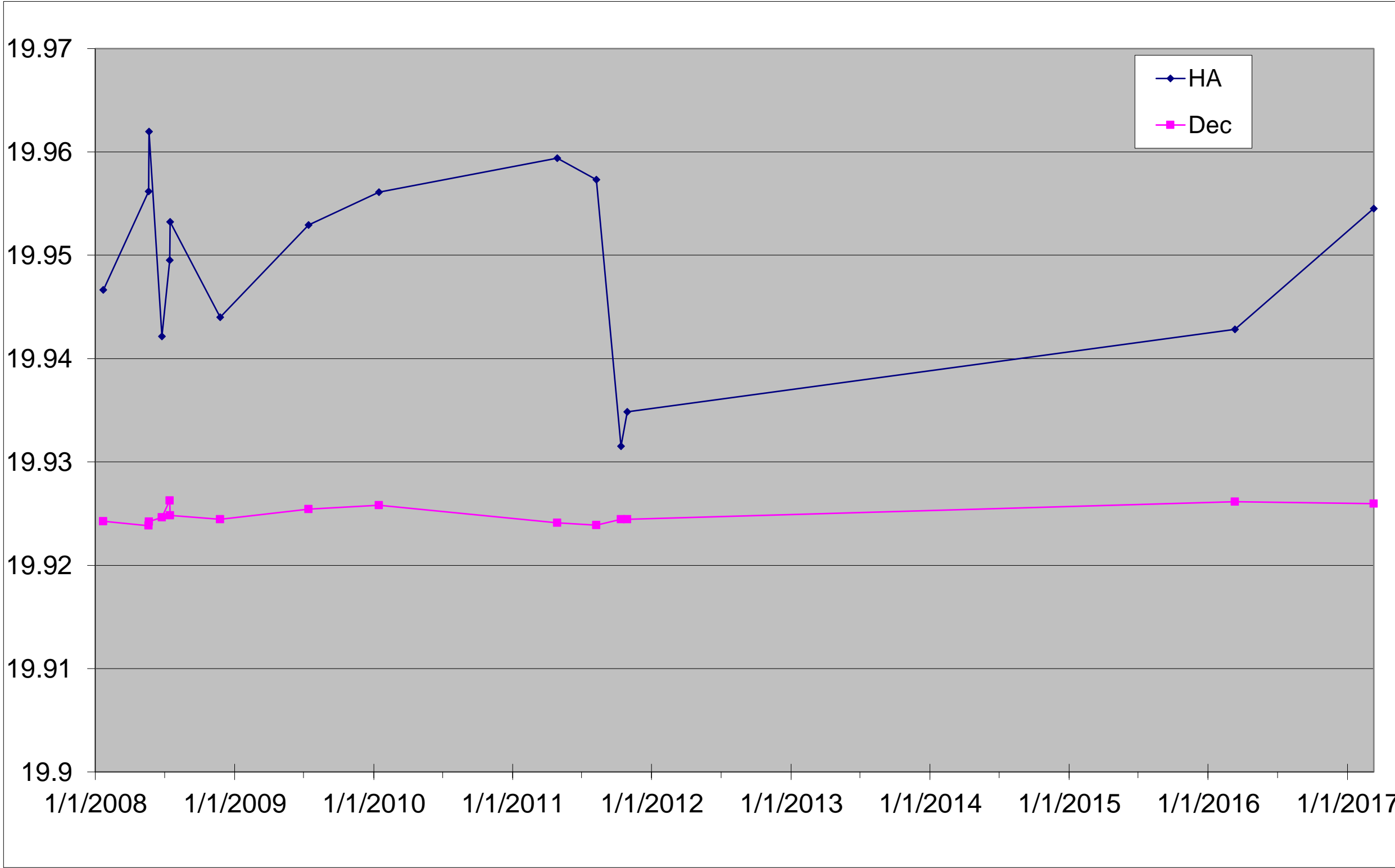


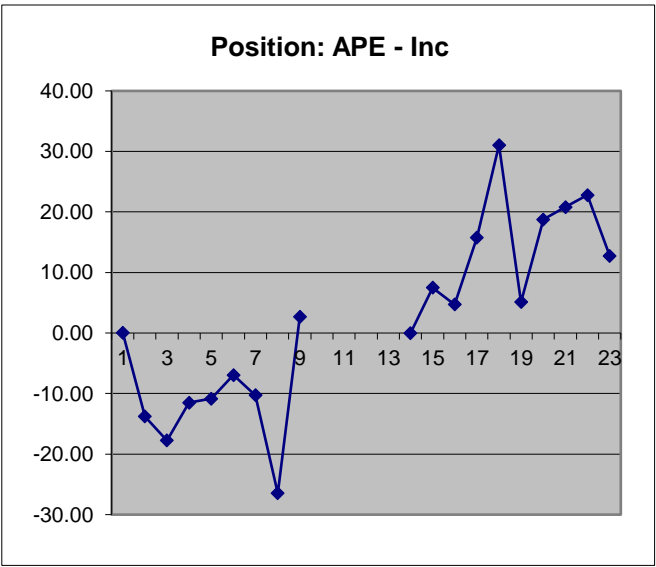
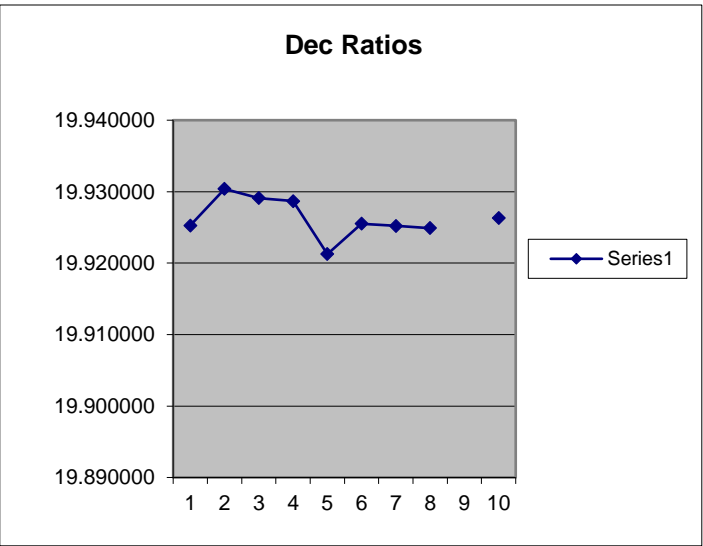
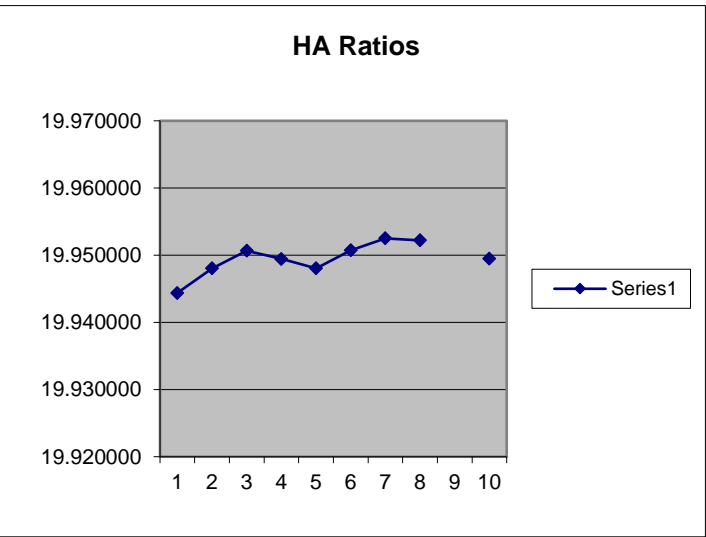
Date	HA	Dec	Comment
3/1/2001	19.939784	19.962039	IRTF hire J.Harwood to do a pointing run. Ration were also determined. See history/0103_tcs1
6/1/2005	19.930643	19.969538	orginial tcs3 encoder ratio were determine by hand. Used during deveopment
1/22/2008	19.946647	19.924248	used encoder_util. High (but constant) HA error - forgot to initialize pmac at Zenith at start. Error -mean are < 10 exept for #3, #8 (-21, 28 as).
5/20/2008	19.956165	19.923822	used encoder_util. 1 day before pointing run. HA gear clear; Dec gears not cleaned (daycrew to do tomorrow)
5/21/2008	19.961969	19.924234	used encoder_util. Dec bullgear was cleaned. Modified TCS3 to used these values.
6/24/2008	19.942145	19.924622	measured the encoders, as the 23June engineer showedn lots of errors in the HA ratios (150" at 3.0 hrs). Previous encoder measurement (of 19.961) is wrong?
7/14/2008	19.949509	19.926278	Measured encoder ration 1 day before tcs3 pointing run.
7/15/2008	19.953245	19.924808	for tcs3 engineering
11/24/2008	19.944008	19.924431	Nov 25 tcs3 pointing run
7/14/2009	19.952926	19.925443	July 14 tcs3 pointing run
1/14/2010	19.956092	19.925797	July 14 tcs3 pointing run
4/28/2011	19.959392	19.924109	March 28, 2011 pointing run
8/8/2011	19.957312404	19.923871	Aug 09, 2011 pointing run
10/12/2011	19.93150814	19.92443211	Oct 12, 2011 - after complains of bad tracking
10/28/2011	19.93485867	19.92446434	Oct 28, 2011 - for oct 29 pointing run.
3/11/2016	19.942813720	19.926165750	March 28, 2016 pointing run
3/10/2017	19.95453445	19.92594474	March 13, 2017 pointing run



7/14/2008

HA APES radians	Counts	radians to IDist APE(h Dist_as		Dist Cnt	Ratio	Using Ration
-0.000003636103	-16	0.000				0.05
-0.261691759162	-1076555	-1.000	-1.000	-53977.05	-1076539	19.944384
-0.523326068000	-2153070	-1.999	-0.999	-53965.95	-1076515	19.948041
-1.046452877000	-4305799	-3.997	-1.998	-107902.65	-2152729	19.950659
-0.000055996000	-14	0.000	3.997	215834.85	4305785	19.949443
0.261584131000	1076526	0.999	0.999	53967.15	1076540	19.948061
0.523182805000	2153040	1.998	0.999	53958.60	1076514	19.950740
1.046261618000	4305770	3.996	1.998	107892.75	2152730	19.952499
0.000009454000	-15	0.000	-3.996	-215805.00	-4305785	19.952202
Average					19.949504	

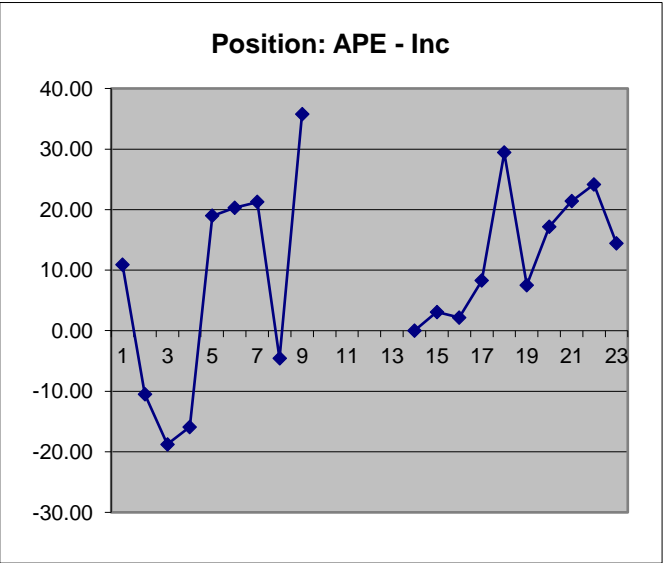
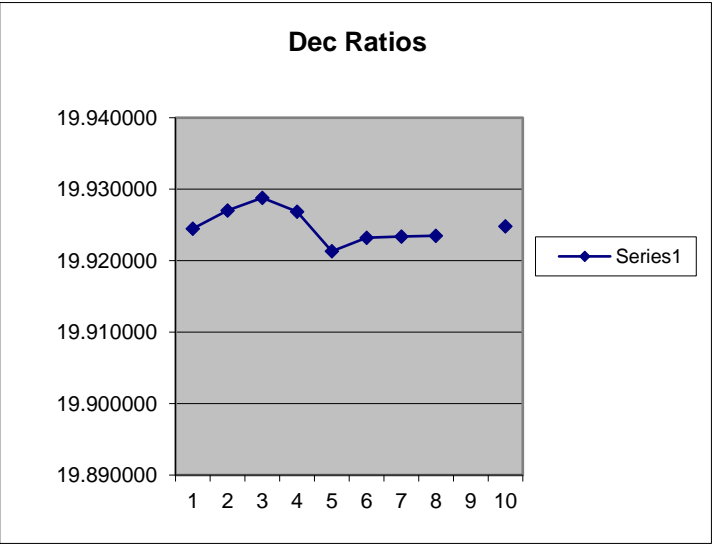
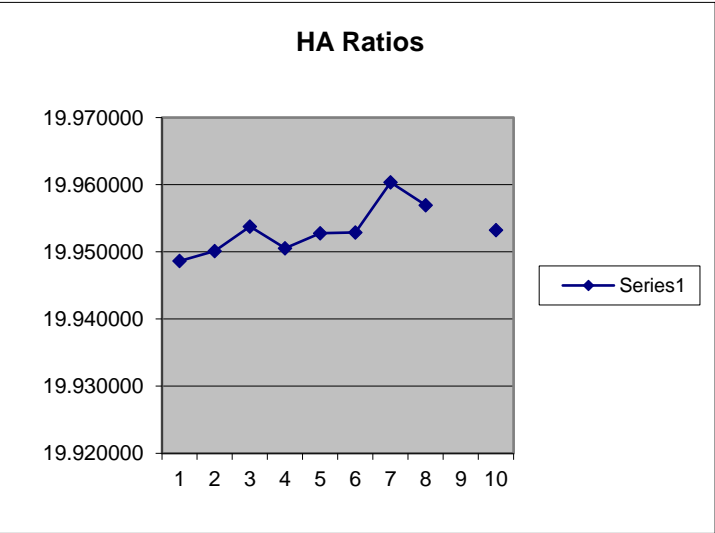
Dec APES radians	counts	radians to IDist APE(hr)		Dist Cnt	Ratio	Using Ration
0.349064881	1434539	20.000				7.51
0.086833524	356800	4.975	-15.025	-1077739	19.925253	4.70
-0.175322687	-720907	-10.045	-15.020	-1077707	19.930373	15.80
-0.699568204	-2875908	-40.082	-30.037	-2155001	19.929097	31.05
0.349053245	1434539	19.999	60.082	4310447	19.928676	5.11
0.611336962	2512277	35.027	15.028	1077738	19.921257	18.76
0.873556683	3589983	50.051	15.024	1077706	19.925527	20.82
1.048362074	4308410	60.067	10.016	718427	19.925200	22.78
0.349090091	1434538	20.001	-40.065	-2873872	19.924900	12.76
Average					19.926285	



7/15/2008

HA APES radians	Counts	radians to I Dist APE(h Dist_as			Dist Cnt	Ratio	Using Ration
0.176559974	726442	0.674					10.90
-0.272420635	-1120979	-1.041	-1.715	-92608.90	-1847421	19.948634	-10.51
-0.526677907	-2167249	-2.012	-0.971	-52444.33	-1046270	19.950108	-18.75
-1.060311741	-4363557	-4.050	-2.038	-110069.88	-2196308	19.953760	-15.91
0.176598838	726441	0.675	4.725	255131.12	5089998	19.950518	18.97
0.436486029	1796020	1.667	0.993	53605.58	1069579	19.952755	20.28
0.702597276	2891222	2.684	1.016	54889.38	1095202	19.952893	21.25
1.054175224	4338710	4.027	1.343	72518.16	1447488	19.960353	-4.58
-0.001066509	-5103	-0.004	-4.031	-217659.23	-4343813	19.956944	35.76
Average						19.953245	

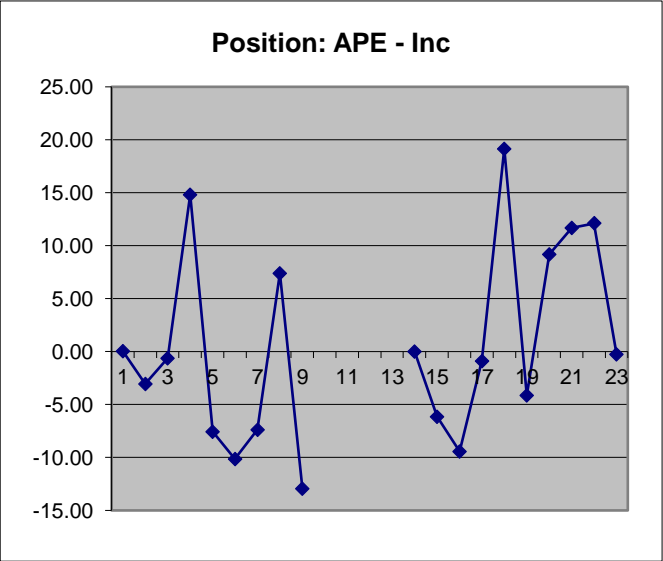
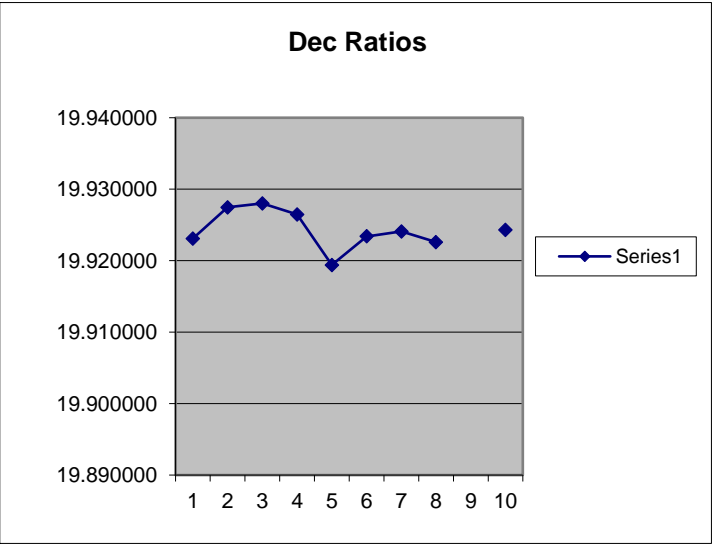
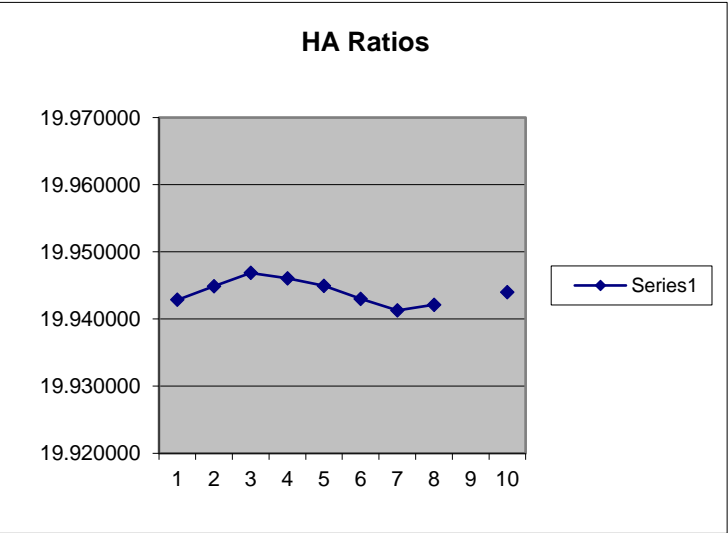
Dec APES radians	counts	radians to I Dist APE(hr)		Dist Cnt	Ratio	Using Ration
0.345051444	1418026	19.770				3.10
0.084583535	347577	4.846	-14.924	-1070449	19.924463	2.17
-0.184189387	-757144	-10.553	-15.400	-1104721	19.927002	8.28
-0.695988461	-2860950	-39.877	-29.324	-2103806	19.928796	29.41
0.340628011	1399759	19.517	59.394	4260709	19.926849	7.50
0.607053621	2494519	34.782	15.265	1094760	19.921307	17.16
0.863937299	3550172	49.500	14.718	1055653	19.923221	21.38
1.047797502	4305743	60.034	10.534	755571	19.923352	24.15
0.341526471	1403314	19.568	-40.466	-2902429	19.923475	14.40
Average						19.924808



11/25/2008

HA APES radians	Counts	radians to l Dist APE(h Dist_as			Dist Cnt	Ratio	Using Ration
-0.000124729	-514	0.000					0.04
-0.261909855	-1077370	-1.000	-1.000	-53997.06	-1076856	19.942864	-3.05
-0.523806249	-2154794	-2.001	-1.000	-54020.01	-1077424	19.944906	-0.62
-1.047517583	-4309518	-4.001	-2.000	-108023.22	-2154724	19.946860	14.82
-0.000011864	102	0.000	4.001	216063.56	4309620	19.946075	-7.56
0.261867493	1077459	1.000	1.000	54016.49	1077357	19.944963	-10.15
0.52377134	2154810	2.001	1.000	54021.55	1077351	19.942987	-7.38
1.047624287	4309514	4.002	2.001	108052.43	2154704	19.941283	7.39
-0.000083203	-84	0.000	-4.002	-216105.18	-4309598	19.942132	-12.95
Average						19.944008729	

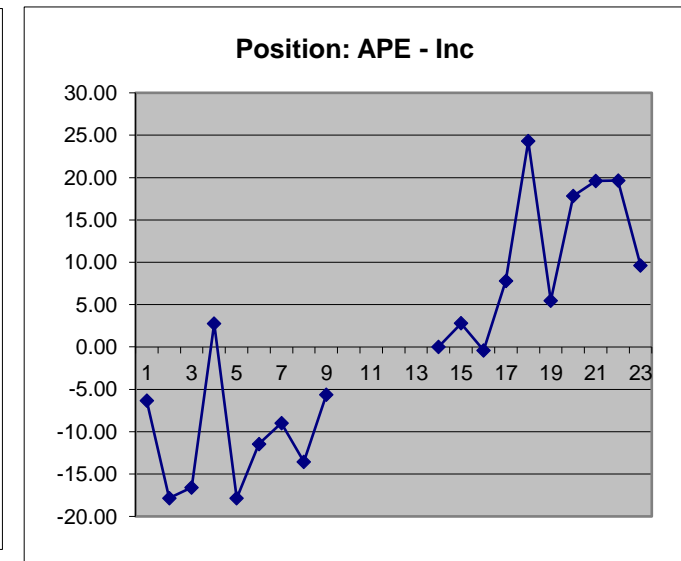
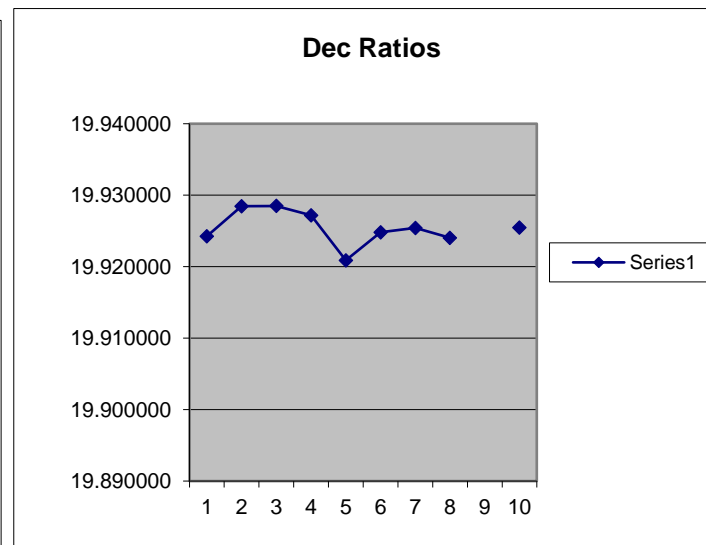
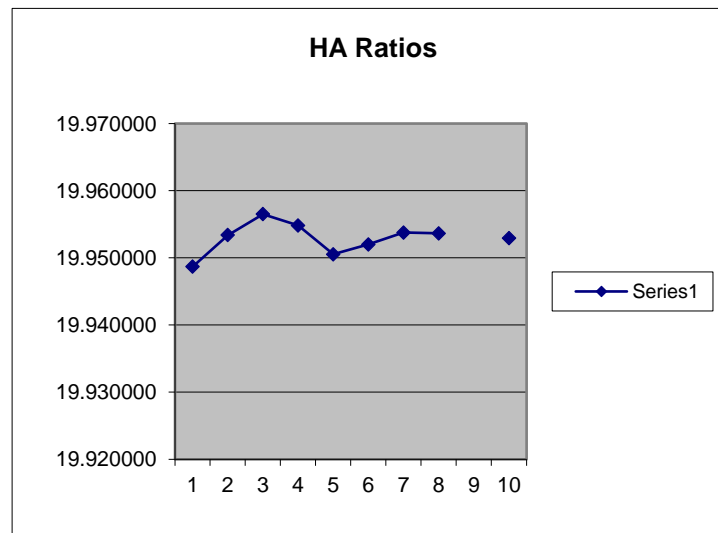
Dec APES radians	counts	radians to l Dist APE(l Dist (AS)			Dist Cnt	Ratio	Using Ration
0.349044598	1434586	19.999					-6.15
0.087237809	358708	4.998	-15.000	-54001.53	-1075878	19.923103	-9.44
-0.174533747	-717261	-10.000	-14.998	-53994.26	-1075969	19.927470	-0.89
-0.698049633	-2869146	-39.995	-29.995	-107982.90	-2151885	19.928016	19.15
0.349047268	1434557	19.999	59.994	215979.24	4303703	19.926466	-4.14
0.610930931	2510551	35.004	15.005	54017.38	1075994	19.919403	9.18
0.872758007	3586528	50.005	15.002	54005.71	1075977	19.923393	11.69
1.047305298	4303854	60.006	10.001	36002.96	717326	19.924082	12.11
0.34909478	1434675	20.002	-40.005	-144016.26	-2869179	19.922605	-0.26
Average						19.924317310	



7/14/2009

HA APES radians	Counts	radians to I Dist APE(h Dist_as			Dist Cnt	Ratio	Using Ration
-0.000044872	-58	0.000					-6.35
-0.261763451	-1076954	-1.000	-1.000	-53983.33	-1076896	19.948676	-17.85
-0.52344636	-2153958	-1.999	-1.000	-53975.97	-1077004	19.953396	-16.57
-1.046730725	-4307966	-3.998	-1.999	-107935.15	-2154008	19.956502	2.77
-0.000097045	-43	0.000	3.998	215883.69	4307923	19.954833	-17.86
0.261625793	1076972	0.999	1.000	53984.21	1077015	19.950556	-11.45
0.523327335	2153978	1.999	1.000	53979.82	1077006	19.952012	-8.98
1.046672391	4307941	3.998	1.999	107947.67	2153963	19.953771	-13.55
-0.000020915	26	0.000	-3.998	-215895.99	-4307915	19.953659	-5.62
Average						19.952925619	

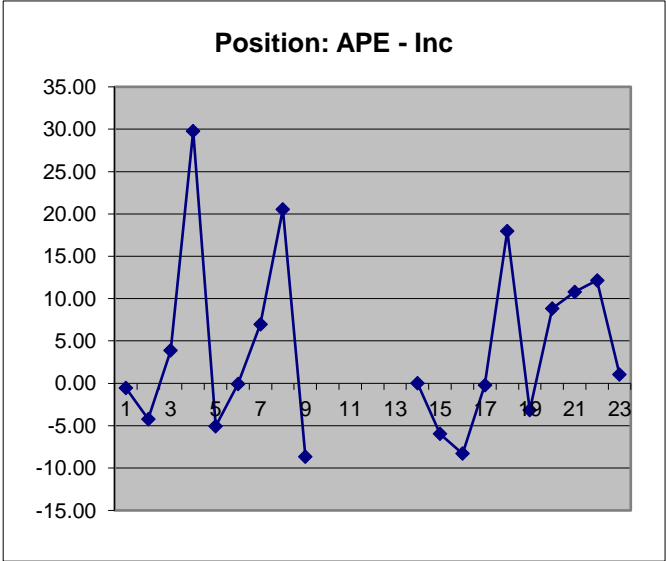
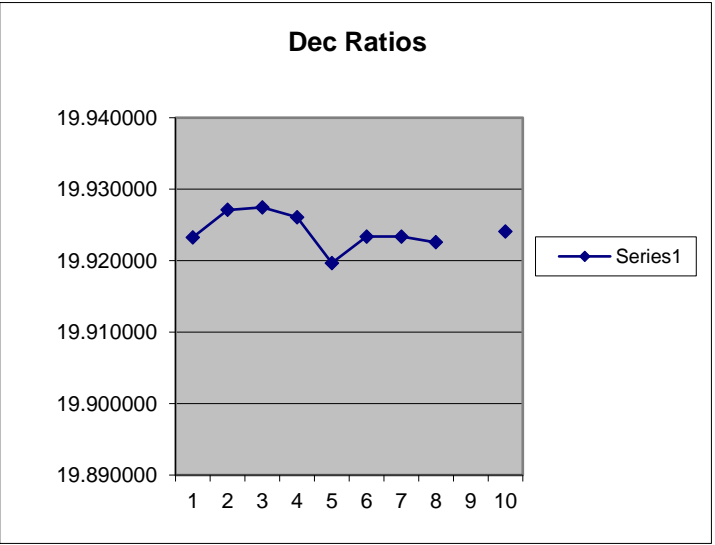
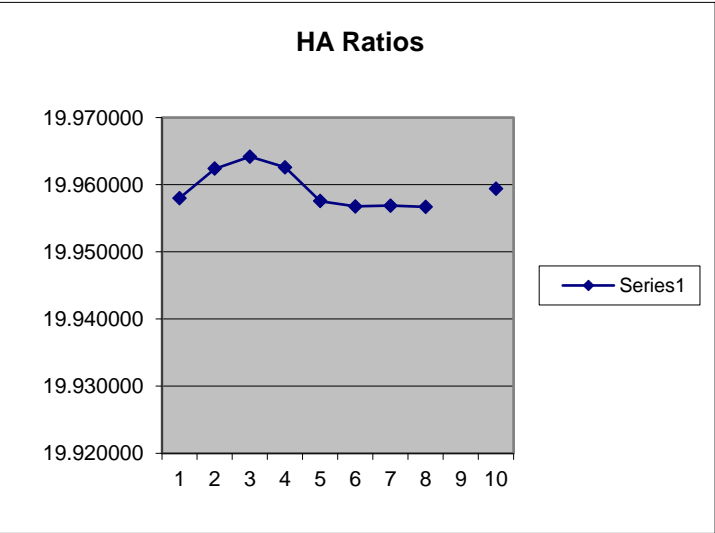
Dec APES radians	counts	radians to I Dist APE(C Dist (AS)			Dist Cnt	Ratio	Using Ration
0.349047268	1434500	19.999					2.79
0.087276245	358706	5.001	-14.998	-53994.15	-1075794	19.924270	-0.39
-0.174465949	-717196	-9.996	-14.997	-53988.20	-1075902	19.928465	7.79
-0.697941263	-2868965	-39.989	-29.993	-107974.53	-2151769	19.928486	24.28
0.349054741	1434477	19.999	59.988	215958.43	4303442	19.927178	5.48
0.610904773	2510413	35.002	15.003	54010.45	1075936	19.920887	17.83
0.872696615	3586321	50.002	15.000	53998.44	1075908	19.924797	19.59
1.047219883	4303596	60.001	9.999	35998.01	717275	19.925408	19.65
0.349110795	1434625	20.003	-39.999	-143995.34	-2868971	19.924055	9.62
Average						19.925443156	



4/28/2011

HA APES radians	Counts	radians to I Dist APE(h Dist_as			Dist Cnt	Ratio	Using Ration
-0.000014526	-49	0.000					-0.54
-0.261738961	-1077474	-1.000	-1.000	-53984.54	-1077425	19.958029	-4.23
-0.523417612	-2154946	-1.999	-1.000	-53975.10	-1077472	19.962391	3.88
-1.046716351	-4309842	-3.998	-1.999	-107938.11	-2154896	19.964181	29.78
-0.000025174	-3	0.000	3.998	215895.55	4309839	19.962611	-5.04
0.261718959	1077478	1.000	1.000	53988.60	1077481	19.957564	-0.10
0.523466287	2154930	1.999	1.000	53989.26	1077452	19.956783	6.96
1.046947099	4309788	3.999	2.000	107975.67	2154858	19.956885	20.53
-0.000061908	-82	0.000	-3.999	-215961.11	-4309870	19.956695	-8.66
Average						19.959392458	

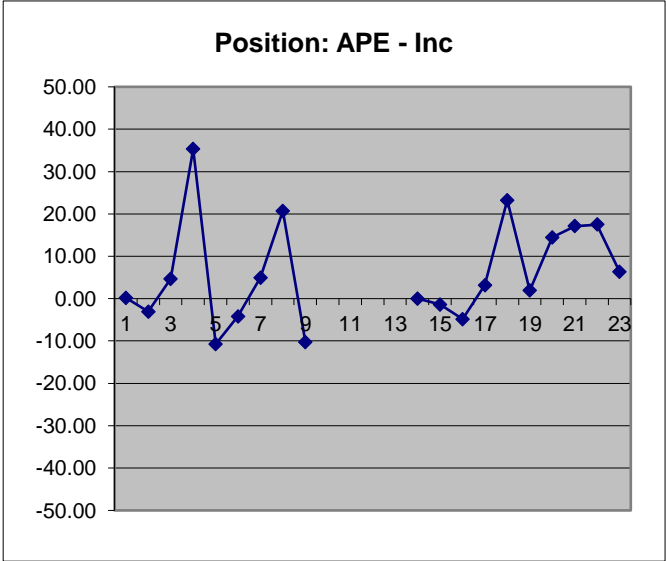
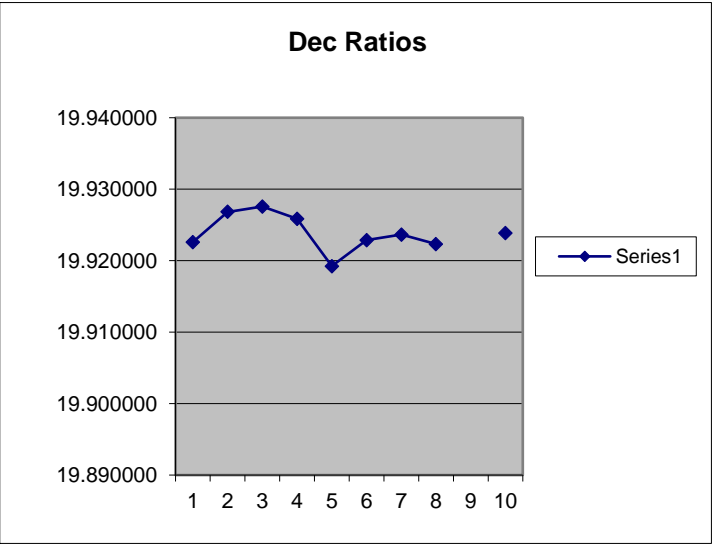
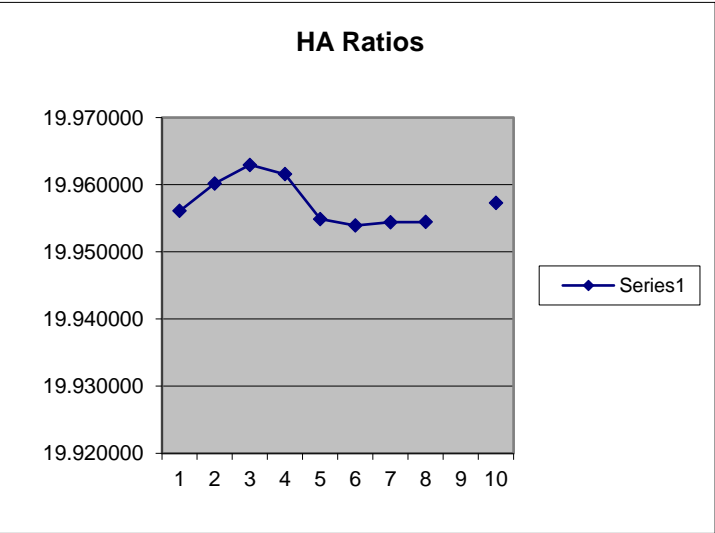
Dec APES radians	counts	radians to I Dist APE(C Dist (AS)			Dist Cnt	Ratio	Using Ration
0.3490462	1434574	19.999					-5.97
0.087258629	358767	5.000	-14.999	-53997.56	-1075807	19.923251	-8.29
-0.174521469	-717217	-9.999	-14.999	-53996.02	-1075984	19.927098	-0.19
-0.698069385	-2869174	-39.996	-29.997	-107989.51	-2151957	19.927463	17.99
0.349051005	1434538	19.999	59.996	215984.08	4303712	19.926061	-3.17
0.610929863	2510527	35.004	15.005	54016.39	1075989	19.919676	8.85
0.872752134	3586484	50.005	15.001	54004.72	1075957	19.923388	10.80
1.047302095	4303795	60.006	10.001	36003.51	717311	19.923361	12.15
0.349117735	1434728	20.003	-40.003	-144010.86	-2869067	19.922574	1.06
Average						19.924108937	



4/28/2011

HA APES radians	Counts	radians to I Dist APE(h Dist_as			Dist Cnt	Ratio	Using Ration
-0.000011864	-53	0.000					0.21
-0.261848632	-1077836	-1.000	-1.000	-54007.71	-1077783	19.956095	-3.09
-0.523648665	-2155689	-2.000	-1.000	-54000.13	-1077853	19.960192	4.70
-1.047162485	-4311340	-4.000	-2.000	-107982.48	-2155651	19.962971	35.32
-0.000037951	58	0.000	4.000	215984.94	4311398	19.961568	-10.73
0.261828097	1077897	1.000	1.000	54013.75	1077839	19.954901	-4.21
0.523699469	2155705	2.000	1.000	54014.85	1077808	19.953921	4.97
1.047425709	4311305	4.001	2.000	108026.29	2155600	19.954402	20.73
-0.000072023	-92	0.000	-4.001	-216061.92	-4311397	19.954451	-10.25
Average						19.957312403	

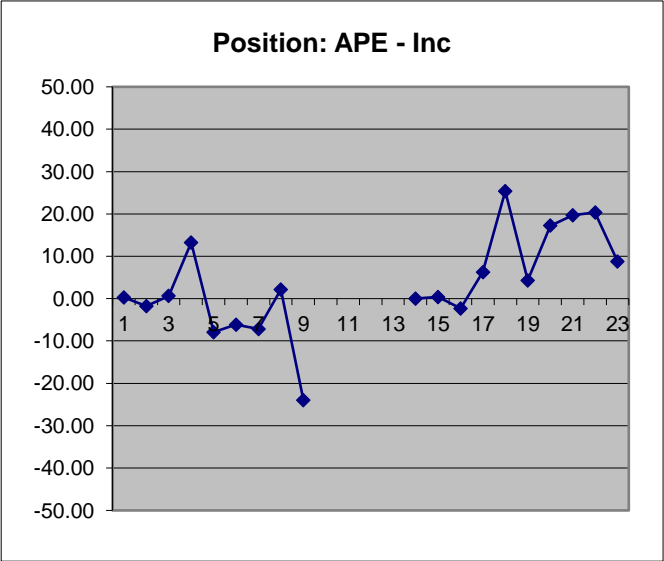
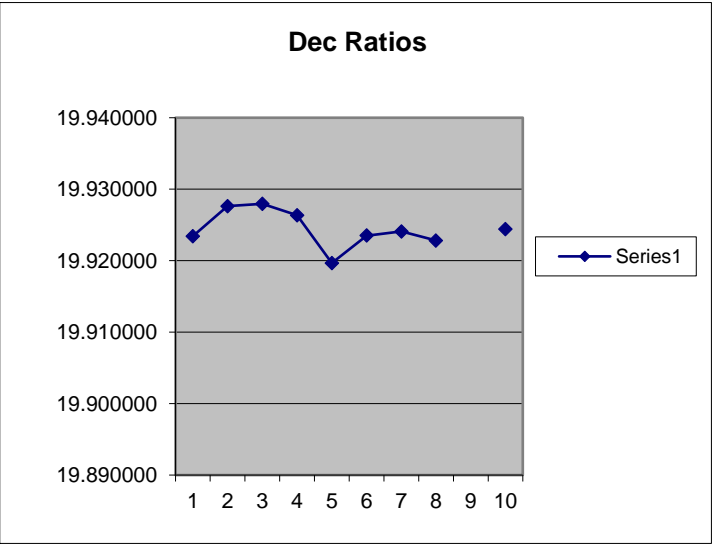
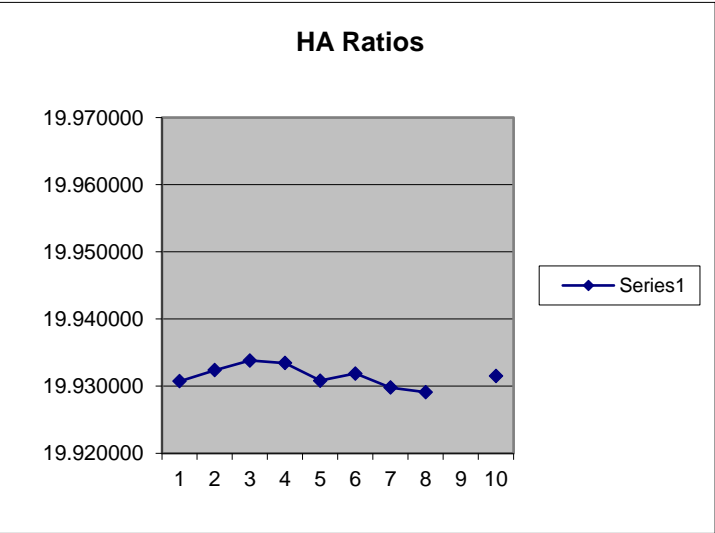
Dec APES radians	counts	radians to I Dist APE(C Dist (AS)			Dist Cnt	Ratio	Using Ration
0.349056343	1434507	19.999					-1.37
0.087258629	358694	5.000	-15.000	-53999.65	-1075813	19.922590	-4.84
-0.174508657	-717223	-9.999	-14.998	-53993.38	-1075917	19.926832	3.18
-0.698017603	-2869032	-39.993	-29.995	-107981.47	-2151809	19.927576	23.26
0.349068621	1434492	20.000	59.994	215977.04	4303524	19.925841	1.91
0.610940006	2510427	35.004	15.004	54014.85	1075935	19.919244	14.45
0.872754804	3586326	50.005	15.001	54003.18	1075899	19.922883	17.13
1.047290884	4303591	60.005	10.000	36000.65	717265	19.923668	17.50
0.349118269	1434607	20.003	-40.002	-144008.44	-2868984	19.922332	6.38
Average						19.923870823	



4/28/2011

HA APES radians	Counts	radians to I Dist APE(h Dist_as			Dist Cnt	Ratio	Using Ration
-0.000316386	-1306	-0.001					0.27
-0.262178175	-1077823	-1.001	-1.000	-54012.87	-1076517	19.930749	-1.79
-0.524339162	-2155659	-2.003	-1.001	-54074.59	-1077836	19.932395	0.62
-1.048609494	-4311274	-4.005	-2.003	-108138.52	-2155615	19.933831	13.22
-0.000035289	13	0.000	4.005	216283.96	4311287	19.933457	-7.93
0.262147525	1077855	1.001	1.001	54079.09	1077842	19.930847	-6.14
0.524310109	2155670	2.003	1.001	54074.91	1077815	19.931885	-7.16
1.048677867	4311249	4.006	2.003	108158.61	2155579	19.929795	2.14
-0.000126326	-42	0.000	-4.006	-216331.39	-4311291	19.929105	-23.95
Average						19.931508145	

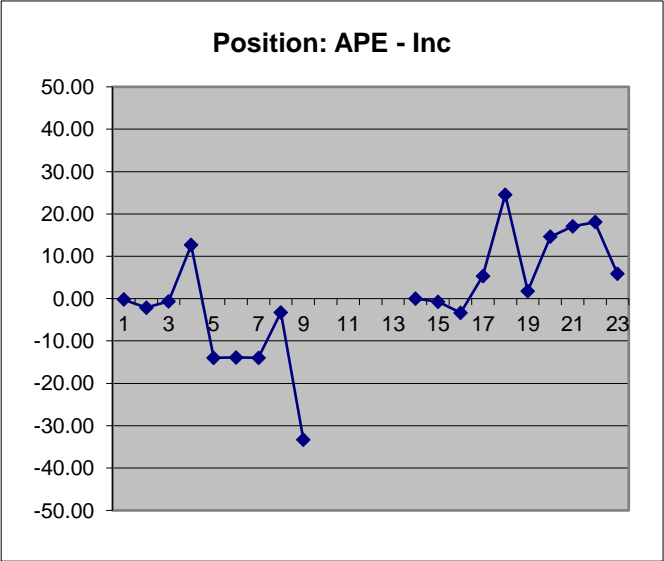
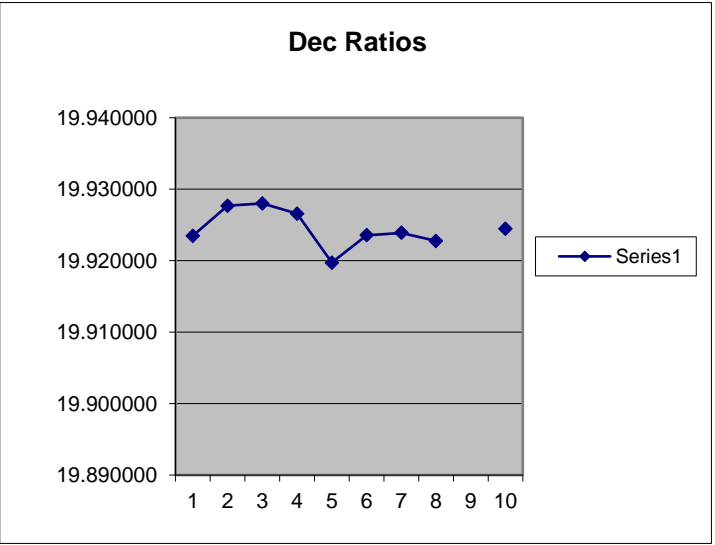
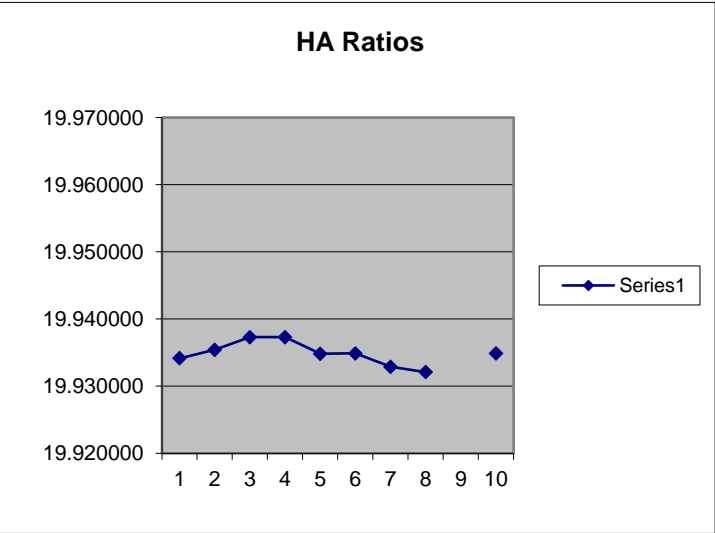
Dec APES radians	counts	radians to I Dist APE(C Dist (AS)			Dist Cnt	Ratio	Using Ration
0.349049937	1434486	19.999					0.39
0.087279449	358740	5.001	-14.998	-53994.04	-1075746	19.923422	-2.35
-0.174472355	-717156	-9.997	-14.997	-53990.19	-1075896	19.927622	6.29
-0.697968489	-2868953	-39.991	-29.994	-107978.83	-2151797	19.927953	25.37
0.349061148	1434454	20.000	59.990	215965.37	4303407	19.926376	4.31
0.610921856	2510368	35.003	15.004	54012.65	1075914	19.919668	17.22
0.872725442	3586255	50.003	15.000	54000.87	1075887	19.923514	19.71
1.047256718	4303515	60.003	10.000	35999.66	717260	19.924077	20.35
0.349125743	1434631	20.003	-40.000	-143999.85	-2868884	19.922826	8.75
Average						19.924432112	



4/28/2011

HA APES radians	Counts	radians to I Dist APE(h Dist_as			Dist Cnt	Ratio	Using Ration
-0.00000867	-31	0.000					-0.23
-0.262135052	-1077820	-1.001	-1.001	-54067.45	-1077789	19.934157	-2.14
-0.524253981	-2155646	-2.003	-1.001	-54065.91	-1077826	19.935408	-0.64
-1.048431147	-4311254	-4.005	-2.002	-108119.30	-2155608	19.937310	12.65
-0.000067764	0	0.000	4.004	216240.47	4311254	19.937313	-13.98
0.262061812	1077838	1.001	1.001	54068.11	1077838	19.934821	-13.87
0.524183935	2155649	2.002	1.001	54066.57	1077811	19.934888	-13.95
1.048467045	4311214	4.005	2.003	108141.15	2155565	19.932883	-3.24
-0.000172111	-44	-0.001	-4.006	-216297.35	-4311258	19.932089	-33.29
Average						19.934858666	

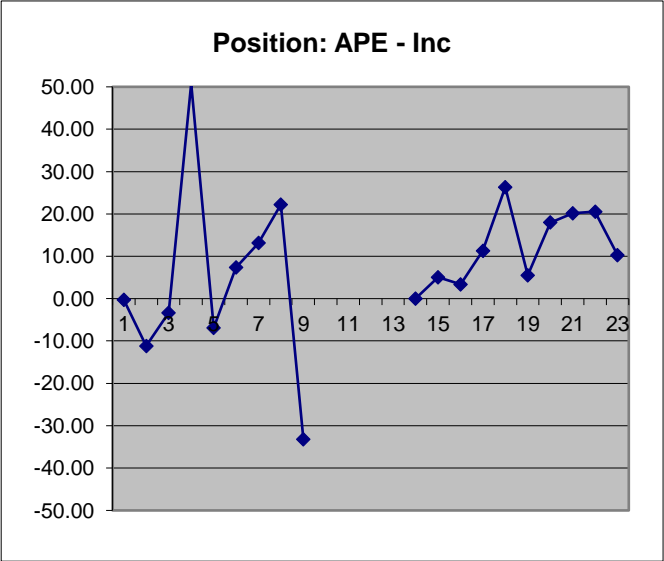
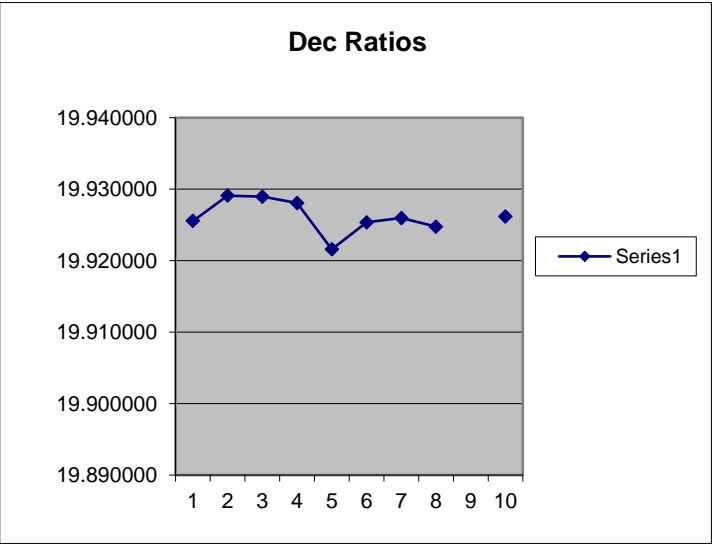
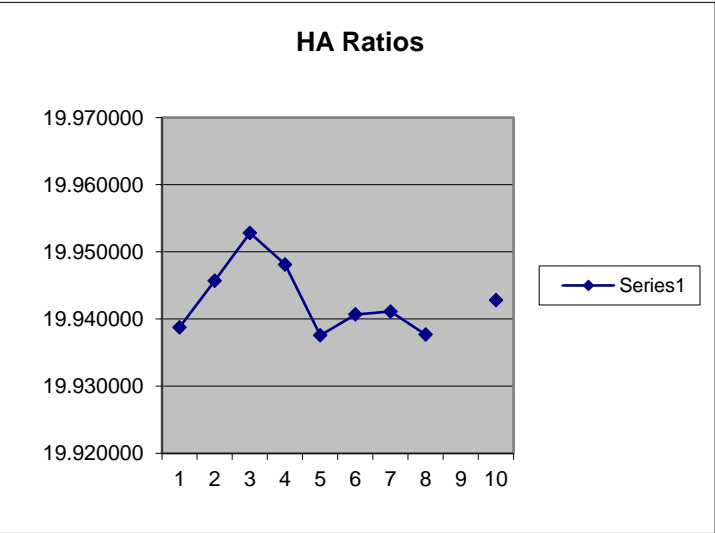
Dec APES radians	counts	radians to I Dist APE(C Dist (AS)			Dist Cnt	Ratio	Using Ration
0.349048869	1434506	19.999					-0.72
0.087281584	358769	5.001	-14.998	-53993.38	-1075737	19.923499	-3.34
-0.174463814	-717103	-9.996	-14.997	-53988.86	-1075872	19.927665	5.34
-0.697948737	-2868860	-39.990	-29.993	-107976.52	-2151757	19.928009	24.55
0.349046734	1434447	19.999	59.988	215958.32	4303307	19.926563	1.80
0.610902103	2510343	35.002	15.003	54011.55	1075896	19.919741	14.61
0.872703555	3586224	50.002	15.000	54000.43	1075881	19.923565	17.04
1.047233229	4303471	60.002	10.000	35999.33	717247	19.923899	18.06
0.349109194	1434623	20.002	-40.000	-143998.42	-2868848	19.922774	5.85
Average						19.924464334	



3/11/2016

HA APES radians	Counts	radians to I Dist APE(h Dist_as			Dist Cnt	Ratio	Using Ration
-0.000013994	-52	0.000					-0.28
-0.261755465	-1076508	-1.000	-1.000	-53988.05	-1076456	19.938781	-11.20
-0.52341282	-2152992	-1.999	-0.999	-53970.70	-1076484	19.945710	-3.36
-1.046542795	-4305967	-3.997	-1.998	-107903.30	-2152975	19.952818	50.77
-0.000046469	-54	0.000	3.997	215855.36	4305913	19.948140	-6.88
0.261722686	1076450	1.000	1.000	53993.76	1076504	19.937562	7.34
0.523454574	2152969	1.999	1.000	53986.08	1076519	19.940678	13.12
1.046885343	4305920	3.999	1.999	107965.35	2152951	19.941130	22.24
-0.000177967	-69	-0.001	-3.999	-215972.31	-4305989	19.937690	-33.25
Average						19.942813722	

Dec APES radians	counts	radians to I Dist APE(C Dist (AS)			Dist Cnt	Ratio	Using Ration
0.349051538	1434525	19.999					5.02
0.087314148	358800	5.003	-14.996	-53987.21	-1075725	19.925552	3.36
-0.174422174	-717112	-9.994	-14.996	-53986.99	-1075912	19.929097	11.30
-0.697895886	-2868923	-39.986	-29.993	-107974.20	-2151811	19.928936	26.31
0.349033388	1434440	19.998	59.985	215944.66	4303363	19.928082	5.55
0.61087381	2510374	35.000	15.002	54008.46	1075934	19.921581	17.97
0.872657644	3586280	50.000	14.999	53996.79	1075906	19.925369	20.13
1.047173438	4303544	59.999	9.999	35996.47	717264	19.925956	20.51
0.349112397	1434670	20.003	-39.996	-143985.43	-2868874	19.924753	10.30
Average						19.926165751	



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HA APES radians	Counts	radians to I Dist APE(h Dist_as			Dist Cnt	Ratio	Using Ration
0.000016884	60	0.000					0.48
-0.261666025	-1076862	-0.999	-1.000	-53975.97	-1076922	19.951877	-6.71
-0.523264819	-2153802	-1.999	-0.999	-53958.62	-1076940	19.958626	4.35
-1.046353268	-4307638	-3.997	-1.998	-107894.74	-2153836	19.962382	46.78
0.00000251	28	0.000	3.997	215826.37	4307666	19.958942	-0.89
0.26174824	1076962	1.000	1.000	53988.93	1076934	19.947311	18.66
0.523448186	2153878	1.999	1.000	53979.49	1076916	19.950467	29.66
1.046730953	4307650	3.998	1.999	107934.82	2153772	19.954376	30.52
0.000033388	12	0.000	-3.998	-215896.87	-4307638	19.952295	6.29
Average						19.954534446	

Dec APES radians	counts	radians to I Dist APE(C Dist (AS)			Dist Cnt	Ratio	Using Ration
0.349041929	1434611	19.999					-2.07
0.087268772	358766	5.000	-14.998	-53994.59	-1075845	19.925052	-4.49
-0.17449798	-717247	-9.998	-14.998	-53993.27	-1076013	19.928651	2.84
-0.698031483	-2869287	-39.994	-29.996	-107986.54	-2152040	19.928781	18.21
0.34903926	1434592	19.998	59.993	215973.84	4303879	19.927779	-1.67
0.610907976	2510628	35.002	15.004	54014.30	1076036	19.921317	10.87
0.872716901	3586640	50.003	15.001	54001.97	1076012	19.925422	12.29
1.047246575	4303959	60.003	10.000	35999.33	717319	19.925899	12.37
0.349111863	1434796	20.003	-40.000	-144000.62	-2869163	19.924657	3.07
Average						19.925944736	

