

Comparing POT

Eric Prebys, 11/21/06

Procedure

In an effort to investigate the vanishing anti-neutrino problem, I've tried to cross check proton sums in a number of ways and compare them to the results which Heather got from the Analysis Framework. For all runs in 2006 (runs 12736 to 14660), I've looked at the following:

- Integrated Booster charge signal from the Booster IRM system for \$1D events. Because this is the same way the B87 program calculates charge, I refer to this total as "B87", although it is actually done in a separate, standalone program.
- Individual TOR860 and TOR875 signals, as read and summed from the "mboon" logger. Unfortunately, these are only available from about two months ago (starting at run 14434, 9/17/06). Generally, I average these two and refer to the result as "average toroid".
- Protons stored in the "boodb_beam_minbymin" database table, summed for each run. These are referred to as "DB".

In all cases, the start and end run times were taken from the "boodb_run_info" database. No quality cuts were made to the data, but according to Heather's analysis, this should only result in a ~2% effect.

Database Issues

Appendix A shows issues found in the "boodb_run_info" table. In one case (run 13629), the end time was taken from the final subrun, even though it was not flagged as "is_last". In addition, 17 other runs had no database information at all. These runs were also missing POT data, so it was assumed that they failed for some reason and were not considered further.

Of the remaining runs, I found 82, listed in Appendix B, that had charge recorded by B87, but no POT in the "boone_beam_minbymin" database. As can be seen, sometimes the charge discrepancy is quite large, and indeed makes quite a difference for the multi-run totals.

Results

Figure 1 shows "DB" POT compared to the "B87" POT for individual runs. There is general agreement, but numerous outliers. In particular, the zero values for "DB" are cases where there was no information in "boodb_beam_minbymin". Although there are small outliers in B87, in only one case was B87 information entirely missing for a run with valid DB data. Figure 2 shows a comparison of the DB data with the average toroid data for the period where the later exists. In general, there is good agreement, but there are again several runs with missing DB data. Note also that there is one case where the DB reports more charge than the summed toroid data. Figure 3 shows the same comparison for B87 with the toroids. In this case, there are no outliers at all.

Figure 4 shows the ratio of the DB POT to the B87 POT for runs where B87 POT is more than 5E16. There seems to be a general change in calibration and also a significant number of outliers in both directions.

Figures 5 and 6 show ratio comparisons of the DB and B87 to the toroid data. Again, there is reasonable overall agreement, but no outliers only in the in the DB case.

Comparison for Heather's Run Sets

Table 1 shows a detailed comparison of the various techniques applied to the run sets used in Heather's analysis. When summing large numbers of runs, the outliers and missing data can make a big difference. I've created an extra set, called "Patched DB", in which I substitute B87 data for runs in which the DB data is missing.

Figure 7 shows a comparison of the various techniques that I've applied. Frustratingly, nothing really seems to agree very well with anything else. Note in particular that the effect of the missing DB runs is almost 20% in some cases. Everything seems to agree much better for the last two running periods (which also include the toroid data).

Figure 8 shows a comparison of Heather's numbers with the other methods. Again, there is disagreement from set to set at the level of 10% or more. Again, agreement seems much better for the last two run sets.

Conclusions

For most runs, there is good agreement between the POT recorded in the minute by minute database, but missing data and outliers can lead to large discrepancies when summing large numbers of runs.

There are disagreements between all of the methods used and the POT as returned by Heather's analysis, at the 10% level, larger than that expected by calibration changes or data quality cuts.

For the period where toroid data exist, they agree very well with the B87 totals.

First Run	Last Run	Average Toroid	B87	DB	Patched DB	Heather
13200	13579	0	8795535	8482051	9150035.951	8345729
13580	13702	0	8005828	8762146	8923383.492	7030705
14200	14229	0	8714225	8081893	8599139.671	8304095
14230	14299	0	8819733	8618570	9088224.771	8065169
14300	14329	0	9575664	8470508	9906063.448	8638146
14330	14349	0	8245474	8002828	8002828.4	8783084
14350	14374	0	9142435	8819755	8821760.619	7878899
14375	14399	0	8958495	8234943	8714586.481	8451980
14400	14449	2641423.181	9548121	8988488	8988487.716	8701334
14450	14539	8818610.483	9156794	9063115	9063114.623	8806433
14540	14612	8372433.684	8562849	8470934	8589255.207	8232819

Table 1 – Total protons for run sets calculated in various ways. Note that the first nonzero sum for the toroids does not include the entire period.

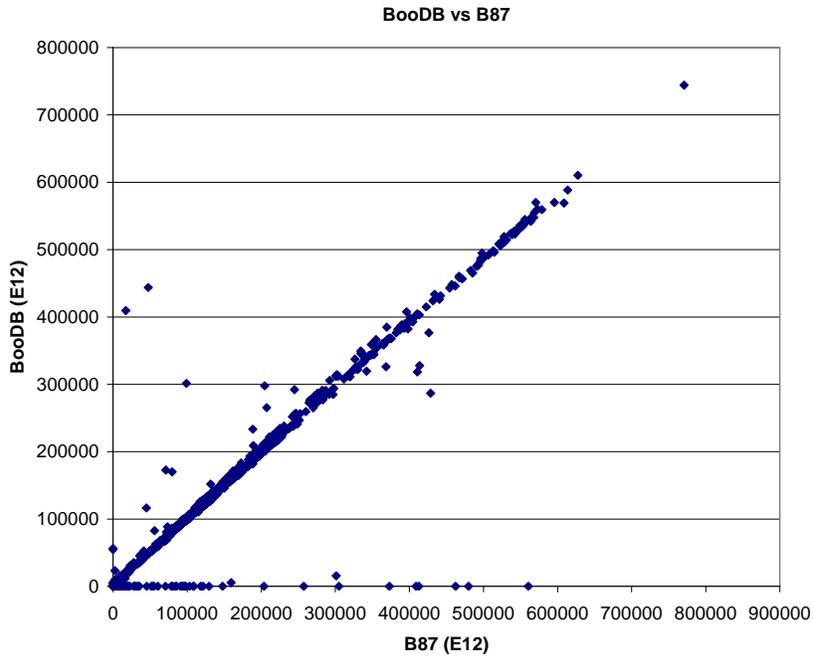


Figure 1 – Total protons as reported by boodb_beam_minbymin compared to B87 calculation. Zeroes represent missing runs.

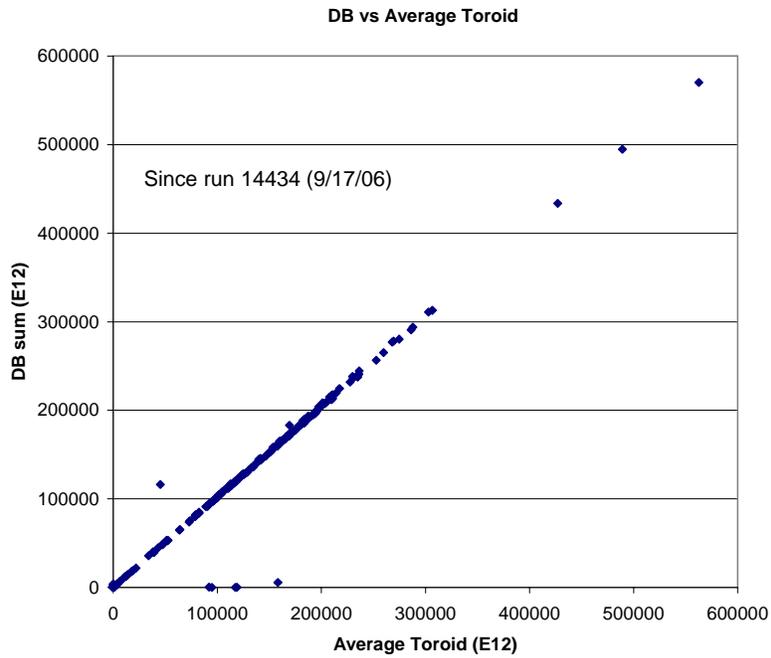


Figure 2 – Total protons as reported by the DB compared to the toroid average, for runs where the latter exists.

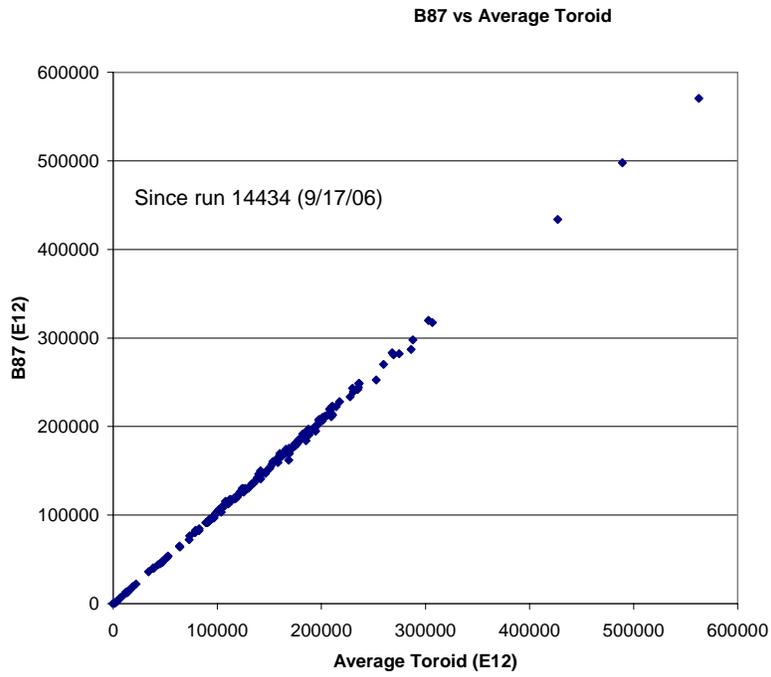


Figure 3 – Total protons as reported by B87 compared to the toroid average, for runs where the latter exists.

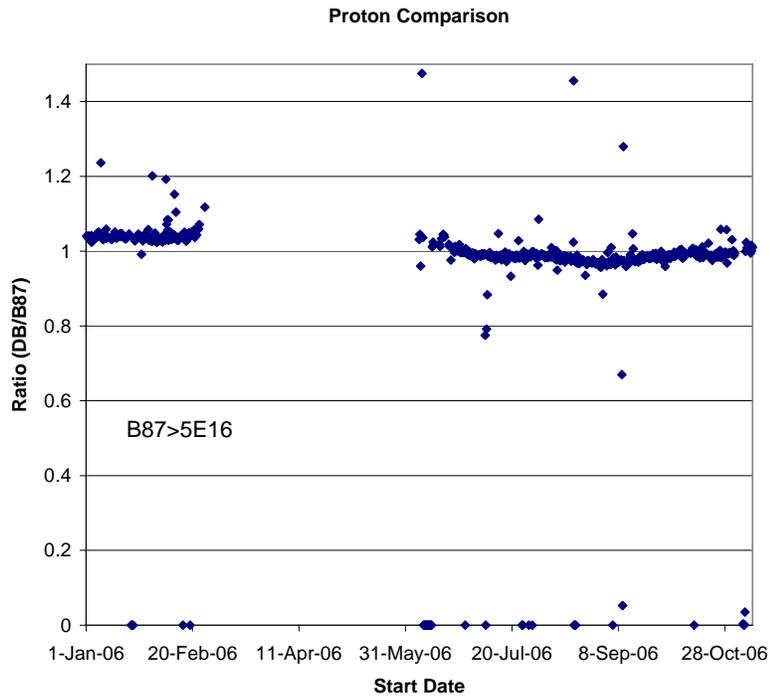


Figure 4 – Ratio of DB POT to that reported by B87 as a function of time for runs with significant B87 POT.

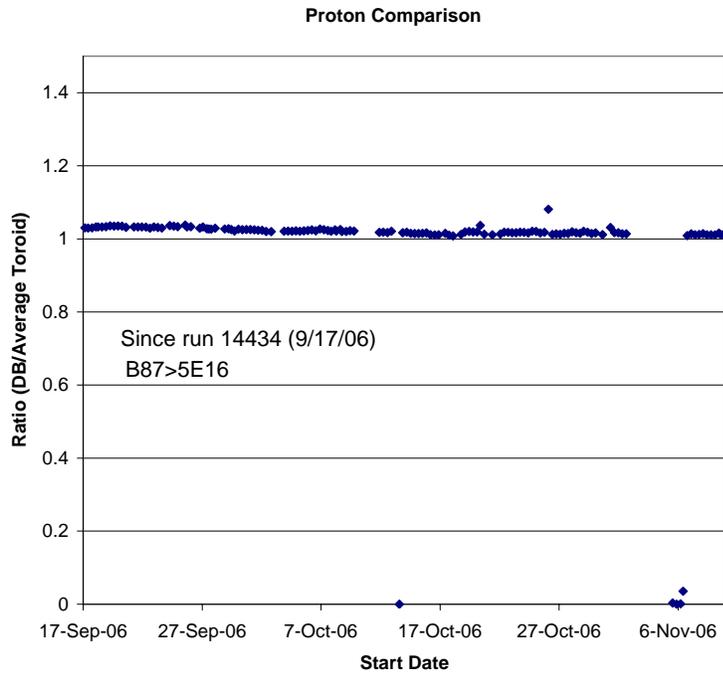


Figure 5 - Ratio of the DB POT to the average toroid sum.

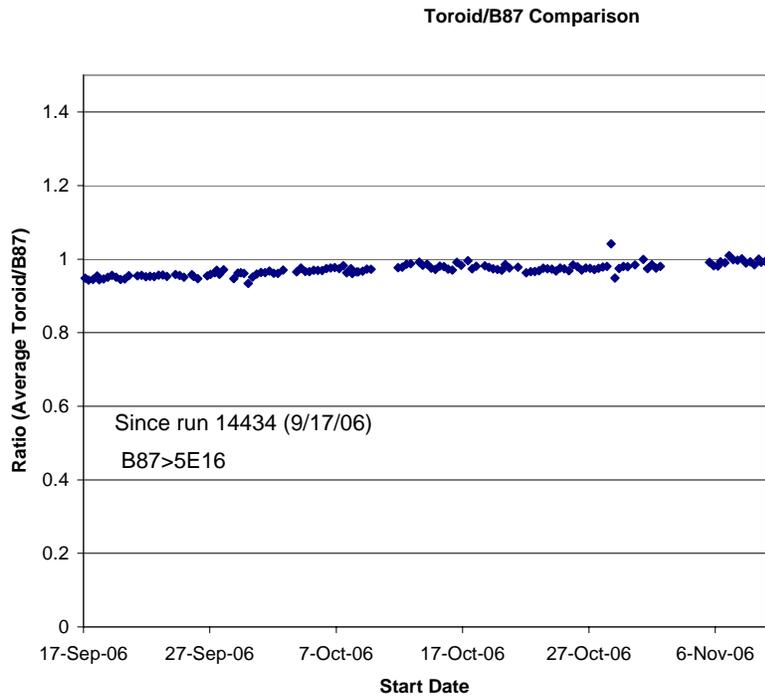


Figure 6 – Ratio of the Average toroid POT to B87.

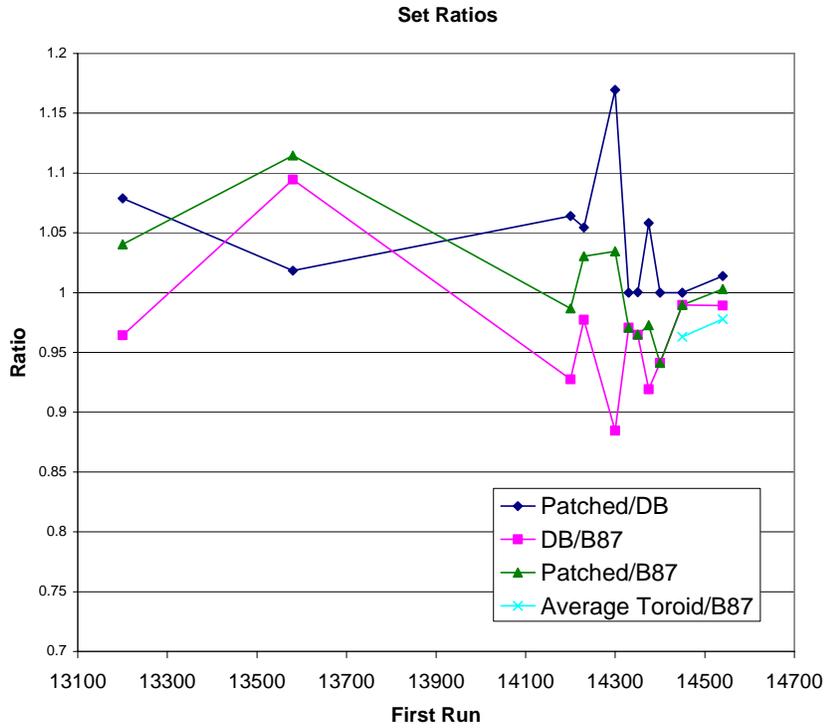


Figure 7 – Comparison of various ways of calculating total POT for the run sets used by Heather. Note that “Patched” refers of using the DB values when they exist and substituting B87 when they don’t.

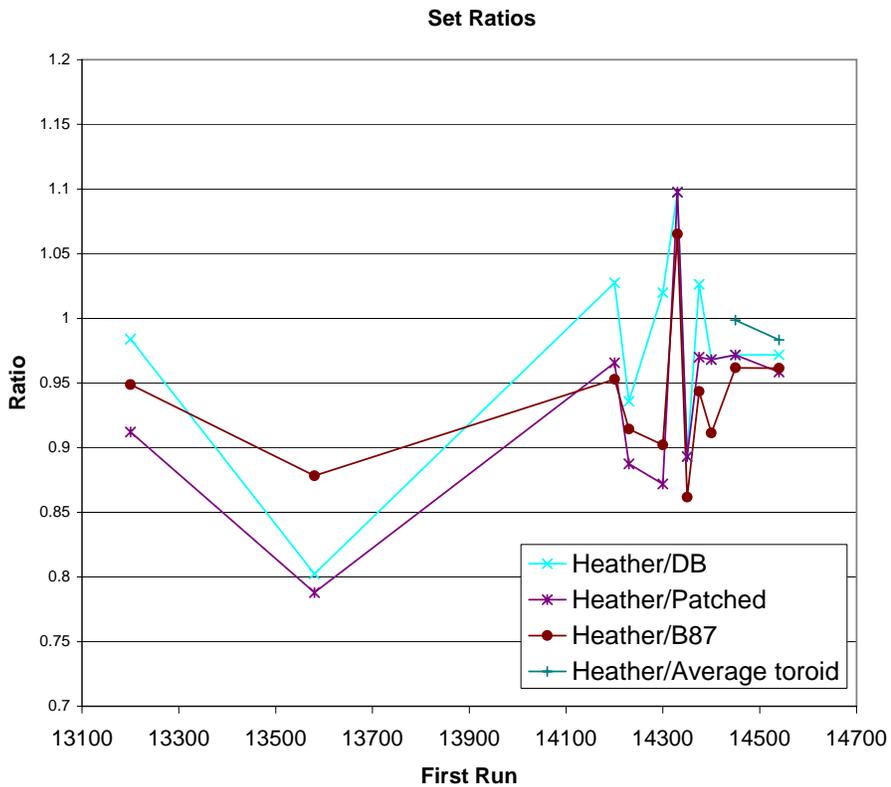


Figure 8 – Comparison of these techniques with the sums from Heather’s table.

Appendix A – Issues on boodb_run_info

The following problems were found when searching for run information in the “boodb_run_info” table for runs between 12736 and 14660:

Run 13629, last subrun 15 not flagged in boodb_run_info
Warning: Run 13630, no boodb_run_info entry
Warning: Run 13871, no boodb_run_info entry
Warning: Run 13889, no boodb_run_info entry
Warning: Run 13893, no boodb_run_info entry
Warning: Run 13894, no boodb_run_info entry
Warning: Run 13895, no boodb_run_info entry
Warning: Run 13896, no boodb_run_info entry
Warning: Run 13897, no boodb_run_info entry
Warning: Run 13898, no boodb_run_info entry
Warning: Run 13899, no boodb_run_info entry
Warning: Run 13973, no boodb_run_info entry
Warning: Run 14465, no boodb_run_info entry
Warning: Run 14466, no boodb_run_info entry
Warning: Run 14473, no boodb_run_info entry
Warning: Run 14474, no boodb_run_info entry
Warning: Run 14475, no boodb_run_info entry
Warning: Run 14478, no boodb_run_info entry

Appendix B – Issues in boodb_beam_minbymin

The following runs had protons reported by B87 (“POT”) but no data in the database:

Warning, Run 12765: Prot POT=34770.94697523117, NO minute by minute DB Data
Warning, Run 12825: Prot POT=174.03802800178528, NO minute by minute DB Data
Warning, Run 13016: Prot POT=2904.1244773864746, NO minute by minute DB Data
Warning, Run 13045: Prot POT=863.9476592540741, NO minute by minute DB Data
Warning, Run 13178: Prot POT=17216.845280885696, NO minute by minute DB Data
Warning, Run 13206: Prot POT=22207.913937807083, NO minute by minute DB Data
Warning, Run 13207: Prot POT=70770.39229440689, NO minute by minute DB Data
Warning, Run 13208: Prot POT=4923.26491522789, NO minute by minute DB Data
Warning, Run 13209: Prot POT=98214.96120917797, NO minute by minute DB Data
Warning, Run 13211: Prot POT=35370.23877739906, NO minute by minute DB Data
Warning, Run 13212: Prot POT=3217.126265525818, NO minute by minute DB Data
Warning, Run 13214: Prot POT=30186.910398960114, NO minute by minute DB Data
Warning, Run 13216: Prot POT=3689.6684374809265, NO minute by minute DB Data
Warning, Run 13221: Prot POT=1179.9787271022797, NO minute by minute DB Data
Warning, Run 13222: Prot POT=5507.185496926308, NO minute by minute DB Data
Warning, Run 13223: Prot POT=7077.915821313858, NO minute by minute DB Data
Warning, Run 13233: Prot POT=21413.741906762123, NO minute by minute DB Data
Warning, Run 13236: Prot POT=1940.9053163528442, NO minute by minute DB Data
Warning, Run 13238: Prot POT=1965.9109239578247, NO minute by minute DB Data
Warning, Run 13240: Prot POT=19550.867382884026, NO minute by minute DB Data
Warning, Run 13241: Prot POT=2443.147714972496, NO minute by minute DB Data
Warning, Run 13242: Prot POT=1974.206963300705, NO minute by minute DB Data
Warning, Run 13243: Prot POT=16418.96452832222, NO minute by minute DB Data
Warning, Run 13246: Prot POT=985.9413228034973, NO minute by minute DB Data
Warning, Run 13262: Prot POT=15940.915505766869, NO minute by minute DB Data
Warning, Run 13267: Prot POT=974.6568698883057, NO minute by minute DB Data
Warning, Run 13275: Prot POT=12689.675349235535, NO minute by minute DB Data
Warning, Run 13277: Prot POT=985.8340449333191, NO minute by minute DB Data
Warning, Run 13279: Prot POT=5917.527814626694, NO minute by minute DB Data

Warning, Run 13283: Prot POT=19605.654938459396, NO minute by minute DB Data
Warning, Run 13299: Prot POT=2439.403258562088, NO minute by minute DB Data
Warning, Run 13303: Prot POT=10008.706162691116, NO minute by minute DB Data
Warning, Run 13305: Prot POT=4060.9825897216797, NO minute by minute DB Data
Warning, Run 13383: Prot POT=1451.4492309093475, NO minute by minute DB Data
Warning, Run 13470: Prot POT=83953.21203744411, NO minute by minute DB Data
Warning, Run 13472: Prot POT=1117.4621436595917, NO minute by minute DB Data
Warning, Run 13473: Prot POT=1095.8893828392029, NO minute by minute DB Data
Warning, Run 13478: Prot POT=29402.383015036583, NO minute by minute DB Data
Warning, Run 13479: Prot POT=27782.387285232544, NO minute by minute DB Data
Warning, Run 13487: Prot POT=28857.265818476677, NO minute by minute DB Data
Warning, Run 13493: Prot POT=14419.981834888458, NO minute by minute DB Data
Warning, Run 13526: Prot POT=806.4015507698059, NO minute by minute DB Data
Warning, Run 13531: Prot POT=4029.933744907379, NO minute by minute DB Data
Warning, Run 13532: Prot POT=11020.771842718124, NO minute by minute DB Data
Warning, Run 13550: Prot POT=9598.277001976967, NO minute by minute DB Data
Warning, Run 13575: Prot POT=32786.55389666557, NO minute by minute DB Data
Warning, Run 13595: Prot POT=1221.627497792244, NO minute by minute DB Data
Warning, Run 13597: Prot POT=14239.272256851196, NO minute by minute DB Data
Warning, Run 13600: Prot POT=9969.637115716934, NO minute by minute DB Data
Warning, Run 13613: Prot POT=51845.20664680004, NO minute by minute DB Data
Warning, Run 13627: Prot POT=80493.90157723427, NO minute by minute DB Data
Warning, Run 13638: Prot POT=3467.72896361351, NO minute by minute DB Data
Warning, Run 14011: Prot POT=348.893390417099, NO minute by minute DB Data
Warning, Run 14041: Prot POT=300.3176281452179, NO minute by minute DB Data
Warning, Run 14061: Prot POT=53596.93299114704, NO minute by minute DB Data
Warning, Run 14063: Prot POT=60621.34857130051, NO minute by minute DB Data
Warning, Run 14064: Prot POT=85817.76733207703, NO minute by minute DB Data
Warning, Run 14065: Prot POT=78640.40137290955, NO minute by minute DB Data
Warning, Run 14066: Prot POT=94471.99192512035, NO minute by minute DB Data
Warning, Run 14067: Prot POT=96344.52661037445, NO minute by minute DB Data
Warning, Run 14068: Prot POT=103179.08831036091, NO minute by minute DB Data
Warning, Run 14069: Prot POT=91149.38220310211, NO minute by minute DB Data
Warning, Run 14070: Prot POT=55296.09822189808, NO minute by minute DB Data
Warning, Run 14071: Prot POT=9179.648831367493, NO minute by minute DB Data
Warning, Run 14072: Prot POT=147907.79488563538, NO minute by minute DB Data
Warning, Run 14073: Prot POT=203721.04663968086, NO minute by minute DB Data
Warning, Run 14074: Prot POT=257349.242182374, NO minute by minute DB Data
Warning, Run 14135: Prot POT=129602.23241901398, NO minute by minute DB Data
Warning, Run 14167: Prot POT=372921.8936161995, NO minute by minute DB Data
Warning, Run 14228: Prot POT=409033.3429980278, NO minute by minute DB Data
Warning, Run 14229: Prot POT=108213.55844664574, NO minute by minute DB Data
Warning, Run 14242: Prot POT=45578.509635686874, NO minute by minute DB Data
Warning, Run 14243: Prot POT=304957.17172563076, NO minute by minute DB Data
Warning, Run 14244: Prot POT=10133.918093681335, NO minute by minute DB Data
Warning, Run 14250: Prot POT=108984.92613434792, NO minute by minute DB Data
Warning, Run 14321: Prot POT=462302.5442444086, NO minute by minute DB Data
Warning, Run 14322: Prot POT=412630.6135201454, NO minute by minute DB Data
Warning, Run 14324: Prot POT=560622.5499732494, NO minute by minute DB Data
Warning, Run 14373: Prot POT=2005.1485333442688, NO minute by minute DB Data
Warning, Run 14391: Prot POT=479643.8412245512, NO minute by minute DB Data
Warning, Run 14551: Prot POT=118320.96835577488, NO minute by minute DB Data
Warning, Run 14628: Prot POT=96512.14332771301, NO minute by minute DB Data

