ST-ECF
Instrument Science Report **POA/FOS - 2001 - 03**

POA Analysis of FOS Flat-fields

P. Bristow, A. Alexov, F. Kerber & M. R. Rosa

December 2001

Abstract

The derivation and use of flat-fields in the calibration pipeline was, from the start, identified as an area for the POA project to examine. The original motivation was the possibility that a more physical model could be applied to decouple the contributions from the photocathode and the diode array respectively. However, it was found that the implications of the GIMP and Y-base corrections made the re-derivation of the flats essential regardless of other considerations. This report discusses first the investigation of possible areas of improvement and then gives details of the modifications made to the FOS blue side flat-fields as used by the poa_calfos pipeline.

Key words*: Data Reduction, Calibration, Space Telescope. Faint Object Spectrograph, Flat-fields, Data Archive*

1. Introduction

The Instrument Physical Modeling Group at the Space Telescope European Co-ordinating Facility is commissioned with developing improvements to the pipeline calibration of HST instruments. Fundamental to our approach are the predictive power of physical modeling techniques and the long temporal baselines provided by the post operational analysis of the entire dataset collected during the lifetime of the instrument. The FOS was adopted as the instrument for our pilot study.

The flat-field calibration was investigated with the aim of applying a more physical model to the flat-fields which took into account the cathode and diode array contributions to the flat-fields. We begin with a summary of our investigation into the derivation of the flat-fields (section 2) and then describe impact of a small shift introduced by other POA corrections upon the flat-fields (section 3). The pre-existing (STScI) software and techniques for flat-field derivation and its adaptation for our use is described in section 4; section 5 discusses missing or non-unique flats. Section 6 describes the new reference files produced by the POA project and the following appendix contains tables detailing all new POA FOS flat-field reference files and all pre-costar FOS flat-field reference files.

2. Diode / Cathode Components

Any flat-field observation with the FOS comprises, in addition to the spectra of the standard star, the signature of the cathode and that of the diode array. The signature of the cathode depends upon which part of the cathode is illuminated, this is a function of the grating and aperture (and obviously the two detectors can be dealt with completely separately). For a given grating/aperture combination, the cathode component is in principle fixed (disregarding the ageing of the cathode), however due to GIMP, Y-base updates and temperature variations, the image of the cathode signature on the diode array varies and so therefore does the combination of the two components.

The signature of the diode array for each detector is in principle, easier to pin down. However, in some cases the processing shifted the final pixel array so that the combined cathode plus diode signatures would be shifted relative to another dataset.

The so-called “super-spectra” method was used to obtain FOS flats: High S/N observations of stars were used to simultaneously compute both the flat-field and a precise stellar “super-spectrum”. Flat fields at other epochs can be derived from the ratio of the observed count rate to the super-spectrum of the same star. When the super-spectra were used to subtract the standard star, they were shifted so as to be aligned with the dataset. Hence the resulting flat-field file maintained any shifts applied during the processing.

An ideal method for flat-fielding would then be to isolate these two components, creating a cathode component appropriate to each grating/aperture(/epoch) combination and a diode component. The diode component could be directly removed from the raw data and the cathode component from data shifted by the poa_calfos processing.

In order to try to separate these effects, we examined existing calfos flats. Simply stacking them all should emphasize the diode component. This test was restricted to post on-board GIMP flats so that there would be no software correction from calfos, the cathode effect should then be smoothed out by its movement from one exposure to another.

However, no diode signature was apparent in the stacked data and moreover, individual inspection and comparison of datasets seemed to confirm that all significant features belonged to specific grating/aperture combination, no features were identifiable that were consistent throughout the reference files. Attempts to cross correlate the files (in case there was some relative shift also of the diode component) also failed; the cathode component was simply dominant. Even masking the prominent cathode features and correlating second order features failed to reveal a convincing diode component.

Restricting the sample to datasets with y-base values falling within a narrow range did not help either. We concluded that the only significant component is that of the cathode, therefore there is no need to separate out the diode component and the flat-fields as classified already according to grating/aperture are appropriate for removing the cathode component.

3. Importance of Using Correctly Shifted Flat-fields

Once adjusted for the POA pipeline, the flats are typically just shifted by approximately five pixels from the original flat. Therefore, in the case of broad flat-field features with shallow gradients the difference between the corrected and uncorrected flat-fields when applied to science data is very small. However, in the case of narrow steep sided flat-field features, the difference is more significant.

In reality, the flat-fields are dominated by such narrow features, mostly no more than five pixels in width themselves. Thus the impact upon scientific data of using the POA pipeline without shifting the flat-fields appropriately is similar to that of neglecting the flat-field correction altogether. (Indeed it is potentially worse. The application of a flat composed only of features much smaller than the POA shift will lead to a further deterioration of the data as if it had been mapped onto another non-uniform detector array and not corrected).

4. Shifted Flats

As a consequence of these considerations, the flat-field should be aligned with the signature of the cathode component in the science dataset, i.e. the flat-field and science dataset (up to the .c5h stage) should have been derived using *poa_calfos*. This requires that all source datasets are re-derived from the raw data to the .c5h stage using *poa_calfos* before the super-spectrum is subtracted and the flat produced.

Tony Keyes from STScI provided the appropriate data and procedures to enable us to re-derive these flats. This had to be ported from VMS to UNIX. At the same time that these items were ported, the procedures were automated so that future changes in *poa_calfos* can be fed through to all the flats by simply running one script for all post-costar flats and another for pre-costar.

The existing software used for deriving post co-star flat-fields ran on a VMS system and was a collection of IDL scripts which would apply the super-spectra procedure to a collection of raw flat-field datasets appropriately collected together in a subdirectory.

The Super-Spectra Method

As the strengths of the spectral lines in the stars were not known a priori at resolutions of 1-10 Angstroms, determination of small scale variation in the intrinsic stellar flux distribution was required in order to obtain better FOS flat-field calibration. A new technique was developed by Lindler et al. (FOS ISR-088) which used high S/N observations of stars to simultaneously compute both the flat-field and a precise stellar “super-spectrum”. Flat-fields at other epochs could then be derived simply from the ratio of the observed count rate to the super-spectrum of the same star.

The initial application of this technique was in the pre-costar era. Observations at nine locations in the FOS 4.3 arc second aperture were obtained in proposal 2821. Some “ringing” (artefacts due to the constant offset used) was seen in the results, though for BLUE data it was at an acceptable level (≤1%). When re-deriving pre-costar flats appropriate for *poa_calfos* use, we used the data from 2821, running all of the data for each super spectrum through *poa_calfos*.

For the post-costar epochs, better stellar super spectra which were free of this ringing were derived. For new flat-fields, it was then necessary only to use one new flat observation and compare with the stellar super spectra. In order to apply this technique, we needed only to ensure that the new flat observations had been run through poa_calfos, the super-spectra were cross correlated appropriately by the pipeline.

POA Implementation

Here we mention briefly only the modifications that we made to the existing procedure:

Post-Costar

- The system was ported to work under UNIX, clearly this did not affect the logic of the IDL scripts, but a few file handling problems had to be taken care of.

- The raw flat-field datasets were taken from our repository; those in the VAX set-procedure directories were not used.

- The OFF_CORR keyword was set to OMIT in all raw flat dataset headers.

- Appropriate DETECTOR, USEAFTER, PEDIGREE APER_ID and DESCRIP keywords were added to the headers.

- The IDL scripts were regenerated on-the-fly to cover the correct set of apertures dealt with by the current version of *poa_calfos*. (This was necessary only for apertures. The regeneration for appropriate grating, detector etc. was easily controlled by the organisation of the directory structure)

The result, in all cases, is a new flat that is simply shifted from that used by the original calfos. However the magnitude of this shift could only be determined by re-deriving the flats due to uncertainties in the header information regarding the on-board GIMP correction applied by calfos when the original flat was derived.

Pre-Costar

- Once again ported to work under UNIX, in particular several IDL save sets containing masks had to be converted from VMS.

- The raw flat-field datasets were taken from our repository.

- The pre-costar procedure proved to be a little harder to automate. However there are relatively few pre-costar flat-field reference files, so it is a trivial task to perform interactively.

The result for pre-costar poa_calfos derived flats is not just a simple shift from the old calfos flat as in this instance the various spectra used to compute the supers-pectra have all been shifted and not necessarily by the same amount (because of integer pixel rounding, and possible slight differences in the conditions of the observations).

5. Missing Flats

Certain modes use flats from other similar modes (usually same grating but different aperture) rather than ones specifically derived for the given mode. This happens for a number of reasons but often the data are available to attempt to derive a more appropriate flat. However in practise this would have involved a lot of "detective work" and tests show that the gain, in terms of the effects on science data would have been modest.

The advice to users reducing science data is unchanged from the CALFOS era: If the flat-field correction is important to the science being performed, then, to be safe, the following comparison should be performed. The data should be processed with the best reference flats; with flats appropriate to the grating in use but for other apertures (possibly more contemporaneous) and without flats altogether. Any spectral feature should be investigated to see if it is possibly an improperly removed flat-field feature, for example, a blemish that occurs in the flat-field file but not in the data. The need for such a level of user interaction where flats are concerned arises from the fact that the y-position of the spectra varies from observation to observation.

6. The New Reference Files

The POA flat-field reference files map one-to-one with the old calfos flat-field files. Indeed, the OPUS system is rather restrictive in this sense and discouraged us from introducing a few new aperture specific flat-fields in cases where, at present, several apertures share just one reference file. However, it was clear that the considerable effort of manipulating the system in order to implement this was not justified by the marginal improvement in calibration for a handful of science datasets. The new file applies to the same grating and range of apertures as the old one and is therefore referenced by the same datasets. Table 1 in the appendix contains the mapping along with the source dataset, the grating, the aperture (of the source dataset, the reference file may apply to several apertures), the *useafter* date and the number of datasets that reference the flat -field.

A further table listing all flat-field calibration datasets along with their proposal ID, and aperture, grating and detector combination is available from the POA FOS website (see below).

We would like to thank Tony Keyes (STScI) and Don Lindler (GSFC) for helping us by sharing their valuable FOS experience.

References

D. Lindler, R. Bohlin, G. Hartig, and C. Keyes, 1993. **FOS ISR 088**

Rosa, M. R., Alexov, A., Bristow P. D. & Kerber, F., 2000. **POA/FOS 001**

POA FOS web site: **http://www.stecf.org/poa/FOS**

Appendix

Pre-Costar Flat-field Reference Files

calfos ref-file	poa_calfos ref-file	source flat data set	mode	aper	Useafter Date mon day year	# of obs
D2F1332PY	L7M1416PY	Y0VH050[LMN]T	H13	A-1	Mar 6 1992	521
		Y0VH080[LMN]T				
D2F1332RY	L7M1416QY	Y0VH050[UVW]T	L15	A-1	Mar 6 1992	299
		Y0VH080[UVW]T				
D2F1332SY	L7M1416RY	Y0VH050[IJK]T	H19	A-1	Mar 6 1992	312
		Y0VH080[IJK]T				
D2F1332TY	L7M1416SY	Y0VH050[9AB]T	H27	A-1	Mar 6 1992	189
		Y0VH080[9AB]T				
D2F13331Y	L7M1416TY	Y0VH050[RST]T	H40	A-1	Mar 6 1992	74
		Y0VH080[RST]T				
D2F13332Y	L7M14170Y	Y0VH050[678]T	PRI	A-1	Mar 6 1992	
		Y0VH080[678]T				
D2F13334Y	L7M14171Y	Y0VH060[456]T	H13	A-1	Mar 6 1992	
		Y0VH070[456]T				
D2F13335Y	L7M14172Y	Y0VH060[GHI]T	L15	A-1	Mar 6 1992	
		Y0VH070[GHI]T				
D2F13336Y	L7M14173Y	Y0VH060[0Y,0Z,10]T	H19	A-1	Mar 6 1992	
		Y0VH070[0Y,0Z,10]				
D2F13338Y	L7M14174Y	Y0VH060[STU]T	H27	A-1	Mar 6 1992	
		Y0VH070[STU]T				
D2F1333AY	L7M14175Y	Y0VH060[ABC]T	H40	A-1	Mar 6 1992	
		Y0VH070[ABC]T				
D2F1333CY	L7M14176Y	Y0VH060[MNO]T	PRI	A-1	Mar 6 1992	
		Y0VH070[MNO]T				
D2F1333DY	L7M14177Y	Y0VH060[789]T	H13	A-1	Mar 6 1992	97
		Y0VH070[789]T				
D2F1333FY	L7M14178Y	Y0VH060[JKL]T	L15	A-1	Mar 6 1992	442
		Y0VH070[JKL]T				
D2F1333GY	L7M14179Y	Y0VH061[123]T	H19	A-1	Mar 6 1992	186
		Y0VH071[123]T				
D2F1333IY	L7M1417AY	Y0VH060[VWX]T	H27	A-1	Mar 6 1992	90
		Y0VH070[VWX]T				
D2F1333JY	L7M1417BY	Y0VH060[DEF]T	H40	A-1	Mar 6 1992	62
		Y0VH070[DEF]T				
D2F1333LY	L7M1417CY	Y0VH060[PQR]T	PRI	A-1	Mar 6 1992	66
		Y0VH070[PQR]T				

Post-Costar Flat-field Reference Files

The `-' indicate flatfields which are no longer referenced by any datasets and have therefore not been re-derived.

For the pre-costar flat-fields there is more than one source dataset as in each case the flat-field was derived from the set of observations used to obtain the *superflat*. These source datasets were all obtained with the A-1 aperture, but the resulting pre-costar flats apply to any aperture.

calfos ref-file	poa_calfos ref-file	source flat data set	mode	aper	Useafter Date mon	day	year	# of obs	Ybase value
I1K1218MY	L7M1412CY	Y28W030MT	H13	A-1	Feb	1	1994	9	-682
I1K1218NY	L7M1412DY	Y2ET010PT	H13	A-1	May	1	1994	39	-682
I1K1218OY	L7M1412EY	Y2K0010AT	H13	A-1	Nov	15	1994	64	-610
I1K1218PY	L7M1412FY	Y2ET0F0PT	H13	A-1	May	1	1995	10	-642
I1K1218QY	L7M1412GY	Y384030FT	H13	A-1	Apr	1	1996	17	-632
I1K1218RY	L7M1412HY	Y3HU510FT	H13	A-1	Dec	15	1996	9	-619
I1K1218SY	-	-	H13	B-1	Feb	1	1994		
I1K1218TY	L7M1412IY	Y2ET010DT	H13	B-1	May	1	1994	1	-682
I1K12190Y	L9Q1211JY	Y2K00107T	H13	B-1	Nov	15	1994	4	-642
I1K12191Y	L7M1412JY	Y2ET0F0DT	H13	B-1	May	1	1995	7	-642
I1K12192Y	L7M1412KY	Y384010CT	H13	B-1	Apr	1	1996	1	-632
I1K12193Y	L7M1412LY	Y3HX5506T	H13	B-1	Dec	15	1996	1	-619
I1K12194Y	L7M1412MY	Y3HX0506T	H13	B-1	Oct	15	1996	1	-619
I1K12195Y	L7M1412NY	Y2960405T	H13	B-2	Feb	1	1994	2	-682
I1K12196Y	L7M1412OY	Y2ET010DT	H13	B-2	May	1	1994	16	-682
I1K12197Y	L9Q1212MY	Y2K00107T	H13	B-2	Nov	15	1994	52	-642
I1K12198Y	L7M1412PY	Y2ET0F0DT	H13	B-2	May	1	1995	64	-642
I1K12199Y	L7M1412QY	Y384010CT	H13	B-2	Apr	1	1996	15	-632
I1K1219AY	L7M1412RY	Y3HX5506T	H13	B-2	Dec	15	1996	21	-619
I1K1219BY	L7M1412SY	Y3HX0506T	H13	B-2	Oct	15	1996	12	-619
I1K1219CY	L7M1412TY	Y2960405T	H13	B-3	Feb	1	1994	15	-682
I1K1219DY	L7M14130Y	Y2ET010DT	H13	B-3	May	1	1994	70	-682
I1K1219EY	L9Q12132Y	Y2K00107T	H13	B-3	Nov	15	1994	49	-642
I1K1219FY	L7M14131Y	Y2ET0F0DT	H13	B-3	May	1	1995	92	-642
I1K1219GY	L7M14132Y	Y384010CT	H13	B-3	Apr	1	1996	55	-632
I1K1219HY	L7M14133Y	Y3HX5506T	H13	B-3	Dec	15	1996	21	-619
I1K1219IY	L7M14134Y	Y3HX0506T	H13	B-3	Oct	15	1996	31	-619
I1K1219JY	-	-	H13	C-2	Feb	1	1994		
I1K1219KY	L7M14135Y	Y2ET010DT	H13	C-2	May	1	1994	1	-682
I1K1219LY	-	-	H13	C-2	Nov	15	1994		
I1K1219MY	-	-	H13	C-2	May	1	1995		
I1K1219NY	L7M14136Y	Y384010CT	H13	C-2	Apr	1	1996	12	-632
I1K1219OY	-	-	H13	C-2	Dec	15	1996		
I1K1219PY	-	-	H13	C-2	Oct	15	1996		
I1K1219QY	L7M14137Y	Y28W030FT	H19	A-1	Feb	1	1994	9	-1036

calfos ref-file	poa_calfos ref-file	source flat data set	mode	aper	Useafter Date mon	day	year	# of obs	Ybase value
I1K1219RY	L7M14138Y	Y2ET010OT	H19	A-1	May	1	1994	62	-1036
I1K1219SY	L7M14139Y	Y2ET0F0OT	H19	A-1	May	1	1995	19	-1018
I1K1219TY	L7M1413AY	Y384030GT	H19	A-1	Apr	1	1996	39	-1001
I1K12200Y	L7M1413BY	Y3HX550ET	H19	A-1	Dec	15	1996	6	-986
I1K12201Y	-	-	H19	B-1	Feb	1	1994		
I1K12202Y	L7M1413DY	Y2ET010CT	H19	B-1	May	1	1994	1	-1036
I1K12203Y	L9Q12147Y	Y2K0010BT	H19	B-1	Nov	15	1994	6	-1018
I1K12204Y	L7M1413EY	Y2ET0F0CT	H19	B-1	May	1	1995	1	-1018
I1K12205Y	L7M1413FY	Y384010DT	H19	B-1	Apr	1	1996	5	-1001
I1K12206Y	L7M1413GY	Y3HX5507T	H19	B-1	Dec	15	1996	2	-986
I1K12207Y	L7M1413HY	Y3HX0507T	H19	B-1	Oct	15	1996	1	-997
I1K12208Y	L7M1413IY	Y296040NT	H19	B-2	Feb	1	1994	2	-1036
I1K12209Y	L7M1413JY	Y2ET010CT	H19	B-2	May	1	1994	13	-1036
I1K1220AY	L9Q1214KY	Y2K0010BT	H19	B-2	Nov	15	1994	41	-1018
I1K1220BY	L7M1413KY	Y2ET0F0CT	H19	B-2	May	1	1995	47	-1018
I1K1220CY	L7M1413LY	Y384010DT	H19	B-2	Apr	1	1996	15	-1001
I1K1220DY	L7M1413MY	Y3HX5507T	H19	B-2	Dec	15	1996	6	-986
I1K1220EY	L7M1413NY	Y3HX0507T	H19	B-2	Oct	15	1996	5	-997
I1K1220FY	L7M1413OY	Y296040NT	H19	B-3	Feb	1	1994	1	-1036
I1K1220GY	L7M1413PY	Y2ET010CT	H19	B-3	May	1	1994	21	-1036
I1K1220HY	L9Q12151Y	Y2K0010BT	H19	B-3	Nov	15	1994	32	-1018
I1K1220IY	L7M1413QY	Y2ET0F0CT	H19	B-3	May	1	1995	40	-1018
I1K1220JY	L7M1413RY	Y384010DT	H19	B-3	Apr	1	1996	25	-1001
I1K1220KY	L7M1413SY	Y3HX5507T	H19	B-3	Dec	15	1996	5	-986
I1K1220LY	L7M1413TY	Y3HX0507T	H19	B-3	Oct	15	1996	5	-997
I1K1220MY	-	-	H19	C-2	Feb	1	1994		
I1K1220NY	L7M14140Y	Y2ET010CT	H19	C-2	May	1	1994	1	-1036
I1K1220OY	-	-	H19	C-2	Nov	15	1994		
I1K1220PY	-	-	H19	C-2	May	1	1995		
I1K1220QY	-	-	H19	C-2	Apr	1	1996		
I1K1220RY	-	-	H19	C-2	Dec	15	1996		
I1K1220SY	-	-	H19	C-2	Oct	15	1996		
I1K1220TY	L7M14141Y	Y28W0408T	H27	A-1	Feb	1	1994	7	-1660
I1K12210Y	L7M14142Y	Y2ET010RT	H27	A-1	May	1	1994	24	-1660
I1K12211Y	L7M14143Y	Y2ET0F0RT	H27	A-1	May	1	1995	17	-1657
I1K12212Y	L7M14144Y	Y384030HT	H27	A-1	Apr	1	1996	20	-1625
I1K12213Y	L7M14145Y	Y3HX550FT	H27	A-1	Dec	15	1996	5	-1629
I1K12214Y	-	-	H27	B-1	Feb	1	1994		
I1K12215Y	L7M14146Y	Y2ET040ST	H27	B-1	May	1	1994	1	-1660
I1K12216Y	-	-	H27	B-1	Nov	15	1994		
I1K12217Y	L7M14147Y	Y2ET0F0FT	H27	B-1	May	1	1995	13	-1657
I1K12218Y	L7M14148Y	Y384010BT	H27	B-1	Apr	1	1996	5	-1625
I1K12219Y	L7M14149Y	Y3HX5508T	H27	B-1	Dec	15	1996	2	-1629
I1K1221AY	L7M1414AY	Y2960408T	H27	B-2	Feb	1	1994	16	-1660
I1K1221BY	L7M1414BY	Y2ET040ST	H27	B-2	May	1	1994	10	-1660
I1K1221CY	L7M1414CY	Y2K0010ET	H27	B-2	Nov	15	1994	56	-1657
I1K1221DY	L7M1414DY	Y2ET0F0FT	H27	B-2	May	1	1995	84	-1657
I1K1221EY	L7M1414EY	Y384010BT	H27	B-2	Apr	1	1996	20	-1625

calfos ref-file	poa_calfos ref-file	source flat data set	mode	aper	Useafter Date mon	day	year	# of obs	Ybase value
I1K1221FY	L7M1414FY	Y3HX5508T	H27	B-2	Dec	15	1996	10	-1629
I1K1221GY	L7M1414GY	Y2960408T	H27	B-3	Feb	1	1994	1	-1660
I1K1221HY	L7M1414HY	Y2ET040ST	H27	B-3	May	1	1994	17	-1660
I1K1221IY	L7M1414IY	Y2K0010ET	H27	B-3	Nov	15	1994	23	-1657
I1K1221JY	L7M1414JY	Y2ET0F0FT	H27	B-3	May	1	1995	43	-1657
I1K1221KY	L7M1414KY	Y384010BT	H27	B-3	Apr	1	1996	16	-1625
I1K1221LY	L7M1414LY	Y3HX5508T	H27	B-3	Dec	15	1996	4	-1629
I1K1221MY	-	-	H27	C-2	Feb	1	1994		
I1K1221NY	L7M1414MY	Y2ET040ST	H27	C-2	May	1	1994	1	-1660
I1K1221OY	-	-	H27	C-2	Nov	15	1994		
I1K1221PY	-	-	H27	C-2	May	1	1995		
I1K1221QY	-	-	H27	C-2	Apr	1	1996		
I1K1221RY	-	-	H27	C-2	Dec	15	1996		
I1K1221SY	L7M1414NY	Y28W040MT	H40	A-1	Feb	1	1994	8	268
I1K1221TY	L7M1414OY	Y2ET010QT	H40	A-1	May	1	1994	11	268
I1K12220Y	L7M1414PY	Y2ET0F0QT	H40	A-1	May	1	1995	8	279
I1K12221Y	L7M1414QY	Y384030JT	H40	A-1	Apr	1	1996	10	293
I1K12222Y	L7M1414RY	Y3HX550HT	H40	A-1	Dec	15	1996	5	309
I1K12223Y	-	-	H40	B-1	Feb	1	1994		
I1K12224Y	L7M1414SY	Y2ET010ET	H40	B-1	May	1	1994	1	268
I1K12225Y	-	-	H40	B-1	Nov	15	1994		
I1K12226Y	L7M1414TY	Y2ET0F0ET	H40	B-1	May	1	1995	1	279
I1K12227Y	L7M14150Y	Y384010ET	H40	B-1	Apr	1	1996	5	293
I1K12228Y	L7M14151Y	Y3HX5509T	H40	B-1	Dec	15	1996	2	309
I1K12229Y	L7M14153Y	Y2960406T	H40	B-2	Feb	1	1994	2	268
I1K1222AY	L7M14154Y	Y2ET010ET	H40	B-2	May	1	1994	7	268
I1K1222BY	L7M14155Y	Y2K00106T	H40	B-2	Nov	15	1994	18	279
I1K1222CY	L7M14156Y	Y2ET0F0ET	H40	B-2	May	1	1995	47	279
I1K1222DY	L7M14157Y	Y384010ET	H40	B-2	Apr	1	1996	14	293
I1K1222EY	L7M14158Y	Y3HX5509T	H40	B-2	Dec	15	1996	7	309
I1K1222FY	L7M14159Y	Y2960406T	H40	B-3	Feb	1	1994	1	268
I1K1222GY	L7M1415AY	Y2ET010ET	H40	B-3	May	1	1994	5	268
I1K1222HY	L7M1415BY	Y2K00106T	H40	B-3	Nov	15	1994	6	279
I1K1222IY	L7M1415CY	Y2ET0F0ET	H40	B-3	May	1	1995	12	279
I1K1222JY	L7M1415DY	Y384010ET	H40	B-3	Apr	1	1996	9	293
I1K1222KY	L7M1415EY	Y3HX5509T	H40	B-3	Dec	15	1996	3	309
I1K1222LY	-	-	H40	C-2	Feb	1	1994		
I1K1222MY	L7M1415FY	Y2ET010ET	H40	C-2	May	1	1994	1	268
I1K1222NY	-	-	H40	C-2	Nov	15	1994		
I1K1222OY	-	-	H40	C-2	May	1	1995		
I1K1222PY	-	-	H40	C-2	Apr	1	1996		
I1K1222QY	-	-	H40	C-2	Dec	15	1996		
I1K1222RY	L7M1415GY	Y28W0308T	L15	A-1	Feb	1	1994	10	-922
I1K1222SY	L7M1415HY	Y2ET010NT	L15	A-1	May	1	1994	39	-922
I1K1222TY	L7M1415IY	Y2ET0F0NT	L15	A-1	May	1	1995	28	-906
I1Q1835PY	L7M1415JY	Y384030ET	L15	A-1	Apr	1	1996	10	-902
I1Q1835QY	L7M1415KY	Y3HU510GT	L15	A-1	Dec	15	1996	2	-883
I1Q1835RY	-	-	L15	B-1	Feb	1	1994		

calfos ref-file	poa_calfos ref-file	source flat data set	mode	aper	Useafter Date mon	day	year	# of obs	Ybase value
I1Q1835SY	L7M1415LY	Y2ET010BT	L15	B-1	May	1	1994	5	-922
I1Q1835TY	L7M1415MY	Y2K0010HT	L15	B-1	Nov	15	1994	2	-906
I1Q18360Y	L7M1415NY	Y2ET0F0BT	L15	B-1	May	1	1995	1	-906
I1Q18361Y	L7M1415OY	Y384030DT	L15	B-1	Apr	1	1996	1	-902
I1Q18362Y	L7M1415PY	Y3HX550AT	L15	B-1	Dec	15	1996	1	-883
I1Q18363Y	L7M1415QY	Y2960407T	L15	B-2	Feb	1	1994	5	-922
I1Q18364Y	L7M1415RY	Y2ET010BT	L15	B-2	May	1	1994	6	-922
I1Q18365Y	L7M1415SY	Y2K0010HT	L15	B-2	Nov	15	1994	5	-906
I1Q18366Y	L7M1415TY	Y2ET0F0BT	L15	B-2	May	1	1995	10	-906
I1Q18367Y	L7M14160Y	Y384030DT	L15	B-2	Apr	1	1996	8	-902
I1Q18368Y	L7M14161Y	Y3HX550AT	L15	B-2	Dec	15	1996	2	-883
I1Q18369Y	L7M14162Y	Y2960407T	L15	B-3	Feb	1	1994	1	-922
I1Q1836AY	L7M14163Y	Y2ET010BT	L15	B-3	May	1	1994	40	-922
I1Q1836BY	L7M14164Y	Y2K0010HT	L15	B-3	Nov	15	1994	32	-906
I1Q1836CY	L7M14165Y	Y2ET0F0BT	L15	B-3	May	1	1995	30	-906
I1Q1836DY	L7M14166Y	Y384030DT	L15	B-3	Apr	1	1996	12	-902
I1Q1836EY	L7M14167Y	Y3HX550AT	L15	B-3	Dec	15	1996	4	-883
I1Q1836FY	-	-	L15	C-2	Feb	1	1994		
I1Q1836GY	L7M14168Y	Y2ET010BT	L15	C-2	May	1	1994	1	-922
I1Q1836HY	-	-	L15	C-2	Nov	15	1994		
I1Q1836IY	-	-	L15	C-2	May	1	1995		
I1Q1836JY	-	-	L15	C-2	Apr	1	1996		
I1Q1836KY	-	-	L15	C-2	Dec	15	1996		
I1Q1836LY	L7M14169Y	Y28W040FT	PRI	A-1	Feb	1	1994	7	-803
I1Q1836MY	L7M1416AY	Y2ET010ST	PRI	A-1	May	1	1994	33	-803
I1Q1836NY	L7M1416BY	Y2ET0F0ST	PRI	A-1	May	1	1995	8	-755
I1Q1836OY	L7M1416CY	Y384030IT	PRI	A-1	Apr	1	1996	9	-757
I1Q1836PY	-	-	PRI	B-1	Feb	1	1994		
I1Q1836QY	L7M1416DY	Y2ET010GT	PRI	B-1	May	1	1994	1	-803
I1Q1836RY	L7M1416EY	Y2ET0F0GT	PRI	B-1	May	1	1995	1	-755
I1Q1836SY	-	-	PRI	B-1	Dec	15	1996		
I1Q1836TY	L7M1416FY	Y296040OT	PRI	B-2	Feb	1	1994	4	-803
I1Q18370Y	L7M1416GY	Y2ET010GT	PRI	B-2	May	1	1994	13	-803
I1Q18371Y	L7M1416HY	Y2ET0F0GT	PRI	B-2	May	1	1995	18	-755
I1Q18372Y	L7M1416IY	Y3HX550BT	PRI	B-2	Dec	15	1996	2	-752
I1Q18373Y	L7M1416JY	Y296040OT	PRI	B-3	Feb	1	1994	1	-803
I1Q18374Y	L7M1416LY	Y2ET010GT	PRI	B-3	May	1	1994	9	-803
I1Q18375Y	L7M1416MY	Y2ET0F0GT	PRI	B-3	May	1	1995	4	-755
I1Q18376Y	L7M1416NY	Y3HX550BT	PRI	B-3	Dec	15	1996	2	-752
I1Q18377Y	-	-	PRI	C-2	Feb	1	1994		
I1Q18378Y	L7M1416OY	Y2ET010GT	PRI	C-2	May	1	1994	1	-803
I1Q18379Y	-	-	PRI	C-2	May	1	1995		
I1Q1837AY	-	-	PRI	C-2	Dec	15	1996		