Fermilab

TM-1222
0002.000

A Brief Summary of Staffing Levels at Fermilab During Initial Construction Years

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November 1983

Introduction

The National Accelerator Laboratory officially began on June 15, 1967 when a handful of dedicated persons, recruited by Director Robert R. Wilson, gathered on the tenth floor of the Executive Plaza Office Building in Oak Brook, Illinois. This group began by organizing the effort to develop the accelerator designs, write the initial design report and start design of the components needed to complete the 200 BeV accelerator.

During the first days this group had to not only consider the technical details of the accelerator design but also learn how to provide for their own needs such as desks, blackboards and other equipment. Much of the initial complement of this equipment came from the Midwestern Universities Research Association at Madison, Wisconsin which was being closed. The group also had to develop the basic requirements for employment of people by providing payroll, procurement and support systems. All of these activities required the development of an administrative group which had the collective capacity to begin the work of the laboratory.

This paper will very briefly summarize the work of the various groups that were involved from the beginning through the end of the initial construction phase of the project (defined here to be July 1, 1972) and the final construction or completion phase which is here defined as December 31, 1973.

The numbers in this report have been gathered by examining the personnel records of Fermilab with the research being done by Chuck Marofske, the Head of Laboratory Services and his staff and by assembling information from the memories of people still with the laboratory in 1983. Since there was much mobility within the laboratory during the construction years and frequent reorganizations were the norm, the numbers presented herein can not be considered to be more accurate than about ± 5%.

Project Administration

The initial complement of persons in the Directorate were very experienced people who had conducted and directed large research programs at other laboratories or universities. The members of the initial directorate were: Director, Robert R. Wilson; Deputy Director, Edwin L. Goldwasser; Associate Director, M. Stanley Livingston; Associate Director, Thomas L. Collins; Assistant Directors, Donald R. Getz and Francis T. Cole. This group proceeded to recruit other persons to assist in the more detailed jobs required to achieve the immediate laboratory goals. Table 1 shows the total employment of the laboratory as it grew through the period of heavy construction and initial operation.

Table 1
Total Laboratory Construction Effort

Date	Employees	Est. Man Years[1] In 6 Mo. Interval	
7/1/67	8	1	
1/1/68	74	24	
7/1/68	190	70	
1/1/69	308	128	
7/1/69	410	183	
1/1/70	598	256	
7/1/70	725	334	
1/1/71	743	371	
7/1/71	769	380	
1/1/72	815	399	
7/1/72	907	432	Σ = 2577
1/1/73	986	475	
7/1/73	1072	519	
1/1/74	1152	557	
		Total 4128	

1. The unit of man years denotes levels of effort throughout. No gender differentiation is intended.

Not included in Table 1 were the persons employed by the architectural-engineering firm which had been formed for the purpose of design of plant facilities. This firm was called DUSAF, an acronym derived from the first letter of the four (Daniel, Urbahn, Seelye and Fuller) engineering firms involved in the joint venture. The DUSAF organization included all design, contracting, management, and inspection activities for civil construction. It was managed by Mr. E. Parke Rohrer. Table 2 shows the total employment distribution over this period of the DUSAF organization. The employment numbers were extracted from the DUSAF annual reports which are preserved in the Milton White History of Accelerators Library.

Table 2
DUSAF Construction Effort

Date	Employees	Est. Man Years In 1 Year Interval	
1/1/68	20	5	
1/1/69	60	40	
1/1/70	160	110	
1/1/71	220	200	
1/1/72	110	150	Σ = 605
1/1/73	70	90	
1/1/74	40	50	
1/1/75	0	10	
		Total = 695	

The growth of the administrative functions of the laboratory are shown in Table 3. Included in the administrative totals, because the numbers of people devoted to each activity was relatively small and also in order to make a smaller number of breakdowns of effort for this paper, are Accelerator Theory and Radiation Physics as well as a spectrum of administrators from such activities as procurement, accounting, personnel and model making. As the laboratory grew this number came to include people involved with other ancillary activities such as receiving, site work and eventually the cafeteria.

Table 3
Total Administrative Employment for Initial Construction and Operation

Date	Employees	Est. Man Years In Interval	
7/1/67	~ 5		
1/1/68	43	13	
7/1/68	78	31	
1/1/69	115	48	
7/1/69	141	65	
1/1/70	179	81	
7/1/70	235	104	
1/1/71	246	121	
7/1/71	274	130	
1/1/72	269	136	
7/1/72	267	134	Σ = 863
1/1/73	283	138	
7/1/73	294	147	
1/1/74	280	143	
		Total 1291	

By the beginning of 1968 the groups had begun to evolve which would carry the responsibility for design and construction of the component parts of the accelerator and experimental facilities. The following paragraphs will describe these individual groups and their functions.

Linac Group[1]

The Linac Group was formed early, partly because Donald E. Young was the second employee of the laboratory and partly because of his earlier association with the MURA laboratory in Madison, Wisconsin from which he was able to recruit a number

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1. The systems groups (i.e. Linac, Booster, R.F., Main Ring and Beam Transfer) were all parts of the Accelerator Division which was headed by R. R. Wilson. Since the Accelerator Division had no staff outside of these systems groups, and for the sake of simplicity and brevity no mention of the Accelerator Division during initial construction will be made.

of colleagues to join the new accelerator project. Since most of these people had previously worked on the design of a 200 MeV linear accelerator, this group was able to proceed rapidly into development work, but first work space and working equipment had to be acquired.

The Linac Group first established a machine shop in rented garage space in Downers Grove and proceeded to acquire machine tools and some experienced machinists. By late fall of 1967, the Linac Group received permission from the Federal Savings and Loan Insurance Corporation to occupy three houses in the bankrupt, speculative housing development which had been known as Weston that was a part of the identified site for the new laboratory. Also, the FSLIC had given permission to the Universities Research Association to build a building which would house the research and development activities for the linac. This new building (now known as the Cut Shop or Lab. 1) was designed to accommodate a 750,000 volt Cockcroft-Walton type preaccelerator and a prototype resonant cavity accelerator structure to raise the proton energy to 10 MeV. A sufficient amount of power was provided in the new building so that development work to be done there could include a full scale machine shop. By getting space on site so early, the Linac Group proceeded quickly to fabricate Fermilab's first accelerator system.

The parts required to build a 750K volt Cockcroft-Walton power supply were borrowed from Argonne National Laboratory spare parts. As soon as the new building was completed, it was possible to begin the assembly and testing of the 750K volt power supply which was soon coupled to an accelerating column that had previously been assembled at MURA.

Table 4 shows the employment history of the Linac Group. By July of 1971 the 200 MeV linac had been completed and was installed in the permanent buildings. The Linac Group could then be utilized for other purposes. Some of the Linac Group became the nucleus of the Accelerator Operations Section which was again headed by Don Young. Others of the group joined the Neutrino Lab to install and test the components required for the neutrino beam lines. The machinists from the group joined the Technical Services Division which had been started earlier.

Table 4
Linac Construction Effort

Date	Employees	Est. Man Years In 6 Mo. Interval
7/1/67	1	0
1/1/68	18	6
7/1/68	28	12
1/1/69	36	16
7/1/69	43	20
1/1/70	46	23
7/1/70	57	26
1/1/71	53	28
7/1/71	Group Disbanded[1]	14
	Total	145

1. Part of group transferred to the Accelerator Section
Part of group transferred to Neutrino Lab.
Machinists were transferred to Tech. Services Section

Booster Group

The Booster Group was started under the direction of Arie Van Steenbergen who was on leave from Brookhaven National Laboratory. He recruited colleagues principally from Cornell and Argonne to begin the design effort of the booster. Soon after the design began to become firm, a second research building was built in the area near the Linac Building. Provisions were made for making magnet measurements as well as for power testing of the resonant sections of the booster magnet system which included two bending magnets with appropriate chokes and capacitors for 15 hertz operation.

After one year Van Steenbergen returned to BNL. He was at that time replaced by Paul Reardon who later became Business Manager and was replaced by Roy Billinge who led the group to completion of the Booster.

The employment history of the Booster Group is illustrated in Table 5. It is noted that the booster was installed at the same time as the linac. The Booster Group also was disbanded as a separate entity by July 1, 1971. Part of the employees of the Booster Group joined in the Accelerator Section and part went to the Meson Lab to finish construction of facilities for the Meson experimental beam lines.

Table 5
Booster Construction Effort

Date	Employees	Est. Man Years In 6 Mo. Interval
7/1/67	0	
1/1/68	3	1
7/1/68	21	7
1/1/69	35	15
7/1/69	49	22
1/1/70	71	31
7/1/70	74	37
1/1/71	62	34
7/1/71	Group Disbanded[1]	15
		Total 162

1. Part of group transferred to the Accelerator Section
   Part of group transferred to Meson Lab
   Machinists transferred to the Technical Services Section

R.F. Group

The RF Group was started with a nucleus of people who had worked on the project as a part of the Lawrence Radiation Laboratory effort for development of the 200 BeV project. This included Quentin Kerns who was the Group Leader and Gerry Tool who was the Associate Group Leader. They began their effort in Berkeley, California, where they already had built models and test equipment. Testing continued at Berkeley until facilities were available for the group to move the work at the Fermilab site. Table 6 shows the employment history of the RF Group. Their work

included the design, development and construction of the rf equipment for both the booster and main ring. This work continued for about six months beyond the formation of the Accelerator Operations Section and by January, 1972, the RF Section was disbanded as an independent organization and was merged into the Accelerator Section.

Table 6
Radio Frequency Construction Effort

Date	Employees	Est. Man Years In 6 Mo. Interval
7/1/67	0	
1/1/68	2	1
7/1/68	11	3
1/1/69	21	9
7/1/69	29	13
1/1/70	37	17
7/1/70	37	19
1/1/71	40	20
7/1/71	39	20
1/1/72	Group Disbanded[1]	10
		112

1. Group transferred to the Accelerator Section.

Main Ring Group[1]

The Main Ring Group was headed by John DeWire from Cornell University until February 1968 after which it was headed by Frank Shoemaker on leave from Princeton University. This group had the responsibility for design, development and construction of the magnets, power supplies, water systems and controls for the main accelerator. Although the initial goal was intended to only provide for 200 GeV, it was an additional requirement to maintain the capability for achieving at least 400 and perhaps 500 GeV as an ultimate goal.

The group moved to the Fermilab site as soon as space became available in an inflatable air building which was purchased and installed on site as their first laboratory work space. This was adjacent to a prototype of the main ring tunnel which was being built.

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1. A much more detailed and accurate accounting of the work of the main ring group is in preparation by Ernest Malamud. That paper will discuss the organizational evolution of the group and its related efforts with the Technical Services Section.

Upon completion of Shoemaker's leave of absence from Princeton (Sept. of 1969) he was replaced by a management "Troika" consisting of Ernie Malamud, Dick Cassel and Henry Hinterberger which reported to R. R. Wilson who served both as group leader and Laboratory Director.

Table 7 shows the employment history of the Main Ring Group.

Table 7
Main Ring Construction Effort

Date	Employees	Est. Man Years In 6 Mo. Interval
7/1/67	2	
1/1/68	5	2
7/1/68	21	7
1/1/69	37	15
7/1/69	45	21
1/1/70	69[1]	29
7/1/70	67[1]	34
1/1/71	76	36
7/1/71	57	33
1/1/72	Group Disbanded[2]	15
		Total 192

1. Does not include as many as 220 agency factory workers.

2. Group transferred to the Accelerator Section and Technical Services.

Not included in this summary were laborers and assembly workers who were hired from local temporary help agencies. In the period of the fourth quarter of 1970 and the first quarter of 1971, from 200 to 220 of these people were utilized for main ring magnet assembly. In the second and third quarters of 1970 this work force had grown from zero to 100 and from the first quarter to the third quarter of 1971 decreased to 120. Many of these remaining persons were then hired by the laboratory and became part of the Technical Services Section. These persons worked in a rented warehouse in West Chicago, Illinois.

The Main Ring Group objectives were sufficiently completed by January of 1972 and the group was merged into the Accelerator Section.

Beam Transfer Group

The Beam Transfer Group was headed by Alfred Maschke. The group had the responsibility for design, development and construction of equipment for transfer of 200 MeV protons from the linear accelerator to the booster and for injection into the booster accelerator ring. They also had the responsibility for extraction from the booster, transfer to and injection into the main accelerator ring, as well as extraction from the main accelerator and transport of the proton beams to the experimental areas.

Table 8 shows the employment history of the Beam Transfer Group. At the end of 1971, this group was disbanded. part of the group went to work with the Experimental Facilities Group to complete the Proton Lab and part was merged into the Accelerator Section.

Table 8
Beam Transfer Construction Effort

Date	Employees	Est. Man Years In 6 Mo. Interval
7/1/67	0	
1/1/68	2	1
7/1/68	8	3
1/1/69	12	5
7/1/69	27	10
1/1/70	42	18
7/1/70	59	25
1/1/71	56	29
7/1/71	54	27
1/1/72	Group Disbanded[1]	13
	Total	131

1. Part of group transferred to Accelerator Section
Part of group transferred to Proton Lab.
Machinist transferred to Technical Services

In the period that they were a separately identified group, the Beam Transfer Group developed electrostatic septa and magnetic septa for extraction. and magnetic and electrostatic septa for beam splitting so that protons could be shared to the three experimental areas (meson, neutrino and proton) concurrently. Additional splitting stations were designed and fabricated to deliver concurrent proton beams to each of the three areas of the Proton Laboratory.

Accelerator Section

As has been pointed out earlier, the Accelerator Operations Section was started at the time of completion of the Linac and Booster. The group was originally headed by Don Young. It eventually was the beneficiary of transfers from the RF, Main Ring and Beam Transfer Group.

This group had the responsibility for completion and commissioning of accelerator systems. Early in this stage Wilson divided the construction effort of this enlarged group between three task managers, Rich Orr, Dick Lundy and Phil Livdahl, to attack systems completion in a coordinated manner. Support for these managers was provided by all other organizations of the laboratory as needed. Coordination of all accelerator activities was provided by Boyce McDaniel, who came in February of 1972 on sabbatical leave from Cornell University.

Since a large amount of construction was completed by this group, the employment history is summarized in Table 9.

Table 9
Accelerator Section Construction Effort

Date	Employees	Est. Man Years In 6 Mo. Interval	
1/1/71	0		
7/1/71	90	23	
1/1/72	265	89	
7/1/72	219[1]	121	Σ = 233 man years
1/1/73	223	111	
7/1/73	237	116	
1/1/74	291	133	
		Total 593 man years	

1. Includes Internal Target

On the return of Boyce McDaniel to Cornell in the Fall of 1972, this group became the Accelerator Division under the leadership of Paul Reardon.

Experimental Facilities

Concurrent with the design of the accelerators, a staff was developed under the direction of J. R. Sanford and A. L. Read to plan experimental facilities such as secondary beam lines and detectors to meet the initial needs of experimenters. The persons who had originally been recruited into this group were supplemented as mentioned above by people from the Linac, Booster and Beam Transfer Groups upon completion of those groups' projects. The employment history of this organization is illustrated in Table 10.

Table 10
Experimental Facilities Construction Effort

Date	Employees	Est. Man Years In 6 Mo. Interval	
7/1/67	-	-	
1/1/68	1	-	
7/1/68	5	2	
1/1/69	16	6	
7/1/69	32	12	
1/1/70	53	21	
7/1/70	72	32	
1/1/71	86	40	
7/1/71	125	53	
1/1/72	147	69	
1/7/72	254	101	Σ = 336
1/1/73	304	140	
7/1/73	349	163	
1/1/74	347	174	
		Total 813	

Again, for the sake of brevity and simplicity the above summary includes those persons from several organizations which at one time or another were separate entities but who through various reorganizations eventually merged into what is now known as the Research Division. Groups included in this consolidation include Theoretical Physics, Meson Lab, Neutrino Lab, Proton Lab, Research Services, 15' Bubble Chamber and the original Experimental Facilities group.

Physics Department

In order to begin to plan a physics program for in-house physicists, a Physics Department was started in early 1969. The first head of the Physics Department was Deputy Director Goldwasser. It was understood that any physicist could spend up to 1/2 of his time doing experimental physics. This could be done as part of an experimental collaboration but was formally in the Physics Department. The persons who joined this effort were recruited to build detectors for the initial round of experiments and to plan facility and detector requirements to carry out these experiments. Table 11 shows the employment history of the Physics Department.

Table 11
Physics Department Construction Effort

Date	Employees	Est. Man Years In 6 Mo. Interval	
7/1/69	0		
1/1/70	21	5	
7/1/70	25	12	
1/1/71	27	14	
7/1/71	29	15	
1/1/72	34	16	
7/1/72	37	18	$\Sigma = 80$
1/1/73	38	19	
7/1/73	44	21	
1/1/74	52	24	
		Total 144	

Technical Services

Technical Services was an organization which was begun in early 1969 to provide engineering, central machine shop and drafting services to support all of the growing activities of the sections which were assigned the responsibility for building major components of the accelerator systems and experimental areas.

Over the first three years of their existence most of the Technical Services' effort was in support of work required by the Main Accelerator Group. This group was formed under the direction of Henry Hinterberger who had been recruited from the University of Chicago at the time this section was formed. Table 12 shows the employment history of Technical Services.

Table 12
Technical Services Construction Effort

Date	Employees	Est. Man Years In 6 Mo. Interval	
7/1/67	0	0	
1/1/68	0	0	
7/1/68	18[1]	5	
1/1/69	36[1]	14	
7/1/69	44	20	
1/1/70	80	31	
7/1/70	99	45	
1/1/71	97	49	
7/1/71	101	50	
1/1/72	100	51	
7/1/72	130	58	= 323[2]
1/1/73	138	67	
7/1/73	148	72	
1/1/74	183	83	
		Total 545	

1. Called Engineering Services in this period.

2. Accelerator Construction defined as complete 7/1/72.

Summary

In summary, the total man-years of effort of all of the organization units of Fermilab required to construct and commission the original cascade of accelerators has been estimated. Phase I, which includes all activities prior to June 30, 1972, was completed by 2577 person years of work. This phase included most construction and initial start-up of the accelerators with some completion of experimental facilities.

Phase 2, the time included between July 1, 1972 and December 31, 1973, completed construction and commissioning of the accelerators and commissioned the experimental facilities. This phase consumed nearly 1550 additional person years of effort.

Table 13 summarizes the data of Tables 1 thru 12.

Table 13
Total Effort Summary

Phase 1 (6/15/67 to 6/30/72)

Administrative	-	863
Linac	-	145
Booster	-	162
RF	-	112
Main Ring	-	192
Beam Transfer	-	131
Accelerator Section	-	233
Experimental Facilities	-	336
Physics	-	80
Technical Services	-	323
		2577

Phase 2 (7/1/72 - 12/31/73)

Administrative	-	428
Accelerator Section	-	360
Experimental Facilities	-	477
Physics	-	64
Technical Services	-	222
	Total	1551

Note: The above tables do not include DUSAF.

Appendix I is a list of the 200 earliest employees divided by categories and listed in the order in which they came onto the Fermilab payroll.

APPENDIX 1

F N A L - First 200 Employees

Physicists	Engineers	Adm/Clerical	Support
R. Wilson	G. Lee	D. Getz	R. Gram
D. Young	J. O'Meara	D. Poillon	A. Frelo
A. L. Read	M. Palmer	C. Sazama-Reay	T. Elrod
E. Goldwasser	R. Rihel	C. Daley	A. Gonzales
A. Maschke	G. Tool	U. Hoenighausen	R. Krischel
F. Cole	R. Cassel	G. Baker	R. Timke
C. Curtis	R. Juergens	M. Hanson	L. Sobocki
C. Owen	J. Satti	M. Kasak	D. Miller
J. DeWire	R. Winje	R. Wagner	J. Hagarty
L. Teng	H. Feng	F. Walsh	J. Buffenmeyer
A. Garren	L. Klaisner	D. Smith	W. Jones
Q. Kerns	R. Daniels	D. Latzke	A. Skraboly
M. S. Livingston	H. Lau	A. E. Rennels	L. Hardy
P. Livdahl	H. Hinterberger	P. Duffield	R. Remp
A. Roberts	J. Dinkel	S. Mangum	J. Widensadt
S. Snowdon	E. Anderson	C. Hines	J. Fiedler
A. VanSteenbergen	E. Laukant	L. Wolner	L. Senesch
T. Collins	H. Miller	C. Marofske	M. Hankerson
M. Awschalom	B. Sandberg	J. Sullivan	D. Tokarz
E. Malamud	J. Ryk	J. Plese	F. Bowker
L. Smith	W. Hanson	B. Kristen	E. Boswell
E. Gray		D. Sullivan	W. Horsiek
E. Hubbard		K. Williams	R. Lewandowski
R. Billinge		M. Zier	J. Wendt
F. Shoemaker		D. Bart	R. Hren
T. White		P. Klein	R. Kreml
R. Yamada		J. Pollock	R. Wischermann
Y. Kang		A. Albert	L. Hepinstall
R. Juhala		K. Perkins	F. Sarver
G. Bingham		K. Cooper	J. Poces
J. Sculli		S. Bickel	C. Sharp
M. Green		J. Hallett	S. Paulson
		H. Severence	A. Stump
		G. Notley	W. Hoeschelle
		R. Schultz	E. Bowker
		N. Hill	D. Mendenhall
		C. Gifford	T. Parnell
		N. Marshall	J. Feltus
		D. Blackwell	G. Michaud
		M. R. Donaldson	K. Fitzgerald
		C. Larsen	R. Smith
		C. Vanecek	R. Utt
		R. Auskalnis	L. Mapalo
		M. Palmer	R. Maleto
		N. Redmon	W. Tobias

Physicists	Engineers	Adm/Clerical	Support
		G. Boon	D. Ziobro
		E. Santiago	J. Skowron
		D. Blayney	W. Pear
		R. Thompson	S. Sierman
		J. Arado	J. Hogan
		G. Abbey	H. Minster
		P. Arthur	E. Barrich
		S. Hill	P. Ruiz
		B. Cartwright	W. Pelczarski
			A. Tanner
			D. Hoffman
			R. Nelson
			J. Otavka
			L. Ray
			W. Martin
			G. Doyle
			B. Quinn
			H. Koecher
			G. Reid
			G. Allen
			A. Fuentes
			W. McCaw
			V. Smith
			R. Huendorf
			D. Sobecki
			R. Rodriguez
			R. Huggins
			J. Carter
			A. Tumescrillo
			H. Gerzevske
			L. Beverly
			A. Georgoulakis
			R. Schlick
			R. Stegman
			H. Barber
			G. Rehbein
			S. Tawzer
			J. Thompson
			E. Slavinskas
			C. Schmidt
			J. Klen
			W. Sundeen
			E. Schmidt
			W. Schultz
			E. Steigmeyer
			C. Mantsch
			T. Mendoza
			C. Graves