



**13.8 KV FEEDERS AND LOAD DISTRIBUTION IN  
THE NEUTRINO LABORATORY**

T. E. Toohig

April 1971

The electrical power distribution from the Master Substation to the Neutrino Laboratory consists in two 13.0 kV feeders, Feeder 32 and Feeder 33, running the length of the area. Appropriate unit substations at various locations as detailed in Figure 1 convert the 13.0 kV to voltages required for equipment. These are DUSAF-supplied substations with the exception of the supply for the Chicago cyclotron in the Muon Laboratory Area and the 30-inch ANL bubble chamber. The feeders are rated for about 7 KVA each and loads are distributed accordingly.

Tables I and II illustrate operating loads for maximum running of various beam lines and facilities in the area. From the point of view of power, it is apparent that compromises in beam momentum and/or experimental equipment operating levels must be made to operate facilities simultaneously. In particular, the lumped loads for the cyclotron and bubble chambers are so large relative to the power consumption of the beams even under extreme operating conditions, that substantial compromises must be made in the operating levels of these to achieve simultaneous operation.





## ENGINEERING NOTE

- 2 -

SUBJECT

Neutrino Laboratory - magnet loads  
Power requirements and distribution

NAME

T. E. Toohig

DATE

4-20-71

REVISION DATE

TABLE I

Beam N-7N-3 to 500 GeV/c  
+ 30-inch b.c.

Transf.	Encl.	Power (MW)	Fdr.
NL-1	S.B. 11	.5	32
	G	.5	
NL-2	S.B. 12	.3	33
	100	.5	
NL-3	101	.75	32
NL-5	103	.03	33
NL-6	S.B. 13	.5	32
NL-7	105	.2	32
NL-8	108	.04	33
NL-8	112	.08	33
NL-9	114	.25	32
NL-13	"D"	1.	32*
NAL	b.c.	6.3 (MVA)	33

Beam N-1 to 300 GeV/c  
+ v.c. cyclotron

Transf.	Encl.	Power (MW)	Fdr.
NL-1	S.B. 11	.5	32
	G	.5	
NL-2	S.B. 12	.3	33
	100	.4	
NL-3	101	.6	32
NL-4	102	.4	32
NL-5	103	.5	32
NL-6	S.B. 13	.5	32
	104	.4	
NAL	cyclotron	2.	32

Totals:

Feeder 32 3.7 MW (1.7 MW beam)  
" 33 7.3 MW (0.65 " " )

Put "B" on fdr. 32

\* can be switched to the other  
feeder.

Totals:

Feeder 32 5.4 MW (2.4 MW beam)  
" 33 0.7 MW (0.7 " " )

Non-redundant loads†

Feeder 32 8. MW (4.1 MW beam)  
" 33 8. MW (1.35 " " )

† may need a little more divergence plus conventional.



## ENGINEERING NOTE

- 3 -

## SUBJECT

Neutrino Laboratory - magnet loads  
Power requirements and distribution

## NAME

T. E. Toohig

## DATE

4-20-71

## REVISION DATE

TABLE II

Beam N-7, N-5 to 500 GeV/c  
+15-foot b.c.

Transf	Encl.	Power (MW)	Fdr.
NL-1	S.B. 11 G	.5 .5	32
NL-2	S.B. 12 100	.5 .5	32
NL-3	101	.75	32
NL-6	S.B. 13	.5	32
NL-7	105 106	.75 .2	32
NL-8	109	1.	33
NL-9	113 115	.25 .15	32
NL-10	"B"	1.	33
NL-11	"B"	1.	33


Beam N-0 + Lab "C" experiment

Transf.	Encl.	Power (MW)	Fdr.
NL-1	S.B. 11 G	.5 .5	32
NL-12	"C"	.5	32*

Totals			
Feeder	32	1.5	MW
"	33	0	"

Totals:		
Feeder	32	3.6 MW (2.6 MW beam)
"	33	3.0 MW (1.0 " " )

\* can be switched to the other feeder.

 <b>NATIONAL ACCELERATOR LABORATORY</b> <b>ENGINEERING NOTE</b>	SECTION	PROJECT	SERIAL-CATEGORY	PAGE
	SUBJECT <b>Neutrino Laboratory</b> <b>13.8 KV Feeders and Substations</b>			
NAME <b>T. E. Toohig</b>		DATE <b>4-20-71</b>		
REVISION DATE				

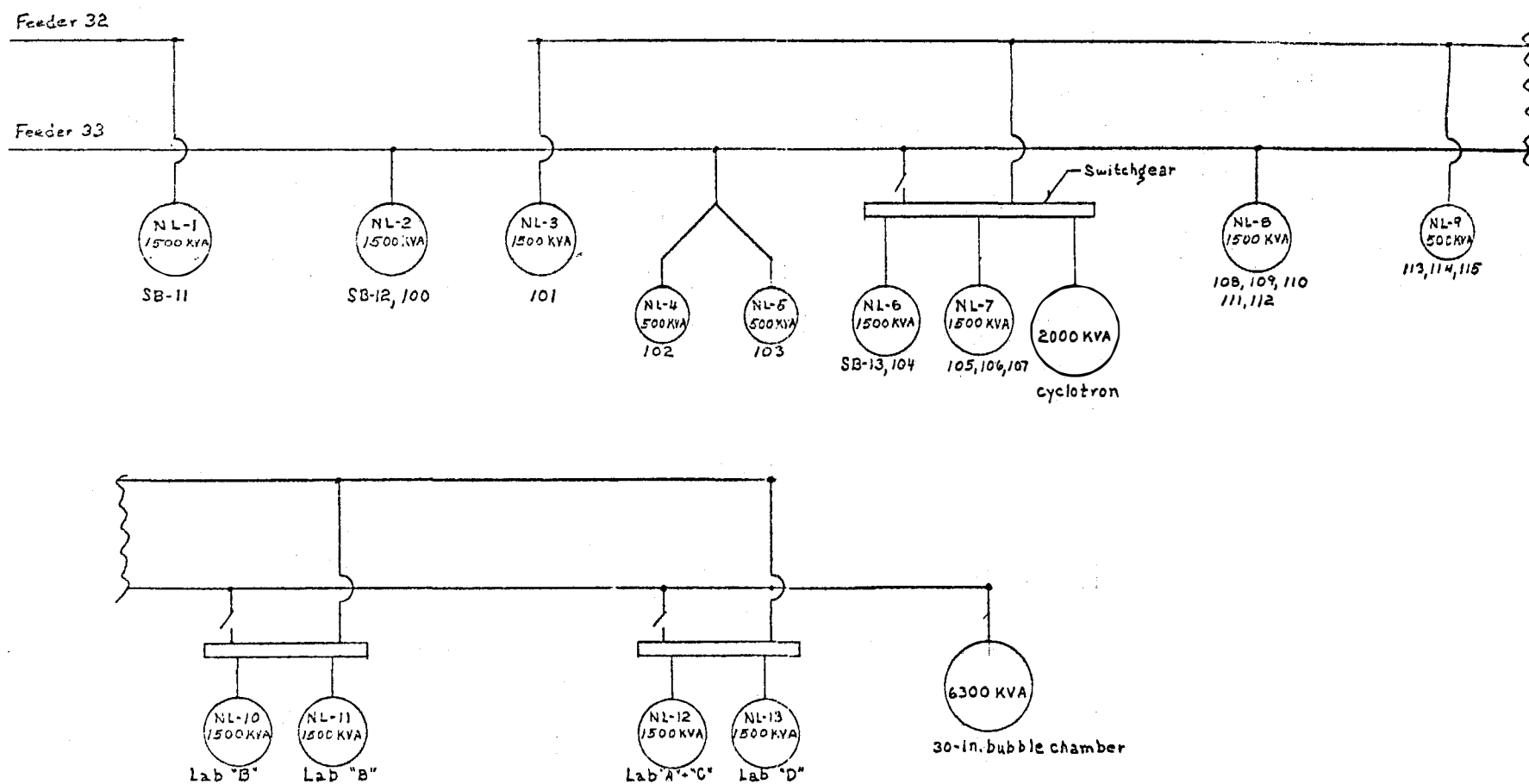


FIGURE 1



13.8 KV FEEDERS AND LOAD DISTRIBUTION IN  
THE NEUTRINO LABORATORY

T. E. Toohig  
May 1971

The electrical power distribution from the Master Substation to the Neutrino Laboratory consists in two 13.8 kV feeders, Feeder 32 and Feeder 33, running the length of the area. Appropriate unit substations at various locations as detailed in Figure 1 convert the 13.8 kV to voltages required for equipment. These are DUSAF-supplied substations with the exception of the supply for the Chicago cyclotron in the Muon Laboratory Area and the 30-inch ANL bubble chamber. The feeders are rated for about 7 KVA each and loads are distributed accordingly.

Tables I and II illustrate operating loads for maximum running of various beam lines and facilities in the area. From the point of view of power, it is apparent that compromises in beam momentum and/or experimental equipment operating levels must be made to operate facilities simultaneously. In particular, the lumped loads for the cyclotron and bubble chambers are so large relative to the power consumption of the beams even under extreme operating conditions, that substantial compromises must be made in the operating levels of these to achieve simultaneous operation.




	NATIONAL ACCELERATOR LABORATORY	SECTION	PROJECT	SERIAL-CATEGORY	PAGE
	ENGINEERING NOTE				
SUBJECT			NAME		
Neutrino Laboratory - magnet loads			T. E. Toohid		
Power requirements and distribution			DATE	REVISION DATE	
			4-20-71	5-11-71	

TABLE I

Beam N-7, N-3 to 500 GeV/c  
+ 20-inch b.c.

Transf.	Encl.	Power (MW)	Fdr.
NL-1	S.B. 11	.5	32
NL-2	S.B. 12	.5	32
	100	.5	
NL-3	101	.75	32
NL-5	103	.03	33
NL-6	S.B. 13	.5	32
NL-7	105	.2	22
NL-8	108	.04	33
NL-9	112	.08	33
NL-9	114	.25	32
NL-13	"D"	1.	32*
NAL	b.c.	6.3 (MVA)	33

Beam N-1 to 300 GeV/c  
+ v.c. cyclotron

Transf.	Encl.	Power (MW)	Fdr.
NL-1	S.B. 11	.5	32
	G	.5	
NL-2	S.B. 12	.3	32
	100	.4	
NL-3	101	.6	32
NL-4	102	.4	33
NL-5	103	.5	33
NL-6	S.B. 13	.5	32
	104	.4	
NAL	cyclotron	2.	22

Totals:			
Feeder 32	4.5 MW	(2.2 MW beam)	
" 33	6.5 MW	(0.15 " " )	


Put "B" on fdr. 32

\* can be switched to the other feeder.

Totals:			
Feeder 32	5.2 MW	(1.4 MW beam)	
" 33	0.9 MW	(0.9 " " )	

Non-redundant loads†			
Feeder 32	7.9 MW	(3.6 MW beam)	
" 33	7.4 MW	(1.1 " " )	

† may need a little more divergence plus conventional.

	NATIONAL ACCELERATOR LABORATORY	SECTION	PROJECT	SERIAL-CATEGORY	PAGE
	ENGINEERING NOTE				
SUBJECT Neutrino Laboratory - magnet loads Power requirements and distribution			NAME T.E. Toohig		
			DATE 4-20-71		REVISION DATE

## TABLE I

Beam N-7, N-5 to 500 GeV/c + 15-foot b.c.				Beam N-0 + Lab "C" experiment			
Transf.	Encl.	Power (MW)	Fdr.	Transf.	Encl.	Power (MW)	Fdr.
NL-1	S.B. 11 G	.5 .5	32	NL-1	S.B. 11 G	.5 .5	32
NL-2	S.B. 12 100	.5 .5	32	NL-12	"C"	.5	32*
NL-3	101	.75	32	<div style="border: 1px solid black; padding: 5px; display: inline-block;">           Totals            Feeder 32 1.5 MW                  33 0       "         </div>			
NL-6	S.B. 13	.5	32				
NL-7	105 106	.75 .2	32				
NL-8	109	1.	33				
NL-9	113 115	.25 .15	32				
NL-10	"B"	1.	32				
NL-11	"B"	1.	33				
<div style="border: 1px solid black; padding: 5px; display: inline-block;">           Totals:            Feeder 32 3.6 MW (2.6 MW beam)                  33 3.0 MW (1.0 " " )         </div>							

\* can be switched to the other feeder.

Feeder 32

Feeder 33

NL-1  
1500 KVA

SB-11

NL-2  
1500 KVA

SB-12, 100

NL-3  
1500 KVA

101

NL-4  
500 KVA

102

NL-5  
500 KVA

103

NL-6  
1500 KVA

SB-13, 104

NL-7  
1500 KVA

105, 106, 107

2000 KVA

cyclotron

NL-8  
1500 KVA

108, 109, 110  
111, 112

NL-9  
500 KVA

113, 114, 115

Switchgear

NL-10  
1500 KVA

Lab "B"

NL-11  
1500 KVA

Lab "B"

NL-12  
1500 KVA

Lab "A" + "C"

NL-13  
1500 KVA

Lab "D"

6300 KVA

30-in. bubble chamber

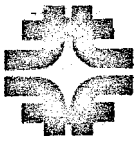
Neutrino Laboratory

13.8 KV Feeders and Substations

Rev. 1: NL-2 to feeder 32

FIGURE 1





**13.8 kV FEEDERS AND LOAD DISTRIBUTION IN THE NEUTRINO AREA**

**T. E. Toohig**

**March 1973**

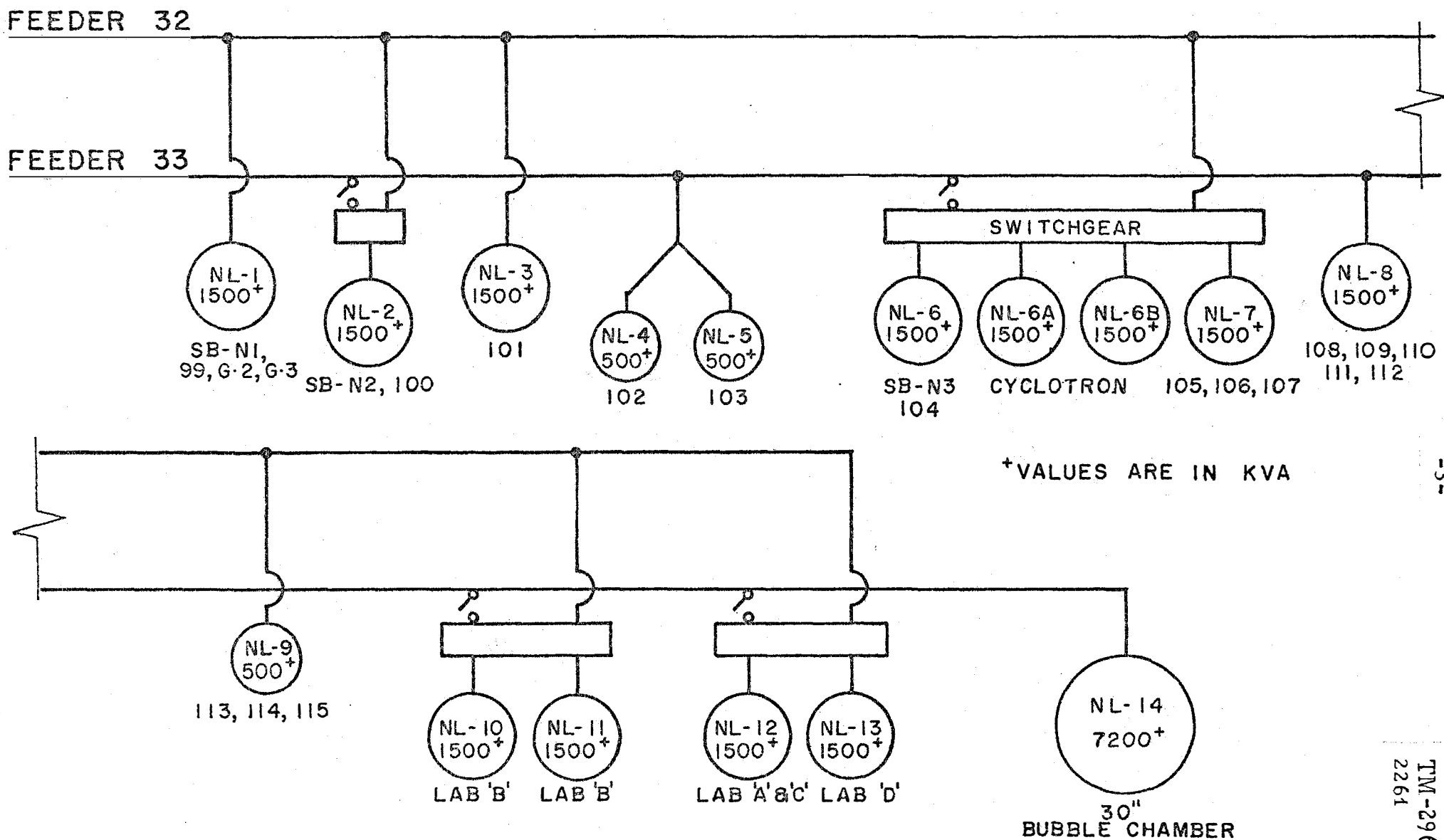
The electrical power distribution from the Master Substation to the Neutrino Area consists in two 13.8 kV feeders, Feeder 32 and Feeder 33, running the length of the area. Appropriate unit substations at various locations as detailed in Fig. 1 convert the 13.8 kV to voltages required for equipment. These are DUSAF supplied substations with the exception of the supply for the 30-inch hydrogen bubble chamber. The feeders are rated for 7.0 MVA each as installed in the power ducts and loads are balanced between the feeders accordingly.

The attached graphs, NL-1 to NL-14, illustrate operating loads on the various substations under different conditions of beam settings and facility operation. The shading on the graphs indicates the approximate increment of power available from the substation if fans were to be added. An efficiency of 0.75 was used for the power supplies, and a power factor of 0.8 was used over-all in calculating the graphs. These numbers are derived from early operating experience and will probably have to be refined with time.

The curves labelled N-0, N-1, etc. refer to the N-0, N-1, etc. beam lines as specified in the beam line data sheets dated March 12, 1973. N-1' refers to the proposed increased-aperture version of the muon beam, N-1.

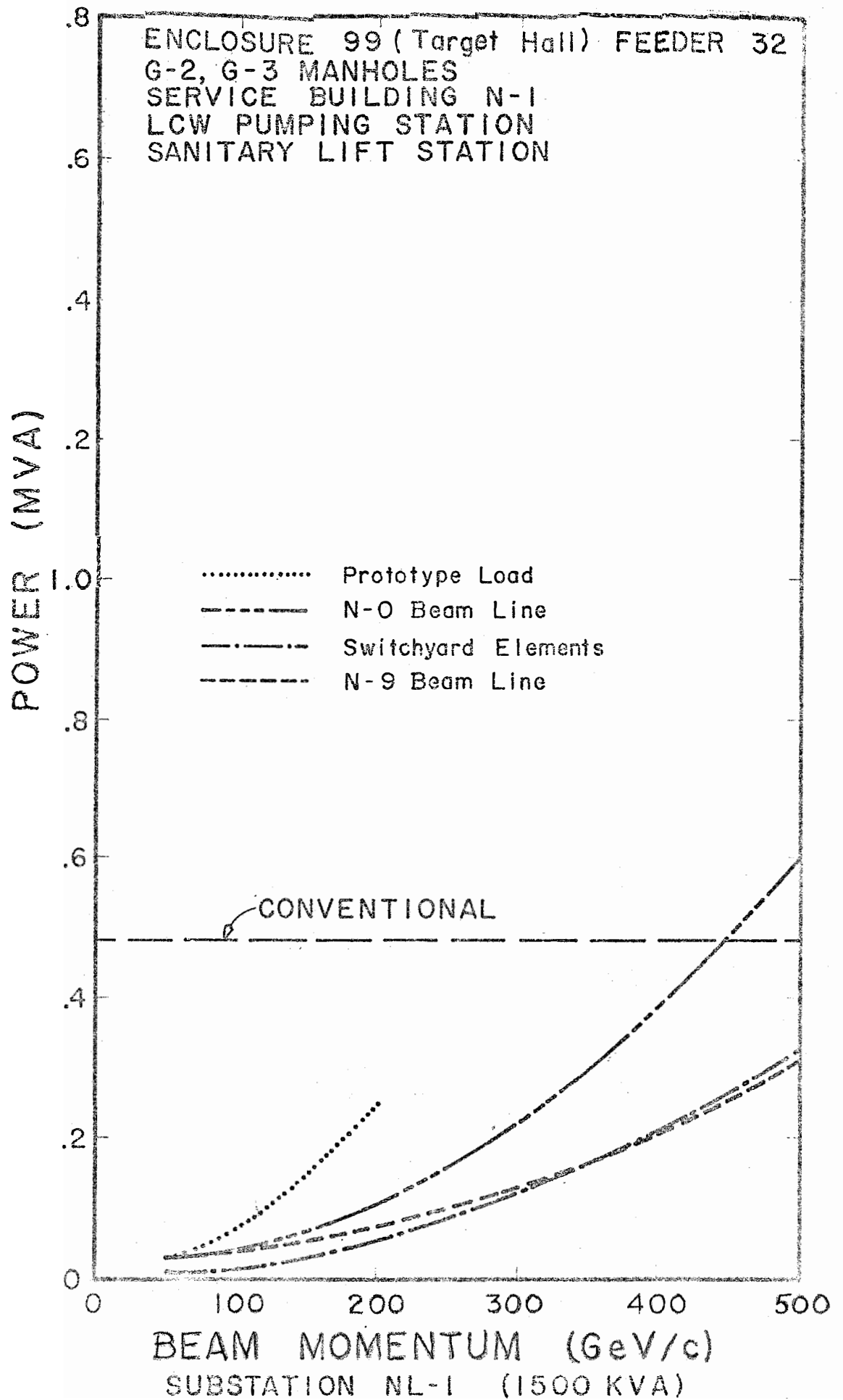


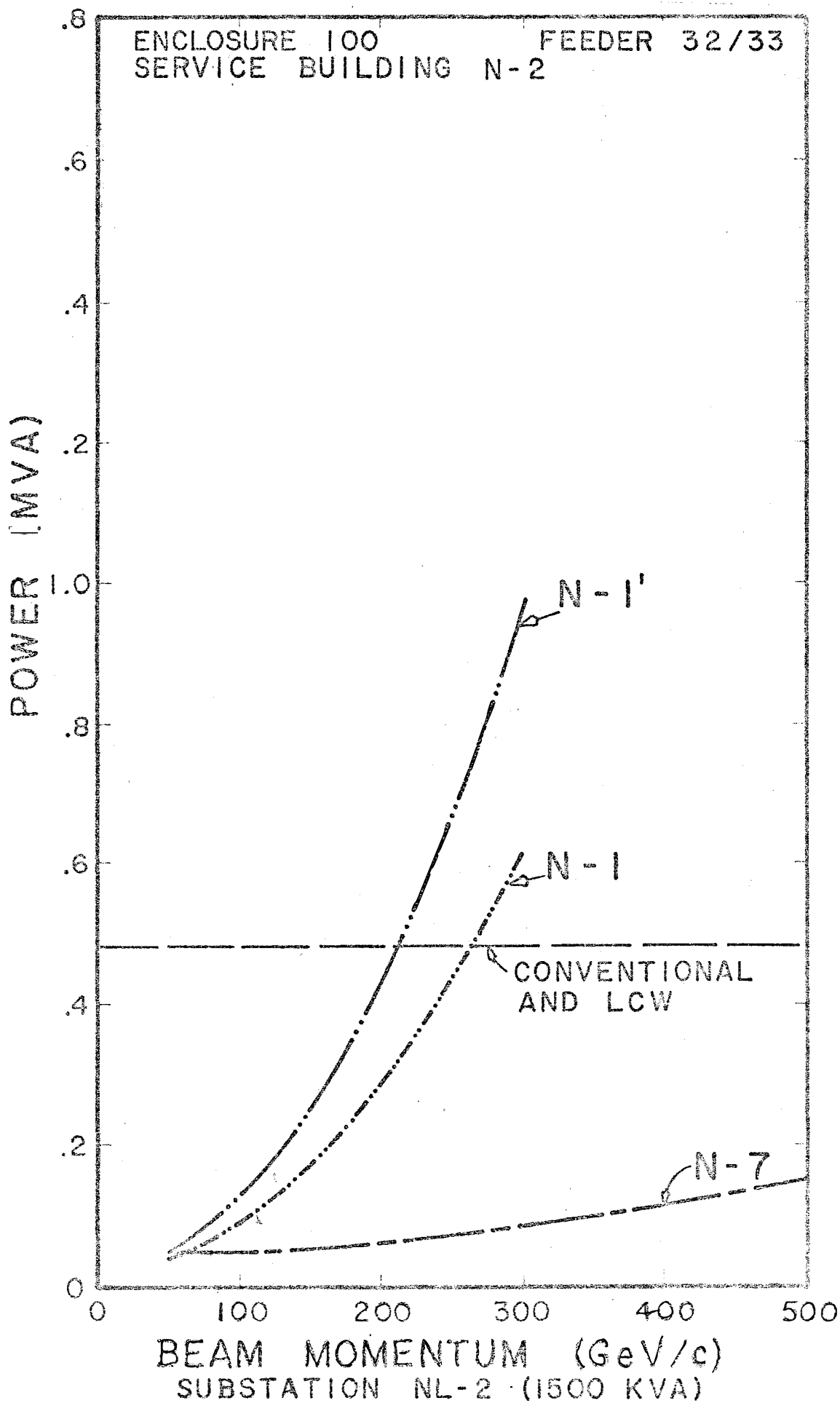
From the point of view of power, it is apparent that under certain conditions compromises in beam momentum and/or experimental equipment operating levels must be made if facilities are to be operated simultaneously.

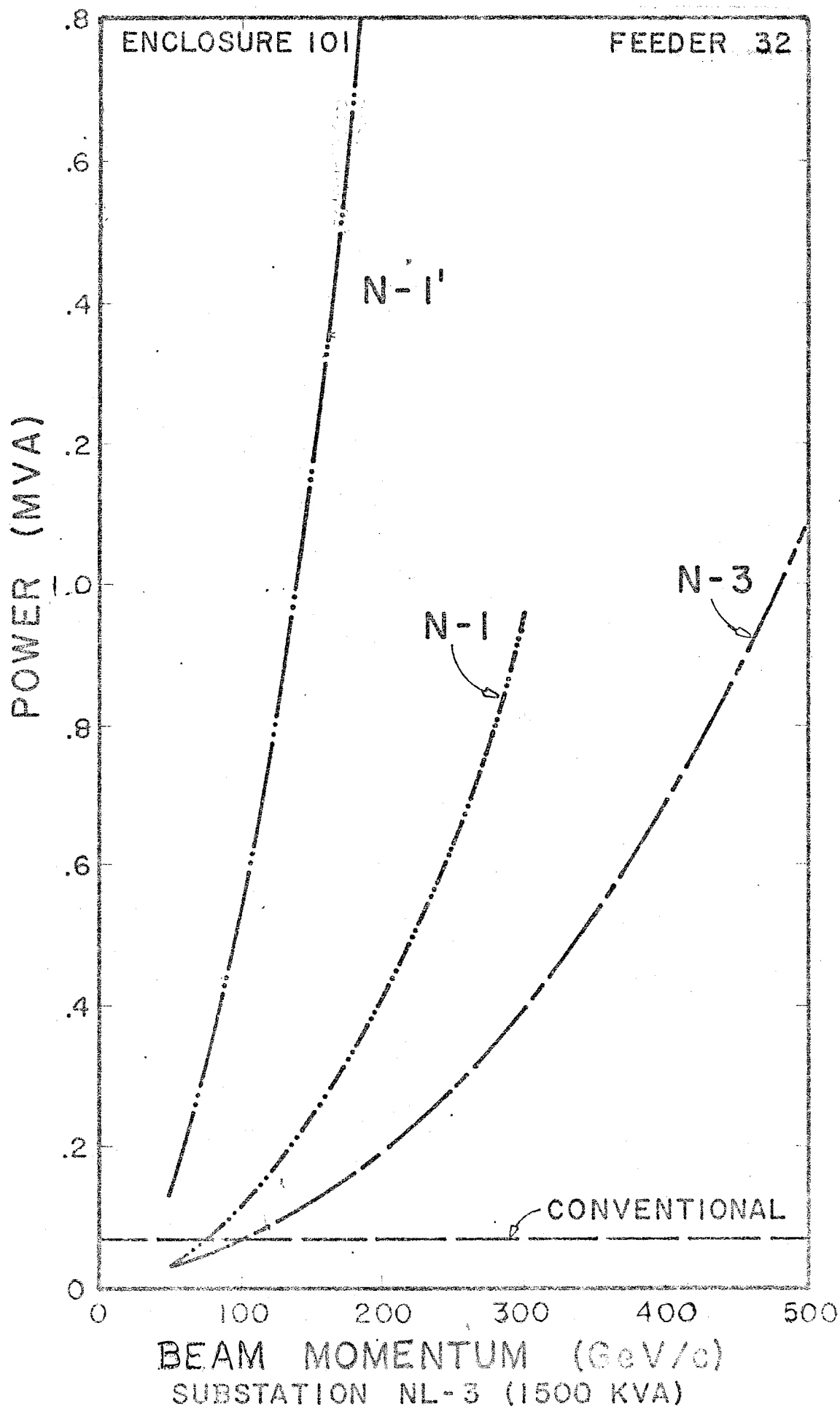


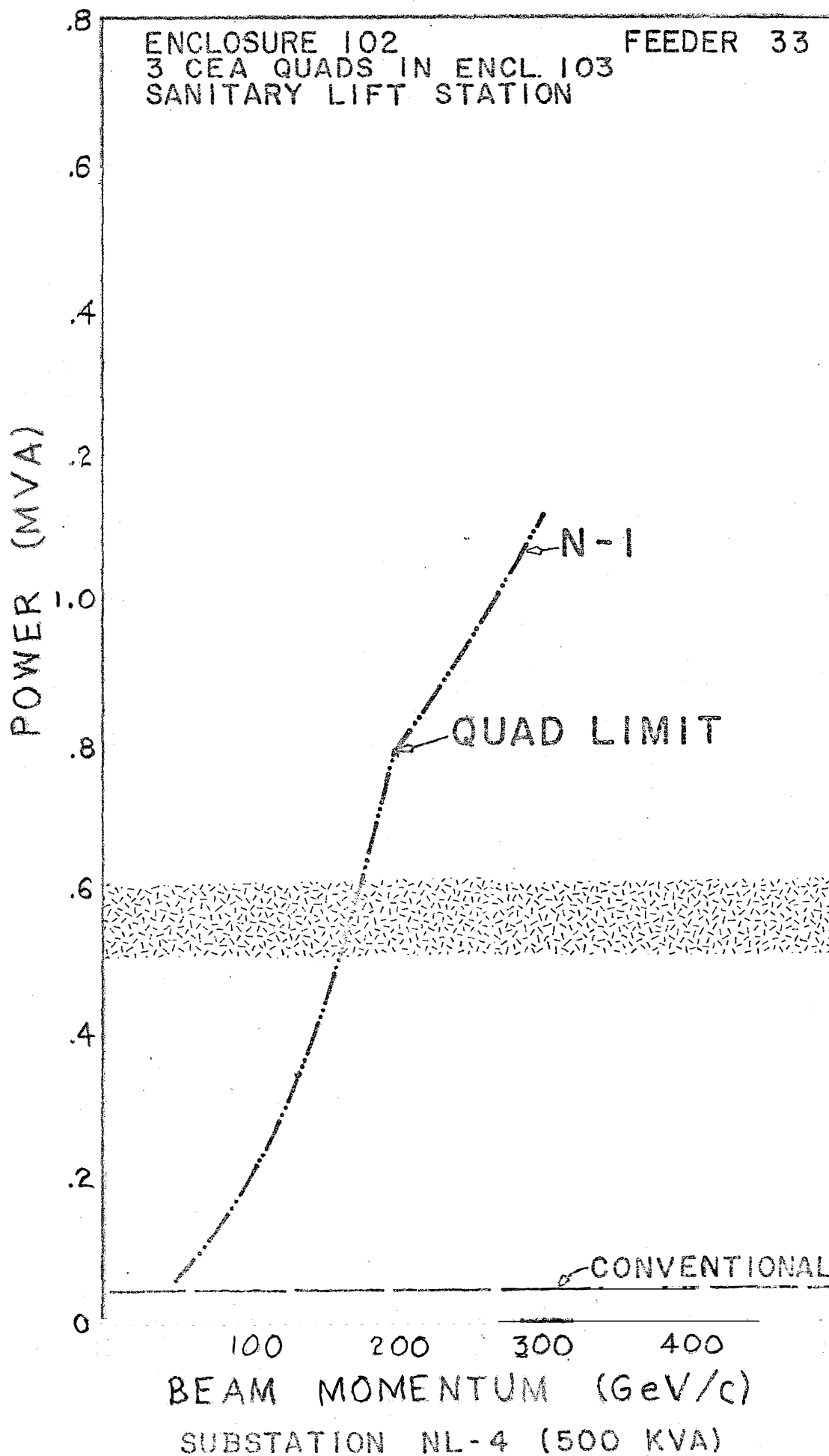
NEUTRINO LABORATORY 13.8 KV FEEDER AND SUBSTATIONS

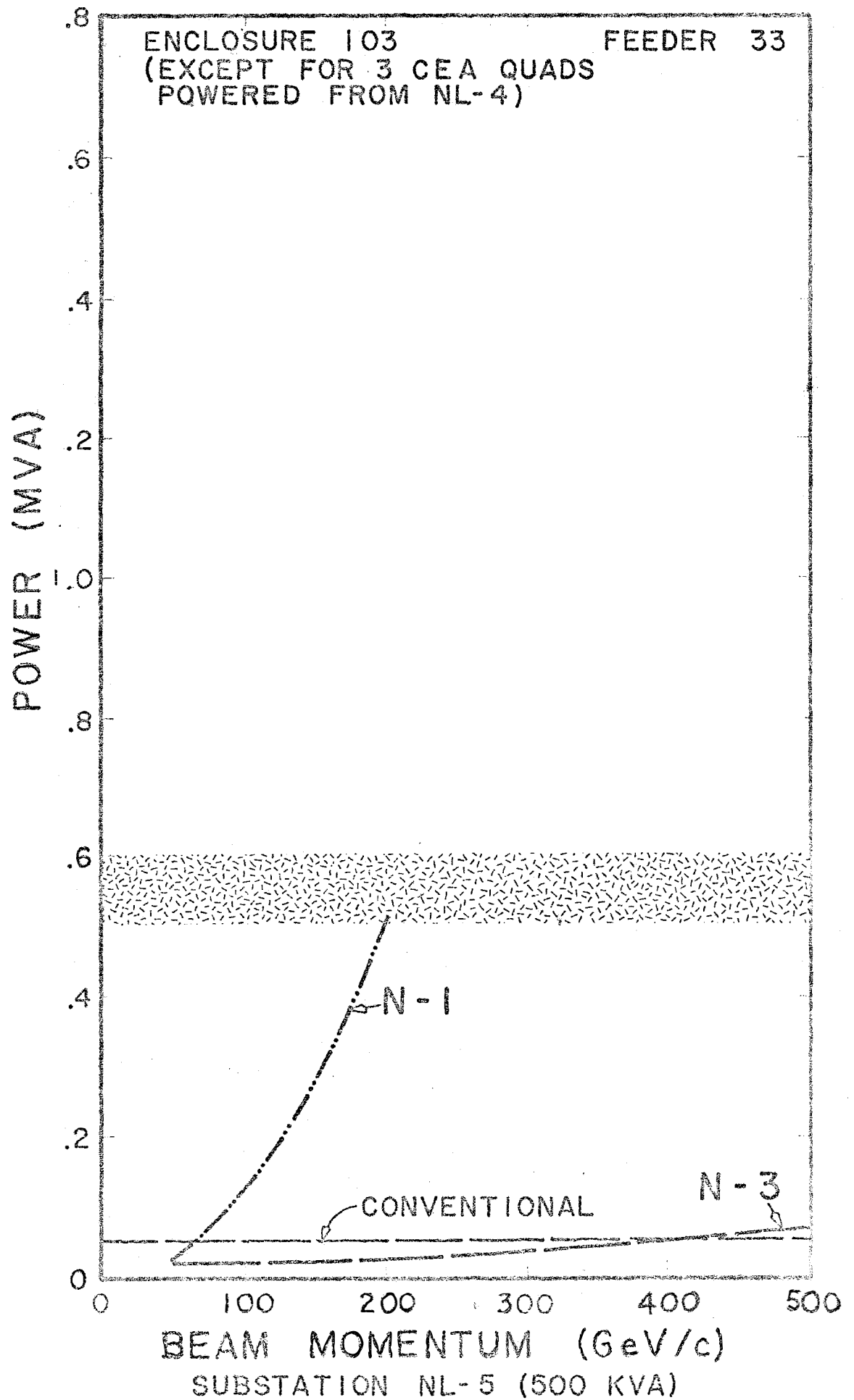
Figure 1



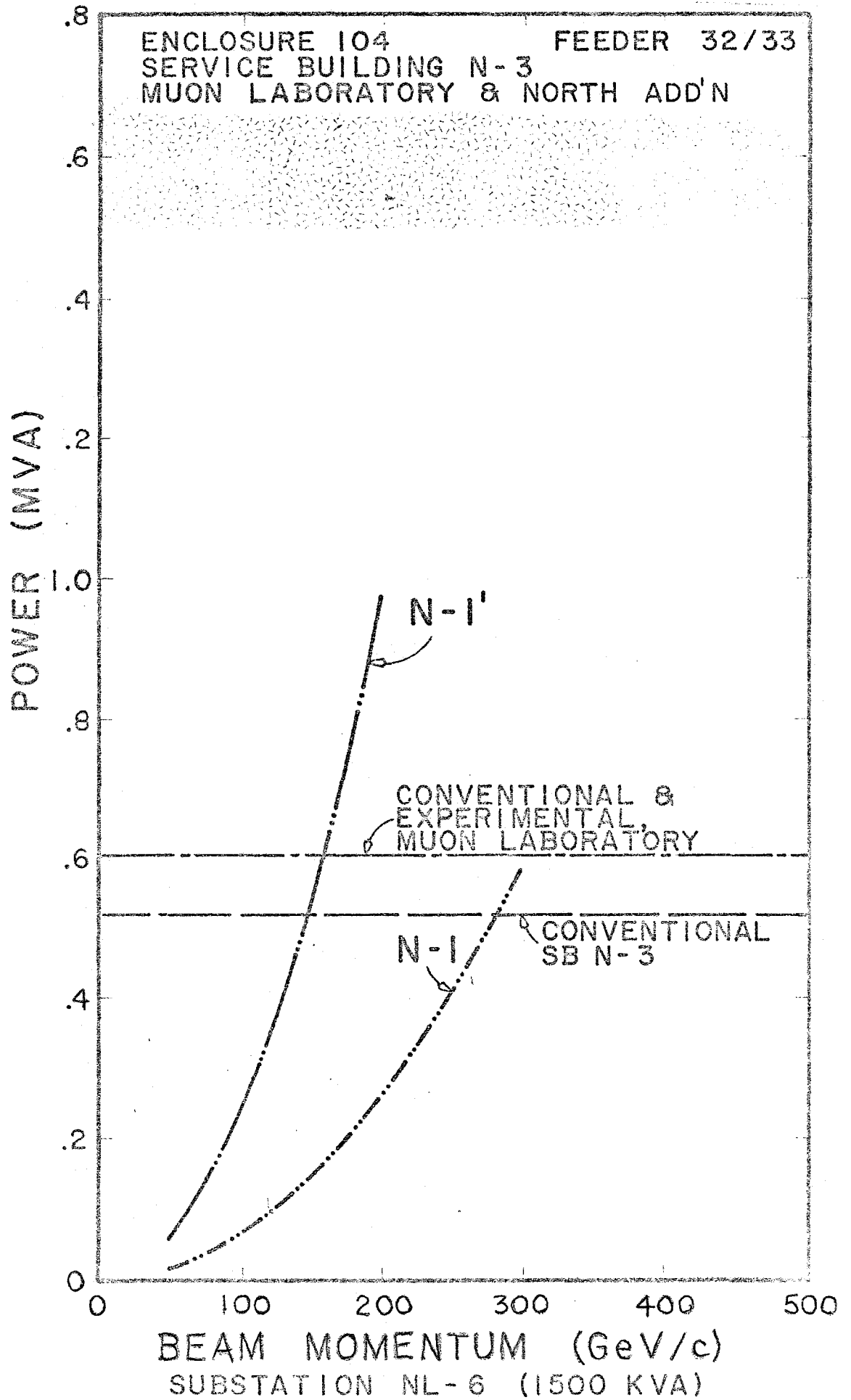


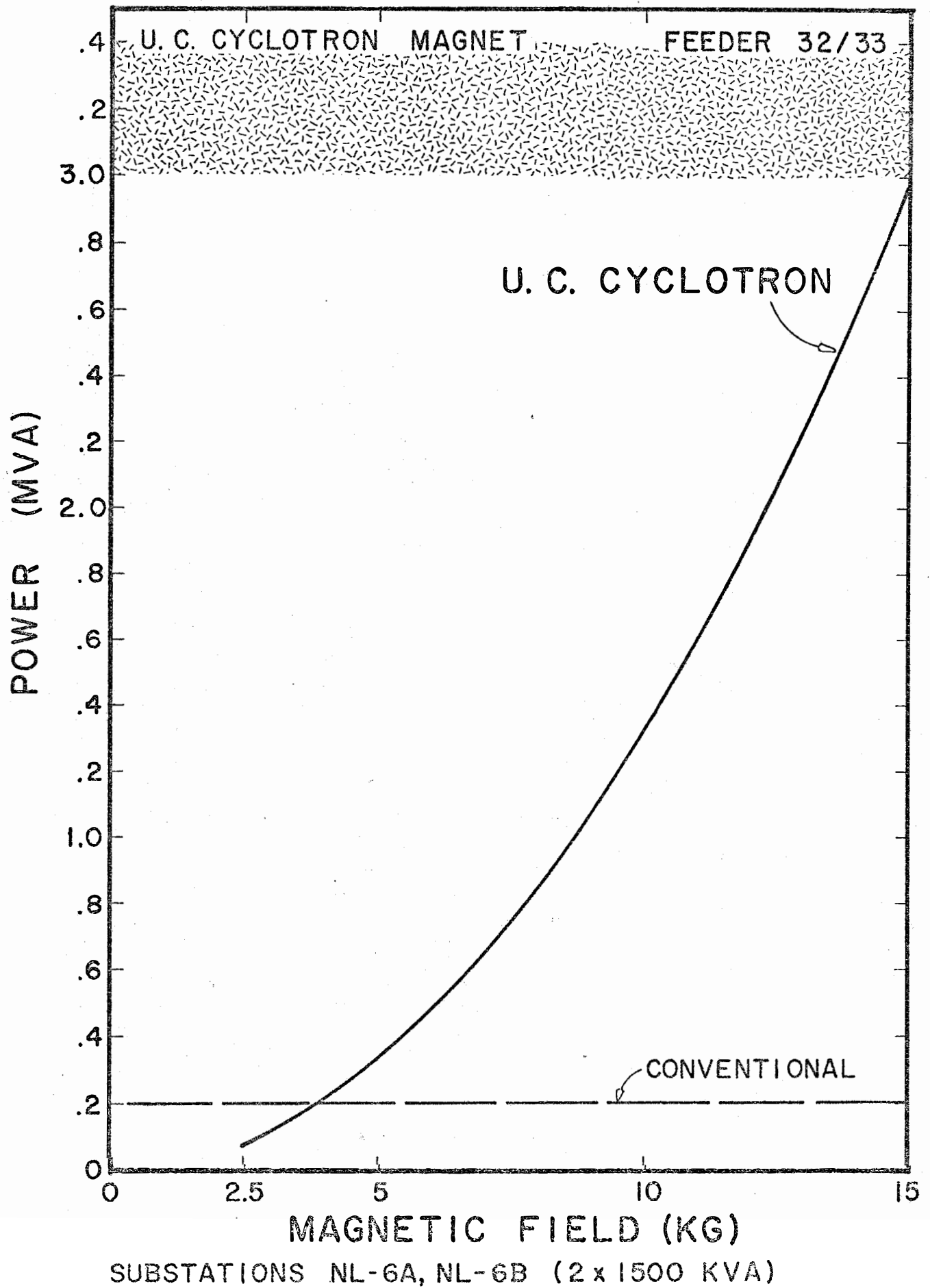


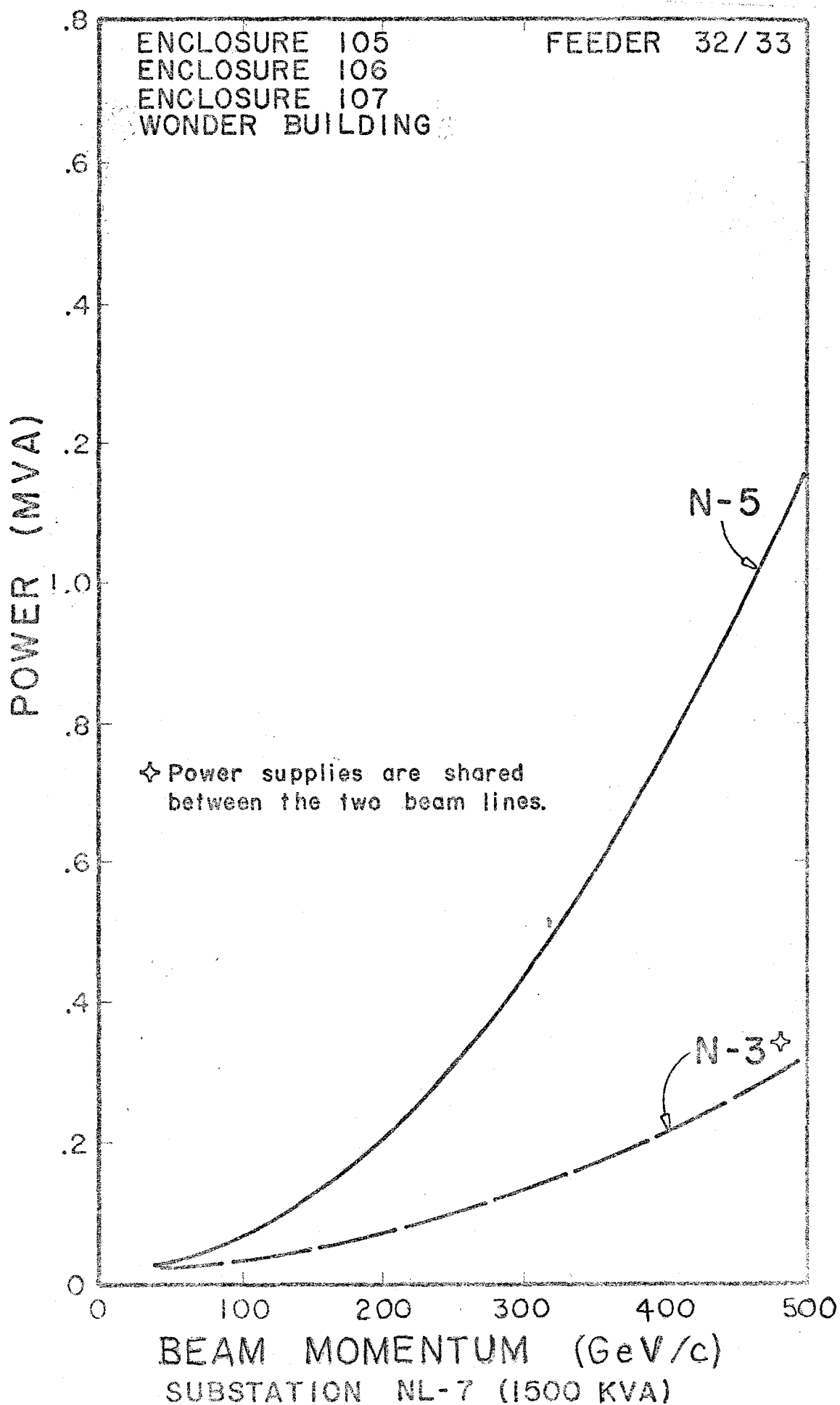


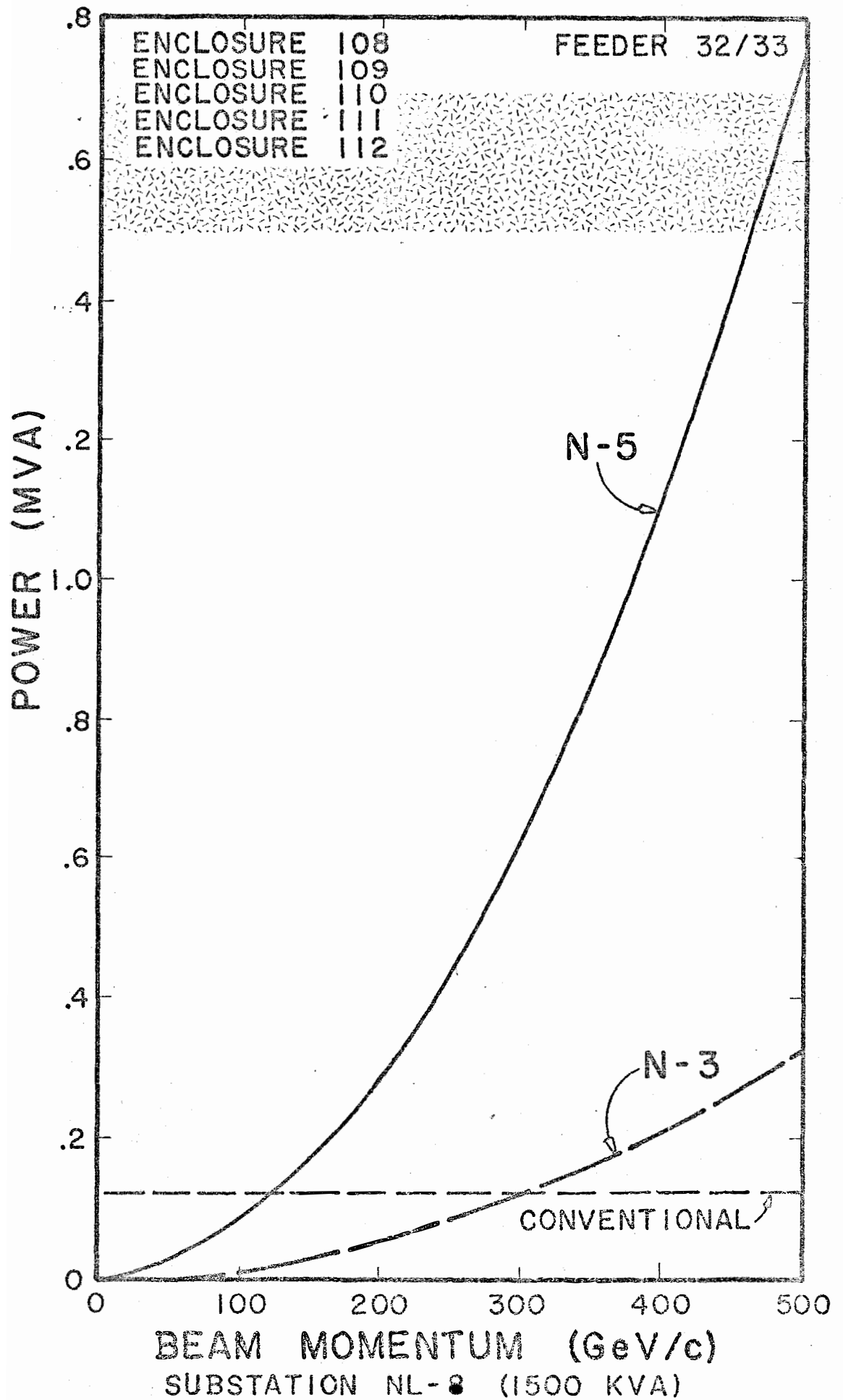


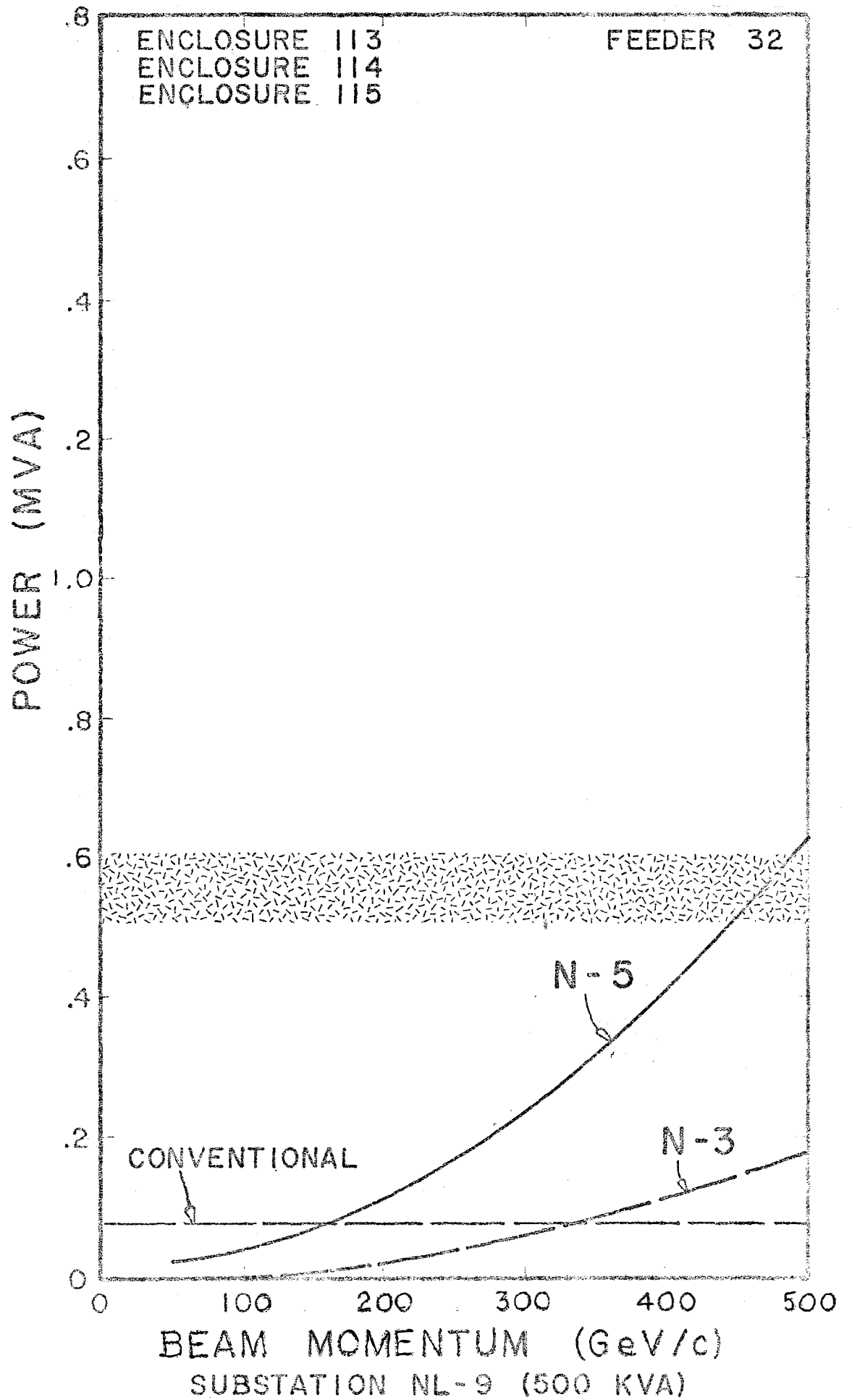


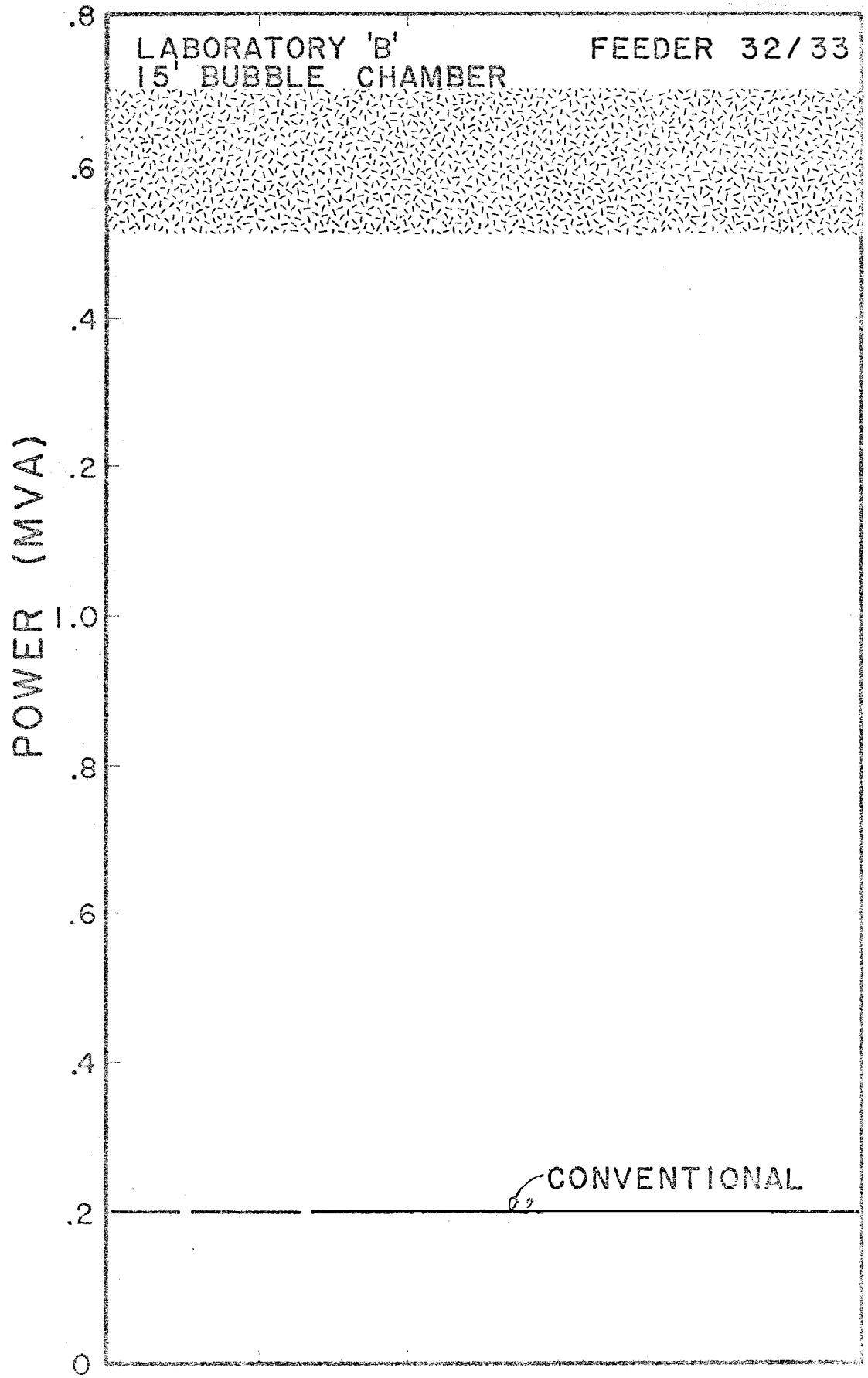




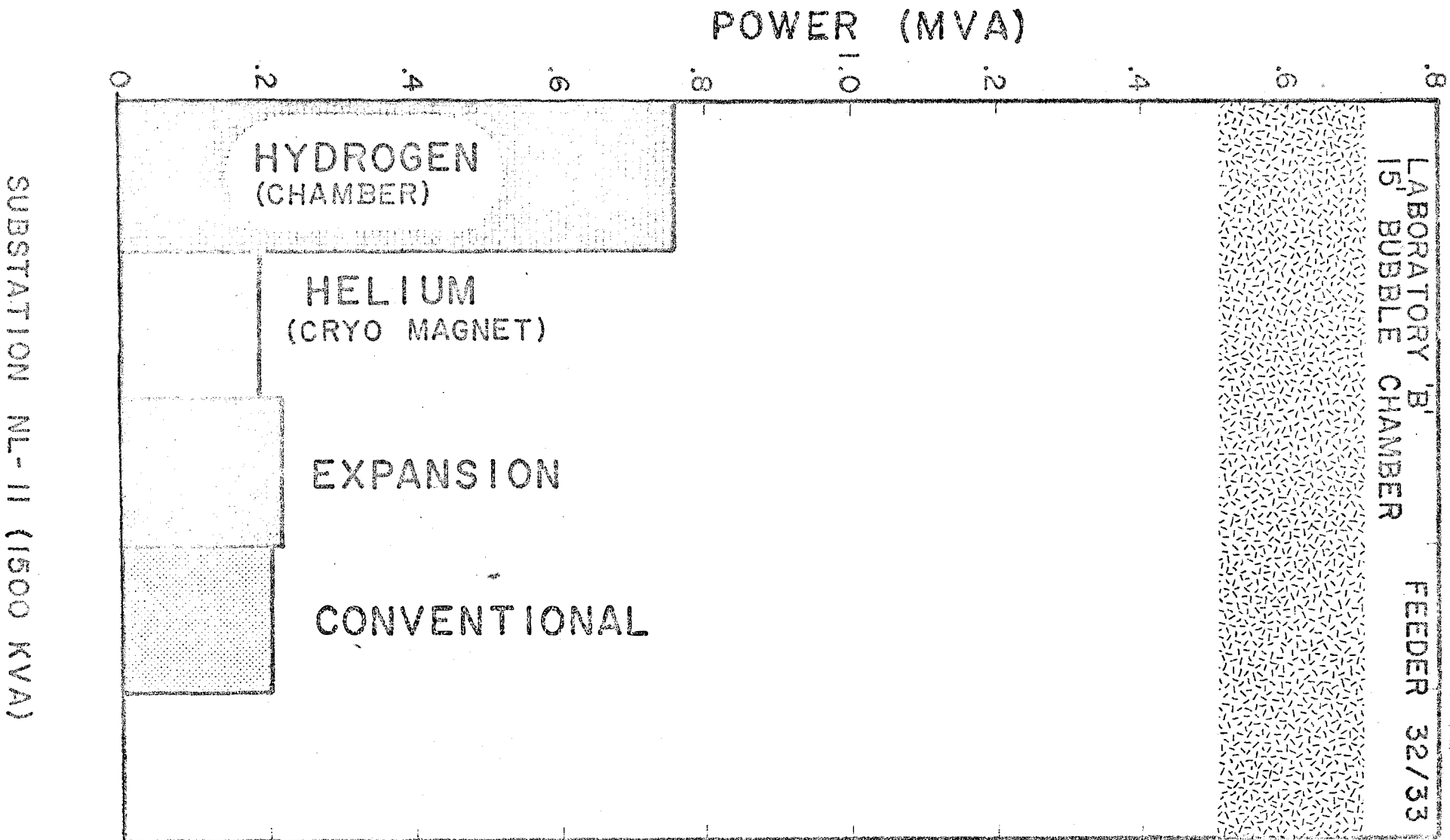


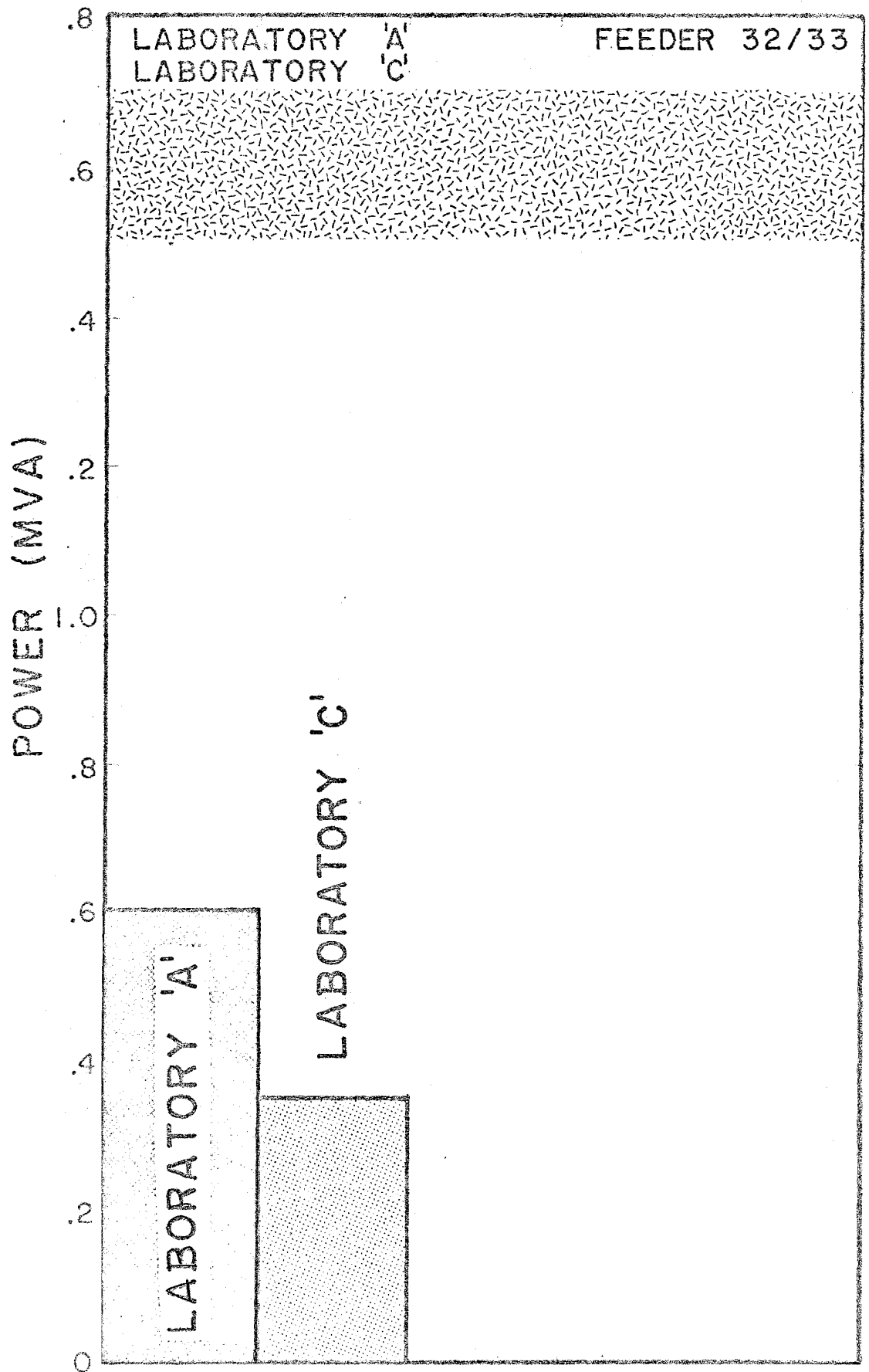






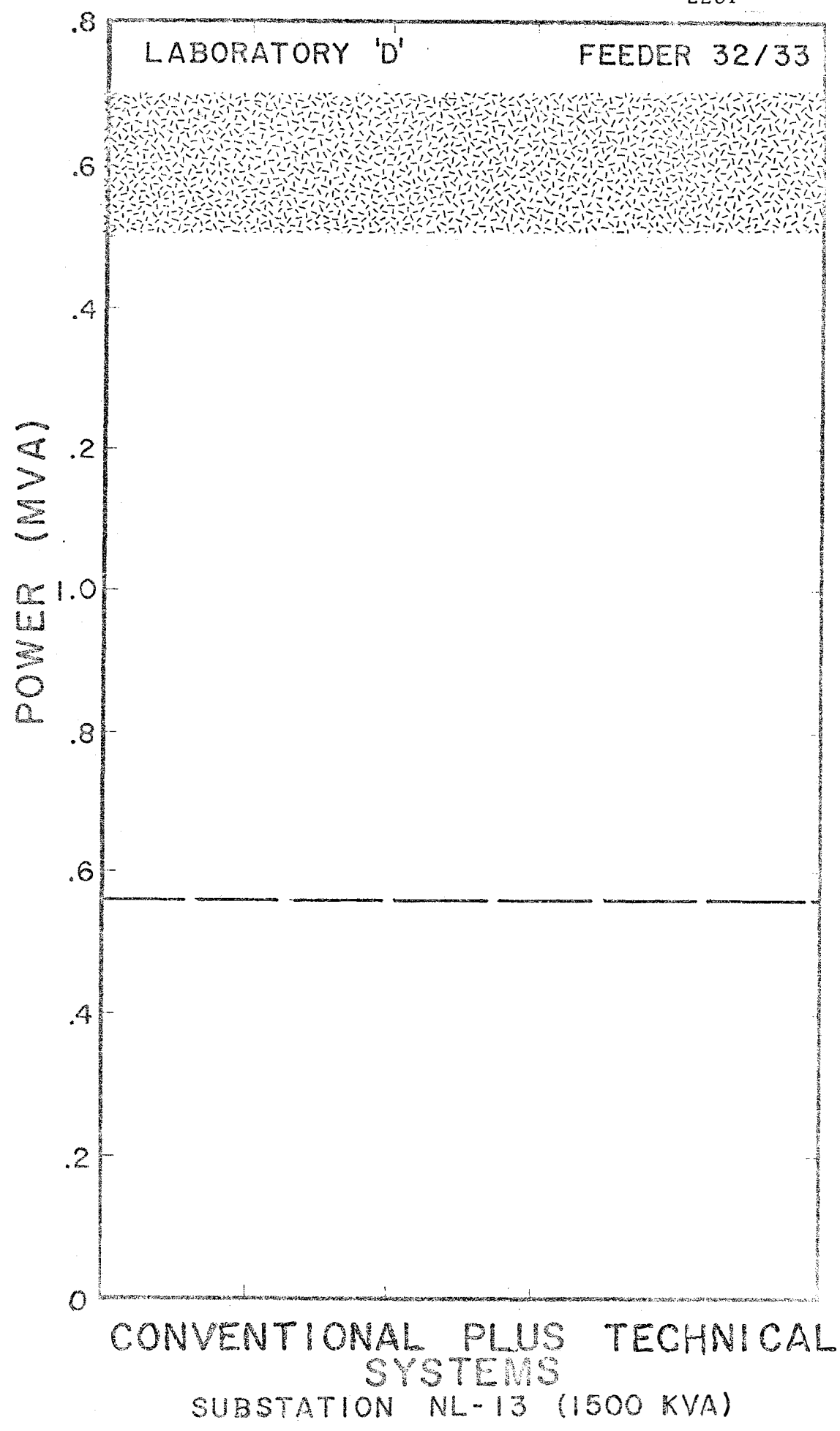
CONVENTIONAL SYSTEMS  
SUBSTATION NL-10 (1500 KVA)

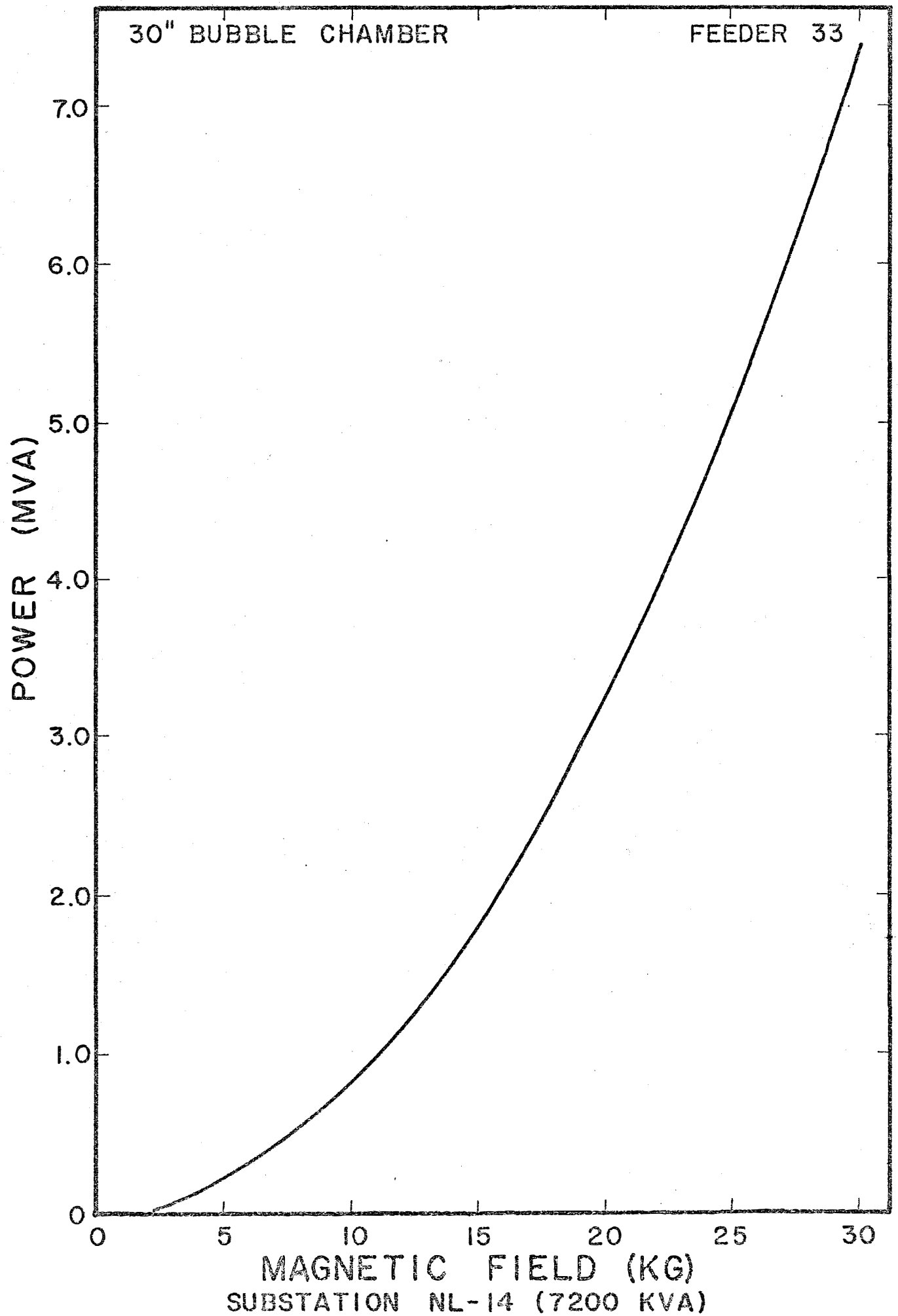




SUBSTATION NL-12 (1500 KVA)









### 13.8 kV FEEDERS AND LOAD DISTRIBUTION IN THE NEUTRINO AREA

T. E. Toohig

November 1973

The electrical power distribution from the Master Substation to the Neutrino Area consists at present of two 13.8 kV feeders, Feeder 32 and Feeder 33, running the length of the area. Appropriate unit substations at various locations as detailed in Fig. 1 convert the 13.8 kV to voltages required for equipment. Table I lists the capability for switching between feeders for this configuration. In early 1974 these will be supplemented by a third feeder, Feeder 35 providing the distribution shown in Fig. 2. The feeders are rated for 7.0 MVA each as installed in the power ducts and loads are balanced between the feeders accordingly.

The attached graphs, NL-1 to NL-14, illustrate operating loads on the various substations under different conditions of beam settings and facility operation. An efficiency of 0.75 was used for the power supplies, and a power factor of 0.8 was used over-all in calculating the graphs. These numbers are derived from early operating experience and will probably have to be refined with time.

The curves labelled N-0, N-1, etc. refer to the N-0, N-1, etc. beam lines as specified in the current beam line data sheets.

From the point of view of power, it is apparent that under certain conditions compromises in beam momentum and/or experimental equipment operating levels must be made if facilities are to be operated simultaneously.

TABLE I  
NEUTRINO AREA POWER DISTRIBUTION

1. Non-Switchable Power

1.1 Feeder 32

NL-1: SB-N1, G-2, G-3, NeuHall, Sanitary Lift Station

NL-3: 101

NL-9: 113, 114, 115

1.2 Feeder 33

NL-4: 102, 103

NL-5: 103

NL-8: 108, 109, 110, 111, 112

NL-14: 30-inch bubble chamber

2. Switchable Power

NL-2: SB-N2, 100

NL-6: SB-N3, 104, Muon Lab

NL-6A: U.C.Cyclotron, Muon Lab

NL-6B:

NL-7: 105, 106, 107, Wonder Bldg

\* † NL-10:

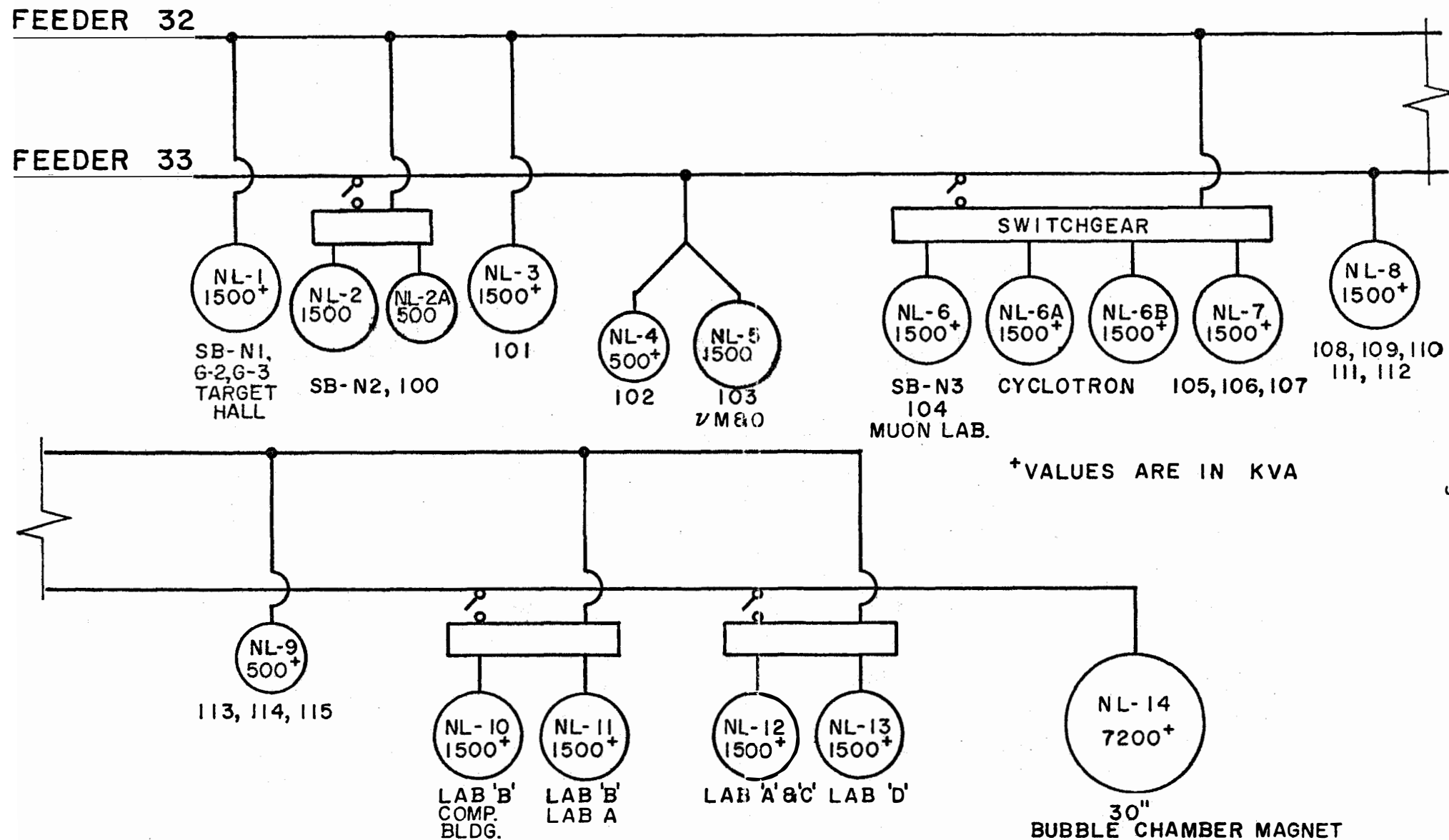
\* † NL-11: Lab "B"

\* † NL-12: Lab "A" and "C", Casey's Pond Pumping Station

\* † NL-13: Lab "D"

\*Coupled to emergency power system

†Critical if 15-foot is cooling down



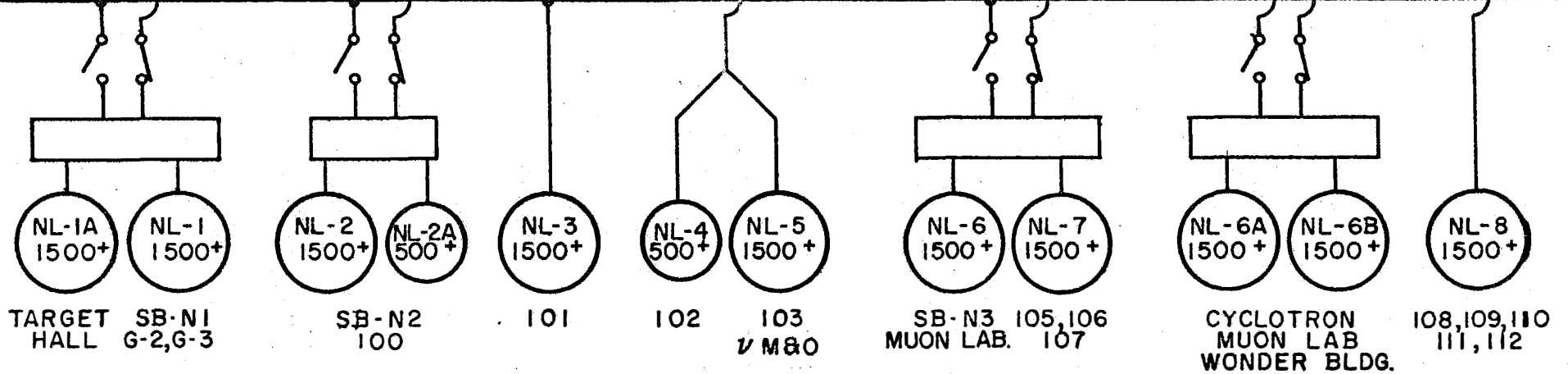
NEUTRINO LABORATORY 13.8 KV FEEDER AND SUBSTATIONS

Figure 1

FEEDER 35

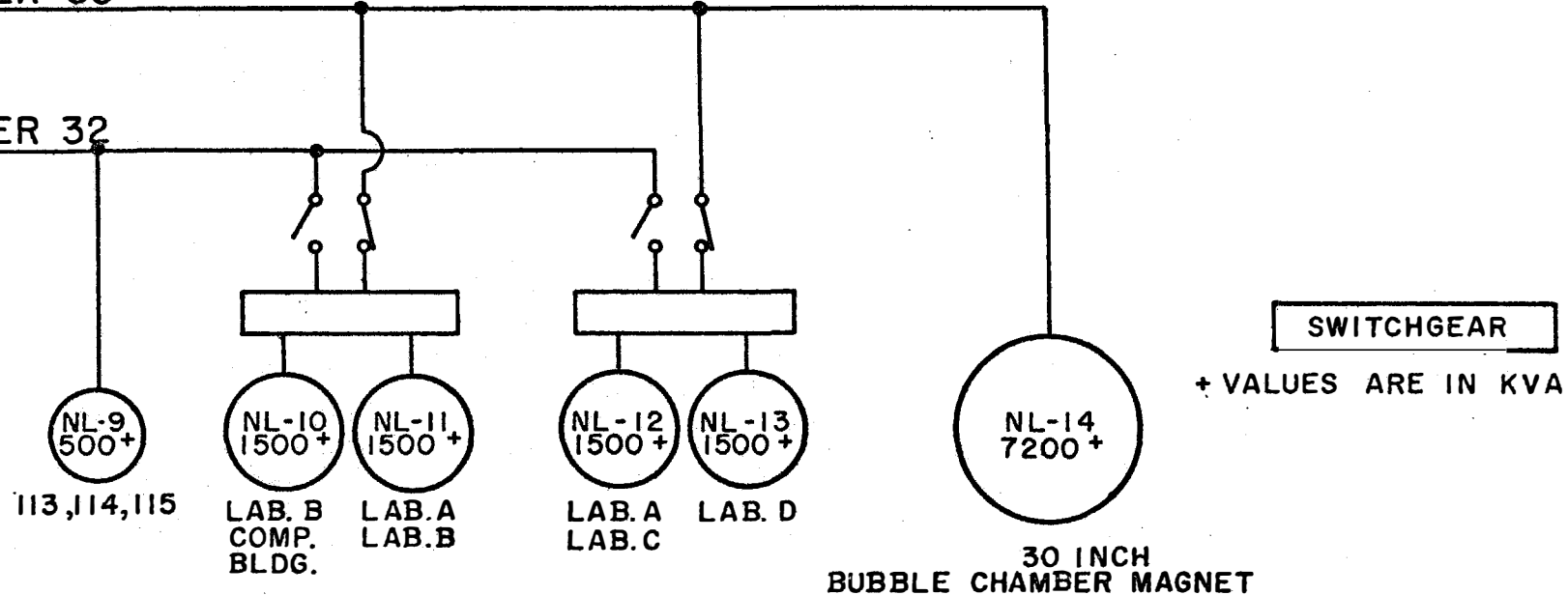
FEEDER 33

FEEDER 32



FEEDER 35

FEEDER 32

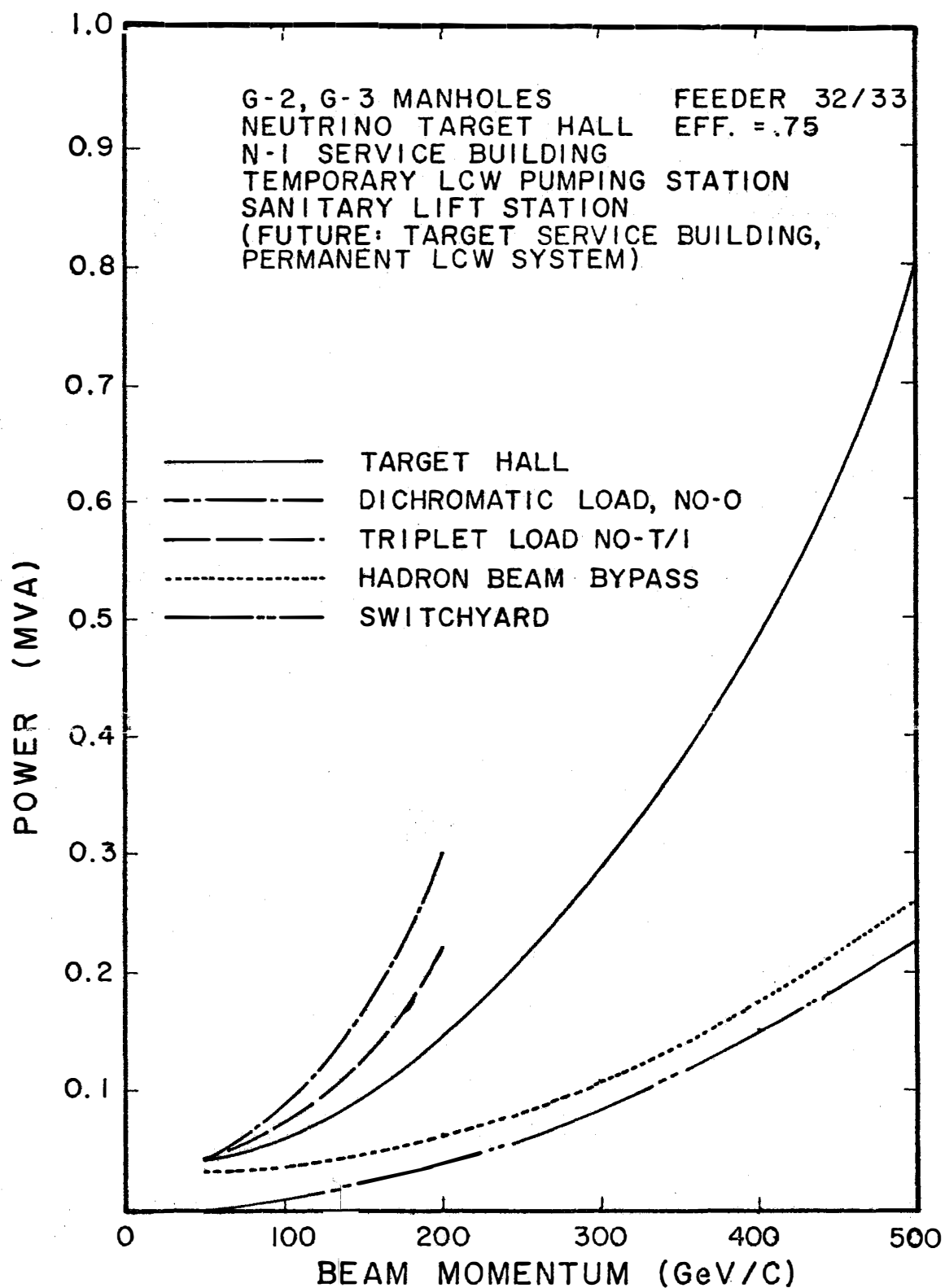


SWITCHGEAR

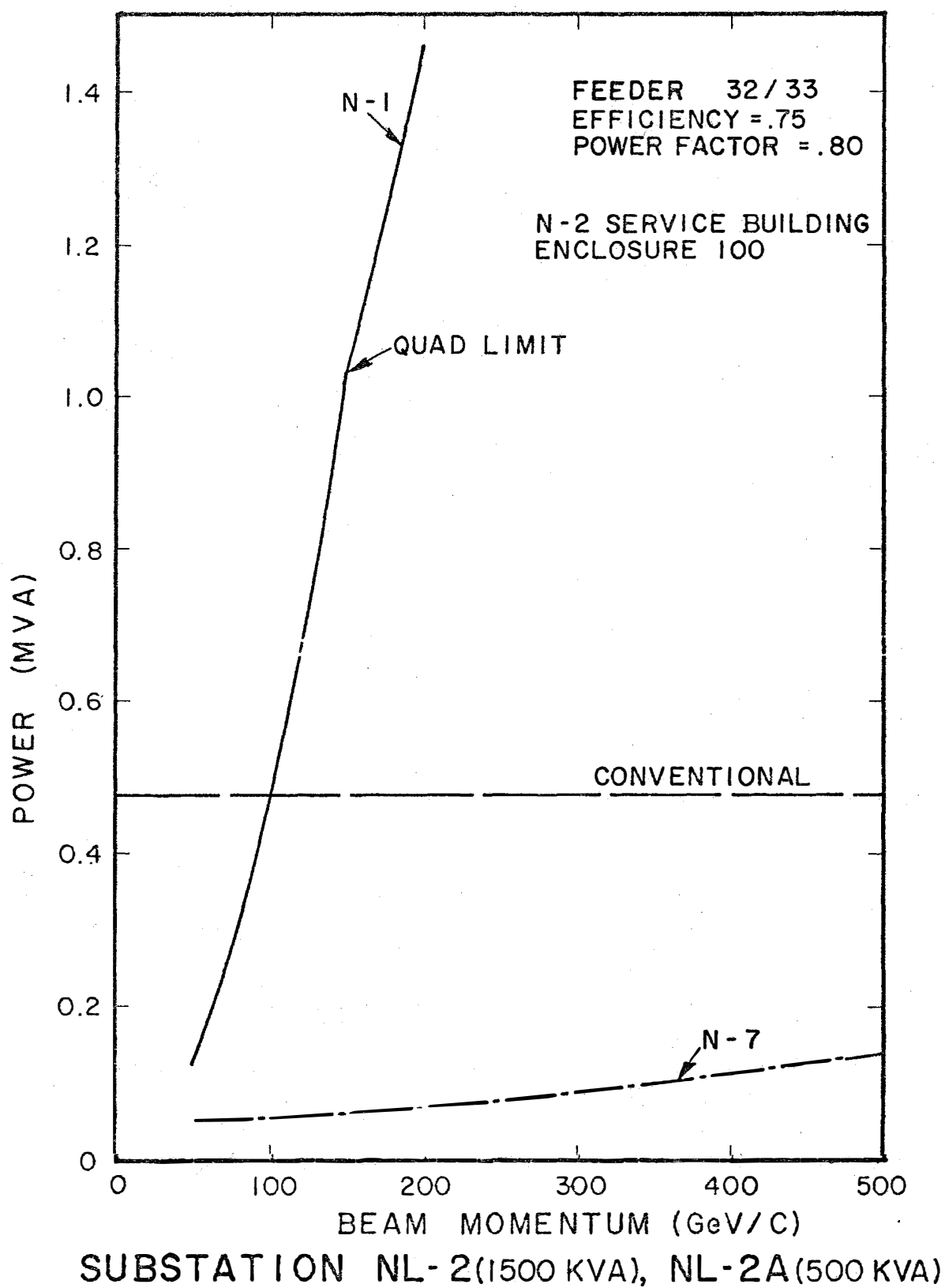
+ VALUES ARE IN KVA

# NEUTRINO LABORATORY 13.8 KV FEEDERS AND SUBSTATIONS

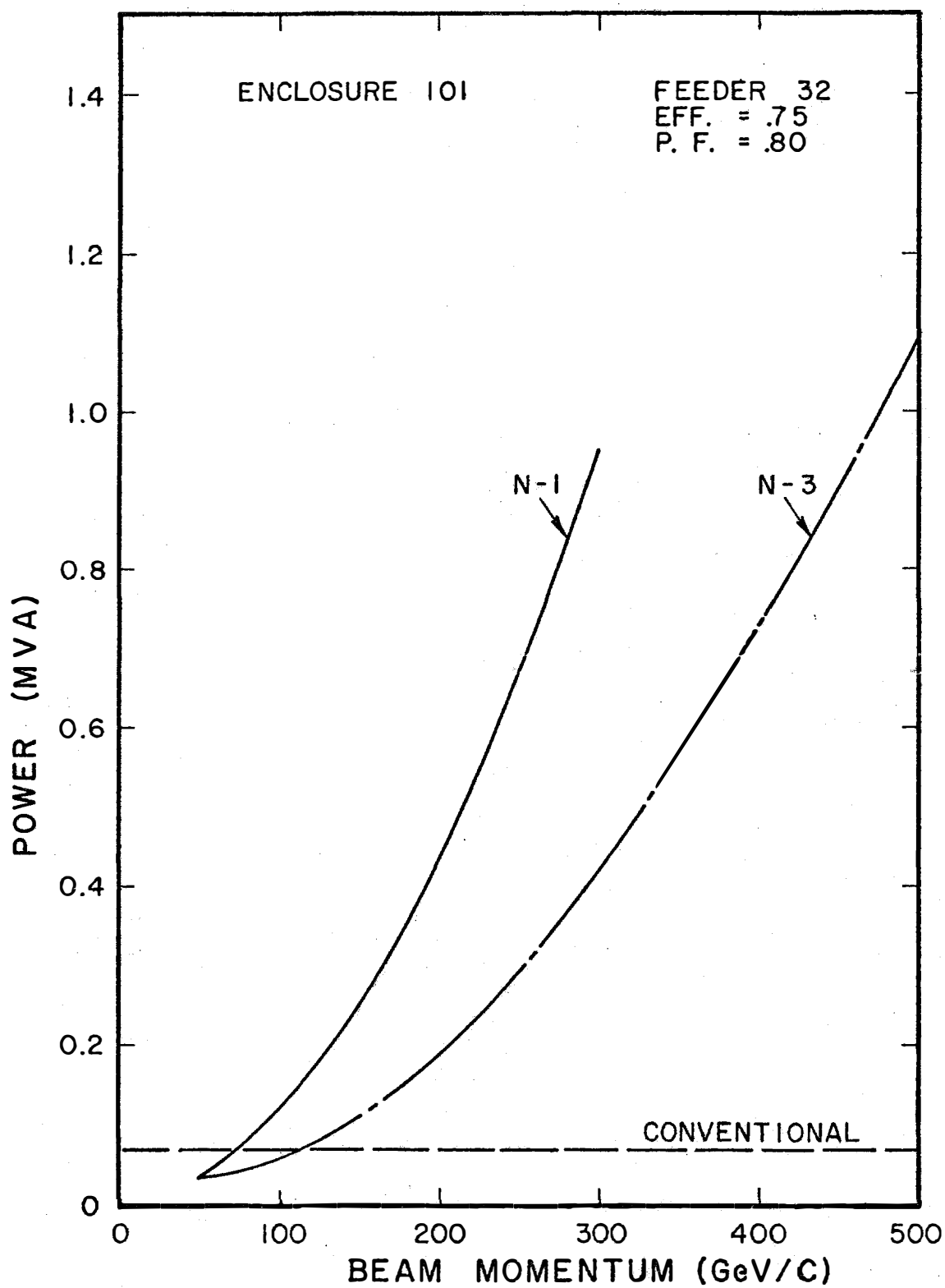
Figure 2



SUBSTATION NL-1 (1500 KVA), NL-1A (1500 KVA)

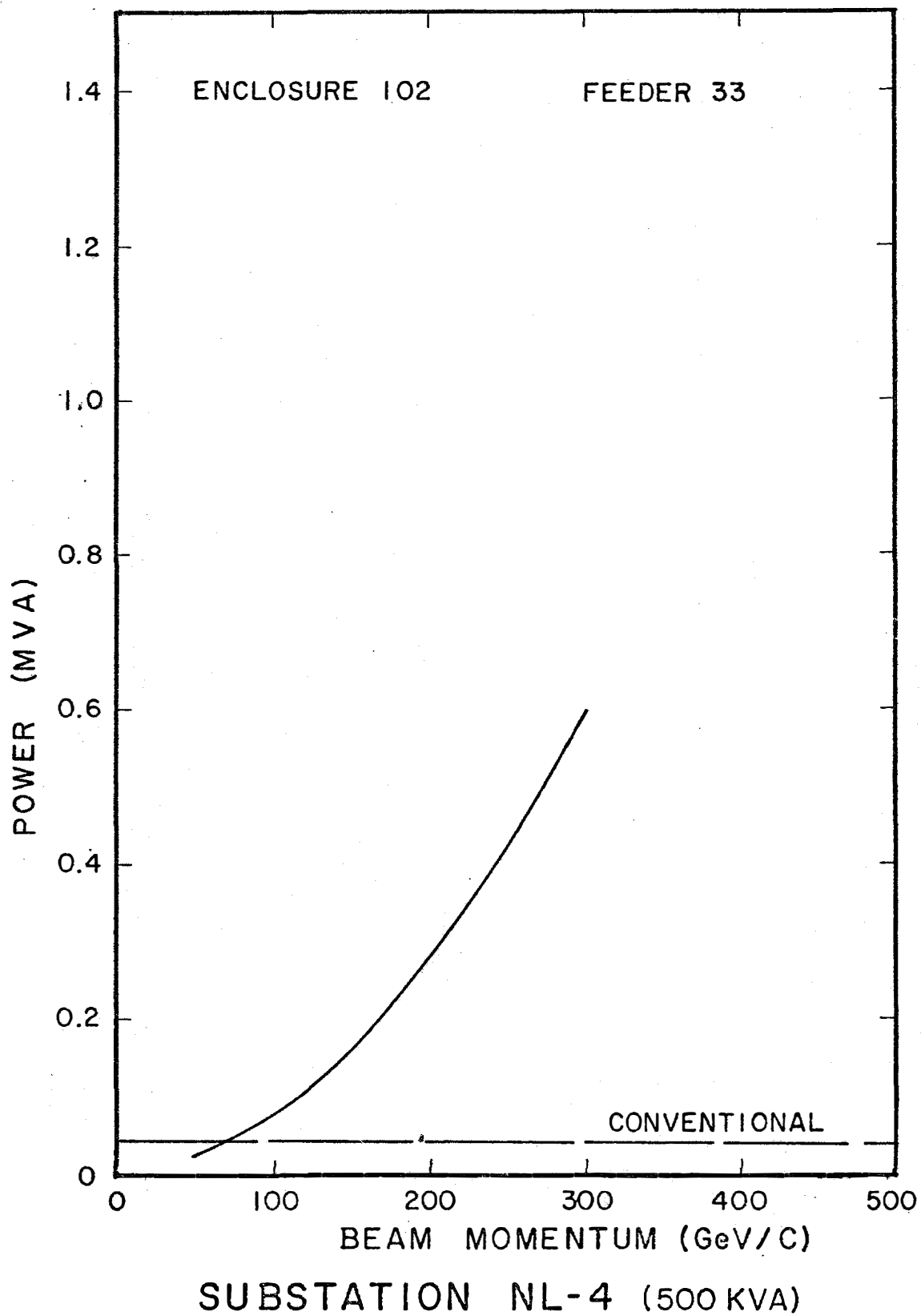


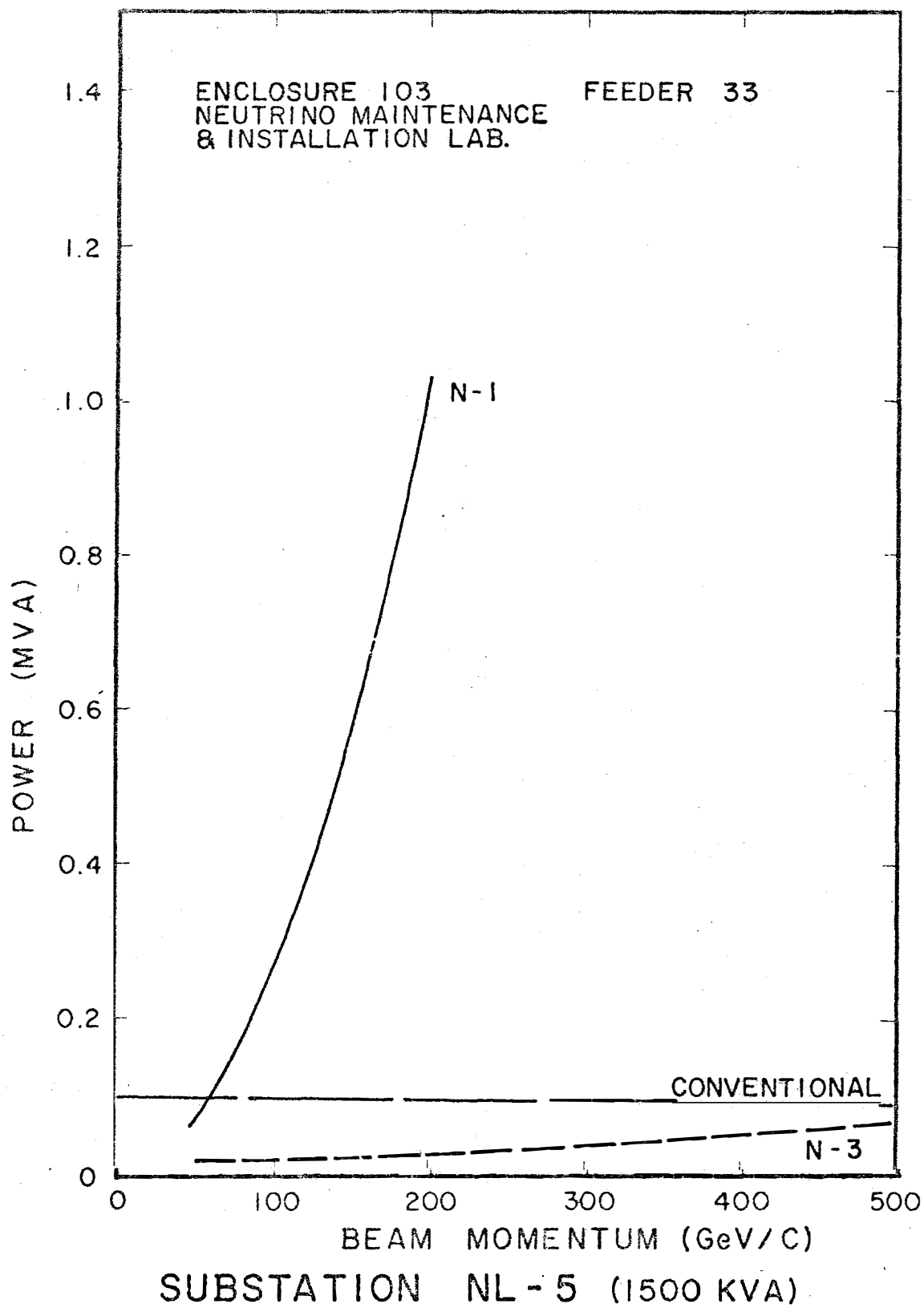


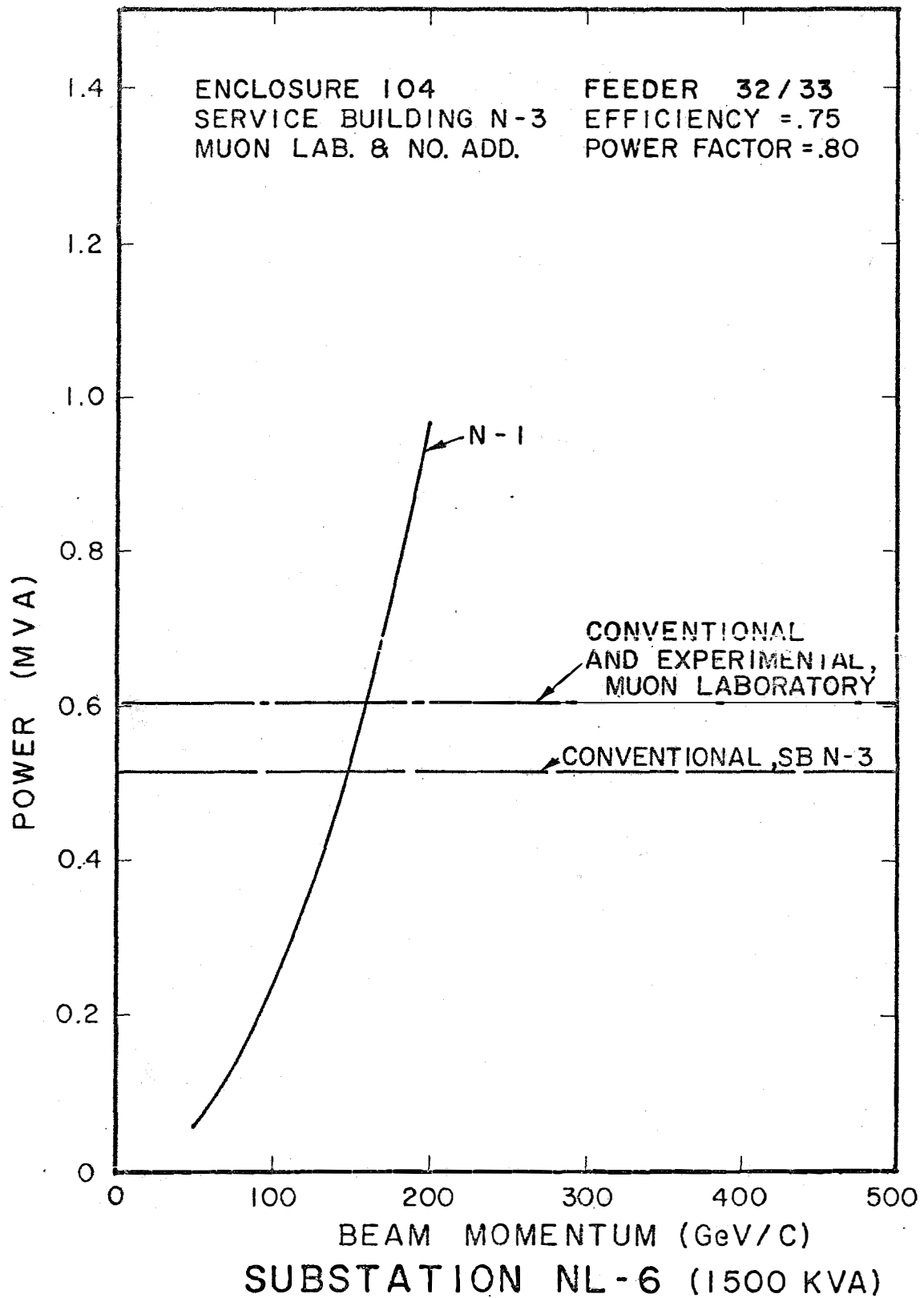


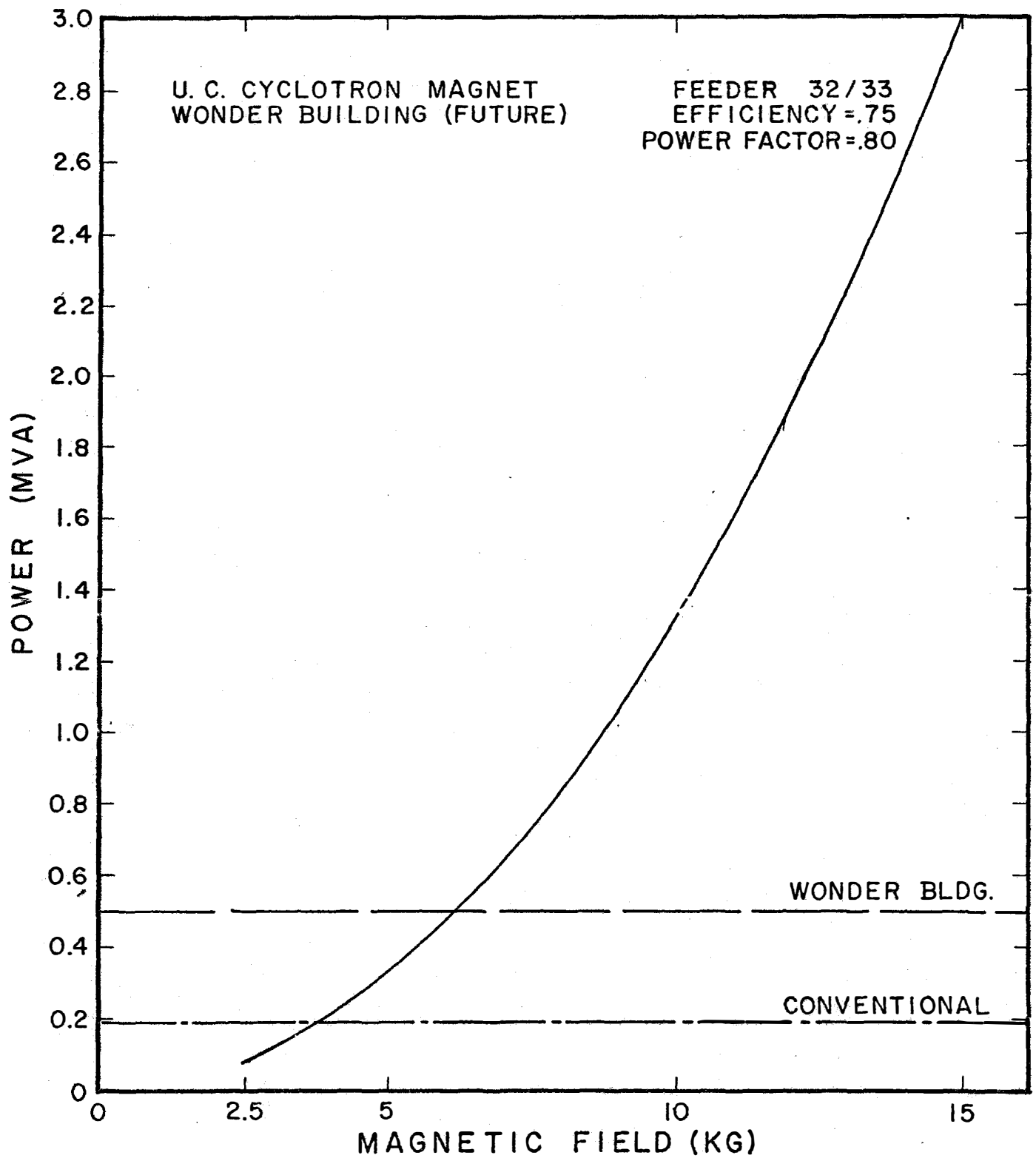
SUBSTATION NL-3 (1500 KVA)

-8-

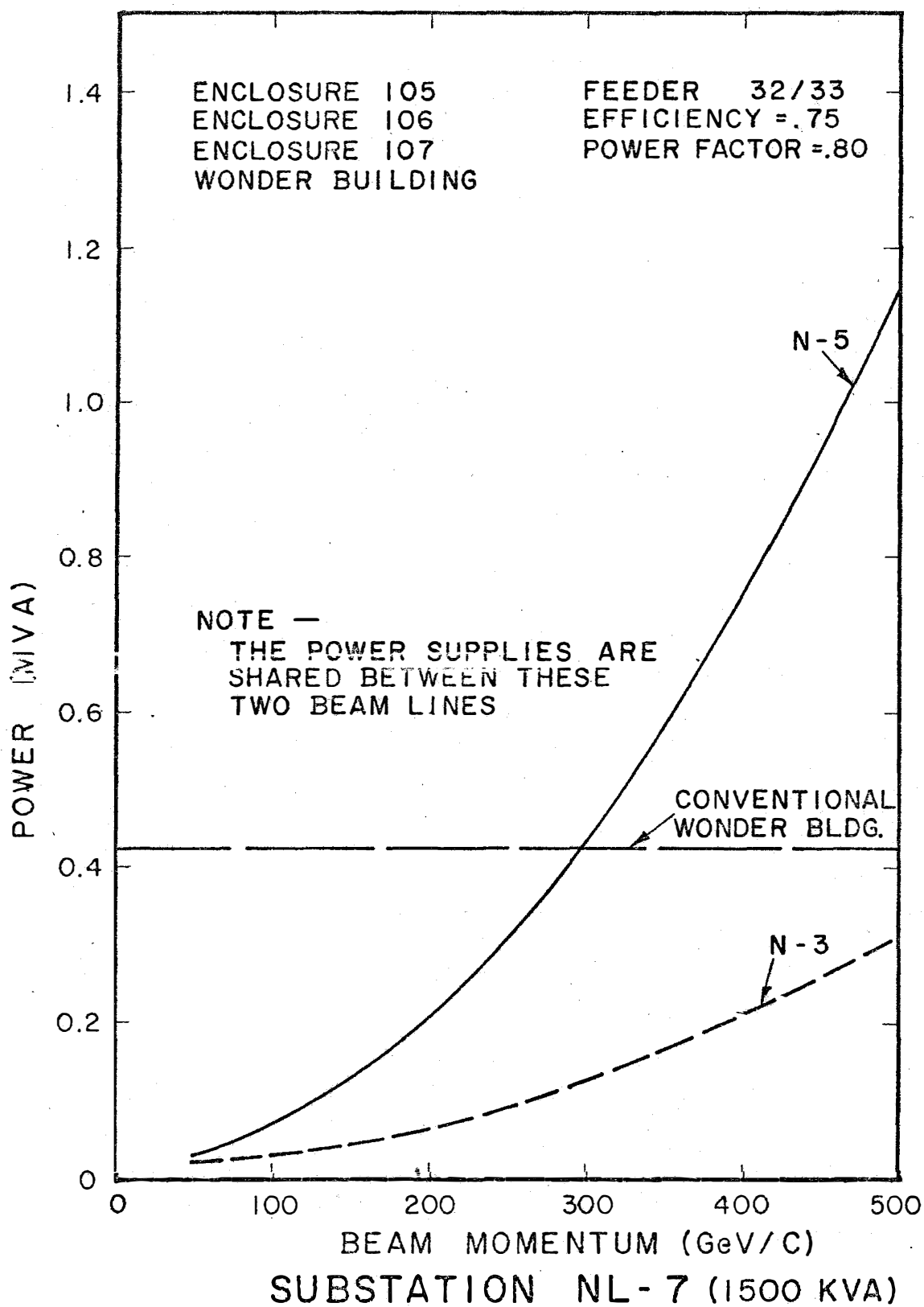


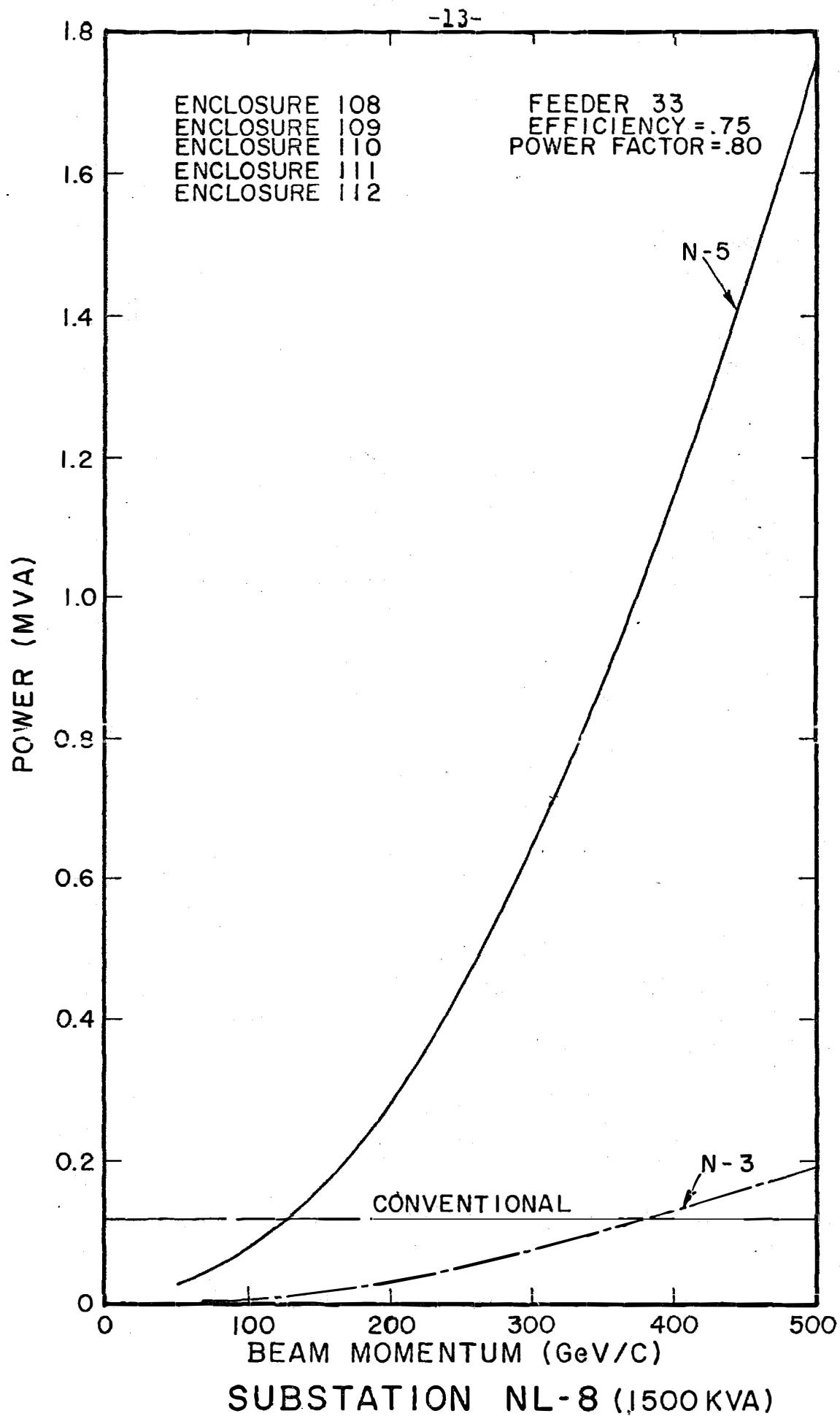




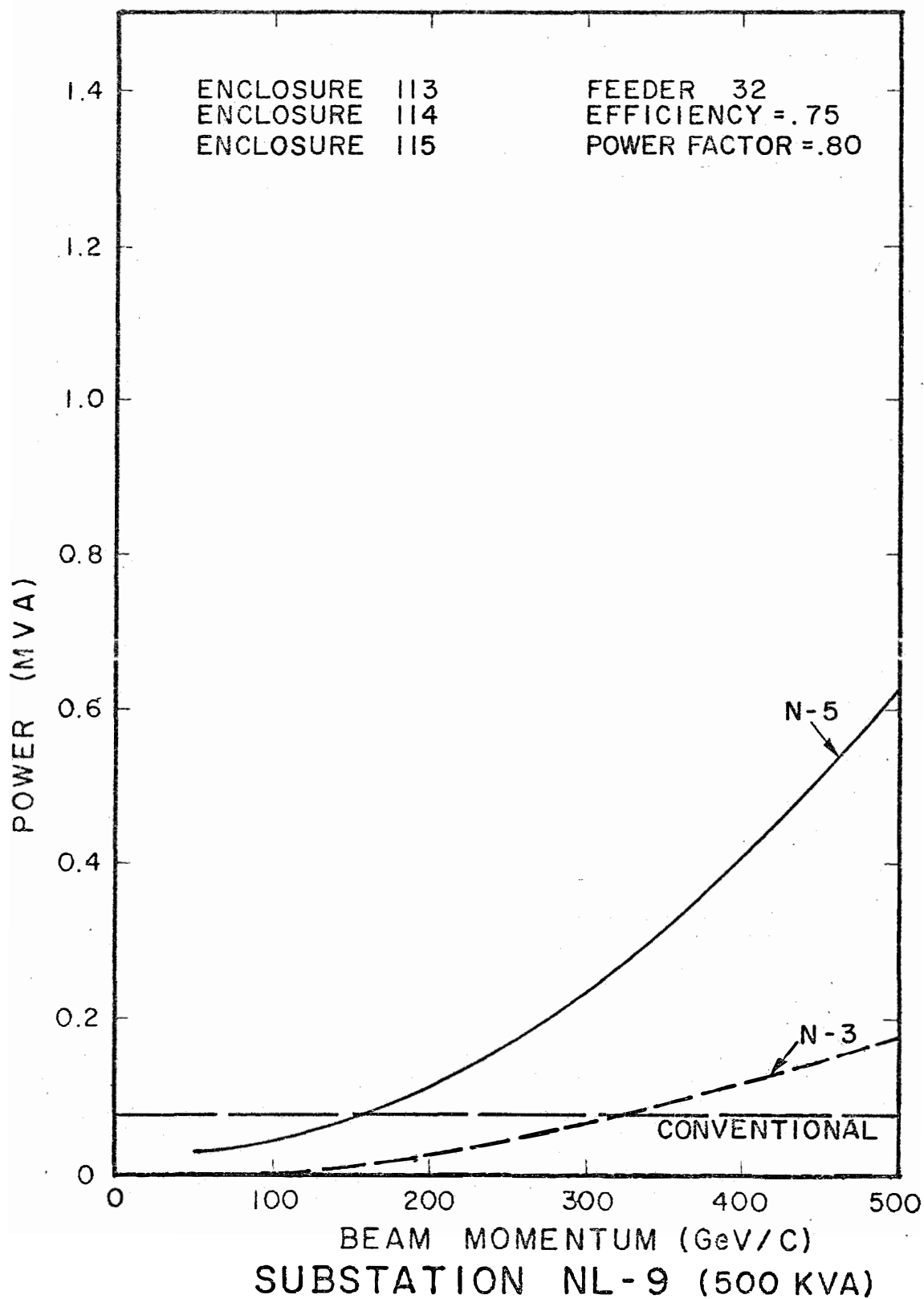


SUBSTATIONS NL-6A(1500 KVA), NL-6B(1500 KVA)

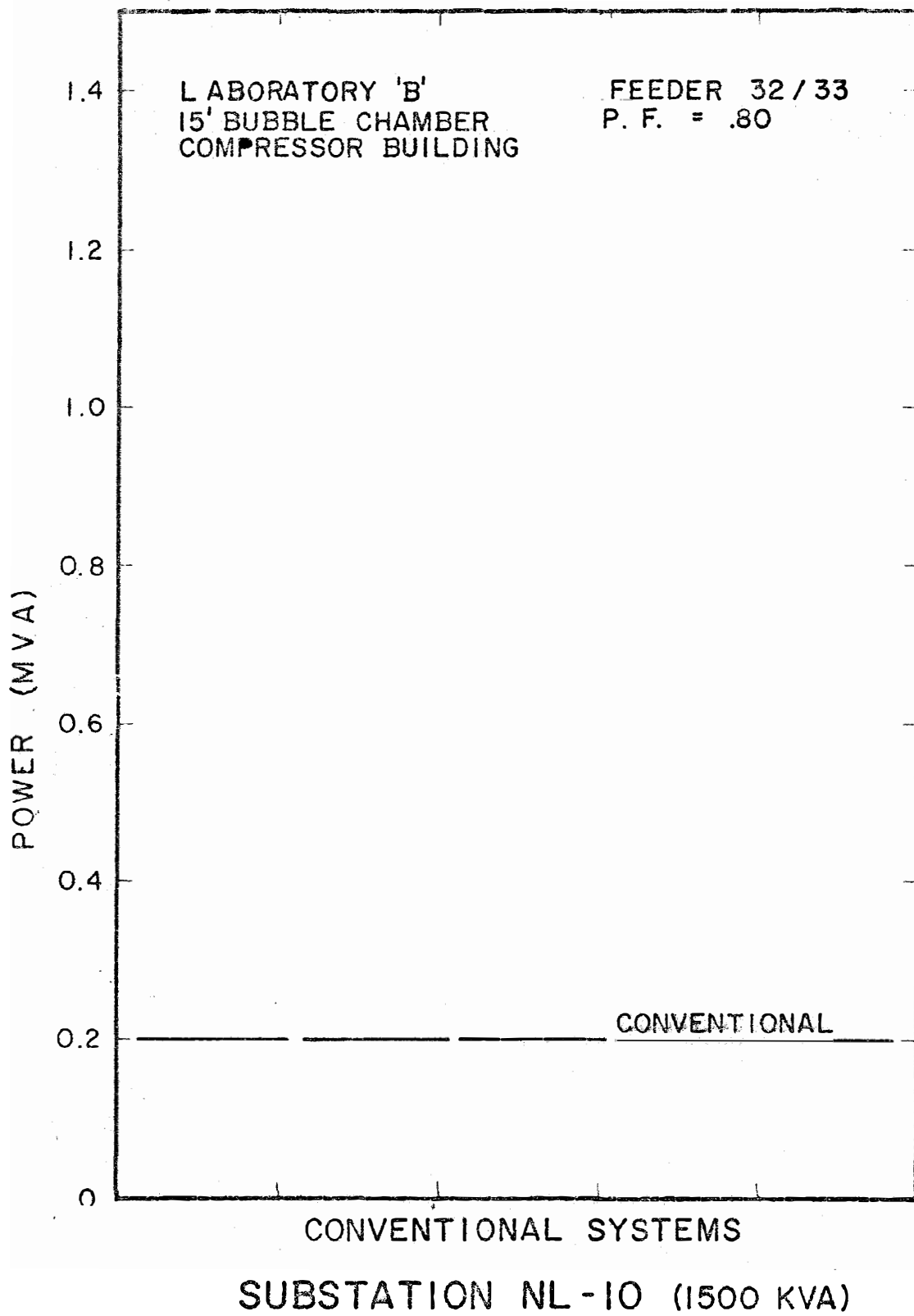


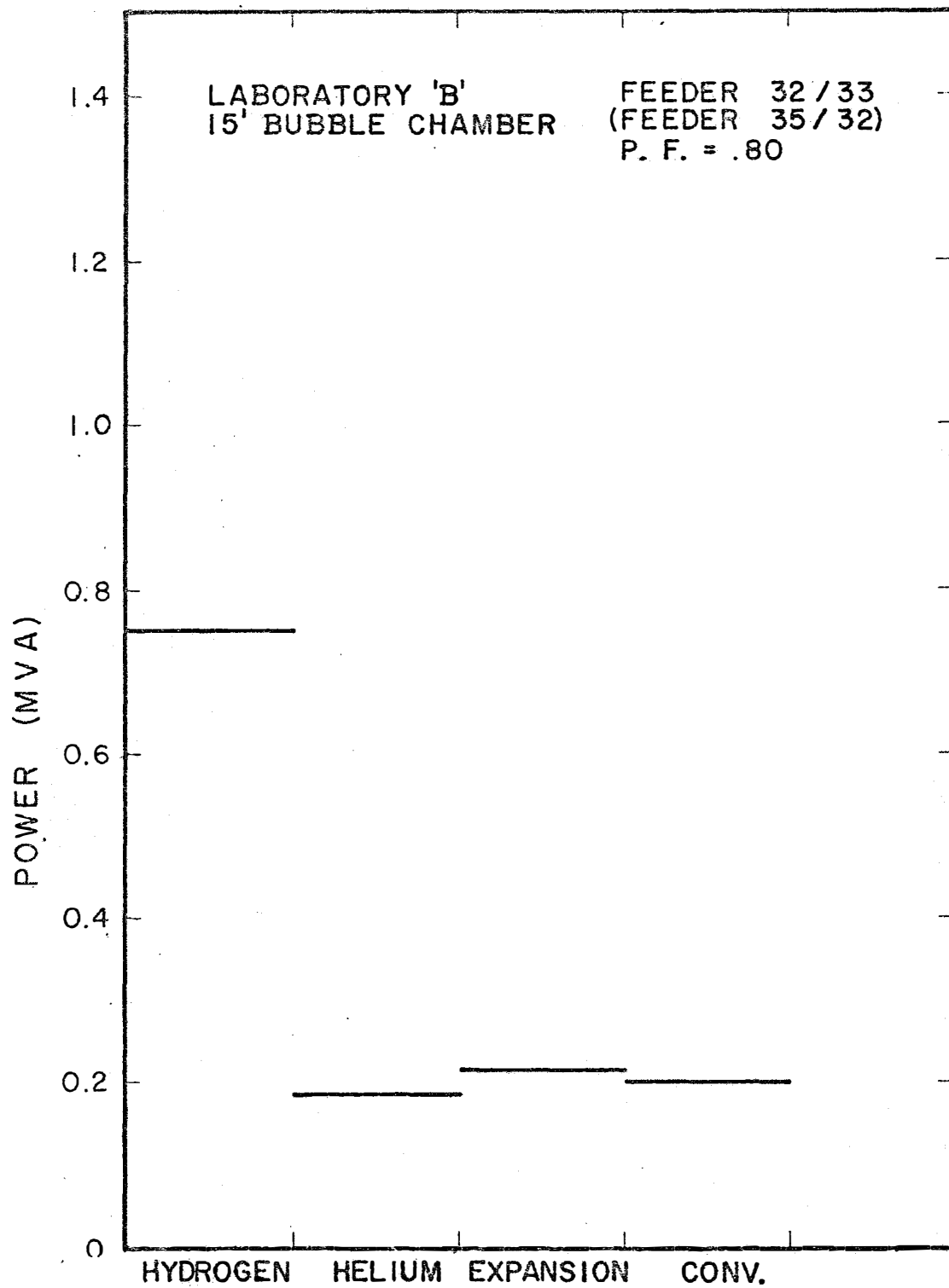


-14-

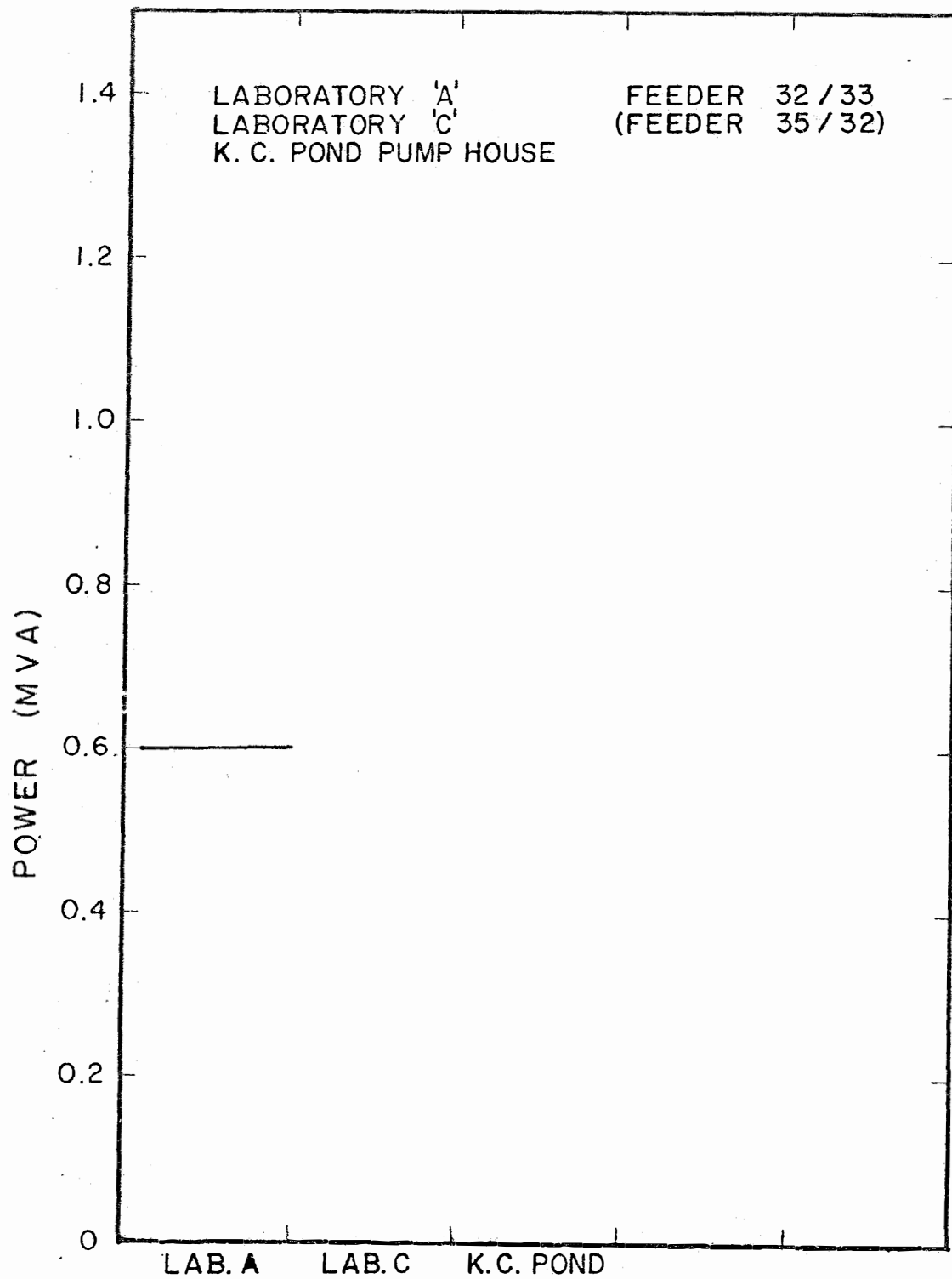




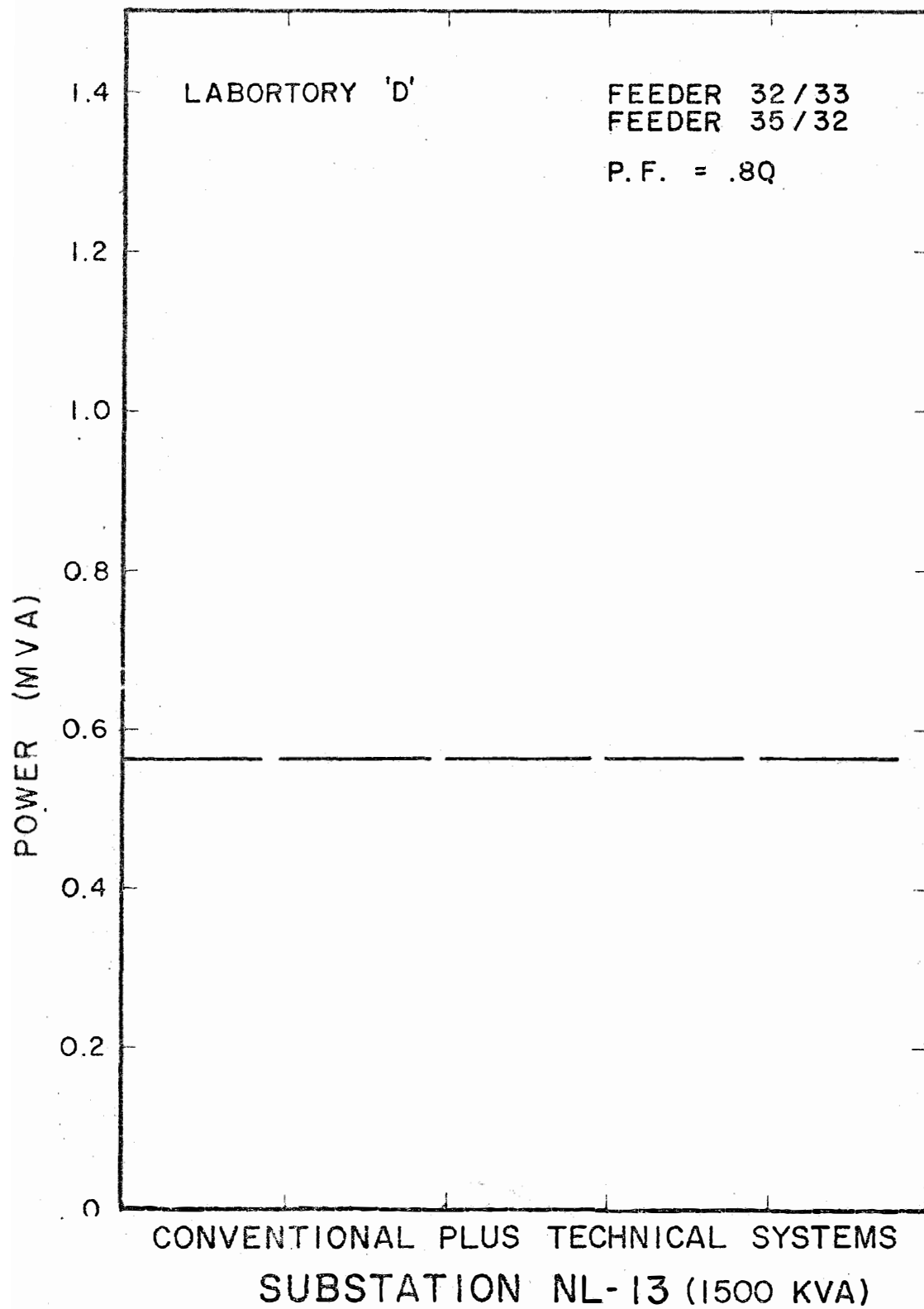




SUBSTATION NL-II (1500 KVA)



SUBSTATION NL-12 (1500 KVA)



-19-

