

BNL-104071-2014-TECH AGS.SN195;BNL-104071-2014-IR

Injection Porch Parameters for Heavy Ion Injection

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December 1985

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U.S. Department of Energy

USDOE Office of Science (SC)

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Number 195

AGS Studies Report

Date(s)----December 23, 1985 Time(s)---0400-0700

Experimenters--H. Ashby, J. Curto, A. Feltman

Reported by----A. Feltman

Subject ----Injection Porch Parameters for Heavy Ion Injection.

Observations and Conclusions

The Injection Porch length was set to 800 milliseconds so that more accurate measurements of the subharmonic components of ripple could be obtained. Each stations output D.C. voltage was set to 250 volts yielding a total of 500 volts across the Main Magnet. Both station firing times were then adjusted to minimize the subharmonic r^{i} Pple components. Station two was then readjusted to introduce a small

t controlled amount of riPPle. This will then allow an evaluation of the Kind of tolerances required for Heavy Ion injection.

Frequency spectrums averaged over fifty pulses were taken at the following Points.----

1) Station one before the ripple filter.

- 2) Station two before the ripple filter.
- 3) Station one after the ripple filter.
- 4) Station two after the ripple filter.

5) Magnet current.

As indicated in the sPectrum diagrams for station #1 before and after the ripple filter all the subharmonic components of ripple 3100 well behaved. The 360 Hz. component of ripple however is somewhat hiSher than anticiPated and althouSh the riPPle adjustment controls of this station were able to minimize it they were not able to reduce it to zero. It appeared as though there was a quadrature component of 360 Hz si9nal bein9 introduced from an ununderstood reason. This will ha investigated in greater detail.

For station #2, the results are not so easily interPretable because of some inconsistencies that have not been fully analyzed at Present time. All comPonents of signals as determined by the srectrum analyzer after the riPPle filter were about 10% higher than they should have been. This includes even the D.C. comPonent of magnet voltage. If a 10% correction is included in the data everything falls into Place.

 \mathcal{E}^{i}

1/3/86

The magnet current frequency spectrum shows that the 60 Hz. component of current is of the order of 0.3 Amps. R.M.S. and do to the i t this was intentionally introduced, could in Principal be reduced to essentially zero. The most troublesome component of subharmonic is the 1400 Hz. component. This component is about equivalent to 4.0 amps Peak to Peak. This Peak to Peak value is about 4% of the injection current and can Produce Prohibitively large radial excursions of the beam Position during injection. I do not believe this number for the following reason.----

If the Power suPPly were Phased back to Produce zero volts D.C. (the worst condition for riPPle), the raw riPPle would be 750 volts Peak to Peak at 1400 Hz. The waveform would be a PuP tent which would therefore Yield a value of 2(750)/(3.1416)=477 volts Peak to Peak aPPlied to an inductance of 9reater than 0.5H. This would Yield a current of something of the order of 0.1 AmPs. Peak to Peak at 1400 Hz. The conclusion could only be that the 4.0 AmPs Peak to Peak is inconsistent with the rough calculation of 0.1 AmPs Peak to Peak. Additional studies will be required to resolve this discrepancy.

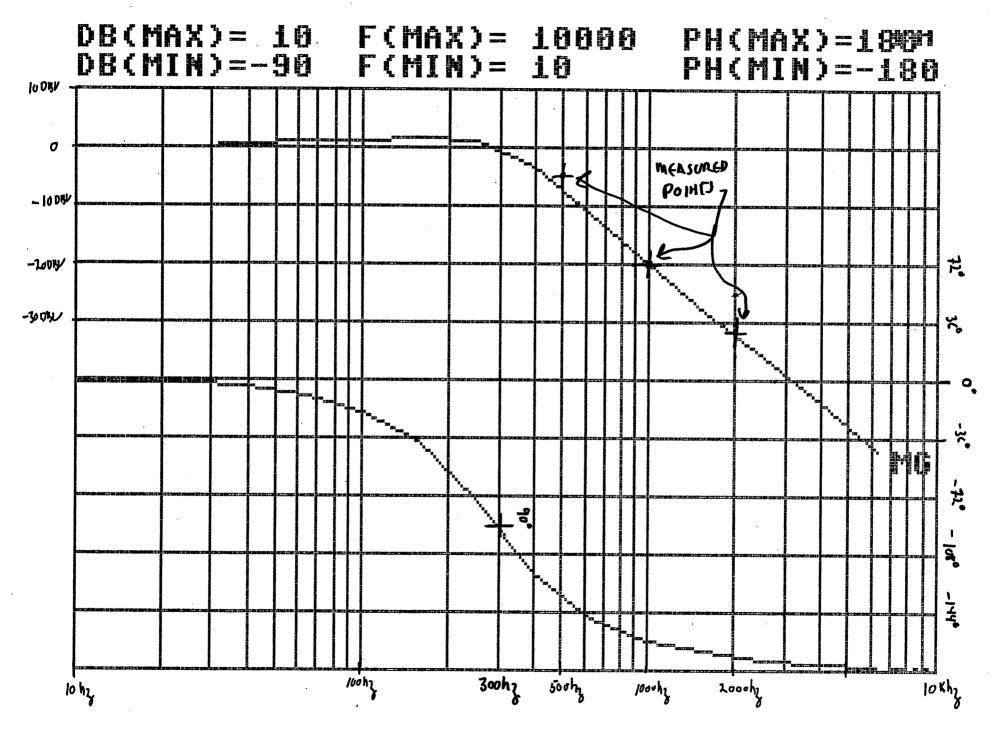
At the conclusion of the run, the bus connections to the ripple filter were Pulled and the ripple filter Parameters were measured. The individual PancaKes of the inductors were measured and also the series aiding inductance of each inductor was measured. The results are as follows------

Station #1	upper PancaKe3,352	mh.
Station #1	lower Pancake3.276	mh.
Station #1	series aidin9 inductance9.46 m	h.
Station #2	uPPer PancaKe3.34 m	h.

Station	#2	lower F	PancaKe-	a andar anter attas attas attas state attas attas attas desir frans jumo yeun	3.27	mh.
Station	#2	series	aiding	inductance	9.68	mh.

Using a nominal value of 10 mh. for the ripple filter inductance, the frequency magnitude and Phase responses of the ripple filter were calculated and compared to several nominal measured Point on the roll of. The ripple filter calculations agree very well with the measurements. The filter break frequency is at about 300 hz. and the roll off is about 40 db. Per decade or 12 db. Per octave. The overshoot is 28% at 200 hz.

As Previously Pointed out, station #2 had some subharmonic riPPle left in. This riPPle can now be used to compare the filter against calculations. At 360 hz, the filter response calculates that it should be down to about 80%. the 360 hz component before and after the filter measure 21.3 and 16 (corrected) volts P/P. this is 75%, which agrees closely with calculations. At 720 hz., the filter calculation predicts that the filter response should be about 20%. the 720 hz. before and after the filter measured 251.5 and 54 (corrected) volts P/P. this is a response of 21%, which is a good close fit.



Phase

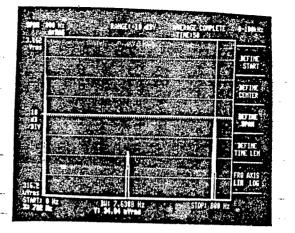
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	1.00763109	15621	FREQ.(HZ)	V-4 /V-1 MAG	PHASE
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12.5892541	1.01186362	25495	1412.53753	.0515696785	-166.24
14.1253754	1.01473858	33025	1584.89318	.0408380575	-167.90
15.8489319	1.01825272	43085	1778.2794	.0323587128	-169.17
17.7827941 19.9526232	1.02251876 1.02765515	56507	1995.2623 2238.72112	.0256523504 .0203438851	-170.37 -171.44
22.3872114	1.02760010	74351 97940	2511.88641	.0161390846	-172.39
25.1188643	1.04099858	-1.2888	2818.38291	.0128066447	-173.22
28.1838293	1.04939765	-1.6906	3162.27763	.0101643908	-173.97
31.6227766	1.05902626	-2.2066	3548.13386	8.06861691E-03	-174.63
35.481339	1.06988727	-2.8603	3981.07167	6.40581254E-03	-175.22
39.8107171	1.08192977	-3.6766	4466.83588	5.08622056E-03	-175.74
44.6683593	1.09505047	-4.6810	5011.87228		-176.20
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63.0907346 70.7945786	1.15535152	-11.080	7943.28225	1.60662121E-03	
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125.892541	-1.24215761	-27.015		·	
141.253755	1.25983302	-31.933			
158.489319	1.27528332	-37.739 -44.631			
177.827941	1.28500561 1.28280195	-52.802			
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251.188643	1.20371462	-73.284			
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354.813388	.830685882	-108.55			
398.107169	.682376209	-118.76			
446.683591	.548685544	-127.54 -134.93			
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562.341323 630.957341	.270761099	-146.26			
630.957341 707.94578	.213074037	-150.60			
794.32823	167773021	-154.27			
891.250933	.132235182	-157.41			
999.999993	.104341285	-160.10			
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12/18/85

Number 194

AGS Studies Report

Date(s) <u>Decembe</u>	r 9, 1985	Time(s)0300-0700
Experimenter(s)	A. Feltman, F. Heimroth,	C. Staal
Reported by	A. Feltman	
Subject	Injection Porch Setup fo	r Heavy Ion Injection

Observations and Conclusion

A complete new set of ICOMA cards were installed into the injection porch control buckets. Between weeding out bad cards, troubleshooting and re-aligning both stations, about three hours were used up before tets were ready to be run. An additional hour was lost trying to determine who was supposed to have the machine and when.

Because of the time crunch, even though the power supply was not really finely adjusted to obtain complete elimination of the lower frequency components of ripple, it was decided to take some preliminary measurements.

The 360 Hz and 720 Hz Siemens synchronized components of ripple averaged over 50 pulses of magnet current were measured. At 600 Amps the average rms value of the 360 Hz componet of current ripple was 0.6 Amps. The 720 Hz component was of the same order of magnitude. It is felt that this amount of ripple could be reduced by one or two magnitudes with more meticulous adjustment of the power supply.

There was no sign of 60, 120, 180, 240, or 300 Hz present.

After completion of tests, the power supply was restored to the original condition. The machine was run for a few minutes to confirm that previous operating parameters were restored.

At 6:00 a.m., the power supply was secured to allow time for main magnet leakage current measurements. These measurements were conducted with 400 volts on each half of the main magnet to ground. Section "A" drew 3 mA and section "B" drew 2.5 mA.

