BNL-105092-2014-TECH

Booster Technical Note No. 45;BNL-105092-2014-IR

Calculation of Booster power requirements based on a constant RF bucket area

M. Meth

June 1986

Collider Accelerator Department

Brookhaven National Laboratory

U.S. Department of Energy

USDOE Office of Science (SC)

Notice: This technical note has been authored by employees of Brookhaven Science Associates, LLC under Contract No.DE-AC02-76CH00016 with the U.S. Department of Energy. The publisher by accepting the technical note for publication acknowledges that the United States Government retains a non-exclusive, paid-up, irrevocable, world-wide license to publish or reproduce the published form of this technical note, or allow others to do so, for United States Government purposes.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

CALCULATION OF BOOSTER POWER REQUIREMENTS BASED ON A CONSTANT RF BUCKET AREA

Booster Technical Note

No. 45

MARVIN METH

JUNE 12, 1986

ACCELERATOR DEVELOPMENT DEPARTMENT

Brookhaven National Laboratory

Upton, N.Y. 11973

CALCULATION OF BOOSTER POWER REQUIREMENTS BASED ON A CONSTANT RF BUCKET AREA

Marvin Meth

During the summer of 1985, the author conducted a preliminary study of the feasibility of exciting the AGS Heavy Ion/ Proton Booster directly from the electric power distribution system[1]. In the interim a number of critical magnet parameters have been modified. In addition, the time variation of the magnetic field has been changed from a linear ramp as used in the original study to a function that maintains the RF accelerating bucket area constant. The magnetic field function required to maintain the bucket area constant was developed by J. G. Cottingham.[2]

Based on the new magnet parameters and the magnetic field function the power requirements have been recalculated and the power grid flicker evaluated at the LILCO substation and on the Lab site. The flicker calculations were performed using the modify routine of the circuit analysis program ECAP.

In general, for the proton cycle the stored energy in the magnet has been substantially reduced but the field function "peaks" the power at the end of the rectification phase. The net affect is that the peak power and power swing has not been significantly changed from that of the original study.

Table I lists the parameters used this study.

The power requirements for the proton cycle for a bucket area of 0.71 ev. sec. (period of 0.1 sec) and 1.0 ev. sec. (period of 0.133 sec) are given in Figures 1 and 2. To limit the reactive power flow for the proton cycle the power supply was constructed from six modular supplies series connected and sequentially switched on to develop the drive voltage.

The power requirements for the Heavy Ion Cycle has not significantly changed from the original study and is repeated in Figure 3.

The results of the power grid flicker evaluation at LILCO, on the 69 Kv Bus on site, and the 13.8 Kv Bus Feeding the Booster is summarized in Table II. The flicker given is for the 0.71 ev. sec. bucket area, since this cycle requires the largest power swing for the proton cycles studied.

A summary of the magnet power requirements is included as Table III.

---

1. M. Meth, Preliminary Study of AC Power Feeders for AGS Booster, Accelerator Division Technical Note No. 220, October 1, 1985.

2. J.G. Cottingham, RF Bucket Area, Booster Technical Note No. 31, May 6, 1986.

	DIPOLE	QUADRUPOLE
TOTAL INDUCTANCE	.1152H	.0168H
TOTAL RESISTANCE	.0432Ω	.048 Ω
PROTON CYCLE		
I - Injection	635A	635A
I - Maximum	1672A	1672A
HEAVY ION CYCLE		
I - Injection	0	0
I - Maximum	5174A	5174A

TABLE I

MAGNET PARAMETER

LOCATION	CYCLE	MAXIMUM AMPLITUDE FLICKER	MAXIMUM PHASE FLICKER
LILCO SUB STATION	PROTON	0.17%	0.39°
	HEAVY ION	0.31%	0.31°
69 KV FIFTH AVE SUB STATION	PROTON	0.26%	0.58°
	HEAVY ION	0.48%	0.39°
BOOSTER 13.8 KV	PROTON	1.97%	3.96°
	HEAVY ION	2.88%	3.24°

TABLE II

RESULTS OF FLICKER STUDY
Based On
0.1 Sec. Period For Proton Cycle

	PROTON CYCLE (0.1 sec)	HEAVY ION CYCLE (1.0 sec)
STORED ENERGY	.185 MJ	1.56 MJ
PEAK POWER	8.9 MW	9.0 MW
PEAK POWER SWING	16.0 MW	13.4 MW
AVERAGE POWER	.070 MW	.72 MW

TABLE III

MAGNET POWER REQUIREMENTS

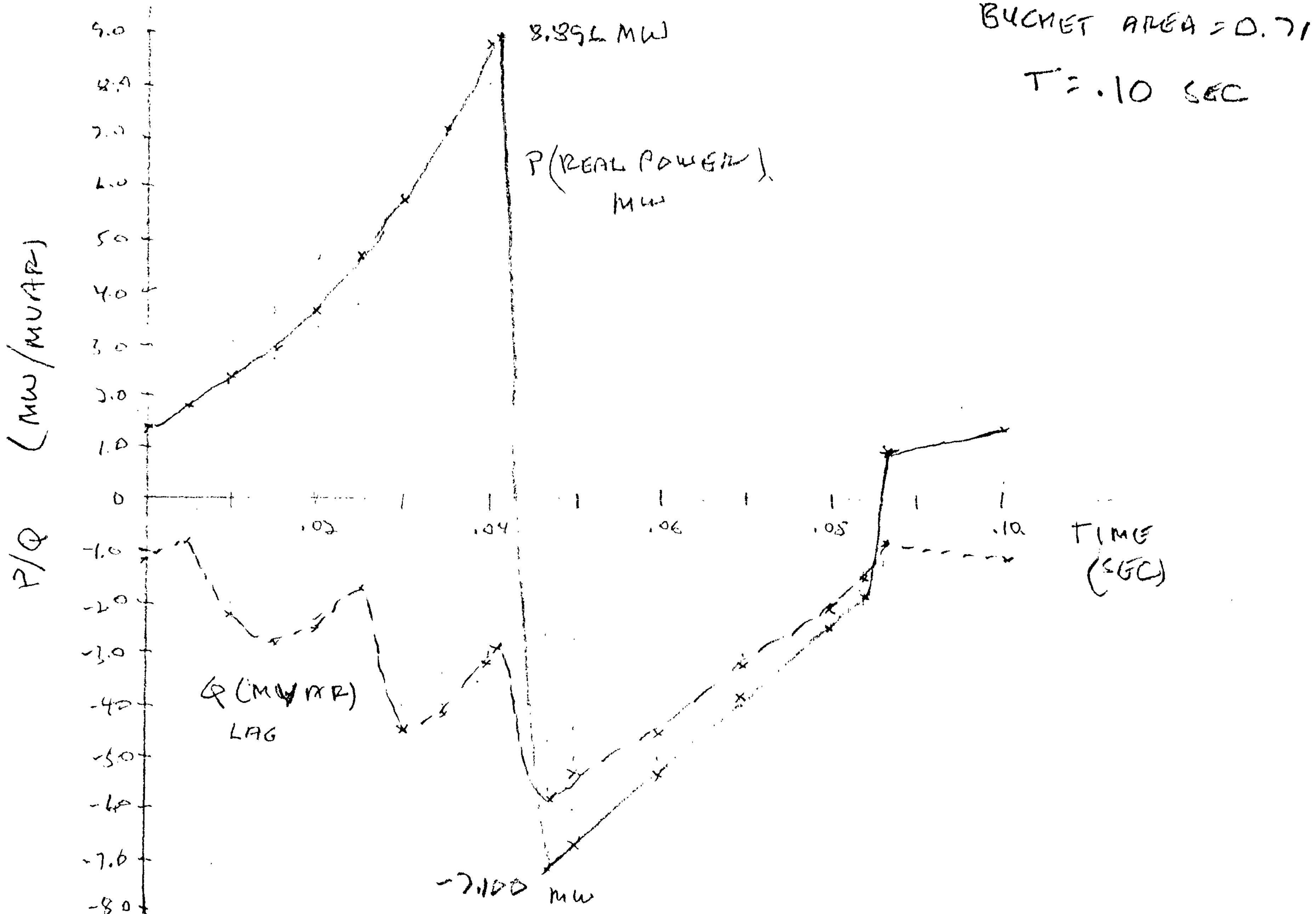

FIG 1 TOTAL POWER AT AC BUS BAR (PROTON CYCLE)

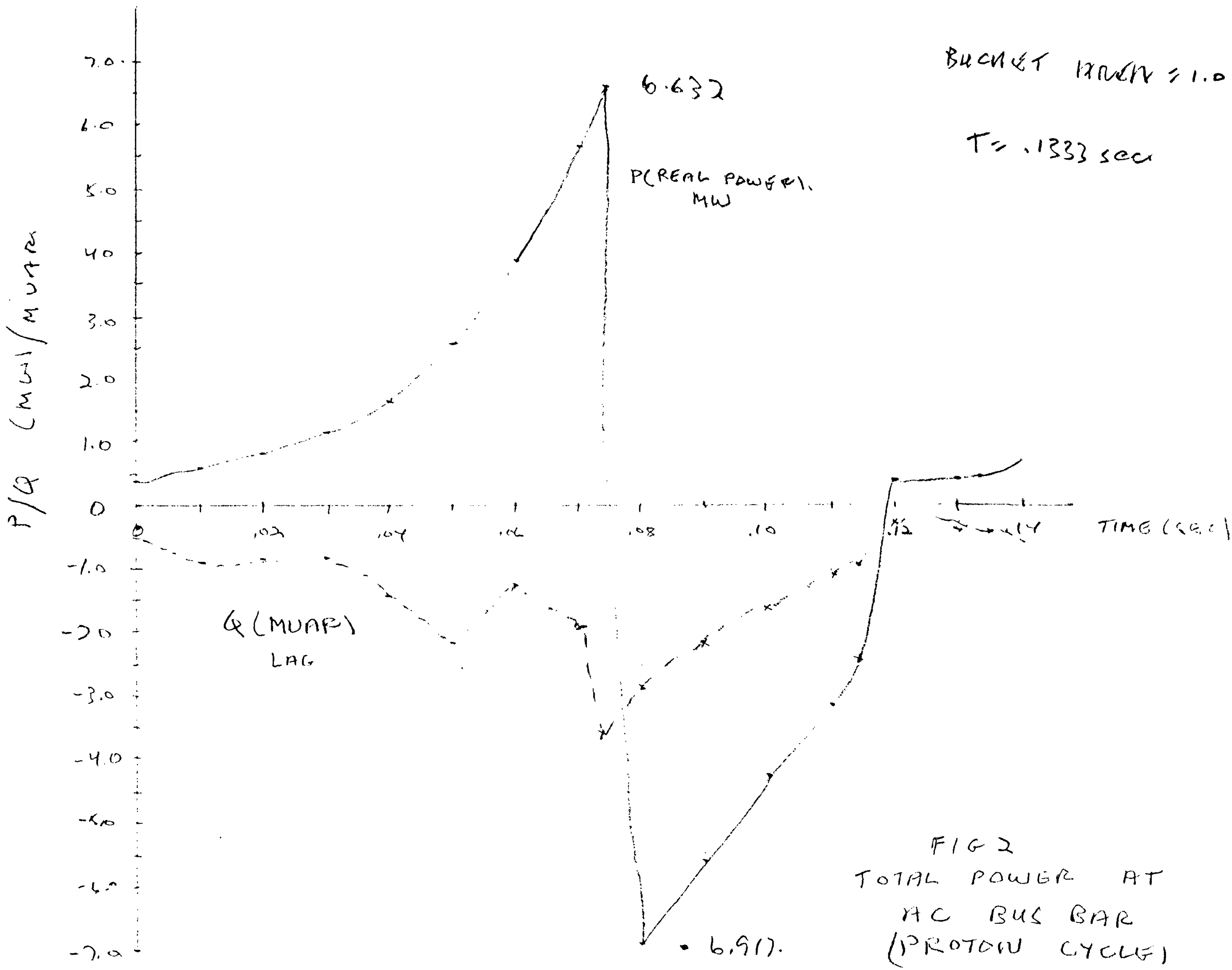

FIG 2
TOTAL POWER AT
AC BUS BAR
(PROTON CYCLE)

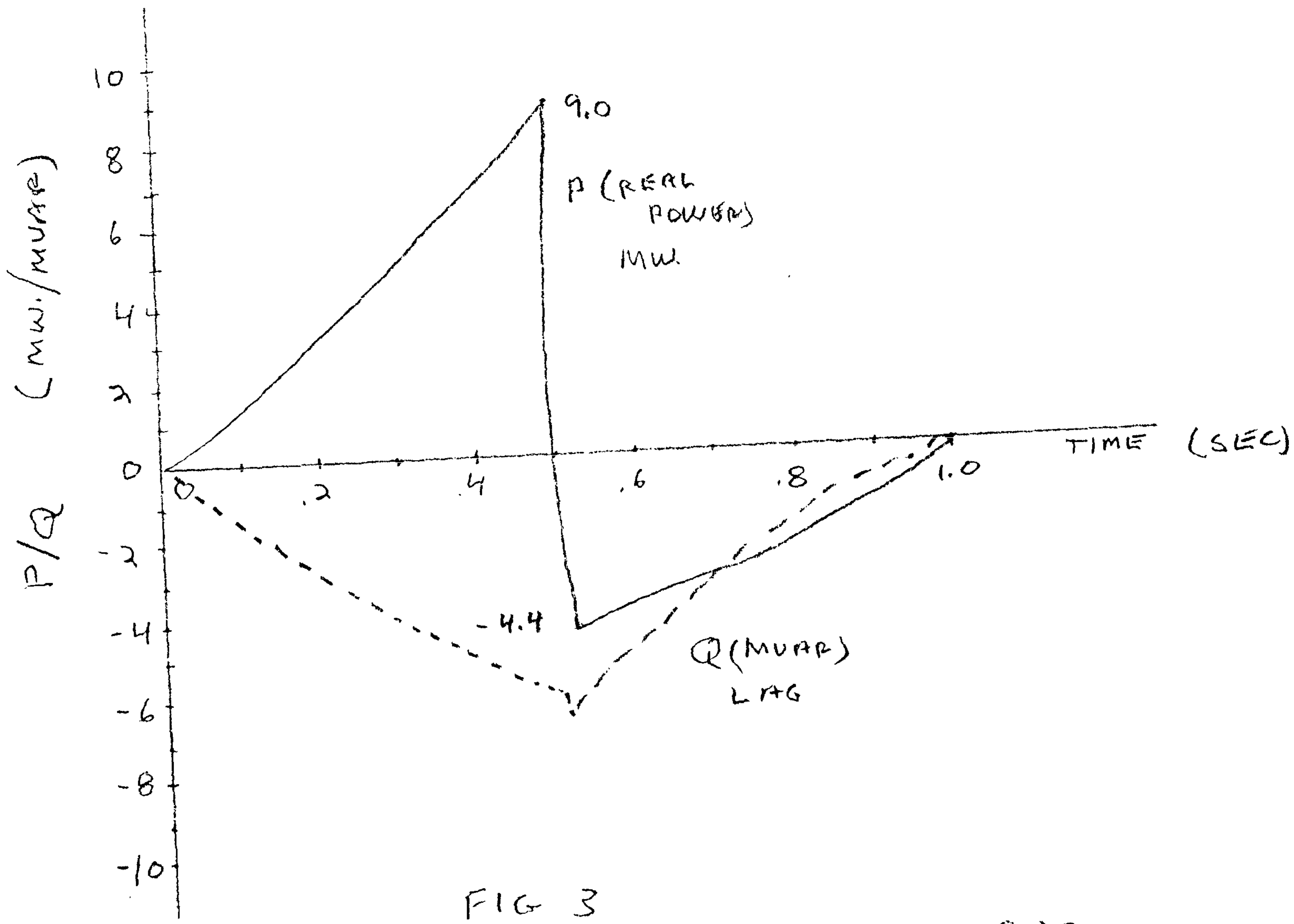

FIG 3
TOTAL POWER AT AC BUS BAC
(HEAVY END CYCLE)