Peterborough Distribution Inc.
1867 Ashburnham Drive,
PO Box 1425 Station Main
Peterborough, ON K9J 6Z5

Electric Thermal Storage Units Project

Submitted to the LDC Tomorrow Fund

July 2005

Draft Submission

PETERBOROUGH DISTRIBUTION INC.
1867 Ashburnham Drive, PO Box 4125, Station Main
Peterborough ON K9J 6Z5

July 20, 2005

File: O37

John Wong
Director of Financial and Business Solutions
The MEARIE Group
3700 Steeles Ave. West, Suite 1100
Vaughan, Ontario
L4L 8K8

STORAGE HEATER PROJECT

Dear John:

This is a report on our findings with the conversion of baseboard heaters to storage heaters. Storage heaters were installed in late November, 2004. The heaters were installed in one row of electrically heated social housing located at 290 Parkhill East, Peterborough, Ontario. One row consisting of units 12,13,14,15 and 16 were selected for the experiment. These units, like most electrically heated social housing units, have separate meters for the regular electric service and the electric heating service. Time of Use Meters were installed on the heating service for units 12 to 16 on December 2, 2004. Time of Use meters were also installed on the heating service for units 17 and 18, which had regular base board electric heating. These two units were to act as the "control" group to assess the amount of electricity that is used off peak under regular conditions. All of the meters have been read monthly. I have attached a spreadsheet showing the kwh consumption for each of the units involved.

Not knowing what would be considered as off peak hours, for the purpose of our experiment, we installed TOU meters that measured peak as any day, 8 am to 8 pm. Off peak was considered any day 8 pm to 8 am.

For the period up to the end of June, units with storage heaters, a total of 64,781 kwh were used for heating during the off peak period, or 87.8 % of the electricity consumed. For the control group, only 5,196 kwh were used off peak or 36.7% of the electricity consumed.

Steffes, with head office in Dickson, North Dakota, storage heaters were selected. We chose Steffes because we have had favourable experience in dealing with Steffes in the past and the controls used by the Steffes designed heaters provide a great number of control features. In the row of housing that was selected, two storage heaters were placed on the main floor and one storage heater placed on the upper floor for the outside units, where heat loss was the greatest, and in the inside units only one storage heater was installed on each of the main floor and upper floor. . The other baseboard heaters were either removed or disconnected. All of the storage heaters in all of the five units were controlled by the use of one controller which employed power line carrier technology to send the control signal to the individual storage heaters. One controller would be able to control any storage heater connected to the secondary side of a distribution transformer.

Under “normal” conditions, a time of use meter would provide a contact to tell the controller when peak and off peak times occurred. As we did not want to expose the experiment to the risk of wrong time signals, in lieu of the meter contact, we used a controller, managed by a radio signal from our SCADA system, to tell the Steffes controller when peak and off peak times were occurring. During the second week of the experiment, the peak and off peak signals became “crossed”, so we were in fact taking energy at peak times and using the stored heat during off peak times. Had this been operating as intended, the percentage of off peak energy use would have exceeded 87.8%.

As I understand it, it is common for the local municipality to pay for the heating portion of the energy bill for social housing, while the resident normally pays for the energy bill for other applications. As a result, my observation and information supplied to me by others working for social housing, suggest that many social housing residents, do not exercise conservation of energy with respect to heating. For example, on three different occasions, while visiting the site, I saw windows open on some of the units. During a response to a complaint from one resident, our staff noted that the temperature in the downstairs was 19 Celsius and upstairs, 24 Celsius. The resident made the comment that they had the right to keep the temperature at 30 Celsius if they wanted. Upon installation, the internal controls for the storage heaters were set so that in spite of the thermostat setting, the temperature in the room where the storage heater was located, would not exceed 24 Celsius.

One matter that must be considered when installing storage heaters is the capacity of the transformer supplying the load. I have attached graphs of the primary current, for the week of February 7 to 13, 2005, on the single phase 16 kv distribution transformer used to serve the storage heaters. The transformer supplies not only the 5 units but also 15 other units with baseboard heating. The increased loading at 8 pm is apparent.

Typically the current increases from about 2 amps to 5 amps when the storage heaters begin their charge cycle. Upon designing a storage heater installation, the off peak loading of the distribution transformer would need to be considered. One option that we will employ, as we will be installing more storage heaters in this and other social housing complexes, is the delay of the charge cycle for some of the heaters served by the distribution transformer. Steffes heaters offer this feature. The primary current graphs indicate that most of the heaters will have recharged after about 4 to 5 hours. We expect that we can add a substantial number of storage heaters to the distribution transformer by implementing a 4 hour delay of the charge cycle for about one half of the storage heaters.

Conclusions:

1. Storage heaters are very effective in shifting load to off peak times.
2. They can provide technology that can be used to ensure some measure of non-abuse of the energy, ie. temperature limiting.
3. Transformer loading could be a serious issue if the was a mass effort to convert to storage heaters.
4. Social housing residents need to have some method to be accountable for their energy use.
5. With the advent of smart meters and time of use rates, the storage heater could be a very effective tool in controlling heating costs, especially where conversion to gas is not a reasonable option.

Yours very truly,

Robert G Lake

Robert G. Lake P.Eng.
President
Telephone (705) 748-9301 ext 1280
e-mail rlake@puc.org

F:\ADM\BLAKE\2005\O05\EDAreport2.doc

December	Readings		Consumption		Total
	Dec 21 Off Peak	Dec 21 On Peak	Consumption Off Peak	Consumption On Peak	Total Consumption
UNIT					
C12 Loc 34124	1033	397	1033	397	1430
C13 Loc 34125	811	318	811	318	1129
C14 Loc 34126	890	429	890	429	1319
C15 Loc 34127	840	416	840	416	1256
C16 Loc 34128	1237	437	1237 - 4,811	437 - 1997	1674

outside 3 sides

January					
	Jan 24 Off Peak	Jan 24 On Peak	Consumption Off Peak	Consumption On Peak	Total Consumption
UNIT					
C12	3924	780	2891	383	3274
C13	2803	562	1992	244	2236
C14	3274	879	2384	450	2834
C15	2945	865	2105	449	2554
C16	4588	946	3351 - 12,723	509 - 2,035	3860
D17 Loc 34086	0	0			
D18 Loc 34087	0	0			

inside [illegible]

February					
	Feb 22 Off Peak	Feb 22 On Peak	Consumption Off Peak	Consumption On Peak	Total Consumption
UNIT					
C12	7394	940	3470	160	3630
C13	5557	725	2754	163	2917
C14	6498	1345	3224	466	3690
C15	6621	1279	3276	414	3690
C16	8282	1242	3694 - 16,418	296 - 1,499	3990
D17 Loc 34086	749	1338	749	1338	2087
D18 Loc 34087	801	1282	801 - 1550	1282 - 2,620	2083

March					
	Mar 22 Off Peak	Mar 22 On Peak	Consumption Off Peak	Consumption On Peak	Total Consumption
UNIT					

C12	10394	1192	3000	252	3252
C13	7922	860	2365	135	2500
C14	9271	1746	2773	401	3174
C15	8899	1467	2278	188	2466
C16	12536	1483	4254 - 14,670	241 - 1,217	4495
D17	1327	2725	578	1387	1965
D18	1495	2680	694 - 1272	1398 - 2,785	2092

April

UNIT	Apr 22 Off Peak	Apr 22 On Peak	Consumption Off Peak	Consumption On Peak	Total Consumption
C12	12032	1363	1638	171	1809
C13	9345	942	1423	82	1505
C14	10973	2076	1702	330	2032
C15	10040	1530	1141	63	1204
C16	14518	1598	1982 - 7,886	115 - 761	2097
D17	1952	3695	625	970	1595
D18	1870	3337	375 - 1006	657 - 1,627	1032

May

UNIT	May 25 Off Peak	May 25 On Peak	Consumption Off Peak	Consumption On Peak	Total Consumption
C12	13414	1564	1382	201	1583
C13	10665	1001	1320	59	1379
C14	12368	2366	1395	290	1685
C15	11155	1627	1115	97	1212
C16	16173	1675	1655 - 6,367	192 - 839	1847
D17	2555	4636	603	941	1260
D18	2290	3924	420 - 1,023	587 - 1528	1007

June

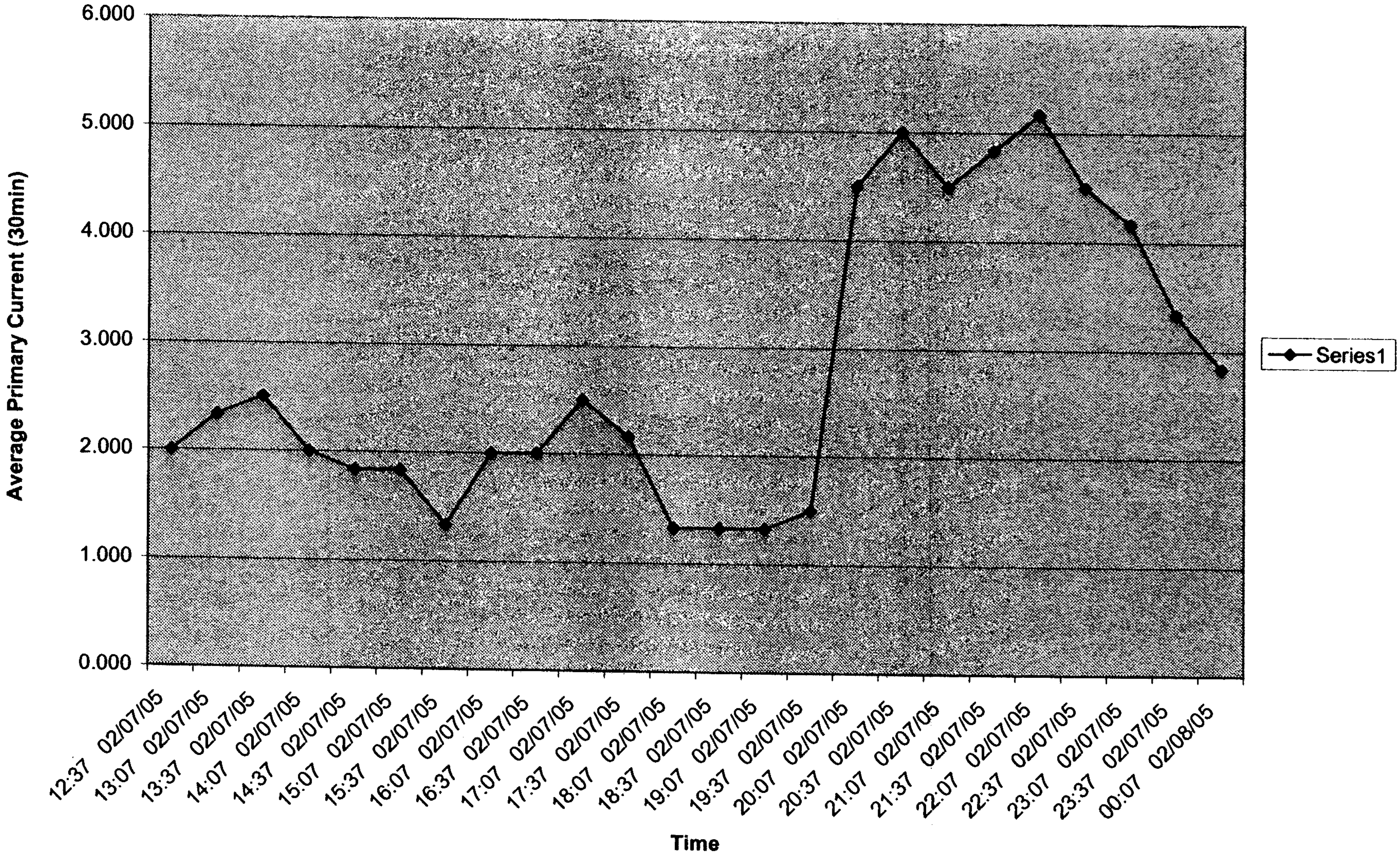
UNIT	**June 22 Off Peak**	**June 22 On Peak**	**Consumption Off Peak**	**Consumption On Peak**	**Total Consumption**
C12	13635	1661	221	97	318
C13	11074	1230	409	229	638
C14	12550	2487	182	121	303
C15	11562	1746	407	119	526

C16	16360	1792	187 - 1406	117 - 683	304
D17	2696	4786	141	150	291
D18	2500	4205	210 - 351	281 - 431	491

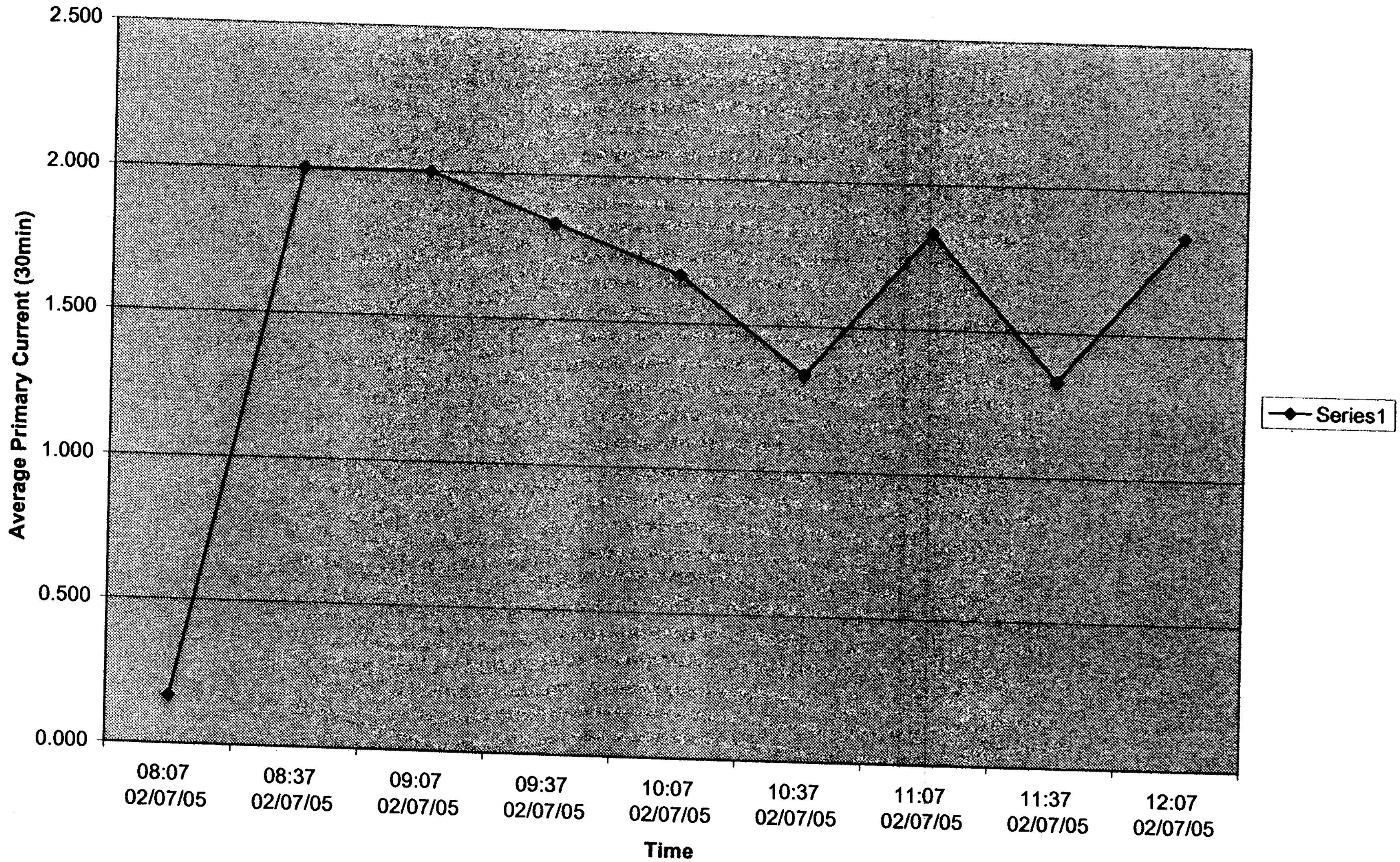
July

UNIT	xxx Off Peak	xxx On Peak	Consumption Off Peak	Consumption On Peak	Total Consumption
C12					
C13					
C14					
C15					
C16					
D17					
D18					

Feb 7/2005

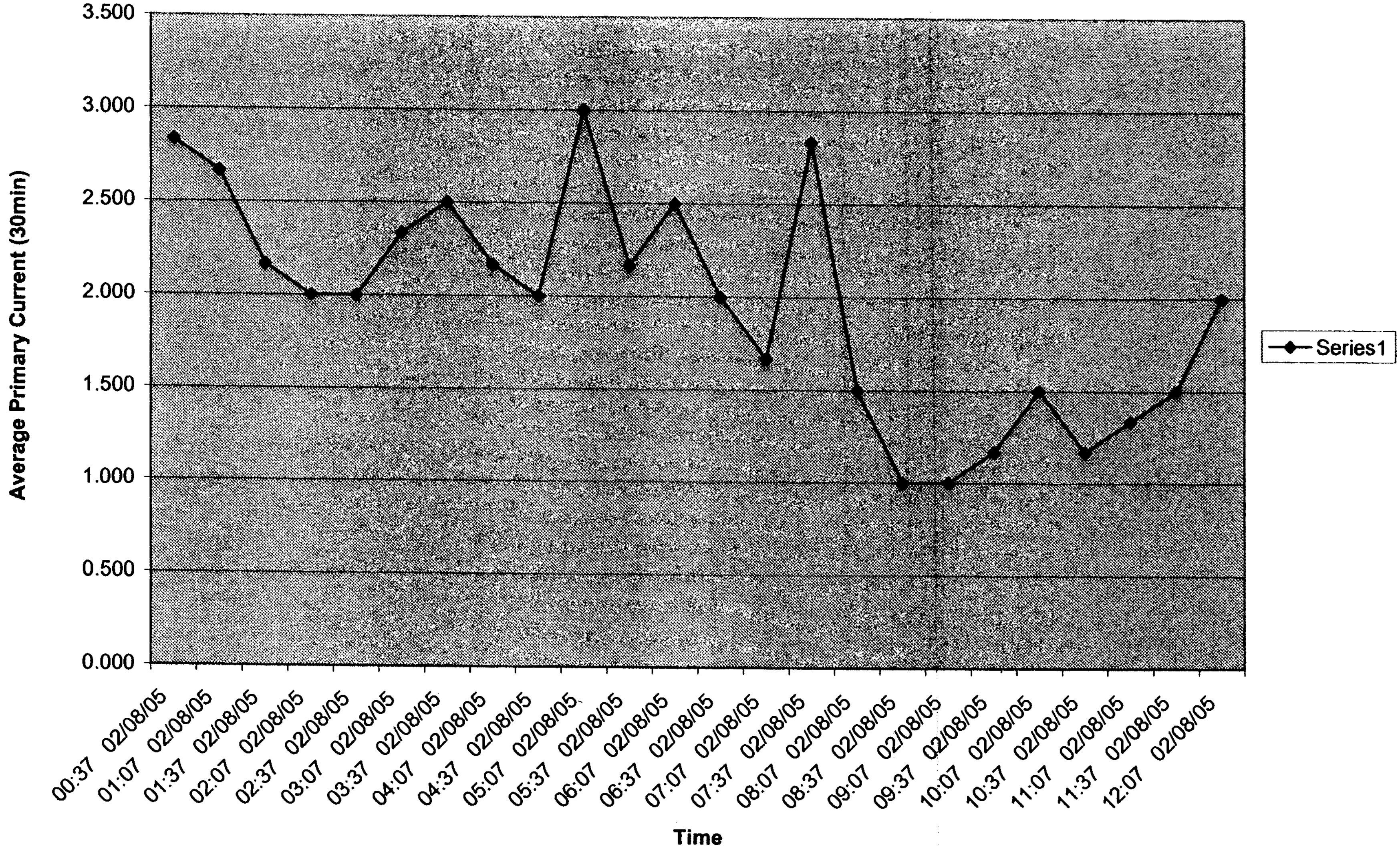

Average Primary Current (30min)
6.000
5.000
4.000
3.000
2.000
1.000
0.000
12:37 02/07/05
13:07 02/07/05
13:37 02/07/05
14:07 02/07/05
14:37 02/07/05
15:07 02/07/05
15:37 02/07/05
16:07 02/07/05
16:37 02/07/05
17:07 02/07/05
17:37 02/07/05
18:07 02/07/05
18:37 02/07/05
19:07 02/07/05
19:37 02/07/05
20:07 02/07/05
20:37 02/07/05
21:07 02/07/05
21:37 02/07/05
22:07 02/07/05
22:37 02/07/05
23:07 02/07/05
23:37 02/07/05
00:07 02/08/05
Time
Series1

Feb 7/2005



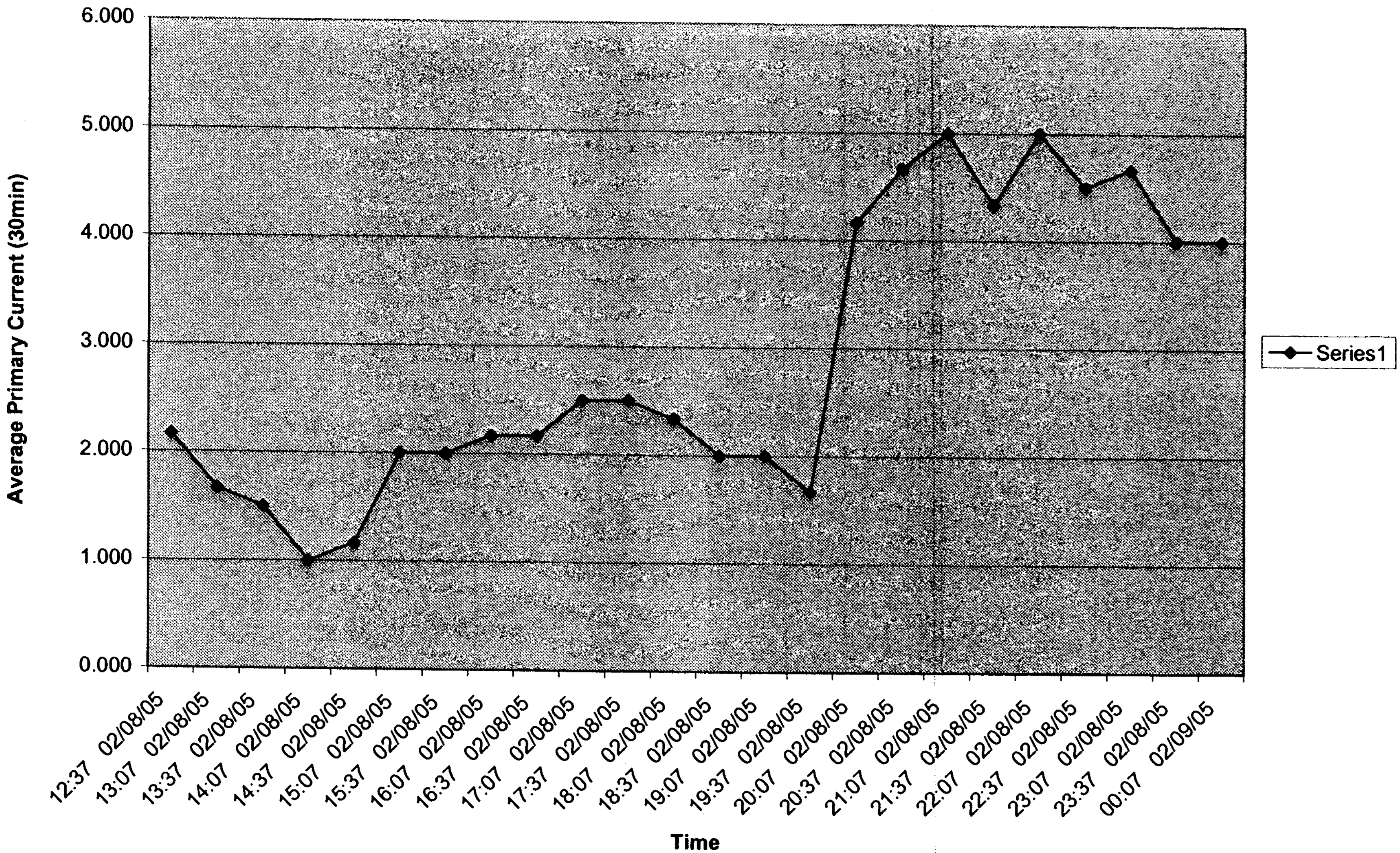
2.500
2.000
1.500
1.000
0.500
0.000
Average Primary Current (30min)
08:07 02/07/05
08:37 02/07/05
09:07 02/07/05
09:37 02/07/05
10:07 02/07/05
10:37 02/07/05
11:07 02/07/05
11:37 02/07/05
12:07 02/07/05
Time
Series1

Feb 8/2005

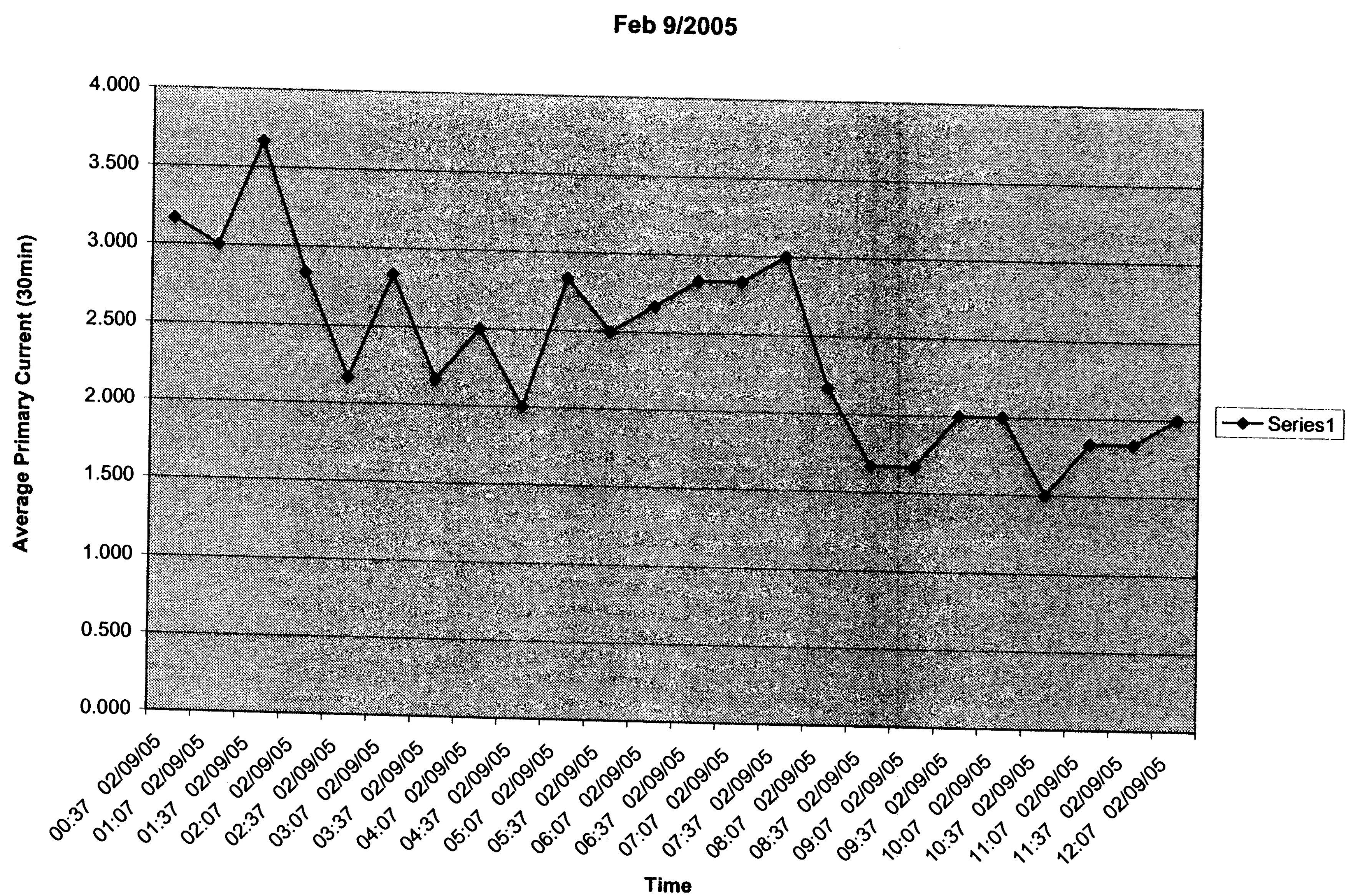


3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
Average Primary Current (30min)
Series1
02/08/05 00:37
02/08/05 01:07
02/08/05 01:37
02/08/05 02:07
02/08/05 02:37
02/08/05 03:07
02/08/05 03:37
02/08/05 04:07
02/08/05 04:37
02/08/05 05:07
02/08/05 05:37
02/08/05 06:07
02/08/05 06:37
02/08/05 07:07
02/08/05 07:37
02/08/05 08:07
02/08/05 08:37
02/08/05 09:07
02/08/05 09:37
02/08/05 10:07
02/08/05 10:37
02/08/05 11:07
02/08/05 11:37
02/08/05 12:07
Time

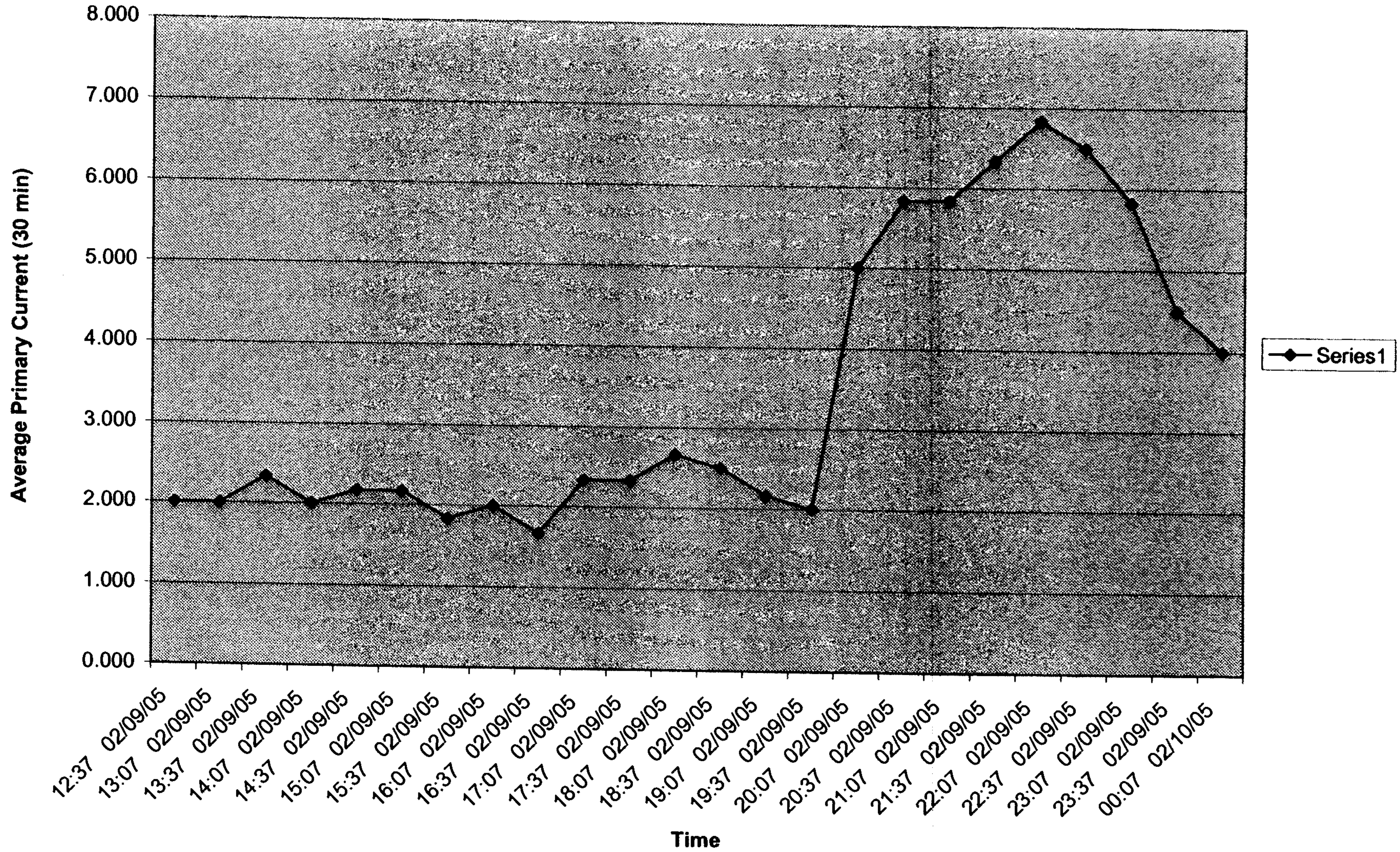
Feb 8/2005



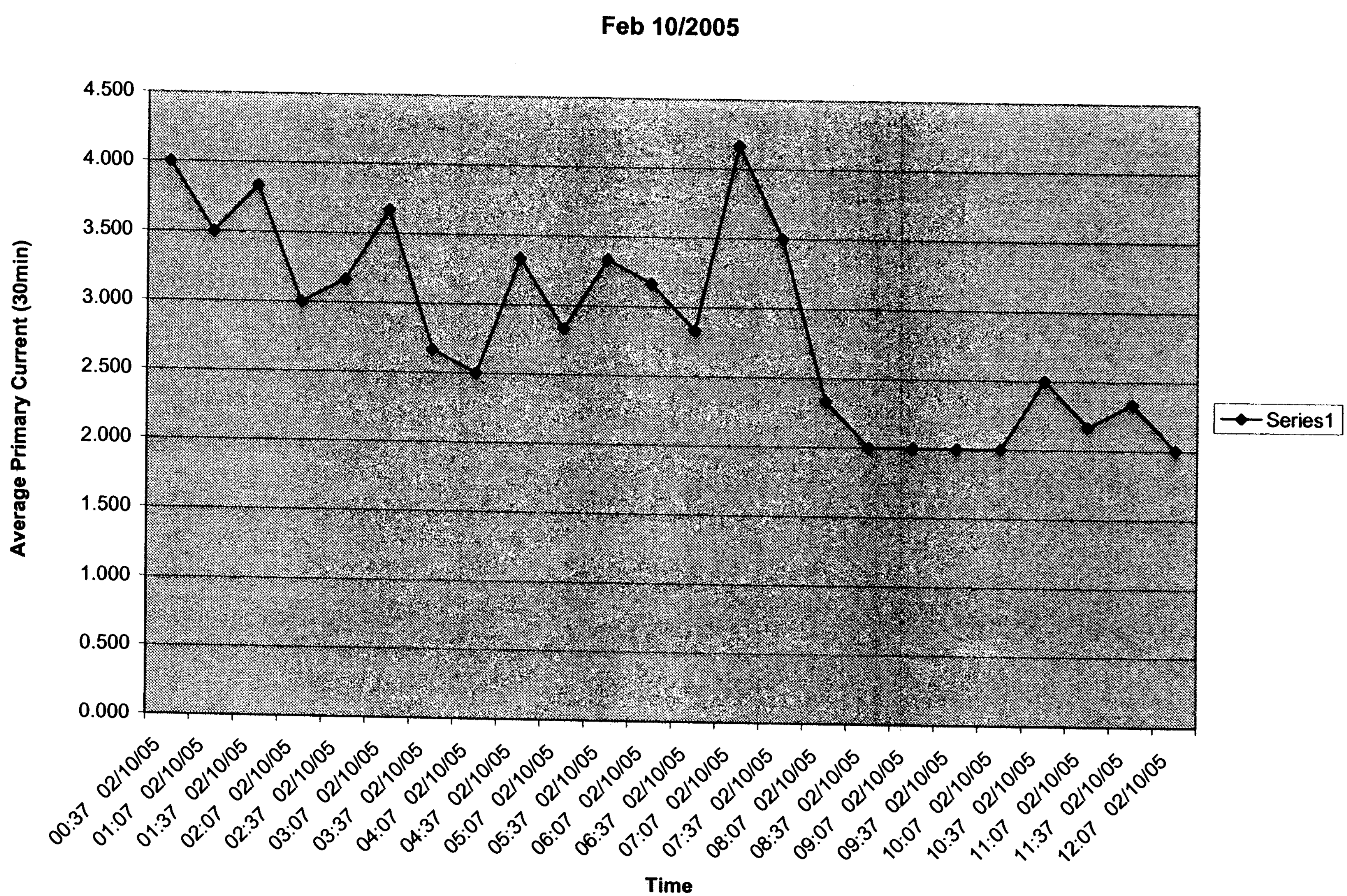
Average Primary Current (30min)
6.000
5.000
4.000
3.000
2.000
1.000
0.000
12:37 02/08/05
13:07 02/08/05
13:37 02/08/05
14:07 02/08/05
14:37 02/08/05
15:07 02/08/05
15:37 02/08/05
16:07 02/08/05
16:37 02/08/05
17:07 02/08/05
17:37 02/08/05
18:07 02/08/05
18:37 02/08/05
19:07 02/08/05
19:37 02/08/05
20:07 02/08/05
20:37 02/08/05
21:07 02/08/05
21:37 02/08/05
22:07 02/08/05
22:37 02/08/05
23:07 02/08/05
23:37 02/08/05
00:07 02/09/05
Time
Series1


Feb 9/2005
Average Primary Current (30min)
4.000
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
00:37 02/09/05
01:07 02/09/05
01:37 02/09/05
02:07 02/09/05
02:37 02/09/05
03:07 02/09/05
03:37 02/09/05
04:07 02/09/05
04:37 02/09/05
05:07 02/09/05
05:37 02/09/05
06:07 02/09/05
06:37 02/09/05
07:07 02/09/05
07:37 02/09/05
08:07 02/09/05
08:37 02/09/05
09:07 02/09/05
09:37 02/09/05
10:07 02/09/05
10:37 02/09/05
11:07 02/09/05
11:37 02/09/05
12:07 02/09/05
Time
Series1

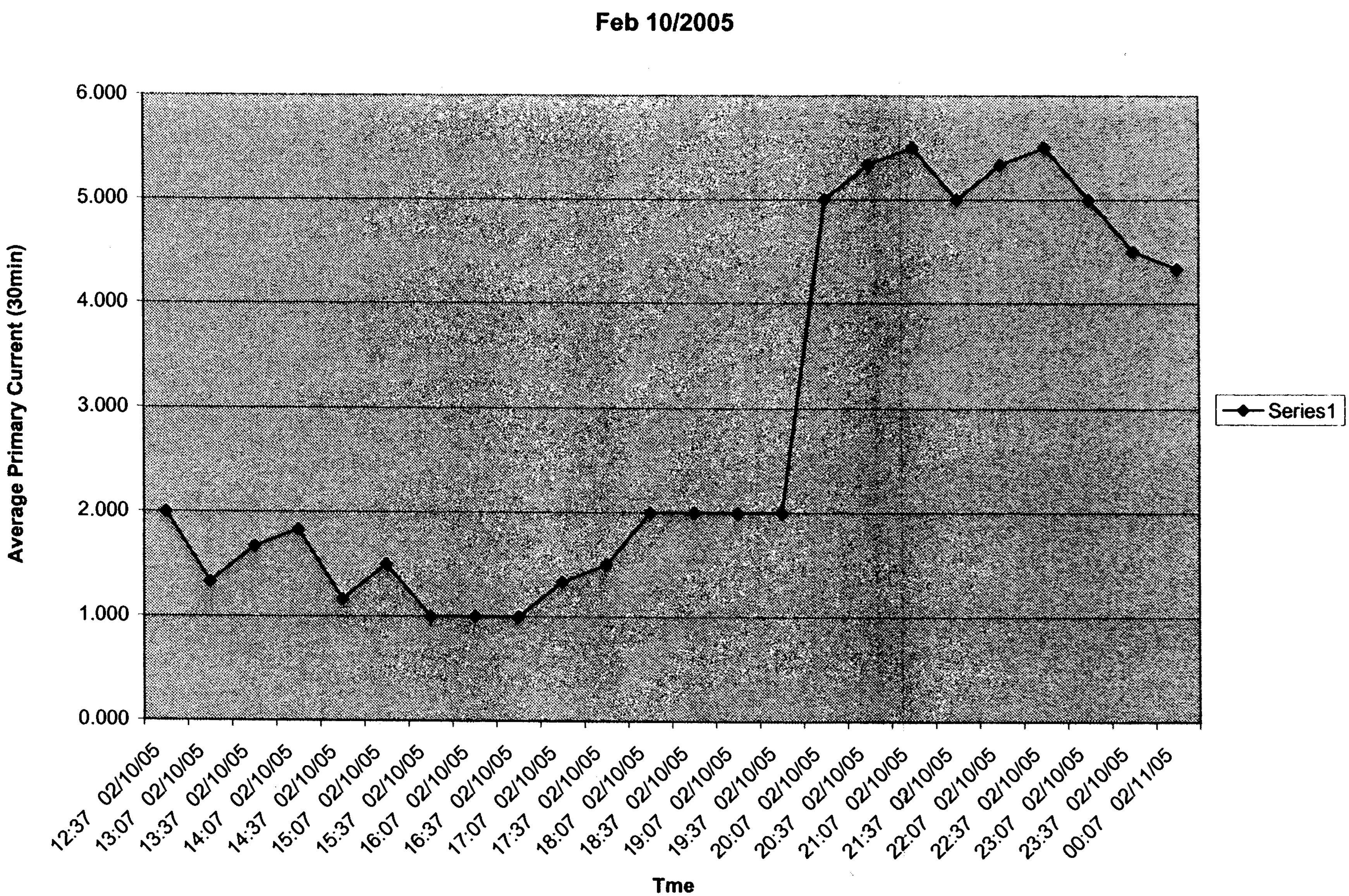
Feb 9/2005



Average Primary Current (30 min)
8.000
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
12:37 02/09/05
13:07 02/09/05
13:37 02/09/05
14:07 02/09/05
14:37 02/09/05
15:07 02/09/05
15:37 02/09/05
16:07 02/09/05
16:37 02/09/05
17:07 02/09/05
17:37 02/09/05
18:07 02/09/05
18:37 02/09/05
19:07 02/09/05
19:37 02/09/05
20:07 02/09/05
20:37 02/09/05
21:07 02/09/05
21:37 02/09/05
22:07 02/09/05
22:37 02/09/05
23:07 02/09/05
23:37 02/09/05
00:07 02/10/05
Time
Series1

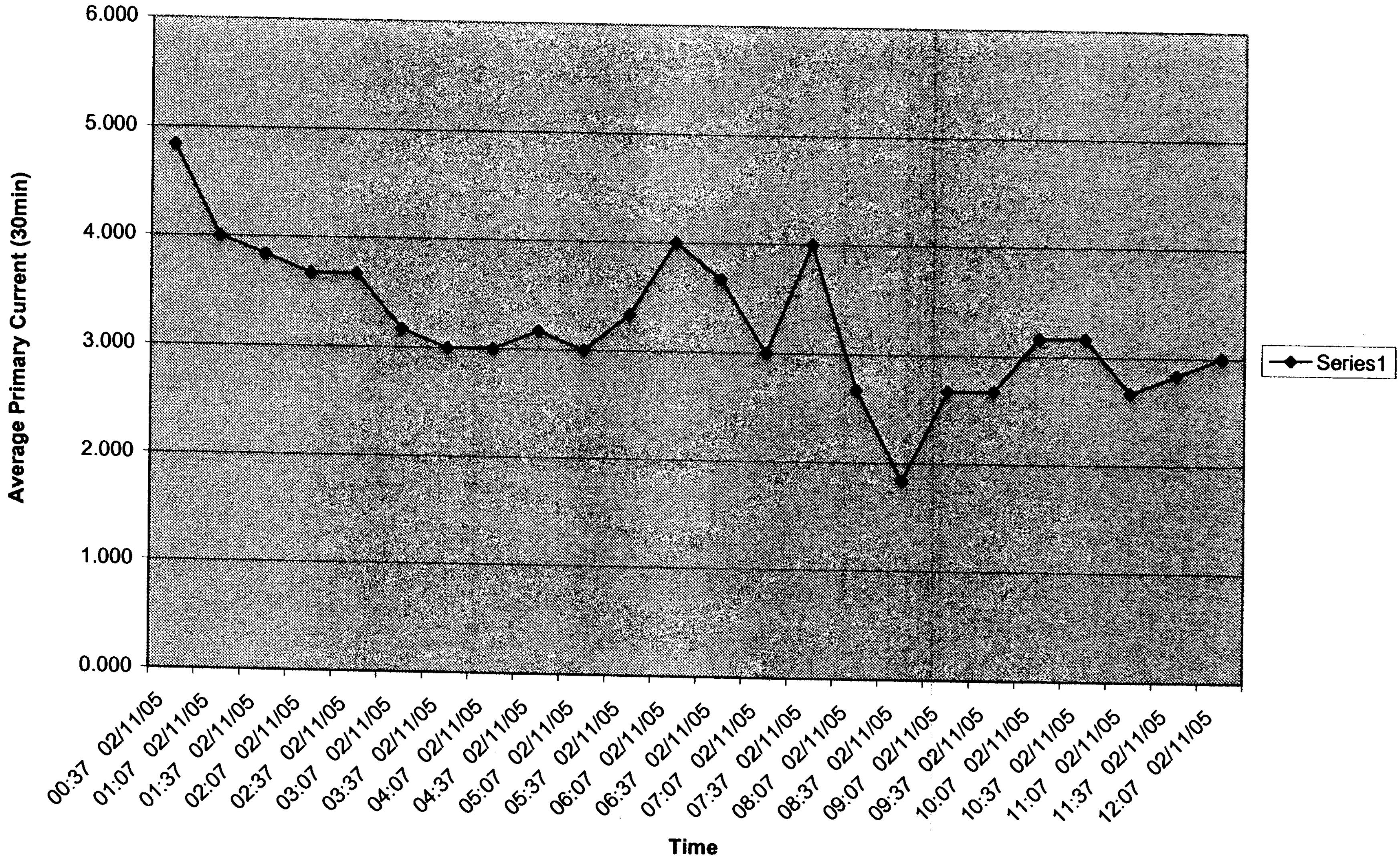


Feb 10/2005
Average Primary Current (30min)
4.500
4.000
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
00:37 02/10/05
01:07 02/10/05
01:37 02/10/05
02:07 02/10/05
02:37 02/10/05
03:07 02/10/05
03:37 02/10/05
04:07 02/10/05
04:37 02/10/05
05:07 02/10/05
05:37 02/10/05
06:07 02/10/05
06:37 02/10/05
07:07 02/10/05
07:37 02/10/05
08:07 02/10/05
08:37 02/10/05
09:07 02/10/05
09:37 02/10/05
10:07 02/10/05
10:37 02/10/05
11:07 02/10/05
11:37 02/10/05
12:07 02/10/05
Time
Series1

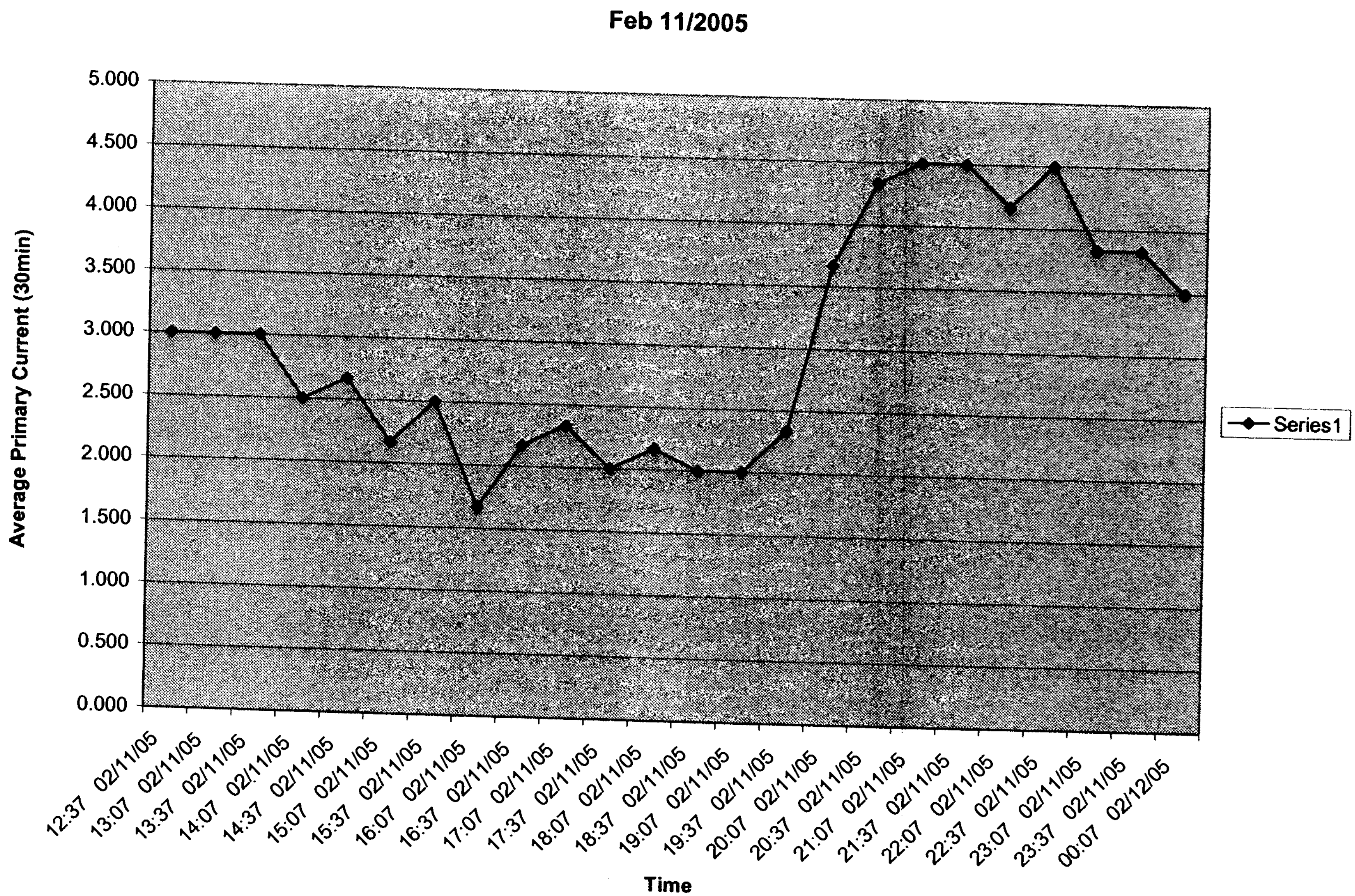


Feb 10/2005
Average Primary Current (30min)
6.000
5.000
4.000
3.000
2.000
1.000
0.000
12:37 02/10/05
13:07 02/10/05
13:37 02/10/05
14:07 02/10/05
14:37 02/10/05
15:07 02/10/05
15:37 02/10/05
16:07 02/10/05
16:37 02/10/05
17:07 02/10/05
17:37 02/10/05
18:07 02/10/05
18:37 02/10/05
19:07 02/10/05
19:37 02/10/05
20:07 02/10/05
20:37 02/10/05
21:07 02/10/05
21:37 02/10/05
22:07 02/10/05
22:37 02/10/05
23:07 02/10/05
23:37 02/10/05
00:07 02/11/05
Tme
Series1

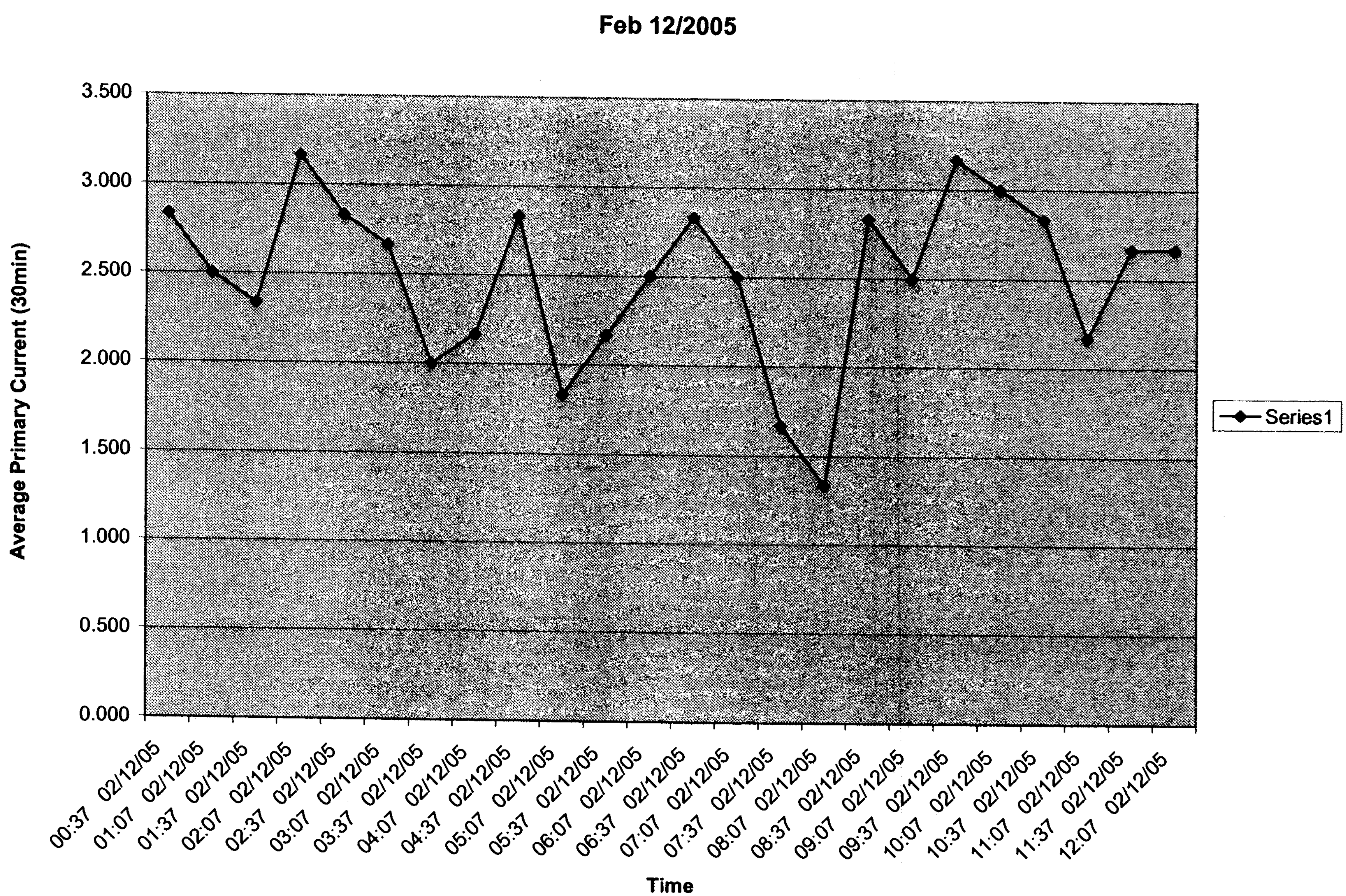
Feb 11/2005

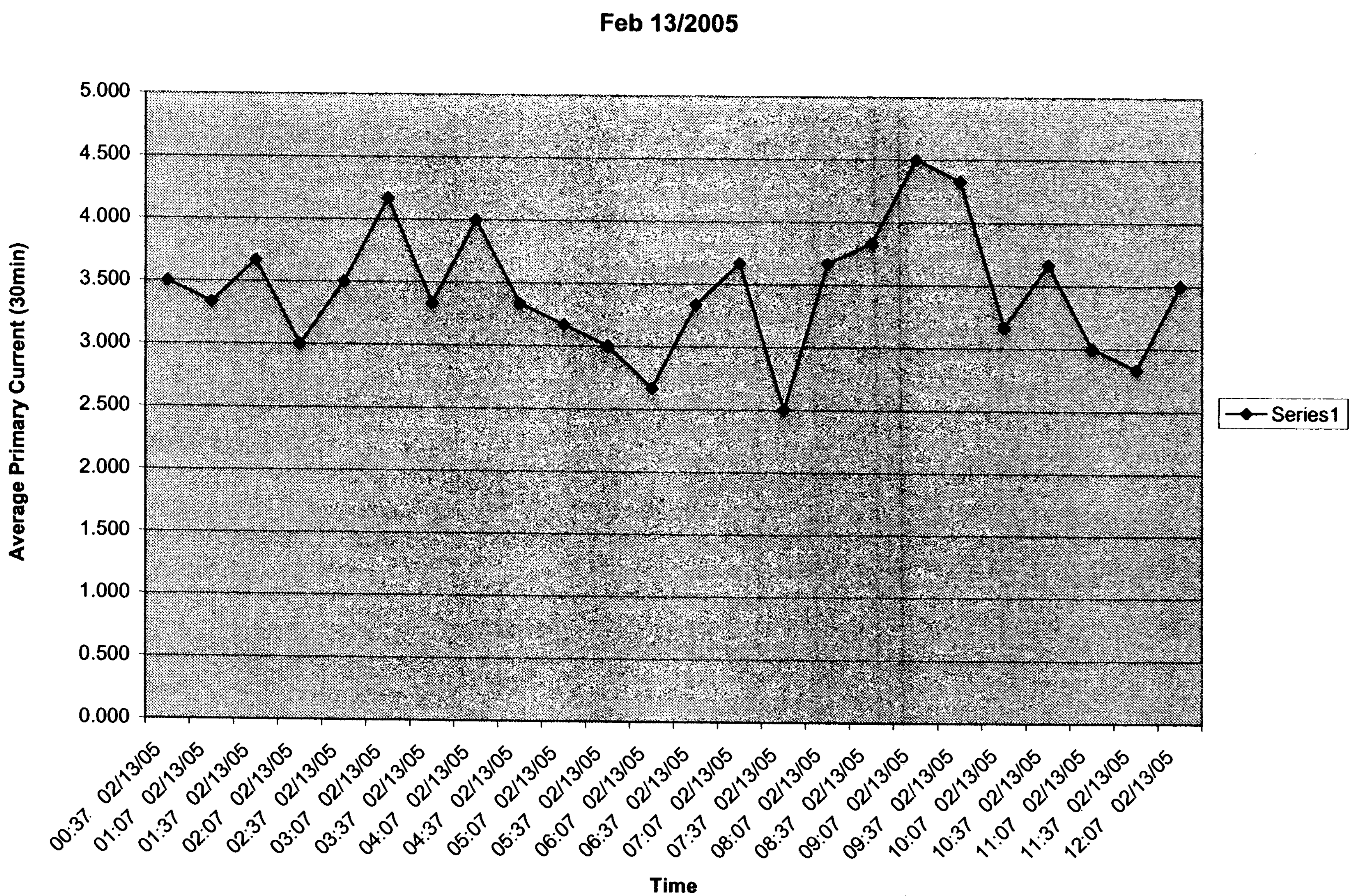


Average Primary Current (30min)
6.000
5.000
4.000
3.000
2.000
1.000
0.000
00:37 02/11/05
01:07 02/11/05
01:37 02/11/05
02:07 02/11/05
02:37 02/11/05
03:07 02/11/05
03:37 02/11/05
04:07 02/11/05
04:37 02/11/05
05:07 02/11/05
05:37 02/11/05
06:07 02/11/05
06:37 02/11/05
07:07 02/11/05
07:37 02/11/05
08:07 02/11/05
08:37 02/11/05
09:07 02/11/05
09:37 02/11/05
10:07 02/11/05
10:37 02/11/05
11:07 02/11/05
11:37 02/11/05
12:07 02/11/05
Time
Series1

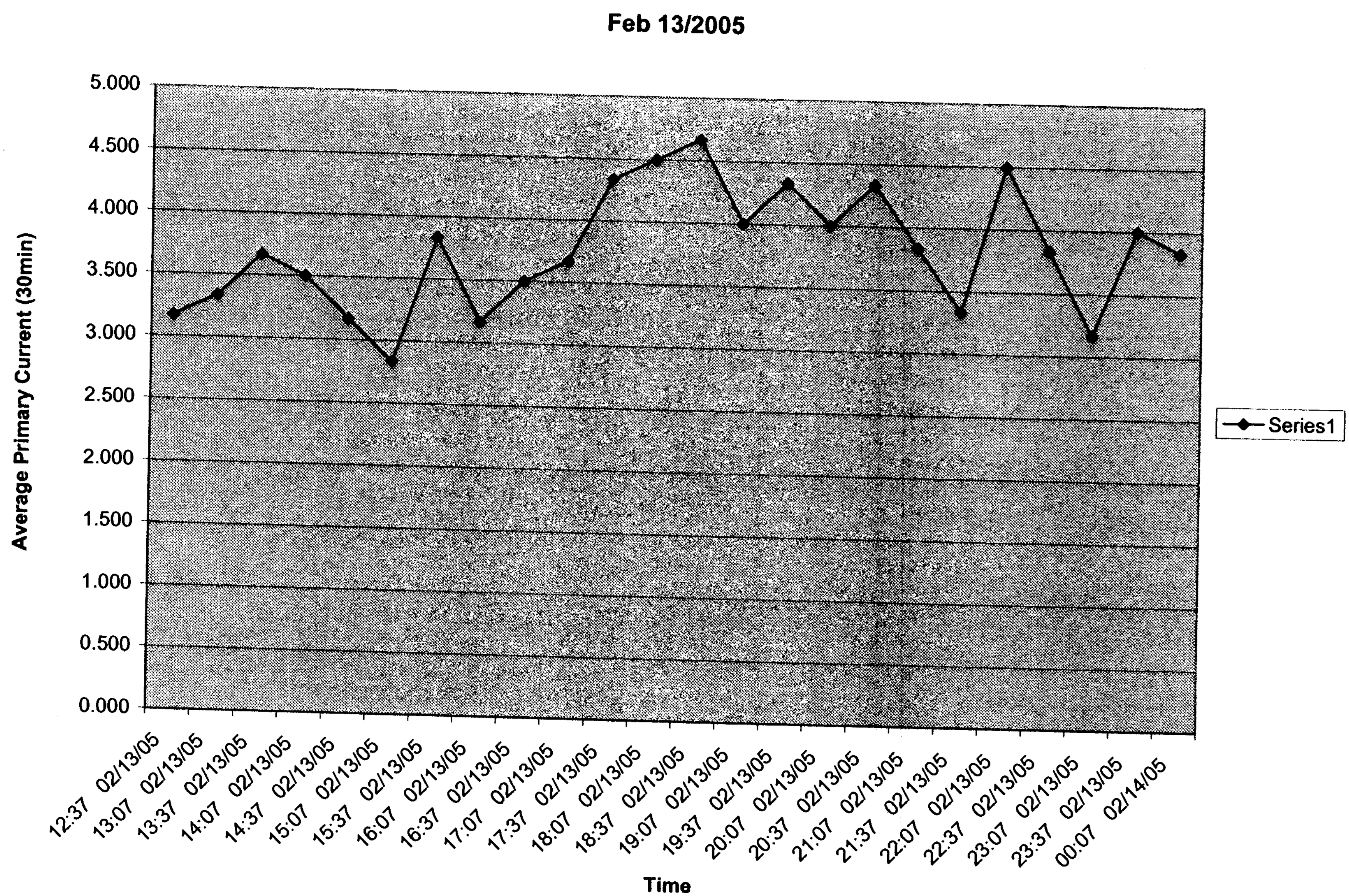


Feb 11/2005
Average Primary Current (30min)
5.000
4.500
4.000
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
12:37 02/11/05
13:07 02/11/05
13:37 02/11/05
14:07 02/11/05
14:37 02/11/05
15:07 02/11/05
15:37 02/11/05
16:07 02/11/05
16:37 02/11/05
17:07 02/11/05
17:37 02/11/05
18:07 02/11/05
18:37 02/11/05
19:07 02/11/05
19:37 02/11/05
20:07 02/11/05
20:37 02/11/05
21:07 02/11/05
21:37 02/11/05
22:07 02/11/05
22:37 02/11/05
23:07 02/11/05
23:37 02/11/05
00:07 02/12/05
Time
Series1


Feb 12/2005
Average Primary Current (30min)
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
Series1
00:37 02/12/05
01:07 02/12/05
01:37 02/12/05
02:07 02/12/05
02:37 02/12/05
03:07 02/12/05
03:37 02/12/05
04:07 02/12/05
04:37 02/12/05
05:07 02/12/05
05:37 02/12/05
06:07 02/12/05
06:37 02/12/05
07:07 02/12/05
07:37 02/12/05
08:07 02/12/05
08:37 02/12/05
09:07 02/12/05
09:37 02/12/05
10:07 02/12/05
10:37 02/12/05
11:07 02/12/05
11:37 02/12/05
12:07 02/12/05
Time

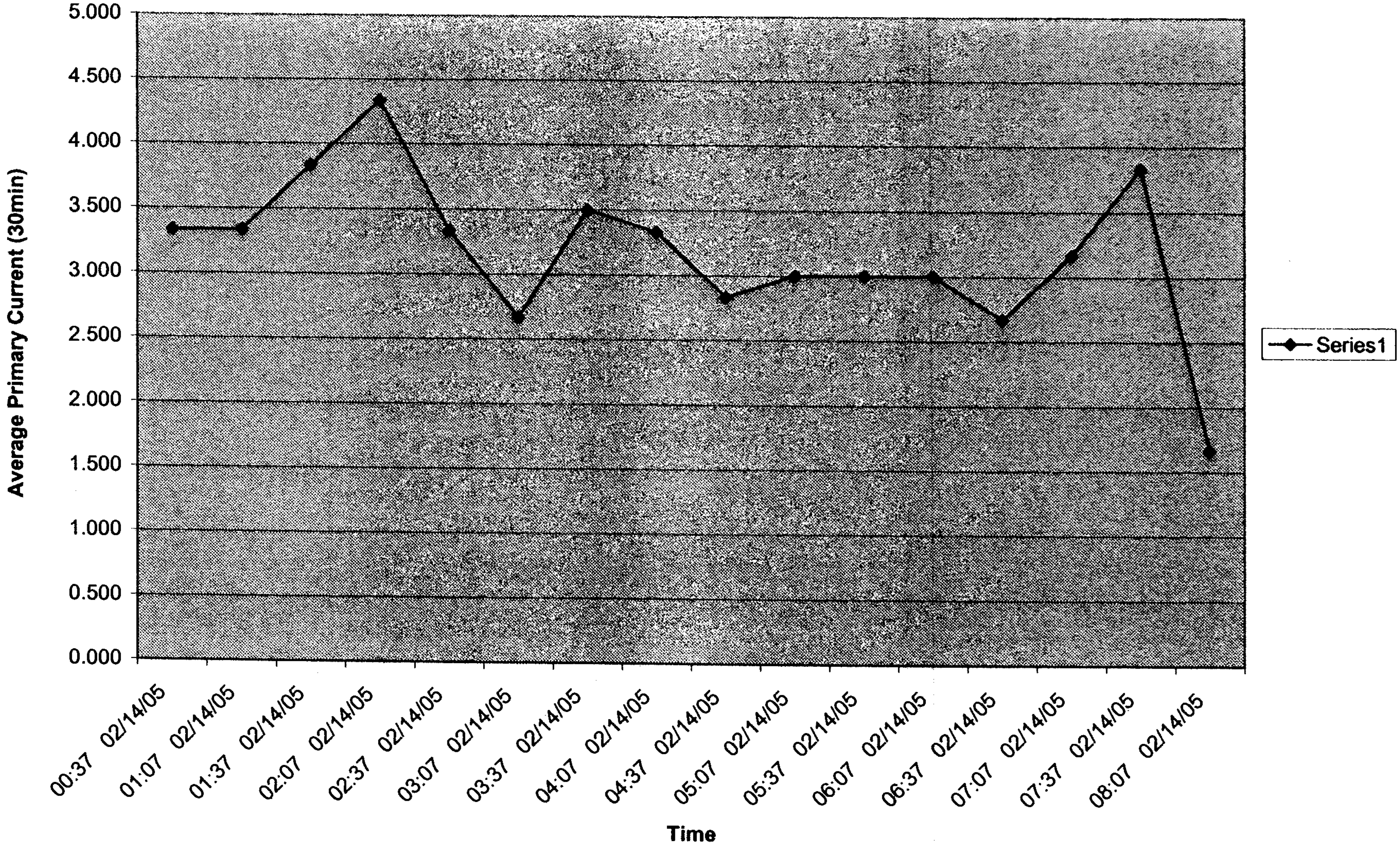


Feb 13/2005
Average Primary Current (30min)
5.000
4.500
4.000
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
00:37 02/13/05
01:07 02/13/05
01:37 02/13/05
02:07 02/13/05
02:37 02/13/05
03:07 02/13/05
03:37 02/13/05
04:07 02/13/05
04:37 02/13/05
05:07 02/13/05
05:37 02/13/05
06:07 02/13/05
06:37 02/13/05
07:07 02/13/05
07:37 02/13/05
08:07 02/13/05
08:37 02/13/05
09:07 02/13/05
09:37 02/13/05
10:07 02/13/05
10:37 02/13/05
11:07 02/13/05
11:37 02/13/05
12:07 02/13/05
Time
Series1



Feb 13/2005
Average Primary Current (30min)
5.000
4.500
4.000
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
12:37 02/13/05
13:07 02/13/05
13:37 02/13/05
14:07 02/13/05
14:37 02/13/05
15:07 02/13/05
15:37 02/13/05
16:07 02/13/05
16:37 02/13/05
17:07 02/13/05
17:37 02/13/05
18:07 02/13/05
18:37 02/13/05
19:07 02/13/05
19:37 02/13/05
20:07 02/13/05
20:37 02/13/05
21:07 02/13/05
21:37 02/13/05
22:07 02/13/05
22:37 02/13/05
23:07 02/13/05
23:37 02/13/05
00:07 02/14/05
Time
Series1

Feb 14/2005



5.000
4.500
4.000
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
Average Primary Current (30min)
Series1
00:37 02/14/05
01:07 02/14/05
01:37 02/14/05
02:07 02/14/05
02:37 02/14/05
03:07 02/14/05
03:37 02/14/05
04:07 02/14/05
04:37 02/14/05
05:07 02/14/05
05:37 02/14/05
06:07 02/14/05
06:37 02/14/05
07:07 02/14/05
07:37 02/14/05
08:07 02/14/05
Time