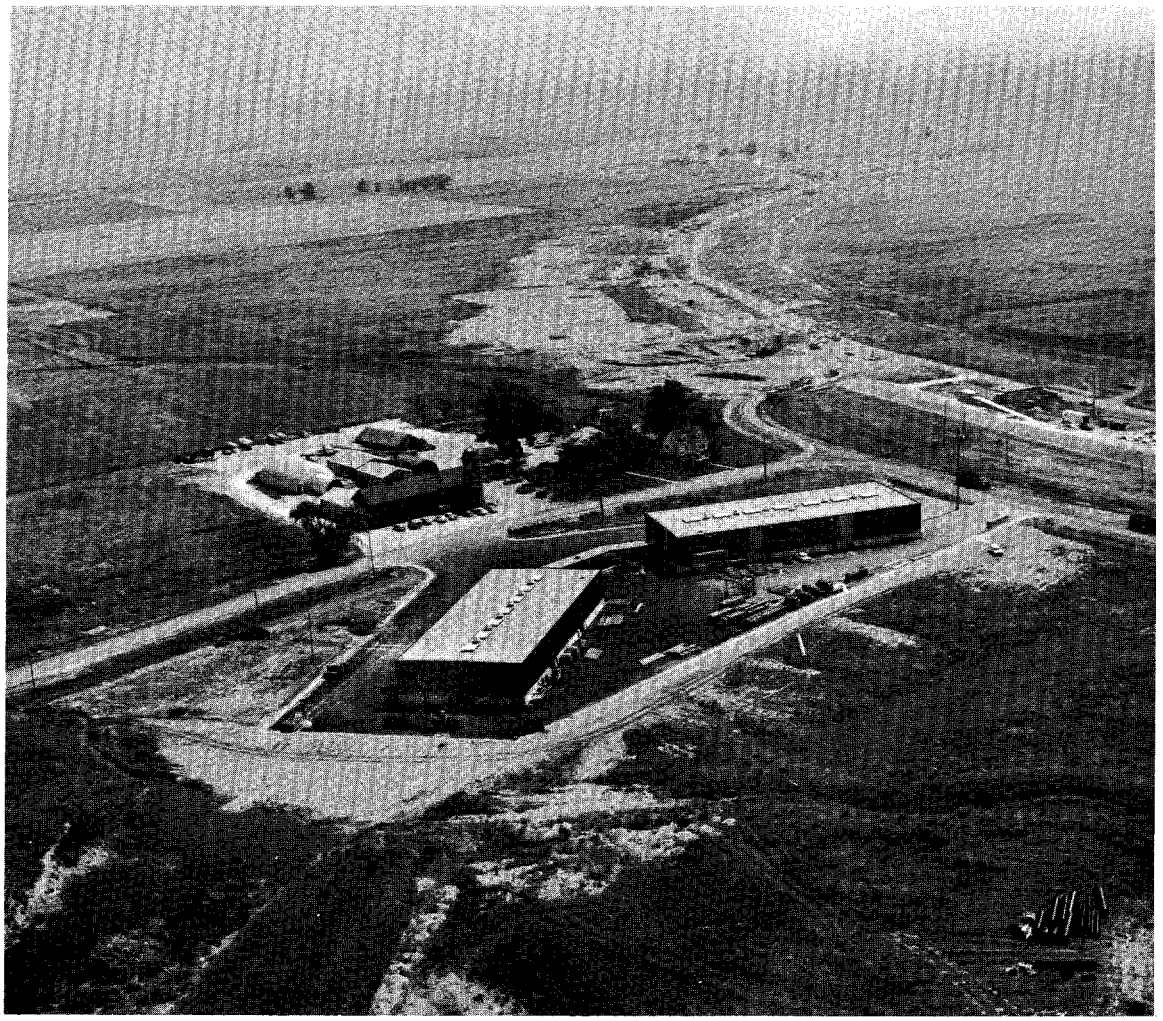

Fig. 9. The Industrial Area from the air, looking southeast. The old air building has been moved from the Village and is across Feldott Road, being used as a stores building. We are now planning on building another Industrial Building south of the present location of the air building.

radiation levels in the 66-MeV beam dump made it impossible to accelerate maximum beam, but a current of 45 milliamperes at 66 MeV (without buncher) was observed. The mean energy was measured to be 65.5 MeV. Crude emittance measurements were also made and some problems uncovered. The destructive and nondestructive measurements are not yet as well correlated as we would like.

2. Construction. All linac tank sections are now on hand. Tanks 6 and 7 have been moved to the permanent building. Drift-tube alignment is complete through Tank 5. The first five rf systems have been operated at full power, and system 6 is ready for full-power tests. Electrical installation of the rf systems has been completed.

Booster

The first half of the Booster ring, except for two girders (four magnets) is installed in the ring. Water and power connections are almost complete and vacuum bakeout and alignment are in progress. Installation of final vacuum components, correction coils, and beam detectors has begun. Fig. 10 is a photograph of the Booster tunnel. Installation in the 200-MeV transport area is also almost complete.

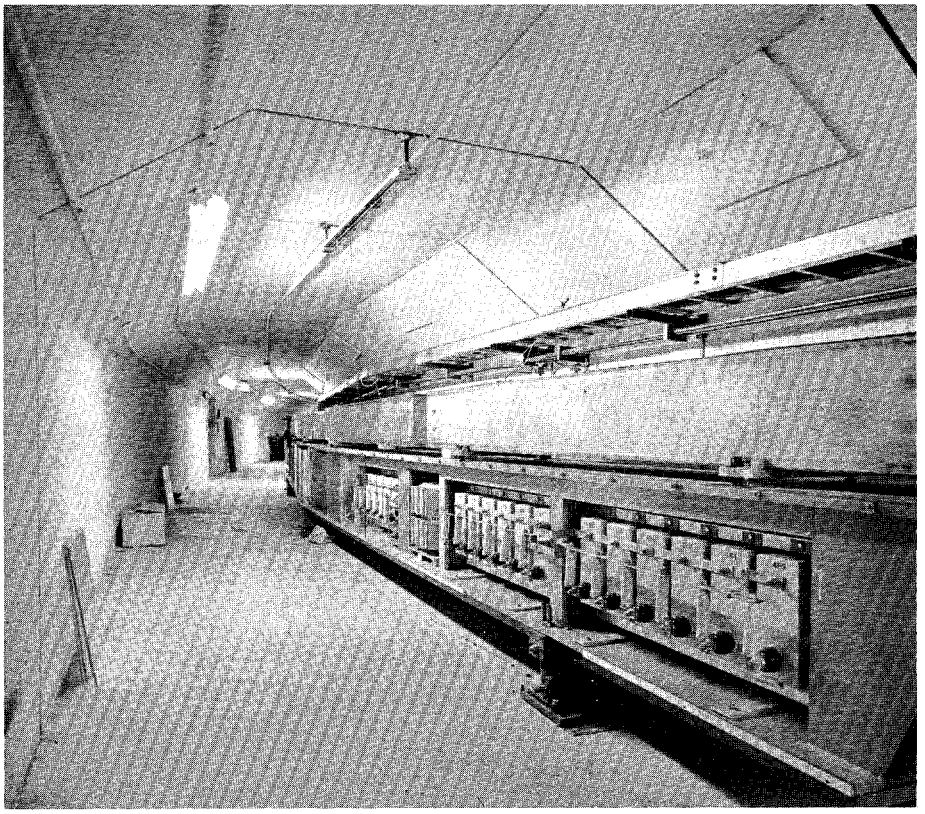

Fig. 10. Interior of the Booster tunnel.

The second half of the main magnet power supply has been shipped from England and will be here early in September.

Main Accelerator

1. Construction. A total of 200 magnets has been assembled. Of these, 70 have been placed on bases in the tunnel and 14 more are in the tunnel. Magnets are being placed in the tunnel in positions depending on their measured fields.

Assembly of water piping, magnet power bus, and cable trays is complete in Superperiod A except for the Transfer Hall. Installation work is now in progress on Superperiod B.

2. Test Results. Temperature tests have been made on production magnets. At 22.5 kG (corresponding to 500 BeV), a 50° C temperature rise caused a 0.5% decrease in field. Mechanical measurements were also made of the effect of temperature rise on deflection of the long bending magnets. The effect was very small--the variation in deflection was approximately 0.00025 inches.

Vacuum tests have been conducted in the prototype section in the Village. Results indicated that it will require 3 to 4 hours to pump 800 feet of chamber down to 2×10^{-4} torr with an oil-diffusion and mechanical pump system. Similar results were obtained with a portable system utilizing only a mechanical pump with a liquid-nitrogen trap.

Beam Transfer

Installation of the Booster-to-Main Ring beam-transport line has been started. These elements are being built on site.

Construction of the main beam dump has also begun. A $12 \times 12 \times 16$-foot stainless-steel box is being fabricated, and 500 tons of steel has been delivered to fill it. A 6-foot aluminum billet that will be at the center of this mass of steel has been completed.

Radio Frequency

Full-power operation of a booster rf station was achieved on August 3. Later in August, a cavity was controlled and monitored from the Booster West Gallery through the control system. Components for the remaining booster rf stations are being received, and installation is under way.

The two prototype main-ring rf cavities are still under test. One has been sent back to the manufacturer for modifications to the damping ferrite used to suppress undesired modes. The second has not achieved the expected quality factor and is being investigated.

Radiation Physics

An environmental-monitoring program including analysis of underground and surface water for radionuclides is in progress to give comparison data when operation begins. The Radiation Physics section is also working with accelerator-component sections in monitoring operation (see, for example, the Linac report above).

APPENDIX. ADDITIONAL PROPOSALS RECEIVED

77. Proposal to Study High Energy Hyperon Physics at NAL

J. B. Kopelman, L. M. Libby, and T. H. Tan

78. A Study of Multiparticle p-p and π-p Interactions Above 50 GeV by Utilizing a Small Bubble Chamber at NAL

Illinois Institute of Technology High Energy Physics Group and R. A. Burnstein

79. A Measurement of the Regeneration Parameter in the 100 GeV/c Range

C. D. Buchanan, D. J. Drickey, F. C. Rudnick, P. F. Shepard, D. H. Stork, and H. K. Ticho

80. General Survey of π^- Interactions in a Hydrogen Bubble Chamber

L. Madansky, A. Pevsner, R. A. Zdanis, L. A. Ettlinger, B. B. Cox, C. Y. Chien, D. Denegri, T. Ferbel, P. F. Slattery, B. L. Werner, H. D. Taft, T. W. Ludlam, and D. Bogert

81. Preliminary Survey of 200 GeV Proton Interactions with Complex Nuclei

S. Kaufman, E. Steinberg, B. Wilkins, G. Friedlander, S. Katcoff, L. Remsberg, N. Sugarman, A. A. Caretto, P, Karol, N. T. Porile, and L. Church

82. Proposal to Investigate Regeneration of Neutral K-Mesons at Very High Energies

S. H. Aronson, R. G. DeVoe, H. Hofer, P. McIntyre, and V. L. Telegdi

83. Study of Antiproton Interactions in the NAL Hydrogen Bubble Chamber at Very High Energies, 40-140 GeV

T. Kitagaki, K. Takahashi, S. Tanaka, K. Abe, Y. Ohnuki, K. Hasegawa, T. Sato, R. Sugawara, K. Tamai, T. Takayama, and M. Kondo

84. Proposal for an Experiment to Study the Reaction $\pi^- p \rightarrow \pi^o n$ at 30 to 150 GeV at NAL

W. R. Frisken, T. L. Jenkins, W. M. Smith, A. G. Strelzoff, C. R. Sullivan, W. S. Brockett, G. T. Corlew, A. R. Kirby, and E. T. Clark, III

85. Proposal for an Exposure of the 15 Foot Deuterium Filled Bubble Chamber to a Beam of Separated π^+ Mesons at 40 GeV/c at NAL

V. E. Barnes, D. D. Carmony, R. S. Christian, A. F. Garfinkel, J. A. Gaidos, L. J. Gutay, S. Lichtman, F. J. Loeffler, R. L. McIlwain, D. H. Miller, T. R. Palfrey, R. B. Willmann, D. Cords, J. Lamsa, K. Paler, K. Rangan, J. H. Scharenguivel, A. C. Ammann, H. R. Barton, Jr., R. DeBonte, C. R. Ezell, R. F. Holland, S. Kramer, W. J. Miller, T. A. Mulera, and J. Tebes

86. A Proposal to Study Inelastic Diffractive Processes by Observing Coherent Production of Multi-Pion Final States from He Nuclei

P. L. Bastien, V. Cook, R. Kenyon, L. D. Kirkpatrick, H. J. Lubatti, D. Wolfe, J. J. Veillet, R. Harris, A. Jonckheere, and S. Spencer

87. Proposal to Search for Heavy Leptons and Intermediate Bosons from Photon-Nucleon and Photon-Nuclei Collisions

W. Lee, J. Appel, M. Tannenbaum, D Yount, and L. Read

88. NAL Bubble Chamber Proposal Search for Fractionally Charged Particles

J. R. Albright, A. P. Colleraine, S. Hagopian, V. Hagopian, J. E. Lannutti, and G. Yost

89. Interactions of 150 GeV π^- Mesons in a Large NAL Bubble Chamber Filled with H_2-Ne

H. H. Bingham and W. B. Fretter

ERRATA IN PREVIOUSLY LISTED PROPOSALS

Proposal 10 should be

A Proposal to Measure the Total Cross Sections for $\pi^{\pm}$, $K^{\pm}$, p and $\bar{p}$

W. F. Baker, E. J. Bleser, D. P. Eartly, E. Malamud, K. P. Pretzl, S. M. Pruss, A. A. Wehmann, R. Yamada, and T. Yamanouchi

M. Atac is an additional author of Proposal 24A.