White Sands Complex

White Sands Complex News

The White Sands Complex (WSC) continues to face new challenges while maintaining scheduled progress on existing projects such as the Guam Remote Ground Terminal (GRGT) effort, EOS Data and Operations System (EDOS) support, ISO9000 certification, and the effort to merge the WSC and WSTF (White Sands Test Facility) contracts. Normal WSC operations continue to set new highs for customer support satisfaction and the site is approaching the desired "six sigma" reliability rating.

TDRS training support has been extended to the Electronic Systems Test Laboratory (ESTL), at Johnson Space Center in Houston, Texas. The training is in direct support of ESTL's efforts to develop a mobile TDRS support link. Engineering support has also been extended, especially in the area of High Powered Amplifiers.

WSC has "passed" its final pre-ISO9000 inspection and should achieve full certification in November. Some minor problems were discovered and will be corrected before the final inspection.

One of the most exciting events at WSC these past few months was the incredibly rapid development of a support system for the Lewis satellite. WSC Engineering, Software, and Hardware Maintenance Depot personnel deserve special recognition for their fast response to the need to improvise an emergency link support for the Lewis satellite.

The Lewis satellite experienced a spacecraft emergency in August and the control center requested Space Network (SN) support. The first major problem to be overcome was that the Lewis satellite was only configured for Ground Network (GN) support, which is incompatible with normal TDRS operations. WSC personnel designed, constructed, and implemented a working prototype bypass modulator in less than four hours.

The prototype design was enhanced and two GN-style, bypass modulators were operational within four days. This achievement was especially impressive as the bypass modulators had to be built from existing stock materials and test equipment, mandating considerable ingenuity. The bypass modulators allowed the Lewis Project Operations Control Center (POCC) to attempt satellite recovery procedures for hours on end, as opposed to a normal GN support which is measured in minutes and is not available on every orbit. This exceptional level of performance bodes well for future support of the International Space Station and the Manned Mission to Mars.

The Danzante site at WSC. (Photo courtesy of Bill Gardner)

Article by Douglas Perkins/WSC Training Coordinator

For more information, please see the WSC Project Office homepage at http://wscproj.gsfc.nasa.gov/, or contact Jim Gavura, Station Director or Bryan Gioannini, Deputy Station Director at (505) 527-7000.

Space Network Supports Mir VHF Communications

Though not generally known, the Space Network has been supporting the Soviet Space Station (Mir) VHF passes via Dryden Flight Research Center, and more recently, Wallops Flight Facility and the White Sands Complex (WSC). The VHF support provides voice-only communications between the Mir and the Moscow control center.

Mir Space Station is in a low earth orbit, with Mir orbiting the earth approximately once every 90 minutes. Because Mir is over a point on the globe for only a short period of time, it is out of communication with Moscow for a large portion of the orbit. With the addition of Dryden (West Coast), the WSC

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(central), and Wallops (East Coast), VHF communication is now provided over the majority of the United States.

Dryden was the first of the NASA sites to install the VHF capability followed by Wallops. The WSC began the installation in early June with a predicted completion date of mid July. Although originally conceived to aid the Soviet Space Agency, this capability is also used by NASA for a direct communication link with the astronauts.

The importance of this increased capability became evident on June 25 of this year when the supply ship known as Progress collided with the Mir Space Station. In the highly publicized events that followed, Moscow and the Mir cosmonauts assessed the damage. The WSC VHF system was activated after the report of the accident in an exceptionally short period of time, two full weeks ahead of schedule. Critical communication between Moscow and the Mir was provided by the three NASA sites immediately after the collision. Without the additional coverage provided by the NASA facilities, communication between Moscow and the Mir would have been delayed until the Mir was in view of a Russian tracking station. In appreciation of the efforts of the three centers, the Soviet Space Agency presented NASA with an official flag of the Mir Space Station. That flag is currently on display at WSC.

Article by Mike Milligan/ATSC

For more information, please contact the author at (505) 527-7070 or via email at Milligan@tdrss.wsc.nasa.gov

The WSC VHF antenna installation utilized for Mir communications. (Photo courtesy of Bill Gardner)

Network Control Center News

Network Control Center Bustling With Activity

The Network Control Center (NCC) continues to provide support with a 99.9% operational proficiency. Over the past couple of months, in addition to daily support requirements and activities, the NCC has provided Mir support during several Mir spacecraft emergencies and, beginning on August 26, began supporting the Lewis spacecraft emergency after the Lewis control center was unable to establish communications via the ground stations. The NCC has provided continuous service in planning the Lewis TDRSS contacts for the Payload Operations Control Center (POCC) and scheduling those contacts by entering SHOs and transmitting them to the White Sands Complex (WSC). This is a very labor-intensive effort for the operations personnel involved. The NCC successfully responded to several requests from the POCC in Chantilly, VA for real-time updates to the NCC database to change the forward frequency. While Lewis was not planned to be TDRSS compatible, NASA, Fred Herold & Associates, and AlliedSignal Technical Services Corporation personnel devised an innovative method to provide TDRSS support. This was done by configuring WSC systems to support the 16 Khz non-spread Ground Network RF subcarrier with an S-band Single Access service and sweeping the frequency to provide optimal opportunities for lock. Several engineering tests established that TDRSS was likely the best

vehicle for establishing communication with the spinning spacecraft. Unfortunately, communications were not established and the spacecraft reentered the atmosphere on September 28.

In addition to the above activities, the NCC supported eight Expendable Launch Vehicle launches and three Space Shuttle missions since July 1.

During a ceremony held in the NCC on July 31, several NCC personnel received awards for their efforts in support of the HST Servicing Mission, launched in February of this year. The honorees were presented with certificates of appreciation and a pizza luncheon was held in their honor.

Upcoming activities at the NCC include the implementation of NCC 97, which will include new TCP interface capabilities that are required to support EOS-AM1 and Landsat-7 mission testing phases (See NCC 97 article, page 3). Additional activities include continued planning for implementation of NCC 98 and the NCC floor space reduction (See NCC 98 article, page 4), NCC 98 Integration and System testing, coordination of NCC 98 training activities, and coordination for transition of physical security at the NCC to GSFC Code 205 (Goddard Security).

Article by Joe Snyder/ATSC

For more information, please contact Bill Webb at (301) 286 -3264, or visit http://ncc.gsfc.nasa.gov on the Internet.

NCC 97 Project Prepares for First Major Delivery

The Network Control Center (NCC) is preparing to release the first phase of the upgrade known as NCC 97. The NCC 97 project is dedicated to supporting customers communicating via Transmission Control Protocol/Internet Protocols (TCP/IP) by providing a secure operational IP interface to the NCC Data System (NCCDS). The first phase of this project, NCC 97.1, has successfully completed testing and was delivered as a test system the week of October 13. This system is designed to allow the Earth Observing System (EOS) Operations Center (EOC) and the Landsat-7 Mission Operations Center (MOC) — both using open communications protocols — to conduct mission testing with the NCCDS prior to the launch of their respective spacecraft.

The NCC 97.1 system is a single-string configuration consisting of an NCCDS Protocol Gateway (NPG) and firewall. The NPG serves as the protocol translator for incoming TCP/IP messages from the MOCs and outgoing 4800 Bit Blocks from the current NCCDS. The firewall offers network security, protecting the gateway from external attack.

Additional features will be added in future releases of the NCC 97 system. NCC 97.2 will offer a File Transfer Protocol (FTP) capability allowing the Landsat-7 MOC to place spacecraft acquisition data where it can be translated by the NPG and accessed by the NCCDS. Phase 2 is currently in development and delivery is expected in early December. The third and final phase will provide full operations support for TCP/IP MOCs requiring a connection to the NCCDS 24 hours a day, 7 days per week, prior to the NCCDS transition to NCC 98 operations. This capability will be implemented in mid March in time for the launch of Landsat-7 and EOS AM-1 that summer.

Article by Steve Simmons/Booz•Allen & Hamilton

For further information, please contact Lynn Myers at (301) 286-6343 or via email at lynn.myers@gsfc.nasa.gov

NCC Firewall Update

In order to provide TCP/IP support for Landsat-7 Missions Operations Center (MOC) and EOS Operations Center (EOC) mission testing in a timely manner, a Firewall delivery for the NCC 97 releases has been added to the development effort and has been done in parallel with the NCC 98 implementation. The NCC 97 Firewall provides protection for the Network Protocol Gateway (NPG) system.

The NCC 97 Firewall implementation is being delivered in three phases. Phase 1 provides the basic Firewall as well as Multicast/Unicast IP address translation. For NCC 97 the Domain Name Services (DNS) reside on the Firewall platform. Phase 1 has completed testing and is ready for the transition to operations. Phase 2 will provide a new Checkpoint Firewall-1 release as well as rule modification to support the new acquisition data interface with the Landsat-7 MOC. Phase 2 is expected to be operational in December 1997. Phase 3 will furnish full operational support with automatic switchover for Space Network (SN) TCP/IP customers. It will provide support for operational SN TCP/IP customers until NCC 98 is accepted for operational use.

The Firewall being implemented as part of NCC 98 will protect the NCCDS from unwanted intrusions by restricting communications between external entities and internal components. For that purpose, the Firewall acts as a filter, allowing only inbound messages that conform to a predefined set of rules to reach the protected NCCDS network, and performing the same validation on outbound messages routed out to the closed IP Operational Network (IONET). As a security measure, the Firewall logs all packet headers and provides alarms for possible intrusions.

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For NCC 98, the management of the Firewall may be controlled from the Network and System Management (NSM) subsystem via a TCP/IP link, supplying centralized management. Configuration data being maintained behind the Firewall contributes added security. The DNS will be removed from the Firewall and will reside on the NSM station. At this point the entire NCCDS will be protected by the Firewall which will be fully implemented for both TCP/IP customers and 4800 bit block customers.

The biggest challenges to date are identifying the best switchover implementation and determining if the Firewall can be managed from the NSM. The Firewall development team is evaluating custom High Availability (HA) software and vendor-supplied HA software.

Article by Reine Chimiak/NASA GSFC, Mary Foote/CSC, and Gus Massey/CSC

For further information, please contact Reine Chimiak at (301) 286-3469 or via email at reine.chimiak@gsfc.nasa.gov

Operations Control Room (OCR) at the Network Control Center

NCC 98 Rollout is 11 Months Away!

Development of the major NCC 98 subsystems is essentially complete as the final build entered into integration last month. Assuming a successful final round of testing, NCC 98 capabilities will be available for customer support in less than a year!

Recall that NCC 98 will provide customers increased Space Network resource scheduling flexibility, scheduling of new TDRS H, I, J services, and the ability to communicate with the NCC via either 4800 bit blocks or TCP/IP. Two internal builds have been integrated and tested, providing valuable system insight and a number of challenges to overcome.

Earlier this year a project review was initiated following the first internal system integration and test phase. A revised operational date of September 1998 was projected and announced. The second internal release completed integration testing and system testing in September, as a number of design refinements brought system stability and functionality more in line with requirements. Not fully unexpected, final requirements refinements and design changes in the third release are expected to increase the burden on the final testing phases. No change in the release date is anticipated and a number of contributing factors are credited. A second complete test string, two-shift test support, resource sharing, and minimizing overlapping tests between test phases are key success factors in the months to come.

Major subsystems completing development include the Service Planning Segment Replacement (SPSR), Communications and Control Segment (CCS), NCCDS Protocol Gateway (NPG), Network and Systems Management (NSM) system, and the Firewall. Development teams will continue to provide software resolutions to anomalies identified during testing. A significant amount of testing on the NPG and Firewall, accomplished in support of NCC 97 (please see previous articles), should reduce the amount of problems encountered. Experience gained on these systems by operations and test personnel is an asset heading into the final NCC 98 testing efforts.

Enhancements to non real-time systems are also included in the new release, including the Service Accounting Segment, Automated Conflict Resolution Segment, TDRSS Unscheduled Time (TUT) Server, and Central Delogger. The complement will undergo internal testing well into winter, with limited external testing in the spring.

Full external testing will be performed with all Space Network customers and elements during Operations Evaluation Testing in the summer of 1998 in the new operations environment. Each customer will be contacted to participate in EIF testing. Overall, NCC 98 does not impact current customers who will retain their existing type of support. Regression testing will be performed with baseline SN customers to verify full backward compatibility, and new IP customer testing will be performed to verify connectivity and services. Full support customers will be required to upgrade their systems to take

advantage of the flexible scheduling or enhanced TDRS H, I, J services. Only minor NCC database changes are required to test full support customers.

Customers who wish to change their NCC interface to IP are welcome. Those who wish to take advantage of TUT information can do so by simply using a standard web browser with connectivity to the closed IP Operational Network (IONET). These capabilities will be available following operational transition.

Article by David Taylor/Booz•Allen & Hamilton

Further information can be obtained from Roger Clason at (301) 286-7431.

Space Network Elements

Nascom Internet Protocol Transition Nears Completion

Nascom continues to implement the complex transition away from its legacy 4800 bit block data transport protocol toward the utilization of Internet Protocol (IP). The new IP system is standards-based, predominantly utilizing commercial-off-the-shelf (COTS) products. By implementing the IP conversion, Nascom will optimize the costs associated with equipment, labor, and maintenance, thereby reducing the cost of communications network support. The conversion to IP involves transitioning customers from two systems: the Message Switching System (MSS) and the Multiplexer/Demultiplexer (MDM) System. To convert 4800 bit blocks to IP, conversion devices [either the Small Conversion Device (SCD) or the Programmable Telemetry Processor (PTP)] were placed at each customer site currently utilizing MSS or MDM services. SCD and PTP installations for all of the MSS Services and a majority of the MDM Services provided at GSFC and MSFC were completed in mid September, with over 200 devices installed. The remaining Conversion Devices required for the MDM Transition will be deployed by Mid November. In June of last summer, the MDMs at Johnson Space Center and the White Sands Complex were modified to accommodate IP, and an MDM software revision was successfully installed in July.

Nascom installed new router software during the second week of September, effectively correcting the multicast routing problems experienced previously. Nascom has since supported the STS-86 mission successfully, predominantly in shadow mode. Current plans are to support the next Shuttle mission (STS-87, which is scheduled for November) from launch to landing with the new IP system prime for MSS Services. If prime IP support of the STS-87 mission is successful, Nascom's goal is to turn down the legacy MSS system by the end of December 1997. All MDM systems will be transitioned to the new IP system by February 1998.

Monthly overall status reports, the status of individual sites, the IP Transition Plan, Test Approach, and other information about the transition are available on the IP Transition homepage listed below. The Nascom team's goal is to accomplish this complex transition as smoothly as possible. Nascom wishes to express gratitude to all customers for their continued patience and cooperation. Such teamwork is crucial to the success of the entire effort.

To obtain further technical information and points of contact concerning the Nascom IP transition, refer to the IP Transition Homepage at http://skynet.gsfc.nasa.gov/transition/ip-main.htm, or contact the IP Transition Manager, Scott Douglas at (301) 286-9550.

Update on Nascom's Secure Gateway Upgrade

The NASA Communications Division has been working feverishly to get a new Secure Gateway system on line by the end of the Fiscal Year. Many problems with configuration and software capability have prevented the new Secure Gateway system from being considered for operational use.

However, the new system should be coming on line soon. Some previous hardware problems have been corrected and

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some of the software problems have been resolved with up-to-date software patches and revisions.

In June 1997, two new time servers were put on line within the closed segment of the IP Operational Network (IONET). These time servers are configured in a primary and secondary setup. They provide time synchronization within the closed portion of the IP network. These network time servers are fed from a NASA 36 source that provides the same time synchronization as the legacy Nascom systems.

The hardware and software upgrades to the closed segment Domain Name Server (DNS) have been delayed due to shuttle mission freezes that Nascom must observe before, during, and after the missions. A new approach to getting these systems updated is in the planning phase and is intended to be completed before the end of the calendar year.

Due to the possibility of security breaches resulting from numerous obsolete rules based on old Secure Gateway requests, Nascom will require all projects that make use of the Secure Gateway to reevaluate their mission requirements and submit deletions for those services that are no longer required or needed. Many projects forget to provide notification when services are no longer required, thereby weakening the protection that is provided to other projects. If a service is not used but is still in place, others can possibly exploit the service and gain unauthorized access. Secure Gateway request forms and DNS request forms are located at the WWW site: *http://skynet.gsfc.nasa.gov/IONET*

Article by Matthew Kirichok/NASA GSFC

For more information, please check out the URL listed above, or contact the author at (301) 286-3435 or via email at matthew.kirichok@gsfc.nasa.gov

Pacor II Transition Nearly Complete

Two major milestones have been reached in the transition from Pacor I to Pacor II operations. On October 1, Pacor I stopped sending data for the Solar, Anomalous, and Magnetospheric Particle Explorer (SAMPEX) to the University of Maryland Science Operations Center (UMSOC). UMSOC has been sending Pacor II data (which it has been receiving in parallel to the Pacor I output) to customers since September 1. On October 2, Pacor I ceased Compton Gamma Ray Observatory (CGRO) data delivery to Oriented Scintillation Spectrometer Experiment (OSSE) and Energetic Gamma-Ray Experiment Telescope (EGRET) customers, as well as to Imaging Compton Telescope (COMPTEL) customers at the University of New Hampshire and the Max Planck Institute for Extraterrestrial Physics. This successful transition of CGRO processing is the culmination of a major development effort in Pacor II. The Burst and Transient Source Experiment (BATSE) facility at Marshall Space Flight Center is the only remaining CGRO Pacor I customer, and is expected to make the transition to the Pacor II format early in October.

In addition to the BATSE transition, the remaining milestones for the Pacor I shutdown are the finalization of the transfer of EUVE processing to the University of California, Berkeley (UCB) and physical removal of the equipment. UCB has been successful at processing tape-recorder dumps, but still has work remaining on real-time processing. They anticipate that they will have all work completed by the end of October. When BATSE and EUVE processing are completely off Pacor I, a date will be set for the removal of the equipment.

Article by Don Davenport/ATSC

For further information, please contact the author via email at donald.g.davenport.1@gsfc.nasa.gov

Flight Dynamics Facility Plans Support to Spacecraft Without TDRSS Transponder

NASA GSFC and Ames personnel are coordinating TDRSS support of Lunar Prospector (LP) between Lunar trajectory insertion and Goldstone acquisition of signal. The objective of the support will be simultaneous TDRSS telemetry and 2-way TDRSS tracking. LP does not have a TDRSS transponder. Preliminary testing done at GSFC in April 1997 was successful, and additional testing is planned prior to launch, which is currently scheduled for December 1997.

Information provided by Greg Marr/NASA GSFC

For more information, please refer to the Flight Dynamics Division Web Page at http://fdd.gsfc.nasa.gov or contact the author via email at greg.marr@gsfc.nasa.gov

User Planning System Supporting Year 2000 with Next Software Release

Due to the extension of the User Planning System (UPS) 98 schedule in support of NCC 98, the opportunity exists to provide UPS support for the year 2000 earlier than previously stated. Release 11 Build 3 will include upgrades to the HP/UX operating system, the Oracle Database Management System, and application software and is scheduled to be available in November of this year. In addition to supporting the year 2000, this release will also support Hubble Space Telescope's new HP hardware purchase.

UPS Release 11 Build 2 was released in July 1997 for Landsat-7 interface testing with the NCC and operational readiness testing at the Multi-Satellite Operations Control Center (MSOCC). This release supports communication with the NCC via direct TCP/IP connection and also provides the capability for missions to broadcast UPS schedule information to multiple electronic customers. With the delivery of Release 11 Build 2, UPS installations will be able to eliminate their UPS Nascom Gateway interface, and communicate with the NCC via TCP/IP, resulting in significant savings of maintenance costs. Current plans call for cessation of support for the UPS Nascom gateway six months after the NCC begins operational support of TCP/IP, currently scheduled for January 1998. Missions considering this option in the near future should contact John Brown (UPS development, phone: 301-794-2427) or Roger Clason (NCC Project Engineer, phone: 301-286-7431).

UPS 98 development is currently scheduled to coincide with that of its counterpart project, NCC 98 (see NCC 98 article, page 4). Several UPS builds are scheduled, culminating in UPS Release 12 which will support all NCC 98 flexible scheduling capabilities.

Important Note: As stated in previous *Integrator* articles, operational support for the UPS DEC Ultrix based system will not be provided beyond April 1998.

Article by John Brown/CSC

Further information can be found on the World Wide Web at http://isolde.gsfc.nasa.gov/ups/ or contact the author via email at john.e.brown.1@gsfc.nasa.gov

Space Network Customers

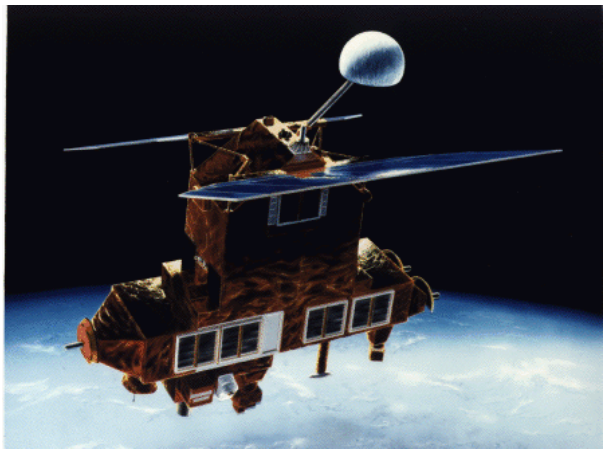
Earth Radiation Budget Satellite Mission Continues....

The Earth Radiation Budget Satellite (ERBS) began its 13th year of operation on October 5, and reached the 70,000 orbits milestone on August 8 of this year. ERBS continues its single battery operations using Constant Current Mode battery management that adequately provides spacecraft power for monthly yaw maneuvers and the two remaining science instruments on board. The data recovery continues to be excellent for ERBS' remaining two instruments, the Earth Radiation Budget Experiment Non-Scanner (ERBE-NS) and the Stratospheric Aerosols and Gases Experiment (SAGE-II), as the instruments continue to gather valuable data on atmospheric and regional, zonal, and global energy transfer.

The ERBS Flight Operation Team also provided Earth Radiation Budget Experiment Non-Scanner solar measurements in support of the Solar Constant Experiment (SOLCON) instrument flown on Shuttle mission STS-85 in August. SOLCON flew as part of the TAS-01 (Technology Applications and Science) Hitchhiker payload.

Article By Jack Murphy/ATSC

For additional information, please contact Robert Sodano, ERBS Mission Director/NASA GSFC at (301) 289-6506.



The Earth Radiation Budget Satellite (ERBS)

Marshall Space Flight Center Supports the First Microgravity Science Laboratory on STS-83 and STS-94

The First Microgravity Science Laboratory (MSL-1) was a Marshall Space Flight Center (MSFC) managed mission and Spacelab operations support was conducted out of the Payload Operations Control Center (POCC) at MSFC. The MSL-1 payloads consisted of experiments representing Materials, Fluid, Combustion, and technology disciplines in microgravity. Individual experiment teams on board the Orbiter Columbia were as follows: Combustion Module (CM-1); Droplet Combustion Experiment (DCE); Expedite the Processing of Experiments to the Space Station (EXPRESS); Large Isothermal Furnace (LIF); Middeck GloveBoX facility/investigations (MGBX); Plant Generic Bioprocessing Assemble (PGBA); Microgravity Measurement Assemble (MMA); Protein Crystal Growth (PCG); Physics of Hard SphEres (PHaSE); Quasi-Steady Acceleration Measurement System (QSAM); Space Acceleration Measurement System (SAMS); Electromagnetic Container Processing Facility (TEMPUS-in German); Orbital Acceleration Research Experiment (OARE); and HI PACked digital TV (HI PAC).

Experiment teams that supported their experiments from the MSFC Science Operations Areas (SOA) included TEMPUS, CM-1, PHaSE, DCE, SAMS, QSAMS, EXPRESS, MGBX, LIF, PCG, MMA, HI PAC, and MGBX. The MSFC POCC provided remote data to the following sites/experiment teams: Lewis Research Center (LeRC) for SAMS, OARE, CM-1, DCE, LIF, and PHaSE; University of Colorado for PGBA; and Tsukuba, Japan, for the LIF team. The National Space Development Agency of Japan (NASDA) established this new communications interface with data, voice, and video for the LIF team provided from MSFC to Japan. To prepare for the mission, the MSFC POCC performed extensive interface testing with Japan as well as with LeRC in Ohio and the University of Colorado in Boulder.

The Microgravity Science Laboratory mission resulted in a unique opportunity for the same crew of Columbia to fly on STS-83 in April and 84 days later fly again on STS-94 in July. Though an anomaly on STS-83 resulted in a minimum duration mission of four days, good science data was collected during payload activation. A decision to perform a quick turn-around for a reflight was made. This decision provided the crew a chance to utilize experience gained and adjust the methodology used for payload activation and experiment operations. The MSFC POCC was able to work with individual experiment teams, both local and remote, to identify and solve all problems discovered, resulting in enhanced overall data collection and processing.

The reflight of MSL on STS-94 was a full-duration (16 day) mission and was deemed a complete success. Several experiment teams exceeded their expectations for science data by a considerable margin. More Spacelab data was acquired and recorded at MSFC for MSL-1 than for any previous mission. Payload post-mission debriefs resulted in high praise from the experiment teams for all involved. Additionally, the Shuttle Crew commended personnel at all Centers for dedication that made this mission such a great success. Unique situations provide the opportunity to excel.

Questions may be addressed to Mike Blum at Michael.Blum@msfc.nasa.gov or additional information on MSFC Projects may be obtained from the MSFC Web Server. The Home Page address is http://www.msfc.nasa.gov/. The specific address for the Microgravity Science and Applications Division is http://otis.msfc.nasa.gov.

The Compton Gamma Ray Observatory Begins Seventh Successful Year

The Compton Gamma Ray Observatory (CGRO), launched in April 1991 by the space shuttle Atlantis, is ready to begin its seventh annual observation cycle next month. For each cycle, an international community of scientists compete for observing time through a proposal process. Proposals can be submitted by anyone, and they are judged and ranked based on scientific merit through a process of peer review. This type of open competition is standard for NASA scientific missions and leads to a wealth of valuable ideas and contributions. Data acquired by the four instrument packages on board the 17-ton observatory are then distributed for analysis to the scientists whose proposals were accepted. After six months the data devolves to the publicly accessible archive at the NASA Goddard Space Flight Center.

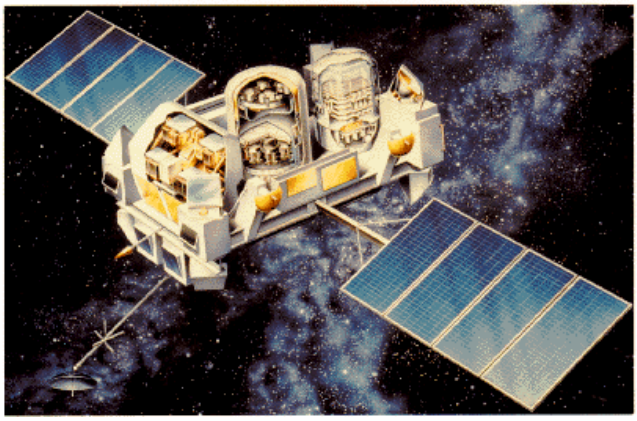
The CGRO spacecraft and instrument packages continue to operate successfully, now well into the seventh year of operations. A new plan for cost-saving measures is expected to be to be implemented in the fall of this year. This will involve changing console monitoring from 24 to 8 hours per day. During other times, data recovery and state-of-health monitoring would all be done automatically. A computer screen with “red” and “yellow” limits would be watched by a “multi-mission” operator. Spacecraft safety issues and the possible impact on science operations have been carefully scrutinized, and there is a general sense of confidence that this can be successfully carried out. Monitoring of the spacecraft batteries is a primary concern, as expedient (human)

operator intervention is sometimes needed. A longer-term plan to more greatly expand the automation capabilities — a system named "ROBOTT" (Reduced Operations By Optimizing Tasks and Technologies) — is planned for implementation by the Flight Operations Team in 1998.

As noted in the previous issue of *The Integrator*, the observatory was successfully boosted from an orbital altitude of 435 km to 515 km during April and May of this year. Approximately 628 lb. of fuel were used for the reboost, leaving about 2500 lb. for future operations and reentry. CGRO will now likely remain above 300 km until about 2005. Since the recent reboost, the Imaging Compton Telescope (COMPTEL) and Oriented Scintillation Spectrometer Experiment (OSSE) instrument teams have noted an increase in background count-rates, occasionally reaching the available telemetry limit for the highest-priority events. The elevated count-rates are presumably due to the increased radiation environment at the newer, higher orbital altitudes. Continued study is underway.

Meanwhile, progress on the scientific front continues. The Energetic Gamma-Ray Experiment Telescope (EGRET) instrument detected a significant brightening in the enigmatic source known as "BL Lac" at gamma-ray energies above 100 MeV. This followed the announcement of dramatic activity in the visual brightness of the source as reported by ground-based astronomers — the brightest this source has been in over 20 years. The OSSE instrument also detected the source's lower gamma-ray energies. Prior to 1995, EGRET only detected upper limits from BL Lac, and OSSE detections from this object class have been rare. The combined OSSE and EGRET detections allow for the Synchrotron-Self Compton component of the spectral energy distribution to be characterized with unprecedented detail for this type of Active Galactic Nuclei. The EGRET light-curve profile provides the most dramatic confirmation to date for the presence of relativistic beaming in a radio-selected BL Lac object.

The Burst and Transient Source Experiment (BATSE) instrument team has recently implemented a new "BATSE Rapid Burst Response" system to quickly (within 20 min.) compute and distribute gamma-ray burst locations accurate to approximately two degrees (refer to the CGRO article in the July 1997 issue of *The Integrator* for a description of the gamma-ray burst phenomena). The system has been used 18 times in the past three months, and the resulting event locations scanned within 3-4 hours with the Rossi X-Ray Timing Experiment in several cases. In one case, a weak variable x-ray source was detected. Further improvement in the positional determination was obtained through triangulation methods using data obtained by the burst detector on board the Ulysses spacecraft; this led to approximately a 0.1 degree error box, initiating a large search for radio/optical afterglow counterparts. Together, the three NASA satellites offer a significant new capability for gamma-ray burst counterpart studies.



The Compton Gamma Ray Observatory

Article by Chris R. Shrader/Compton Gamma Ray Observatory Science Support Center, NASA Goddard Space Flight Center

For additional information refer to http://cossc.gsfc.nasa.gov on the World Wide Web.

Hubble Space Telescope Project Begins Vision 2000 Deployment

Important and exciting activity characterizes the Hubble Space Telescope (HST) Project this quarter. Operations with the telescope have proceeded very smoothly, and many special "short-fuse" targets of opportunity have been observed. HST is supporting the aerobraking maneuver of the very successful Mars Global Surveyor Mission by providing periodic details of the Red planet's atmospheric conditions. The observatory has also recently made headlines with the discovery of solar system-sized knots of gaseous debris moving away from the periodic stellar nova called T Pyxidis. This followed on the heels of the discovery of an apparent optical counterpart to one of the elusive astronomical gamma-ray bursts seen by the Compton Gamma Ray Observatory.

While exciting science operations continue, however, much attention in the HST Project has recently been focused on the ground. The first phase in the deployment of the new Vision 2000 Control Center System is now well underway. The Project plans an intensive delivery, testing, and verification program over the next few months, culminating in the complete operation of the spacecraft with the new system by the end of

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March. To accomplish this, an extraordinary amount of work is being simultaneously accomplished in the areas of facility conversion, operations procedure conversion and verification, documentation, display generation and verification, training and certification, and, of course, testing. Testing and operations personnel are working closely with the Space Network to verify all the new ground system components and the procedures for the correct operation of the observatory. The new Vision 2000 systems are also being deployed in many of the HST flight software testing facilities at GSFC and elsewhere, including the high-fidelity flight hardware and software simulator in the GSFC building 29 highbay known as the Vehicle Electrical Systems Test (VEST) Facility.

On top of it all, planning is being done in earnest for the next HST servicing mission, SM-3, scheduled for late in calendar year 1999. Testing by the astronaut corps has already begun in the neutral buoyancy simulator to ascertain the level of difficulty of the six (likely) Extra-Vehicular-Activities (EVAs). NASA HQ also recently announced the selection of a new science instrument for installation on HST in the year 2002 on SM-4. Its name is "Cosmic Origins Spectrograph" (or COS), and its Principal Investigator is Dr. James Green of the University of Colorado.

HST continues as a vital, healthy mission. Many thanks to all within the Space Network and the extended HST family whose dedication and hard work have made it the success that it is.

Article by Kevin Hartnett/Deputy HSTOMS Manager

For more information, check out the following World Wide Web site: http://edocs2.hst.nasa.gov/ or contact the author at (301) 286-6064 or via email at Kevin.Hartnett.1@gsfc.nasa.gov

Long Duration Balloon Program Completes Historic Flight

The Long Duration Balloon Program (LDBP) had a near circumglobal balloon flight launched from Fairbanks, Alaska this summer. The launch was on June 23, 1997, and was terminated on July 6, 1997 in Northwestern Canada. The flight trajectory took the balloon west over the Bering Strait, Russia, and Northern Europe, ending in termination and recovery in Northwestern Canada. Nominal altitudes during the flight were as expected between 107 Kft to 125 Kft.

Flight Trajectory of the 1997 Alaska Mission

The TDRSS support received from the networks personnel was excellent for the duration of the flight. Even during the so-called Zone Of Exclusion, the project was able to receive excellent data. On average, only six hours per day were lost. The National Science Balloon Facility (NSBF) Operations group was very impressed by the support we received. Because of the near full-time return telemetry, we had excellent feedback about the payload performance. Scheduled MA forward events performed flawlessly, and, when needed for the termination phase of the flight, were scheduled for the project nearly continuously. The over-the-horizon control we utilized from Palestine, TX — considered routine for TDRSS spacecraft customers — was very new to us on these types of missions.

Science instrumentation on the balloon included an experiment for studying interactions of high energy-heavy nuclei, analyzing composition and spectra of cosmic rays, and analyzing the low energy backgrounds for northern hemisphere latitudes. Because of the 100% success of this flight, much interest has been initiated by the science community for Long Duration Ballooning in the Northern Hemisphere at midlatitudes. The project expects much activity in this area in the future and, therefore, much reliance on SN support.

The Long Duration Balloon Program is still seeking vendor support for supplying balloon class TDRSS transponders. A review of the current LDBP TDRSS transponder specifications is near completion and will be out for industry review soon.

Article by Bryan Stilwell/NSBF/Physical Science Laboratory, NMSU

For more information, please contact the author at (903) 723-8097 or via email at Stilwell@master.nsbf.nasa.gov

Prelaunch activities, including inflation of the balloon, from the 1996 Alaska campaign (Photo by the author)

Fast Action by Rossi X-Ray Timing Explorer Flight Operations Team

The Rossi X-Ray Timing Explorer (RXTE) continues to perform nominally since its launch on Dec. 30, 1995. The scientific campaign to chase Gamma-Ray bursts and detect their afterglow in the X-Ray spectrum is ongoing and has produced some good results already. Passage through the South Atlantic Anomaly (SAA) has been the most consistent source for problems on RXTE. It has resulted in two SafeHolds and has caused a warm restart of the Attitude Control processor numerous times, although these events are rather benign in comparison to the SAA-induced anomaly on Sept. 23, 1997. During a passage through the SAA, an upset to the Attitude Control processor was significant enough to cause the processor to halt. This forced an autonomous hardware reboot of the processor. Without attitude knowledge, high-gain antenna communications were not possible, and the transponders had to be reconfigured in the blind to transmit through the omni-directional antennas. Once communications were restored the degraded solar arrays became a primary concern.

Due to the spacecraft being in SafeHold and because SafeHold requires that the solar arrays remain directly on the sun line, recovery needed to be quick to allow the arrays to be offset to prevent increasing temperatures from cracking more of RXTE's weakened solar cells. The anomaly occurred at 3:18 AM and a goal was set to have the arrays offset within 12 hours. By 11:45 AM the Attitude Control processor was sufficiently recovered to exit SafeHold and enter a sun-pointing safe mode. This allowed the arrays to be returned to their offset position from the sun line. Full recovery of the Attitude Control processor was achieved by 8:45 PM and the scheduled science plan was resumed within an hour. Exact details surrounding the cause of the processor reboot are not clear, and investigation is difficult since most of the useful diagnostic data was lost in the reboot.

Article by Peter J. Gonzales/ATSC

For more information, please contact Herman Williams at (301) 286-2342 or via email at Herman.A.Williams.1@gsfc.nasa.gov. Additional information can also be found on the World Wide Web at http://heasarc.gsfc.nasa.gov/docs/xte/xte.html

TOPEX/Poseidon Mission Continues

TOPEX/Poseidon space and ground operations have been completely nominal over the last six months. The spacecraft remains healthy and we are hopeful that we will be able to continue the mission through the end of the century. This will provide an overlap with the Jason-1 spacecraft — the follow-on sea surface monitoring mission — which is scheduled for launch in May of 2000.

Science activities continue to add to the growing database of sea-surface measurements. In addition, special observations have recently been made

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of several eastern Pacific hurricanes and the continuing El Nino phenomenon remains under close scrutiny. TOPEX/Poseidon data and images are available from the Physical Oceanography Distributed Active Archive Center (DAAC) at *http://podaac.jpl.nasa.gov*. Both quick-look (latest 8- and 24-hours) and longer-term representations of significant wave height, wind speed, and water-vapor content are available.

Article by Terry Adamski/JPL

More information on the TOPEX/Poseidon spacecraft is available on the Internet at http://www.jpl.nasa.gov/mip/topex.html, or contact the author via email at Terrence.P.Adamski@ jpl.nasa.gov

Extreme Ultraviolet Explorer Project Celebrates Two Anniversary Milestones

On 7 June 1997, NASA's Extreme Ultraviolet Explorer (EUVE) Project celebrated the five-year anniversary of the launch of the satellite back in 1992. During the intervening 5+ years, the satellite has performed exceedingly well and has provided the science community with a wealth of interesting data on a large number of celestial objects. Another recent anniversary of note occurred on 14 September with the completion of six full months of outsourced EUVE spacecraft operations at the University of California, Berkeley (UCB). The UCB Flight Operations Team (FOT) has now fully settled into its new role in controlling both payload and spacecraft, and overall operations have gone very smoothly. Just during the past few months (June-August) EUVE has conducted 71 individual pointings of 35 science targets and a handful of engineering ones; there was also a brief payload reset (due to a bad command load) on 26 June.

Figure 1: TPOCC Front-end Processors at UCB

Five of the recent science targets were especially interesting, but in different ways. The first target, a two-week observation of Comet P/Encke, posed particular challenges for the UCB FOT. In addition to being time-critical and coordinated with the ROSAT and RXTE satellites, this observation was carried out with the three secondary "scanning" imaging telescopes that are mounted 90 degrees away from the primary spectroscopic one. To top it off, the Comet was moving at a brisk pace from EUVE's perspective, which required that the FOT initiate constant pointing adjustments — about 80 total — to keep the Comet's image centered in the telescopes' fields of view.

Four other science targets of interest were "targets of opportunity" (TOO), all transient source locations as detected by the ALEXIS satellite. Of special note was the so-called "ALEXIS Bastille Day Transient" on 14 July, during which — for the very first time — EUVE detected a source very near the reported ALEXIS detection position. This EUVE detection was, in large part, due to the FOT's best-ever TOO response time of only two hours and nine minutes! On 14 August EUVE conducted a follow-up observation of this source, the scientific implications for which are still under review by UCB and ALEXIS scientists.

Shifting gears back to the EUVE outsourcing, work continues at both UCB and GSFC to clean up a number of outstanding items. In early June GSFC delivered to UCB a new EUVE-specific software release (v4.4) for the Transportable Payload Operations Control Center (TPOCC) command and control system. This release, which contained major improvements in command processing, has been fully tested out by the FOT and is now being used operationally as shown in Figures 1 and 2. The GSFC TPOCC development team continues to work on the final GSFC-funded EUVE release, which is expected to be delivered some time later this year.

In mid June UCB software developers completed a major expansion to the "eworks" software system. Eworks is an automated telemetry monitoring and paging system (based on Talarian Corporation's Rtworks package) that UCB has used since early 1995 to transition to single-shift — and later zero-shift — payload operations. The new expanded eworks now fully integrates payload and spacecraft monitoring to support single-shift satellite operations at UCB. Since its initial release, the eworks system has been refined and is now mature, stable, and performing very well.

Figure 2: EUVE Control Center at UCB

Finally, the actual EUVE outsourcing process itself has now been described in two joint GSFC/UCB publications — one led by Kevin Hartnett at GSFC and one by myself here at UCB — to be presented at upcoming conferences. As with all EUVE papers, the abstracts for these papers were recently run in the monthly EUVE Electronic Newsletter (see the WWW address below for subscription information); interested parties can obtain copies of the full papers from either author.

Article by Brett Stroozas / EUVE Mission Flight Director

For more information, please visit the UCB/EUVE WWW site at URL http://www.cea.berkeley.edu or contact the author at (510) 643-7312 or via e-mail at bretts@cea.berkeley.edu

Upper Atmosphere Research Satellite Upgrades Flight Software

September 12, 1997 was the sixth anniversary of the Upper Atmosphere Research Satellite (UARS). Six years significantly surpasses the original design objective of three years. UARS has overcome numerous adversities and still continues to provide science data from eight of the original ten instruments. The UARS Improved Stratospheric and Mesospheric Sounder (ISAMS) instrument failed early in the mission and the Cryogenic Limb Array Etalon Spectrometer (CLAES) instrument reached its predetermined operational life.

UARS was carried to orbit by the Space Transportation System (STS) 48 mission on September 12, 1991. Following activation and orbital checkout, UARS was released at 12:23:06 AM EDT on September 15, 1991 in a 576 kilometer orbit which was subsequently boosted to an operational altitude of 585 kilometers.

A new version of the onboard computer flight software was prepared and then uplinked along with a clock epoch update on September 11, 1997. This flight software, completed and tested by the Flight Operations Team (FOT), corrected minor errors and improved operability, but most importantly, it included a new software processor developed by the FOT. The new processor takes advantage of the satellite Three-Axis Magnetometer data as an input to the attitude control system. This new software will allow the Magnetometer to be used as a backup for the remaining unreliable earth sensor during orbit maintenance maneuvers. The Magnetometer will also serve as an additional input to the control system update filter providing increased redundancy for orbital gyro-error correction.

Science data collection today is somewhat restricted as a result of recent power-system degradation. Innovative operational planning, instrument on-time multiplexing, and development of onboard software power management techniques have contributed to continued and significant instrument operation. In January of 1992, power management became an operational challenge when a battery deficiency was identified, followed somewhat later by a solar array drive anomaly, and finally, the recent loss of one of a three-battery complement.

The current Goddard management team is composed of Mr. Ed Macie, Program Manager; Ms. Debi Knapp, Mission Director; and Dr. Mark Schoeberl, Project Scientist.

UARS has captured 99.9608 percent of the data intended for downlink as of the anniversary date. UARS continues to perform its mission with no indication of additional problems and targets a mission operational goal of many additional years.

Article by: John C. Speer/UARS Flight Operations Team

For more information please visit the UARS Web Page at http://uarsfot08.gsfc.nasa.gov on the WWW, or contact Ed Macie at edward.c.macie@gsfc.nasa.gov

Satellite Telemetry and Return Link

Satellite Telemetry and Return Link (STARLink) mission support for the year appears to have concluded with successful flight support during August. No additional missions are planned until the spring of 1998, due in part to the transfer of NASA ER-2 aircraft 706 and 709 to the Dryden Flight Research Center, which is being accomplished as part of NASA's cost-cutting initiatives. The STARLink Project will remain at the Ames Research Center along with the satellite terminal equipment that was used to transport experimenter data back to the STARLink POCC.

Much was accomplished during the past year including modifications to the ER-2 aircraft and installation of the remote POCC and STARLink Unique Equipment (SLUE) at the White Sands Complex.

Several missions are on the drawing board for the coming year and other missions are expected to be added. Details will be provided in the next issue of *The Integrator*.

The accompanying photo was provided by Tom Kalaskey who has replaced Andrew Roberts as the STARLink Program Manager at Ames. The photo was taken with a Minolta digital camera that is being tested for possible STARLink application.

Article by Joe St. John/ATSC

Additional STARLink mission information is available on the Internet at http://hawkeye.arc.nasa.gov or contact William Webb at (301) 286-3264

NASA ER-2 Aircraft 709 is ready for the day's mission as it sits on the tarmac at AMES. In the background is building 240 which houses the STARLink POCC and on the roof is the AMES earth station antenna which returns STARLink data from White Sands via the STAT MUX. (Photo by Tom Kalaskey / NASA AMES)

Additional Activities of Note

International Space Station Early Communications Transceiver

Since late June, the Early Communications Transceiver (ECOMM XCVR) project has completed major milestones and is progressing toward ECOMM Subsystem integration. The ECOMM system will be stowed in the Shuttle mid-deck lockers on the July 1998 Endeavor (STS-88) flight which will carry the International Space Station (ISS) Node 1 module in the payload bay. GSFC Code 500 is working with Stanford Telecom to provide the ECOMM transceiver to ISS and is performing the critical role of verifying that the transceiver units are TDRSS compatible. In May, following thorough TDRSS compatibility testing at GSFC, the ECOMM XCVR Engineering Unit (EU) was delivered to Johnson Space Center (JSC) for acceptance and integration testing. This test period confirmed many of the same anomalies

that were uncovered at GSFC during functional testing: undesired signal coherency, temperature control anomalies, and elevated phase noise. Test results were documented and presented during the ECOMM XCVR Critical Design Review (CDR) conducted in June 1997. The tests at GSFC and JSC resulted in several design modifications to the Qualification Unit (QU). As a result of these changes and the continuing design evolution of the transceiver to meet the ISS environmental requirements, a Delta CDR was held on September 11 to evaluate design changes.

At the JSC Electronic System Test Laboratory (ESTL), EU #1 successfully underwent acceptance testing, including environmental testing and system testing integrated with the other units of the ECOMM system. Most recently, the EU completed successful radiation testing at the University of Indiana. As a final objective, the XCVR EU #1 will again be integrated with the other components to form a "Functional Equivalent" system and will be interfaced to TDRS for end-to-end testing.

The EU has served its purpose through the rigorous testing and provided valuable insight into the development of the QU. QU enhancements include a redesigned backplane, a new phase noise-reduction board, a modified (noncoherent) frequency plan, and a new temperature control board that will more intelligently react to the ISS Node environment.

The ECOMM XCVR test program will continue through the fall and early winter with GSFC playing an increasing role. One QU and two Flight Units (FU) will be delivered to GSFC for TDRSS compatibility testing similar to that conducted on the EU. The QU will be delivered to JSC for final certification and acceptance testing. GSFC/Code 500 will perform the certification and acceptance testing on the flight units as well as the environmental testing with the support of the GSFC Code 750. Given the aggressive ECOMM integration schedule, performing the environmental testing at GSFC provides the advantage of close proximity to the transceiver vendor and utilizes the extensive experience of the Applied Engineering and Technology Directorate in environmental testing flight hardware. This will provide JSC with the "turnkey" solution to obtaining flight hardware that they desire.

The QU is scheduled to complete GSFC compatibility testing in early November and complete acceptance testing and certification at JSC by January 1998. The testing with FU #1 will begin in November and FU #2 will begin in December. Both flight units will undergo acceptance and environmental testing at GSFC in the early January 1998 time frame. Both units will then be shipped to JSC Engineering in late January for final processing and packing before shipment to Kennedy Space Center for flight stowage.

Article by Ted Sobchak/NASA GSFC, John Smith/LMSC, and Dave Zillig/NASA GSFC

For additional information regarding ECOMM, please contact Ted Sobchak at (301) 286-7813 or via email at Ted.Sobchak@gsfc.nasa.gov

McMurdo TDRS Relay System

The McMurdo TDRS Relay System (MTRS) continues to successfully relay data to the White Sands Complex. Recently, project members completed engineering changes to support the Fast Auroral Snapshot Explorer (FAST) in its southerly campaign. FAST scientists were ecstatic with the MTRS-provided capability of obtaining data in near real time. The MTRS project was also involved in the attempt to maintain contact with the Lewis spacecraft. Additional MTRS engineering changes were implemented very rapidly to allow commands to be sent to the Lewis spacecraft from its Payload Operations Control Center. MTRS successfully supported the Lewis launch vehicle during the first pass and verified spacecraft separation. MTRS also continues to flow RADARSAT 105 Mbps data for reduction at the Alaska Science Facility (ASF). The MTRS continues to function reliably as evidenced by the support described above.

Information from Frank Stocklin/NASA GSFC

For more information, contact Frank Stocklin at (301) 286-6339 or via email at Frank.Stocklin@gsfc.nasa.gov

TDRSS Range-Safety Update

GSFC personnel continue to investigate the feasibility of Space Network (SN) Support to Range Safety. Based on the feedback from the various ranges, we have placed our focus specifically on the ability of the SN/TDRSS to provide the important S-Band Command Destruct services. During the past summer, we completed the "Tactical Guidelines for TDRSS support to Range Safety" document and developed a business case that illustrates the significant cost savings that can be gained by using a space-based platform to cover the down-range command-destruct functions. Most

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recently, we are placing some of the final touches on our "Concept and Feasibility Study" which provides more detail and illustrates the potential for future capabilities. GSFC personnel are conducting an independent study, as are the Eastern Range (45th Space Wing) and the Western Range/ Range Standardization and Automation (RSA) Phase II Teams. The SN option remains in the forefront of these studies because of the system's ease of use and level of performance. Teams will report findings in the near future, but at this time more analysis is required to determine exactly what role the SN's S-Band Command Destruct capabilities may play in the future of Range Safety.

Article by Ted Sobchak/NASA GSFC

For more information, please contact the author at (301) 286-7813 or via email at Ted.Sobchak@gsfc.nasa.gov.

Coming Attractions

Tropical Rainfall Measuring Mission Readies for Launch

The Tropical Rainfall Measuring Mission (TRMM) has reached several new milestones in 1997 since our last report in *The Integrator*. We have completed three mission simulations as part of the Mission Operations Center (MOC) and ground data system certifications, and seven launch rehearsals as part of the launch team training. The combined Flight Operations Review and Operations Readiness Review was conducted July 29 and 30, 1997 and was followed by the Pre-Ship Review on August 6 and 7.

The observatory and the ground support equipment (GSE) were shipped to the launch site at Tanegashima, Japan, during the week of August 18. The shipment process was a massive undertaking. A lot of the GSE and personal belongings of the launch-site teams were shipped by sea transport in six tractor-trailer loads. The observatory and a tractor (to pull the flat bed trailer that carried the observatory) were flown on two C5A aircraft to Japan. From the airport on the mainland, the observatory was ferried by boat to Tanegashima Island and then transported overland to the launch site.

Launch-site personnel are now performing final assembly and touch-up work. The observatory comprehensive performance test was successfully completed. One of the tests included an RF end-to-end test between the observatory and the MOC at GSFC using TDRS. GSFC engineers did an excellent job in supplying and installing the communication equipment at the launch site to make this test possible.

In addition to this test, we have conducted hard-line tests between the observatory and the MOC utilizing dedicated voice and data circuits. Nascom engineers and service personnel provided excellent support in overcoming obstacles to provide voice communication units and data routing units to and from the launch site and to the White Sands Complex.

The next step for the observatory is to move to a special facility at the launch site for fueling and encapsulation of the upper fairing. Following that activity, it will be transported to the launch tower for mating to the launch vehicle.

As of the time of publication, the TRMM launch date slipped from October 31 (EST) to November 18 (EST). The slip was caused by two problems within the companion ETS-VII spacecraft.

Article by Karl Schauer/TRMM Ground System Project Manager

For more information please contact the author at (301) 286-8857 or via email at Karl.N.Schauer.1@gsfc.nasa.gov

EBnet News

In June of this year, the EBnet team established connectivity between an EBnet router at GSFC and an Earth Remote Sensing Data Analysis Center (ERSDAC) router in Tokyo to support the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Ground Data System (GDS). ERSDAC is a Japanese agency which is providing the ASTER instrument for flight on the AM-1 spacecraft. ERSDAC is also providing the ASTER GDS to

perform processing of the ASTER science data. A dedicated 512 Kbps circuit between Greenbelt, MD and Tokyo was installed under a competitively awarded contract with MCI. The primary challenge of this install was the fact that the ERSDAC router and the EBnet router had to support Internet Protocol (IP) multicast. This technology, which allows one sender to send to multiple receivers, is not widely deployed in the router industry. Since we are one of the early customers, the router vendor (Cisco) worked closely with us to wring out problems. Their assistance, coupled with our extensive prototyping in the lab, helped this installation go smoothly. Following installation, the end customer performed some testing which showed that each packet was being incorrectly duplicated. Working closely with our Japanese counterparts, we were able to identify and correct the offending configuration. This connection has been stable since then.

The EBnet team also installed a router at the EOSDIS Core System (ECS) Development Facility (EDF) in Landover, MD to support the mini-Distributed Active Archive Center (DAAC) and the Verification Acceptance Test Center (VATC) DAAC. These two DAACs provide the ECS project with much-needed test capabilities. They allow the developers and testers at the EDF to interact with fielded ECS DAACs at GSFC; Langley; the EROS Data Center (EDC) in Sioux Falls, SD; and the National Snow and Ice Data Center (NSIDC) in Boulder, CO. We also installed routers at the Jet Propulsion Lab (JPL) in Pasadena, CA and NSIDC. The JPL router currently supports the ASTER Instrument Support Terminal (IST) which accesses the ASTER GDS in Tokyo, Japan. The NSIDC router currently supports the ECS DAAC.

The EBnet team is currently installing the EBnet portion of the SvalSat facility in Longyearbyen, on the island Spitzbergen in Norway in support of Phase I of the EOS Polar Ground Station (EPGS) Project. This project provides direct downlink capability for EOS spacecraft at two high-latitude ground stations. One is located at Poker Flats, Alaska and the other is on the island of Spitzbergen, Norway. Phase I of this project provides a primary downlink capability for the Landsat-7 project while also providing contingency downlink capability for the EOS-AM-1 project. The communication service for this contingency support is an EBnet requirement and consists of a T1 multiplexer to provide extension of the clock and data interfaces from the EPGS at SvalSat to the EOS Data and Operations System (EDOS) system located in Building 32 here at GSFC.

In addition, the team is supporting a number of short turn-around contingency actions for various EOS issues, including the installation of a mini-EDOS at Valley Forge, PA. EDOS is the front-end system for the EOS spacecraft. It receives the raw telemetry and performs frame sync, error correction, and Consultative Committee for Space Data Systems (CCSDS) service processing. Once it has recovered the CCSDS packets, it builds level zero data files from the packets and FTPs them to the level zero data customers. In order to support instrument integration and test for the AM-1 spacecraft, a stripped-down version of EDOS will be installed at the AM-1 development facility at Valley Forge, PA. This mini-EDOS will take the raw high rate (150 Mbps) telemetry from the spacecraft and separate out the various instrument teams' data. The instrument teams will connect to EBnet to receive the FTP files directly from the EDOS system at Valley Forge. EBnet personnel are also supporting the installation of EDOS-developed hardware at GSFC to correct problems with the solid state recorder (SSR) on the AM-1 spacecraft. The SSR design introduces deterministic errors into the spacecraft health/safety data. The new hardware corrects these errors prior to CCSDS processing of this telemetry. The team is also supporting deployment of the Moderate Resolution Imaging Spectroradiometer (MODIS) Emergency Backup System (MEBS) which was developed to provide higher-level product processing of MODIS data in light of the inability of the ECS DAAC to provide the required functionality. This system will generate the higher-level products and then share them with the other DAACs and with end customers.

The EBnet team has also been working to update our documentation to accommodate new requirements and additional services that have been implemented. Changes are being made to the EBnet Level II Requirements document; the Interface Requirements Document (IRD), which lists all of the systems which EBnet is required to support; and the Interface Control Documents (ICDs), which document detailed interface designs. The EBnet team is also preparing a Design Update Presentation to present the current status of the EBnet implementation and requirements baseline since our last Design Review in May 1996. All updated documents, as well as the Design Update Presentation, will be available on the EBnet web site described below.

The EBnet web site has been enhanced. In addition to providing all EBnet documentation, we now provide a capability for anyone to examine the EBnet traffic requirements database. The EBnet traffic requirements database contains every known flow assigned to EBnet. You can download our entire traffic requirements baseline or perform queries for specific subsets of requirements (e.g., by spacecraft). The best way to access the EBnet web server is to start from the Nascom web server *(http://skynet.gsfc.nasa.gov)* and then follow the EBnet hyperlinks.

Article by Chris Garman/NASA GSFC

For additional information, please visit the web site described above, or contact the author at (301) 286-6383 or via email at Chris.Garman@gsfc.nasa.gov

Earth Observing System Data and Information System Update

The Earth Observing System Data and Information System (EOSDIS) elements are in the final year of preparation for the launch of EOS AM-1 in late FY98. Major development is in its final stages for every system and formal testing has begun. Key activities and dates for the EOSDIS Elements in the past quarter included:

MILESTONE	DATE
EOS Data and Operations System (EDOS) Version 3 (V3) Demo	6/13
Flight Operations Segment (FOS) Consent-to-Ship Review (CSR) Pt. 1	7/25
FOS CSR Pt. 2	8/20
FOS Release B Release Readiness Review (RRR)	9/2
EOSDIS Core System (ECS) August Demo	8/28
EOSDIS Test System (ETS) Multimode Portable Simulator (MPS) Release 1.2	6/6
ETS High Rate System (HRS) Delivery	6/13
ETS Simulated Consultative Committee for Space Data Systems (CCSDS) Telemetry Generator (SCTGEN)	8/15
ETS Multimode Portable Simulator (MPS) Release 1.3	9/19
EOS Polar Ground Station (EPGS) S-band Installation @ Svalbard Ground Station	6/2
EPGS S-band Installation @ Alaska Ground Station	7/31

Each of these was successful with minor problems and issues raised. Mission system support provided by the NCC and Flight Dynamics Division also met key milestones in this quarter:

MILESTONE	DATE
NCC97/EOS Operations Center Internet Protocol Interface Phase 1 Completion	9/20
FDF/EOS Operations Center Technical Interchange Meeting	8/17

Installation of the flight hardware on the AM-1 (now at Valley Forge, PA) started on July 11 and was completed on September 25.

Major concerns remain over EOS and EOSDIS element schedules and test activities.

Article by Gene Smith/NASA GSFC

For more information, contact the author at gene.smith@gsfc.nasa.gov

South Pole TDRSS Relay To Be Implemented

The South Pole TDRSS Relay (SPTR) "proof-of-concept" venture will be a TDRS relay from the true south pole, allowing scientific data gathered by experiments at the south pole to be sent directly to an experimenter's PC at GSFC. Local scientists will be able to access their experiments at the pole and receive the data in near real time at their desks at rates significantly higher (2-10 Mbps) than currently available. As part of the "proof of concept," TCP/IP protocol will be utilized and demonstrated through the TDRSS for the first time. Currently SPTR is in the implementation stage. Installation is planned for this December/January, with start of operations scheduled for February. This project is being funded by the GSFC Mission to Planet Earth Program Office and implemented by GSFC Applied Engineering and Technology Directorate personnel. Equipment used for SPTR consists of a mix of old, recovered WSGT hardware as well as some new hardware and software. A unique feature of SPTR is that it takes advantage of the high inclination of the "oldest TDRS," TDRS F-1, which has visibility at the pole for approximately 2-3 hours/day. Since the system is being designed for 50 Mbps capability, future upgrades with higher-rate computers are under consideration.

Article by Frank Stocklin/NASA GSFC

For more information, contact the author at (301) 286-6339 or via email at Frank.Stocklin@gsfc.nasa.gov

The Latest on the Earth Observing System Polar Ground Stations Project (EPGS):

- The antennas and associated RF equipment have been installed at Svalbard and Poker Flat.
- Testing and training of on-site personnel is underway.
- Both systems will attempt to shadow track the Total Ozone Mapping Spectrometer/Earth Phase (TOMS-EP) and RADARSAT spacecraft this fall.

Information provided by Dan Elwell/NASA GSFC

Questions concerning EPGS can be directed via email to Dan Elwell at Daniel.W.Elwell.1@gsfc.nasa.gov.

Guam Remote Ground Terminal Nearing Completion

The Guam Remote Ground Terminal (GRGT) is well on its way toward the scheduled acceptance date of June 9, 1998 and an operational date of July 9, 1998. GRGT will replace the current GRO Remote Terminal System (GRTS) in Canberra, Australia, continuing to provide closure of the Zone of Exclusion, while significantly expanding customer service capabilities. GRGT will be an extension of the White Sands Complex (WSC) and will be operated exclusively from the Cacique ground terminal. GRGT will include a single Space to Ground Link Terminal (SGLT) relocated from Cacique, an MA system using equipment relocated from GRTS and newly manufactured equipment — an 11-meter antenna and a 4.5-meter End-to-End test antenna. GRGT will provide S- and Ku-band TDRS Telemetry, Tracking, and Command (TT&C) capabilities; two S-band Single Access (SSA) forward and return links; two Ku-band Single Access (KSA) forward and return links; one Multiple Access (MA) forward link; and two MA return links for customers. The WSC Project Office (WSCPO) at GSFC is managing the implementation of GRGT.

Work has been ongoing since Congress and NASA HQ approved final funding for the project in 1996. After Guam was chosen as the site, Navy SEABEES began demolition, construction, and remodeling efforts. Back in the States, contracts were awarded to various vendors to supply GRGT subsystems including TIW for the 11-meter antenna, Antenna Control Unit (ACU) and the support tower; Lockheed Martin Corporation for the Guam Data Interface System (GDIS) Multiplexer/ Demultiplexer; and AlliedSignal Technical Services Corporation (ATSC) for the manufacture of several system chassis.

MA equipment needed to add MA to the SGLT was shipped from GRTS and integrated into the SGLT at WSC. ATSC has almost completed the manufacture of several new chassis needed to fully populate the SGLT. Also, the Common Time and Frequency Subsystem (CTFS) and the Voice Subsystem assembled by ATSC have been delivered and tested. Most of the SGLT itself has been successfully tested at the subsystem level, and the SGLT will be ready for system testing in October. Also, all software formal testing (except for the DIS portion) has been completed.

The project is currently on schedule, despite a delay in the anticipated delivery date of the GDIS MUX. WSCPO personnel are actively monitoring project activities and replanning to mitigate the risk of the slip to the acceptance date. An Operational Readiness Review for GRGT is scheduled for July 9, 1998.

Meanwhile, project personnel have been actively working to inform the customer community of upcoming GRGT project events. The GRGT Customer Kickoff

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meeting was held at GSFC on July 1, 1997 to discuss GRGT capabilities, schedules, test plans, and configurations. Full customer/network acceptance testing is still scheduled to begin at Guam in late May 1998.

In addition, a Memorandum of Agreement was signed in late summer by NASA and Navy personnel. This document formally establishes the agreement for use of the facility on the Navy complex at Guam.

For more information, please contact Tom Gitlin at (301) 286-9257. You may also want refer to the WSC Project homepage on the Internet at http://wscproj.gsfc.nasa.gov. The Web page has quite a few interesting photos of the progress of the GRGT project!

The Latest on the Merritt Island/Bermuda Reengineering (MBR) Effort:

- Completed the Operational Readiness Review for equipment installed at Bermuda and Ponce DeLeon (PDL).
- Supported two previous Shuttle missions with significant success and some minor problems.
- Continuing to develop remaining software and complete Merritt Island (MILA) implementation. Also need to complete MILA/PDL microwave relay replacement.
- Essentially all hardware under contract – expect to complete project by fall '98.

Information obtained from Frank Stocklin/NASA GSFC

For more information, contact Frank Stocklin at (301) 286-6339 or via email at Frank.Stocklin@gsfc.nasa.gov

International Space Station News

The International Space Station (ISS) Program passed a major milestone as the first U.S.-manufactured component began a year of launch preparations at the Kennedy Space Center (KSC) in Florida. A connecting module called Node 1 is now in the KSC Space Station Processing Facility (SSPF) where it will be joined with two pressurized mating adapters that will serve as the connecting point for the U.S. and Russian station segments and as a docking location for the Space Shuttle. Node 1 will be the first U.S. segment for the station to reach orbit when it is launched in July 1998 aboard the Space Shuttle Endeavour on the STS-88 mission.

Development of the ISS Early Communication (ECOMM) system is progressing at GSFC (See the ECOMM article, page 14). The ECOMM system will provide the ISS early S-band voice, data, and video conferencing capability prior to installation of the baseline S-band and Ku-band Communications and Tracking System. ECOMM is also scheduled for launch on the STS-88 mission.

Currently, the GSFC ISS Test Team is busy working with the ISS Program and contractors to develop test plans for two major TDRSS Compatibility tests of the ISS baseline Communication, Data and Tracking (CD&T) subsystems which will be conducted in CY 1998.

The first TDRSS compatibility test of the S-band and Ku-band Protoflight models is planned for January/February 1998 at the Boeing integration facility in Seattle, WA. The GSFC Compatibility Test Van (CTV) will provide initial Space Network simulation and will provide the RF link to TDRS for radiated tests. Test objectives are to evaluate the functionality of the S-band forward/return link, the Ku-band return link, and compatibility with the TDRS and the White Sands Complex (WSC).

Later in the year (August/November 1998) the Space Network will be a major support element in the second integration test, a performance test of the CD&T Flight Model components. This test, entitled Multi-Element Integration Test (MEIT), will integrate four launch package configurations at the KSC SSPF containing the S-band, Ku-band, and UHF communications systems. This test will evaluate the S/Ku-band FM equipment's interfaces with other subsystems and TDRSS, validate/verify system requirements for end-to-end performance of the CD&T on-orbit configuration, and exercise the data flows to/from the JSC Space Station Control Center and the Marshall Payload Operations Integration Center through the SN.

In addition, the GSFC Mission Management Office continues to work with the European Space Agency (ESA) and National Space Development Agency of Japan (NASDA) in the detailed requirements development for Communications, Data &

Tracking for their resupply vehicles, the Autonomous Transfer Vehicle (ATV), and the H-II Transfer Vehicle (HTV).

The ATV provides the capability to deliver pressurized and unpressurized cargoes with associated containers as well as Space Station modules to the ISS. The ATV uses the services of the Ariane 5 launcher for the launch up to injection into orbit, and then performs all operations up to direct docking to the Space Station. After the time spent attached to the Space Station (up to 6 months), a departure from the Station takes place, followed by a destructive reentry into the earth's atmosphere.

The HTV is an autonomous, unmanned cargo transportation system that will transport pressurized or unpressurized experiment equipment and materials, system equipment, crew items, consumables, etc., to the ISS. It can also dispose of nonrecoverable items upon destructive reentry. The HTV uses the services of the H-II launcher for the launch up to injection into orbit and then performs all operations up to berthing to the Space Station.

Article by David Goff/ATSC, John Smith/Lockheed Martin, and Doug Lumsden/Lockheed Martin

For more information, check out the Human Spaceflight Web site at http://joy.gsfc.nasa.gov/501_MSM/HSD/hsd.html or contact Bob Stelmaszek at (301) 286-5263.

Landsat-7 Spacecraft Development

Landsat-7 is scheduled to launch in July of 1998 from the Western Test Range at Vandenberg Air Force Base, CA on a Delta-II Expendable Launch Vehicle. It is the latest in a series of satellites that have provided a continuous set of calibrated Earth science data to both national and international customers since the early 1970s. The program is a triagency program, established by a Presidential Decision Directive, with unique responsibilities assigned to the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Geological Survey (USGS). Landsat-7, which is part of NASA's Mission to Planet Earth, will provide images of the land surface and surrounding coastal regions to a diverse national and international customer community for global change research, regional environmental change studies, national security uses, and other civil and commercial purposes.

The Landsat instrument, the Enhanced Thematic Mapper Plus (ETM+), has completed its baseline performance tests and Electro-Magnetic Interference / Electro-Magnetic Compatibility (EMI/EMC) testing at the plant of the developer, Santa Barbara Remote Sensing. It was shipped to Lockheed Martin Missiles and Space (LMMS) in early October. At LMMS, it will undergo vibration and thermal vacuum tests prior to installation on the spacecraft. Spacecraft bus integration has been completed. The bus is now undergoing EMI/EMC tests, Comprehensive Performance Tests, and Acoustic testing in parallel with the instrument environmental tests. Integration of the spacecraft bus and the instrument is scheduled for November and will be followed by a complete set of environmental tests.

The Landsat Ground System [Landsat Ground Station (LGS), Landsat Processing System (LPS), Mission Operations Center (MOC), and Image Assessment System (IAS)] being developed by Goddard is proceeding on schedule and will be turned over to NOAA for operations. The MOC has been running a series of compatibility tests with the spacecraft to check out all command and data paths. The LGS antenna and electronic equipment were delivered to the USGS's Earth Resources Observing System (EROS) Data Center (EDC) in Sioux Falls, SD this summer. Unfortunately, a storm with "baseball-size" hail damaged the antenna so badly that it had to be disassembled and is now undergoing repair by the manufacturer (see the Landsat-7 Ground Station article on page 22). This has impacted the schedule for a number of ground system and intersegment tests but will not impact ground system readiness for launch. LPS hardware and software have been installed at EDC. While the LPS has not been declared "operational" it is being used to process instrument data in support of end-to-end verification of wideband data integrity.

The Earth Science Data and Information System (ESDIS) Project will archive the Landsat data at the EDC Distributed Active Archive Center (DAAC) and will, as the Landsat customer interface, take orders and distribute the data.

The Landsat Science Team held their third team meeting in October. The Landsat Technical Working Group, which is made up of the Ground Station Operators from around the world, will meet in Annapolis, MD in November. This meeting will be chaired by our partner, NOAA. The American Society for Photogrammetry and Remote Sensing is sponsoring a conference entitled, "Land Satellite Information in the Next Decade" in Washington, DC in December. At the conference there will be a number of Landsat papers presented, a Landsat booth, and a reception to celebrate the 25th Anniversary of the first Landsat, ERT-1.

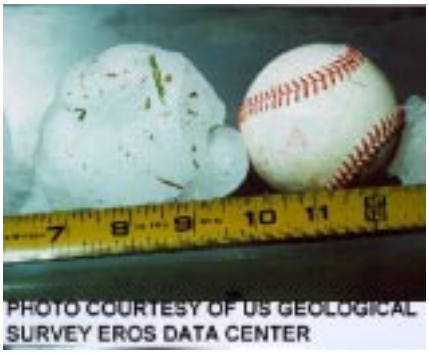
Our ten-minute Landsat video is available for use at conferences, meetings, etc. Call the Landsat Project Office at (301) 286-8536 to borrow a copy.

Article by Ken Dolan /NASA GSFC

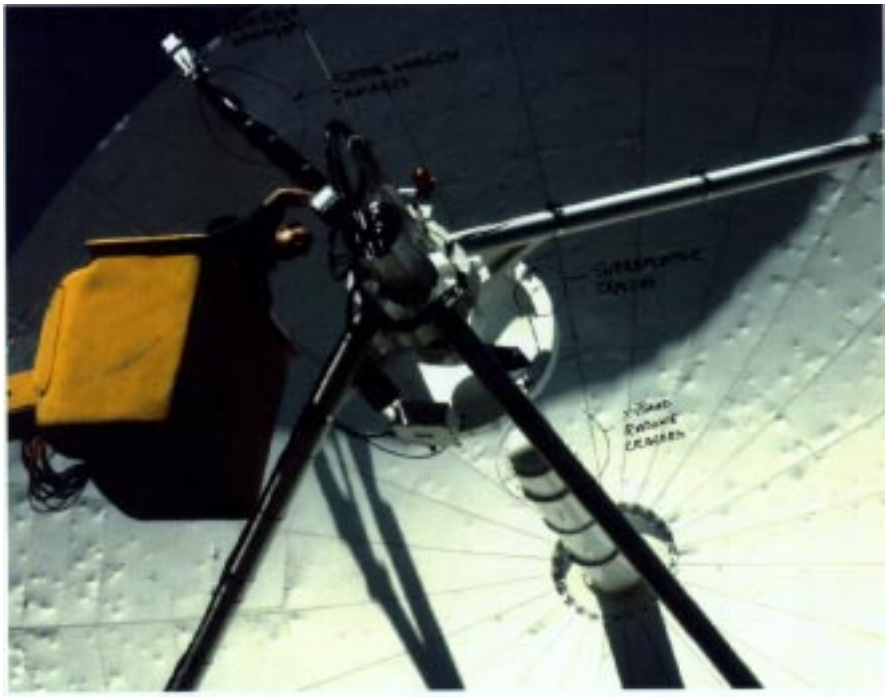
For more information please contact the author via email at stephen.k.dolan.1@gsfc.nasa.gov or visit the Landsat WWW site at http://landsat.gsfc.nasa.gov.

Hailstorm Severely Damages Landsat-7 Ground Station Antenna

On July 13, 1997 a violent hailstorm pounded the Landsat-7 Ground Station (LGS) 10-meter antenna located at the USGS's Earth Resources Observing System (EROS) Data Center (EDC) in Sioux Falls, SD. The chunks of ice, baseball-sized and larger, deformed the main reflector, cracked the subreflector and X-Band feed window, and dented waveguides and cables. The small bore-sight antenna, located on the water tower, was declared a total loss. The hail caused extensive damage to the EDC solar collectors, skylights, and both private and Government cars. Corn in nearby fields was stripped from the stalks and the ground was cratered.



Hail Size in Comparison to a Baseball



LGS Antenna Following Hail Damage

At the time of the storm, the LGS antenna was a week away from Site Acceptance Testing (SAT). The antenna arrived at EDC a few weeks earlier after successfully passing the Factory Acceptance Tests (FAT). Following extensive discussions and negotiations, the antenna vendor was put under contract to repair the antenna.

In early September the LGS 10-meter antenna reflector was dismantled and sent back to the subcontractor for installation of a new reflecting surface. The damaged subreflector, feeds, and cabling were shipped back to the antenna vendor. Following inspection, the components will either be repaired or replaced. The antenna is scheduled for reassembly at EDC in early 1998. The recovery schedule will permit the LGS to be ready before the Landsat-7 launch currently scheduled for summer 1998.

Article by Armen Caroglanian/NASA GSFC

For more information, please contact the author at (301) 286-4340, or via email at armen.caroglanian@gsfc.nasa.gov

First X-38 Atmospheric Vehicle Begins Test Flights

In the early years of the ISS, a Russian Soyuz spacecraft will be attached to the station as a crew return vehicle. But, as the size of the station crew increases, a return vehicle that can accommodate up to six passengers will be needed. The X-38 is such a vehicle. It was designed and built at Johnson Space Center (JSC) to validate technologies required for a future ISS emergency Crew Return Vehicle (CRV), or "lifeboat," which would be delivered to the ISS by the Space Shuttle.

The first captive-carry research flight was conducted from the Dryden Flight Research Center (DFRC) in July. During this flight the X-38 remained attached to a B-52 for approximately two hours, reaching an altitude of 20,000 feet.

The first of many free-flight drop tests of the vehicle, when it will be released at an altitude of 25,000 feet, is planned for the fall 1997. An unpiloted space flight test is scheduled for launch aboard a Space Shuttle in the spring of 2000.

Goddard Space Flight Center will continue to work with the X-38 Project, providing data communications for the test flights to the DFRC and JSC.

Article by David Goff/ATSC

For more information, check out the Human Spaceflight Web site at http://joy.gsfc.nasa.gov/501_MSM/HSD/hsd.html or contact Bob Stelmaszek at (301) 286-5263.

X-33 Test-Range Development

The X-33 will integrate and demonstrate in a scale version all the technologies that would be needed for industry to build a full-size Reusable Launch Vehicle (RLV). About half the size of a full-scale RLV, the X-33 will be a remotely-piloted, suborbital vehicle, capable of altitudes up to 50 miles and speeds of Mach 15.

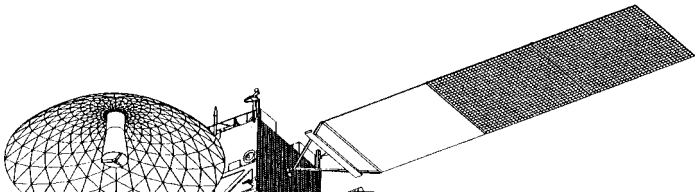
Work continues on defining the X-33 test-range requirements baseline. Goddard Space Flight Center, a member of the X-33 Extended Test Range Alliance Team, which also includes NASA Dryden, the Air Force Flight Test Center (AFFTC) at Edwards Airforce Base, and the Wallops Flight Facility, was recently selected to develop and implement range communication for the proposed X-33 test-range landing sites.

Proposed range landing sites under study are Silurian Lake, CA; China Lake Naval Weapons Center, CA; Michael Army Air Field at Dugway Proving Ground, UT; Moses Lake, WA; and Malstrom Air Force Base, MT.

As many as 15 flight tests of the X-33 are planned to originate from Edwards Air Force Base, CA between March and December of 1999.

Article by Ernie Keith/ATSC

For more information, check out the Human Spaceflight Web site at http://joy.gsfc.nasa.gov/501_MSM/HSD/hsd.html or contact Bob Stelmaszek at (301) 286-5263.



Look for more network news and activities on the world wide web at http://defiant.gsfc.nasa.gov/530homepage.html

The Integrator newsletter can also be found on line at this location in the News/Events section.