FERMI NEWS

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Photo by Reidar Hahn

SPECIAL ISSUE

MAIN INJECTOR

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INSIDE:

It Takes a Laboratory...

by Sharon Butler

Rome wasn't built in a day, and neither was the Main Injector. It took seven long years of planning, designing, estimating, calculating, budgeting, digging, razing, connecting, guiding, and finetuning to pull together the $260-million machine that will usher in a new era of particle physics at Fermilab.

Needless to say, no one person took the project from dream to finish.

Raising the Main Injector was the work of an army of Laboratory personnel —managers and technicians, secretaries and physicists, truckers and engineers. Space does not begin to allow us to name them all. Here are just a few.

Civil construction

One was Dixon Bogert, associate head of the Beams Division, who oversaw the civil construction—the excavation of the ground, the laying of the tunnel floor, the placement of one concrete block after another to create the two-mile tunnel for the Main Injector, the digging of cooling ponds, the building of a new substation, the creation of new service buildings.

Photo by Reidar Hahn

Dixon Bogert

Working with Bogert were not only the contractors who handled the demolition and construction work but Fermilab workers who got their hands very dirty. More than 100 workers, for example, emptied out the magnets, pipes, cables, trays, buses, stands and radiofrequency modules from what is known as the F0 area of the old Main Ring so that the 638-foot tunnel space could be reconfigured to allow room for the new beamline from the Main Injector. People like Theo Gordon, of the Mechanical Support Department, pulled out multiton magnets. Matt Ferguson, of the Radiation Protection Group, checked them for radioactivity. Beam operators like Chuck Broy and Dwayne Newhart were recruited to help cut the cables.

"It was like the old days," said Duane Plant, project coordinator for the dismantling of the area. "People were actually having a good time, even though it was a lot of long hours…. One morning, as I watched 30-plus people in the tunnel removing, well, everything, I thought to myself, this is it, this is really it, 'water to the ropes.'" With spirit like that, the project came in 10 days ahead of schedule.

Magnets

The magnets for the Main Injector came from far and wide. Under the direction of Gale Pewitt, now retired, the cores and coils of more than 350 dipoles were fabricated elsewhere and then assembled back here at Fermilab. Meanwhile, some 100 sextupoles, 80 quadrupoles and dozens of specialty magnets were built from scratch on site, according to Dave Harding, a physicist in the Technical Division. John Carson, also in the Technical Division, raised tooling to the level of an art in helping build the magnets. Gregg Kobliska, from the Division's Material Control Group, dealt with vendors to meet schedule and quality requirements for the magnets, hired on-site inspectors, monitored day-to-day activities—and saved Fermilab a bundle on the price of the magnets' 15 million pounds of steel.

Gale Pewitt

All the new magnets were designed by Fermilab staff, including Dave Johnson, an engineering physicist in the Beams Division's Main Injector Department. Johnson devised spanking new, silver-painted Lambertson magnets weighing the equivalent of two African elephants. Without his Lambertsons, you couldn't get beam out of the Main Injector and into the Tevatron.

Still more magnets—quadrupoles and octupoles—were pulled from the Main Ring and then refurbished. Technical Division staff put new feet on them, replaced their electrical and water system manifolds, cleaned out 25 years' worth of copper oxide deposits and gave them a new coat of paint. Staff in the Development and Test Department tested the magnets' field strengths—a critical measurement to ensure their fitness and determine their placement in the new accelerator.

The coordination plan for getting all these magnets sorted and placed was the responsibility of Phil Martin, head of the Main Injector Department. His 13-page, color-coded spreadsheet was the envy of every other manager on the Main Injector project. It was a meticulous map of what goes where and when.

But without Fermilab's transportation crew, all those magnets might still be sitting in the Industrial Building complex, wrapped in plastic and lined up like mannequins in a warehouse.

Veteran truck drivers like Wayne Smith delivered the magnets to the Main Injector, loading them on flatbed trucks, wrapping them in tarpaulin to keep them clean and dry, and crawling along at a mere

Gregg Kobliska, Dave Harding, and John Carson

Photo by Jenny Mullins

Wayne Smith

10 miles per hour so as not to disturb any of the fine craftsmanship.

It fell to Dan Hellberg, in the Beams Division, to oversee the "critical moves"—the installation of the magnets in their proper places in the new ring. A 17-year veteran at Fermilab, Hellberg remembered the days when placing magnets followed rough instructions: "a little to the left, a little to the right." For the Main Injector, positioning magnets was a state-of-the-art affair. The Particle Physics Division's Alignment Group had mapped the entire ring using laser guides, and magnets were placed according to a fixed numerical and alphabetical scheme painted on the wall of the tunnel.

And more

Mike May

More than magnets are needed to make the new accelerator run, of course. Low-conductivity water, ionization free, is needed for cooling purposes. When the LCW system sprang leaks last year after bacteria had eaten holes in the stainless-steel pipes, Mike May, a Beams Division engineer, together with Pat Hurh, saved the day. Using a golf ball and wooden bocci

Photos by Reidar Hahn

Bob Oberholtzer

Raising the Main Injector was the work of an army of LABORATORY PERSONNEL

Patrick Hurh

Joe Collins and Rich Farritor

balls purchased at Sportmart, May cobbled together a device to clean the infected pipes. The $120 cleaning gadget worked like a miracle. Repairing the welds was costly, but not as costly as ripping out and replacing the entire system, as many had feared would be necessary—with unthinkable consequences for the project's cost and schedule.

The Main Injector couldn't run without power, either. Staff from the Facilities and Engineering Services Section helped replace faulty wiring in the most problematic of Fermilab's old electrical power feeders. As David Nevin, head of FESS, put it, the new Main Injector wouldn't be worth a penny if a 25-year-old electrical feeder failed.

Electrical engineer Bob Oberholtzer, better known as the cable czar, made sure that power was distributed through the accelerator. He took charge of correctly routing both power and signal cables, all 3 million feet of them, from power stations, electronics rooms and control buildings over to the Main Injector. The task took over a full year, with contractors working weekends so that they wouldn't trip over workers busy installing other parts.

Behind the scenes

Behind the scenes from the beginning was Fermilab's crack purchasing team, in the Business Services Section, overseeing the negotiation, writing and signing of contracts. Joe Collins, for example, handled negotiations with companies manufacturing magnet parts, and Rich Farritor covered the construction contracts. Thanks to a new agreement between the U.S. Department of Energy and Universities Research Association, Inc., which oversees the operation of Fermilab, new procurement guidelines simplified the purchasing of all the specialized items for the Main Injector. In fact, Fermilab was not required select the lowest bidder, but could pick a contractor on the basis of both price and technical qualifications, weighing the tradeoffs to obtain best value.

Finally, there was Danny Lehman, the no-nonsense DOE official who periodically dropped in, rolled up his white shirtsleeves and, with a trail of high-powered outside consultants, reviewed progress. His mince-no-words reviews became famous—and kept the pressure on to ensure that the high-profile Main Injector project came in on time and on budget.

BUILDING the MAIN INJECTOR

Photo by Reidar Hahn

Steve Holmes (left), Beams Division head and Main Injector Project Manager, celebrates the good news with Main Injector commissioning chief Shekhar Mishra after achieving resonant extraction, the seventh and final commissioning goal. Looking on are Ralph Pasquinelli and Tom Meyer.

by Stephen D. Holmes, Main Injector Project Manager

Creating something on the scale of the Main Injector is not the work of one person. The successful completion of this newest Fermilab accelerator represents the attainment of a vision shared by literally hundreds of people: politicians and laborers, engineers and contract administrators, technicians and laboratory managers, scientists and accountants, surveyors and electricians, drafters and plumbers, welders and riggers, government officials and machinists... nearly everyone associated with Universities Research Association, Fermilab and the world high energy physics community. My role in this enterprise has been to guide a large group of very talented people in defining what we want to do, help them when obstacles arose, and stay out of the way when things went smoothly.

The Main Injector has been a decade in the making. My involvement began with a request in 1987 from Helen Edwards, the Accelerator Division head, to Gerry Dugan, John Marriner and me to undertake a study of how Fermilab could enhance the performance of the Tevatron beyond its original (but as-yet-to-be achieved) performance goals, by integrating a new accelerator or accelerators within the existing complex. We wrote a report identifying several possibilities, all with a common strategy—produce more antiprotons for the collider. Building on this report, we completed and estimated the costs for several designs. They included constructing two new accelerators operating at 20 GeV and constructing a second Tevatron (for proton-proton collisions), supported by a new Main Ring. We finally settled on a Main Ring replacement supporting continued proton-antiproton collisions in the existing Tevatron as providing the most bang for the buck. Fermilab proposed the project to the Department of Energy in January 1989.

Many people wonder about the name for the new accelerator. Helen suggested “Main Injector,” because the accelerator was destined to replace the “Main Ring.” There were significant challenges in the early days gaining support for the accelerator both within the high-energy physics community and in Congress. Getting the project off the ground in October, 1991, benefited from the support of many people, including the Illinois congressional delegation, the Governor’s office, and an advocacy group called the Illinois Coalition. I remember the first meeting we had with the Illinois Coalition. The chairman, David Baker, started the meeting by saying the first agenda item was to develop a better name. “Main Injector,” he felt, conjured up images of a bad trip to the doctor’s office. We spent several hours discussing this but never came up with anything better.

Funding for the Main Injector Project was approved starting in October 1991. After an extended design and R&D period, the construction really got underway in the spring of 1993. Over the years, the team working on the accelerator has experienced literally thousands of small victories and some not-so-small setbacks. From Coopers’ hawks (an Illinois threatened species) nesting in trees we were trying to cut down, to stopped-up drainage systems, to floods of the enclosures, to transformers refusing to pass acceptance tests,

We faced all the *CURVEBALLS* that fortune could throw us. *Fortunately* we smacked a few over the fence....

to microbes attacking the water system, to magnet compensator going down with the ship during a storm in the Atlantic, we faced all the curveballs that fortune could throw us. Fortunately we smacked a few over the fence, allowing for the addition of a second storage ring, the Recycler, to the complex and still completing the project on budget and on schedule.

The completion of the Main Injector represents not an end but a beginning. It will take great effort to realize its full potential for the improvement of the research program at Fermilab. However, with the Main Injector now operational, we have taken a big step along this road. As we embark, we can reflect on how things have gone, as well as how they will go. As on any project there were times when we did not see how we could succeed, and other times we did not see how we could fail. At last, we have reached a point where we can see clearly that Fermilab will reap the benefits of this new accelerator, the Main Injector, for decades to come.

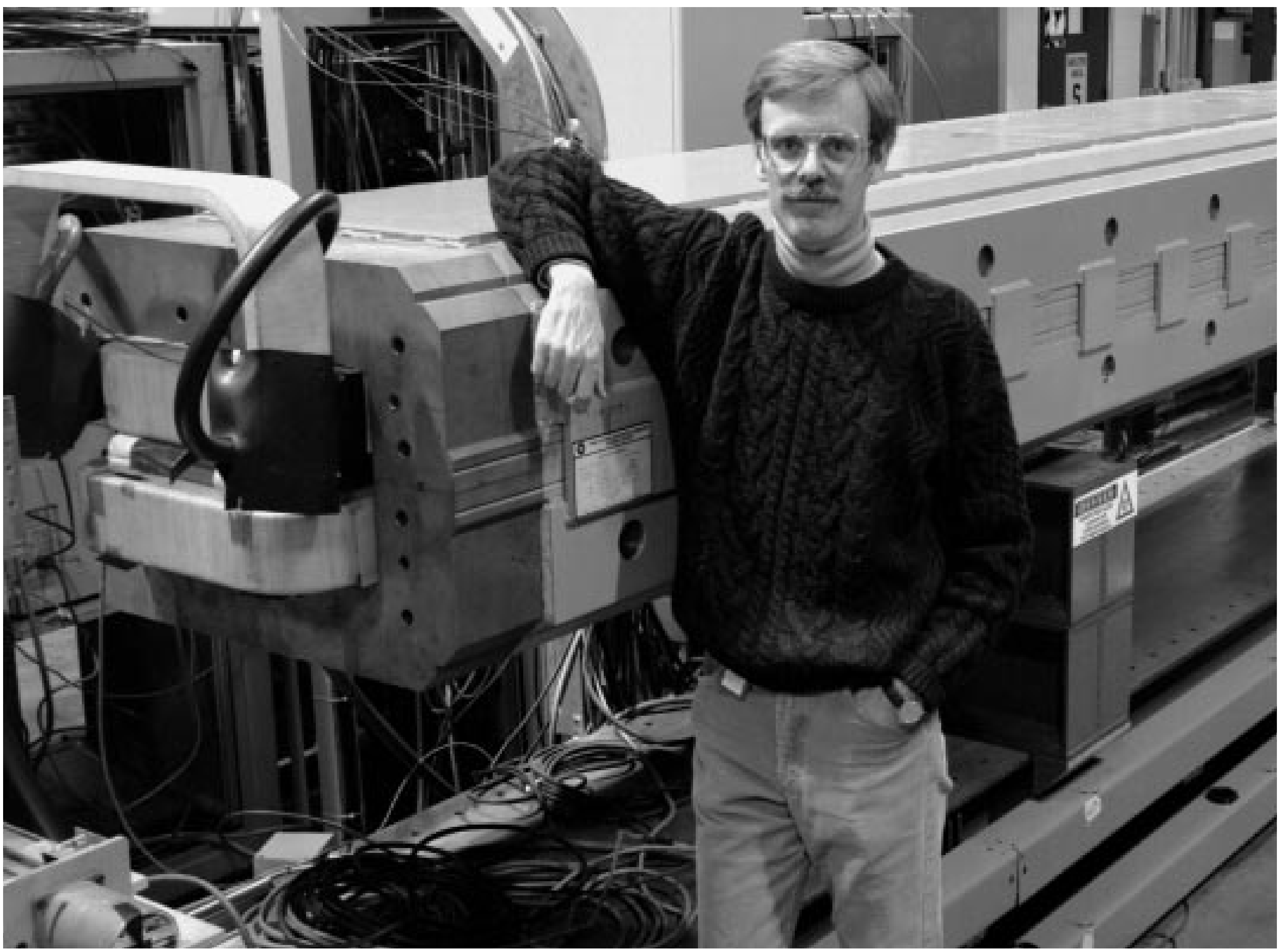


Photo by Reidar Hahn

Steve Holmes, with a prototype magnet for the Main Injector in 1991.

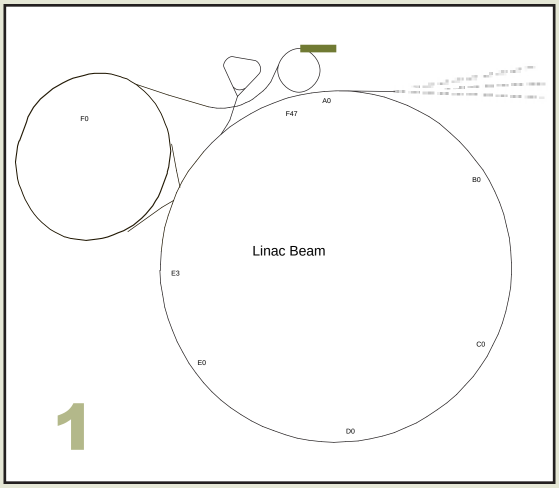
Physics for the New Millennium:

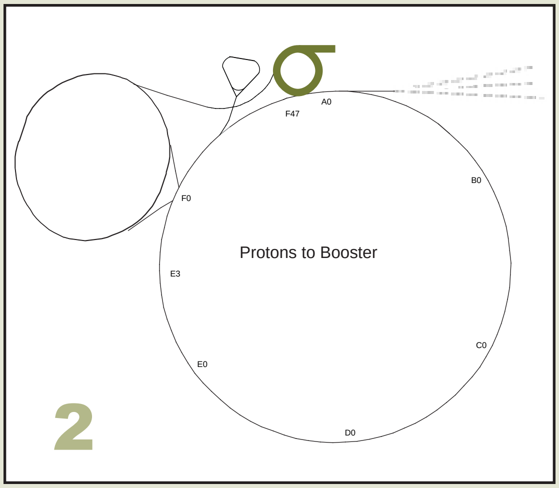
1. **Linac Beam:** The Linear Accelerator takes hydrogen ions from the Preaccelerator at 750,000 electron volts (eV), and accelerates them to 400 million electron volts (MeV).

2. **Protons to Booster:** At the Booster, the hydrogen ions are stripped of their electrons. The remaining protons are then accelerated from 400 MeV to 8 GeV (billion electron volts).

3. **Protons to Main Injector:** The Main Injector provides high-intensity proton beams for antiproton production; combines proton bunches from the Booster into a single high-intensity bunch for collider operations; accelerates antiprotons to inject into the Tevatron; decelerates antiprotons from the Tevatron, sending them to the Recycler; and sends protons to the NuMI experiment for neutrino production. The Main Injector accelerates protons from 8 GeV to 120 GeV for antiproton production, and to 150 GeV for the Tevatron. Particles circle the Main Injector's two-mile circumference nearly 100,000 times per second.

4. **Protons to Tevatron:** The Main Injector sends protons and antiprotons to the Tevatron. The Tevatron's 1,000 superconducting magnets operate at the temperature of liquid helium (-450° F). Protons and antiprotons collide at CDF and DZERO—5,000-ton detectors that track the results of the collisions. Particles circle the Tevatron's four-mile circumference nearly 50,000 times per second.





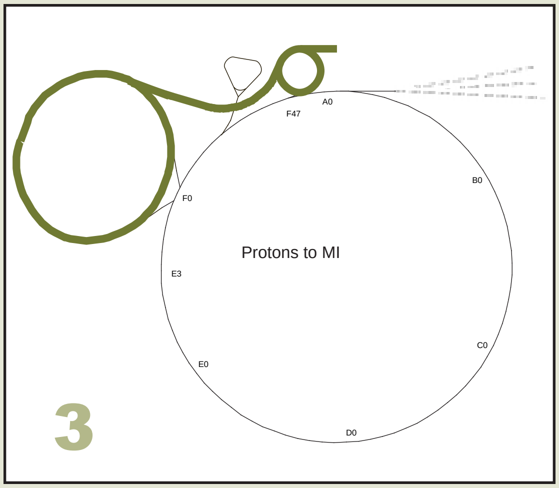
The Main Injector Raises the Stakes for Fermilab's Accelerators

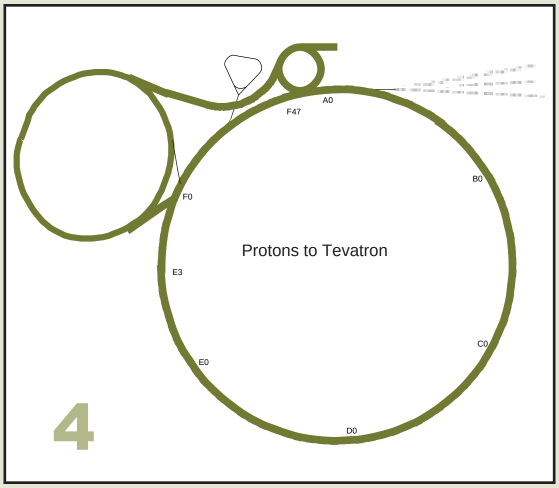
5. 800 GeV Beam to Switchyard: In the fixed target mode, the 800 GeV beam is extracted from the Tevatron and relayed via the switchyard to fixed target experiments.

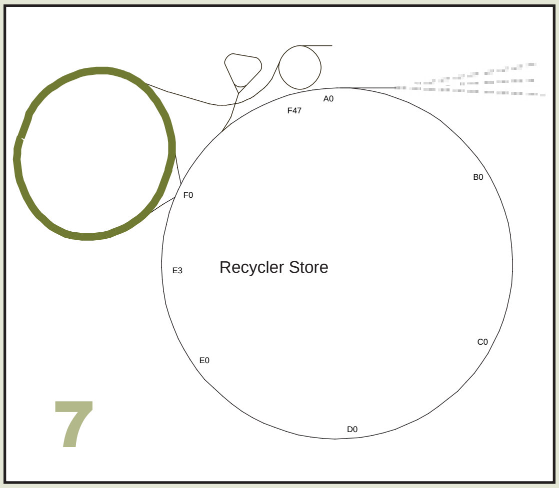
6. 120 GeV Beam to Switchyard: The Main Injector allows fixed-target experiments to proceed simultaneously with colliding-beam experiments, with a 120 GeV proton beam.

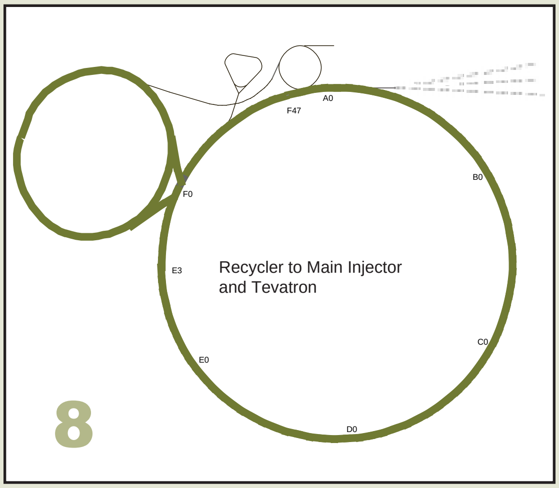
7. Recycler Storage: The world's largest use of permanent magnet technology, the Recycler shares the tunnel with the Main Injector, recovering and recycling antiprotons from the Tevatron. Permanent magnets do not need power or cooling water. The Recycler will provide more antiprotons for the Tevatron, for a tenfold increase in collisions. More collisions mean more possibilities for discovery.

8. Recycler to Main Injector and Tevatron: The Recycler recovers and stores antiprotons that would have been discarded. The recycled antiprotons are transferred to the Main Injector, and accelerated for use in further Tevatron collider experiments.









ON Time, ON Budget

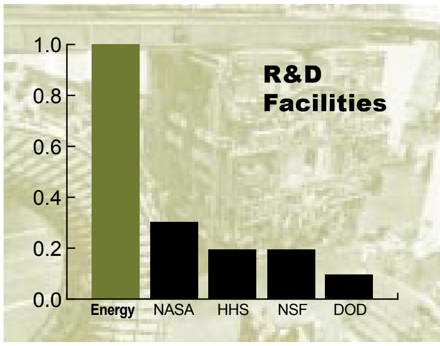
By Ron Lutha and Dan Lehman, Department of Energy

The Department of Energy has a long and proud history of building and operating large-scale scientific user facilities. Of the five agencies that fund most federally sponsored scientific research in the U.S., DOE is by far the largest supporter of research and development facilities. The national laboratories, including Fermilab, are living proof of DOE's long-term investment in the megatools of science.

Dan Lehmann, Director of DOE's Construction Management Support Division, and Ron Lutha, DOE project manager.

In recent years, however, the Department's record on building such projects within the time and budget allotments prescribed by Congress has been less than perfect. The example of the Superconducting Super Collider, a project whose initial price tag of $5.9 billion rose to $10.5 billion before Congress pulled the plug, will not soon fade from physicists'—or Congress's—memories. So it is particularly important for the Department of Energy and its national laboratories to demonstrate that they can reliably build large scientific facilities on time and on budget. We have all had that reality in mind as we built the Main Injector.

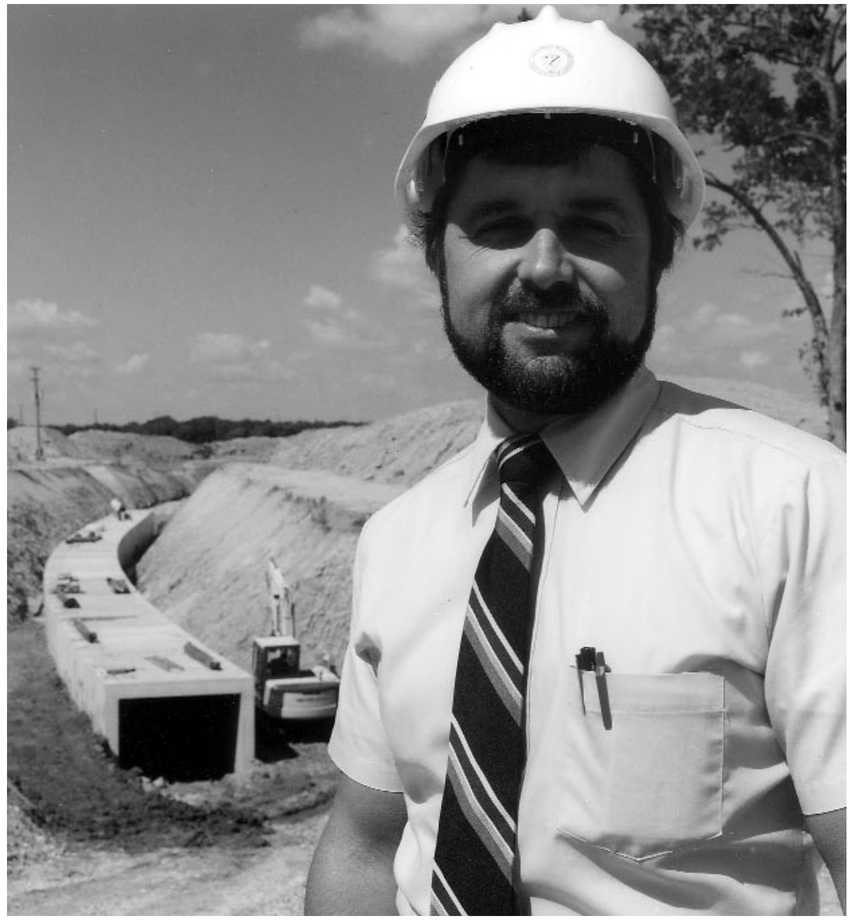
Keeping a project on schedule and within budget is neither rocket science nor black magic. It does require a good project management team, good designs, good market conditions, good labor relations, low inflation rates, the ability to control changes, and the appropriate use of management tools. Obviously we have more control over some of those factors than we do over others. We can't do much about the price of copper or the rate of inflation. But by far the most critical factors, in our experience, are good rapport and cohesive teamwork among all the individuals and organizations involved in the project. Much of the success in keeping the Fermilab Main Injector Project on schedule and within budget has come from the working relationship between the Fermilab Main Injector organization and the Department of Energy. This relationship has allowed both organizations to carry out their project obligations cost-effectively and efficiently. Together, they made a team that was determined to adhere to their schedule and budget commitments.



DOE leads all federal science agencies in building and operating large scientific facilities. Fiscal year 1999 budget request, in billions of dollars. Source: OMB.

The Main Injector Project's baselines for scope; cost and schedule; and management plan were presented by the DOE project manager to the Energy Systems Acquisitions Advisory Board and approved by Secretary of Energy James Watkins on June 16, 1992. The project's budget and schedule baselines stipulated that the project be completed by the third quarter of FY1999 within a cost estimate of $259 million. These baselines constitute the project's commitment to Congress. The project has achieved them.

Throughout the life of the Main Injector, the Department of Energy's High Energy Physics program office has tracked these commitments by means of reviews, held every six months. The onsite DOE project manager has also met weekly with the Laboratory project managers. The Main Injector Project team's commitment to the baseline, their ability to make timely decisions and their willingness to take corrective actions when they were called for kept the project within budget and on schedule.


Fermilab Photos

Ron Lutha, DOE Project Manager for the Main Injector, in 1994.

The Main Injector Project carried on Fermilab's tradition of building only what was necessary and avoiding "gold-plated" designs. Although the original design appeared realistic, design changes are almost always required to resolve unforeseen problems, and the Main Injector was no exception. But proposed design changes—"engineering change requests"— were approved only after careful consideration by the project management team and the DOE review committee. The use of permanent magnets to focus and bend the beam for the 8 GeV beam transfer line, instead of the originally proposed electromagnets, is a good example. Making this change allowed the project to capture savings in maintenance costs, energy consumption, and water use by adopting a new concept in accelerator design. And when unexpected problems arose, such as the infamous microbiological induced corrosion (also known as "bugs in the water pipes"), the project team met the challenge head on to overcome the problem.

Experience counts. The success in building the conventional facilities (that's project-speak for concrete tunnels and buildings) owed much to the Main Injector Project team's experience, backed up by the strong support of the Facilities Engineering Services Section, in working with Fluor Daniel, the architectural engineering firm, and the many construction subcontractors. These teams have built things before. Although most of the Main Injector construction took place on a "green," or previously unused, site, several pieces of the project were especially challenging because they interlaced with existing accelerator facilities. Keeping them on track required tight shutdown schedules and careful coordination with the rest of the Laboratory.

While there were clearly many factors at work to keep the Main Injector Project on track, we continue to believe that the truly indispensable elements were the quality of the project team and the good working relationship between the project management and the Department of Energy. With those pieces in place, the Main Injector Project has carried on the Fermilab tradition of building great particle accelerators within budget and on schedule. The results will benefit not only Fermilab and its users but the entire Department of Energy science mission, now and in the years to come.

The Rundown

A Quick Jog: The Main Injector is about two miles in circumference (as is its tunnel-mate, the Recycler). Particles will travel around the Main Injector and Recycler nearly 100,000 times per second.

State-of-the-art funding: A $2.2 million Challenge Grant from the State of Illinois in 1991 gave Fermilab enough funding to take the first step in building the new Main Injector: the completion of the required environmental impact studies. With that vote of confidence from the State of Illinois, Fermilab was able to go on to build the eight-year, $259 million project that will soon be creating the best opportunities anywhere on earth for physics at the energy frontier.

Photos by Reidar Hahn

Pulling Together: Building the Main Injector required 900 person-years of Fermilab effort and six years of construction, with the use of 35 major outside contractors. Total cost: $259,000,000. The project was completed on time and on budget.

Great Acceleration: The Main Injector can accelerate 30 trillion protons to an energy of 150 GeV (billion electron volts). It will allow Fermilab to produce 200 billion antiprotons every hour.

Anchors Aweigh: Building the new magnets for the Main Injector required 8,300 tons of steel, equivalent to the weight of a U.S. Navy destroyer in World War II.

The Main Attraction: The Main Injector uses two types of dipole electromagnets to steer the particle beam. There are 216 Type I magnets (14 feet long, weighing 26,400 pounds each) and 208 Type 2 magnets (20 feet long, weighing 37,400 pounds each).

Sound Construction: The Recycler permanent magnets use a total of 45,000 strontium-ferrite “bricks” (each measuring 4” x 6” x 1”) to produce their magnetic fields. Each brick is similar in composition and weight to the material used in a stereo speaker.

Utilities Included: The permanent magnets in the Recycler operate without the need for power and water.

Department of Energy: The average home carries an electrical current of 20 amperes. Both Type 1 and Type 2 Main Injector magnets carry a peak current of 9,375 amperes, almost 500 times that of the average home.

on THE MAIN INJECTOR

Not for Refrigerators: The Main Injector uses three types of quadrupole electromagnets to focus the particle beam, or keep it narrow. There are 48 Type I magnets (8 feet long, weighing 11,100 pounds each); 32 Type 2 magnets (10 feet long, weighing 12,900 pounds each), and 128 Type 3 magnets (7 feet long, weighing 9,400 pounds each).

Power Saver Mode: The Main Injector quadrupole magnets carry a peak current of 3,630 amperes.

How Many Pennies is That? Making the coils for the Main Injector electromagnets took 888 tons of copper.

What a Line: Power distribution to the Main Injector service buildings and to the adjacent area of the Tevatron required installing 182,000 line-feet of triplexed cable in new underground duct banks.

Cable Guy: A network of more than 8,000 cables, carrying signals for more than 44,000 system parameters, was installed to operate the Main Injector. If the cables were laid end to end, they would stretch about three million feet—long enough to traverse the 550 miles between Fermilab and Memphis, Tennessee.

Concrete Examples: The Main Injector civil construction project required more than 1,460,000 cubic yards (CY) of excavation, and 50,300 CY of cast-in-place concrete. An additional 1,392 precast concrete elements (each weighing approximately 18 tons) were used, requiring 11,935 CY of concrete.

Heavy Metal: More than 10,400 tons of 9-inch-thick continuous-cast steel plate was installed as shielding over the beam enclosures.

But No Condos: New service buildings added more than 58,700 square feet of building area.

Traffic Pattern: Adding and changing access routes added 2.5 miles of paved roadway to the site system.

Staking A Claim: The Main Injector project affected more than 500 acres of the Fermilab site.

Waterfront Acreage: The six new cooling ponds have a surface area of more than 20 acres, and hold some 32.5 million gallons of water.

It's Always Saturday Night: The Main Injector uses de-ionized Low Conductivity Water (LCW) to cool electrical components, including magnets. LCW passes through each magnet at a rate of 12 gallons per minute (GPM), or about the equivalent of the water flow in a bathtub.

Go With The Flow: Cooling all the Main Injector components—magnets, copper bus, power supplies—requires 8,000 GPM regulated to 95 degrees (Fahrenheit). The Main Injector needs an estimated 50,000 gallons of LCW to fill all the pipes, storage tanks, bus tubes and magnets. A total of 4.5 miles of six-inch stainless steel pipe was installed in the Main Injector enclosure.

Pumped Up: Each of the six service buildings in the Main Injector ring has three pumps, for a total of 18. Each pump has a 100 horsepower motor and delivers 550 GPM with a pressure head of 164 pounds per square inch (PSI).

All's Weld That Ends Weld: Repairing the 200 leaks discovered in the LCW system in November 1997 meant repairing nearly 4,000 welds in the stainless steel pipe, eradicating several strains of stubborn bacteria, and inventing miniature machines to scour out the inside of the pipe, at a cost of about $1,000,000.

(Compiled by Bill Fowler, John Satti, Tom Pawlak, Dan Wolff, Bob Mau, Bruce Brown and Mike Perricone)

The Science of Run II:

The Main Injector will fire up the Tevatron for making NEW discoveries

Photo by Fred Ullrich

Theoretical physicist Joe Lykken demonstrates simple mirror symmetry. Lykken and other theorists will be on the lookout for evidence of supersymmetry in Run II of the Tevatron.

by Mike Perricone

Run II of the Tevatron offers Big Science that even a banker can love: the promise of making spectacular discoveries without making a spectacle of the budget.

"With the new Main Injector and our detector upgrades, we've taken a facility that we already have, and without spending billions and billions of dollars, we've essentially remade it into a much more powerful physics facility," said Fermilab theoretical physicist Joe Lykken. "We could be looking ahead to a golden age of particle physics at Fermilab."

Lykken and other scientists envision breakthroughs into new physics beyond the Standard Model of Elementary Particles, with the Main Injector enabling increased luminosity levels at the Tevatron (at least 20 times as many proton-antiproton collisions as in Run I); and with improved data-handling and tracking capabilities at the CDF and DZero detectors (at least 20 times the data generated in Run I). The greater the number of collisions, the greater the chances for new discoveries; the greater the data-handling and detector sophistication, the greater the ability to record those discoveries and analyze them in exquisite detail.

Now, consider the possibilities. Lykken capsulized the Run II wish list:

1. More top quarks—Producing thousands of top quarks, instead of just a hundred or so, means achieving a new level of detail in studying the massive elementary particle discovered at Fermilab in 1995. More precise measurements of the top and of the W boson (one of the force-carriers in the Standard Model) might point the way toward the discovery of the Higgs boson—the brass ring on the particle physics carousel. Nobel laureate and Fermilab Director Emeritus Leon Lederman has dubbed it "The God Particle."

2. New B Physics—The bottom quark is next heaviest after the top. As the world's highest-energy particle accelerator, the Tevatron can conduct B physics in realms inaccessible to the lower-energy "B-factories" (which manufacture B-mesons made from bottom quarks). The Tevatron is thus uniquely suited to investigate instances of CP violation (anomalies between matter and antimatter) exclusive to the bottom quark. "If you were to guess where we would first see evidence of new physics from Run II," Lykken predicted, "the safest bet is probably CP violation in B physics."

3. New Particle Discoveries—Increasing Tevatron luminosity also increases the possibility of creating higher-energy collisions that could produce particles heavier than the top, opening the door to supersymmetry. The many different models within the supersymmetry (SUSY) framework all propose that every particle in the Standard Model has one or two superpartner particles, which are much heavier and have a different spin. "If supersymmetry is the right way to extend the Standard Model," Lykken said, "then we know there are lots and

Photo by Reidar Hahn

Clockwise from top left:
Representative Dennis Hastert of Illinois' 14th Congressional District spoke at the top quark announcement. Now Speaker of the House, Hastert is taking part in the June 1 Main Injector dedication ceremonies.
At Hastert's left is Martha Krebs of the Department of Energy's Office of Science.

New discoveries in Run II could produce headlines around the world, such as these prompted by Fermilab's announcement of the discovery of the top quark in 1995.

Fermilab physicist G.P. Yeh meets the press to discuss the top quark discovery.

lots of particles out there waiting to be discovered. And if SUSY tells us some of those particles are not too heavy, we have a chance of seeing at least one or two of those particles in Run II."

While Run II is projected as a two-year excursion into the borderland of new physics, it will also serve as a test run for the new configuration of Fermilab's accelerator, and a measurement of the experimental reach with the higher luminosity at the Tevatron.

How far will the new reach exceed the grasp of Run I?

Quite likely, far enough to extend an open-ended invitation for Run III, or "extended Run II," as it was described by Fermilab Director John Peoples at the recent Department of Energy Annual Review: a continuation of Run II, evolving with upgrades to increase the Tevatron's luminosity, while the experiments continue and the detectors keep churning out data, taking this scientific expedition beyond the borderlands of new physics and into even more exciting new realms.

"Basically, we hope to keep running the accelerators until we're told to stop," Lykken said.

The stop order is expected to come at some point after the Large Hadron Collider begins operating at CERN, the European particle physics laboratory in Geneva, Switzerland. But as Lykken points out, that debut won't be before 2006—and it could be as late as 2008 before LHC begins generating what he calls "real physics results."

That leaves Fermilab with nearly a decade on the frontier of high energy physics contemplating the ultimate challenge—finding the Higgs with a machine that wasn't designed to find it, whereas LHC and the late Superconducting Super Collider were dedicated to the Higgs quest.

The last major undiscovered Standard Model particle, the Higgs is "in some senses the most important particle," Lykken explained. "It's supposed to do a lot of neat tricks. It's supposed to be related to the process that gives mass to quarks, leptons, and the W and Z bosons. It's the particle that talks to all the other particles in a very important and unknown way."

Lykken said a 75-member working group from theoretical physics and from the CDF and DZero detectors spent a year studying whether the Tevatron was capable of discovering the Higgs. The group's conclusion: current measurements of top mass and other Standard Model parameters predict a fairly light Higgs, probably lighter than the top itself; so if the number of collisions in the Tevatron can be nudged beyond the Main Injector's capabilities, finding the Higgs before LHC "is not a crazy idea."

"Even if we don't find direct evidence of the Higgs," Lykken said, "we can point the way for LHC and say, 'Here's where to look.' But taking the Tevatron, and pushing it to the point of actually discovering the Higgs—that would be incredible, a great discovery for particle physics, a triumph for Fermilab. The Tevatron could become a legend in particle physics."

LAB NOTES

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The CY1998 Report to the Director on the Fermilab Environment is now available on the Web at http://www-esh.fnal.gov/Envir_Reports/.

Fermilab Pool Delayed Opening

Due to inclement weather painting of the Village pool has been delayed. The opening is now June 5th. Watch for notices posted at http://fnalpubs.fnal.gov/benedept/recreation/announce.html.

MILESTONES

HONORED

IMSA mentors: Left off the list was Joe Incandela. Sorry, Joe!

RETIRING

Leon Strauss, I.D.# 10307 from Business Services Section/Purchasing Department, on June 4.

CALENDAR

Web site for Fermilab events: http://www.fnal.gov/faw/events.html

JUNE 1 & 2 (7&9)

Academic Lectures: *Statistics for Particle Physicists*, Louis Lyons, University of Oxford, 11 a.m., Curia II.

http://www-ppd.fnal.gov/epp_www/Academic_Lectures/Academic_Lectures.html

JUNE 3

Tunnel Visions Symposium: *VLHC High Field Option*, P. Limon, Fermilab, 1 West 3–5 p.m.

JUNE 9

Health Fair 11-2, Wilson Hall Atrium

JUNE 11

Potluck outside the Village Barn, 6 – 8 p.m. Enjoy the company, conversation and cuisine of lab employees, associates & visitors from around the world. We will barbeque outside, so bring your own meat to grill and a side dish to share or contribute $ 3 to cover costs. Hot dogs & hamburgers will be provided for the kids. For more information, call Selitha (630) 305-7769 or SelithaR@aol.com.

International Film Society Presents: *Wilde* Dir: Brian Gilbert (UK, 1997, 116 mins). Film at 8 p.m., Ramsey Auditorium, Wilson Hall, $4. (630) 840-8000. http://www.fnal.gov/culture/film_society.html

ONGOING

English Classes, Thursdays at the Users' Center from 10–11:30, classes are free. NALWO coffee for newcomers & visitors every Thursday at the Users' Center, 10:30–12, children are welcome. In the barn, International folk dancing, Thursdays, 7:30–10 p.m., call Mady, (630) 584–0825; Scottish country dancing Tuesdays, 7–9:30 p.m., call Doug, x8194.

NOTE

Classifieds for this issue are posted in the Web version of FERMINEWS. Publication of classifieds will resume in the next issue.

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The deadline for the Friday, June 18, 1999, issue is Tuesday, June 8, 1999. Please send classified advertisements and story ideas by mail to the Public Affairs Office MS 206, Fermilab, P.O. Box 500, Batavia, IL 60510, or by e-mail to ferminews@fnal.gov. Letters from readers are welcome. Please include your name and daytime phone number.

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