NASA
National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Houston, Texas

Lunar base

Transfer and excursion vehicles will be key elements in the establishment of a lunar base. Story on Page 3.

Quality group

The JSC Quality Partnership Award goes to a group instead of an individual for the first time. Story on Page 4.

Space News Roundup

Vol. 29 **February 2, 1990** No. 5

Bush seeks $15 billion '91 NASA budget

Request asks $2.45 billion for space station

By Linda Copley

President Bush has proposed a 23 percent increase in NASA's budget request for fiscal year 1991. The $15.1 billion proposed package includes $2.45 billion for space station, an increase of 40 percent over this year's $1.8 billion, NASA Administrator Richard Truly said Monday.

"FY 1991 will be the year that Space Station *Freedom* makes the critical transition from design to actual fabrication of major long-lead-time hardware," Truly said.

In addition to increased space station funding, President Bush's 1991 federal budget request asks for funds earmarked for the lunar-Mars initiative, and for new programs to study the Earth's environment.

The 1991 budget requests 731 new federal positions agencywide, primarily in the space station and Earth Observing System (EOS) areas, with 35 of those coming to JSC. This brings the number of permanent full-time workers at JSC to 3,625. After other than full-time employees are added to that number, JSC's full-time equivalent (FTE) ceiling becomes 3,740.

"With more than 85 percent of NASA's appropriation going to the private sector, we simply must have the in-house expertise to manage contract performance," Truly said.

Construction of facilities funds requested for

Please see **TRULY**, Page 4

JSC coming to grips with '90 appropriation

By Kelly Humphries

As President Bush announced his plans for next year, JSC budget experts were coming to grips with the impact of fiscal 1990 appropriations on this center.

Congress gave final approval to a $12.3 billion 1990 NASA budget in November, but the full ramifications of that spending plan to JSC have only recently been established.

Overall, JSC should spend $590 million more this fiscal year than it did last year. For fiscal '90, JSC is expected to spend a total of about $3 billion—a 24 percent increase over the $2.412 billion spent here in 1989.

JSC's outlook includes a boost of $410 million, or 128 percent, for Space Station *Freedom*; a modest $82 million increase for the space shuttle, from $1.49 to $1.572 billion; and a doubling of the construction of facilities account, from $21.2 to $42.5 million.

However, a minimal increase in research and program management (R&PM) spending has become the source of some significant belt-tightening at JSC. R&PM expenditures are expected to increase to $318.7 million, an increase of only $17.6 million, or 5.8 percent over 1989.

"Although the JSC budget in its entirety is encouraging, we continue to be concerned with the funding for the institution," said JSC Comptroller Wayne Draper. "Due to the

Please see **BUDGET**, Page 4

JSC Photo by Bob Walck

JSC scientist Herb Zook points to the JSC-developed experiment that flew on the Long Duration Exposure Facility (LDEF). The JSC scientists planning to get up close and personal with LDEF include, from left: Mike Zolensky, Fred Horz, Steve Koontz, Lubert Leger, Zook, Tom See and Don Kessler.

JSC scientists to inspect LDEF

Looking for micrometeoroids on a school bus

By Kelly Humphries

For many people at JSC, the return of the Long Duration Exposure Facility (LDEF) marked the successful conclusion of the latest space shuttle mission.

But five JSC scientists are still waiting to begin their real work with the school bus-sized LDEF, examining every surface and seam after its five-year-plus stay in orbit. Fred Horz, Don Kessler, Steve Koontz, Mike Zolensky and Herbert Zook are chomping at the bit because in the next few days they're supposed to fly to Kennedy Space Center and get their first look.

They're also a little envious of Lubert Leger and Tom See, who have been there a week already, and saw *Columbia*'s payload bay cracked open Tuesday.

The scientists' primary tasks are to document the effects of LDEF's long stay in space and to better understand the near-Earth space environment. Knowing how many natural and man-made particles are up there colliding at cosmic velocities with spacecraft will help spacecraft designers develop

Please see **LDEF**, Page 4

New manifest projects nine missions in 1990

NASA issued a new 1990 Payload Flight Assignments manifest for both the space shuttle and expendable launch vehicles (ELV) on Monday. The manifest plans 64 shuttle and 30 ELV missions through September 1995.

"The principal change, when you see the new manifest, is that we are going to put the Gamma Ray Observatory (GRO) mission to follow Ulysses," said NASA Administrator Richard H. Truly. "The reason for that is not a low priority for the GRO mission, but the fact that we have made a commitment to the solar window for the Ulysses mission. By 1992 or so, we'll be back to the same essential manifest that we published last summer."

Moving GRO from June to November will preserve the 19-day launch window for Ulysses, a joint ESA/NASA mission to send a spacecraft around the Sun's poles. The Space Shuttle *Discovery* must be launched during that window, which opens Oct. 5, to avoid waiting 13 months before another opportunity opens.

On a calendar year basis, there are nine shuttle launches planned in 1990, including the recently completed STS-32, eight in 1991, 12 in 1992, 13 in 1993 and 11 in 1994 and 1995.

Remaining shuttle launches in 1990 include a dedicated Department of Defense (DOD) mission on *Atlantis* on Feb. 22; launch of the Hubble Space Telescope aboard *Discovery* on April 18; the May 9 launch of *Columbia* with the Astro-1 payload; another dedicated DOD mission in July aboard *Atlantis*; the Spacelab Life Sciences-1 mission on Aug. 29 on *Columbia*; the Ulysses launch on Oct. 5; the Nov. 1 launch of Gamma Ray Observatory aboard *Atlantis* and the International Microgravity Laboratory flight Dec. 12 aboard *Columbia*.

The 64 flights carried in the shuttle manifest have *Columbia* and *Discovery* each making 16 missions, *Atlantis* flying 17 times, and *Endeavour* being launched 12 times. Six of *Columbia*'s missions, beginning with the March launch of the U.S. Microgravity Laboratory-1 mission, will be extended duration, lasting 13 or 16 days.

The first flight of *Endeavour* will be February 1992 carrying Geostar and Eureca. First element launch of Space Station *Freedom* is planned for March 1995 aboard *Endeavour*.

1990 Shuttle Manifest

STS-36 *Atlantis*
2-22-90 Department of Defense

STS-31 *Discovery*
4-18-90 Hubble Space Telescope

STS-35 *Columbia*
5-9-90 Astro-01, Broad Band X-Ray Telescope

STS-38 *Atlantis*
7-9-90 Department of Defense

STS-40 *Columbia*
8-29-90 Space Life Sciences-01

STS-41 *Discovery*
10-5-90 Ulysses

STS-37 *Atlantis*
11-1-90 Gamma Ray Observatory

STS-42 *Columbia*
12-12-90 International Microgravity Laboratory

Payload commanders named; Carter gets Cleave's mission

By Jeff Carr

In a move to provide long-range leadership in the development and planning of payload crew science activities, four currently assigned space shuttle mission specialists have been designated payload commanders.

The payload commanders will have overall crew responsibility for the planning, integration and on-orbit coordination of payload/space shuttle activities on their missions. The crew commander will retain overall responsibility for mission success and flight safety.

Norman E. Thagard, M.D., has been chosen as payload commander for STS-42, the first flight of the International Microgravity Laboratory (IML-01) set for late 1990. In addition, Navy Capt. Manley L. "Sonny" Carter, M.D., has been named as a mission specialist on the IML crew, replacing Mary L. Cleave, Ph.D., who has resigned her flight assignment for personal reasons.

Kathryn D. Sullivan, Ph.D., will serve as payload commander for STS-45, the first flight of the Atmospheric Laboratory for Applications and Science (ATLAS-01), slated for launch in 1991.

Payload commander for STS-46 is Jeffrey A. Hoffman, Ph.D. The STS-46 mission, set for 1991, will feature the first flights of the European

Please see **PAYLOAD**, Page 4

Astronaut Norm Thagard will be the first payload commander when he flies on STS-42, the International Microgravity Laboratory mission.

Needed repairs shouldn't delay launch of *Atlantis*

By Kyle Herring

Launch of *Atlantis* on its Department of Defense mission Feb. 22 remains on schedule despite the required replacement of components on the solid rocket boosters (SRBs) and a main engine.

A small depression found in one of the two gasket seals on an SRB recovered from the STS-32 mission last month led shuttle managers to decide to replace those on the pad for STS-36. The managers were unable to find conclusive paperwork that an inspection of the seals had been properly performed.

Also, the high pressure fuel turbopump on space shuttle main engine (SSME) number 3 aboard *Atlantis* will be changed out because paperwork indicates larger-than-allowable weld defects were not fixed. Work to change out the pump began yesterday.

Carl Kotila, SSME engineer here at JSC, said the pump will be replaced as a safety precaution because the paperwork does not indicate the weld repair was made.

The replacements are not expected to affect the planned launch date or in remaining work schedule leading

Please see ***ATLANTIS***, Page 4

STS-36

JSC

Ticket Window

The following discount tickets are available for purchase in the Bldg. 11 Exchange Gift Store from 10 a.m. to 2 p.m. weekdays.

General Cinema (valid for one year): $3.75 each.

AMC Theater (valid until May 1990): $3.50 each.

Sea World (San Antonio, year long): adults, $17.25; children $14.75.

Barefoot in the Park (8:15 p.m., Feb. 2, 3, 9, and 16; League City Civic Center): adults, $6; students, $4.

Harlem Globetrotters (2 p.m., Feb. 3, Summit): $8 each.

Sesame Street Live (10:30 a.m., Feb. 24, Summit): $7 each.

JSC Evening Sea Adventure (5:30 p.m.-3 a.m., Feb. 3, Europa Cruise Line out of Galveston; transportation from JSC parking lot J-2 to dockside and return; full casino; dining and entertainment included): $65 each.

Go Texas Bus Trip (1:30 p.m.-midnight, Feb. 24, Astrodome, includes bus trip, refreshments, Houston Livestock Show and Rodeo admission, Chutes Corral Club admission, Ricky Van Shelton concert): $13.

JSC

Gilruth Center News

Sign up policy—All classes and athletic activities are first come, first served. To enroll, you must sign up in person at the Gilruth Recreation Center. Everyone will be required to show a badge or EAA membership card. Payment must be made in full at the time of registration. Classes tend to fill up four weeks in advance. For more information, call x35789 or x30304.

EAA badges—Dependents and spouses may apply for a photo I.D. 6:30-9:30 p.m. Monday-Friday.

Defensive driving—Course is offered from 8 a.m.-5 p.m., March 17 and April 21; cost is $15.

Weight safety—Required course for those wishing to use the Rec Center weight room. The next classes will be from 8-9:30 p.m. Feb. 8 and Feb. 22. Cost is $4.

Ballroom dance—Professional instruction in beginning, intermediate, and advanced ballroom dancing. Classes begin March 1, and meet every Thursday for 8 weeks. Beginning and advanced classes meet 7-8:15 p.m., intermediate class meets 8:15-9:30 p.m. Cost is $60 per couple.

Taekwondo/hapkido—Classes in the Korean art of self-defense, and mental and physical discipline are held Tuesday and Wednesday nights. The next session starts Feb. 6; cost is $40 monthly.

Low-impact aerobics and exercise—Each eight-week session runs twice a week from 5:15-6:15 p.m. Cost is $24.

Country and Western dance—Six-week session begins March 12. Lessons are held each Monday night. Cost is $20 per couple.

Softball sign-ups—Summer softball league sign-ups will be held the week of Feb. 20 at the Rec Center.

JSC

Dates & Data

Today

Cafeteria menu—Special: tuna and noodle casserole. Entrees: broiled codfish, fried shrimp, baked ham. Soup: seafood gumbo. Vegetables: corn, turnip greens, stewed tomatoes.

Saturday

Child care lottery—Space Family Education Inc. will conduct a lottery to select the initial children for the JSC Child Care Center at 10 a.m. Feb. 3 in the Gilruth Recreation Center ballroom. Registration will begin at 9:30 a.m. The 62 slots will be allocated randomly with civil servants' children selected first, followed by on-site contractors' children. For more information, call Mike Evans, x37667, or Lori Beauregard, x36600.

Monday

Cafeteria menu—Special: meatballs and spaghetti. Entrees: wieners and beans, round steak with hash browns. Soup: chicken noodle. Vegetables: okra and tomatoes, carrots, whipped potatoes.

Tuesday

ASQC to meet—The American Society for Quality Control will meet at 6 p.m. Feb. 6 at the American Host Hotel on NASA Rd. 1. For more information, contact Ray Swindle, x33808.

Space station conference—A conference on "Space Station Evolution: Beyond the Baseline," sponsored by NASA Headquarters' Strategic Plans and Program Division will be Feb. 6-8 at the South Shore Harbour Resort and Conference Center. Registration is $75 for federal employees, $200 for non-federal, academic and international attendees, and $70 for students. Contact Carla Armstrong at x39071 for more information.

Cafeteria menu—Special: fried chicken. Entrees: beef stew, shrimp creole, sweet and sour pork chop with fried rice. Soup: beef and barley. Vegetables: stewed tomatoes, mixed vegetables, broccoli.

Wednesday

Astronomy seminar—The JSC Astronomy Seminar will present a videotape of Dr. B. Tully, University of Hawaii, discussing the "Large Scale Structure of the Universe" at noon Feb. 7 in Bldg. 31, Rm. 193. Call Al Jackson, x33709, for more information.

Cafeteria menu—Special: Swiss steak. Entrees: fried perch, New England dinner. Soup: seafood gumbo. Vegetables: Italian green beans, cabbage, carrots.

Thursday

Cafeteria menu—Special: stuffed bell pepper. Entrees: turkey and dressing, enchiladas with chili, wieners and baked beans. Soup: cream of chicken. Vegetables: zucchini squash, English peas, rice.

Feb. 9

Astronomical society—The JSC Astronomical Society will present a program entitled "Beginning Astrophotography" at 7:30 p.m. Feb. 9 at the Lunar and Planetary Institute. For more information, call Bill Williams at x33849 or 339-1367.

Call for abstracts—The Joint Applications in Instrumentation, Process and Computer Control conference (JAICC '90) is seeking abstracts. Deadline is Feb. 9. The conference, sponsored by the local IEEE and ISA sections and the University of Houston-Clear Lake, is scheduled for March 22. For more information, call John Schuessler, 280-1520, Aamer Rizvi, 333-7282, or Dr. Joe Giarratano, 283-3874.

Cafeteria menu—Special: Salisbury steak. Entrees: baked scrod, broiled chicken with peach half. Soup: seafood gumbo. Vegetables: cauliflower au gratin, mixed vegetables, buttered cabbage, whipped potatoes.

Feb. 10

Valentine dance—The Employee Activity Association (EAA) will hold a Valentine Dance at 7 p.m. Feb. 10 in the Gilruth Rec Center ballroom. Two bands, the Sterling Silver Orchestra playing Big Band music, and Kendrick playing rock, country, and request tunes, will be featured. Tickets cost $12.50 each, and include dinner and cocktails. Contact Dick McMinimy, x34037, for information.

Feb. 12

AIAA lecture seminar—The Houston Section of the American Institute of Aeronautics and Astronautics (AIAA) will present a Guidance, Navigation and Control Invited Lecture Seminar from 8 a.m.-5:30 p.m. Feb. 12 at the Gilruth Rec Center. Admission is $25 for AIAA members, $30 for non-members, and $10 for students, and includes lunch and a copy of the proceedings. Reservations must be made by calling Chris Burmeister at 333-6866 by Feb. 7.

Feb. 27

BAPCO to meet—The Bay Area PC Organization will meet at 7:30 p.m. Feb. 27 at the League City Bank and Trust. For more information, call Earl Rubenstein, x34807, or Ron Waldbillig at 337-5074.

JSC

Swap Shop

Swap Shop ads are accepted from current and retired NASA civil service employees and on-site contractor employees. Each ad must be submitted on a separate full-sized, revised JSC Form 1452. Deadline is 5 p.m. every Friday, two weeks before the desired date of publication. Send ads to Roundup Swap Shop, Code AP3, or deliver them to the deposit box outside Rm. 147 in Bldg. 2.

Property

Galveston Mardi Gras, seawall accommod., Feb. 11-17, sleeps 6, $250 per night or $1,000 for wk. Sarah, 283-5659 or 482-0815.

Sale: 25 acres, 4 mi. from Alvin, 1,200 ft. road frontage, good fence, lg. barn, water, well w/ pump, $3,800/acre. 585-8035.

Sale: Fairmont at Beltway 8, 3-2-2, 5 yr. old, $5K down, assum. $661/mo. Susan, 282-3868 or 487-9276.

Sale: League City, Ellis Landing, 5-2.5-2, 2,650 sq. ft., FPL, new A/C's, assum., $95K. Joe, 332-1205.

Sale: El Lago rental prop., 4-2-2, assum. note, $79,900. 532-4237.

Trade: Custom canyon view, 4-3, west of Austin, prefer 5-yr.-old, open plan within 20 min. of JSC. 471-8795 or 333-6083.

Sale: Baywind I condo, 1 BR, new A/C, upgraded carpet, overlooks pool, $25,900, OBO. Mike, 488-0984.

Lease: El Dorado Trace, lg. 1 BR condo, two balconies, all appli. full-size W/D, alarm sys., cov'd. pkng., no pets, $425 plus dep. Mark, x30131 or 332-2411.

Rent: Ski Heavenly Valley at Lake Tahoe, NV, 2 BR condo, 3/26 to 4/2, $350 for week. Tom, x38298 or 488-4089.

Sale/Lease: Nassau Bay townhouse, 4-2-2 over 2K sq. ft. w/2-story den, deck, atrium, FPL, oversized gar., $995/mo. or $109/900. Jerry, x38922 or 488-5307.

Sale: Lake Country brick 2-story, 4-2.5-2, formal LR w/FPL, wet bar, game room w/walk-in wet bar, garden bath w/jacuzzi, island kitch. w/JennAir range, $159K. 282-2958 or 532-2129.

Sale or 1/2 for lease/rent: Austin duplex 2-1, carport, fenced backyard, FPL., $390/mo. Karl, x31236 or 554-6180.

Sale: Lg. lots, excl. subdiv., near NASA, mid $30's, can fin. Don, x38039 or 333-3313.

Sale: 1 1/4 hr. west of Houston, Country Restaurant, well estab., 3 BR home on 3 acres, Pecan trees, $175K. Gene, x33016 or (409) 732-6321.

Sale: Seabrook, 3-2-2, both formals, lg. den w/FPL, 1,800 sq. ft., remod. w/new A/C, heater, roof, int., deck w/spa, never flooded, $67,500, $4K total move-in. Richard, x30271 or 474-9334.

Lease: Webster, El Dorado Trace, lg. 2-2.5 townhome, FPL, W/D, ceiling fan, no pets, $575/mo. plus dep. Joe, 483-0255 or 480-5470.

Sale: Pebblebrook, 1 BR condo, W/D, 700 sq. ft., new carpet, paint, $25K. 480-3613.

Sale: 60 acres, 3 mi. from Karnes City, TX, on Hwy. 80, 50 mi. from San Antonio; El Campo, TX, 2-story house on 1.5 lots. 783-9164.

Rent: Hwy. 3 in Dickinson, mobile home lot, $70/mo. 282-2802 or 332-0365.

Sale: Ganado, TX, 1.5 acre lot, 5 min. from Lake Texana, $6K. 335-1250.

Cars & Trucks

'81 Ford Bronco, full-size w/remov. top, 4x4 w/mudders, rebuilt 351, auto, AM/FM, new carpet, seat covers, and gas tank, $2,800, OBO. Richard, x30271 or 474-9334.

'85 Toyota MR2, silver, tailfin, loaded, 5-spd., 54K mi., $6,500, OBO. Cindy, 779-4515 or Darwin, x32142.

'81 Mazda RX7 GSL, loaded, new tires, $3,450. John, x38178 or 482-5837.

'86 Toyota PU, custom paint, $4,250. John, x38178 or 482-5837.

'83 Chevy Caprice sta. wag., 2-tone blue, maint. and repair records, shop manual, 96K mi., $2,295. Jim, x30038 or 488-3353.

'79 Buick s.w., 350 V-8, new tires, batt., alt. hoses, more, radiator and carb. rebuilt, must sell. 333-6558 or 339-1337.

'88 Hyundai Excel SE, 2-tone, sunroof, 22K mi., $1,200, OBO. Kim, 283-6150.

'81 Honda Accord, A/C, auto., 4-dr., $1,900. 485-8852 or Janice, 799-5325.

'80 Bronco XLT, blue/white, 8K mi., 351 V8, $3,995. 483-2754 or 559-2415.

'83 Buick Regal, one owner, $3K. Mariann, x39238 or 332-7574.

'88 Acura Integra RS, standard, 5-dr., blue, cassette, tint, low mi., $10,300.

'83 Honda Accord, 4-dr., tan, PS, PB, AC, AM/FM stereo, $3,200. Tina, x30725 or 326-2540.

'65 Olds Starfire sport coupe, classic values, $3K restorable, $8K restored, 106K mi., orig. owner, $3,500, OBO. Tom, x38298 or 488-4089.

'83 Toyota Celica GT, lift-back, 3-dr., orig. owner, brn., $4,100. x31598 or 472-2163.

'84 Honda Civic, 4-dr. sedan, auto., A/C, AM/FM/cass., tint. wind., $3,800. Vic, 334-2335 or 282-3216.

'86 Buick Regal, auto., AC, PS, PB, $6,250. x30443.

'84 Nissan Sentra Coupe, 2-dr., AM/FM/cass., A/C, 5-spd., gar. kept, 39,500 mi., orig. owner, $3,200. 476-5711.

'84 Ford Ranger V6, 55K mi., $3,300. Shayla, x30167.

'84 Ford F-150 PU, 302-V8, AC, PS, PB, auto., tilt, new tires, 53K mi., $4,950. Musgrove, x38356 or 488-3966.

'71 Bata VW bug, runs, new brakes, $800. 482-7835.

'76 VW bug, AM/FM w/tape, runs good, $1,800. 282-4623.

'78 BMW 320i, 4-spd., AC, $2,560, OBO. 996-8022.

Cycles

Women's 3-spd., $15; men's 10-spd., $30. 333-6558 or 339-1337.

26" men's trailblazer, 10-spd. mountain bike, $65; 26" women's open road 10-spd. mountain bike, $65. 474-5558.

Boats & Planes

Sabot (wooden shoe) sailboat, 7.5' long, good for children, $125. x30038.

16' Hobie Cat w/Tequila Sunrise sails, galv. trlr. and UV protective cover, $2,500. 333-5811.

16' Hobie Catamaran sailboat w/trlr., $800. Joe, 483-8496 or 480-6975.

OMC control unit w/16" cables, never used, $125. 332-0365 or 282-2802.

'77 27' Columbia sailboat 110, 150, Spinnaker, VHF, FM, inbd., new teak, $14K. 480-3613.

Audiovisual & Computers

Complete C-64 computer sys., C-64, one disk drive, one tape drive, one animation station (digitizing pad), two joysticks, icon-controller, modem, printer interface (no printer), and many programs and ROM cartridges, $550. Brad, 282-3570.

2 MTX computer spkr. boxes w/handles and tweeters, fits 10" and 5" midranges, $20/ea. 482-7835.

ITT XTRA IBM compat., 80286 processor (XT compat.), 640K, 30 Meg hard disk, monochrome, very fast, $850. Michael, x34378 or 486-4983.

Zenith console AM/FM/8-track/phono stereo, $125, OBO. 538-1989.

TI 994A computer game cartridges and access. Irv, x36461.

Stereo system, Sansui receiver, Fisher dual cass., JVC spkrs., $275. Dave, x32592 or 482-6673.

IBM 10 MHZ XT compat. computer, 640K, new 10 Meg hard disk, 360K floppy, 101 keyboard, amber monographics monitor, baby AT case, SER/PAR/game/clock, 2400B modem, manuals, $500. 487-3799.

Color monitor for Apple IIe. Tino, x30725.

Household

Waterbed, black lacquer, smoked glass hdbd. w/mirror, heater, $250, OBO. 282-5500 or 488-3330.

Executive size, solid oak desk, $125. Mike, 280-4330 or 332-0289.

19.3 cu. ft. upright commercial freezer, manual defrost, $400, OBO. 282-4618.

Sears 19" color TV w/remote, $225. Dave, x32592 or 482-6673.

LR furn., price nego. x32060 or 488-5437.

Corelle dish set, white w/yellow trim, 8 lg. and 8 med. size plates, 4 bowls, 4 cups and saucers, $15. 486-8716.

Sealy queen-size matt., box springs, frame, and solid oak hdbd., 4 yrs. old, used 18 mos., $425. Laurie, x33748 or David, 283-5374.

Whirlpool elec. dryer, works fine, $100, OBO. x38520 or 332-1614.

RCA 25" color TV w/remote control. 280-8394 or 488-1083.

Contemp. solid oak king size waterbed w/ six drawers, mirrored hdbd. w/matching highboy and nightstand, $850. 282-3985 or 488-0151.

Scandinavian style entertain. center, $250; Magnavox 25" color TV, $175; rust colored high-back recliner, $150. 282-3985 or 488-0151.

Musical Instruments

Alto sax w/case, COM 20mm, $500. Angie, 534-2985.

Piano, upright, ex. cond., $600, or trade for exer. station or Soloflex machine. Glenn, 333-4743 or 660-9526.

5'10" Grand piano, polish ebony, 4 mos. old, 10-yr. full warr. transferrable, $6,500. Joe, x32099 or 946-8198.

Bundy plastic clarinet, used 9 mos. hard case incl., exc. for school band use, $350. Philip, 488-5969 or 480-9576.

Very rare CG Conn E-flat sopranino sax, $950; Bundy alto sax, good student horn, $150; rare Wurlitzer C-Melody sax, interesting horn, plays well, $350; Buescher PRO model tenor sax, plays well, $400; King Zephyr bari sax, plays well, ex. cond., $450. Karl, 944-8717.

Very rare double-belled euphonium, interesting and unusual horn, plays well, $400; cornet, $75; Conn trombone, $150; soft big bag for trumpet, $40. Karl, 944-8717.

Lost & Found

Found 1/16/90, football in Rec Center vicinity, identify and its yours. Steve, x30419.

Lost bifocal sunglasses. 333-6083.

Photographic

Canon 35mm camera w/AEC, $75; Sears elec. corr. typewriter, $50. x38520 or 332-1614.

Yashica FR II SLR camera w/two lenses (ML 50mm, ML 28mm), flash and cases, $195. Gene, x33016 or 534-2372.

Fujica ST-701 SLR 35mm camera, f1.8 lens, Spiralite elec. flash, $40, OBO. 486-8266.

Pets & Livestock

White cat, female, about 1 1/2 yrs. old, med. long hair, lovable, free to good home. 282-4148 or 479-6315.

AKC Chihuahuas, shots, wormed and dipped, $100 to $200. Irv, x36461.

Sociable black cat needs home w/no other cats. Dave, 283-5763 or 947-7964.

German Shepherd, Heidelburg, AKC, female, 10 wks., blk./tan, champion sired, $400, nego. x36474 or 482-4219.

Cocker spaniel pups, 1 buff and 2 white/buff males, 2 white/buff fem., mother has papers, father has none, both are purebred, avail. after Feb. 1, $30/ea. John, 472-7779.

Wanted

Roommate, 3-1.5-2, CLC, pref. fem., non-smoker, $250 plus 1/2 util. Connie, x31344 or 480-2466.

Someone to share 2 BR, rec. renov. house off Egret Bay Blvd., $210 plus 1/2 util. Rick Davis, x36042 or 332-7695.

Nonsmoker to carpool from SW Houston, Bissonnet and Hwy. 59 to JSC, hrs. 7:30 to 4:00 or 7:30 to 4:30. x38072.

Roommate for Nassau Bay townhouse, 2-2.5, W/D, $200 plus 1/2 elec. Jim, x32508 or 333-2238.

Roommate for 2-2 apt. in Seabrook, $250/mo. plus 1/2 util., 5 min. from JSC, W/D, sec. gate. Kathy, x32021 or 326-3801.

Miscellaneous

Teen boy's clothes, Levis, OP, Gotcha, Quicksilver, pants, shorts, etc., ex. cond., sz. 14S and larger. 480-7194 or 283-5387.

Pink Rose "Climbing Old Blush", 1 gal., on its own roots, $5. 996-8020.

Antiques: Quilts, heavy wooden wheel chair, iron bed, sewing mach., walking plow, 1847 Wm. Rogers Silverplate, 8 pc., set of 56 plus 7 extra pcs. 783-9164.

Mike Myers 5'8" twinfin surfboard, $150. Richard, 483-0415 or 480-0524.

Smith Corona typewriter, model #250 SD, like new, w/built-in spellwrite, dictionary and expand. memory, $200. Richard, 483-0415 or 480-0524.

Antiques: Singer treadle sewing mach., $125; walnut parlor pump organ, $600; church organ, $800. 943-2208.

Full size pinball mach., $150; Gestetner color offset printer, $150; IBM typewriter, $30. 943-2208.

Sofa chair, loveseat, lt. blue, $150; queen sz. bed, $180; DR table and 4 folding chairs, $90; office desk, $50; 25" color TV, $90; 52" ceiling fan, $30; barbecue grill, $40. x36091 or 333-5326.

Mistral windsurfer, beginner and intermed. board, extra Gaastra speedsail (6.8), $290; men's bike, $10. x36091 or 333-5326.

Western tan cowhide fringe coat, size 40, made in U.S.A., $79, OBO. Boyd, 488-8806 or 482-5274.

Rowing mach., $60, OBO; queen sz. box springs/matt., $100, OBO. x38918 or 482-9447.

Airline ticket, Delta Airlines, Houston to Orlando, FL, on Feb. 15/return on Feb. 20, $250, OBO. Dave Cree, x38370.

2 Pan Am ticket vouchers for Cont. U.S., Latin Am., Carib., Hawaii, BO. 282-2806 or 955-0866.

Satellite, 10' alum. antenna, MA/COM receiver, positioner, descrambler, chaparral polarotor, cables, instr. books, was $2,500, now $1,200. 472-4667.

DP rowing machine, $40; 3 twin box springs, matt. and frame sets, $40/set; one twin wicker hdbd., $40; king size bed, 6-drwr. dresser and mirror, $150; weight bench, $7. Lee, 996-0921.

Men's 14K chain link bracelet, $100. Linda, 480-3909.

Phone Mate telephone and answering mach., $80; Fisher Price children's kitch. w/dishes, $50; big wheel, $20; girls' bicycle w/training wheels, $30. Joe, x35896 or 488-7982.

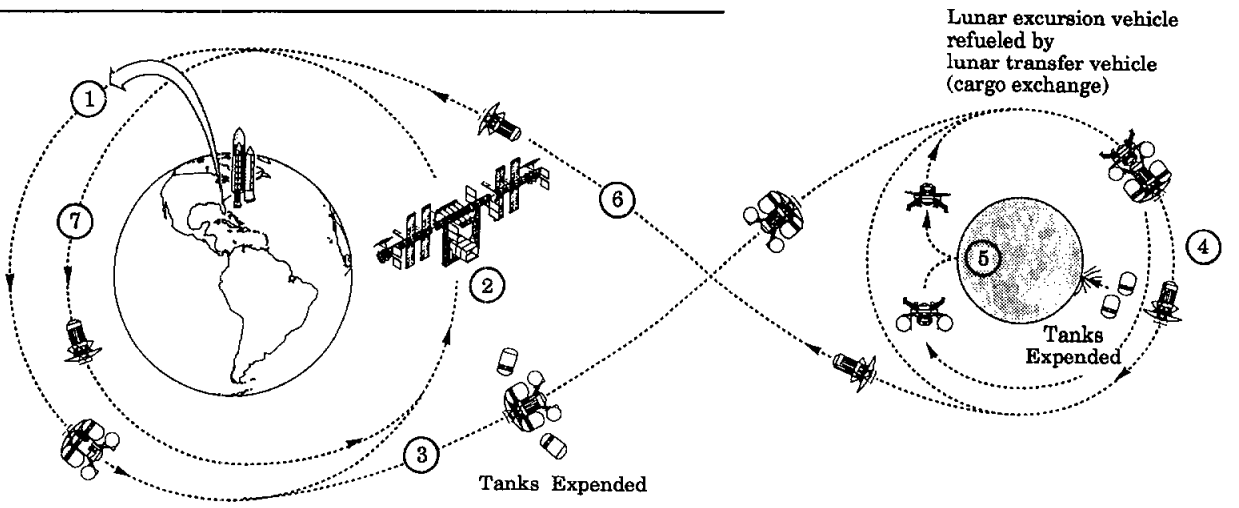
Heavy-duty Italian bar, 8' long, $250; four upholstered bar stools, $25/ea.; student desk, $35; Amana Touchmatic II microwave, $100; kit table w/4-padded chairs, $90. Larry, x33168 or 488-7460.

New windows, light fixtures, and decor. cabinet pulls. Don, x38039 or 333-3313.

Scuba dacor mask, 3-view, silicon skirt, used only once, w/case, $47, OBO. Darwin or Youm, 483-2142.

Vehicles are key to lunar outpost development

The Human Exploration Initiative



1. Payload Delivered to Space Station *Freedom*
2. Lunar Transfer Vehicle Mated with Payload at *Freedom*
3. Trans-Lunar Phase with Lunar Transfer Vehicle
4. Lunar Transfer Vehicle Rendezvous with Lunar Excursion Vehicle from Moon
5. Excursion Vehicle Returns to Moon with Payload
6. Trans-Earth Phase with Transfer Vehicle
7. Transfer Vehicle Aerobrake Maneuver and Return to *Freedom*

(Editor's note: This is the fourth installment in a series of articles summarizing the Report of the 90-Day Study on Human Exploration of the Moon and Mars. JSC Director Aaron Cohen directed the study, which was completed in November. Excerpts will continue next week.)

LUNAR OUTPOST

The next step in the strategy is the development of a permanent lunar outpost, which begins with two or three launches of the lunar payload, crew, transportation vehicles, and propellants from Earth to Space Station *Freedom*. At *Freedom*, the crew, payloads, and propellants are loaded onto the lunar transfer vehicle that will take them to low lunar orbit. The lunar transfer vehicle meets in lunar orbit with an excursion vehicle, which will either be parked in lunar orbit or will ascend from the lunar surface, and payload, crew, and propellants are transferred. After the excursion vehicle descends to the lunar surface, the transfer vehicle will return to *Freedom*. The transfer vehicles will be serviced and maintained at *Freedom*, and the excursion vehicles will be serviced and maintained at the outpost. Facilities will be provided at the outpost site to maintain the excursion vehicle during the crew's stay on the surface, which can be as long as one year.

Missions to the Moon fall into two categories: piloted and cargo. A piloted mission delivers a crew of four and some cargo to the lunar surface and returns a crew of four and limited cargo to *Freedom*; a cargo mission delivers only cargo, and the vehicle is either expended or returned empty. The missions use common transfer and excursion vehicles: the piloted missions add a crew cab for personnel transfer, and cargo missions use only a cargo pallet. The vehicle for cargo missions can be expended, which increases the payload delivery capability to the lunar surface. For piloted flights, the transfer vehicle employs an Earth-to-Moon trajectory that allows the crew to return safely to Space Station *Freedom* if necessary.

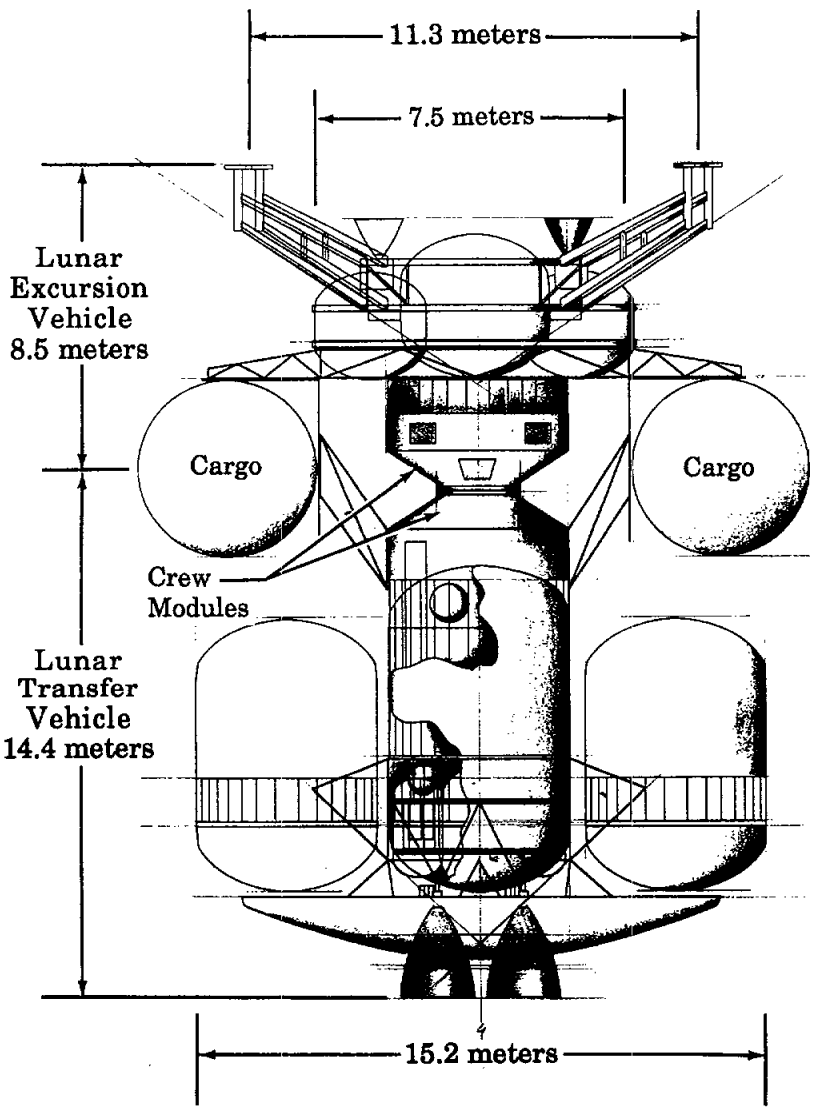
EMPLACEMENT

Emplacement of the lunar outpost begins with an unmanned cargo mission that delivers the first elements to the selected outpost site and is also an extensive flight test of the lunar transportation system. It is flown as a partially loaded mission, delivering an unpressurized manned/robotic rover and the equipment necessary to prepare the outpost site and off-load payloads from the excursion vehicles. The rover, which will initially be operated telerobotically, will enable the study of subsurface characteristics and aid in determining where the outpost will be located. The second flight to the Moon is also a cargo mission, which will deliver the initial permanent habitation facilities: a habitation module, airlock, power system, and associated support equipment.

The first two cargo missions will be followed by a piloted mission with a crew of four, who stay on the lunar surface for up to 30 days. This crew will check out the habitation module and associated support systems and use the rover to conduct geologic traverses and to emplace scientific instruments, including the first few elements of astronomical telescope arrays. Longer visits will begin after cargo missions deliver additional habitation and laboratory space and facilities to service and maintain excursion vehicles. At this point, the outpost can be operated in a human-tended mode, or permanent occupation of the outpost can begin.

The initial lunar outpost will consist of self-contained systems that allow for relatively simple emplacement operations. Later, to expand the capabilities at the outpost, a constructible habitat will be erected to provide additional habitable volume for a larger crew to stay longer and to provide additional space for increased biomedical and life sciences research. The design of the facilities is driven by the desire to simulate the eventual 600-day surface stays anticipated for the Mars outpost, and the constructible lunar module will serve as the prototype for the Mars module.

Power capacity at the lunar outpost will be expanded to support increased demands. The increased power capacity at the outpost will be used to begin operational processing of the Moon's resources and to help reduce the outpost's dependence on Earth. For example, oxygen extracted from the lunar soil can help make up losses from the outpost's life support system and could be used as propellants for the excursion vehicles. Nitrogen, hydrogen, and helium could also be extracted from the lunar soil and used at the outpost. Processing resources on the Moon will also develop an experience base for operational techniques for use in Mars resource utilization. In addition, dependency on Earth will be reduced by relying on systems with higher levels of recovery of life support consumables.



Right: The lunar transportation system will be the lifeline between Earth and a Moon base. Two separate but closely related classes of vehicles will be needed. Lunar transfer vehicles will carry crews and supplies to and from Space Station *Freedom* and the Moon. Transfer vehicles will have an inert mass of 8.1 metric tons, carry a propellant load of 7 metric tons and a crew module (including the crew) weighing 8.4 metric tons. Drop tank inert mass will total 5.8 metric tons, and the propellant load will be 129.8 metric tons. Lunar excursion vehicles will shuttle crews and cargo between lunar orbit and the lunar surface. Excursion vehicles will have an inert mass of 5.8 metric tons, carry a propellant load of 22.4 metric tons and a crew module (with crew) weighing 4.4 metric tons. Docking will be through shuttle-sized hatches. During landing operations, the excursion crew module will provide two crew members with console positions and windows from which to see all critical landing activities.

LUNAR VEHICLES

The size of the lunar vehicles and payload and the amount of material delivered to Space Station *Freedom* require a heavy-lift launch vehicle with capabilities beyond those of the current fleet of shuttles and expendable launch vehicles. Two lunar heavy-life launch vehicle options, one derived from the shuttle and the other a version of the Advanced Launch System will have a payload shroud large enough to allow lunar transfer and excursion vehicles to be launched virtually intact from Earth, but a single launch approach would require an extremely large launch vehicle. Instead, the transfer and excursion vehicles will be launched with the cargo in one flight, and the required propellant will be delivered to *Freedom* in two additional flights.

The various components are assembled and checked out at *Freedom*, which will serve as a transportation node for exploration missions. The planned baseline configuration of *Freedom* is capable of accepting the evolutionary modifications.

The lunar transfer vehicle transports crew and cargo between *Freedom* and lunar orbit; the lunar excursion vehicle provides transportation between lunar orbit and the surface of the Moon. Key mission design criteria are: (1) timing of the launch and return opportunities from *Freedom*, (2) payload mass delivered to the lunar surface and mass required in low Earth orbit, (3) mission abort/safe-return options, and (4) Earth-to-orbit launch vehicle/payload manifesting.

The lunar transfer vehicle concept is a 1-1/2 stage design consisting of a reusable core and expendable propellant tanks. Using expendable drop-tanks reduces the vehicle's propellant load by approximately 10 percent compared to a single-stage reusable lunar transfer vehicle.

On initial crew delivery flights, the vehicles will be packaged and launched to *Freedom* on a single heavy-lift launch vehicle. Packaging includes the fully fueled core propulsion/avionics module, the aerobrake central core and peripheral segments, transfer vehicle crew module, excursion vehicle crew cab, and partially fueled excursion vehicle. At *Freedom*, the eight peripheral segments of the aerobrake will be attached to the aerobrake central core, and the combination will be checked out for structural integrity. Two additional heavy-lift vehicles will launch four fully loaded expendable main propellant tanks to *Freedom* for mating to the transfer vehicle. The shuttle will deliver cargo modules and crew to *Freedom*, where the cargo modules will be added to complete the integrated lunar transportation vehicle. The transfer vehicle will become a staging base in low lunar orbit for the excursion vehicle and the cargo, and it will also transfer cryogenic propellants and consumables to the excursion vehicle when it is reused.

ENGINE SELECTION

Lunar transfer vehicle engines were selected on the basis of vehicle thrust-to-weight, number of engines, throttle range, and man-rating. The need for man-rating with multiple engines for engine-out capability, the desire for a common engine, and the excursion vehicle touchdown "g" limit with a throttling requirement of less than 20:1 resulted in the selection of four engines at 89 kilonewtons of thrust each.

Aerobraking significantly reduces the initial mass required in low Earth orbit. The aerobrake is a rigid structure made of composite materials with advanced thermal protection materials used to protect the aerobrake in the maximum heating region. Aerobrake reuse for five missions is assumed.

The lunar transfer crew module attaches to the transfer vehicle and provides habitable support to the crew for four days on the translunar segment and up to seven days for return to *Freedom*.

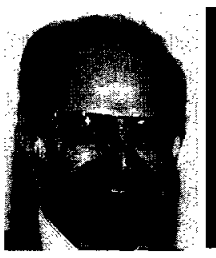
The lunar excursion vehicle can be used on the lunar surface, covered by a thermal tent and ready for launch and rendezvous with the lunar transfer vehicle, or it can be stored in low lunar orbit awaiting the return of the lunar transfer vehicle. The lunar excursion vehicle is sized to deliver approximately 33 metric tons to the lunar surface in an expendable cargo-only mode or approximately 13 to 15 metric tons of cargo plus a crew module in a piloted mode. The lunar excursion vehicle elements include a propulsion system, landing legs, crew cab, and other subsystems.

Automated rendezvous and docking in low lunar orbit are provided for reusable cargo missions, whereas piloted missions provide crew monitoring and control for rendezvous and docking operations.

The lunar excursion crew module, which shares a common system design with the transfer crew module, has no radiation shielding and accommodates both lunar-gravity and zero-gravity operations. It transports four crew members between the crew transfer module in lunar orbit and the lunar outpost. During landing operations, the lunar excursion crew module provides two crew members with console postions and windows from which to visually monitor all critical landing activities, including forward landing pad touchdown.

Transfer between modules and surface systems is initially by extravehicular activity, and later by pressurized transfer using surface-based systems.

Cools new data processing chief



Cools

Barringer

Haynes

John E. Cools Jr., a 22-year veteran of JSC, has been appointed chief of the Data Processing Systems Division.

Cools, who has been deputy chief of the division since March 1988, replaces John R. Garman, associate director of Mission Support for information systems planning, who had been serving as acting chief.

Cools began his JSC career in 1967 in the Flight Operations Directorate (FOD) and has held progressively responsible positions in FOD, the Space Station Program Office and the Mission Support Directorate.

JSC People

Barringer top secretary

Cynthia A. Barringer, secretary tothe chief of the Data Processing Systems Division, has received the Marilyn J. Bockting Secretarial Excellence Award.

Barringer was recognized for her dedication to assuring excellent secretarial support throughout the division, and for her leadership in establishing monthly division secretarial meetings and a "buddy system" to assure support for any office when a secretary is out.

She received a plaque and a $500 stipend.

Haynes hangs plaque

Mark Haynes, lead Flight Dynamics Officer (FDO) in Mission Control for STS-32, earned the honor of hanging the mission plaque.

Lead Flight Director Granvil A. "Al" Pennington said he chose Haynes and the FDO team for their excellent support from launch to landing. He took special note of the FDO team's quick work in turning around a complicated Long Duration Exposure Facility rendezvous profile when launch delays occurred.

In presenting the emblem to Haynes, Pennington also recognized Lynda Slifer and Rick Gavin, the two FDO team members who prepared the rendezvous plan.

JSC Photo

JSC Director Aaron Cohen presents the Quality Partnership Award to members of IBM's JSC Test and Operations Department. From left are: Danny Cushman, Albert Jerry, Monty Queener, Cassandra Johnson, Louise Farrell, Cohen, Hugh Stovall, George Markham, Larry Adkins, John White and Duane Batiste.

Software group earns quality award

IBM's JSC Test and Operations Department has become the first group to win the year-old JSC Quality Partnership Award.

The group is responsible for installing and integrating space shuttle flight software in the Shuttle Mission Simulator (SMS), the Guidance and Navigation Simulator (GNS), the Shuttle Avionics Integration Laboratory (SAIL) and the Johnson Avionics Equipment Laboratory (JAEL) at JSC.

The department supports anomaly investigation, capability updates and configuration documentation, as well as user community use of the IBM-developed flight software. It also supports in-flight software data processing during mission operations.

In performing these tasks, the department has developed its own quality reporting system to reduce errors and detect them in house. This, in turn, has raised the quality of the flight training software and thus made an outstanding contribution to the overall space shuttle effort, said Harry T. Briggs, Partnership Award coordinator.

The department's staff includes Larry R. Adkins, Duane M. Batiste, Madison W. Beaty, Danny J. Cushman, Louise A. Farrell, Albert Jerry, Cassandra L. Johnson, George M. Markham, Monty A. Queener, Hugh D. Stovall and John P. White.

The Quality Partnership Award, established by the Safety, Reliability and Quality Assurance Office, recognizes the quality-related contributions of employees not currently working in the quality field.

Hernandez Engineering wins support contract

Hernandez Engineering Inc. has been awarded JSC's technical information and public affairs support contract. The basic period of performance began Jan. 1, 1990.

The cost-plus-fixed-fee contract is for a basic year effort plus four one-year options. Estimated cost and fee for the basic year is $7.7 million. If the options are exercised, the contract value will increase by $8.1 million for the first option, $8.5 million for the second option, $9.1 million for the third option, and $9.7 million for the last option.

The effort involves about 205 employees, both on-site at JSC and in other designated locations. The contract includes providing public affairs support services, such as exhibit, public information, and visitor services and maintaining the Teacher Resource Center now located in Bldg. 2.

Other services provided are correspondence and communications management, including the operation of JSC's Mail Center, Communications Center and central switchboard; security support services; and information resource management, including the operation of the engineering drawing control center, maintenance and operations reference center, technical library, data management support and history office.

Hernandez also will provide documentation management, including editing, graphics and word processing services to JSC documents and publications; technical information support services; and printing, reproduction, microforms, and distribution management.

The new contract was awarded under a Small Business Administration (SBA) program. The previous contractor, Omniplan Inc., had provided these services to JSC since 1981, and is no longer under the SBA program.

Unsuccessful offerors included ASI Universal, Houston; ETC Inc., Oklahoma City; Operational Technology Corp., San Antonio, and CARA, Inc., Kingsville, Texas.

JSC credit union plans annual meeting

The JSC Federal Credit Union will hold its annual membership meeting at 7 p.m. on March 1 in the credit union lobby. Reports of the board of directors and the supervisory committee will be presented, and new directors will be elected.

Members may cast their ballots for candidates for the three open director positions during regular business hours on March 1, and prior to the meeting that evening. Primary credit union members are entitled to one vote for each position open.

Directors are volunteers, serving without pay, who determine the policy which guides the day-to-day operations of the credit union. Nominations for director may be made by petition with the signature of 1 percent, or 210 members, of the current membership. The deadline for nominations by petition is Feb. 14.

Truly discusses 1991 budget proposal

(Continued from Page 1)

JSC are $58.5 million. Major projects include $15 million for phase one of the Neutral Buoyancy Laboratory, $12 million for construction of an addition for flight training and operations in Bldg. 4, $11 million for an addition to an on-site electrical substation, and $8.5 million for the rehabilitation of the Mission Control Center power and control systems.

The total NASA request for space shuttle funding is $5.3 billion, up from $4.6 billion in 1990. Research and Program Management (R&PM) funds for the agency would increase to $2.3 billion, from this year's $2 billion.

In support of the president's Human Exploration Initiative address last July 20, the budget includes requests for funding to develop two new robotic missions, the Lunar Observer and Lifesat. The enhancement of the operation system of the Mars Observer, scheduled to launch in 1992, also is provided for.

Truly's request supports the development of EOS as the first element of the Mission to Planet Earth program. The 1991 request would fund the start of two polar-orbiting platforms, the first to be launched in fiscal year 1998. Plans call for EOS to eventually include two series of three platforms, plus instruments on the space station.

The budget also proposes the development of smaller Earth probes to focus on specific, high priority data needs, including ozone depletion.

Payload commanders

(Continued from Page 1)

Retrievable Carrier (EURECA) and the Tethered Satellite System (TSS-01), a joint project between NASA and the Italian space agency, Agenzia Spaziale Itialiana (ISA).

Air Force Lt. Col. Mark Lee will be the payload commander on mission STS-47 for Spacelab-J, a joint science venture between NASA and the Japanese space agency, NASDA, also in 1991.

Future assignments of payload commanders will normally be made in advance of the remainder of the flight crew in order to help identify and resolve training issues and operational constraints prior to crew training.

The role of the payload commander is also expected to serve as a foundation for the development of a Space Station mission commander concept.

Space News Roundup

The **Roundup** is an official publication of the National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Texas, and is published every Friday by the Public Affairs Office for all space center employees.

Editor . . . . . Kelly Humphries
Associate Editor . . . . . Linda Copley

Budget experts get grip on 1990 appropriation

(Continued from Page 1)

increasing costs associated with operating the installation, the current numbers for R&PM we have received from Headquarters fall short of our projected requirements.

"To ascertain the effect of such a shortfall, the center has gone through an exhaustive exercise to determine how we could operate under the fiscal '90 numbers given to us," Draper explained. "It appears we can meet our objectives, although we will have to spend funds most judiciously in all phases of operations concerned with the management of the installation."

The budget does allow JSC 147 addition full-time equivalent (FTE) employees this fiscal year, said Human Resources Director Jack Lister, although those new workers have come on board at the expense of some special temporary employee programs. Lister said most of the new FTE allocation was distributed among the directorates in June 1989 in anticipation of the increase.

That brings JSC's FTE ceiling up to 3,705 civil servants. Current hiring remains slow because of slower than expected turnover, he added.

The big increase in the construction budget will fund the new Space Station Control Center addition to Bldg. 30, and additions to Bldgs. 5 and 9. Also included are rehabilitation of the Central Heating and Cooling Plant in Bldg. 24, and a modification for expanded solar simulation in Chamber A of Bldg. 32.

Atlantis repairs planned

(Continued from Page 1)

to the call-to-stations for the start of the countdown on Feb. 19.

Yesterday, the STS-36 crew arrived at the Kennedy Space Center for the practice countdown which is scheduled to end tomorrow morning. The mission will be commanded by J.O. Creighton. Pilot for the sixth *Atlantis* mission is John Casper. Mission specialists for the flight are Dave Hilmers, Mike Mullane and Pierre Thuot.

LDEF scientists travel from JSC to Florida to inspect veteran spacecraft

(Continued from Page 1)

more durable materials and innovative designs. Even tiny particles can create significant damage when traveling at average meteoroid and orbital debris velocities of 10-20 kilometers a second.

The only JSC scientist with his own experiment on the Langley Research Center-developed satellite is Fred Horz. Horz worked with J. Joerns, D. Chandler, David S. McKay and Donald A. Morrison of JSC, Donald Brownlee of the University of Washington, and Robert M. Houseley of Rockwell International Science Center to develop "The Chemistry of Micrometeoroids" experiment. Lockheed provided contractor support and the instrument was built in house by the Technical Services Division.

Zolensky, micrometeoroid curator in the Planetary Science Branch, and Zook, of the Space Sciences Branch, have been added to the list of co-principal investigators for the chemistry experiment.

All are part of a large team representing various agencies and will be trying to determine the impact history of the entire satellite. They'll attempt to distinguish between natural and man-made particles that hit LDEF and determine where they came from by chemically analyzing the residue in impact craters.

"The overall collision hazard really relates to the total particle population," Horz said. "That's the main question for spacecraft designers and this will help us understand that. LDEF will be the baseline for many years to come."

Leger, chief of the Materials Branch in Engineering's Structures and Mechanics Division, is a member of the LDEF initial inspection team and the special investigation working group for materials that will gather and evaluate engineering data from LDEF, particularly those concerned with erosion processes due to atomic oxygen bombardment in space. That database will be kept here at JSC, a resource for current and future spacecraft design, he said.

Steve Koontz, who works with Leger in the Materials Branch, will be focusing on the thermal control materials tested on LDEF. Another member of the branch, Jim Visentine, estimated atomic oxygen exposure conditions for LDEF.

Don Kessler of the Space Sciences Branch and an expert on orbital debris, will be trying to determine how many man-made particles between the sizes of 0.2 and 2 millimeters are in orbit. Good estimates don't exist for the small—but still dangerous—particles.

Zook is interested in the direction hypervelocity particles are coming from. He hopes to learn something about their sources and how many are from asteroids or comets.

Tom See, a Lockheed scientist, will be helping with the stereo-microscopic video imaging of every inch of LDEF. These images, when combined, will provide a three-dimensional image of the impact craters over the whole satellite. This documentation will allow continuing impact crater research at JSC even after most principal investigators have removed their hardware and taken it to their private laboratories.

"Everybody is anxious to get as much information out of LDEF as possible," said See, who will be at Kennedy Space Center with LDEF for three months.

NASA-JSC