Livingston

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	Gerry S. Tool	RF Group	1 of 5
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Subject

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BOOSTER RF SYSTEM AC POWER AND COOLING REQUIREMENTS

INTRODUCTION

The ac power supply for the rf equipment in the booster is distributed to four transformer pads spaced 90° apart at the gallery level. Each of these four pads contains both 13.8 kV and 480 V distribution equipment. This note describes the anticipated ac loads and cooling loads produced by the rf system during booster operation.

AC POWER DISTRIBUTION

Figure 1 shows the total rf system power demand vs time during a single booster magnet period. These curves do not reflect the smoothing effect of any local energy storage such as power supply filter capacitors. The loads on both distribution systems fluctuate during a magnet period, but the 13.8 kV system demand is a pulsing load with 3 MW peaks alternating with periods of no demand.

In normal operation, the waveforms shown in Figure 1 are repeated 13 times during the main ring filling time. This is then followed by a 2.2-3.2 second period of low constant demand. The resulting waveforms corresponding to a 3 second main ring period, shown in Figure 2, are repeated every 3 seconds when the main ring is operating without flat-top.

The table below lists the peak demands and averages taken for a booster magnet period and for a main ring magnet period:

	480 V System	13.8 kV System
Peak Demand	2 MW	3 MW
Average for Booster Period	1.4 MW	1 MW
Average for 3 Second Main Ring Period	0.7 MW	0.3 MW

The fluctuating nature of the ac demand requires that careful attention be paid to which criteria guide the choice of the various components of the power distribution system. For example, the capacity added to the primary sub-station for the benefit of the booster rf system should probably be based on the overall long-term average demand of 1 MW. However, the size of the four transformer systems and associated wiring to the rf components where a voltage regulation of ± 5% is needed should be chosen on the basis of the peak demand curves.

COOLING LOADS TO LCW AND AIR

The cooling loads which are long-term averages that result from the rf system are tabulated below:

	Ring	Gallery
LCW Cooling Load	370 kW	460 kW
Air Cooling Load	40 kW	100 kW

The LCW load in the ring is about equally split between dissipation in the ferrite and in the final amplifier vacuum tubes. The ferrite cooling water is specified to have a supply temperature of 65°F and a return temperature of 75°F, ±5°. The temperature of the LCW to other components is not critical, but the maximum pressure allowed in the cooling system for the various vacuum tubes in the rf system is 80 psi gauge. The conductivity required is $\leq$ 2 μmho/cm. Various systems have been suggested ranging from a completely separate low temperature system for the full rf load to combinations of some water from the higher temperature magnet LCW system at reduced pressure along with a smaller low temperature system for ferrite cooling. It has also been suggested that the rf system cooling for booster and main ring might be combined in a single system.

Water pressure surges in the rf power tubes are particularly bad because of the thin wall construction of the anode. Hence, any system supplying water to the power tubes should not have the possibility of producing surges due to either component failure or operations error. It seems that the combination of ideas which results in the most economical and reliable system satisfying the particular temperature and pressure requirements stated above should be the goal in designing the LCW system.

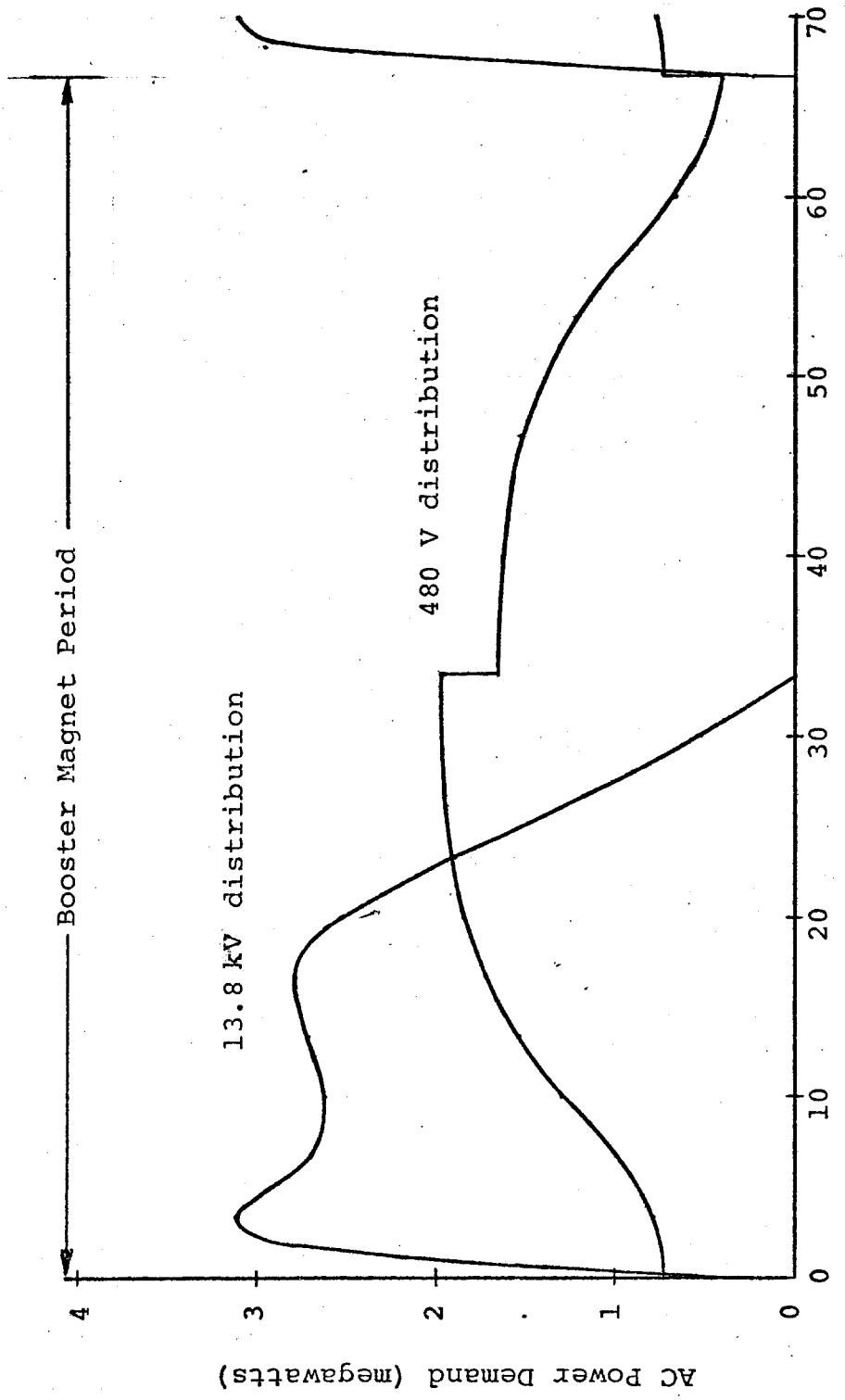

Fig. 1 Booster rf system ac power demand during booster magnet period.

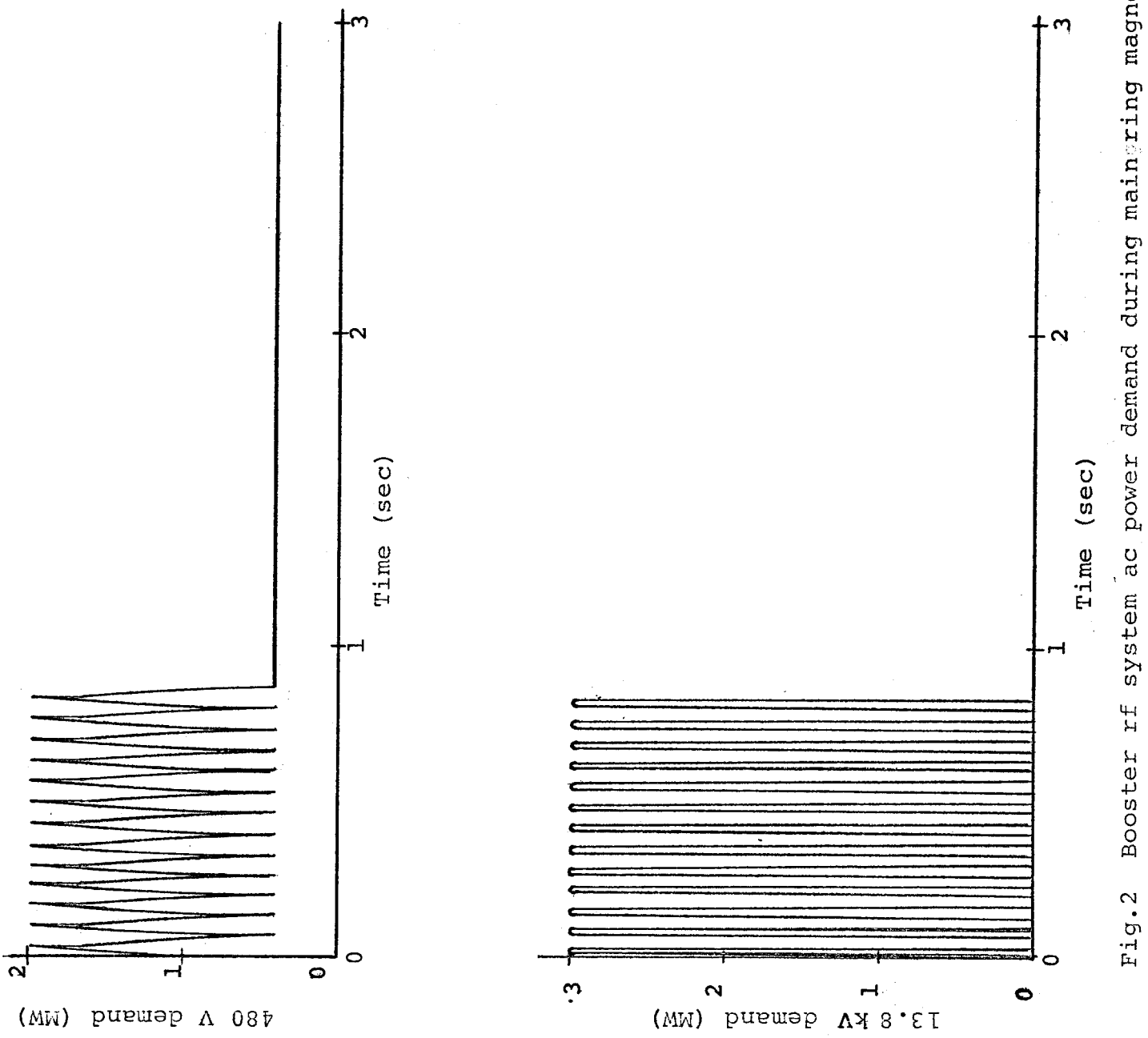

Fig.2 Booster rf system ac power demand during main ring magnet period.