To: Darrel T. Emerson

From: Elizabeth B. Stobie

Subject: Status of 12-meter Computer Software 08-December-1986

Many changes were made to both the control and analysis systems during the 1986 summer shutdown and the few months that followed. These changes are described below.

CONTROL:

I. Spectra

A. The ability to take total power spectral line scans was added to SPECTRA for baseline diagnostic tests. TPON takes the specified number of ON scans using the main position offsets. TPOFF takes the specified number of OFF scans using the reference position offsets. Quotients are calculated in the analysis task. I have written code to expand these features into a total power mapping procedure, but it has not been implemented.

B. A beam-switched spectral line observing technique was implemented. Initial tests showed occasional bad baselines for a single integration. We (Dave Hogg, Bob Brown, Phil Jewell and myself) determined that the number of 100 millisecond samples for the signal and reference integrations was occasionally unequal. When the telescope position is not within observing tolerance or the receiver has dropped lock the control program drops the current sample instead of a pair of samples. The control loop requires that the sum of the signal and reference integrations equal the specified integration time. The solution was the separate normalization of the signal and reference integrations to the number of samples in each. Calibration of the data is done in the link task by multiplying the data by (TC/(VANE-SKY)). The control system performs a normal VANE calibrate, then replaces the GAINS array with the quantity (VANE-SKY). The operator selects this type of calibration by specifying BSCAL. The default calibration mode is PSCAL (normal VANE calibrate). The switching rate of the subreflector is operator selectable. There are three different speeds: 5 Hz (the default), 2.5 Hz and 1.25 Hz.
One problem remains with spectral line beam switched observing. The data writtten on the FORTH binary tape is useless because of quantization problems in data scaling (all numbers are integers between -1 and 1). It is necessary to change the computation of S-R for the FORTH binary tape.

C. The same error of unequal signal and reference integrations exists for the frequency switched observing mode. There has not been an opportunity to correct this code.

II. Continuum

A. I implemented a North-South Translation Stage Focalize observing procedure in the control system. The North-South Translation Stage is moved from -3.0 to 3.0 mm with an integration every 1 mm. The pointing is adjusted 34 arcseconds according to the position of the North-South Translation Stage (0 mm has 0 offset). Very little time was available to test this routine during the summer shutdown. An analysis procedure is needed to process the data and compute the optimum focus value.

B. A digital backend observing program equivalent to the analog backend TWO program was written. Initially, the digital backend code was part of the TWO observing program. This was cumbersome for the operators and led to observing errors. The digital backend code was moved to a separate observing program after the Owen observing run. A full compliment of Continuum observing words: sequences, mapping, five points focalizes and sptips was implemented. At this point the control program displayed some rather unstable characteristics (corruption of the status control block). The FORTH system was then rebuilt from the 14-September-1986 version omitting all digital backend code. The control system has behaved very well since then (27-November-1986) although the culprit was not the digital backend code itself. Several hours of test time are needed to restore this code and test it thoroughly.

Doomsday System

At the end of summer shutdown we were running the pre-shudown analysis system under VMS 4.4. The first observer experienced several difficulties with this system, the most severe was the computer halting when data was transmitted from the control system. We immediately stepped back to VMS 4.3. As an additional safety precaution I created a Doomsday Control System. This Doomsday Control System was designed to be used when the VAX is out of service. It has no capability to transmit data across the link to the VAX and some observing features are omitted in order to allow some data analysis in FORTH. There is no capability to take digital backend continuum data, spectral line beam switched data or spectral line total power scans. It has the capability to display and stack spectral line scans and display continuum data including five points, tips and focalizes and fit five points. It is intended to be a complete stand alone system so that the astronomer does not have to observe "blind" in an emergency.

ANALYSIS:

I. New Data Format. The link task and the line and continuum analysis tasks were rewritten to conform to the "General Single Dish Data Format". The new format is an attempt to standardize data formats with the rest of the single dish community and establish the design of the data for the new control system. This format is inherently flexible - it can expand and contract at will because a preamble to the data defines its contents.

We found the overhead for this flexibility was too high for the telescope environment. Since the data format is well defined at the telescope, the data pointers are fixed for speedy execution. In the downtown systems, data pointers are set by subroutine according to the information in the preamble to the data which allows us to mix data from many telescopes in one program.

II. Data Files. All analysis data files were reconfigured for the new data format. All data files are personal to each observer in his own subdirectory. The raw data file allocates space for 1,024 scans but its directory can hold 2,048. The file can expand to a maximum of 2,048 scans. The KEEP and EDIT files were merged together with space for 1,152 scans. In the file's directory scans are identified as EDIT or KEEP so that the observer can use the space in the manner that best suits his needs. The individual record file writes the header for a given scan only once, followed by the records for that scan, optimizing the number of records that can be contained in the space allowed. The total size of all files was limited by the number of disk blocks that would comfortable fit on one 2,400 foot reel of tape at 1600 bpi. Each observer has all of his data including: raw data, individual records, gains and zero checks and reduced or edited data archived on tape for one year. If a data request is misplaced we can rely on the archive for a full year to recover the data.

III. FITS tapes. Lorrie Morgan wrote a general FITS tape writing program for the 12-meter new data format in September. I modified that program for our specific files. Jennifer has copies of these programs and has filled several observer requests without difficulty. Lorrie and I wrote a memo describing the new FITS format to be included with each tape.

IV. Hardcopy. There were several problems using a non DEC-standard symbiont for driving the laser printer. The laser printer was very sensitive to out of paper conditions and the job queue occasionally was clobbered. Lorrie and I updated the analysis programs to work with the DEC symbiont. All program I/O had to be done by ENCODE's and the subroutine PWRITE in order to include an extra carriage control - line feed. (This was a requirement when using the PASSALL option). Subseqently using the laser printer FORMs with the DEC symbiont removed the necessity of extral carriage control - line feeds. Since this implementation there have not been any difficulties with the laser printer.

V. Full support of the digital backend. Verbs have been defined to process the digital backend data. FIXDBE computes switched power, total power, calibration signal and zero level from the individual phases. SWITCHED computes and calibrates the switched power. TOTALPWR computes and calibrates the total power. CALDBE computes the calibration signal and the calibration factor. Zero computes the zero level and RMS. Most of the builtin analog backend analysis procedures will process the digital backend data transparent to the observer because the analysis system automatically takes care of the necessary bookkeeping. (The GET verb sets the appropriate value of the flag, DIGITAL, for the procedures to use.)

VI. 12-meter Surface Measurement. In August Dr. Findlay and the operations crew remeasured the 12-meter surface. The analysis program at the telescope was updated with Findlay's additional edge ball corrections. I created a program downtown that allowed Findlay to plot the current measured radius overlayed with its projected values should the radius be adjusted a given amount. Later this program was modified to plot the 12-meter surface before and after adjustment where the after adjustment data was plotted as a broken line over the before adjustment data. The data was sent to Charlottesville where Fred Schwab verified the RMS results and produced a contour map of the surface.

VII. Analysis program versions similiar to AIPS. The 12-meter analysis programs were essentially frozen as of early December in the "current" and "old" programs. Any new program development or bug correction is done in the "test" version. The observer has access to all three versions of the programs and a memory file for each one. These programs are invoked by LINE, OLDLINE, TESTLINE, CONDAR, OLDCONDAR and TESTCONDAR. I am currently implementing this system downtown.