national accelerator laboratory

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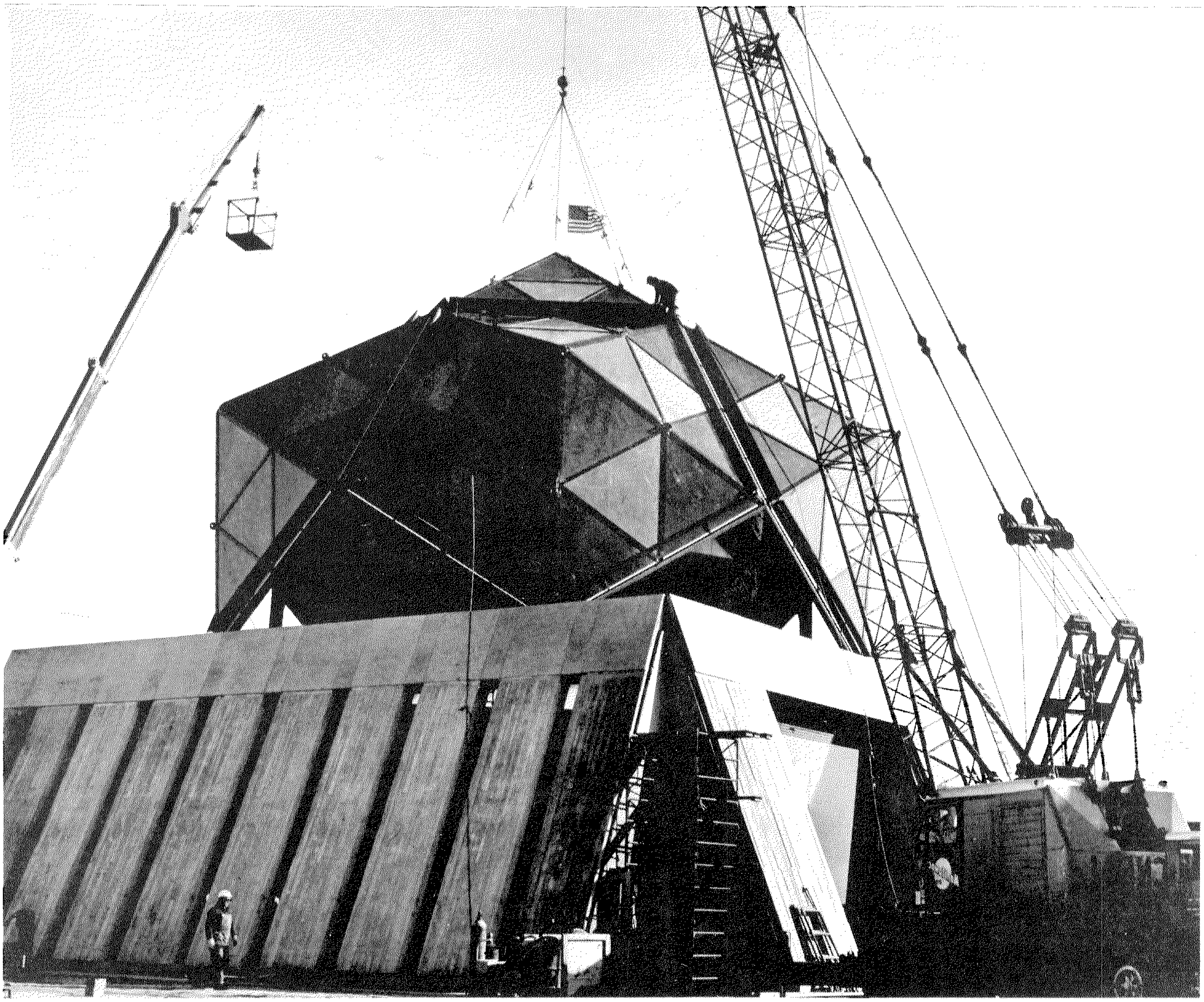
0090.01

MONTHLY REPORT OF ACTIVITIES

November 30, 1971



DOME FOR BUILDING A OF NEUTRINO LABORATORY

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MONTHLY REPORT OF ACTIVITIES

November 30, 1971

Abstract: This report summarizes the activities of the National Accelerator Laboratory in November, 1971.

Last month's report summarized the problems and status of the main ring. A report on November progress appears later in this report. The following is a summary of problems and status of the injection system.

The injection system is designed to provide pulses of 8-GeV protons for the Main Ring. Each pulse is two microseconds long and should contain about 4×10^{12} protons. To achieve design intensity of 5×10^{13} protons per pulse in the main ring, twelve such pulses are to be injected successively into the main ring in about 0.8 seconds. The Linac has already accelerated beam at an intensity of 100 milliamps, well above its design intensity, and is performing now at a duty cycle of better than 90 per cent.

The principal problem in the booster is with the reliability of its rf accelerating system. There were some flaws in the rather complicated biasing coils of the rf ferrite tuners that were delivered to us by the vendor (steel slivers that pierced the insulation), and we have just finished rebuilding all of those units. That should increase considerably the reliability of operation of our present cavities but there remain various mechanical troubles (water leaks, for example) to be corrected. The accelerator is designed to have 16 of these rf cavities to provide acceleration to 8 GeV in 1/15th of a second. With the designed rf voltage it should be possible to achieve 8-GeV acceleration with only 14 cavities in operation, the other two being on standby. In practice, it is difficult to achieve 8 GeV with less than all 16 cavities in operation. For this reason, after some running at 8 GeV, we have temporarily dropped the operating energy of the booster to 7.2 GeV (14 cavities required) in order to have the redundancy that is necessary for reliable operation.

At the present time, although the Booster magnet runs at its resonant 15 cycles per second, we pulse the rf system only once each second. One pulse per second is all we can use effectively in our tuning operations of the Main Ring, because that is the rate we pulse the Main Ring at present, and also because we do not wish to produce radioactivity unnecessarily. We have as yet had no operating experience at the designed 12 pulses in 0.8 seconds.

Two problems at least must be solved before we can accelerate protons in the Booster at a frequency of 15 cycles per second. One of the problems has to do with the power transformer of the rectifier for the RF amplifier. It did not meet our design specification in that the secondary coil moved slightly every time the protective crowbar circuit fired, leading eventually to an insulation failure. A temporary solution was provided by installing a resistor in series with the amplifier in order to limit the current and hence the motion. At present these resistors are all right at one pulse per second but would fail at a higher rate; they are being replaced by a water-cooled version. The other solution has been to have the transformers rebuilt, on a rotational basis, so that the secondary coils are properly braced. We have also purchased other transformers, to be used as spares, from a different and hopefully more reliable, manufacturer.

Main Ring

November has been a month combining operational tests and a continuation of the work of October, to bring the main-ring magnets and power supply to a point where they will operate reliably above the 100-GeV level. This latter work progressed to the point where the entire ring was pulsed to peak currents of over 1000 amperes, which corresponds to an energy of approximately 100 GeV. The power supply operated smoothly through many of these long periods. In addition, good progress was made in installation and commissioning of protection circuits in the power supply.

Between power-supply tests, the "high-potting" tests discussed in last month's report have been systematically carried out on all magnets in the ring. A total of nine magnets (six bending and three quadrupoles) were found during November to have unacceptably low resistance to ground and were replaced.

The quadrupoles were aligned during November. Particle orbits are much more sensitive to quadrupole positions than to bending-magnet positions. At the end of the month, bending-magnet rolls and twists were being investigated and decreased.

The spear discussed in last month's report has been put through the entire ring. The permanent magnet picked up large numbers of metal whiskers (vacuum-chamber cuttings) and a metal dowel pin of the type used in magnet survey and alignment work. Very little of this material was measurably radioactive, and it is not clear that the beam decay observed was related to this material.

Significant progress was also made in upgrading the main-accelerator control system. It is now much easier to control power supplies. There is also much better status information.

There were three periods of Main-Ring injection studies during November. In the first period, the Booster did not yet have stable 8-GeV beam, and no beam was transported to the main ring. In the second, stable beam in the booster was at hand and beam was observed through a part of the first sector of the Main Ring.

For the third period, the Booster energy was dropped to 7 GeV because of continuing difficulties with the Booster rf tuners. With stable 7-GeV beam, a systematic centering of the first-turn beam was done around the ring.

It is planned to continue concentrating on operation during December.

Neutrino Laboratory

With construction of the Neutrino Laboratory area substantially complete and several significant installation milestones behind, it is an opportune time to summarize the area status in a series of photographs.

Fig. 1. View of completed shielding berm downstream of the Muon Laboratory Area. Magnet enclosures and beam pipes for hadron beams to the 30-in. and 15-ft bubble chambers are in the foreground.

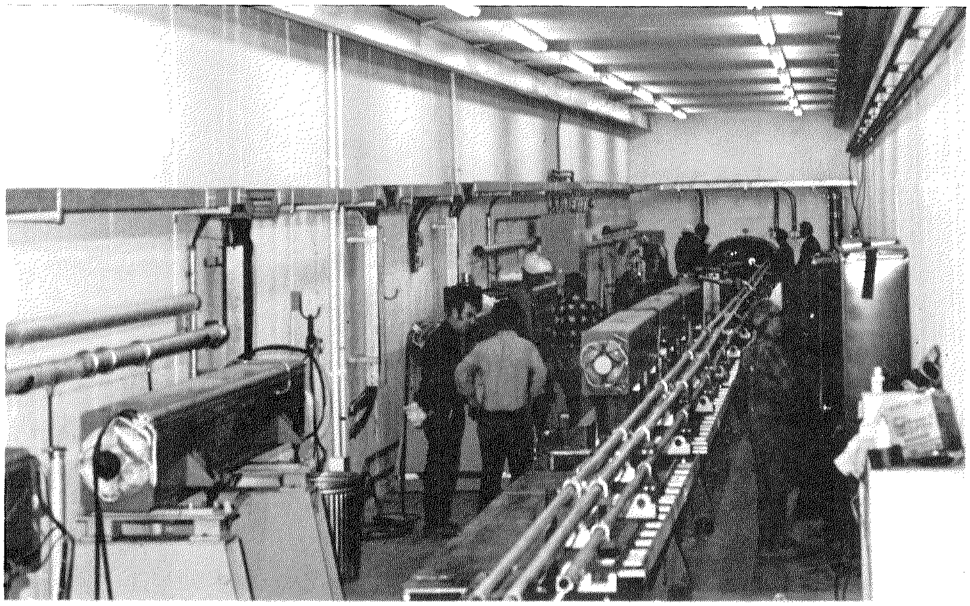

Fig. 2. View inside Neutrino Target Hall showing target system NBS-I being carried into 6-ft target tube by narrow-gauge transporter.

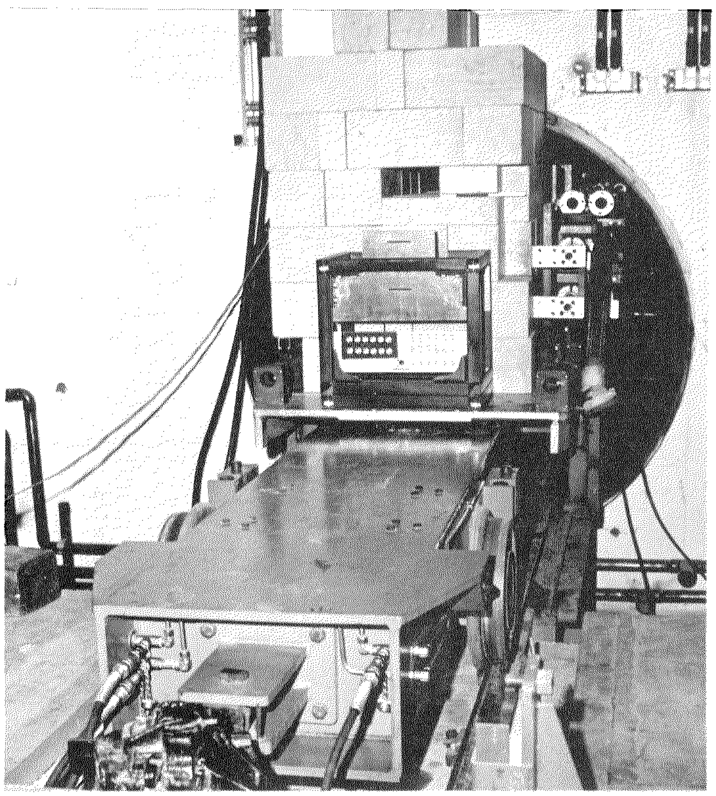

Fig. 3. Neutrino target system installed in 6-ft target tube showing connections for power, water, and signals and controls.

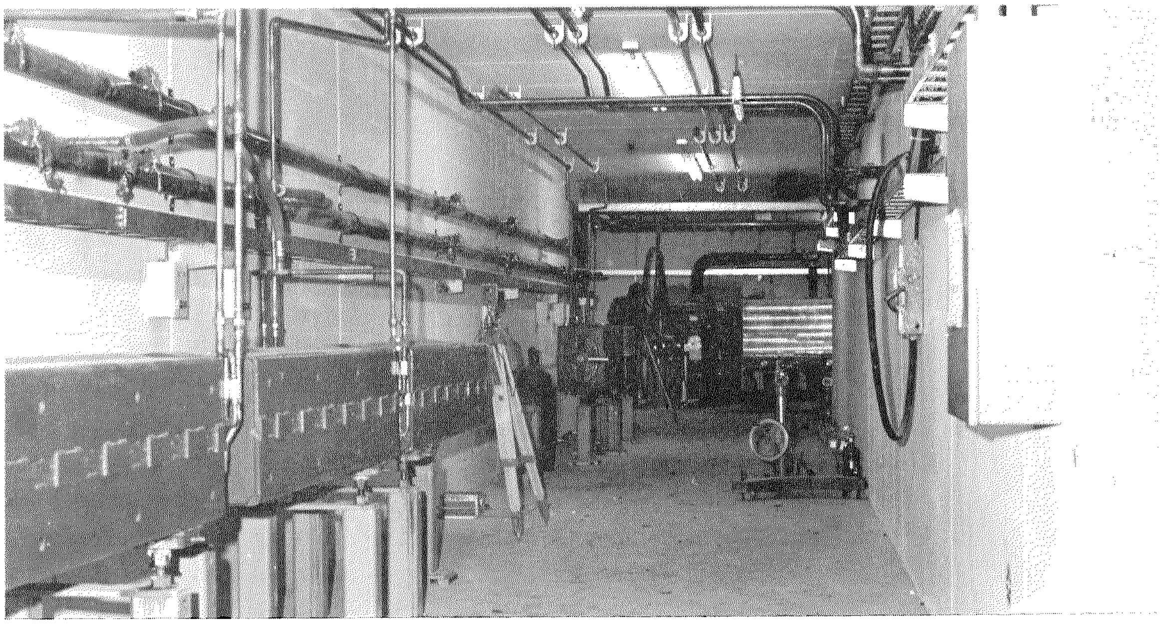

Fig. 4. Enclosure 100 showing N7 beam magnets installed. Beam Dump Box terminating the 3-ft 400-meter meson decay pipe is visible at the upstream end of the Enclosure.

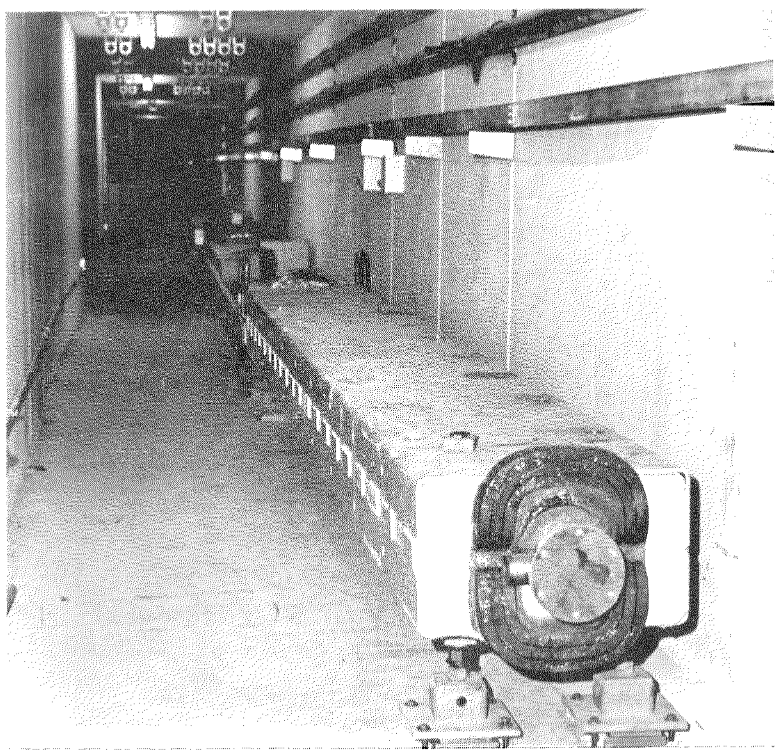

Fig. 5. Hadron beam N3/N7 primary momentum-defining magnets installed in Enclosure 101.

Fig. 6. Neutrino Experiment E-21 installed in Neutrino Laboratory I (Wonder Building).

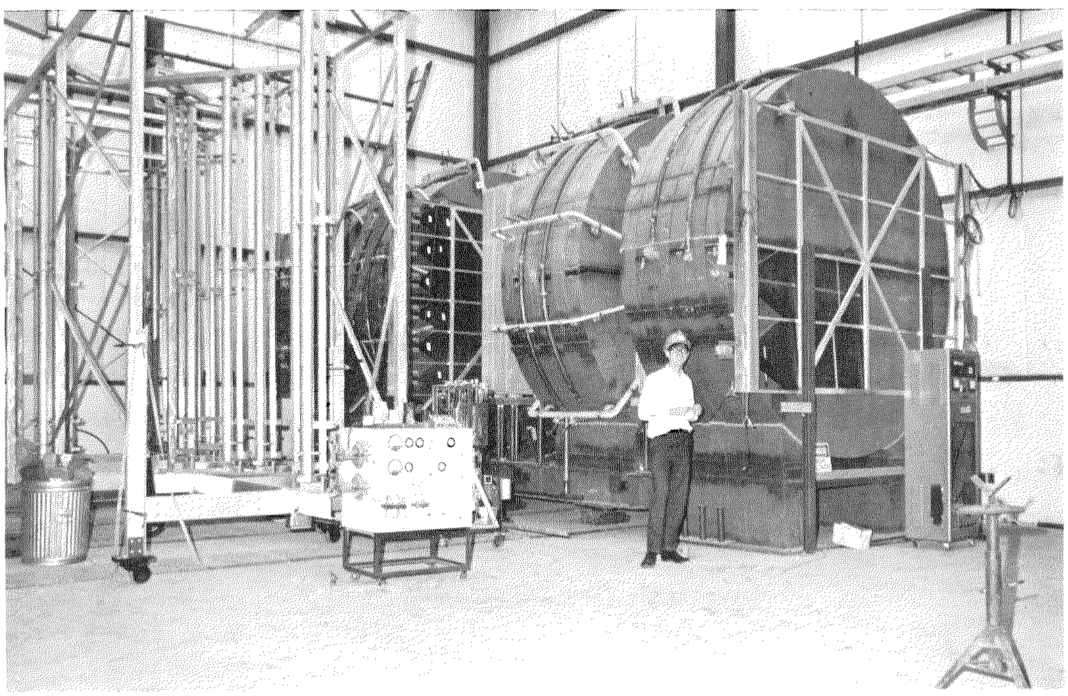

Fig. 7. Neutrino Experiment E-1 being installed in Neutrino Laboratory II (Building C).

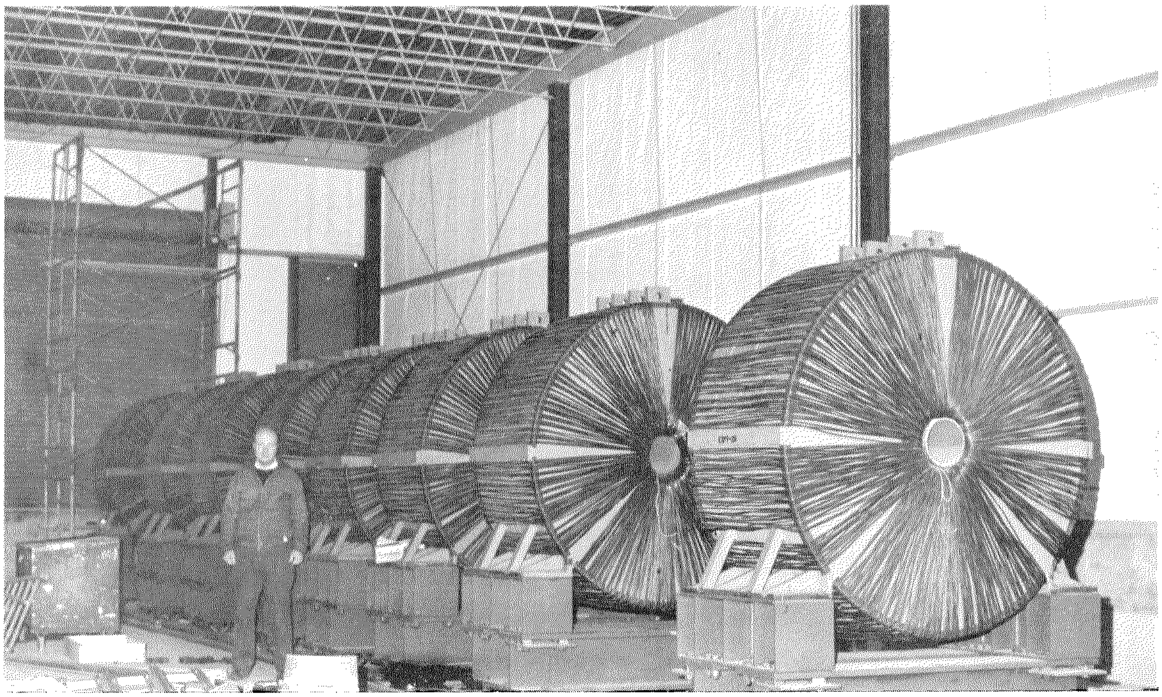

Fig. 8. Magnet system for muon Experiment E-26 installed in Muon Laboratory Building.

Fig. 9. Magnet foundations prepared to receive U. of Chicago Cyclotron magnet.

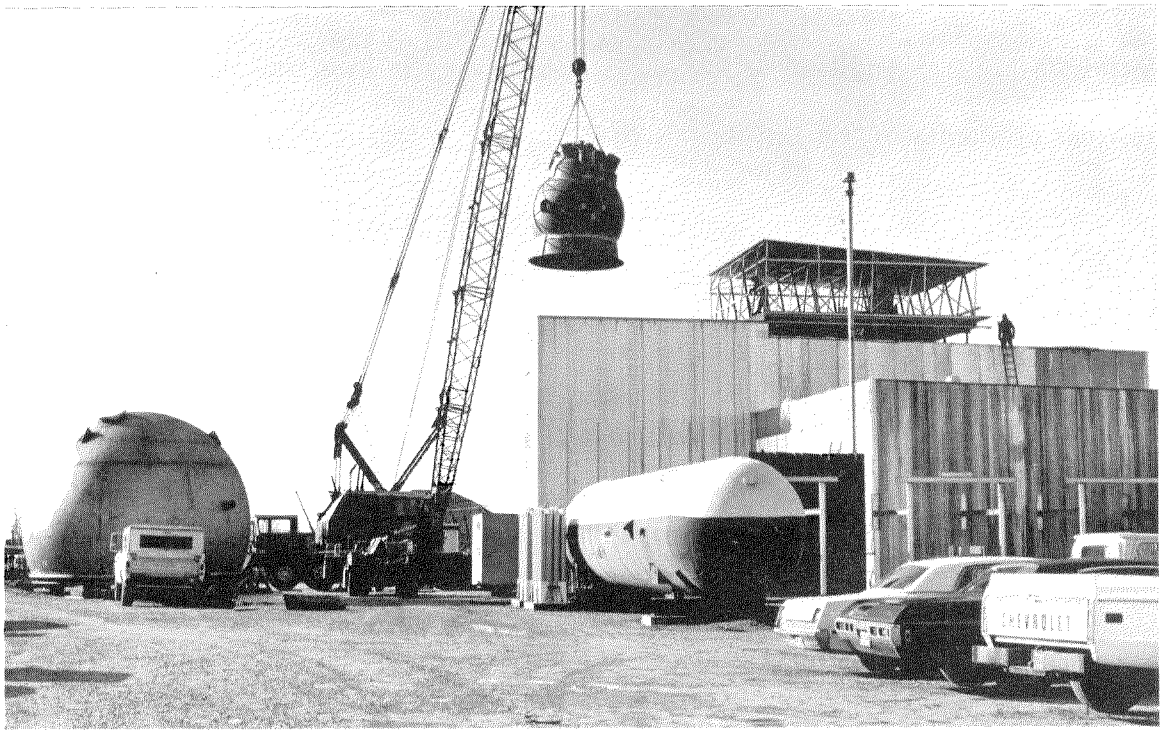

Fig. 10. Fifteen-foot bubble chamber being lowered into its permanent housing.

The target system to provide particles for the hadron beam to the 30-in. bubble chamber, constructed by the Proton Laboratory Section under sub-contract to the Neutrino Laboratory Section, has been assembled and installed in the Target Tube. All magnets and power supplies for the hadron beam to the 30-in. bubble chamber have been installed and the first elements have been successfully powered. The area control computer is installed and operating in the basement of the Cross Gallery and the control system is operational as far downstream as Enclosure 101.

Neutrino Experiment E-21, NAL/Caltech, is installed and ready to take data. Neutrino Experiment E-1, Harvard/Pennsylvania/Wisconsin is in an advanced state of readiness. The first elements of muon Experiment E-26, Cornell/Michigan, have been installed in the Muon Laboratory Building. The Cyclotron Magnet Addition to the Muon Laboratory is awaiting the arrival of the first elements of the University of Chicago Cyclotron magnet.