Centralized Storm Information System

(CSIS) Implementation Plan

A REPORT

from the space science and engineering center
the university of wisconsin-madison
madison, wisconsin

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University of Wisconsin, Madison

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I. Introduction

Meteorological data for many years has been received at weather forecast offices in a large variety of formats: charts, teletype messages, cloud photos, radar displays, and others. These varying sources of data have been difficult to handle and they require mental superpositions and intercomparisons in order for meteorologists to make subjective forecasts.

With the many kinds and formats of data available to the meteorologist, and especially with the inclusion of satellite and radar data, it has become increasingly apparent that a significant barrier to the improvement of short-term forecasts and warnings was not the lack of some new and different measurements but the inability to assimilate and understand all that is currently available in real time. This is especially true for the National Severe Storms Forecast Center (NSSFC) in Kansas City, MO. This key center in NOAA's National Weather Service is responsible for issuing all of the severe thunderstorm and tornado watches in the country. At the NSSFC, data is still handled using paper, charts, film, grease pencils, scissors, and tape with the data arriving and being analyzed and displayed in different formats and map projections, at a number of locations within the forecast center.

There currently exists a strong need to collect and display all useful information on storms at NSSFC as well as at other NOAA operational facilities. In order to address this need, a joint NASA/NOAA effort has been initiated to provide a Centralized Storm Information System (CSIS) at Kansas City. The primary objectives of this joint project are: (1) to improve the overall severe storm forecast and warning procedure, and (2) to demonstrate the operational utility of techniques developed within applied research environments.

As part of the CSIS program, an advanced interactive computer system will be installed in Kansas City along with a GOES receiving antenna system. This new system will enable forecasters to nearly instantaneously superpose, intercompare, and display all available data including satellite derived data at the NSSFC on a color image terminal through an on-site data collection and processing system. The data will be transformable to the same map projections for different areas of interest. This is to achieve an ease of intercomparison and calculation of forecasting indices.

The capability to directly superpose satellite cloud images, IR temperature maps, radar reflectivity data, contours of surface and upper air data and to track and extrapolate the motions of severe storms is expected to produce a marked improvement in the speed and accuracy with which forecasters can interpret the data and alert the public. This qualitative expectation is based upon case studies examined in research environments.

The purpose of this implementation plan is to outline the characteristics of this CSIS computer system, itemize and describe the hardware which will make up the system, itemize and describe the software which will go into the system, and provide schedules of the implementation of the system. The parties involved in this CSIS implementation are NASA, NOAA, and the University of Wisconsin's Space Science and Engineering Center (SSEC). NASA is responsible for the overall management of the planning, procurement, and implementation of the program. NOAA is responsible for the facility accommodations, use, and evaluation of the system. A separate CSIS test and evaluation plan is being prepared by NOAA. The University of Wisconsin is responsible for the building, installation, and maintenance of the CSIS. This implementation plan will primarily center on the role of the University of Wisconsin in providing the CSIS hardware, software, and maintenance.

The implementation of CSIS actually started prior to the actual CSIS program and has been called by some "Phase 0 of CSIS". As part of the VAS program, a remote McIDAS terminal was installed in March 1980 in Kansas City at the NESS field station which provides support for the NSSFC operations. The purpose of this terminal was to allow an evaluation of the utility of remotely sensed temperature sounding for severe storm forecasting. This terminal was connected through a phone line to the University of Wisconsin. This terminal has three full resolution image frames, 12 coarse resolution frames, and three graphic overlays of three colors each. It requires several minutes to load a TV image because of the phone line limitations. The other functions of the terminal, such as interactive graphics, interactive information transfer, etc. are not degraded by the phone line. A second remote terminal was installed at NSSFC in December 1980. This terminal has 10 full resolution frames, five graphic overlays, and a dual channel enhancement system. The original terminal can only display an image and put in false color. The new terminal with the dual channel enhancement system allows the functional combination of two images, such as coloring the visible with the infrared information, false stereo presentations, etc. In addition to the VAS remote sounding evaluation, these terminals are being used for McIDAS system familiarization, training, and support of the NSSFC functions. The terminals were used an average of 20 hours/day for these functions. Kansas City is providing feedback to Wisconsin on problems, limitations, and considerations for improvements which should be incorporated into the CSIS computer system. Their feedback has been incorporated in the following implementation plan.

II. CSIS Hardware

The CSIS hardware will consist of a GOES receiving antenna system, three computers, three interactive terminals, and interface equipment. The system is designed with sufficient redundancy to allow a fail soft capability which will allow operations at a degraded level in the event of component failures. The system, however, is considered a demonstration system, and as such, will not be operational in NOAA's strict 24-hour duty, redundant capability sense of the word. The initial system is planned to be delivered and working by January 30, 1982. However, because of the funding plan delivery of all backup equipment and some of the terminals will not occur until later in 1982. Details of the delivery are contained in the section on hardware schedules.

A. GOES Antenna System

GOES imagery will be acquired by an antenna on the roof of the Federal Office Building in Kansas City. The GOES receiving system performs the data reception, demodulation and synchronization functions necessary to receive GOES data. Except for the reflector and mount, the system is designed so that redundancy can be provided in all components. The only single point long term failure is the mechanical destruction of the antenna. This is unlikely as the proposed antenna is rated for wind survival up to 125 mph (no ice). Several hundred installations have been made of this antenna model and are in service without a single structural failure. The system is patterned after the GOES receiving system recently installed at Wisconsin on the roof of the SSEC building. This antenna and mount are shown in figure 1. The reflector and mount are manufactured by Andrew Corporation. The reflector is a two piece 15-foot aluminum assembly backed and supported

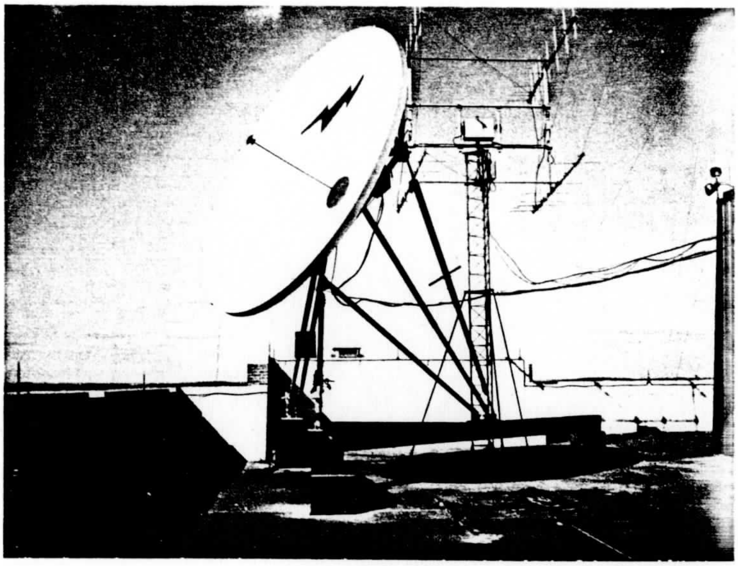


Figure 1a. 15' Andrews antenna and mount on the roof of SSEC. This antenna and mount are very similar to that which will go on the roof of the Federal Building in Kansas City.

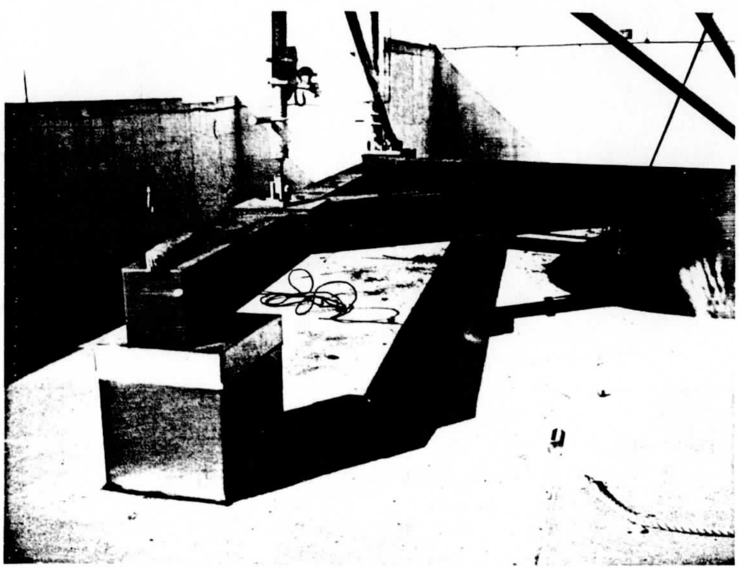


Figure 1b. Base of antenna at SSEC showing the interface pedestals which attach to the building's beams, the interface structure built from I beams, and the antenna mounting pads.

by a galvanized steel mount. The mount is steerable through use of motor controls. The antenna will be steerable so that it can receive either GOES-East or GOES-West. A Synergetics Model 10-02 down converter feeds the signal into a Synergetics Model 10-04 receiver. The IF output of the receiver is further processed by the EMR Telemetry 728 PSK Demod, 726 Bitsyncs and 822 mode A Frame Sync. The output of the frame sync is a digital data stream which will then go into the CSIS computers. In order to provide system reliability, NESS is being requested to allow use of GOES antenna electronics from FOB-4 in Washington in the event of antenna electronic failures.

In addition to the CSIS activities in Kansas City which requires a GOES antenna, The Corps of Engineers in the Federal Building in Kansas City have expressed plans for a GOES antenna to support remote platform data collection activities. The CSIS antenna will allow the Corps of Engineers a signal from which the remote platform data can be extracted. No operational support will be guaranteed by NOAA. Any additional funding required must be provided by the Corps. SSEC will provide the Corps of Engineers specifications on the antenna, down converter, and receiver to be procured for the CSIS system. If the Corps also installs an antenna, NOAA and NASA will consider an additional effort to assimilate both GOES East and West data.

The installation of the antenna on the roof of the Federal Building in Kansas City requires an RFI survey, GSA permits, structural plans for the roof modifications, construction on the antenna pads, and the actual antenna installation. The GSA permit for the installation of the CSIS antenna has been obtained. The assistant chief of the facilities engineering of the NWS central region has been appointed as the GSA contact point. GSA will have to approve the final plans of the building modifications required for the antenna installation.

Before the final decision to put the antenna on the roof of the Federal Building is made, a radio frequency interference (RFI) study is needed to insure that radio transmitters on the Federal Building and on other nearby buildings will not interfere with the reception of the GOES data. An RFI study was performed in 1971 when plans were to put a GOES antenna on the Federal Building roof. (NESS changed its policy plans about direct reception of GOES data by field offices and the antenna never was installed.) While the 1971 survey showed a favorable RF environment for an antenna, it is sufficiently out of date because of new construction and new transmitters in the neighborhood to warrant a new RFI survey. The Institute for Telecommunication Sciences of the Department of Commerce, Boulder, Colorado (who also did the original survey) are being contracted to do a new RFI survey. They will perform this during April 1981.

A preliminary structural analysis of the Federal Building roofing plan was performed which showed that the 15 ft. Andrew antenna can be safely mounted on the roof without major building modifications. The work to be done in order to provide an antenna foundation includes mostly interface type changes, as opposed to major structural beefing up. The nature of the work needed is in principal the same as that recently done at SSEC during the installation of the Andrew antenna there. The structural analysis showed there is a configuration of structural elements on the roof which is ideal for accommodating the antenna pad geometry. This ideal configuration occurs at 15 locations on the south side of the roof. (A similar configuration also exists at 15 locations on the north side of the roof). The proposed antenna foundation approach is shown in figure 2. Three interface pedestals

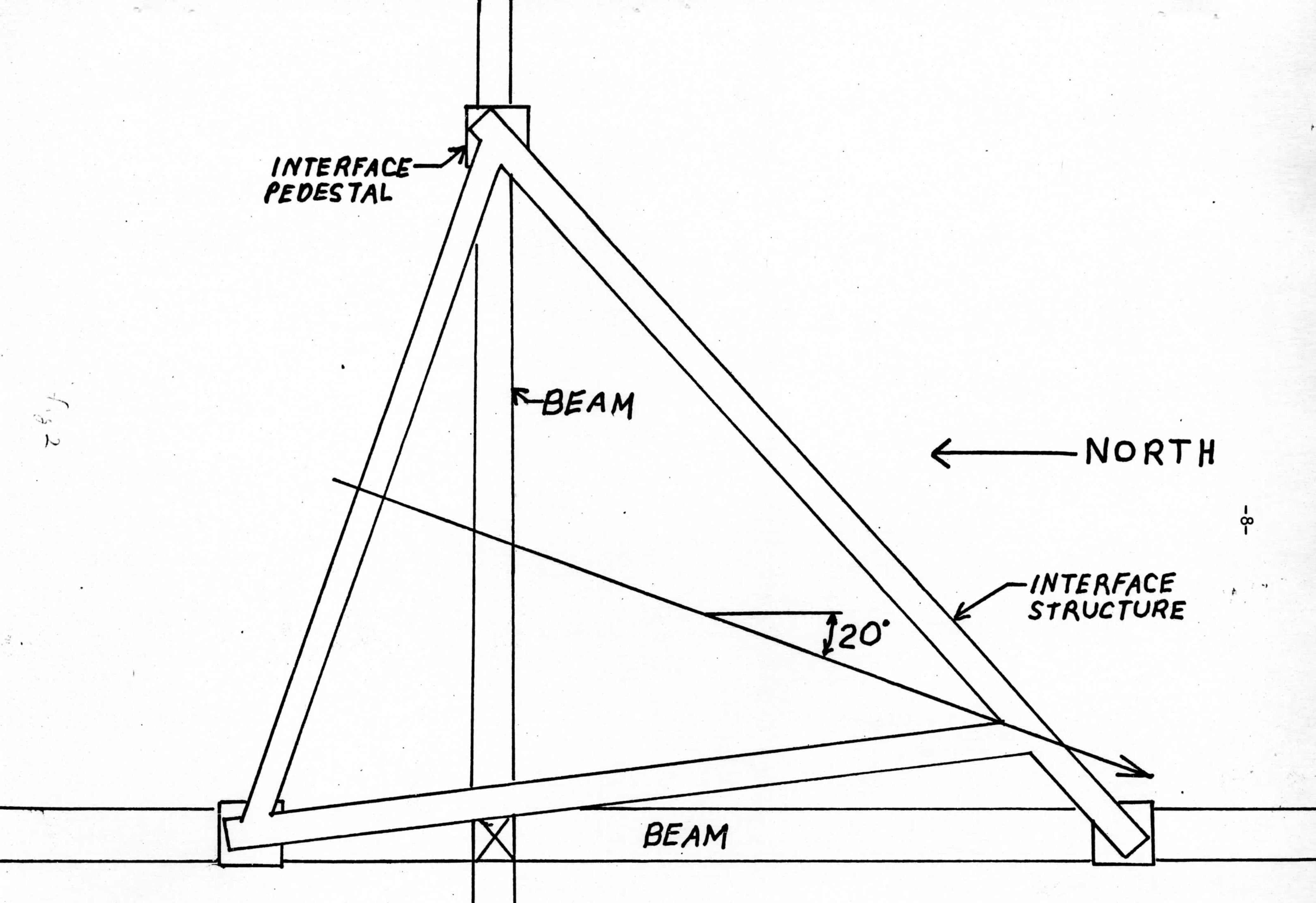


Figure 2. Plan for interface structure of antenna mount for Federal building in Kansas City.

are attached directly to the structural I beams of the building. Holes are cut into the roof and the interface pedestals tie directly to the beams. These pedestals are fastened to the roof beams using long "bolts" attached to channels (which act as "washers") which are located on the underside of the beam. An interface structure ties the three pads together. This structure rests on top of and fastens to the three interface pedestals. The interface structure contains the antenna pads and the antenna mounts directly to these pads. A simple stress analysis shows a worse case loading with 125 mph winds of 37,610 psi stress on one of the beams. This is 20,000 psi below the yield stress of that beam, an adequate safety margin. However, a "certified" analysis conducted by a licensed Missouri Professional Engineer will be needed to fulfill legal requirements. This analysis will serve as a totally independent analysis of our design. The building modifications and the antenna installation will be performed by contractors with GSA approval of the plans and the work. The installation of the 15 ft. antenna dish on the roof of the Federal Building will require the use of a helicopter to lift the antenna from the parking lot beside the building up to the roof. The antenna installation is planned to be completed in the fall of 1981. The detailed schedule is contained in the section on hardware schedule.

B. Computer Fail-Soft Design Philosophy

The computer systems will consist of three computers with identical hardware configurations, but with different functions and software. The conceptual configuration is shown in figure 3. One of the computers will act as a data base manager (DBM). Its function will be to bring in, if necessary preprocess, and then store all of the data which will be used by

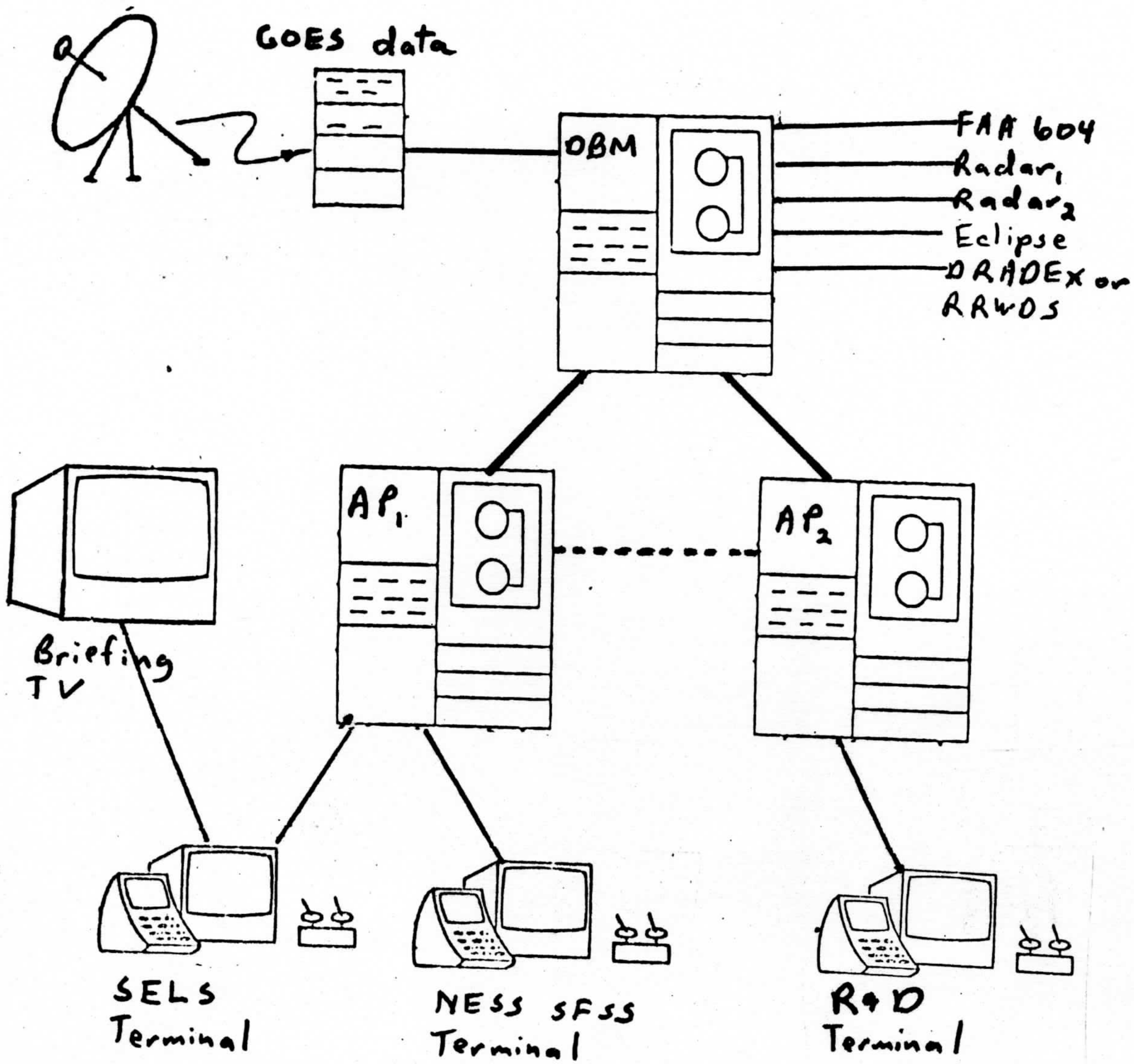


Figure 3. Conceptual plan for the hardware of the centralized storm Information System (CSIS)

CSIS. The second computer will be used as an applications processor (AP) for the operational support of CSIS. This AP will be connected to three interactive terminals and will perform all of the analysis and display functions for the forecasters. The three terminals will be assigned to SELS, NESS SFSS, and CSIS briefing, test, and evaluation. The SELS, and NESS terminals will have occasional use, while the CSIS briefing terminal will have continual use. The third computer will be used as an applications processor for research and development activities. It will have a single interactive terminal attached to it. Communications between the computers will be with a high speed (10 Mbit/sec) link. This interprocessor link will be used for remote file reads and writes. The speed of the link is the same as the speed to the local disk storage device. The two AP's will talk to the DBM over this link. While there physically will be a line between the two APs, it will not be used except during system reconfiguration.

The system is designed for a fail-soft, degraded operations mode. All of the computers will have identical hardware configurations. All of the input data lines will go to all of the computers, but only the DBM will actively listen to these lines. The terminals will be attached to the APs through a patch panel. Any terminal can be plugged into any computer, but only the APs will listen to the terminals i.e. if one plugs a terminal into a DBM, nothing will happen. The criteria which determines if a computer is a DBM or an AP is software on the disk pack. If one of the computer systems should fail, the system would be reconfigured with the two remaining computers becoming a DBM and single AP. The reconfiguration would take place through switches on the front of the computers. For instance, if the DBM failed, the research computer would become the new DBM. The operations on the forecast AP would continue, but the research people will have to wait until the computer is fixed before they can go back to work.

Loss of data during system failures is also designed as a fail-soft capability. The normal operation will have all of the data on the disk of the DBM. On the disks of the APs will be the data which is actually being used by the forecaster. If this AP fails, after reconfiguration where the forecasters plug their terminals into the research AP, the forecasters can reobtain their data from the DBM. If the DBM fails, the only historical data will be that which is on the AP's disks. Operational procedures will be developed to keep a sufficient amount of data on the AP disks to insure sufficient historical data if the DBM is somehow lost.

A further extension of the fail-soft philosophy is the complete redundancy of the conventional surface and upper air data inputs from the FAA 604 data line. This data is considered vital to the successful operation of the NSSFC that even a short outage would not be considered acceptable. The 604 data will be ingested by all three computers simultaneously and redundant files will be kept on each computer. Hence the only way that conventional data would be lost would be the total failure of all three computers, or a failure of the 604 line.

C. CSIS computer systems

All three CSIS computers will have identical hardware configurations. Hence only one computer will be described in detail in this section. The CSIS computer is a Harris/6. The computer will be supplied with a scientific arithmetic unit (SAU), 128 kilowords of 24 bit memory with error correcting codes, a complete options pack of program restrict, address halt, interval timer, and programmers panel. Highspeed I/O is done using the Harris Universal Block Control (UBC) board while low speed I/O is done through the Harris Priority Input Output Channel (PIOC) board. Figure 4 shows a block diagram of the computer. Online storage is supplied with a 300 MB disk with a removable disk pack and controller. A second 300 MB could be added in the future using the same disk controller. Offline storage and program saves are done on a 800/1600 BPI tension arm tape drive. Filtered power for the system is provided by a 3KVA sola transformer/regulator. The above computer equipment will be purchased from Harris and CDC.

The data interface equipment will be constructed by SSEC. The GOES data preprocessor (or "byte mangler") interfaces the CPU with the frame sync of the antenna system. In addition to providing proper interface, it performs line averaging of the data into 1/2, 1, 1 1/2, 2, 3 or 4 mile resolution, packs the data into 24 bit words, and provides interrupts to the computer when the satellite data is ready.

The asynchronous interface (sometimes called "the 8 holer") provides interfaces to a total of eight low speed data lines. The computer console CRT and the hard copy error logger model 43 printer connect to the async interface. The console CRT and printer lines from the three computers will go to a data concentrater multiplex box so that a single CRT and printer will be used by all three computers. The cardreader/line printer lines likewise go to a central location so that a single Documation 600 cpm card reader and a Teletype model 40 high speed printer can serve all three computers. In the cabinet below the card reader is a small microprocessor station with Intel 80/24 and 534 boards. This microprocessor performs the routing and buffering functions to the computers. Other data lines into the

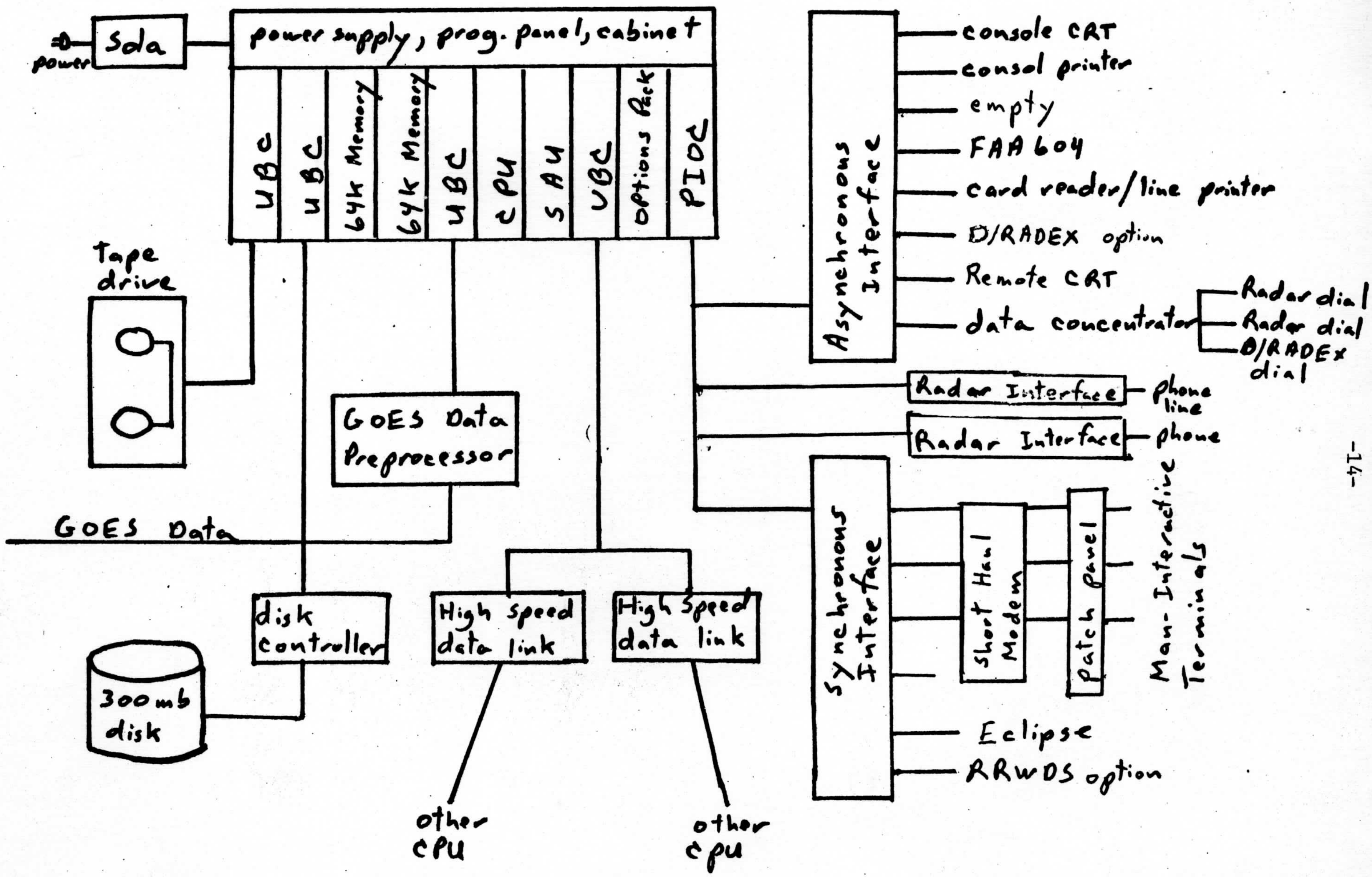


Figure 4. Block diagram of one of the CSIS computers

asynchronous interface include the FAA 604 line. The two WBRR radar phone lines autodialers and the D/RADEX or RRWDS dialer will share a data concentrator. An in house CRT could also share this data concentrator. The D/RADEX or RRWDS phone line will go directly into the async interface while the WBRR phone data will go through a separate radar interface box into the PIOC. This uses a total of seven out of the possible eight asynchronous ports. If there is a need for future data lines, another data concentrator could be put on.

The synchronous interface is for low to medium speed ports which obey bit serial protocol. There are six ports on the synchronous interface. Three of these ports will be dedicated to interactive terminals with connections through a short haul modem to a patch panel. The patch panel will allow rapid interchange of terminals. On the computer which is normally used for research, one of these terminal ports will be attached to a modem and connected to a remote interactive terminal at Wisconsin. The computer link to the Eclipse will also be connected to the synchronous interface. There will be two unused ports on the syncronous interface. One could be used for an ADCCP line to a remote computer such as Wisconsin's Data Base Manager.

The Eclipse-CSIS link will use the synchronous interfaces of the two computers. The Eclipse has a SLM-2 synchronous interface which currently has one empty port which will be used for the CSIS link. While there are three CSIS computers, only one will talk to the Eclipse at a time. The three CSIS computer synchronous interface parts will be fed into a patch panel so that the CSIS computer which is acting as the data base manager can be connected to the Eclipse. The low level communications between the two systems will use the Binary Synchronous Communications Protocol for which both computer operating systems have service routines available. The higher level communications routines will have to be developed as is described in the software section.

The other interface box built by SSEC is the high speed data link (or "burn line") box. This interface allows 10 Mbit/sec communications between the three computers. The data base manager is the hub of this network. The two APs talk to the DBM but not to each other. Software makes the link between the APs inactive. Only on reconfiguration when one of these APs become a DBM will the software activate the line.

The CSIS computers, tape drives, disk drives interfaces and computer operator station will be housed in the existing computer room at the NSSFC. This will provide an environment of 70°F (Max 78°F.) with 20-80% relative humidity, non-condensing, which the CSIS equipment requires. Figure 5 shows the existing layout of the computer room. The back of the existing room will be cleared out, with the tables, bookcases and Eclipse diablo printer moved to other rooms at NSSFC. The key punch for the Eclipse will be moved to the adjacent room. Figure 6 shows the proposed layout with the CSIS equipment installed. The three computers and tape drives would be mounted in a row with the disk drives behind the computers. There is room for another three disk drives if the system should be expanded at some time in the future. The CSIS computer operator terminal CRT would be put on the table next to the existing Eclipse. The hardcopy error logger model 43 printer would be placed next to the existing Varian. The error messages to the printer will also go to the operator's CRT. All of the computer interface equipment and antenna electronics will be housed in the bottoms of the CSIS computers and tape racks. The phone modems and the terminal patch panel will be mounted on a rack against the wall. The CSIS

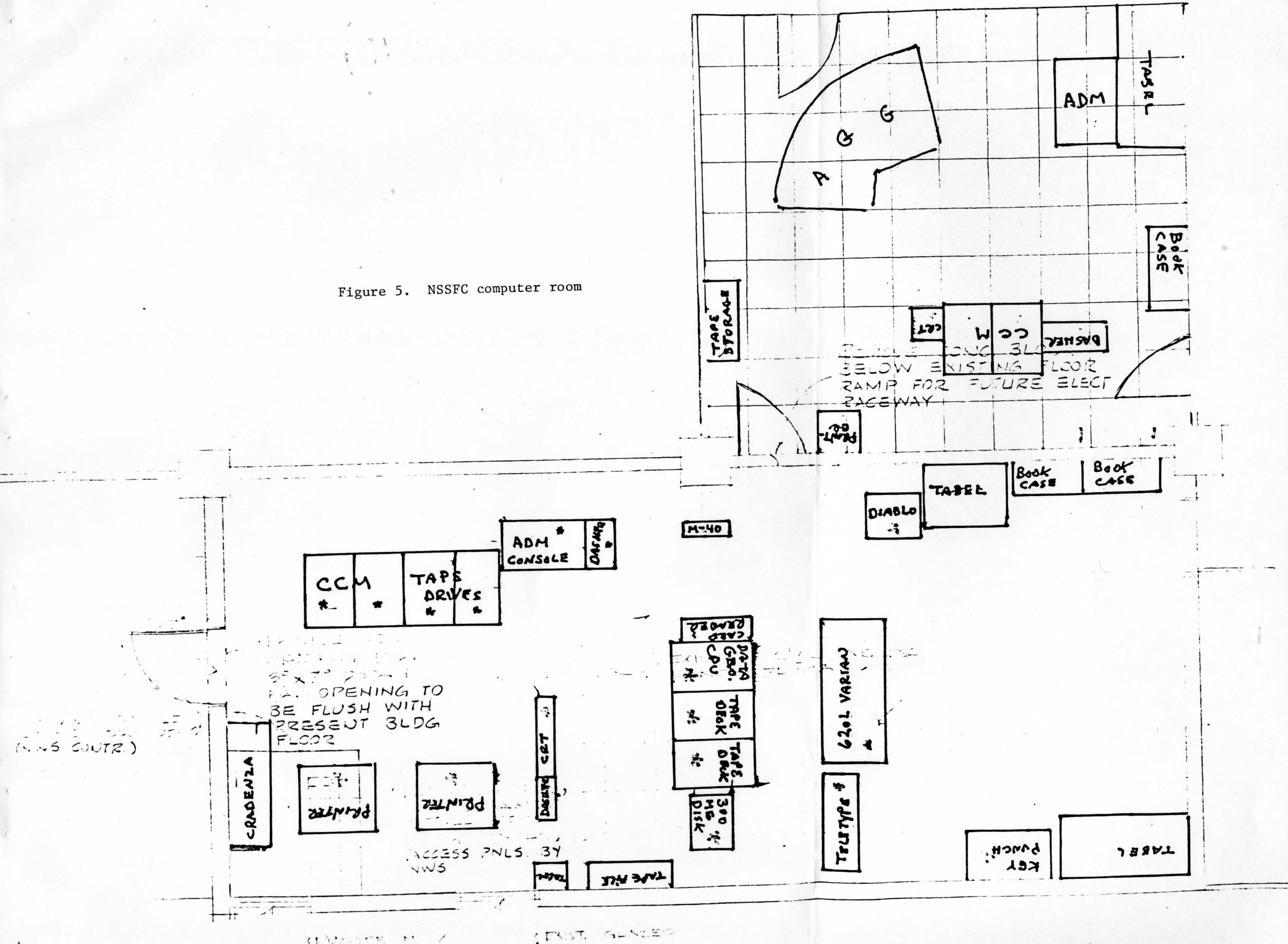


Figure 5. NSSFC computer room

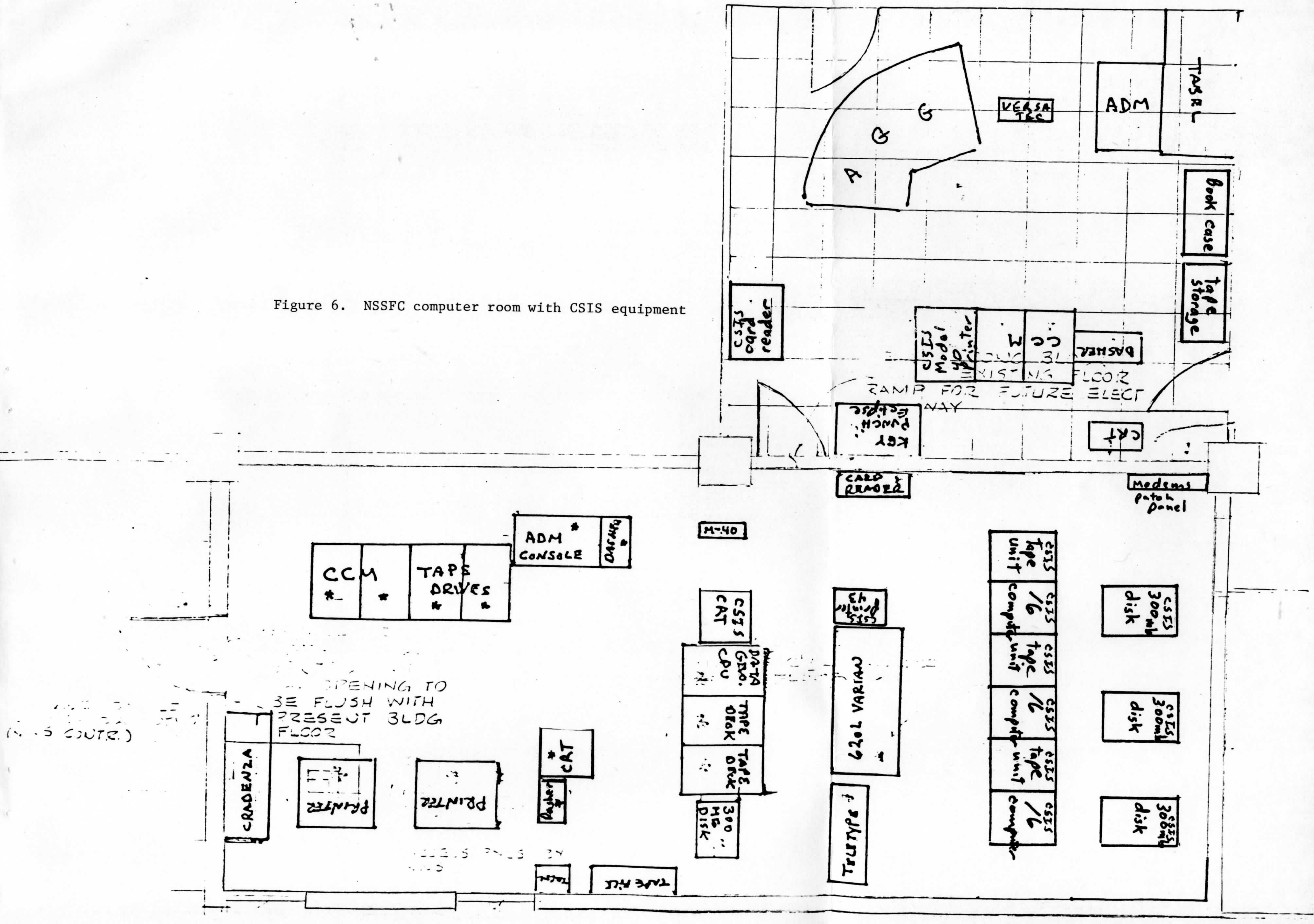


Figure 6. NSSFC computer room with CSIS equipment

card reader and high speed printer model 40 will be installed in the room next to the computer room.

D. Interactive Terminals

The CSIS terminals form the primary man-machine interfaces. Each terminal consists of al alphanumberic CRT, a high resolution color TV monitor, a joystick pair, an alphanumeric hardcopy printer, terminal electronics and the terminal enclosure-desk. There will be a total of three CSIS terminals. Each will be functionally identical except for the number of image frames available. Figure 7 shows a terminal similar to that which will be built for CSIS. The terminal electronics and digital refresh electronics are enclosed in the two cabinets to the right of the operator's desk. Remote location for electronics may be required because of climate constraints. If this is necessary, the terminal electronics would be located in racks (one per terminal) in the computer room. Figure 8 shows a functional block diagram of the terminal. The data coming or going to the applications processor computer goes through a patch panel, a short haul modem used for isolation purposes, and is received by the bisync card. The bisync communications card provides protocol control and buffering. The timing signals necessary to drive the color monitor are generated by the TV timing card. The position of the joysticks are sensed by the joystick card, which relays this to the host AP, which in turn commands the cursor generator to position a cursor on the color monitor. The terminal is under the control of the Intel 80/24 microprocessor. The meteorologist will use the Ann Arbor CRT terminal to communicate with the host applications processor computer via the microprocessor in the terminal. Hardcopy alphanumeric output is provided by a terminal printer. The colorizer cards

Figure 7. Man-Interactive terminal similar to the CSIS terminal. The terminal electronics are in the doors to the right of the operator. The printer is not shown.

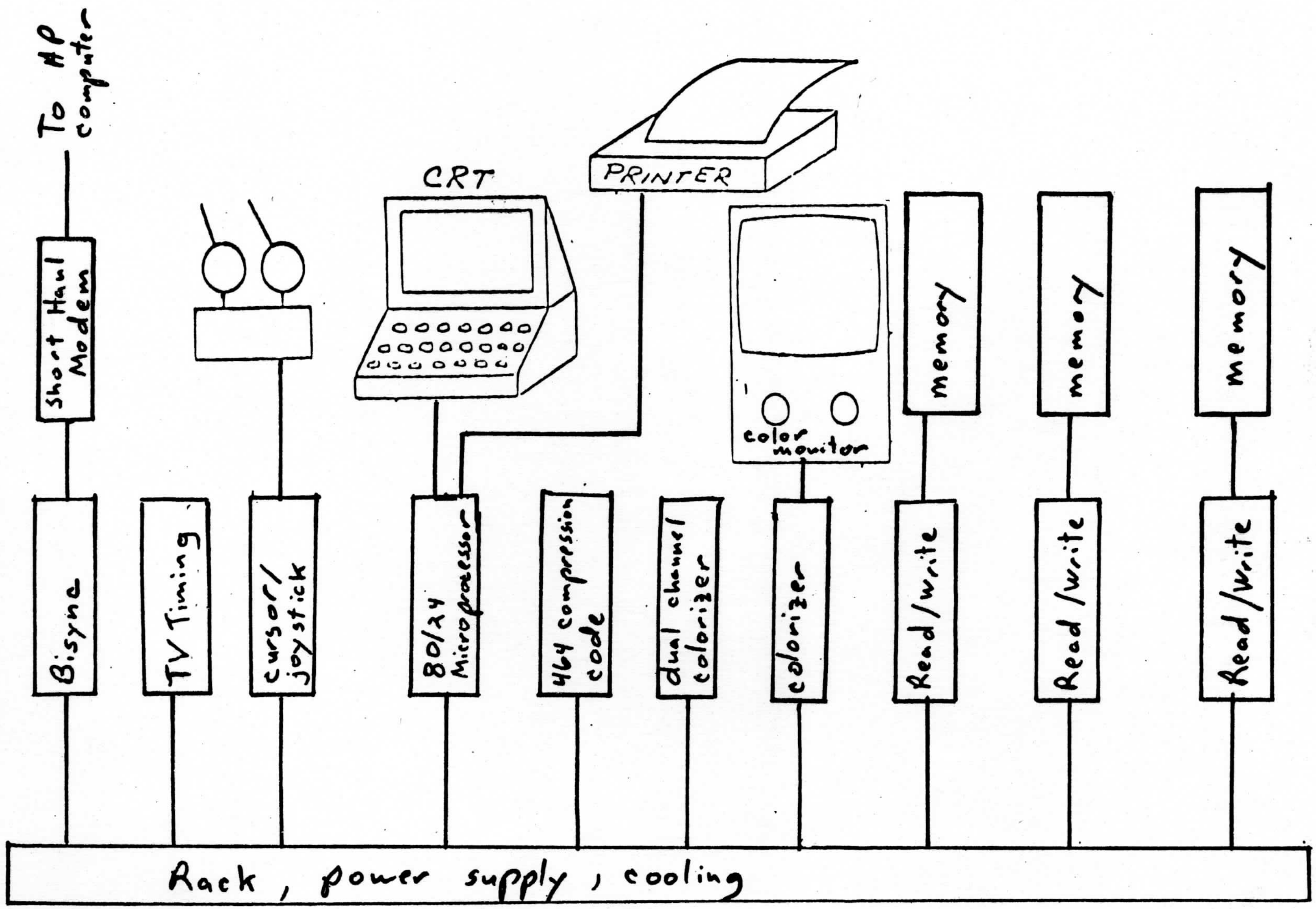


Figure 8. Block diagram of CSIS Man-Interactive Terminal

provides false color and enhancements to the TV image, and also allows selectable colors for the graphic overlays. The dual channel colorizer allows the functional combination of two images into one (such as coloring the visible image with the infrared temperature). The read/write cards control the input and retrieval of image and graphic data to and from the memory. The image and graphics are read out of the memory every 1/30 sec to refresh the television monitor. The memory is solid state CDC memory cards with CDC chassis and timing control boards. The 464 compression code board allows data compression to be used on the image data. The six bit image data (64 gray scales) will be stored as three bit compressed data in the memory. The data is unpacked on the fly allowing six bit data to go to the colorizer card. This data compression concept and also the dual channel colorizer were put into the "phase 0" terminal which was delivered to Kansas City in December 1980.

The number of images and graphics is controlled by the number of CDC memory boards in the terminal. Three of the terminals will each have a total of 26 high-resolution image frames with 13 graphic overlays. The image grames will be configured into paired opposites in keeping with the concept of visible/infrared frame pairs. A single key provides transfers between image pairs or dual channel combination of the pairs. The image data will have six bits of information (64 gray scales or false colors). The graphic overlays will have three bits of information (seven colors plus off). The colors will be selectable by the meteorologist via the colorizer tables. The terminals will have an NTSC encoder which will allow the video to be connected to a large briefing TV.

The initial CSIS hardware is scheduled to be installed in January 1982. Because of funding constraints, not all the terminals will be delivered at this time. Two of the terminals will be delivered with the initial installation. One of the terminals installed as part of "phase 0" will be returned to Wisconsin to be used as a remote terminal to CSIS. When the CSIS equipment is working properly, the remaining phase 0 terminal will be connected to the CSIS computers. When the last terminal is delivered later in 1982, the remaining phase 0 terminal will be returned to Wisconsin. Details of the terminal construction and delivery schedule are in the schedule section of this plan.

Development activities involved in the construction of the CSIS terminals involve reworking the read/write boards to accomodate the increased frame space, redesigning the colorizer to allow graphic selectable colors, and modifications to other boards. The developments involved with the dual channel colorizer, three bit data compression, the 80/24 microprocessor board, use of the new CDC memory system, and use of the Optima table/equipment enclosures were done on prior McIDAS terminals.

E. Hardware Maintenance

Hardware maintenance for CSIS equipment through the end of FY 83 will be the responsibility of SSEC. The maitenance of the Harris computers, tape drives, disks, and card reader will be subcontracted to the Harris Corporation-Computer Systems Division. Maintenance of the Teletype printers will be subcontracted to the Teletype Corporation. The maintenance of the SSEC built equipment (the terminals and the computer interface boxes) and the antenna system will be the responsibility of SSEC with local assistance by NSSFC personnel. A government Electronics Technician (ET) is required to support this a activity on a half time basis. NOAA will provide an ET to assist in CSIS maintenance.

If there is a problem with the CSIS equipment, the NSSFC personnel will first attempt to define the problem area. SSEC will be available during normal working hours to provide telephone assistance in identifying the problem and determining if maintenance contractors, such as Harris should be called in. SSEC will provide a computer operator's manual which will outline problem identification and "get well" procedures. If the problems are isolated to SSEC equipment responsibility, telephone trouble shooting by NSSFC personnel in communications with SSEC technical experts will be attempted. If the NSSFC personnel cannot fix the problem or replace the bad boards with CSIS spare boards, SSEC will either ship functioning hardware or send SSEC repair technicians to Kansas City within 48 hours after it has been mutually agreed that NSSFC personnel cannot fix the problem. Any components replaced by spares will be shipped back to SSEC for repair. The spare equipment is listed in the section of this plan on schedule.

F. Hardware schedule

The CSIS hardware is scheduled for installation in Kansas City in January 1982. At this time the system will consist of a GOES antenna system, three computers, tape drives, interface equipment for these three computers, and two new CSIS interactive terminals. The final CSIS terminal and all the spare equipment will be delivered later in 1982. The hardware capital equipment which will be purchased as part of CSIS is listed in table 1 with brief explanation of purposes. Table 2 lists the equipment which will be built by SSEC with a brief explanation of purposes. A more detailed description of the equipment is contained in the preceding sections C and D.

The antenna is scheduled for installation in October 1981. The details of the antenna schedule are shown in figure 9. The CSIS computer schedule is shown in figure 10. The three CPU system is scheduled to be working in September, 1981 at SSEC.

The terminal delivery schedule is shown in figure 11. The first CSIS terminal will be complete in September 1981 and will be used for software development. The second terminal will be completed in December and used on the system for a month to insure that everything is working correctly. The delivery of the system to Kansas City which includes antenna electronics, three CPUs, and two terminals is scheduled for January 1982. At that time one of the phase 0 terminals will be returned to Wisconsin for use as a remote terminal to the CSIS research applications processor. The last CSIS terminal will be built with FY 82 funds, as will all the spares for the system. The spare interface boards for the CPUs will be completed in February 1982. The third CSIS terminal will be done in May 1982. When the final terminal is delivered, the remaining phase 0 terminal will be returned to Wisconsin. The spare terminal boards will be completed in October 1982.

Table 1. CSIS Capital Equipment

	Quantity	Description
A.	3	Harris /6 CPU systems including 128 K 24-bit word memories with tape drives (main CSIS computers)
B.	3	CDC 300 M Byte disk drives with disk packs (disk storage for CPUs)
C.	10	CDC Chassis
	10	CDC Timing Control boards
	46	CDC Memory boards (128 K x 20) (for the three small terminals [24 frames, 12 graphic overlays] each gets three chassis, three timing control boards, and 15 memory boards. There is one spare chassis, one spare timing control board, and one spare memory board)
D.	5	Ann Arbor Ambassador CRT terminals (one CRT for each of the three interactive terminals, one for the computer operator, and one spare.)
E.	4	Aydin RGB TV monitors (one color monitor for each of the three interactive terminals and one spare.
F.	1	Teletype Model 43 printer (error logger for computer operator)
G.	1	Teletype Model 40 printer (main printer for CPU output)
H.	1	Documation 600 cpm card reader with card case and cabinet (main card reader for CPU input)
I.	4	3 KVA Solar transformer/regulator, 208V input (one for each CPU system and one spare)

	Quantity	Description
J.	6	2 KVA Solar transformer/regulator (one for each of the three terminals, one for the card reader/line printer station, one for the antenna electronics, and one spare
K.	1	Decwriter III line printer
L.	6	Intel 80/24 microprocessor boards (one for each terminal, one for the card reader/line printer station, and two spares)
M.	2	Intel 534 board (one for the card reader/line printer station, and one spare)
N.	4	Intel Industrial chassis (one for each terminal and one spare)
O.	3	Optima enclosure (desk-enclosure of terminal, one for each terminal)
P.	4	E.S.I. card cages for Intel chassis (one for each terminal and one spare)
Q.	4	Intel 464 boards (contains firmware compression code. One for each terminal and one spare)
R.	1	Andrew Antenna with motor drives or equivalent (GOES 15 ft. receiving antenna)
S.	1	Sets of Antenna electronics (down convertor, demod, bit syncs, mode A frame sync from Synergetics, EMR or equivalent)
T.	1	Large screen color monitor (briefing monitor)

	Quantity	Description
U.	1	Chrono-log clock (provides current time to the computers at time of system boot.)
V.	4	Computer terminal work stations

Table 2

Boards built by SSEC

	Quantity	Description
A.	4	Asychronous Interface (one each CPU, one spare
B.	4	Synchronous Interface (one each CPU, one spare)
C.	5	High Speed Data Links pairs (Burn Boxes) (one each CPU, one spare)
D.	3	GOES Data Preprocessors (Byte Mangler) (one each CPU [only one used at any one time])
E.	2	Card Reader/Line Printer station (one for card reader/line printer station, one spare)
F.	4	Joy stick pair (one each terminal, one spare)
G.	4	Dual channel colorizer card (one each terminal, one spare)
H.	4	Colorizer card (6 bit enhancement) (one each terminal, one spare)
I.	20	Bisync card [9] three each CPU for terminal connections [4] one on each of four terminals [3] one on each CPU for Eclipse link [5] five spares
J.	4	TV Timing card (one each terminal, one spare)

	Quantity	Description
K.	4	Cursor generator card (one each terminal, one spare)
L.	4	Harris Interface Card (one each CPU, one spare)
M.	11	Ram Write card (three each terminal, two spare)
N.	11	Ram Read card (three each terminal, two spare)
O.	6	WBRR radar interface (two each CPU [only two used at any one time])
P.	3	Radar auto dialer (one each phone line and one spare)
Q.	5	Data Concentrators (one for each CPU for radar dialer lines, one for operator CRI and error logger, and one spare)
R.	4	Six port short haul modems (one each CPU, one spare)
S.	4	Two port short haul modems (one each terminal, one spare)

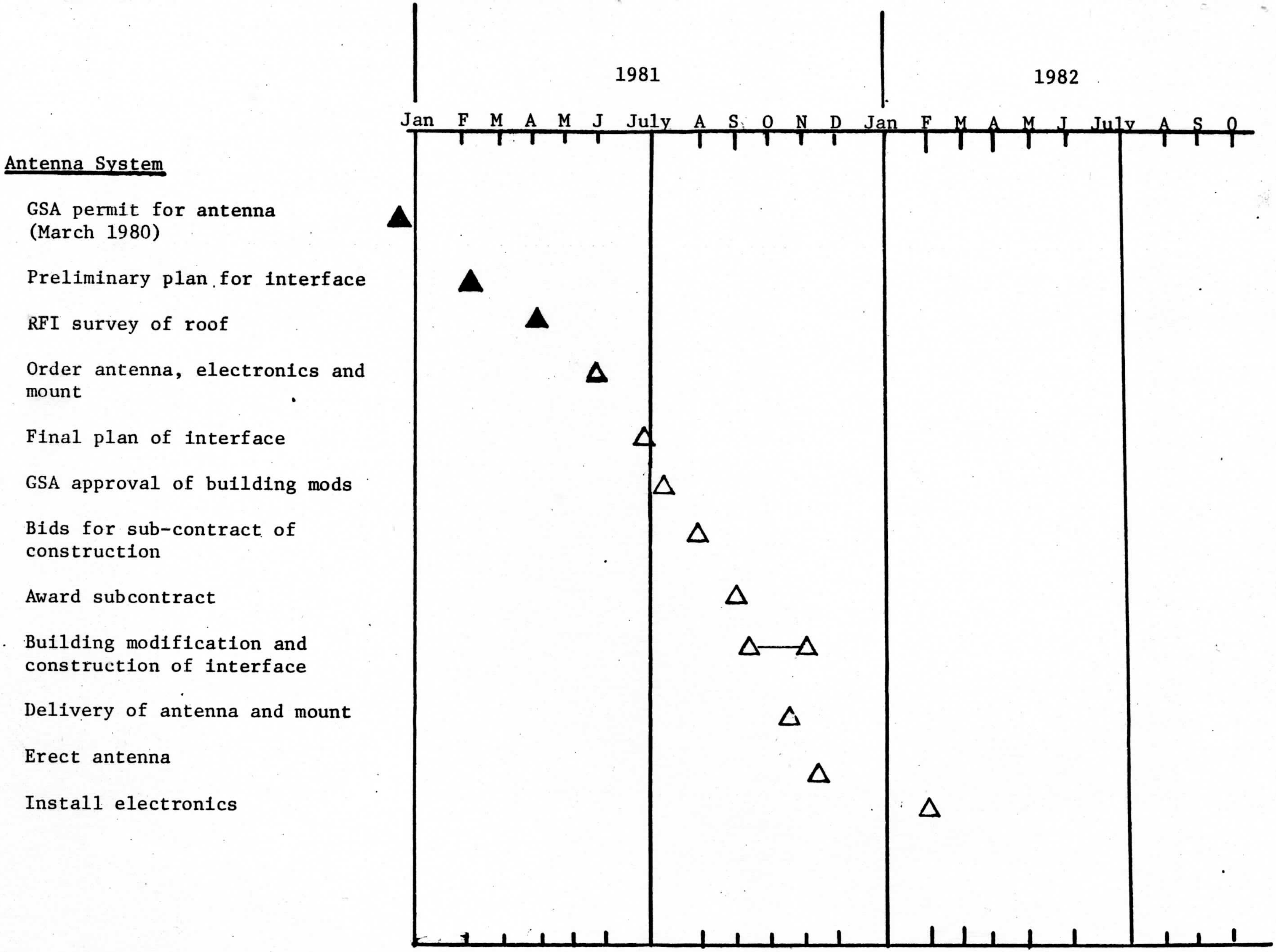


Figure 9. Schedule for CSIS Antenna System

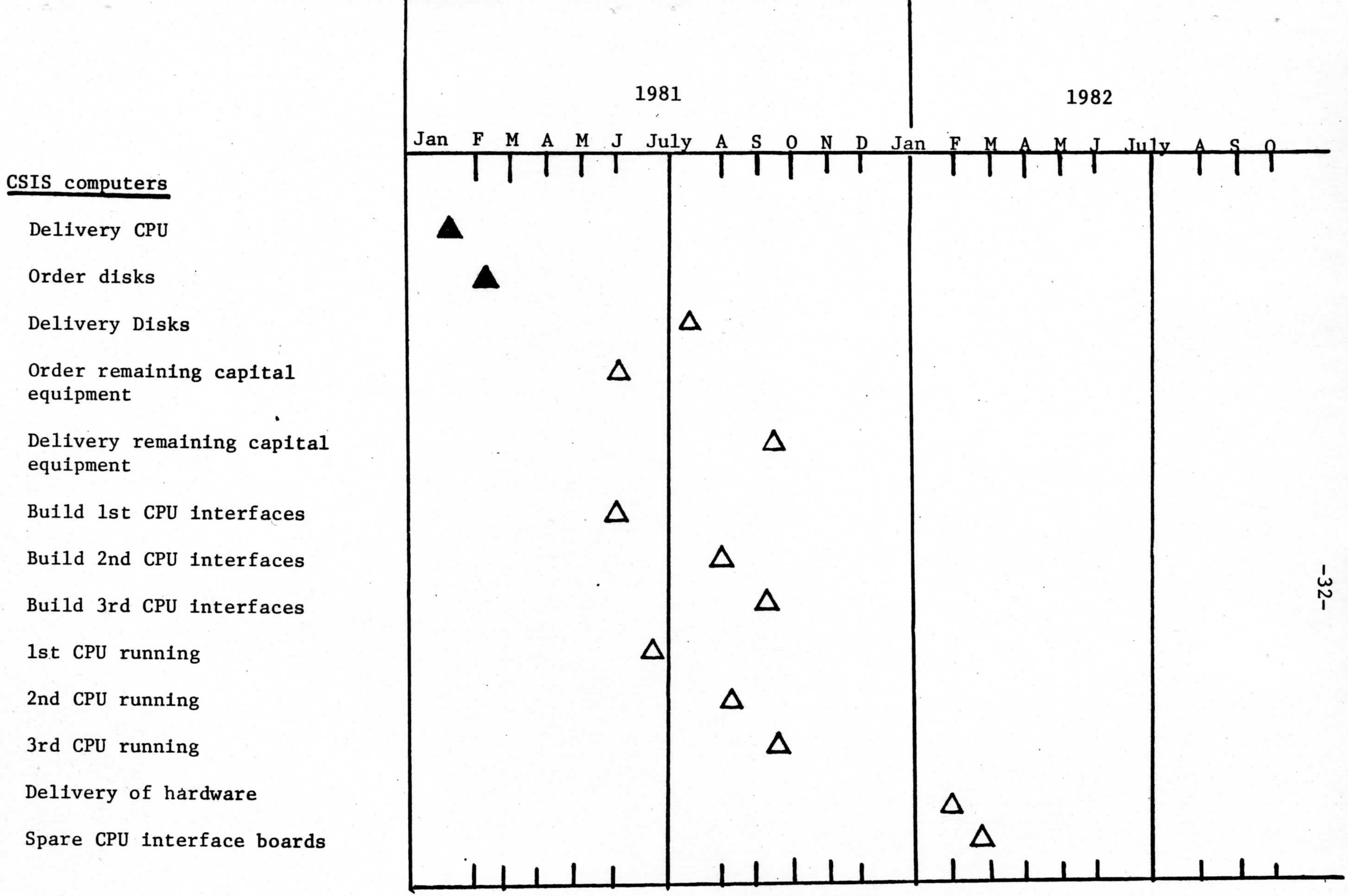


Figure 10. Schedule for CSIS computers

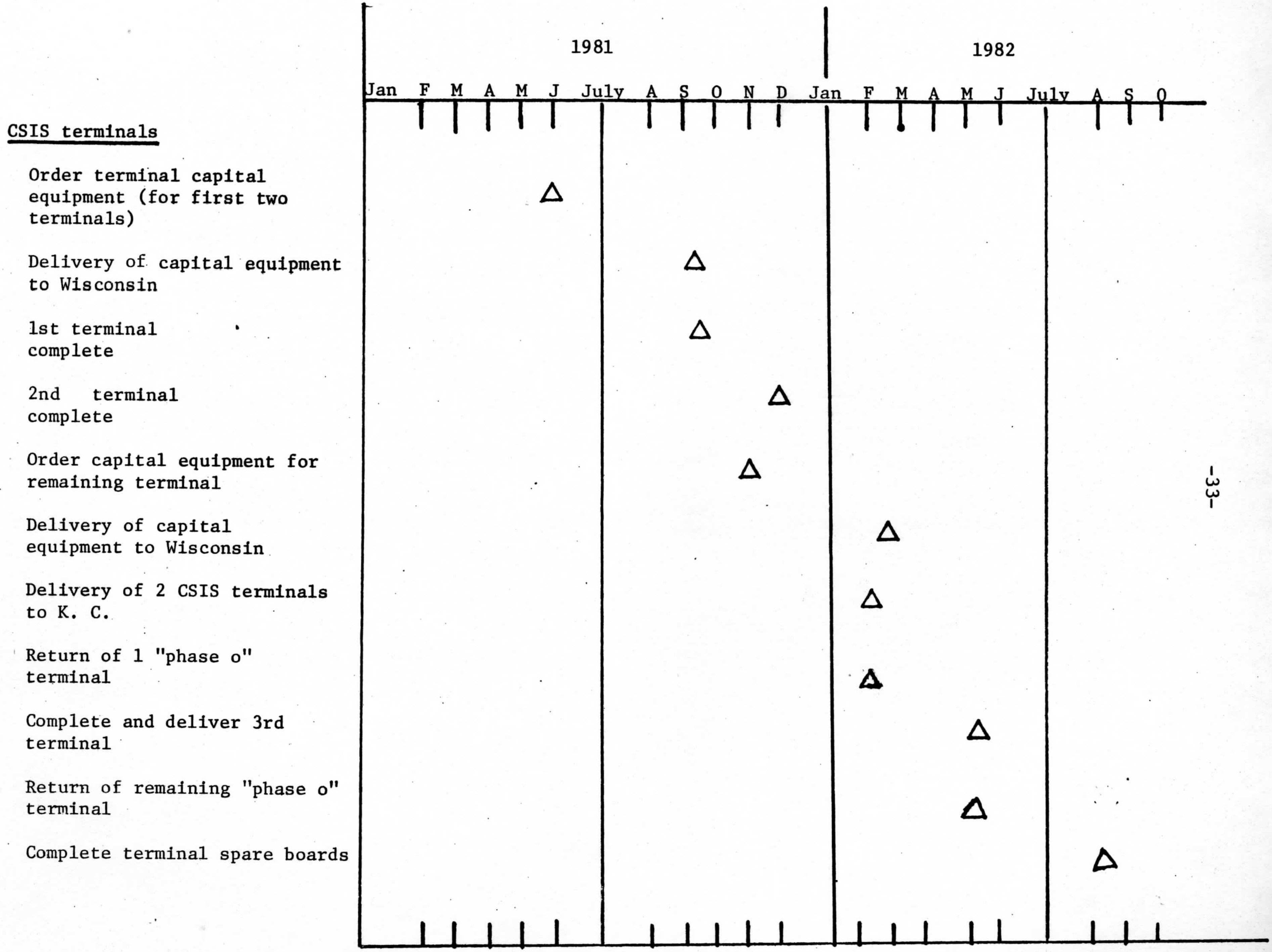


Figure 11. Schedule for CSIS Man-Interactive Terminals

III. CSIS Software

CSIS is an outgrowth of the Man-Computer Interactive Data Access System (McIDAS) developed by SSEC. Much of the McIDAS software is directly applicable to the CSIS problem. However, the CSIS problem is sufficiently different from the McIDAS design goals that some new software is required to better tailor CSIS to the demands of the operational severe storm forecasting environment. Part of the phase "0" activities was a familiarization of McIDAS software capabilities. NSSFC has provided feedback to Wisconsin of limitations and problems with the existing software. A further evaluation of the adequacy of the McIDAS software is part of the CSIS test and evaluation activities planned for the spring of 1981.

There are three types of software activity related to CSIS. The first is new system software which is required to make the CSIS hardware perform as described in the previous section. Since the CSIS hardware is somewhat different than McIDAS, this new system software is required. The second type of software activity is developing new applications modules specifically for CSIS requirements. The third type of software activity is responding to the evaluation of deficiencies in the McIDAS/CSIS software by fixing, modifing, or rewriting the software which is causing problems or limitations.

A. Existing McIDAS Software to be Delivered as part of CSIS

McIDAS is a continually evolving system. The McIDAS software has a central core which is common to many projects and project software which is used by specific individual projects. The central core of software has over 700 programs. A listing of this software by program name and a one line description of its function is contained in Appendix A of this plan.

All of this software will be part of the CSIS software package. This list will grow throughout the CSIS project as software written for CSIS and experimental software from other projects are available for transfer to CSIS.

The software is made accessable to the McIDAS user through keyins on the CRT of the interactive terminal.

There are three distinct types of keyins. The first is program names. These are generally six letters long and are used for new experimental or project dependent software. The second type of keyin is a program alias. These are one or two letter keyins which call up a program. One letter keyins are basic functions which execute when the key is struck, such as "A" advances the TV frame to the next image, "E" gives the earth location in latitude-longitude of the cursor on the satellite image, etc. Provisions are available for user defined one letter function keys. Two letter keyins are the workhorse of the McIDAS commands as most programs are accessed through two letter commands. The command is made up of a line feed followed by the two letter command, followed by a string of parameters containing information pertinent to the desires of the user, and ended with carriage return key. The third type of keyin is a three letter macro. The macros are strings of two letter commands set up in a primitive programming logic and are used to execute preset sequences of commands. Most macros are very project or individual dependent.

The data used in CSIS will be arranged in the three basic types of data bases used on McIDAS, i.e. Images, Station Data Sets (SDS) and Grids. Images are pictures which can be displayed on a TV. When they are residing on digital disk they are referred to as areas and when they are residing on the TV monitor they are referred to as frames. Since the frame is a subset of the area, with the area being allowed to be larger than the frame, the two terms of area and frame are necessary to avoid confusion. The Station Data Sets (SDS) are used for storing data which has a day, time, and location point. All of the weather observations are contained in this data base. The third type of data are grids which serve as an interface between raw data (such as SDS data) and analysed displays on the graphics such as contours. Model data is also stored in grid files.

The McIDAS keyins which will be supplied to CSIS are listed in Table III. The frame/cursor manipulation keyins are listed in Table IIIa. These commands allow the user to loop frames and graphics together or separately, turn either on or off, switch back and forth between visible and infrared opposites, define cursor type and position, and inquire as to the status of the frames or cursor. Table IIIb lists the commands used to inquire about the data bases of the image SDS and grid files, access the data bases, and display the images and graphics. Table IIIc lists the services available for generalized graphics. Table IIId lists the McIDAS keyins available for pseudo coloring of the image frame. These include black and white enhancement, false coloring, and dual channel combination of images. Table IIIe lists the commands used in the WINDCO package. This package allows one to track clouds to get their velocity and height. Table IIIf lists the routines available for image data massaging. Table IIIg list routines available for generating statistics on portions of areas defined interactively by the user. Table IIIh lists the keyins associated with the generalized curve fitting routines and the use of them associated with navigation prediction. Table IIIi lists the keyins associated with meteorological data services. Table IIIj lists the meteorological parameters

TABLE IIIa FRAME/CURSOR MANIPULATION

KEYIN	COMMAND
A	Advance 1 Frame
B	Back up 1 Frame
DC	Define Cursor Size and Bounds
DR	Define Loop Dwells
DT	Define Cursor Type and Color
E	List Earth Coordinate of Cursor
F	List Frame Position
I	List Image Coordinate of Cursor
J	Connect Graphics Frames to Loop Control
K	Turn Image Frame On and Off
L	Start and Stop Looping
LB	Define Loop Bounds
N	Pictel Interlace Switch
O	Switch Signal System
P	Position Cursor
PC	Point Cursor
R	Frame Position Reset
SF	Set Frame Position
T	List TB Coordinate of Cursor
W	Turn Graphic Overlay On or Off
Y	Connect Image Frames to Loop Control
V	Loop Velocity Cursor
Z	Size Cursor

TABLE IIIb ACCESSING THE DATA BASES

KEYIN	COMMAND
AA	Area Mover
AM	Area Migrate
BU	Define Frame Blow Up
C	List Frame Content
CA	Change Area Directory Entries
DAD	Multiple Area Fetches
DF	Define Frame
GA	Generate Area Size
JA	SDS File Move
JD	List PFS Element Directory
JG	Generate SDS File
JL	List SDS Directory
JO	Output SDS Record
JQ	Quit SDS File(s)
JX	Set SDS File Number
LA	List Contents of Digital Area(s)
MOM	Multiple Area Fetches
QA	Quit Digital Disk Areas
GG	Grid Utility
GU	File Utility
HM	Creates Lat/Lon grid from SDS file
ZC	Multi-WRRRM/GRID Weather Data Contouring
ZJ	Save SVC "A" or "C" data

TABLE IIIc GRAPHICS

KEY IN	COMMAND
CW	Clear WRRRM Graphics
EG	Erase Graphics
FG	Plot Figure
GD	Graphic Device
GF	Generate Figure
GI	Grid Image
IC	Plot Map Outlines
J	Connect Graphics Frame to Loop Control
K	Blank/Restore Video
L	Start and Stop Looping
LB	Define Loop Bounds
O	Switch Signal System
SG	Set Graphics Frame
SU	Save Utility
W	Graphics System Display Toggle
ZA	Text Annotation
ZB	Text Annotation - Joystick
ZL	Cursor Line Drawing

TABLE IIId PSEUDO COLORING

KEYIN	COMMAND
EB	Black-White Contrast Pseudo Coloring
EC	Color Breakpoint Pseudo Coloring
EF	Display Pseudo Coloring Transform
EL	Interval Pseudo Coloring
EM	Pseudo Coloring Movie
ER	Restore Pseudo Coloring for Frame
ES	Save Pseudo Coloring for Frame
ET	Dual Channel Color Pseudo Coloring
N	Pictel Interlace Switch
SC	Select Color Pseudo Coloring

TABLE IIIe WINDCO

KEY-IN	COMMAND
AL	ALPHA
CH	Cloud Height Mode
DM	Data Massage
DV	Delete Vector
H	Cloud Height
HM	Creates Lat/Lon grid from SDS file
HP	Height Plot
IO	Wind File Input/Output
IW	Initialize WINDCO
JA	SDS File Move
JD	List PFS Element Directory

TABLE IIIe WINDCO (cont.)

KEYIN	COMMAND
JG	Generate SDS File
JL	List SDS Directory
JQ	Quit SDS File(s)
JX	Set Default SDS File Number
LS	Define Lag Size
PV	Plot Vectors
QC	Quality Control
RD	Residual Distribution
RP	Reset WINDCO Vector File Pointer
SD	Surface Display
V	Loop Velocity Cursor
VC	Define Velocity Cursor Increments
VG	Vector Graphics
WC	Wind Vector Coordinate
WM	WINDCO Metric
WN	Lag Interpolation
WO	Wind Vector Output Mode
WS	WINDCO Status
X	List All Vectors within Cursor
Space Bar	Track Target

TABLE IIIf DATA MASSAGING AND LISTING

KEYIN	COMMAND
BN	Brightness Normalization
D	List Data Sample
LP	Line Plot
MA	Modify Area
MC	Multiple Area Combination
OD	Output Data
PA	Post Digital Area
PM	Multispectral Channel Graph

TABLE IIIg STATISTICAL ANALYSIS

KEYIN	COMMAND
AC	Compute Statistics (Area Statistics)
ASI	Area Statistics File Initialization
AX	Set Area Statistics Options
AXL	Set Multiple Area-Statistics Levels
GO	Generate Outline (Area Statistics)
OD	Output Data
PO	Position Outline

TABLE IIIh CURVE FITTING

KEYIN	COMMAND
UD	Move Data from Navigation File to CRVFIL
UE	Edit CRVFIL
UF	Find Least Squares Best Fit Function
UP	Measure Point on Curve
UW	Transfer Wind Component to Curve File

TABLE IIIi METEOROLOGICAL DATA SERVICES

KEY IN	COMMAND
GG	Grid Utility
GU	File Utility
HM	Creates Lat/Lon Grid from SDS File
IA	Plot Data on Graphics
PYK	Four Panel YK
PZK	Four Panel ZK
XS	Cross Sections
YA	Weather Text Listing
YC	Analyze Upper Air Data
YI	RAOB Information Retrieval
YP	Plot Upper Air Data on Printer/CRT
YS	Stuve Plotter
ZC	Multi-WRM/Grid Weather Data Contouring
ZI	SVC-A Information Retrieval
ZJ	Save/Restore SVC-A/RAOBS
ZK	Contouring SVC-A Data
ZM	Plot Base Maps
ZP	Plot SFC Weather Data on Printer/CRT
ZQ	SVC-A 24 Hour Data Listing

TABLE IIIj AVAILABLE METEOROLOGICAL PARAMETERS

KEY	PARAMETER
T	Temperature
TD	Dew Point
PRE	Pressure
WIND	Wind Data
LO,MID,HI	Cloud Data
CLD	Composite Cloud Data
THA	Potential Temperature
THE	Equivalent Potential Temperature
Q	Mixing Ratio
PCP	Precipitation (6-hour)
VIS	Visibility
GUS	Wind Gusts
Z	Height of a Constant Pressure Surface
STR	Streamlines
WX	Current Weather
DIV	Divergence
VOR	Vorticity
DSH	Deformation - Shear
DST	Deformation - Stretching
TAD	Temperature Advection
DAD	Dew Point Advection
QAD	Mixing Ratio Advection
AAD	Potential Temperature Advection
EAD	Equiv. Potential Temperature Advection
PAD	Pressure Advection
SNO	Snow Cover
TDI	Temperature Divergence
DDI	Dew Point Divergence
QDI	Mixing Ratio Divergence
ADI	Potential Temperature Divergence
EDI	Equiv. Potential Temperature Divergence
PDI	Pressure Divergence

TABLE IIIk MISCELLANEOUS

KEYIN	COMMAND
FS	Free Lockwords
SH	Find
SS, (?)	System Status
SX	String Definition
U	List Project User
ZS	Utility
OM	Terminal Communications
!	Whoder Location finder

available for use in the meteorological data services at Table IIIi. Table IIIk lists miscellaneous other commands.

The list of keyins in Table III will grow prior to the delivery of the CSIS in January 1982. As software is written for CSIS and as experimental software from other projects are ready for use by CSIS, they will be included as part of the CSIS package.

B. New System Software

The system software effort consist of three types of tasks. The first is modification of the system software to reflect the CSIS hardware configuration. The second is communications software to allow input of various data sources. The third system software effort is to improve the system's performance and reliability.

The system configuration effort is relatively straightforward. The McIDAS operating system needs to be modified to reflect the CSIS hardware. The CSIS hardware which is different from the McIDAS hardware (such as the 300 Mb disks on the APs) requires new system drivers. Likewise, the operating systems which ignore some data lines when the systems are APs and pay attention to them when they are DBMs and vice versa needs to be developed. We plan to load all of the CSIS software from source code and will have an executable linked version. While this is considerably more time consuming than copying the McIDAS relocatable code, it does insure that all of the CSIS code is consistant with the software documentation and listings. The system integration at U.W. and bring-up is estimated at requiring two man months of effort spread out over four to six calender months and is reflected in the delivery schedule.

The communications software allows the CSIS to gather data from outside sources. The FAA 604 ingestor and the GOES satellite ingestor which will be used for CSIS are already working on McIDAS. The WBRR ingest software was started as part of VAS and phase 0 of CSIS. During phase 0 it was determined that the hardware design for the radar interface was deficient and a new design was started. When this is completed, it will take about one man-month to complete the WBRR ingest software, and integrate it into the radar system software already written. The D/RADEX or RRWDS software will be done in 1982. The main communications task,is the Eclipse/NMC link. Its primary purpose is to obtain NMC observations and forecast fields. Initially the link will be established by implementing Remote Job Entry (RJE) between NMC's IBM 360/195 System and CSIS. This capability will be manually controllable (switchable) by NSSFC personnel so that either the Eclipse System or CSIS can be used selectively for the RJE function. Scheduling of the use of RJE on the Eclipse or CSIS systems will be NOAA's responsibility.

The second phase for the establishment of the CSIS/NMC link involves the development of software ahd hardware to support more efficient communications between the Eclipse and CSIS systems, so that, at the minimum, NMC observations and forecasts can be transfered without burdening the CSIS computer system.

Work on the link will begin during the fall of 1981 with the final debugging of the link during the early part of the spring of 1982 after the CSIS hardware has been installed.

The third type of CSIS system software development has to do with improving the system's performance and reliability. Records are being kept on the McIDAS performance. These have shown that an improvement in system performance and reliability can be accomplished by improving the McIDAS and Harris operating system. A total of five man-months of effort is planned for this task in 1981 prior to delivery of the system in January 1982.

C. New Applications Software

The CSIS will have sources of data which are different from that currently on McIDAS. The CSIS users also have demands on the system which are different that those on McIDAS. This requires an effort on new applications software and data base management. There currently is software for data base management of surface hourlies reports, radiosonde reports, manually digitized radar, locally generated grids, and satellite images. Before the system is delivered in January 82, the WBRR will be added to this list.

Work on new applications software will begin during 1981. For some areas, data base design and communication software will be necessary; otherwise, new applications programs will be needed for radar, grids, satellite winds, graphics, conventional data, text handling, and geography.

Radar data from MDR, WBRR, and later the D/RADEX or RRWDS will be ingested and stored for later processing which includes navigation, remapping and compositing. Accuracy of remapping will not exceed that of the input data.

Work on locally-generated grids will concentrate on adding speed and flexibility to the present procedures. Additionally, unification of the interpolation procedure from a variety of data sources will be realized. The handling of NMC gridded data will also be added. These data will then be available for manipulation and display utilizing the same software that operates on locally-generated grids.

To aid interpretation, we will work on graphics displays in an effort to improve animation capabilities, provide for rapid recall of previously display graphics, and decluter data plots.

Conventional data (including routine and special surface and radiosonde.) capabilities will be expanded to include cloud height reports, recall of reports with significant remarks, display of stability parameters from raob data, analysis and display of isentropic data, and plotting of pilot reports, In addition, work will be done to enhance data editing capabilities.

Improvements in message text handling of FAA604 data will be made so that text is recalled in a "LIFO" (last in-first out) manner.

A map base containing county outlines will be added to the present capabilities, and the ability to plot city names on the graphics will be added. Improvements will also be made in the procedures for updating the weather station location dictionary. The detailed schedule for these software tasks is shown in the section on software schedule.

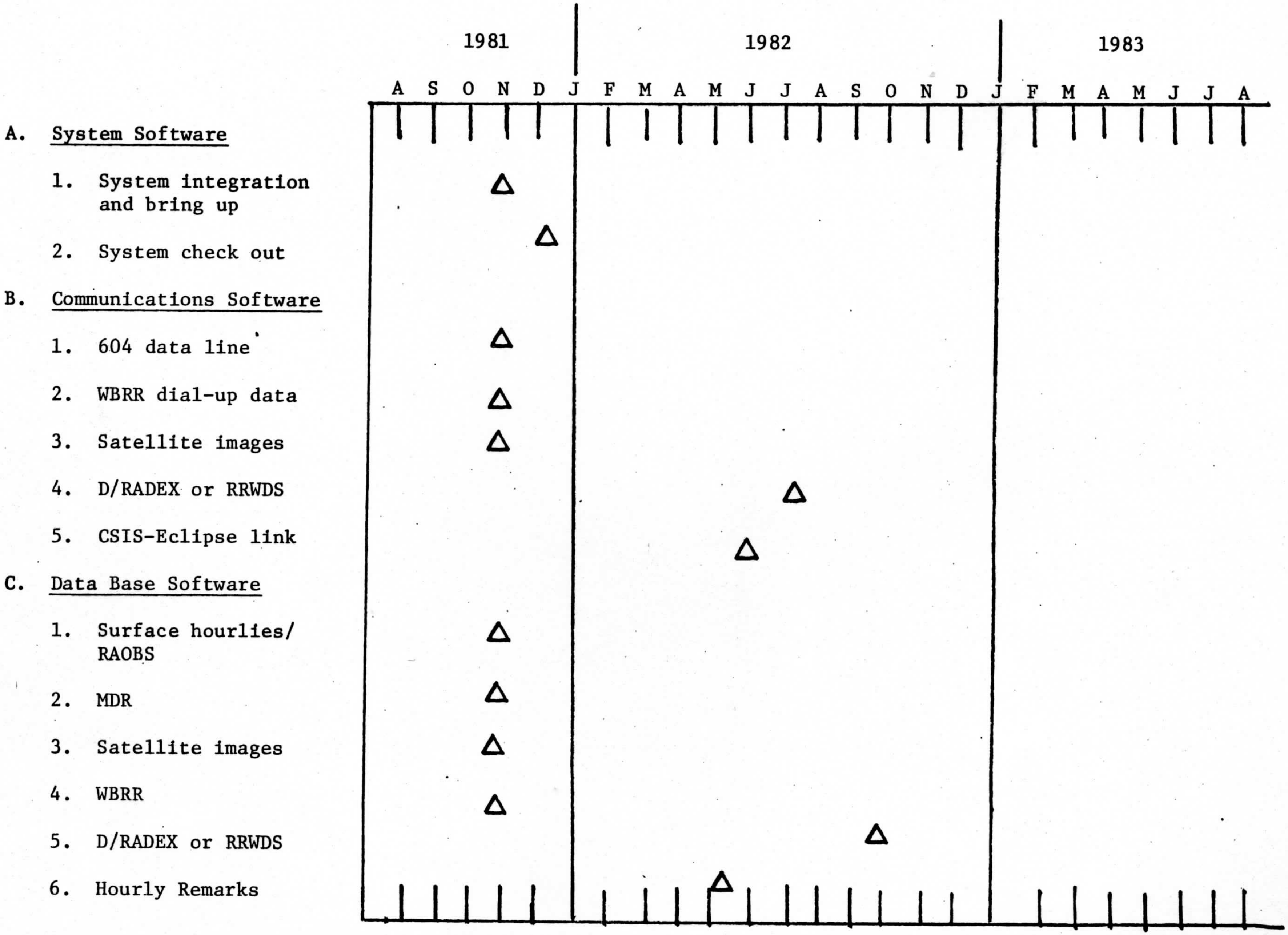
D. Evaluation and Improvement Software

In keeping with the concept of CSIS as an experiment in interactive technology, a certain amount of flexibility is required. SSEC will augment and modify existing McIDAS software modules to address the NSSFC-specific application needs. This will be done on an iterative fashion with the Techniques Development Unit of NSSFC. Through normal use of the McIDAS and CSIS systems, and from the results of the test and evaluation activities, there will be identified deficiencies, limitations, and inconveniences of the system. SSEC will then attempt to correct these problems. The details of this effort are difficult to plan to advance. However, SSEC is planning to provide at least 12 staff months per year of programmer support to this effort.

Some of this effort has already begun in response to Kansas City's comments of McIDAS limitations. The program which prints out data has been modified to allow temperature printout of infrared data rather than satellite counts. The TV display program has been modified to allow a non-linear gray scale presentation of the infrared images which shows up the details of the convective cloud tops. A program has been written (Whoder) which allows the meteorologist to locate the towns nearest a point on the satellite image, or shows the location of any given town name. The keyin handler has been modified in support of the test and evaluation program to allow the collection of statistics on program utilization by the meteorologist. A program has been written to collect statistics on the timeliness of the FAA604 data collection. The program which loads the TV image on the terminal is being modified to speed it up and to reduce the memory requirements for TV loads of remote users so that other operations can go on in parallel. In response to the comment that McIDAS is not using all possible surface data, the master location table of currently available weather stations has been updated. An effort is planned at allowing dynamic plotting density to allow various resolution plots without overwriting previously plotted data. These efforts at responding to Kansas City's requests will continue throughout the CSIS program.

E. Software Schedule

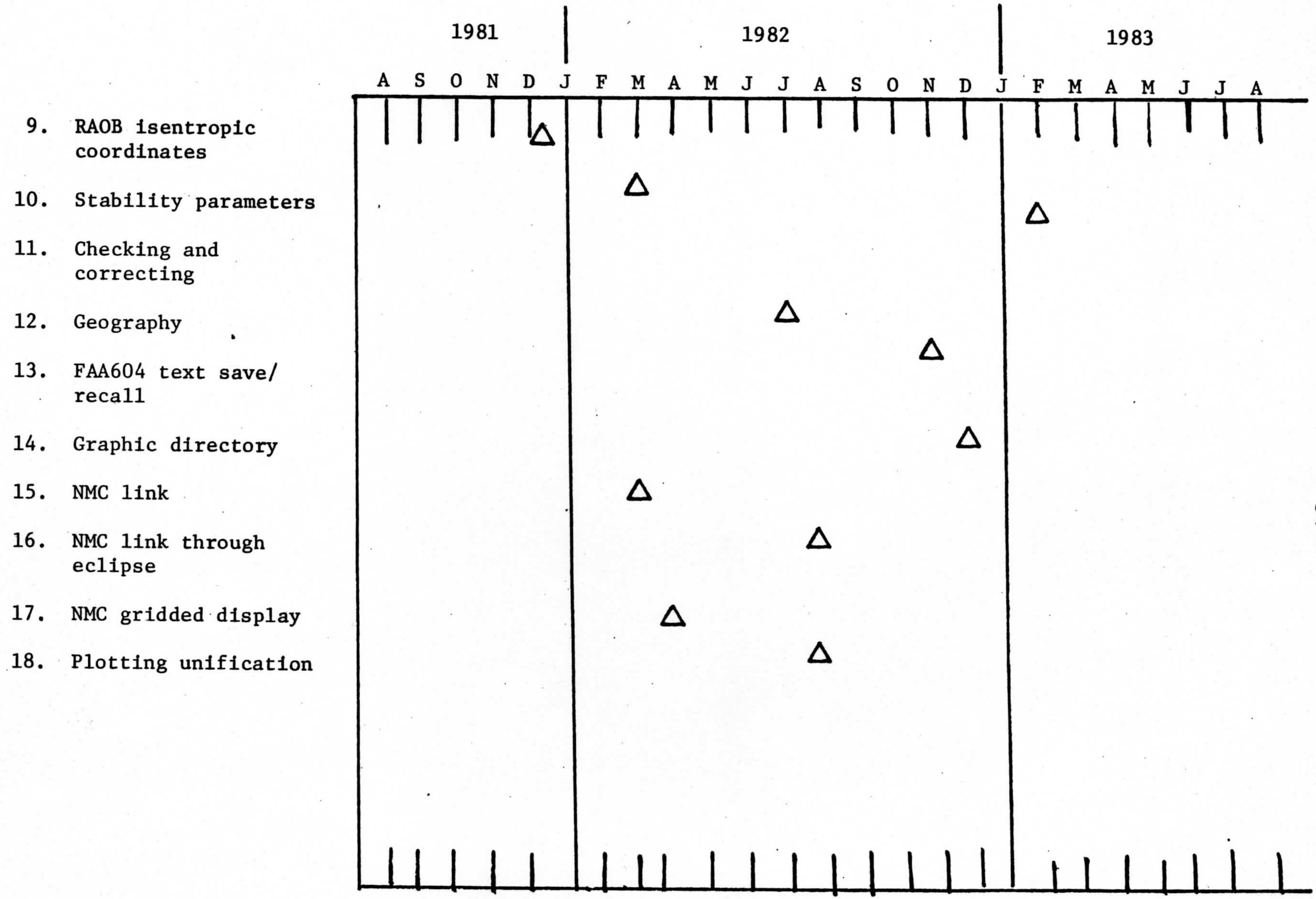
The schedule shown in Figure 12 shows the plan for software development activities. While many of the tasks can be performed asynchronously and in parallel, the tasks which require new data bases which are not on McIDAS are to be performed in the order of forming the data base, writing file management software and then writing applications software. In addition to the tasks shown on the software schedule, there will be the unscheduled software effort associated with the evaluation and improvement effort described in section IIId. This effort will add at least 12 staff months per year to the effort shown on the schedule.



CSIS Software Implementation Schedule

figure 12

	1981					1982												1983							
	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A
7. Local grids				Δ																					
8. NMC grids							Δ																		
9. Pilot Reports																Δ									
10. Geography																				Δ					
11. Graphic paging/ directory												Δ													
D. <u>Applications</u>																									
1. WBRR Radar remap and display							Δ																		
2. Grid Interpolation					Δ																				
3. Unification of all data bases										Δ															
4. Satellite winds							Δ																		
5. MDR display								Δ																	
6. Surface hourly specials												Δ													
7. Pilot reports																							Δ		
8. D/RADEX or RRWDS remap and display																					Δ				


1981
1982
1983
A S O N D J F M A M J J A S O N D J F M A M J J A
9. RAOB isentropic coordinates
10. Stability parameters
11. Checking and correcting
12. Geography
13. FAA604 text save/recall
14. Graphic directory
15. NMC link
16. NMC link through eclipse
17. NMC gridded display
18. Plotting unification

IV. Documentation and Training

SSEC will have the responsibility for both hardware and software maintenance of the CSIS at least through 1983. NSSFC will have the responsibility of using the system. Consequently, the primary documentation provided to NSSFC will focus on the knowledge required for the user and the operator of the CSIS. The manuals will include a general system overview, an explanation of each user keyboard command, its function, the user specified data that is required for successful execution, related software modules, and anticipated output. The McIDAS user manual was updated in April 1981, and a computer operator's manual will be completed by the summer of 1981. These manuals will be updated and expanded prior to the delivery of CSIS equipment in January 1982. In addition to the computer operator's manual of keyins to ingest data, etc., there will be an operator's trouble shooting manual which allow the operator to recognize problems and decide what to do about them.

In addition to the user manuals, SSEC will provide to NSSFC available hardware documentation, program source listings, documentation on file structures, and other program documentation. This documentation should be considered for information purposes only as no major effort is planned at insuring the completeness of this documentation.

The training of the CSIS users and computer operators will be done at NSSFC after delivery of the system. SSEC instructors will teach several on-site training sessions of approximately 3 days each with up to six training sessions per year. The sessions will provide individualized instruction related to practical applications of CSIS to the particular meteorological problems of the individual in addition to generalized CSIS capabilities. The training of the NOAA Electronics Technician who will provide CSIS hardware maintenance support will be done at Wisconsin in two one week training sessions prior to the delivery of the CSIS equipment in January 1982.

V. MANAGEMENT RESPONSIBILITIES

The Centralized Storm Information System (CSIS) is a cooperative project of NASA and NOAA established by a Memorandum of Understanding between the two groups. This Memorandum outlines the basic responsibilities of the two groups. NASA is responsible for the overall management of the planning, procurement, and implementation of the program. NOAA is responsible for the facility accommodations, use, and evaluation of the system. The University of Wisconsin - SSEC, under contract to NASA, is responsible for building, installation, and maintenance of the CSIS. Major project changes involving schedules and costs will be coordinated with NOAA by NASA. The Memorandum specifies that NASA and NOAA identify single points of contact to represent each agency in the resolution of any substantive issues which may arise in the course of accomplishing the CSIS project. These individuals are Dr. L. R. Greenwood for NASA and Dr. R. E. Hallgren for NOAA.

The CSIS project involves three organizations which closely coordinate and cooperate with each other. Fig. 13 shows the organization structure involved with the CSIS implementation. The solid lines in the figure show direct paths of direction and responsibility within organizations. The dashed lines show paths of coordination between organizations. There are two basic levels of coordination. The top level of coordination is between the administrators involved with planning, financing, and monitoring the project. The second level of coordination is at the technical level between individuals involved with the actual implementation of the CSIS project. Table IV lists the key personnel currently involved with CSIS projects and their role in the project.

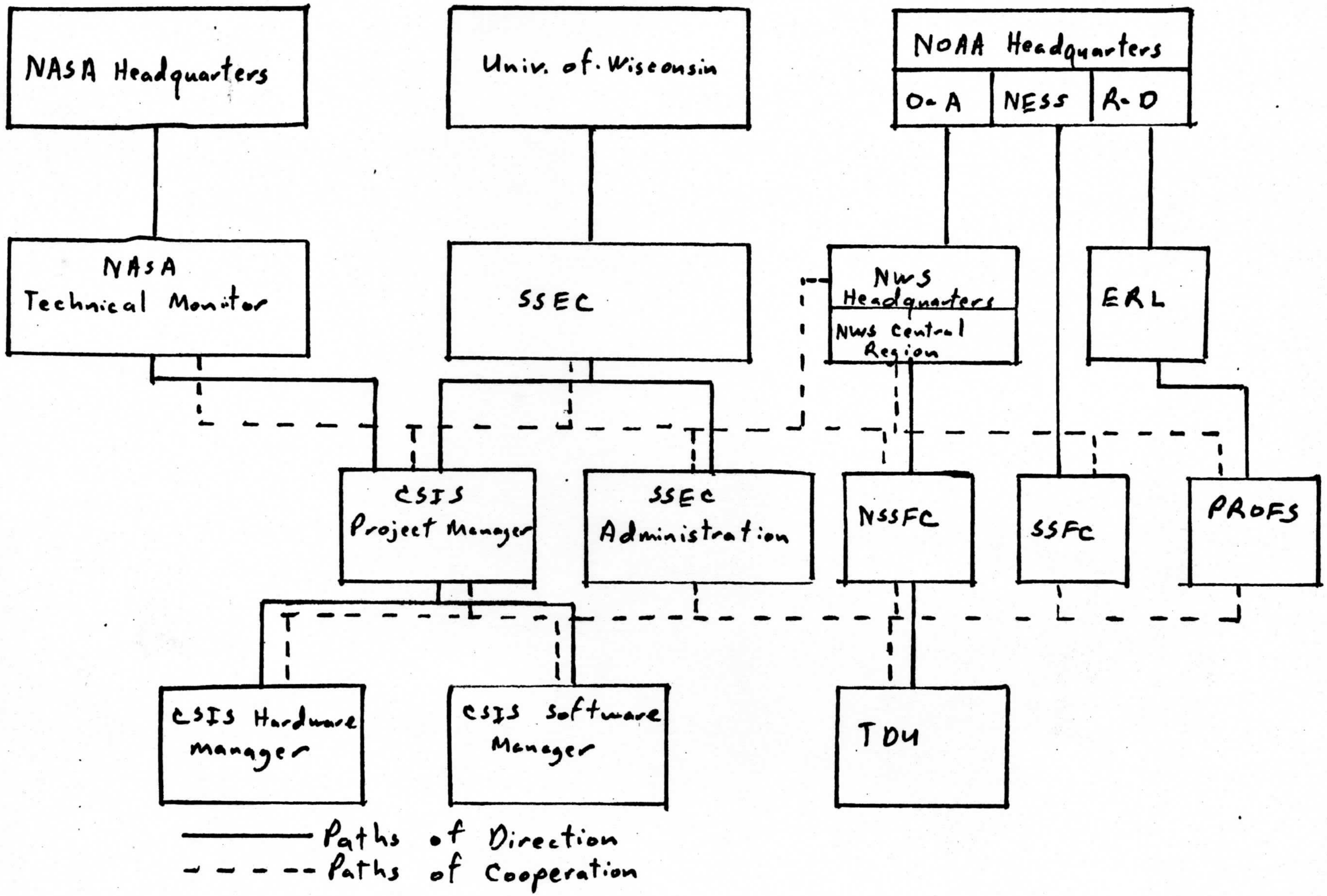


figure 13. CSIS organizational structure

TABLE IV

Key CSIS Personnel

NAME	ORGANIZATION	ROLE	PHONE #
Lawrence Greenwood	NASA Hq.	CSIS single point of contact for NASA	202-755-8620
James Dodge	NASA Hq.	NASA Technical Monitor	202-755-8596
Debbie Macellaro	NASA Hq.	NASA Contract Officer	202-755-3494
Richard Hallgren	NOAA Hq.	CSIS single point of contact for NOAA	301-427-7711
Doug Sargeant	NOAA SDO	NOAA Coordination	301-427-7745
Fred Zbar	NWS/OM&O	NWS Headquarters focal point	301-427-7714
Jim Giraytys	NOAA/OA2	NOAA Headquarters focal point	301-443-8811
Larry Hyatt	NOAA/NESS	NESS focal point for CSIS	301-763-8282
Fred Ostby	NWS/NSSFC	NSSFC Director	816-374-5922
Ed Ferguson	NWS/NSSFC	NSSFC Assistant Director	816-374-3427
Joe Schaefer	NWS/NSSFC/TDU	CSIS focal point at K.C.	816-344-3367
Brian Heckman	NOAA/NESS	Acting Manager K.C. NESS SFSS	816-374-2102
Roger Remboldt	NWS/Central Region	GSA contact point	816-374-5364
Sandy MacDonald	ERL/PROFS	PROFS-CSIS coordination	303-497-6852
Verner Suomi	Univ. of WI/ SSEC	SSEC Director	608-262-6172
Bob Fox	Univ. of WI/ SSEC	SSEC Executive Director	608-262-0544
Fred Mosher	Univ. of WI/ SSEC	SSEC CSIS Program Manager	608-262-3755
Rob Uram	Univ. of WI/ SSEC	SSEC CSIS Hardware Manager	608-262-6757
Tom Whittaker	Univ. of WI/ SSEC	SSEC CSIS Software Manager	608-262-9538
John Roberts	Univ. of WI/	SSEC contracts and finance	608-262-0985

List of Acronyms

ADCCP	Advanced Data Communications Control Protocal
AFOS	Automation of Field Operations and Services
AP	Applications Processor
CDC	Control Data Corporation
CPU	Central Processing Unit
CRT	Cathode Ray Tube
CSIS	Centralized Storm Information System
DBM	Data Base Manager
D/RADEX	Digital Radar Experiment
ET	Electronics Technician
FAA	Federal Aviation Administration
GOES	Geostationary Operational Environmental Satellite
I/O	Input/Output
MB	Megabyte
Mvit	Megabit
McIDAS	Man-Computer Interactive Data Access System
NASA	National Aeronautics and Space Administration
NESS	National Earth Satellite Service
NMC	National Meteorological Center
NOAA	National Oceanic and Atmospheric Administration
NSSFC	National Severe Storms Forecast Center
PIOC	Priority Input Output Channel
RAWARC	Radar and Warning Coordination Circuit
RFI	Radio Frequency Interference
RRWDS	Radar Remote Weather Display System
SELS	Severe Local Storms

SFSS	Satellite Field Services Station (of NESS)
SSEC	Space Science and Engineering Center
TDU	Technique Development Unit
UBC	Universal Block Control
VAS	VISSR Atmospheric Sounder
VISSR	Visible Infrared Spin Scan Radiometer

Appendix A McIDAS Software Which Will Be Part of CSIS

	Program Name	Programmer		library	function
C	CHGARA	BENSON	Ø173	GENL	CHANGE ENTRIES IN AREA DIRECTORY
C	DIRUPD	RUEDEN	1178	SDSB	BAKGRND SDSDIR FILE ALLOCATOR (BY PROJ#)
C	GLUN	RUEDEN	1178	DBMR	GET LUN &/OR BUFFER
C	MTDEFP	BENSON	Ø176	GEN	DEFINE TYPE AND REEL NUMBER OF TAPE ON DRIVE
C	ODISRD	RUEDEN	Ø179	DBM	READS/REFORMATS ODIS TAPES INTO AN AREA
C	RDVHRR	DALY	Ø678	GENL	SIMPLE READ PROG FOR VHRR TAPES
C	RENAMA	DALY	Ø78Ø	DBM	MOVES AREA BY RENAME
C	RESGRD	RUEDEN	Ø98Ø	DBML	READ GRD SAVE TAPE
C	RESSDS	RUEDEN	1278	DBML	READ SDS SAVE TAPE
C	RESTDK	RUEDEN	Ø375	DBM	RESTORES AREAS FROM SAVE TAPE
C	RSTDK2	RUEDEN	Ø375	DBM	RESTORES AREAS FROM SAVE TAPE
C	RZDOC	DALY	Ø578	GENL	BIMANGLER EXCERSIZER FOR HARDWARE DEBUGGING
C	SACMFL	DALY	Ø173	DBM	INITIALIZES FILE SACMFL
C	SAVEDK	DALY	Ø579	DBML	WRITE DIGITAL AREA SAVE TAPE
C	SAVGRD	RUEDEN	Ø98Ø	DBML	WRITE GRD SAVE TAPE
C	SAVSDS	RUEDEN	1278	DBML	WRITE SDS SAVE TAPE
*	STATDB	HIBBAR	Ø177	DBM	LISTS SYSTEM STATUS ON CRT
C	TAPDIR	DALY	Ø279	DBML	SQ'ED BY LISDIR TO LIST SAVE TAPE DIRECTORY

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C TDUMP  DALY   0179 DBM  TAPE DUMP KEYIN FOR GRID TAPE
C TREAD  DALY.  1079 DEML SIMPLE TAPE TO AREA IMAGE LOADER


C ARTOAR DALY   0779 GENL NEW AREA TO AREA TRANSFER
C AREMOV BENSON 0173 GENL DELETE SPECIFIED DIGITAL AREAS
C ARSIZE BENSON 1279 GENL GENERATES DIGITAL DISK AREA
C BLOUP  DALY   0174 GENL DISPLAY BLOWUP OF AREA ON A FRAME
C CHGARA BENSON 0173 GENL CHANGE ENTRIES IN AREA DIRECTORY
C CREBUB BARRET 0380 GENL  CREATE BLOCKED OR UNBLOCKED FILE
C CURDEF DALY   0179 GENL DEFINE/LIST CURSOR SIZE
C CURLOC WHITTA 0478 GENL SENDS SVCA OR RAOB STATION LOCATION TO PC
C DATOUT SMITH  0174 GENL APPLIES SELECTED MASSAGE TO DATA IN CURSOR
C DBOUND RUEDEN 0173 GENL DEFINE LOOP FRAME BOUNDS
C DDPROC BENSON 0277 GENL SET UP AREA FOR SMS S/T OR REAL TIME INGEST
C DEFCUR BENSON 0579 GENL DEFINE CURSOR SHAPE AND COLOR
C DEFVEL RUEDEN 0279 GENL DEFINE/LIST VELOCITY CURSOR FRACTIONAL DISPLACEMENTS
C DRATE  RUEDEN 0279 GENL DEFINE/LIST LOOP DWELL VALUES
C ERMESS RUEDEN 0173 GENL OUTPUTS ERROR MESSAGE FROM ERMESX FILE
C LDCNTV DALY   0173 GENL DISPLAYS DIGITAL AREA ON SPECIFIED TV FRAME
C LISDIR DALY   0180 GENL LIST AREA DIRECTORY (BURN-BOX VERSION)
C LOGIN  BENSON 0979 SYSL INITIALIZE TERMINAL AT USER LOGIN
C LOGLOG RUEDEN 0173 GENL FILES LOGIN/LOGOUT RECORD IN LOGFIL
C LOGOUT BENSON 0180 GENL CLEANS UP AT TERMINAL LOG OUT TIME
C MDAREA BENSON 0174 GENL MODIFY DATA IN DIGITAL AREA
C MDCOMB DALY   0177 GENL MULTIPLE AREA COMBINATION
C MEMEXO ERICKS 1280 GENL: CHECK MEMOREY ABOVE 64K
C NORMAL MOSHER 0676 GEN: PERFORM BRIGHTNESS NORMALIZATION ON DIG DATA
C ODIEAR DALY   0680 ODIL COMPUTE INGEST BOX CENTER FROM UL CORNER
C OMESS  BENSON 0174 GENL SENDS MESSAGE TO USER TERMINAL
C POSCUR BENSON 0173 GENL POSITION CURSOR AT SPECIFIED COORDINATE
C POSTAR DALY   1277 GENL
C PUBLSH BARRET 0980 GENL  PUBLISH INDEXED NOTES, DOCUMENTS, ETC.
C SETFRM BENSON 0173 GENL SET VIDEO DISPLAY TO SPECIFIED FRAME
C SQIT   RUEDEN 1079 GENL  SQ PROGRAM WITH PARAMETERS VIA KEYIN

C ANNDLN WHITTA 0176 GRAL DRAW LINE ON GRAPHICS DEVICE WITH CURSOR
C ANNOT  WHITTA 0176 GRAL TEXT ANNOTATION ON GRAPHICS DISPLAY
C CONPTR SANTEK 0279 GRAL OUTPUT GRID ON LINE-PRINTER.
C CONTUR SANTEK 0179 GRAL PLOT CONTUR/STREAMLINES FROM GRIDFILE(MULTI-WRM)
C CWMAIN DALY   0175 GRAL SET ALL WRRRM BITS IN CURSOR TO SPECIFIED LEV
C ERASGR ERICKS 0180 GRAL: ERASE GRAPHICS DEVICE
C FILFIG DALY   0579 GRAL PLOT A FILLED GRAFIC OBJECT ON WRRRM
C GENFIG DALY   0479 GRAL LETS USER DRAW A GRAFIC FIGURE AND SAVE
C GRAFLC WHITTA 0975 GRAL LIST GRAPH SCALE VALUES UNDER CURSOR
C IGCBND DALY   1278 GRAL PROJECTS AND PLOTS MAP OUTLINE ON SAT IMAGE
C IGGRID DALY   0377 GRAL PLOT LAT-LON GRID ON WRRRM OVER SAT IMAGE
C IGGRID DALY   0177 GRA: PLOTS LAT-LON GRID ON SAT IMAGE
C KONPTR WHITTA 1076 GRAL PUTS GRIDS ON PRINTER...SIMILAR TO KONTUR/PLTMAP.
C KONTUR WHITTA 1076 GRAL PLOT CONTOUR OR STREAMLINES FROM GRIDFILE DATA
C LINCON SANTEK 0279 GRAL GREY SHADES
C LINPLT DALY   0175 GRAL PLOTS IMAGE LINE BRIGHTNESS VS SAMP POSITION
C PLSEL  DALY   0579 GRAL SET SYSCOM TO SELECTED GRAPHICS OUTPUT DEVICE
C PLTFIG DALY   0479 GRAL PLOTS A GRAFIC FIGURE INSIDE CURSOR
C PLTMAP WHITTA 0576 GRAL PLOT MERC MAP ON WRRRM,AND OTHER FUNCTIONS
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C PLTMCH DALY   0175 GRAL MULTISPECTRAL CHANNEL GRAPH
C PLTRES WHITTA 0075 GRAL RESTORES SAVED PLOTS TO PLOT FILE OR WRRRM
C PLTSAV WHITTA 0075 GRAL SAVES PLOT FILE BY TRANSFERRING IT TO DIGITAL
C SCEUTI DALY   0779 GRAL SCENE FILE UTILITY
C SETGRA DALY   0179 GENL SET SYSCOM TO CHANGE WRRRM CURRENTLY DISPLAYED
C SVCALS WHITTA 0176 GRAL PLOT MAP ON CRT WITH REQUESTED SVCA STATION
C TXTFIG DALY   0579 GRAL SQ-ED BY PLTFIG TO DRW A TEXT ON WRRRM
C WIDFIG DALY   0579 GRAL SQ-ED BY PLTFIG TO DRW A WIDELINE FIGURE
C ZBMAIN DALY   0677 GRAL JOYSTICK CONTROLLED TEXT ANNOTATION

C BARB   RUEDEN 0279 GRAR PLOT WIND BARB ON ACTIVE GRAPHICS PLANE
C DYTMSA DALY   0577 GRAR CONVERTS IMAGE DAY-TIME TO SVC-A OR RAOB DTG
C GRAPH  WHITTA 1073 GRAR GENERATE A LABELED GRAPH FROM AN INTEGER ARRAY
C LALOTV DALY   1278 GRAR LAT-LON TO TV COORD XFORM, FOR SAT IMAGE OR MAP.
C MRCMAP DALY   0577 GRAR DRAWS MERCATOR MAP,XFORMS LAT-LON TO TV COORD
C PLT3D  DALY   0777 GRAR PLOTS 3-D SURFACES ON WRRRM
C PLTDIG WHITTA 0575 GRAR PLOTS INTEGER VALUES ON GRAPHICS DISPLAY (R)
C PLTSTA DALY   0577 GRAR PLOTS 6 PIXEL CROSS ON WRRRM AT TVLIN.TVELE
C PLTWNV DALY   0577 GRAR PLOT WIND VECTORS ON WRRRM
C PLTXTN WHITTA 0175 GRAR TEXT STRING WRITER (BLOC CHAR) GRAPHICS DISPLAY (R)
C QCON   WHITTA 0575 GRAR LINE PRINTER SHADE-CONTOUR ROUTINE (R)
C SETUP  DALY   0679 GRAR USED BY MCIVAM SOFTWARE TO RESCALE FIGURES
C STREAM WHITTA 0676 GRAR STREAMLINE CONSTRUCTION PROGRAM (R)
C SVCMAP WHITTA 0575 GRAR CONSTRUCT PSEUDO-MERC MAP ON LINE PRINTER (R)
C SVTMAP WHITTA 0175 GRAR CONSTRUCT PSEUDO-MERC MAP ON GRAPHICS DISPLAY (R)
C SVTMAP WHITTA 0176 GRA: PLOT MAP ON WRRRM,THEN XFORM LAT-LON T6-TV L-E
C SVTMAP WHITTA 1079 GRAR: MODIFIED THIS DATE FOR 91 DEG INPUT PARAMETERS...
C SVTMAP ERICKS 1179 GRAR: CHANGED TO ELIMINATE USELESS CALLS TO PLOT
C WRTEXT WHITTA 0575 GRAR ASCII TEXT WRITER FOR GRAPHICS DISPLAY (R)
C BITCH  BENSON 0173 GEN: OUTPUTS TAPE MOUNT MESSAGE TO OPERATOR
C CHGARA BENSON 0173 GENL CHANGE ENTRIES IN AREA DIRECTORY
C DIRUPD RUEDEN 1178 SDSB BAKGRND SDSDIR FILE ALLOCATOR (BY PROJ#)
C GLUN   RUEDEN 1178 DBMR  GET LUN &/OR BUFFER
C MTDEFP BENSON 0176 GEN DEFINE TYPE AND REEL NUMBER OF TAPE ON DRIVE
C ODISRD RUEDEN 0179 DBM  READS/REFORMATS ODIS TAPES INTO AN AREA
C RDVHRR DALY   0678 GENL SIMPLE READ PROG FOR VHRR TAPES
C RENAMA DALY   0780 DBM  MOVES AREA BY RENAME
C RESSDS RUEDEN 1278 DBML  READ SDS SAVE TAPE
C RESTDK RUEDEN 0375 DBM  RESTORES AREAS FROM SAVE TAPE
C RZDOC  DALY   0578 GENL BIMANGLER EXCERSIZER FOR HARDWARE DEBUGGING
C SACMFL DALY   0173 DBM  INITIALIZES FILE SACMFL
C SAVEDK DALY   0579 DBML WRITE DIGITAL AREA SAVE TAPE
C SAVSDS RUEDEN 1278 DBML  WRITE SDS SAVE TAPE
* STATDB HIBBAR 0177 DBM  LISTS SYSTEM STATUS ON CRT
C TAPDIR DALY   0279 DBML SQ'ED BY LISDIR TO LIST SAVE TAPE DIRECTORY
C TDUMP  DALY   0179 DBM  TAPE DUMP KEYIN FOR GRID TAPE
C TREAD  DALY   1079 DBML SIMPLE TAPE TO AREA IMAGE LOADER

C CURSCR BARRET 0280 HMLR  LOCATE CURSOR AND ADJUST FOR TV EDGE
C DESFIL BARRET 0680 HMLR  DESTROY FILE
C DEVCOD BARRET 0580 HMLR  RETURN PRINT DEVICE CODE FROM LETTERS
C FINDFS BARRET 0980 HMLR  FIND FILE SECTION (IN BLOCKED FILE)
C GETLIN BARRET 0980 HMLR  READ 1 LINE FROM BLOCKED FILE, CHECK FOR EOF
C GETWRD BARRET 0980 HMLR  ISOLATE NEXT WORD ON LINE
C ICEIL  BARRET 0280 HMLR  SMALLEST INTEGER .GE. M/N, OR 0 IF N=0
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C IFLOOR BARRET Ø280 HMLR  LARGEST INTEGER .LE. M/N, OR Ø IF N=Ø
C INSECT BARRET Ø180 HMLR  READ  FILE AT SECTOR BY FILENAME OR LUN
C KCHAR  BARRET Ø980 HMLR  FETCH CHARACTER FROM (A3) LINE
C LHF    BARRET 1279 NASR  FETCH LEFT HALF OF WORD
C MAKSCR BARRET Ø680 HMLR  CREATE SCRATCH FILE AND RETURN ITS NAME
C MATCHR BARRET Ø480 HMLR CHECK WHETHER LETTER (A1) OCCURS IN TEST (A3)
C OPNBFI BARRET Ø980 HMLR  CHECK BLOCKED FILE, DYMASG IT, OPN IT.
C OUSECT BARRET Ø180 HMLR  WRITE FILE AT SECTOR BY FILENAME OR LUN
C PCHAR  BARRET Ø980 HMLR  PUT A1 CHARACTER INTO A3 LINE
C PHDIPP BARRET Ø180 HMLR  RUN MSG TO USER &OR OPER &OR PRNTR &OR LOG
C SPLICE BARRET 1279 HMLR  MAKE WORD WITH L AS LEFT HALF, R AS RIGHT HAF
C TPMES  BARRET Ø280 HMLR  OUTPUT TEXT + INTEGER/A3 ON DEVICE(S)
C TQMES  BARRET Ø280 HMLR  OUTPUT TEXT + INTEGER/A3 ON CRT
C UREAD  BARRET 1080 HMLR  UNIVERSAL DISK READ--REMOTE OR LOCAL
C WHERES BARRET Ø180 HMLR  CALCULATE WHERE'S RECORD N IN BLOCKED FILE
C WHOAMI BARRET Ø180 HMLR  RETURN NAME OF CURRENT LOAD MODULE

C ADSCHD HIBBAR Ø679 INGL ADD AN AREA TO AN IMAGE'S SCHEDULE
C CLOCK2 HIBBAR Ø679 INGR ROUTINES USED BY INGEST CLOCK TASK
* CLOCK3 HIBBAR Ø679 INGR SQ TO DEFBTA
* CLOCKE HIBBAR Ø679 INGL INGESTOR FOR EAST SATELLITE
* CLOCKW HIBBAR Ø679 INGL INGESTOR FOR WEST SATELLITE
* CPU    HIBBAR Ø679 INGR HOME STATE FOR INGESTOR CPU TASK
* DB     BENSON Ø679 INGR SQ TO DEFBTA
C DESCHD HIBBAR Ø679 INGL DELETE AN AREA FROM AN IMAGE'S SCHEDULE
* DISC   HIBBAR Ø679 INGR HOME STATE OF INGESTOR DISC TASK
C FWAIT  BILL   Ø679 INGR WAIT FOR NOMINAL START TIME
* INTRPT HIBBAR Ø679 INGR BIMANGLER INTERUPTER HANDLER
* IRTASK HIBBAR Ø679 INGR HOME STATE OF INGESTOR IR TASK
C LISCHD HIBBAR Ø679 INGL LIST AN IMAGE'S SCHEDULE
* LOGIC  HIBBAR Ø679 INGR HOME STATE OF INGESTOR LOGIC TASK
* LOGIC2 HIBBAR Ø679 INGR ROUTINES USED BY INGEST LOGIC TAS2
* LATQ   BILL   Ø679 INGR PUT LATENCY MOVE ON CPU QUEUE
* MOVQ   BILL   Ø679 INGR PUT BLOW DOWN MOVE ON CPU QUEUE
C NASCHD HIBBAR Ø679 INGL LIST THE TIMES SCHEDULED FOR A SATELLITE
C PRSCHD HIBBAR Ø679 INGL PREPARE AN IMAGE'S SCHEDULE FOR INGEST
C RESCHD HIBBAR Ø679 INGL RESCHEDULE AN IMAGE

C ACOS   DALY   Ø175 LIBR
C ADF    BENSON Ø173 LIBR ADVANCE LUN PAST ONE EOF MARK
C ARLOC  DEDECK Ø374 LIBR FIND AREA OF INPUT FRAME OR TIME
* ASCII  BENSON Ø677 LIBR BINARY TO VIDEO CHARACTER
C ASIN   SMITH  Ø173 LIBR
C BSR    BENSON Ø174 LIBR BACKSPACE LUN ONE RECORD
C CHR    SMITH  Ø174 LIBR CONVERT INTEGER TO CHAR,1 CHAR PER WORD
* CLOS   DALY   1078 LIBR CLOSES LUN, DE-ASSIGNS FILE NAME
C COAREA SMITH  Ø173 LIBR INPUT ENTRY FROM AREA DIRECTORY
C CODE   BENSON Ø174 LIBR DECODE 'KEY' PARAMETER INTO (I,E,T),AND (U,C,D)
* CORE   BENSON Ø173 LIBR WAITS UNTIL SPECIFIED AMOUNT OF CORE AVALABLE
C CRUM   BENSON Ø173 LIBR RELEASE SPECIFIED AREA'S SECTORS TO SYSTEM
* CSF    BENSON Ø173 LIBR ENTRY POINTS SQ,IQ,TQ,CQ,GU,TSQUSH,M$NAM
C CURAR  SMITH  Ø174 LIBR COMPUTE SIZE OF CURSOR
C CURSIZ BENSON Ø173 LIBR RETURNS CURSOR SIZE IN RASTERS AND PIXELS
C DEL    BENSON Ø173 LIBR DELETE DISK FILE SPECIFIED
C DFLOAT DALY   Ø175 LIBR
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C DIRECT SMITH  0173 LIBR COMPUTE A WIND DIRECTION IN DEGREES FROM U,V
C DIRLIS BENSON 0173 LIBR LIST TERM OR SAVE TAPE DIRECTORY ON LUN
C DISKIO BENSON 0173 LIBR I OR O'S RECTANGLE OF DATA FROM AREA
* DYNOPN DALY   1078 LIBR ASSIGNS,OPENS FILENAME/LUN,RETURNS STATUS OF OPEN
* EMESS  BENSON 0173 LIBR SENDS ERROR MESS TO TERM VIA SQ TO ERMESS
C ENAREA BENSON 0173 LIBR MAKE AN ENTRY IN AREA DIRECTORY
C ENCOD  DEDECK 0276 LIBR ENCODE ROUTINE, BINARY TO ASCII
C ENCODR DALY   0173 LIBR
C ENH12B DALY   0878 LIBR
C ENHIO  DALY   0677 LIBR EHNHANCEMENT TABLE IO HANDLER
C FLALO  SMITH  0173 LIBR DDDMMSS TO FLOATING POINT DEGREES
C FLOAT  DALY   0173 LIBR
C FRESET BENSON 0173 LIBR RESET VIDEO DISPLAY TO FRAME ONE
C FRMBAK DALY   0279 LIBR MOVE FRM AND/OR WRM BACK ONE
C FRMFOR DALY   0279 LIBR MOVE FRM AND/OR WRM FORWARD ONE
* FSYNK  BENSON 0173 LIBR SUSPEND EXECUTION TILL NXT TV VERT RETRACE
C FTIME  SMITH  0173 LIBR  HHMMSS TO FLOATING POINT HOURS
C FUVCOM SMITH  0173 LIBR SCALED INTEGER (*100) TO FLOATING POINT
* FVALID SAWYER 0175 LIBR VERIFY EXISTENCE OF A MACRO FILE
C GEF    BENSON 0173 LIBR GET ENTRY F09 09 45 6964 F9AME DIRECTORY
C GEN    BENSON 0173 LIBR GENERATE AREA
C GEOLAT PHILLI 0174 LIBR GEODEDIC TO GEOCENTRIC LATITUDE CONVERSION
* GETDAY SAWYER 1075 LIBR RETURN CURRENT YYDDD
* GETIOB DALY   1078 LIBR RETURNS 72 CHARACTERS FROM TCB I/O BUFFER
* GETMDD DALY   0878 LIBR GET MASTER DISC DIRECTORY ENTRY FOR FILE
C GETTIM BENSON 0173 LIBR RETURNS CURRENT HHMMSS
* GK     BENSON 0173 LIBR RETURNS TERM CONTROL BLOCK POINTER WORD
C GRAHOR SMITH  0173 LIBR
C GRAVOR SMITH  0173 LIBR
C GTAP   BENSON 0177 LIBR CALL OPERATOR TO MOUNT TAPE, WAIT TILL DONE
C HOWBIG BENSON 0173 LIBR RETURNS SIZE OF SPECIFIED AREA
* IA     BENSON 0173 LIBR RETURNS CONTENTS OF SPECIFIED ABSOLUTE ADRESS
* IADDR  RUEDEN 0279 LIB:  GET ADDRESS OF FORTRAN VARIABLE OR ARRAY
C IASCII RUEDEN 0778 LIBR  EBCDIC TO ASCII CONVERSION ROUTINE
* IDDT   BENSON 0173 LIBR RETURNS WORD FROM DISK DEF TABLE,USED BY GEN
C IEBCDC RUEDEN 0778 LIBR  ASCII TO EBCDIC CONVERSION
C IEOF   RUEDEN 1278 LIBR  END-OF-FILE CHECKING FUNCTION
C IEOT   RUEDEN 1278 LIBR  END-OF-TAPE CHECKING FUNCTION
C IFFILE SAWYER 0173 LIBR
* IFLD   DEDECK 0276 LIBR BIT REPACKER
C ILALO  SMITH  0173 LIBR FLOATING POINT DEGREES TO DDDMMSS
C INDATA SMITH  0173 LIBR INPUT SOME DIGITAL DATA FROM AREA
* IO     BENSON 0173 LIBR FORTRAN LINKAGE TO $IO
* IOPP   DALY   0279 LIBR COMPUTE OPPOSITE FRM OR WRM GIVEN MAX & CURREN
* OISTAT DALY   0878 LIBR .
C IROUND SMITH  0173 LIBR ROUND A FLOATING POINT NUMBER
* ISQRT  BENSON 0173 LIBR INTEGER SQUARE ROOT
* ISYS   BENSON 0173 LIBR SEND MESSAGE TO OPERATION SYSTEM
* ITD    BENSON 0173 LIBR VALUE=WALLCLOCK TIME IN MSEC/10,DATE IN ARG
C ITIME  SMITH  0173 LIBR FLOATING POINT HOURS TO INTEGER HHMMSS
C ITOG   BENSON 0173 LIBR TOGGLES INPUT WORD
C IUVCOM SMITH  0173 LIBR FLOATING U OR V TO SCALED INTEGER (*100)
* IVALFL WHITE  0977 LIBR CHECKS INPUT TO SEE IF VALID PROGRAM FILE NAME
C IVSYS  BENSON 0173 LIBR RETURNS VIDEO SYSTEM OF CALLING TERMINAL
C IWAIT  RUEDEN 0279 LIBR MORE GRACEFUL JWAIT
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* JFLD   DEDECK 0276 LIBR ANOTHER BIT REPACKER
C JOYCUR BENSON 0173 LIBR RETURNS POSITION OF SPECIFIED JOYSTICK
C JWAIT  BENSON 0173 LIBR WAITS FOR LOCK WORD TO FREE,THEN RELOCKS
* KEY    BENSON 0173 LIBR RETURNS BIT KEY FOR SPECIFIED PROJ NUMBER
C LISADE BENSON 0878 LIBR
C LISDAT SMITH  0173 LIBR
C LSTMDD DALY   0878 LIBR
C MAKE   BENSON 0173 LIBR CREATE A NEW FILE WITH SPECIFIED NAME
C MARKDN BENSON 0173 LIBR MARK AREA DIRECTORY ENTRY-AREA AVAILABLE
C MARKOK BENSON 0173 LIBR MARK AREA DIRECTORY ENTRY-DATA PRESENT IN AREA
C MARKUP BENSON 0173 LIBR MARK AREA DIRECTORY ENTRY-AREA IN USE
C MASADD SMITH  0173 LIBR
C MATCH  DALY   0277 LIBR FINDS PATTERN IN STRING,RETURNS 1ST CHAR POS
* MCDLIB HIBBAR 0280 LIBR  BURN LINE RELOCATABLES-RSQ,RREADW,RLOCPU,CPUID,NAMCPU
C MISC   DEDECK 0175 LIBR MISCELLANEOUS UNDOCUMENTED ROUTINES
C MOVE   BARRET 1179 LIBR  MOVE BUFIN(1...NWDS) TO BUFOUT(1...NWDS)
* MPC    BENSON 0878 LIBR
* MVBYTE DALY   0377 LIBR MOVES NBYTES FROM BUFIN TO BUFOUT
C MVCHAR DALY   0580 LIBR MOVE CHAR STRING,CONVERT INTEGER,BLANK BUFFER
C MVCHRE RUEDEN 0380 LIBR MOVE CHARS,CONVERT INETGER(EBCDIC),BLANK BUFFER
C NDAT   BENSON 0173 LIBR RETURNS VALUE OF SPECIFIED SYSCOM WORD
C NOCKED HIBBAR 1078 LIB: DBM AREA NAMER
C NOCT   BENSON 0173 LIBR RETURNS XNN IN ASCII FOR INPUT INTEGER NN
C NSECL  BENSON 0173 LIBR COMPUTE NUM SECTORS FOR SPECIFIED NUM BYTES
* O6     BENSON 0173 LIBR HANDLER FOR SPOOL FILE TO PRINTER
C OM     BENSON 0173 LIBR OUTPUT MESSAGE TO OPERATOR
C OPN    BENSON 0173 LIBR OPEN LUN
C OPNA   BENSON 0173 LIBR OPEN AREA
C OPNDIR BENSON 0173 LIBR USED BY RDIR,RDIRL TO OPEN AREA DIRECTORY FILE
* OPTION SAWYER 0175 LIBR OPTION=.TRUE. IFF CHAR EMBEDDED IN WORD
C OUTINT SMITH  0173 LIBR LISTS AN ARRAY OF INTEGERS ON CRT USING TQ
C OVRFLO SAWYER 0175 LIBR  EVAL TO TRUE IFF X IS MAXIMUM FULL SCALE OR -
C OVRLAY SMITH  0173 LIBR
C PROVAL BENSON 0173 LIBR EXITS IF PROJECT ILLEGAL FOR PROGRAM
C PUTINT CHATTE 0477 LIBR OUTPUTS UP TO 16 INTEGERS VIA CALLS TO TP
C PUTMDD DALY   0878 LIBR
C QUIET  BENSON 0173 LIBR WAITS UNTIL LAST TERMINAL I/O COMPLETED
* RAND   BILL   0679 LIBR RETURNS A VERY RANDOM ARGUMENT
* RANDOM BILL   0679 LIBR RETURNS AN EXTREMELY RANDOM ARGUMENT
C RDADIR DALY   0878 LIBR
C RDAN   BENSON 0173 LIBR ALPHA READ FROM LUN,RETURNS AFTER INITIATION
C RDANW  BENSON 0173 LIBR ALPHA READ FROM LUN, RETURNS WHEN I/O COMPLETED
C RDIR   BENSON 0173 LIBR INPUT AREA DIRECTORY, LOCK WORD NOT SET
C RDIRL  BENSON 0173 LIBR INPUT AREA DIRECTORY, LOCK WORD SET (SYSCOM 96)
C READ   BENSON 0173 LIBR BINARY READ FROM LUN,RETURNS AFTER INITIATION
C READA  BENSON 0173 LIBR READ NWD WRDS AT SEC IS AREA IA INTO BUF A
C READW  BENSON 0173 LIBR BINARY READ FROM LUN, RETURNS AFTER COMPLETION
C REMARA BENSON 0173 LIBR  DELETE SPECIFIED AREA AND RELEASE SECTORS
C REMENH RUEDEN 0478 LIBR FORMATS AND SENDS ENHANCEMENT PACKET FOR NEW TERMINAL
C RENAME BENSON 0173 LIBR RENAME DISK FILE
C REW    BENSON 0173 LIBR INITIATE REWIND ON LUN
C ROOM   BENSON 0173 LIBR OUTPUT DKR ERROR MESS AND CALL EXIT
C RVER   BENSON 0173 LIBR COMPARES TWO READS OF A SECTOR,MESSAGE IF DIF
C SATADR BENSON 0173 LIBR AREA ADDRESS OF DATA SPECIFIED IN IMAGE COORD
C SATTV  BENSON 0177 LIBR TRANSFORM FROM SATELLITE TO TV COORD
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C SCANNR DALY   Ø878 LIBR
C SCRA   BENSON Ø173 LIBR MOVE LUN I TO SECTOR J
C SECPNT BENSON Ø173 LIBR USED BY READA TO SET DISK TO 1ST AREA SECTOR
C SERCP  BENSON 1073 LIBR SEARCHES FOR PROJ NUMBER,USED BY KEY
* SERVIC BENSON 1077 LIBR ENTRY POINTS FOR ND,WD,JW, AND SENOUT
C SLEEP  BENSON Ø173 LIBR SET TIMER, SUSP EXEC UNTIL INTERUPT
C SPEED  SMITH  Ø173 LIBR CUMPUTES WIND VEL IN M/SEC FROM U,V IN M/SEC
* STAGE  BENSON Ø173 LIBR CONTAINS ENTRY POINTS FOR PACK AND CRACK
C SVCEDT WHITTA Ø175 LIBR SINGLE LINE TEXT EDITTING ROUTINE (R)
C SVCFLA WHITTA Ø175 LIBR ASSIGN SVCAFL OR RAOBFL TO LUN,CURRENT OR HIST
C TIMDIF SMITH  Ø173 LIBR TIME DIF IN MINUTES,INPUT IN YR-DAY-HMS
C TP     BENSON Ø173 LIBR OUTPUT MESS TO EITHER CRT OR PRINTER
C IPMES  DALY   Ø577 LIBR OUTPUT A TEXT AND INTEGER ON CRT OR PRINTER
C TQMES  DALY   Ø178 LIBR TQ/S A TEXT + INTEGER MESSAGE
C TRIGFU SMITH  Ø173 LIBR ENTRY POINTS FOR TRIG FUNCTIONS
C TRMNL  BENSON Ø173 LIBR RETURNS NUMBER OF CALLING TERMINAL
C TRMNL8 BARRET 1179 LIBR  RETURNS USER'S (OCTAL) TERM. NO IN A3 FORMAT
C TVSAT  BENSON Ø177 LIBR TRANSFORMS FROM TV TO SATELLITE COORD
C VALID  BENSON Ø173 LIBR ERROR EXISTS IF INVALID FRMAE FOR PROJECT
* VARASG BENSON Ø173 LIBR CALL VARASG(FIL,LUN) FIL IS 3 LETTER FILE NAME
* WASTE  BENSON Ø173 LIBR WASTES TIME IN IDLER LOOP
C WDAT   BENSON Ø173 LIBR WRITE INPUT INTO SPCIFIED SYSCOM WORD
C WDIR   BENSON Ø173 LIBR WRITE COMMON BLOCK DIRBUF ONTO AREA DIRECTORY
C WDIRU  BENSON Ø173 LIBR CALLS WDIR, AND CLEARS LOCK WORD (SYSCOM 96)
C WEF    BENSON Ø173 LIBR INITIATE WRITE EOF ON LUN
C WRADIR DALY   Ø878 LIBR
C WRAN   BENSON Ø173 LIBR INITATE ALPHA WRITE ON LUN AND RETURN
C WRANW  BENSON Ø173 LIBR WRITE ALPHA ON 3UN.9ETUR5 WHEN CO4PLETED
C WROT   BEMSPM Ø173 LIBR BINARY WRITE N WRDS FROM BUF X ON LUN
C WRITA  BENSON Ø173 LIBR WRITE NWD WRDS AT SECT IS AREA IA FROM BUF A
C WRITW  BENSON Ø173 LIBR INITIATE BINARY WRITE NWRD BUF X ON LUN
C WVER   BENSON Ø173 LIBR VERIFY DISK WRITE
* XCOPY  RUEDEN Ø279 LIB:  COPY TO/FROM EXTENDED CORE
* XINFO  RUEDEN Ø478 LIBR FORTRAN CALLABLE INFO
* XIO    RUEDEN Ø279 LIB: PERFORM IO INTO EXTENDED CORE
C XITMSG BENSON 1077 LIBR TIMING MESSAGE TO PROGRAMMING PROJECT MODULES
C XLATAV SMITH  Ø173 LIBR AVERAGES 2 LATS (-9Ø.Ø TO +9Ø.Ø)
C XLATS  SMITH  Ø173 LIBR SUBSTRACTS 2 LATS, (-9Ø.Ø TO +9Ø.Ø)
C XLONAV SMITH  Ø173 LIBR AVERAGES 2 LONS (-18Ø.Ø TO +18Ø.Ø)
C XLONS  SMITH  Ø173 LIBR SUBTRACTS TWO LONS (-18Ø.Ø TO +18Ø.Ø)
C XREADW RUEDEN Ø279 LIB: BINARY READ N WORDS FROM LUN N INTO (IADDR)
* XSTAGE RUEDEN Ø279 LIB: PACK/CRACK TO/FROM EXTENDED CORE
C XWRITA RUEDEN Ø279 LIB: WRITE NWD WRDS AT SECT IS AREA IA FROM (IADDR) APSONLY
C YDDMY  CHATTE Ø977 LIBR CONVERT SSYYDDD TO DAY, MONTH, YEAR

C BETCAL SMITH  Ø174 NAVL  DEFINE BETA CALCULATION PARAMETERS
C CODCHG SAWYER Ø175 NAVL  CHANGE DAY DATA CODE--B L E G 'S ONLY
C DEFATD DALY   3174 NAVL  DEFINE ATTITUDE
C DEFBTA SMITH  Ø18Ø NAVL  DEFINE BETA
C DEFEE  DALY   Ø174 NAVL  DEFINE EARTH EDGE
C DEFGMA DALY   Ø174 NAVL  DEFINE GAMMA
C DEFLND DALY   Ø174 NAVL  DEFINE LANDMARK
C DEFORB DALY   Ø174 NAVL  DEFINE CLASSICAL ORBIT
C DEFPNT DALY   Ø174 NAVL DEFINE EARTH COORDINATE OF NAVIGATION LANDMARK
C DEFPRE DALY   Ø174 NAVL  DEFINE PRECESSION
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C DEFSKW DALY   Ø174 NAVL  DEFINE SKEW
C DEFSPN DALY   Ø174 NAVL  DEFINE SPIN PERIOD
C DELNAV DALY   Ø174 NAVL  DELETE NAVIGATION FILE ENTRIES
C FRMCAM DALY   Ø174 NAVL  DEFINE FRAME AND CAMERA GEOMETRY
C IRDNAV DALY   Ø979 NAVL FRONT END FOR IR DOC SYSTEM...SCED BY INGESTER
C IRDOA  DALY   Ø979 NAVL DECODE IR LINE DOC AND SAVE OA BLOCK
C LISNAV DALY   Ø18Ø NAVL LIST LNDFIL ENTRIES (BURN-BOX VERSION)
C LOCEES HIBBAR Ø378 NAVL LOCATE AND FILE 2 EARTH EDGES
C MANTAN DALY   Ø18Ø NAVL INITIALIZER FOR LNDFIL (BURN-BOX VERSION)
C NAVCRD DALY   Ø979 NAVL COPY NAV DATA ON CARDS TO NAV SAVE TAPE
C NAVFIL DALY   Ø18Ø NAVL HANDLER FOR LNDFIL
C NAVSAV DALY   Ø979 NAVL SAVE/RESTORE NAVIGATION FILE DATA ON TAPE
C SATCAM SMITH  Ø174 NAVL
C SYSNAV DALY   Ø378 NAVL COMPUTE S/C ATTITUDE,IAJUST,GAMMAS,RESIDUALS
C UPGORB PHILLI Ø679 NAVL COMPUTE ORBIT FROM LANDMARKS,BETAS. AND ATTITUØØØ4
C XFORMS SMITH  Ø174 NAVL  SYSTEMS IMPLEMENTATION OF SATEAR

C ATITUD PHILLI Ø177 NAVR COMPUTE SATELLITE ATTIUDE
C BETGAM DALY   Ø878 NAVR
C BUMPT  DALY   Ø277 NAVR ADDS INCMIN TO TIME IN YR,DAY,HOUR,MIN
C CHEBBY DALY   Ø477 NAVR
C CORBET PHILLI Ø278 NAVR
* DOTDOI PHILLI Ø278 NAVR
C EARCOR PHILLI Ø174 NAVR CONVERTS IMAGE LINE-ELEMENT TO LAT-LON
C EARSAT DALY   Ø878 NAVR
C EATOST PHILLI Ø175 NAVR FAST EARTH TO SAT COORD TRANSFORM
C GAJUST PHILLI Ø878 NAVR
C GBBDOT PHILLI Ø377 NAVR IR FM-POTE BETC.BFTF-T6FRR RID-TAPE HEAD R9REC
C GETBET DALY   Ø48Ø NAV& FETCH ALL VALID BETA PAIR RECORDS FROM LNDFIL
C GETGAM DALY   Ø977 NAV& GETS GAMMA,GAMDOT FOR DAY.TIME FROM NAV FILE
C GETLND DALY   1Ø77 NAV& FETCH VALID LNDMRK DATA FOR IDAY FROM LNDFIL
C GETNAV DALY   1Ø79 NAVR FILLS GAMCOM.BETCOM WITH VALUES FROM NAV FILE
C GETREC DALY   Ø977 NAV& READ-ONLY RECORD HANDLER FOR NAVIGATION FILE
C GRDGHA DALY   Ø878 NAVR
C GSHIFT PHILLI Ø174 NAVR COMPUTES GAMMA SHIFTS
C GT     DALY   Ø878 NAVR
C HEXBIN PHILLI Ø278 NAVR
C IBMIO  DALY   Ø878 NAVR
C INVERT SAWYER Ø175 NAVR N-DIMENSIONAL MATRIX INVERSION ROUTINE
C IRDNAV DALY   Ø979 NAVL FRONT END FOR IR DOC SYSTEM...SCED BY INGESTER
C IRDOA  DALY   Ø979 NAVL DECODE IR LINE DOC AND SAVE OA BLOCK
C IYDPSM DALY   Ø878 NAVR
C LISTOA DALY   Ø477 NAVR LIST 12Ø O/A BLOCK ITEMS ON LINE PRINTER
C LLXYZ  DALY   Ø878 NAVR CONVER LAT-LON TO EARTH CENTERED X,Y,Z COORD
C NAVIO  DALY   Ø979 NAVR MAKES HI-VOLUME ENTRIES IN LNDFIL
C OPNLND DALY   Ø977 NAV& OPENS NAV FILE AND SETS UP COMMON /PARAM/
* PACK16 DALY   Ø278 NAVR INPLACE BUFFER PACK OF 3 BYTE TO 2 BYTE WORDS
C POOL   DALY   Ø877 NAV& MANAGES POOL OF AVAILABLE BLOCKS IN FILE
C PUTSYD DALY   Ø579 NAVR MAKES A DAY-BLOCK ENTRY IN NAVIGATION FILE
C PUTHR  DALY   Ø579 NAVR MAKES HI-VOLUME BLEG ENTRIES IN LNDFIL
C RAERAC PHILLI Ø174 NAVR CONVERTS EARTH LON TO CELESTIAL LON
C RECIO  DALY   Ø877 NAV& RECORD HANDLER FOR LNDFIL
C RESIDU DALY   Ø878 NAVR
C RETRAN DALY   Ø878 NAVR
C SATEAR PHILLI Ø868 NAVR MOST GENERAL SAT-EARTH COORD TRANFORMATION
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C SATPOS PHILLI Ø174 NAVR SAT POSITION VECTO9 FRO4 EA9TH CE5TE9
C SATSPO PHILLI Ø173 NAVR SIZLIN & SIZELE IN KM AT INPUT LAT-LON
C SATSUB DALY   Ø277 NAVR COMPUTES LIN,ELE,LAT,LON OF SAT SUBPOINT
C SETUPN DALY   Ø277 NAVR SETS UP NAVCOM AND NAVINI COMMONS FOR EARSAT
C SHADOW PHILLI Ø478 NAVR
C SHIFT  DALY   Ø877 NAV& SHIFTS ALL RECS IN BLK CHAIN 1 REC POSITION
C STAGAT DALY   1Ø77 NAVR RETURNS SAMPLE TIME OF LANDMARK MEASUREMENT
C STSPOT PHILLI Ø177 NAVR AREA OF SMS SCANNER SPOT IN KMSC AT LAT-LON
C STTOEA PHILLI Ø378 NAVR TRANSFORMS SAT COOR TO EARTH COOR.
C TIMUTL DALY   Ø478 NAVR PACKS AND UNPACKS ISYD,IHMS TIME VARIABLES.

C CALCNT BENSON Ø179 SYSL ONE LETTER KEYIN HANDLER
C DATLIS BENSON Ø279 SYSL LIST DIGITAL VALUE OF PIXEL AT CURSOR CENTER
C ENHTOG DALY   Ø677 SYSL TOGGLES ENHANCEMENT BLANK/RESTORE WITH K KEYIN
C FRMEAR SMITH  Ø174 SYSL  EARTH POINT - CURSOR TRANSFORMATIONS
C FRMIMG BENSON Ø173 SYSL LIST IMAGE COORDINATES OF CURSOR
C FRMPOS DALY   Ø179 SYSL LIST IMAGE AND WRRRM FRAMES CURRENTLY DISPLAYED
C FRMTVC BENSON Ø173 SYSL LIST TV COORDINATES OF CURSOR
C LFRAME BENSON Ø177 SYSL LISTS FRAME DIRECTORY INFO FOR CURRENT FRAME
C LNDMRK SMITH  Ø174 SYSL GENERATE LANDMARK FROM CURSOR POSITION
C WHAUSE BENSON Ø173 SYSL LIST PROJECT CURRENTLY LOGGED ON TERMINAL

C FILL   RUEDEN 1178 SDSR   FILL BUFFER AND UPDATE INFO IN OSTAT(JL)
C FILL2  RUEDEN Ø376 SDSR FILL BUFFER AND UPDATE INFO IN OSTAT FOR JD
C PFSASG RUEDEN Ø678 PFSR  ASSIGN FILENAME TO LUN. INIT COMMON IF NECESSARY
C PFSCEL RUEDEN Ø678 PFSR  CREATE ELEMENT (IN DIRECTORY)
C PFSCLS RUEDEN Ø678 PFSR  CLOSE ELEMENT
C PFSCPF RUEDEN Ø678 PFSR  CREATE PARTITIONED FILE
C PFSCPY RUEDEN Ø678 PFSR   COPY SUB
C PFSCSS RUEDEN Ø678 PFSR   SPECIAL CLOSE (UPDATES ELEMENT LENGTH)
C PFSDEL RUEDEN Ø678 PFSR  DELETE ELEMENT DIRECTORY ENTRY
C PFSDPF RUEDEN Ø678 PFSR  DELETE FILE
C PFSDSG RUEDEN Ø678 PFSR  DE-ASSIGN FILENAME FROM LUN
* PFSERR RUEDEN Ø18Ø PFSR  PRINTS PFS ERROR MESSAGE VIA SQ OR RSQ TO PFSMES
C PFSGBA RUEDEN Ø678 PFSR   GET BLOK OF DIRECTORY IN ABSOLUTE ORDER
C PFSGBN RUEDEN Ø678 PFDR   GET BLOK OF DIRECTORY BY NAME
C PFSGBS RUEDEN Ø678 PFSR   GET BLOCK OF DIRECTORY BY SECTOR
C PFSGEI RUEDEN Ø678 PFSR  GET ELEMENT INFO BY REFNO
C PFSGHI RUEDEN Ø678 PFSR  GET HEADER INFO FROM LUN
C PFSGNA RUEDEN Ø678 PFSR   GET NEXT ABSOLUTE DIRECTORY ENTRY
C PFSOPN RUEDEN Ø678 PFSR  OPEN ELEMENT
C PFSPAK RUEDEN Ø678 PFSR   PACK PFS FILE
C PFSPOS RUEDEN Ø678 PFSR  POSITION TO REQUESTED LRN
C PFSPSA RUEDEN 1178 PFSR  POSITION TO ABSOLUTE SECTOR,WORD (UNBLOCKED ELES ONLY
C PFSRD  RUEDEN Ø678 PFSR .READ FROM ELEMENT
C PFSREW RUEDEN Ø179 PFSR  REWIND AND CLEAR ELEMENT
C PFSRNF RUEDEN Ø678 PFSR  RENAME FILE
C PFSRNL RUEDEN Ø678 PFSR  RENAME ELEMENT
C PFSRPL RUEDEN Ø678 PFSR  REPLACE (INC CURRENT CYCLE COUNT) DIRECTORY ELEMENT
C PFSUPD RUEDEN Ø479 PFSR UPDATE RECORD COUNTER W9T86DTØ33  ZNG ELEMENT
C PFSVSG RUEDEN Ø678 PFSR   CREATE VARASG TYPE NAME
C PFSWEF RUEDEN Ø678 PFSR  WRITE EOF ON BLOCKED ELEMENT
C PFSWRT RUEDEN Ø678 PFSR  WRITE TO AN ELEMENT
C PFSZAE RUEDEN Ø678 PFSR  ADD ELEMENT TO RAM LISTS
C PFSZAL RUEDEN Ø678 PFSR ADD LUN TO RAM TABLES
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C PFSZC1 RUEDEN Ø678 PFSR  COPY ELEMENT TO ELEMENT
C PFSZC2 RUEDEN Ø678 PFSR   COPY ELEMENT TO FILE
C PFSZC3 RUEDEN Ø678 PFSR   COPY FILE TO ELEMENT
C PFSZC4 RUEDEN Ø678 PFSR   COPY FILE TO FILE
C PFSZC5 RUEDEN Ø678 PFSR   COPY PFS FILE TO PFS FILE
C PFSZDE RUEDEN Ø678 PFSR  DELETE ELEMENT FROM RAM LISTS
C PFSZDL RUEDEN Ø678 PFSR DELETE (DECREMENT) LUN
C PFSZDS RUEDEN Ø678 PFSR  DIRECTORY SEARCH
C PFSZDT RUEDEN Ø678 PFSR  DETERMINE FILE TYPE
C PFSZEO RUEDEN Ø180 PFSR READ EITHER/OR (REMOTE OR LOCAL)
C PFSZGD RUEDEN Ø678 PFSR GET DIRECTORY ENTRY AT LRN ON LUN
C PFSZGF RUEDEN Ø678 PFSR  GET FILE NAME FROM LUN
C PFSZGH RUEDEN Ø678 PFSR GET HEADER SUBROUTINE
C PFSZGL RUEDEN Ø678 PFSR  GET LINK FOR BLOCKED ELEMENT
C PFSZHF RUEDEN Ø678 PFSR DIRECTORY HASH FUNCTION
C PFSZLS RUEDEN Ø678 PFSR LRN TO SECTOR ,WORD CONVERT (DIRECTORY)
C PFSZPD RUEDEN Ø678 PFSR PUT DIRECTORY ENTRY AT LRN ON LUN
C PFSZPH RUEDEN Ø678 PFSR PUT HEADER SUBROUTINE
C PFSZRD RUEDEN Ø678 PFSR.  READ A BLOCK
C PFSZUD RUEDEN Ø779 PFSR UNPACK DIRECTORY ENTRY
C RSDIRL RUEDEN 1178 SDSR READ SDS DIRECTORY SECTOR AND LOCK
C RSDIRL RUEDEN 1178 SDSR READ SDS DIRECTORY SECTOR AND LOCK
C RSDIR  RUEDEN 1178 SDSR READ SDS DIRECTORY SECTOR
C RSDIRT RUEDEN Ø379 SDSR READ SDS DIRECTORY SECTOR (EXTERNALLY SUPPLIED TERM #)
* SCRACK RUEDEN Ø879 PFSR  SDS CRACK AND READ SUBROUTINE
C SDSASG RUEDEN 1178 SDSR  ASSIGN SDS FILE AND SET-UP FOR I/O
C SDSASN RUEDEN Ø979 SDSR  ASSIGN SDS FILE AND SET-UP FOR I/O (NO DIR LINKAGE)
C SDSGEN RUEDEN 1178 SDSR: GENERATES SDS DIRECTORY ENTRY AND ASSOCIATED FILE
C SDSGN2 RUEDEN Ø180 SDSR: GENERATES SDS DIRECTORY AND FILE FOR ANY TERMINAL
C SDSGNR RUEDEN Ø380 PFSR  GET NUMBER RECORDS IN SDS ELEMENT
C SDSIO  RUEDEN Ø380 SDSR  SDS GENERAL I/O SUB
C SDSNAM RUEDEN 1178 SDSR  CREATE SDS NAME FROM SDS NUMBER
C SDSPTR RUEDEN Ø380 PFSR  GENERAL KEY INDEX FINDER SUB
C SDSRD  RUEDEN 1178 SDSR  READ AND UNPACK SDS RECORD
C SDSSTP RUEDEN Ø380 PFSR  SDS GENERAL PURPOSE SET-UP ROUTINE
C SDSVAL RUEDEN Ø180 SDSR  CHECK FOR VALID TERMINAL/CPU/SDS# COMBINATION
C SDSWRT RUEDEN 1178 SDSR  WRITE AND PACK SDS RECORD
C SETUP  RUEDEN 1278 DBMR  SETUP AND PRINT A LINE FOR LSTSDS
C SETUP2 RUEDEN Ø379 SDSR  SET-UP PRINT BUFFER FOR JD
* SPACK  RUEDEN Ø879 PFSR SDS PACK AND WRITE SUBROUTINE
C WSDIR  RUEDEN 1178 SDSR WRITE A SDS DIRECTORY SECTOR
C WSDIRU RUEDEN 1178 SDSR WRITE A SDS DIRECTORY SECTOR AND UNLOCK
C WSDIRT RUEDEN Ø180 SDSR WRITE A SDS DIRECTORY SECTOR FOR A SPECIFIED TERMINAL


C DIRSDS RUEDEN Ø379 SDS: SDS ELEMENT DIRECTORY LISTER (JD)
C DIRUPD RUEDEN 1178 SDSL BAKGRND SDSDIR FILE ALLOCATOR (BY PROJ#)
C GENSDS RUEDEN 1178 SDSL GENERATE SDS AREA (JG)
C LSTSDS RUEDEN 1178 SDS: SDS DIRECTORY LISTER (JL)
C PFSMES RUEDEN Ø180 SDSL  PRINTS PFS AND SDS ERROR MESSAGES
C PRTSDS RUEDEN Ø979 SDSL   PRINT OR LIST SDS RECORDS (SEMI-ANNOTATED)
C QITSDS RUEDEN 1178 SDSL  QUIT SDS AREA (JQ)
C SDSDBM RUEDEN Ø180 SDSL  MOVE SDS AREAS
C SETSDS RUEDEN 1178 SDSL  SET SDS DEFAULTS (JX)
C UPDSDS RUEDEN Ø979 SDSL  UPDATE OLD FORMAT SDS FILES TO NEW
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C PLTPAK WHITTA Ø175 GRAR BASIC GRAPHICS SUBROUTINES PACKAGE
C PLTPBK DALY   Ø579 GRAR MULTIPLE WRRRM, WRRRM ONLY PLOTTING PACKAGE
C PLTPBK ERICKS 1179 GRAR MODIFIED FOR IMPROVED PERFORMANCE
C INITPL ERICKS 1179 GRA: ENTRY IN PLTPAK TO INITIALIZE PLOT ROUTINES
C PLTPLP WHITTA Ø175 GRAR LINE PRINTER GRAPHICS PACKAGE... (R)

C CRMAIN DALY   Ø377 SVCL CR KEYIN HANDLER FOR SVCA & PIREP CLD REPORTS
C CRPLT  DALY   Ø577 SVC: PLOT SVC-A CLD HGTS ON WRRRM MAP OR SAT IMAGE
C GRDUTL RUEDEN Ø980 SVCL GRID FILE LEVEL MANIPULATION UTILITY
C GRIDWK WHITTA Ø179 SVCL GRID FILE USER INTERFACE PROGRAM...
C IAMAIN DALY   Ø577 SVCL READS IA KEYIN,SQ'S IASVCA OR IARAOB
C IARAOB DALY   Ø577 SVCL PLOTS RAOB DATA ON WRRRM MAP OR SAT IMAGE
C IASVCA DALY   Ø577 SVCL PLOT SVCA DATA ON WRRRM OVER SAT IMAGE OR MAP
C LINKON WHITTA Ø479 SVCL
C LSTGRD RUEDEN Ø980 SVCL GRID DIRECTORY LISTER
C MDRCLR BARRET 1080 MDRL  CREATE AND INITIALIZE MDR GRID FILE ON DBMS
C QITGRD RUEDEN Ø980 SVCL   QUIT GRID FILE
C RAOBDI WHITTA 1176 SVCL RAOB DATA INFORMATION RETRIVAL PROGRAM
C RAOBPT WHITTA 1176 SVCL PLOT RAOB DATA (CONST PRES LEVELS) ON PRINTER
C RBCONT WHITTA Ø178 SVCL UPPER AIR DATA ANALYSIS AND CONTOUR
C RBCONX WHITTA Ø178 SVCL UPPER AIR DATA ANALYSIS AND CONTOUR
C SACNT1 SANTEK Ø179 SVCL SURFACE WX DATA AND CONTOUR (MULTI-GRID/WRRRM)
C SACONT WHITTA Ø177 SVCL SURFACE WX DATA ANALYSIS AND CONTOUR
C SAGRID WHITTA Ø976 SVCL AUTO-GRIDDER FOR SVC-A DATA
C SAKNTR WHITTA Ø576 SVCL CONTOURING OF SVC-A DATA ON LINE PRINTER
C STUVE  WHITTA Ø277 SVCL CONSTRUCT STUVE DIGRAM ON GRAPHICS DISPLAY
C SVCADI WHITTA Ø276 SVCL SVC-A INFORMATION RETRIVAL
C SVCARX WHITTA Ø177 SVCL MAIN ROOT IN TRAFFIC HANDLING ROUTINES
C SVCAUP WHITTA Ø277 SVCL AUTO-PRINT FOR WX TRAFFIC DATA
C SVCCRP DALY   Ø177 SVC: PILOT REPORT INGEST SYSTEM DRIVER
C SVCSAV WHITTA Ø277 SVCL SAVE/RESTORE FOR SVC-A AND RAOB DATA
C SVCSEO WHITTA Ø676 SVCL 24-HR DATA DUMP OF SVC-A INFORMATION
C SVCZRP WHITTA Ø976 SVCL PATH TRACE AND PREDICT PROGRAM
C WISPLT WHITTA Ø576 SVCL DATA PLOTTING ROUTINE (LINE PRINTER)

C BARNE2 SANTEK  78Ø SVCR FAST BARNES ROUTINE FOR ONE VARIABLE
C DYTMSA WHITTA Ø178 SVCR CONVERT SSYYDDD TO SVC-A FORMAT
C FILSUB DALY   Ø377 SVCR
C GENGRD RUEDEN Ø980 SVCR GENERATE AND INITIALIZE A GRID FILE
C GETSND WHITTA Ø177 SVCR CREATE COMPOSITE SOUNDING (R)
C GRADD  WHITTA Ø179 SVCR GRID FILE SUPPORT ROUTINE TO GET SECTOR ADDRESS AND
C GRDDOC RUEDEN Ø980 SVCR  SETUP AND PRINT A LINE FOR LSTGRD AND SAVGRD
* GRDERR RUEDEN Ø980 SVCR  PRINTS GRD ERROR MESSAGE VIA SQ OR RSQ TO PFSMES
* GRDZSQ RUEDEN Ø980 SVCR START PFSMES REMOTELY IF I WAS
C GRDFLL RUEDEN Ø980 SVCR   FILL BUFFER AND UPDATE INFO IN OSTAT
C GRDNAM RUEDEN Ø980 SVCR  CREATE GRD NAME FROM GRD NUMBER
C GRDVAL RUEDEN Ø980 SVCR  CHECK FOR VALID TERMINAL/CPU/GRD# COMBINATION
C GRFIL  WHITTA Ø179 SVCR GRID FILE SUPPORT ROUTINE FOR ATTACHING GRID FILE
C GRFILA RUEDEN Ø980 SVCA ATTACH TO ANY GRID FILE
C GRGNP  WHITTA Ø179 SVCR GRID FILE SUPPORT ROUTINE FOR SCANNING 'IQ' LIST FOR
C GRPDE  WHITTA Ø179 SVCR GRID FILE SUPPORT ROUTINE TO PRINT ONE DIRECTORY ENTRY
C INTPO  WHITTA 1278 SVCR ROUTINE TO IMPLIMENT BARNES GRID POINT INTERPOLATION
C JCDATE MEAD   Ø279 SVCR JULIAN TO REAL AND VISE-VERSA CONVERSION ROUTINE
C LEAST  WHITTA Ø577 SVCR PROGRAM ROUTINE TO PRODUCE LEAST-SQUARES FIT
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C LFGRID WHITTA 0879 SVCR GRID FILE SUPPORT ROUTINE FOR FINE MESH L/L GRID...
C LLGRID WHITTA 0179 SVCR GRID FILE SUPPORT ROUTINE TO FILE A LAT-LONG GRID...
C LLPS   BARRET 1180 SVCR  CONVERT LAT/LON TO POLAR-STEREO COORDS.
C PLTWNF DALY   0577 SVCR PLOT WIND FLG ON WRRPM MAP OR SAT IMAGE
C PSLL   BARRET 0480 SVCR  CONVERT FROM POLAR-STEREO TO LAT/LON COORDS
C RDGRID WHITTA 0179 SVCR GRID FILE SUPPORT ROUTINE TO READ A GRID
C RGDIRL RUEDEN 0980 SVCR READ GRD DIRECTORY SECTOR AND LOCK
C RGDIR  RUEDEN 0980 SVCR READ GRD DIRECTORY SECTOR
C RGDIRT RUEDEN 0980 SVCR READ GRD DIRECTORY SECTOR (EXTERNALLY SUPPLIED TRMNL)
C SAVGRD RUEDEN 0980 DBML  WRITE GRD SAVE TAPE
C SNDANL WHITTA 0277 SVCR COMPUTE STABILITY PARAMETERS FROM SOUNDING (R)
C SVCARY WHITTA 1176 SVCR
C SVCRAB WHITTA 1176 SVCR RADIOSONDE (RAOB) DECODER (R)
C SVCTRA WHITTA 1176 SVCR
C VDRUMR WHITTA 0179 SVCR DISC READ ROUTINE FOR GRID-FILE SUPPORT
C WGDIR  RUEDEN 0980 SVCR WRITE A GRD DIRECTORY SECTOR
C WGDIRU RUEDEN 0980 SVCR WRITE A GRD DIRECTORY SECTOR AND UNLOCK
C WGDIRT RUEDEN 0980 SVCR WRITE A GRD DIRECTORY SECTOR FOR A SPECIFIED TERMINAL
C WRGRID WHITTA 0579 SVCR PROGRAM TO WRITE A GRID IN THE GRID FILE

C BMAGIC RUEDEN 0780 SYSL READS DECK INTO FILE WITH EOF AFTER $EOJ -BLACK MAGIC
C BRATES RUEDEN 0480 SYSL  RATE SETTING PROGRAM FOR BILLING ROUTINE
C DEKDEL RUEDEN 0780 SYSL  DELETE DECK FROM SOURCE DECK FILE
C DEKLIS RUEDEN 0780 SYSL PRINT SOURCE FILES FOR DOCUMENTATION BINDERS
C DEKMRG RUEDEN 0780 SYSL  MERGE TWO SOURCE DECK FILES
C DELSPO RUEDEN 0680 SYSL FOREGROUND SPOOL FILE DELETER
C DELZX  BARRET 0477 SYSL DELETES ABORTED MACRO EXPANSION FILES
C DIAGPR RUEDEN 0278 SYSL PRINTS DIAGNOSTIC DEFINITION FILE
C DMAP   DALY   0978 SYSL FOREGROUND DMAP UTILITY
C DOCUMT DALY   0177 SYSL PRODUCES SORTED LISTINGS OF DOCUMENTATION FILE
C FILPUT HIBBAR 0780 SYSL PUTS FILE TO REMOTE SYSTEM   FILREC
C FILREC HIBBAR 0780 SYSL RECEIVES FILE FROM REMOTE SYSTEM   FILPUT
C FRAMES BENSON 0780 SYSL BACKGROUND DUMP OF FRAMED
C FREEUP DALY   1075 SYSL FREES SYSCOM LOCK WORDS LEFT BY ABORTED
C KEYINS DALY   1277 UTIB LOADS OR UPDATES NAMLIS KEYIN DIRECTORY
C MAGIC  RUEDEN 0780 SYSL  MAGICALLY READS CARD DECK INTO FILE ($EOJ'S & ALL)+
C MCBILL RUEDEN 0480 SYSL  MCIDAS BILLING ROUTINE
C MOVE   DALY   0779 UTIL MOVE A PROGRAM FILE FROM ONE PACK TO ANOTHER
C PRINT  WHITTA 0177 SYSL CARD LISTING UTILITY
C PUTJOB HIBBAR 0780 SYSL PUTJOB TO REMOTE SYSTEM  REMJOB
C PUTPRG DALY   0280 SYSL MOVE A LOAD MODULE FILE FROM FROM/TO ANY CPU
C RECJOB HIBBAR 0780 SYSL RECEIVES JOB FROM REMOTE SYSTEM   REMJOB
C REMJOB HIBBAR 0780 SYSL COORDINATES SENDING JOB TO REMOTE SYSTEM PTJOB,RCJOB
C REMOSQ RUEDEN 0880 SYSL  REMOTE SQ'R
C RENAMA DALY   0780 SYSL MOVES AREA BY RENAME
C RESSRC RUEDEN 0780 SYSL  RESTORE SOURCE DECK FILE FROM TAPE
C RMSTAT HIBBAR 0780 SYSL GETS REMOTE SYSTEM STATUS   STAT
* S.FGSP DALY   0679 SYSL
C SAVSRC RUEDEN 0780 SYSL  SAVE SOURCE DECK FILE ON TAPE
* STAT   HIBBAR 1278 SYSL LISTS SYSTEM STATUS ON CRT RMSTAT
C SVCASP BARRET 0880 SYSL  WHITAKKERS HANDY SYSTEM UTILITY
C SVCASP WHITTA 0177 SYSL WHITTAKERS HANDY SYSTEM UTILITY
C TDUMP  DALY   0578 SYSL GENERAL TAPE DUMP ROUTINE
C TRMDEF RUEDEN 0980 SYSL  SET TERMINAL TIMEOUTS
C VIDSYS BENSON 0177 SYSL CHANGE VIDEO SYSTEM ASSIGNED TO TERMINAL
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C AUTHGT RUEDEN Ø579 WINL SETS SYSCOM AND WINCOM CONTROLLING CLD HGT MODE OF WI
C CHGOUT SMITH  Ø174 WINL SETS SYSCOM WORD CONTROLLING OUTPUT MODE
C CLDHGT RUEDEN Ø579 WINL ONE KEYIN DRIVER TO DETERMINE CLOUD HIGHT
C CORWIN SMITH  Ø174 WINL SETS WINCOM WORD DEFINING WIND VECTOR COORD
C DEFALP MOSHER Ø174 WINL DEFINE CLOUD HEIGHT ALPHA
C DELWIN DALY   Ø174 WINL PHYSICALLY DELETE VECTOR(S) FROM WIND FILE
C DISSUR SMITH  Ø174 WINL SET SURFACE DISPLAY SYSCOM WORDS
C HGTPLT RUEDEN Ø579 WINL
C INWIND SMITH  Ø174 WINL INITIALIZE WINCO CONTROL WORDS
C LAGSIZ SMITH  Ø174 WINL SETS SYSCOM WORDS DEFINING LAG SIZE
C MASAGE SMITH  Ø174 WINL SETS WINCOM WORDS CONTROLLING DATA MASSAGE
C METRIC SMITH  Ø174 WINL SETS WINCOM WORDS CONTROLLING MATCH METRIC
C PLTVEC DEDECK Ø978 WINL PLOTS WIND VECTORS FROM FILE ON WRRRM
C PLTWIN DALY   Ø776 WINL SCATTER PLOT WIND FILE DATA ON GRAPHICS DEVICE
C QCPARM SMITH  Ø174 WINL SET WINCOM QUALITY CONTROL WO9DS
C RPOINT DALY   Ø174 WINL RESETS WINCO/HGT FILE POINTE9S TO ZERO
C SURDIS SMITH  Ø174 WINL GENERATE SURFACE DISPLAY ON GRAPHICS DEVICE
C TERPO  SMITH  Ø174 WINL LAG POSITION INTERPOLATION TYPE CONTOL WORD
C UVDIST SMITH  Ø174 WINL
C VECGRF SMITN  Ø978 WINL SETS SYSCOM WORDS CONTROLLING VECTOR GRAPHICS
C WINDEL RUEDEN Ø479 WINL LIST ALL VECTORS WITHIN CURSOR
C WINDIO DALY   1178 WINL WINDCO FILE TO PRINTER OR CRT
C WINLIS RUEDEN Ø579 WINL DISPLAY THE DOCUMENTATIONS FOR WINDCO KEYINS
C WINRES RUEDEN 1278 WINL RESTORE OLD FORMAT WIND TAPE TO NEW FORMAT WIND FILE
C WINT21 RUEDEN Ø579 WINL
C WINT22 RUEDEN Ø579 WINL    WINDCO SPACE BAR HANDLER
C WINT23 RUEDEN Ø579 WINL    WINDCO SPACE BAR HANDLER
C WINT24 RUEDEN Ø579 WINL    WINDCO SPACE BAR HANDLER
C WINT25 RUEDEN Ø579 WINL

C ANGLES MOSHER 1Ø74 WINR ZENITH ANGLES TO SAT,SUN,AND REL AZIMUTH ANGLE
C CLDPLT DALY   Ø476 WINR 3D PLOT OF CLOUD TOP SURFACE
C WISTAT SMITH  Ø174 WINL LIST WINCO CONTROL WORD STATUS ON SCREEN
C CLDSUB HSIEH  Ø579 WINR FETCHES DATA WITHIN THE CURSOR
C COFMIN PHILLI Ø174 WINR FINDS LOCATION OF MINUMUM VALUE OF LAGCOF
C COMIN  RUEDEN 1178 WINR  READ WINCO DISC COMMON BLOCK
* COMLAG PHILLI Ø174 WINR GENERATES LAG COEFFICIENT ARRAY
C COMOUT RUEDEN 1178 WINR  WRITE WINCO COMMON BLOCK TO DISC
C CONDAT SMITH  Ø174 WINR CONTOUR PLOTS MATCH COEFF ARRAY ON CRT OR PRNT
C CROCUR PHILLI Ø174 WINR CHANGES EUCLIDEAN NORM TO CROSS CORELLATION
C DIF    MOSHER 1Ø74 WINR LOCATES A VALUE IN AN INTERVAL
C EHANCE SMITH  Ø173 WINR APPLY CURRENT COLOR ENH 1Ø INPUT ARRAY
C EMISS  MOSHER 1Ø74 WINR CONVERT VISIBLE OPTICAL THICKNESS TO IR EMISS
C FRACT  MOSHER 1Ø74 WINR FRACTIONAL CLD COVER OF BRIGHT PART OF CURSOR
C GRAHOR RUEDEN Ø579 WINR GRAPH LINE
C HGTSUB MOSHER 1178 WINR MAIN CONTROL MODULE FOR CLOUD HGT COMPUTATION
C INDAT2 RUEDEN 1278 WINR  INPUT DATA FROM AREA WITH SMALLER BUFFER THAN INDATC
C INTEN  MOSHER 1Ø74 WINR GET INTENSITIES FROM DISK FILE MULSCA
C INIERP MOSHER 1Ø74 WINR STANDARD ATMOSPHERE INTERPOLATION
C INTERT MOSHER Ø579 WINR ZTOT LINEAR INTERPOLATION ROUTINE
C IPLANK MOSHER Ø177 WINR CALCULATES TEMPERATURE AS A FUNCTION OF RADIANCE
C IRP1   MOSHER 1Ø74 WINR INPUTS DATA FROM MULSCA FILE
C IRVSAM RUEDEN Ø579 WINR RETRIEVE IR PIXEL CORRESPONDING TO A VISIBLE
C IUVQC  SMITH  Ø476 WINR U,V COMPONENT QUALITY CONTROL CHECK
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C LAGDIS PHILLI 0174 WINR INTERPOLATES LAG MEASUREMENT
C LININT MOSHER 1074 WINR INTERPOLATES BETWEEN BREAK POINTS IN STANDARD STMOS.
C MRKERR HSIEH  1178 WINR FIND PREVIOUS VECTOR AND MARK IN ERROR
C NULVEC DEDECK 0175 WINR PLOTS CROSS FOR WIND VECTOR TOO SHORT TO BE SEEN
C PARTS  MOSHER 1074 WINR FIND BRIGHTEST AND DIMMEST 4X8 BOX IN CURSOR
C PINT   MOSHER 0476 WINR INTERPOLATE CLOUD PRESSURE
C PLANK  MOSHER 0177 WINR CALCULATES RADIANCE AS A FUNCTION OF TEMP
C POSSAT PHILLI 0174 WINR IDENTICAL TO SATPOS
C RADCOR PHILLI 0174 WINR ADJUSTS EUCLIDEAN NORM FOR MEAN BRIGHTNESS
C TAU    MOSHER 1074 WINR SATELITE BRIGHTNESS TO OPTICAL THICKNESS
C TTOZ   MOSHER 1074 WINR TEMPERATURE TO HEIGHT USING STND ATMOS
C WINSUB SMITH  1178 WINR MAIN CONTROL MODULE FOR WIND COMPUTATION
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