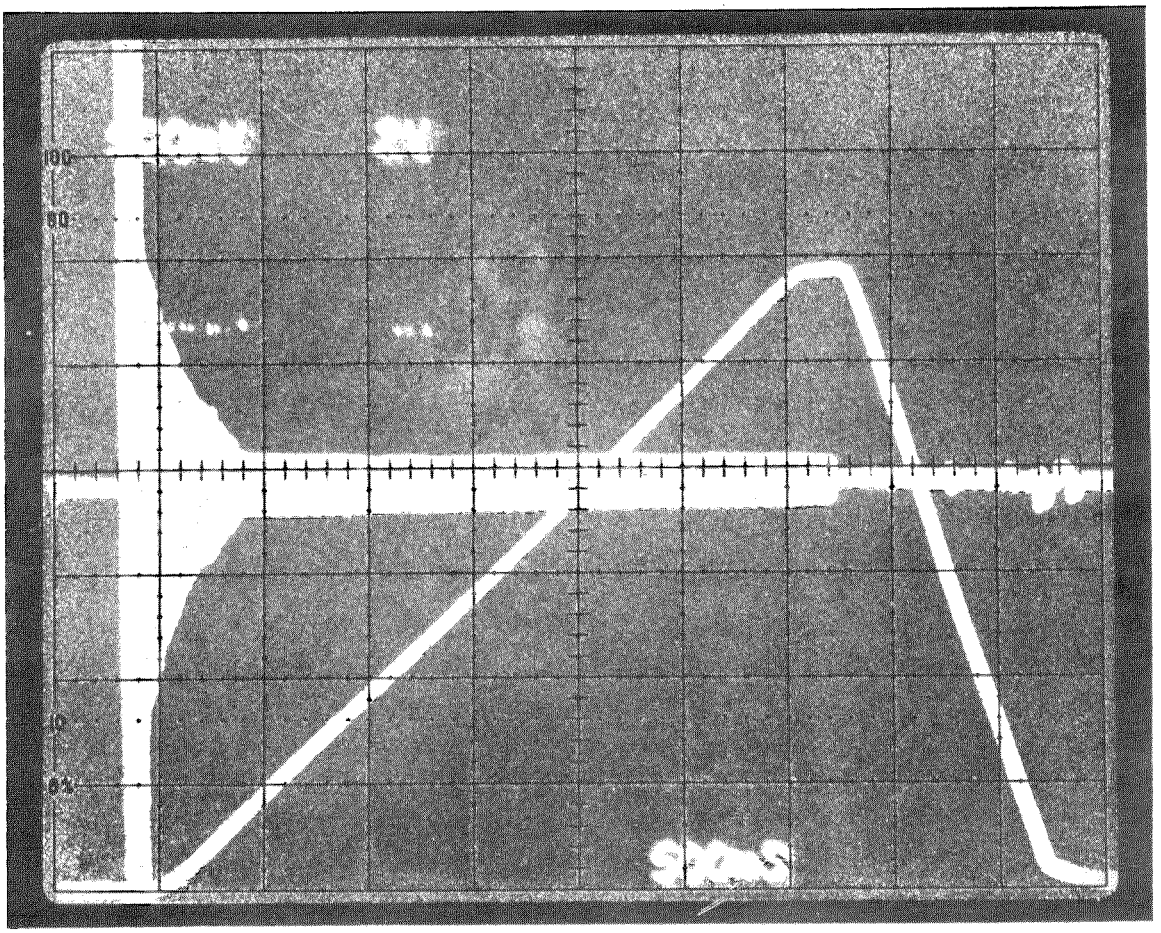
national accelerator laboratory

FERMILAB-NAL-068

0090.01

MONTHLY REPORT OF ACTIVITIES

February 30, 1972



200 BEV!

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THE COVER: Scope trace indicating acceleration to 200 BeV; horizontal trace is the beam, and the diagonal trace is the magnetic field.

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Abstract: This report summarizes the activities of the National Accelerator Laboratory in February, 1972.

Two-hundred GeV, the design energy, was achieved at 1:08 p.m. on February 30. The cover photograph is a beam trace of the first 200-GeV pulse. This milestone was the culmination of a steady progression in energy through the month. Protons were accelerated to 26 GeV on February 3, to 53 GeV on February 4, and to 100 GeV on February 11 at which time the first run for an experiment, p-p scattering utilizing an internal target, was started.

The major effort in February was on magnet power supplies, learning to ramp the magnetic fields to higher values while still preserving regulation and tracking between the bending magnets and quadrupoles. The 53- and 100-GeV accelerations were made with the bending magnets and quadrupoles connected in a single series circuit to avoid the tracking problem, but further work enabled us to solve the problem, and 200 GeV was achieved with the magnets in separate circuits, as designed.

The magnets are not yet water-cooled, and it is therefore not possible to ramp to 200 GeV more often than once every 40 seconds or so without overheating the magnets. At the same time, it is almost impossible to tune up the accelerator with only one pulse every 40 seconds. A "bimodal" ramp

was therefore set up with 40 small ramps to 30 GeV, taking 1 second each, followed by a large ramp to 200 GeV, taking 5 seconds. The first few small ramps after the large one are not useful, but it is possible to tune up on all the succeeding small ramps in preparation for the large ramp.

As has always been the experience when the magnets are excited to a new voltage level, there have been a number of magnet sparkovers. A total of 17 bending magnets and 2 quadrupoles were replaced in February and sent to the factory for rebuilding. It is noteworthy that almost all the failures were in sectors C, D, and E, at the farthest point from the system ground. No magnets rebuilt with the techniques developed in the last few months have yet failed. One of these magnets is shown in Fig. 1.

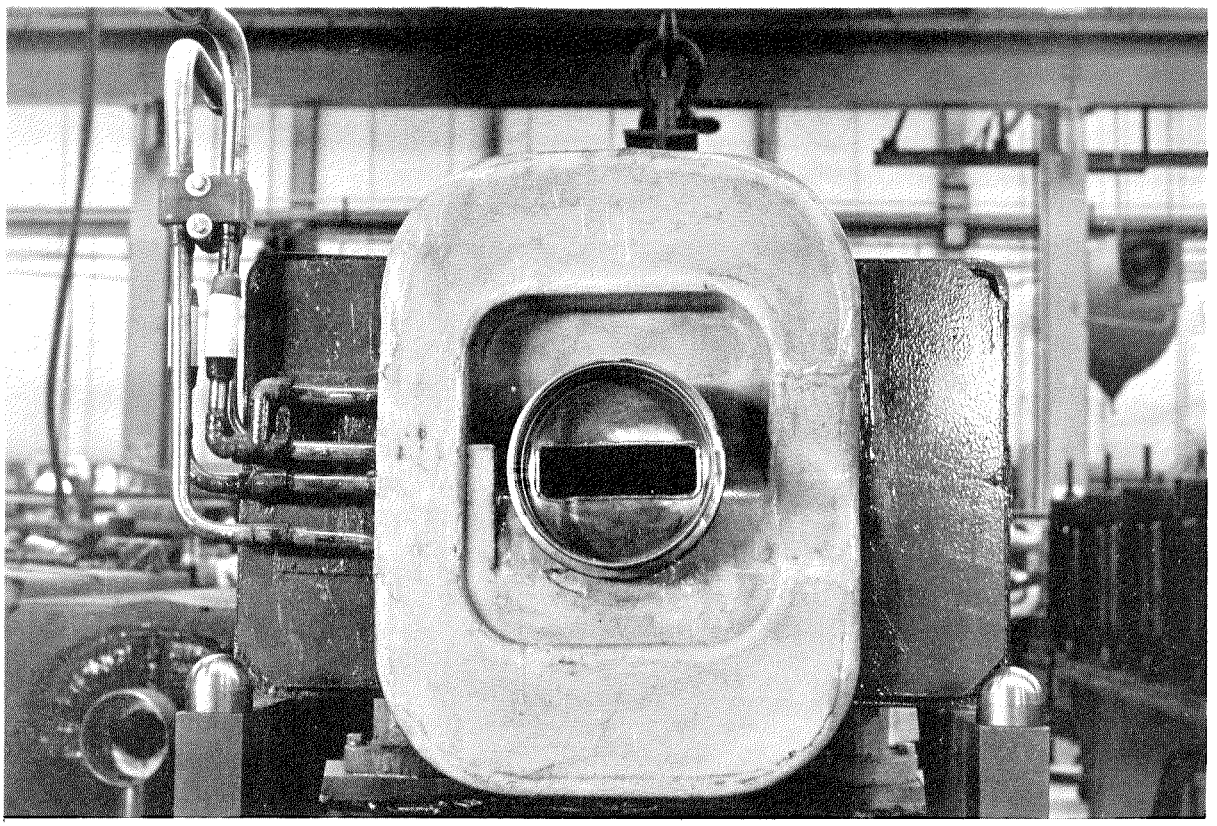

Fig. 1. End view of rebuilt magnet using new impregnation and insulating techniques.

Progress has also been made in understanding particle orbits in the main ring. We have been able to plot resonances (and avoid them) in some detail. A measure of the success in this understanding is that it now takes only a few minutes to establish good coasting beam in the main ring after beam is available from the booster.

These accelerator studies will continue interleaved with periods of operation for experiments and down periods for completion of installation of the water and extraction system.

The electrostatic wire beam extractor has been installed in the vacuum chamber and powered (dc). There was no observable effect on the coasting beam.

Two-hundred air core sextupole magnets have been built and installed around the main ring. (The originally installed sextupoles were lumped at only 36 different locations.) Initial result of tuning of the sextupoles was that the available aperture at injection was approximately doubled over what it had been with no sextupole correction.

Proton Laboratory

General

This third experimental area at the National Accelerator Laboratory was especially initiated to provide flexible facilities for a large class of necessarily unique (e.g., in topology and targeting requirements) very high energy experiments which are inconsistent with the designs of the other two experimental areas.

To satisfy the requirements of several of these experiments simultaneously, the Proton Laboratory is split into three areas side-by-side

approximately 50 ft apart from one another: Proton East, Proton Central, and Proton West with the use of an external proton beam splitting station in the Proton Switchyard. See Figs. 2-5.

Fig. 2. Photograph looking upstream in the tunnel enclosure of the Proton East Laboratory. The beam travels down the center tunnel. The left/right tunnels are maze interconnections to the P2 Service Building, and the P-Central Laboratory respectively.

To maximize flexibility while minimizing costs, these areas consist of fixed beam tunnel areas for beam optics (focusing and splitting) and targeting systems coupled via labyrinths. These are followed by sheet piling housings

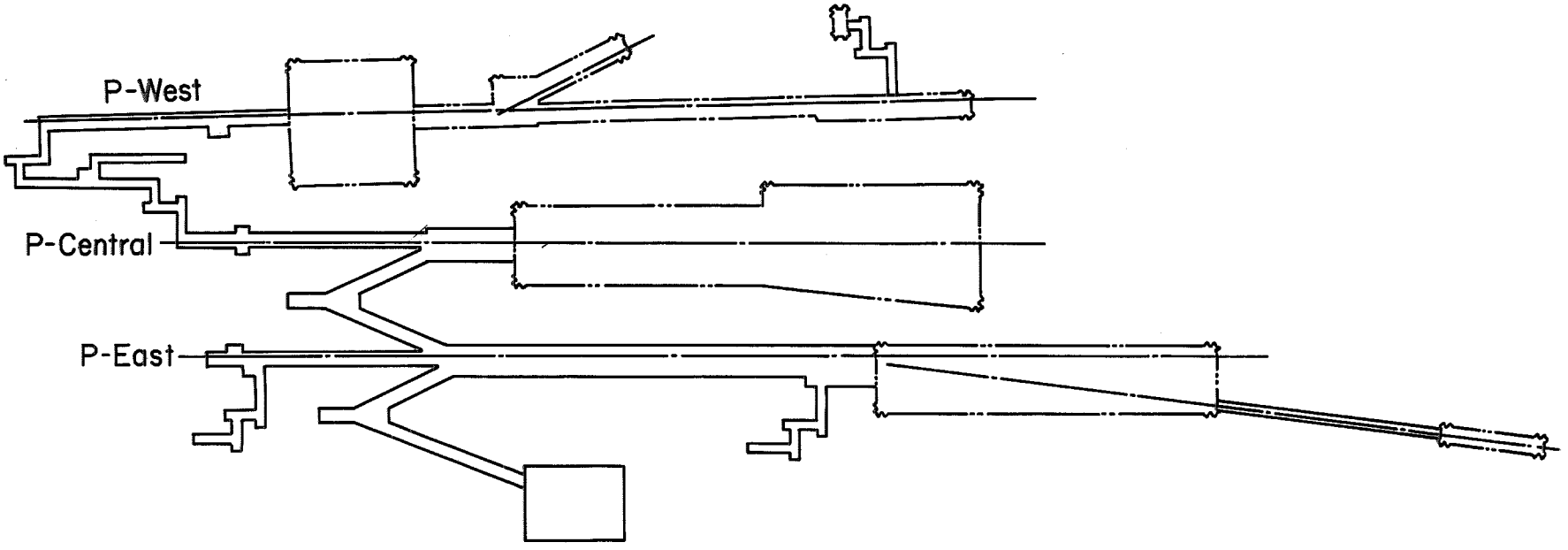

Fig. 3. Proton Laboratory layout.

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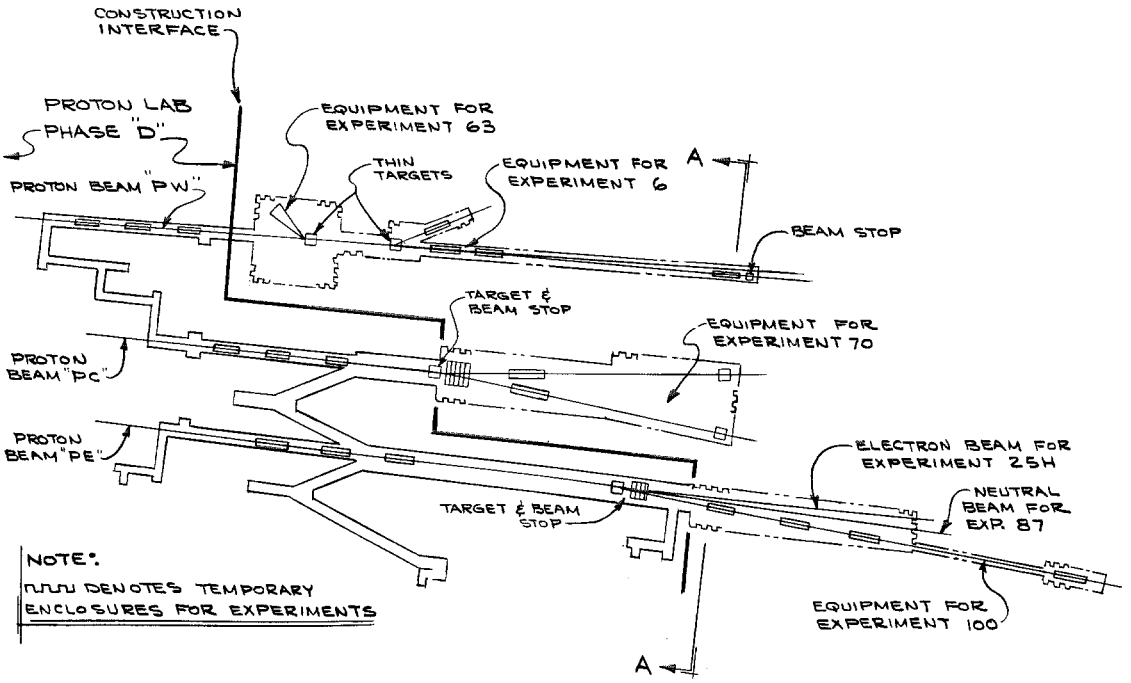

Fig. 4(a). Proton Laboratory experiments layout.

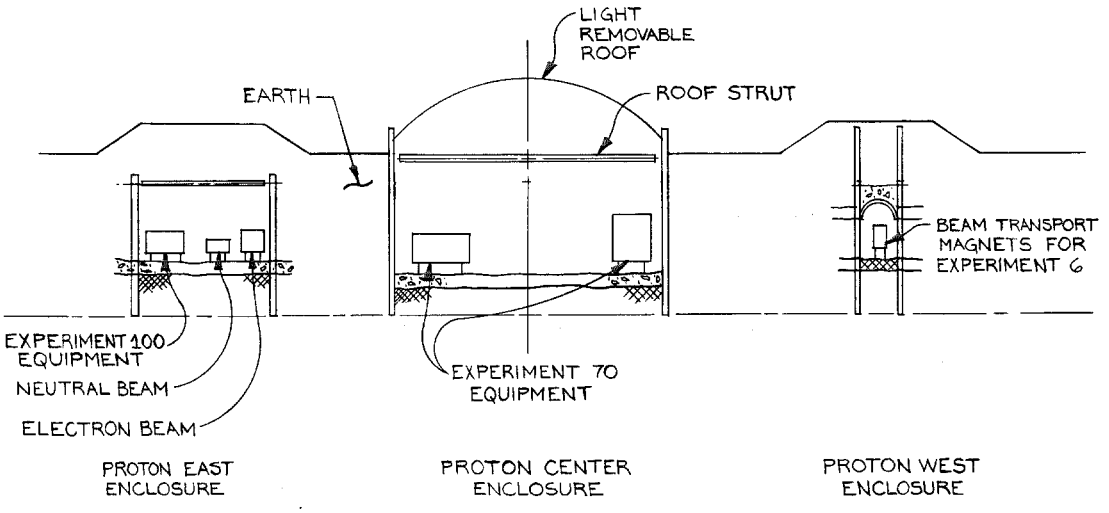

Fig. 4(b). Cross section at A-A.

Fig. 5. Recent aerial view of the Proton Laboratory looking upstream. Proton West appears on the right, and Proton East is on the left.

for secondary beams and experiments. The pits are covered with hatched, removable roofs and serviced with temporary utilities. New experiments will be accommodated by adding to or changing these pits. The central utility and power systems are located in a service building along with an access shaft to the labyrinths through which equipment can be lowered and transported.

This flexibility of the Proton Laboratory extends to the target systems via a scheme of "Target Cannons." A typical target system consists of a sealed box (1 ft 3 in. × 5 ft 0 in.) which holds five "drawers" and is surrounded with bulk shielding supported on jacks. The drawers mount targets, sweeping magnets, beam dumps, shielding, etc. The drawers can be manually transferred to a shielding transporter ("coffin") and removed through the labyrinths. Thus any drawer can be changed. The cannon pile (on jacks) can also be moved to different locations.

Preparations are now underway to house and install the first five high-energy physics experiments in the Proton Laboratory. These are:

Experiment 70--Study of Lepton Pairs from Proton-Nuclear Interactions; Search for Intermediate Bosons and Lee-Wick Structure.

Experiment 100--A Proposal to Study Particle Production at High Transverse Momenta.

Experiment 63--Survey of Particle Production in Proton Collisions at NAL.

Experiment 3--Proposal for a Search for Magnetic Monopoles at NAL. Separation from Beam Dump Target after Removal.

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

Current Construction Status

Construction of the Laboratory through the proton-beam target areas is essentially complete except for backfilling. Beneficial occupancy has been granted. The status through this phase is illustrated in Fig. 2.

Construction of the experimental pits is well along. The P2 Service Building is complete as can be seen in Fig. 6. Mechanical systems are being

Fig. 6. P2 Service Building.

installed and tested. The Proton-Central Experimenters' Pit (E-70) is complete except for the roof as shown in Fig. 7. Figure 8 shows the construction of the sheet piling Proton-East Experimenters' Pit (35% complete).

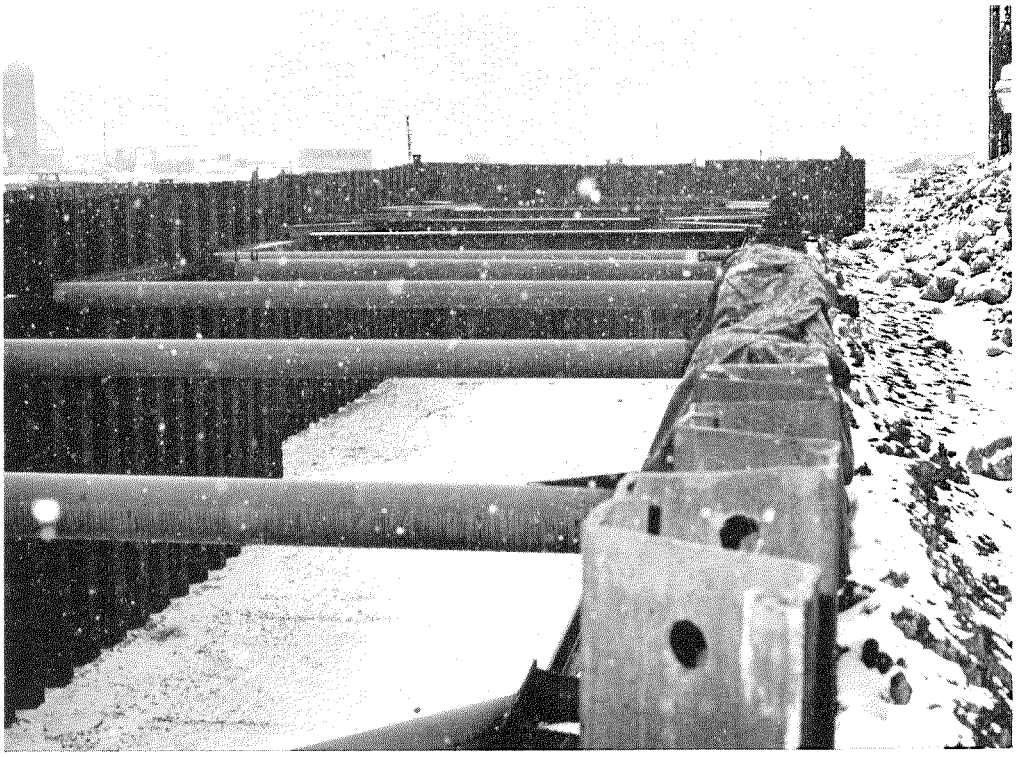

Fig. 7. The P Central Experimenters' Pit.

Fig. 8. Construction on the P East Pit for experimenters' secondary beams.

Fig. 9. Pit for E-100 apparatus.

Figure 9 shows the nearly complete experimental apparatus pit for E-100 in the Proton-East Laboratory.

Phase F of the Proton Laboratory, the roofs for the experimental pits, is out for bid. Specifications of flooring, utilities, and drainage facilities are in progress.

The layout of beams and engineering design of components and target systems are underway.