

Early History of the Fermilab Main Ring

E. Malamud

October 20, 1983

Introduction

This note is written in response to a request from Phil Livdahl (1) for corrections and additions to a TM he is writing (2) on Staffing Levels at Fermilab during Initial Construction Years and to a note that Hank HINTERBERGER is preparing (3) on milestones.

In my spare time over the past few years I have taken the original files of the Main Ring Section, my own notes from that period, and various other collections of relevant paper, and arranged them in a set of 44 large loose leaf binders in chronological order. I call this set of volumes the "Main Ring Chronological Archives". In response to Phil's request I have recently skimmed through these records of the period and extracted a small subset of documents which relate to the specific questions that Phil is addressing: staffing, administration, and milestones.

This note summarizes that information. It will be sent to Phil and Hank to use in preparing their TM's as well as to a few other people whom I think may find it of interest.

Staffing Levels

In the archives there is either an organization chart or a list of employees for almost every month for the period 1969 - 1971. I have extracted a few of these records; the others interpolate smoothly between the ones chosen. Figure 1 and 2 show the staffing levels of the Main Ring Section as obtained from records. (refs 4 - 16). Parentheses next to each point are the references. The totals from Phil's memo (2) are shown for comparison. The agreement for permanent Main Ring Section employees is fairly close, but the number of temporary and agency employees is underestimated in ref 2. In going through these records I have made corrections for those people working on the Main Ring who were administratively in Technical Services. Technical Services was formed 2-21-69 (18) but most magnet and coil (West Chicago) factory workers were administratively in the Main Ring Section until 10-15-71 when they were transferred to Technical Services. (19).

The number of employees of all types -- permanent, temporary, and agency (but not including people from other sections) reached its peak on March 29, 1971 at 293. It then declined gradually until the Main Ring Section was disbanded on October 20, 1971. (17).

If this staffing profile is of interest in terms of projecting how a new effort (e.g. Desertron) might start up then one should also take into account the large number of additional people that came over to help finish building and commissioning the Main Ring. My records are not complete on this subject but I have found the following interesting items:

A Main Ring Steering Committee was formed sometime in June, 1971. It met almost daily and minutes were recorded. From the list of attendees one can deduce the approximate dates when key figures joined the Main Ring commissioning effort: Helen Edwards before 7-27-71 (20) and Al Maschke prior to 8-13-71 (21, 25). Edwards, of course, was one of the leaders of the eventual success in commissioning the Main Ring. Al Maschke's stormy resignation from the laboratory occurred shortly after the beginning of 1972. On 8-20-71 (22, 25) Rich Orr lead about half of his Meson Laboratory Section over to help solve the myriad problems besetting the Main Ring. In particular were 11 physicists and engineers (including Rich); most of them subsequently played key roles in the Main Ring commissioning. Some of them took charge of major systems in addition to serving on commissioning shifts. A list dated 8-18-71 (23) summarizes all the physicist assignments on the Main Ring.

Dick Lundy was one of the Meson Section physicists and shortly after joining the Main Ring effort he became Associate Main Ring Section Head.

Administration

There are a few points on which the Main Ring archives differ from ref. 2. It is stated that the group included a nucleus of former Cornell physicists and engineers. The earliest section list I have (7-16-69, ref. 4) lists 20 physicists and engineers. Of these I only recognize 3 as being "Cornell": Sutter and Malamud who obtained their Ph.D. at Cornell, and Yamada who worked there for some time period.

As stated in ref. 2, Prof. John DeWire was Main Ring Section Head from July, 1967 until February, 1968. From that date until the fall of 1969, the Main Ring Section was headed by Prof. Frank Shoemaker. The Section was administratively part of the Accelerator Division. This Division was headed by Wilson; Tom Collins was Associate Head until his unhappy demise in December, 1969. (24). From that point on the Main Ring Section reported directly to the laboratory director (sometimes with Wilson in both roles) until Spring, 1972 when the Accelerator Division was formed.

In the summer of 1969 after Frank Shoemaker announced his decision to return to Princeton, Wilson attempted to find a leader for the Main Ring Section. Malamud suggested that Wilson himself lead the Main Ring effort with a troika (26) consisting of Dick Cassel, Hank Hintergerber (already Head of Technical Services -- ref. 18), and Malamud reporting to him. (Malamud had already been appointed Assistant Section Head by Shoemaker in January, 1969). Wilson accepted this suggestion and the troika started to function. The exact date when the troika started is not known from the archives; the earliest memos signed by the troika are 7-10-69 (27), 8-6-69 (28) and 9-9-69 (29).

On January 23, 1970 Malamud was promoted to Associate Section Head of the Main Ring Section and asked by Wilson to act as the "senior member" of the troika. In April, 1971 Malamud became Section Head of the Main Ring Section (30) and served in that role until the formation of the Accelerator Section in October of that year. (17).

The formation of the Accelerator Section (not Division) occurred during a particularly painful period in the history of the laboratory. After a series of overoptimistic promises to the users and a rapid succession of commissioning milestones (described in more detail in the next section) progress seemed to stop and we sunk into a morass of problems. Various ways were sought to dig our way out. More and more people from other parts of the laboratory were recruited or volunteered to join the Main Ring effort. They were successfully integrated into this effort in late September and early October as described above.

However, this was still not enough. In mid October Wilson said to Malamud that he wanted to move the Main Ring power supply group under Dick Cassel out of the Main Ring Section and into the newly formed Accelerator Operations Section (combination of Linac and Booster). Malamud did not see how this was an effective solution and countered with a different proposal. Wilson, the greatest accelerator builder of all times, should once again take over the helm. Since by then practically half the laboratory was working in one way or another on Main Ring problems this seemed like the only logical course. The Operations, Main Ring, Beam Transfer, RF and Accelerator Theory Sections would be merged, and along with all the volunteers and conscripts would be led by Wilson. Wilson liked this suggestion and shortly thereafter announced the Accelerator Section with great fanfare, poetry, pep talks and the like.

However, it took almost a month from October 20 until November 16, 1971 before an organization chart for the new section was hammered out. Long, agonizing meetings were held almost daily. During this period the old administrative structures continued to limp along but in my own subjective opinion, looking back, the reorganization should have been accomplished much more swiftly. By dragging it out with all the accompanying emotional baggage it slowed the solution of technical problems that were already difficult enough and prevented us from obtaining accelerated beam by the end of 1971, which in other circumstances, I think, we would have achieved.

When the new Accelerator Section organization chart finally appeared Wilson was Head, Don Young was Associate Head, and Malamud was Assistant Head. Most of the members of the new section reported to three Task Managers: Livdahl, Lundy, and Orr. This was the genesis of the present day Accelerator support groups. Besides this was an intricately balanced system of Commissioners, Crew Chiefs, and Principle Investigators, whose jobs were to get the accelerator commissioned. After all the dust settled, the same small group of physicists continued to lead the commissioning effort as had been before the reorganization although they worked in a somewhat different style. The three commissioning teams that led the effort that culminated in 100 GeV beam on February 11, 1972 (to break the previous record held for several years by Serpukhov in the U. S. S. R.) were Helen Edwards, Shigeki Mori, and Malamud, with a heroic effort contributed by the old RF section led by Quentin Kerns.

Milestones

Figure 3 is a list of Accelerator Milestones, including some of the significant Main Ring Milestones that will be described in more detail below. This figure is a reduction from a poster that was prepared for the first Fermilab open house held in 1975. The dates were extracted from Accelerator logbooks.

The First Cell.

This first important milestone in the construction of the Main Ring was to build a complete working cell of the machine in the protomain tunnel in the Fermilab village. This cell consisted of 8 bending magnets and 2 quadrupoles. It was to be complete in every detail, with functional vacuum, power, water and controls systems. Bases, survey equipment, and the magnet handling vehicle were included in the milestone although some of these latter items got dropped later on.

This milestone was first proposed by Malamud to Wilson. In a meeting between Malamud, Hinterberger, and Wilson on 6-30-69 it was decided to commit the Main Ring section to this milestone. (27) (31) and set a goal of March 1, 1970 for completion. Malamud presented it to the Main Ring Section on 7-2-69. The concept was opposed by Shoemaker but since by that time he had informed us that he was returning to Princeton his influence was diminished. Wilson, of course, embraced the concept enthusiastically and used it as a way of mobilizing and focussing the effort of getting the Main Ring underway.

At the Main Ring Section meeting on 11-5-69 (32) Wilson changed the date for completion of the milestone to 3-20-70 and emphasized how important it was that it be met. Minutes of Main Ring staff meetings in January (33) (34) reflected the frantic pace at which we were working to make two different kinds of laminations (B-1 and B-2) and four different kinds of coils for these magnets. A definition of the milestone written during this period (35) included the goal of powering these magnets to 400 GeV. Wilson, Hinterberger, Malamud, Cassel and many other physicists and engineers rolled up their sleeves, and got themselves full of epoxy as they assembled the first 20 foot long bending magnets. Some of these original magnets, even though the pole tip was slightly altered before going into production, ended up in the Main Ring and stayed there until 200 GeV was achieved.

We also had fun with paint! The whole section turned out one Saturday with cans of paint and brushes. Angela Gonzalez had chosen red for the magnets because "magnets were dangerous", and I remember hearing Wilson scold her that she didn't know anything about magnets. So the color got changed to blue and we had to repaint the whole cell!

Success was achieved on 3-14-69, 6 days ahead of schedule (36). Figure 4 is a reproduction of the notice announcing the celebration party. Messages of congratulation were received from the Linac section (37), and URA (38). We were pleased with the performance of Everson Electric Company and sent them a telegram (39) thanking them for providing the B2 outer bending magnet coils.

Installation of the First Magnet in the Main Ring Tunnel.

With hardly a chance to catch our breath after the hard work on the protomain we turned our eyes to the real main ring tunnel. Ground had been broken for the Main Ring tunnel about 5 months earlier, on 10-3-69. (40) Wilson had set a style for Fermilab ground breakings with a shovel for each and everyone. Now the tunnel was becoming a reality and Wilson wanted us to be hot behind the backs of the contractors. (41) The idea was to fill the tunnel with magnets as rapidly as it was completed. So on 4-15-83 two magnets were transported over to the beginning of A-sector and lowered into a big muddy pit on to the first sections of tunnel slab. This occasion was celebrated with a hayrack to get us to the site (42) (43) followed by beer and pizza (44).

Major design changes occur.

The Main Ring Design -- A final reappraisal.

The Octoberfest--First Sector Completed.

The Final Push to Complete the Main Ring.

The West Chicago Factory.

Triumphs and Failures at the Magnet Factory--doom and gloom as magnets fail.

Decision to go for 500.

Rash promises on commissioning.

Commissioning starts.

Early successes--the first turn, coasting beam.

Initial small amount of acceleration.

The problems intensify. Dark days at the end of 1971.

Managers, Operators, and Commissioners.

Success. Accelerated Beam.

The world's record, recaptured by Fermilab. But there is a long pull ahead to make the machine a usable research instrument.

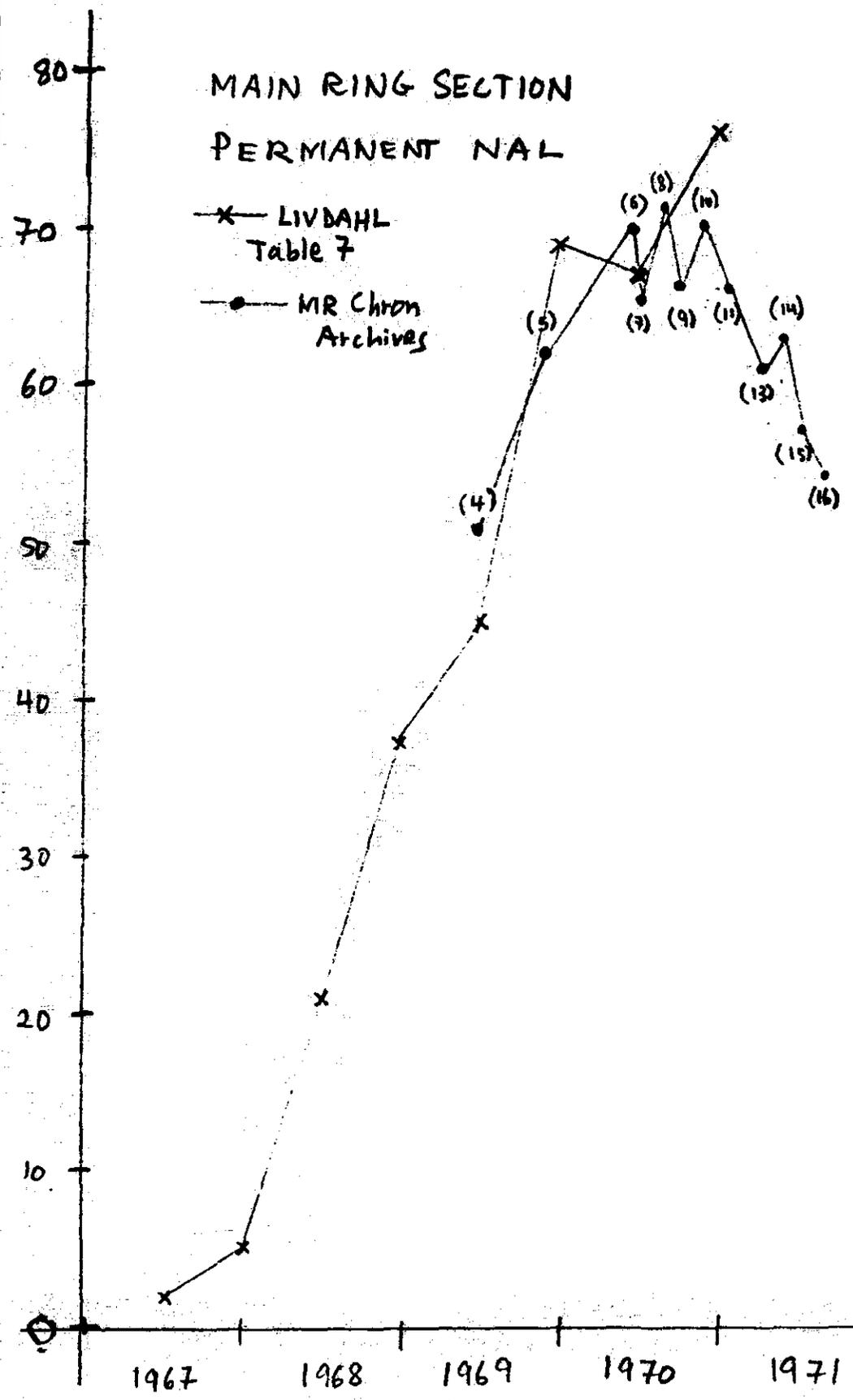
Conclusion

As I skimmed through my archives I kept getting distracted. I was reminded of many interesting aspects to the building and commissioning of the Main Ring but did not have time to pursue most of them. It would be nice someday to have the luxury of sufficient time to write a more detailed history of building the Main Ring.

References

- (1) 7-5-63. Phil Livdahl to Distribution.
- (2) draft. Phil Livdahl. "A Brief Summary of Staffing Levels at Fermilab During Initial Construction Years."
- (3) Hank Hinterberger. Milestones. in preparation.
- (4) 7-16-69. E. Malamud to Dick Auskainis. "Main Ring Section signature authorization list." Lists all employees.
- (5) 11-24-69. Main Ring Section List.
- (6) 6-15-70. E. Malamud to all members of the Main Ring. "Some Organizational Changes." (organization chart attached).
- (7) 7-22-70. Main Ring Section List.
- (8) 8-11-70. Ernie Malamud to Chuck Marofske. Table of number of people and lists.
- (9) 9-25-70. Main Ring Employees. Totals and list of names.
- (10) 11-17-70. Main Ring Organization chart.
- (11) 1-11-71. Summary of Main Ring Employees. (also has list of names).
- (12) 3-19-71. Summary of Main Ring Employees.
- (13) 4-15-71. Summary of Main Ring Employees.
- (14) 5-20-71. E. Malamud to R. R. Wilson. Totals of number of people in the Main Ring Section.
- (15) 7-30-71. Summary of Main Ring Employees.
- (16) 9-3-71. Summary of Main Ring Employees.
- (17) 10-20-71. R. R. Wilson. "Formation of the Accelerator Section."
- (18) 2-21-69. R. R. Wilson. "Announcement of the Division of Technical Services."
- (19) 1-0-15-71. Chuck Marofske to Paul Reardon. "Organizational Change."
- (20) 7-27-71. Minutes. Steering Meeting.
- (21) 8-13-71. Minutes. Steering Meeting.
- (22) 8-23-71. J. R. Orr to Meson Laboratory Personnel.
- (23) 8-18-71. Main Ring Physicists and physicists from other Sections associated full time with Main Ring.
- (24) 12-11-69. R. R. Wilson. "Some Administrative Changes."
- (25) 8-20-71. R. R. Wilson to E. Malamud. (official transfer of Meson Section and Al Maschke to Main Ring effort).
- (26). Webster's Dictionary. Troika = A team of three horses abreast.
- (27). 7-10-69. Hank Hinterberger and Ernie Malamud to Don Getz. "Overtime". (memo implies that troika including Cassel is functioning as administration of Main Ring Section).
- (28). 8-6-71. R. Cassel, H. Hinterberger, E. Malamud to Main Ring Section.
- (29). 9-9-71. E. Malamud, H. Hinterberger, R. Cassel to John Barry. "Money that will be obligated in 2nd Quarter of FY 1970".
- (30). 4-6-71. R. R. Wilson to E. Malamud.
- (31). 7-18-69. E. Malamud to F. Shoemaker. "Summary of Main Ring activities."
- (32). 11-5-69. Minutes of Main Ring Staff Meeting.
- (33). 1-7-70. Minutes of Main Ring Staff Meeting.

- (34). 1-14-70. Minutes of Main Ring Staff Meeting.
- (35). 1-18-70. E. Malamud. "Definition of March 20, 1970 Main Ring Milestone."
- (36). 3-70. Main Accelerator Section Monthly Report.
- (37). 3-13-70. Linac to Main Ring. "Successful Accomplishment of Prototype Milestone."
- (38). 3-13-70. Bradley Bennett to Main Ring Section. telegram.
- (39). 3-13-70. E. Malamud and R. Sheldon. telegram to Everson Electric.
- (40). E. Malamud. "Notice to All Main Ring employees."
- (41). 4-8-70. Minutes of the Main Ring Staff meeting.
- (42). 4-14-70. E. Malamud to All Main Ring Employees.
- (43). E. Malamud to All West Chicago Employees.
- (44). E. Malamud to All Main Ring Employees.



TEMPORARY + AGENCY MAIN RING

—X— LIVDAHL Table 7
—●— MR Chron Archives

300
250
200
150
100
50
0

1967 1968 1969 1970 1971



AN 21

ACCELERATOR MILESTONES

	<u>1969</u>
MAIN RING GROUNDBREAKING.	OCT 3
	<u>1970</u>
1st MAGNET IN RING.	APR 15
SECTOR A COMPLETE.	OCT 1
LAST MAIN RING HOOP IN PLACE.	NOV 30
	<u>1971</u>
200 MeV BEAM FROM LINAC COMPLETES ONE TURN IN BOOSTER.	JAN 24
MULTI-TURNS IN BOOSTER.	JAN 29
BOOSTER ACCELERATION TO 1 GeV.	FEB 6
BEAM TO END OF SECTOR A.	MAR 17
LAST MAIN RING MAGNET INSTALLED IN MAIN RING.	APR 16
PROTONS ACCELERATED IN BOOSTER TO THE DESIGN ENERGY OF 8 GeV.	MAY 20
7 GeV PROTON BEAM INJECTED FROM BOOSTER INTO MAIN RING COMPLETES 1 TURN AROUND MAIN RING.	JUL 1
8 TURNS ACHIEVED IN MAIN RING.	JUL 2
COASTING BEAM OF 10,000 REVOLUTIONS OBSERVED IN MAIN RING.	AUG 1
9 GeV FIRST ACCELERATION IN MAIN RING.	SEP 1
	<u>1972</u>
20 GeV	JAN 22
53 GeV	FEB 4
100 GeV	FEB 11
200 GeV	MAR 1



We are going to celebrate the completion of the Main Ring Milestone with a party this Saturday night, March 14, in the NAL cafeteria starting at 7 P.M. There will be lots of food, wine and beer. Please bring your favorite record.