

Apollo 13 and TRW Rocket Power

by Ed von Delden, TRW ATD, 1961 to 1993.

My colleague, Jack Trost, wrote an informative piece in the March/April NNG about the 50th anniversary of the incredible saga of Apollo 13.

Among the heroics of the astronauts to improvise in so many ways for their survival, it ended up that the only option to return back home after the Service Module explosion was to use the remaining rocket motor - the TRW Lunar Module Descent Engine (LMDE).

I'd like to expand a little about how this remarkable engine came to be. The 10,500 lb thrust LMDE was designed and manufactured at Space Park. The engine was required to allow astronauts to make controlled descents from Lunar orbit to a prescribed landing spot, flare to near zero speed near the Lunar surface, translate laterally like a helicopter, if necessary, and make a soft landing. This required two burns with a deep throttling rocket motor.

The technology to build such a rocket motor was non-existent when President Kennedy committed America to the Apollo Lunar program in the early 60's.

For Apollo 13 to return to Earth, however, required a totally different engine duty cycle. For the rescue, the first burn was to assure a "free return" trajectory around the Moon; the second burn was a "speed-up" to escape Lunar influence and head back towards Earth; and a third burn assured the proper trajectory for the desired Earth arrival location.

Ruggedness and durability of the LMDE allowed it to meet these unexpected emergency requirements and brought the crew home to a safe splash-down.

Many bids came in to NASA from the industry to supply this engine and it narrowed down to TRW in competition with pre-

miere rocket manufacturer Rocketdyne as to who could meet all the requirements and supply the best and safest engine to do the job.

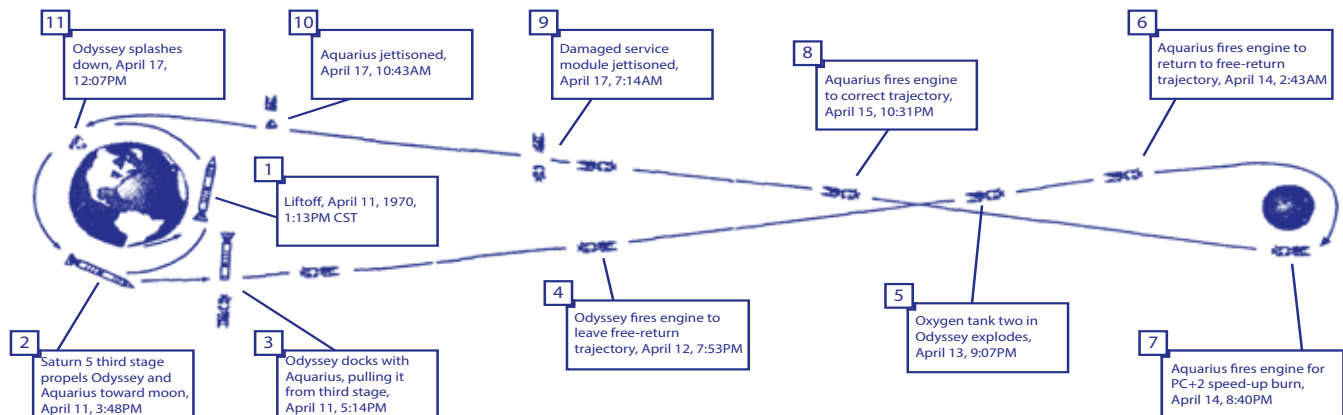
TRW sub-scale fuel injector parameter studies occurred at a sand bag bunker near LAX and soon moved to the Inglewood Test Site, where Dr. Werner von Braun visited to witness the development progress of our unique injector design.

After a year or so, test operations were moved to a new Capistrano Test Site as full scale testing progressed. The test site provided capability for high altitude simulation as well as verifying adequacy of the actual propellant feed system. As competition was winding down, testing activity increased toward 24/7 for fine tuning the engine. Supporting this test cadence required frequent shuttling of hardware back and forth on the 405 Freeway, which was sometimes a little hazardous and interesting, especially if a freshly tested engine was not thoroughly purged of residual propellant before making the trip!

TRW was the winner and awarded the LMDE contract and manufacturing and deliveries were completed. It should be noted that SpaceX has adopted our TRW throttleable rocket engine technology in all of their rocket applications (booster, abort, docking, etc.) wherever variable thrust is required.

The first Lunar landing, Apollo 11 (Neil Armstrong), was July 20, 1969, followed by four more landings (12, 14, 15, 16) when the program was terminated.

You may see the actual, full-size, LMDE hard mockup in the E2 lobby museum. Or, if you wish, in a few years you can catch the next civilian Lunar flight, rent a JPL rover, and personally inspect the five Apollo LM descent stages deposited on the Lunar surface!



TRA for Northrop Grumman Retirees

The Retirees Association (TRA) welcomes the retirees of Northrop Grumman and TRW.

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The No Name Gazette is the official publication of TRA. It is published six times a year.

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By Email:

TRA@tra-spacepark.org - Your emails will be routed to the appropriate source. And, if we have your e-mail address on file, we send out special alerts to TRA members as the need arises. To get on the TRA email list, just send us a brief email requesting to be added to it.

By Web:

Our website is at www.tra-spacepark.org. It is an excellent source for the latest news, lists of the new retirees, travel details, party photos (more than get into the NNG), forms of all sorts, personal photographs, and much more. Register, log on, and browse.

For Membership:

TRA Membership is open to Northrop Grumman and TRW-legacy retirees at \$10 per calendar year. The application is available on the website.

TRW/NG Retirees Meetings Around the US

Find a group in your area and give them a call. Changes from last edition are in **bold**.

GROUP	MEETING LOCATION	DATE & TIME	OTHER INFO	CONTACT
TRA Board Meeting	Bldg. E2/B114, Space Park	3rd Wednesday, 9:30 AM, Monthly except December	Decisions, planning and actions on archives, events, NNG, coordination with NG	All members welcome. Contact TRA prior to attendance to arrange for escort
ATD Friends & Colleagues	Send ideas for meeting location	3 November 2020, 11:00 AM	Social, Nostalgia, Lunch	Jack Trost, Dena Bouskos, Carol Schamp 310-377-2194 cschamp@aol.com
Beach Cities Get-together	Grunions Restaurant, 1501 N Sepulveda Blvd, MB, CA	Last Monday, Even months, 11 AM to 2 PM	Social	Allen Parker 310-780-0712 777allendsp@gmail.com
Brevard Retirees	Various Locations in Brevard, NC	1st Wednesday, 8 AM, 3rd Wednesday, 5 PM	Social	Tom and Vicki Moore 828-883-8080 seneca75@verizon.net, thistle33@verizon.net
Central Coast Chapter	Various Locations in the Central Coast Area	Various days: contact Zaiser for details	Social	George Zaiser 805-473-2105 gzais34@icloud.com
Houston Chapter	Baybrook Denny's, 19212 Gulf Fwy, Friendswood, TX	3rd Tuesday, 8:30 AM	Social	Gary Dinsmore 281-461-6270 samngary@att.net
Huntsville Chapter	Red Lobster	2nd Tuesday, 11:30 AM	Lunch and Social	Jim Troy 850-797-0044 jtroy28x@gmail.com
Las Vegas	Various Locations in Las Vegas Metro Area	Last Tuesday, 11:30 AM	Social	Carol Noblet 702-889-6773 cannob70@gmail.com
Northern Virginia	Old Brogue Pub, Great Falls, VA	3rd Friday, 11:30 AM	Social	Jim Miller 703-483-5448 jmiller158@gmail.com
Utah	Cracker Barrel Restaurant, Layton, UT	1st Thursday, 8:30 AM	Social	Charles Vono 801-745-5879 charlesvono@comcast.net
San Diego Chapter	Event Dependent	3rd Tuesday, Alternate Months	Social or Board Meeting	http://sandiego.tra-spacepark.org Jim Denton 858-385-0150 JWDenton@san.rr.com
Temecula Valley	J. Carter's Tavern Grill, 40365 Murrieta Hot Springs Rd, Murrieta, CA 92562	2nd Wednesday, Lunch	Social	Maureen Locken 951-818-6811 Maureen_Locken@yahoo.com
The Mountain Folks	Various Locations in the Denver Area	First week of each quarter	"We do have fun!"	Carl Winkelman 303-693-0034 winkelman@att.net
TRIN	Sizzler VIP Room, 2880 W Sepulveda, Torrance	2nd Thursday, 1:00 PM, Optional lunch at 12:30	Investment Info based on monthly newsletter reviews	Bob Eshbaugh 310-376-5880 eshonnet@yahoo.com
Ventura Romeos	Mimi's Cafe Thousand Oaks	1st Tuesday, Lunch	Social	Frank Yunger 805-444-1541, Harry Stroud 805-653-5117

HAPPENINGS AT NORTHROP GRUMMAN

NASA Expects to Cover JWST Launch Slip with Budget Reserves

NASA hopes to keep the costs of additional delays in the James Webb Space Telescope within the program's existing reserves and thus avoid asking Congress for additional funding.

At a June 24 meeting of NASA's Astrophysics Advisory Committee, Eric Smith, program scientist for JWST at NASA Headquarters, said that while a new target launch date for the giant space telescope hasn't been determined yet, the agency expected that the costs associated with that slip will be covered by existing budgetary reserves.

"The program has fiscal reserves, in addition to the schedule reserves, and right now we do not anticipate needing additional funding because we have money to pay for extra time in the schedule," he said.

JWST exhausted its schedule reserve because of the slowdown in work caused by the coronavirus pandemic. The program still had nearly two months of schedule reserve when the pandemic caused work to briefly halt in March, then continue at a slower pace. On June 10th, Thomas Zurbuchen, NASA associate administrator for science, said that because of that slowdown, the mission will not make its March 2021 launch date.

Smith said NASA expects to set a new launch date in July after completing reviews, including examining how changes in work procedures required by social distancing protocols affect the remaining activities. "What has changed is the efficiency in which those tasks can be completed," he said. That may include, he said, adding more schedule reserve beyond the two months that the program had in March.

He did not estimate how much the launch date will slip, but it is likely to be at least a few months. Before the pandemic slowed work on JWST, NASA was planning to put the telescope through a final series of acoustics and vibration tests in May and June. Smith said those tests are now scheduled for August.

Smith declined to say how much budget reserve the mission has remaining. "We can go a few months, several months past the March [2021] date and still have reserves to cover that," he said.

JWST has a cost cap of \$8.8 billion set by Congress after the mission's previous schedule slip in 2018. Schedule overruns alone don't require congressional approval, Smith said, but cost increases that exceed the cap would require reauthorization.

Northrop Grumman Receives \$222 Million Contract to Update Aging Missile-Warning Satellites

Northrop Grumman has been awarded a \$222.5 million contract for technology upgrades to the Defense Support Program, a constellation of early warning satellites that has been in operation since the 1970s. The contract would keep the Defense Support Program early-warning satellites in service until 2030.

The contract announced on June 26 by the Space and Missile Systems Center would add another decade of service life to the DSP constellation. Northrop Grumman will provide technical and engineering support until 2030.

HAPPENINGS - Continued on Page 4

IN MEMORIAM

David Clarence Breeding, 94, April 3, 2020. David joined the staff at Ramo-Wooldridge in 1958 in the Inertial Guidance Department. He worked on ICBM projects starting with Thor and through Peacekeeper. He retired in 1986.

Edward J. Bresnen, 89, April 26, 2019. Ed worked at TRW from 1972 to 1991 as a Management Systems Analyst.

Faye George, 85, May 6, 2020. Faye had a long career at STL/TRW as a Human Resources Manager. If you ever had a problem or needed guidance about how to handle a difficult situation, Faye was the one who could help. A wonderful woman and a delight to work with.

Robert A. (Bob) Greenberg, March 15, 2020. He held key positions in the government and at TRW where he was a nationally recognized expert on electro-magnetic technology, sensors and systems. He made major contributions to national security on DSP, FEWS, SBIRS, and several classified programs. As Marketing Director of TRW Defense Systems Division he oversaw the successful acquisition of several major space system programs.

Howard Grossman.

Donald (Don) Gilbert Linke, 89, April 26, 2020. Don held leadership positions for the Air Force Air National Guard, North American Rockwell, and TRW/Northrop Grumman. In addition to his work with Air Force aircraft, Don led testing efforts for the Pioneer 10 and 11 spacecraft.

Glen R. Johnson, 79, January 1, 2019. He was a business manager at TRW. One item he was known for was arranging for the first TRW night at Disneyland.

Robert (Bob) Macintyre, 89, July 4, 2019. Bob worked over 30 years at TRW Defense Systems on ICBM missile projects. Subsequently, he joined SAIC working on their GPS and satellite systems. He devoted his career to keeping America safe.

Robert E. McNeil, 91, March 17, 2020. Bob started work for TRW in Houston, then at Space Park. He transferred to work in Australia, where he lived several years and met his wife Karen, then to work in western North Carolina where he retired in 1990 as a computer specialist.

Ned Sillman, 94, January 1, 2019. Ned was an electronic design engineer in the Communications Laboratory and worked on SGLS, FLTSATCOM, Landsat and classified projects.

William (Bill) Tangemann, June 8, 2020. Bill retired in 1991 after 37 years of service.

Phil Wheeler, January 30, 2020. Phil was in Systems Engineering for many years and was instrumental in the early competition phases of NPOESS. He was the Deputy Program Manager on the capture effort starting in 1994. After retirement, Phil became increasingly involved in the Sierra Club. Phil was really bright and super energetic while on NPOESS and surely applied that same sort of passion to the Sierra Club activities!

If you know of a person that should be included in the "In Memoriam" column, please inform us by either email or mail to the TRA office. As a minimum, we need the name of the deceased, date of death, and the name of the person submitting the information. If more information is available and desired, include age, position and years at NG/TRW, any notable programs, and special skills.

Benefit Contacts for Retirees

Northrop Grumman Benefits Center (NGBC)

www.benefits.northropgrumman.com

Phone: 800-894-4194

This is the main contact for Northrop Grumman employee and retiree benefits. Here you can report a change of address, report a death, or apply for a pension. See the "Retirement" menu item on the NGBC home page for retiree services.

Fidelity NetBenefits

www.netbenefits.com/northropgrumman

Fidelity administers pension payments and the Northrop Grumman savings plan.

Via Benefits (a Tower Watson Company)

www.viabenefits.com

Phone: 855-832-0976 (M-F 8AM-9PM Eastern)

Via Benefits handles Medicare supplemental insurance and open enrollment.

A small number of TRW retirees receive their medical benefits through the Northrop Grumman Benefits **Service** Center. This center is staffed by Benefits Outsourcing Solutions, Inc. Their number is 800-410-6605.

Metlife

www.metlife.com/NGC

Phone: 866-492-6983

Metlife administers your life insurance if, after you retired, you continued your coverage under the Northrop Grumman group plan.

If you were employed by TRW and retired before January 1, 2006, your estate may be eligible for a benefit, payable on your death. Contact the NGBC for more information.

HAPPENINGS - Continued from Page 3

Northrop Grumman built both the DSP satellites and sensors that have been part of the U.S. military's early-warning system since 1970. The satellites detect ballistic missile launches and nuclear detonations using infrared detectors that sense the heat from missile plumes against the Earth's background.

The final DSP was launched on a United Launch Alliance Delta 4 heavy rocket in 2007. Since then, the Air Force has awarded Northrop Grumman multiple contracts to sustain and update the constellation. The latest \$222.5 million contract follows a \$132 million support contract awarded in 2015 that expired in June 2020.

The Air Force does not disclose how many DSP satellites are in orbit. The military's missile-warning system has been updated with the Space Based Infrared System satellites made by Lockheed Martin. Both Lockheed Martin and Northrop Grumman are now under contract to develop new missile-warning satellites known as Next-Generation Overhead Persistent Infrared.

NASA's James Webb Space Telescope Completes Comprehensive System Test

Now that NASA's James Webb Space Telescope has been assembled into its final form, testing teams seized the unique opportunity to perform a critical software and electrical analysis on the entire observatory as a single, fully connected vehicle.

Known as a Comprehensive System Test or CST, this was the first full systems evaluation that has ever been run on the assembled observatory, and one of the final first-time activities the team will perform. Similar performance evaluations have been completed in Webb's history, using simulations and surrogates to infer data about pieces of the spacecraft that had not yet been assembled. Now that Webb is fully built, simulations and simulators are no longer needed, and engineers can confidently assess both its software and electronic performance.

To complete the test, personnel was staffed 24 hours a day, for 15 days consecutively, and approximately 1,070 scripts were executed, and nearly 1,370 procedural steps were performed.

Webb's final series of tests will determine its readiness for launch. This CST just completed establishes a baseline of electrical functional performance. In a few months, after the observatory completes its next and final set of acoustic and vibration tests that simulate the rigors of launch, the team will run another full-system scan. Engineers will then compare the 'before and after' results, which should be the same, indicating that the spacecraft is operating as intended as a complete observatory and will withstand the launch environment to operate as designed once in space.

"I've never seen such effort, collaboration and cross-organizational efforts to bring so many different teams and people in so many different areas together to execute a common goal so successfully," said Randy Pollema, the electrical integration and testing lead for Webb at Northrop Grumman in Redondo Beach, California. "We have a lot of pride, and feel a lot of personal reward in what we've been able to accomplish over the last year in assembling Webb into its final form, and with the completion of this latest systems evaluation we can confidently move forward knowing that the assembly was a success."

The evolving COVID-19 situation is causing significant impact and disruption globally. Following augmented personal safety procedures implemented in March due to COVID-19, the James Webb Space Telescope's Northrop Grumman team in California continued integration and testing work in the clean-room with significantly reduced on-site personnel and shifts. Starting in late May, the team resumed near-full shift clean-room operations.

New TRA Members

David Bloodgood	Rancho Palos Verdes, CA
David Detchmendy	Manhattan Beach, CA
Kathleen Geumlek	Norwalk, CA
Steve Koch	Manhattan Beach, CA
Brooks McKinney	Palos Verdes Estates, CA
James Nelson	Manhattan Beach, CA
Alice Quinn	Washington, DC
Kent Vandenberg	Palm Springs, CA
Michael Waddell	Las Vegas, NV
Tina Welch	Torrance, CA

We hope these new members will send a note to us telling us a little about themselves and where they worked at Northrop Grumman/TRW.

Last Call for 2021 Officer Candidates

This is the last call for TRA Board Officer and Director candidates for the coming year. Officers are elected for a one-year term and Directors-at-Large for two years. If you have an interest, please contact TRA.

Chapter News

Allen Parker - Beach Cities Get Together. We canceled our Beach Cities Get Together on both 27 April and 29 June 2020, obviously due to the Covid-19 virus issues/rules. We are hoping that we may be able to hold the 31 August 2020 event, as planned, but will decide on that much closer to the date.

Jim Denton - San Diego. Well, we have pretty much suspended all activities at the present here in San Diego. I suspect that we'll try to get something going in the future but it appears to be a daunting task due to our collective physical conditions. We will likely try to get our board together soon to discuss options.

Tom Moore - Brevard, North Carolina. Our last get together was held on March 5th for breakfast at one of our members homes. But it looks like we are now becoming more restrictive. The state of North Carolina begins mandatory mask wearing June 26 for both merchants and customers alike. As all of us are 65+, I don't think we'll have any meetings this summer. Perhaps after Labor Day. Will keep you posted. Stay well and keep healthy.

Charles Vono - Utah. All of our events in Utah are canceled until further notice. I still share obits and other news via email. I would love to hear if any of the non-Los Angeles sites are staying in touch right now via Zoom or something similar.

How do you do it? How well is it working? What are the benefits and drawbacks?

Robert Eshbaugh - TRIN. The TRIN meetings are currently being hosted by Al Fletcher on Zoom. Same time. Need your name and email to join.

Jim Troy - Huntsville. In currently booming Huntsville, our TRA meetings resumed after two canceled months in June with only 2 attending, where typically we have from 12 to about 80 members. The lightly filled Red Lobster was very thoughtful. We shall continue to meet monthly with whomever wants to join us as stores are now open with procedures and the danger appears to some mostly past. By now most of us have gotten haircuts, manicures, and caught up with dental appointments with re-openings. The massive construction of new homes\tracts, factories such as Blue Origin, Toyota, Mazda, and business buildings, has continued non-stop. The small historic downtown shows three tall construction cranes at present. Pubs galore in Appalachia are gradually filling again, street dining, carry-out drinks, micro-breweries,

micro stills and the many churches - all waking up. The US Space and Rocket Center has reopened. At this juncture malls and shopping are still often low on attendance but numbers are obviously increasing. We hope those who depended on more business will soon recover from this terrible world event.

Testing has greatly increased and is now easily available even at drive-throughs, with some new found cases finding more being treated. In Alabama we have seen about 812 total virus deaths now greatly subsiding, from about 5 million people, with perhaps 60 fewer vehicle deaths due to reduced driving. Locally, Huntsville's three counties suffered 7 virus deaths total for about 600,000 population, I think it is around average. It is understandable that some wish to stay home into this transition, which is a fully respected viewpoint, none of us know. Our newsletter is being expanded to include more member hellos, comments, jokes, and in our case, local news. We live in a very newsy area with thousands new jobs and companies flooding in. We invite anyone wishing to receive these newsletters for reference to let me know, they are not in a class with the excellent NoName Gazette.

Carol Schamp - ATD Friends and Colleagues. We are starting to plan for the next ATD Friends and Colleagues event for November 3rd at the Proud Bird. I want to mention that Hermosa Five-O Tech Volunteer David Lombard and his Laptop Elf Project are still in need of laptops. With students returning to virtual, on-line classes this fall, many underprivileged children don't have access a computer. What David does is safely and securely remove personal data from donated laptops, refurbish them, and then provide them free of charge to teachers and low income families. For more information on the Laptop Elf Project go to www.facebook.com/TheLaptopElfProject.

James Miller - Northern Virginia. The NOVA contingent of former TRW employees took March and April off but Zoom-ed back to life in May. This screen-shot from our June "lunch" includes (top row) John Kim, Jim Miller (not sleeping), Jim Radley, Prissilla Guthrie, (middle row) Mike Goldstein, Shelley Gersten, Les, Meyer, Greg Fox, Lee Stern, Linda Brooks, and Bob Kaplan. We meet the 3rd Friday of every month (by Zoom until further notice). If interested, email me. As a side note, you can order John Kim's book, In Pursuit of Science and Technology, on Barnes and Noble (publishing date 7/7/20).



The Northern Virginia Chapter Zoom "Lunch"



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The next NNG will be
mailed in September.

THE MAIL POUCH

By Pam Overton and Joan Merritt

◆◆◆ **Stephanie Sundius** and her husband **Dave** (still working at Raytheon) still love living in the Los Angeles South Bay, close to the beach, mountains and restaurants. Since retiring from Space Park in 2014, Stephanie became interested in Hawaiian culture (especially hula, the language, and ukulele), tai chi and volunteering with TRA. "I love Hawaiian music - playing and singing with groups and dancing when I know the songs, because it's such a social, joyful experience." I still do these things, but now on-line. Not the same experience, but I'm glad to still be able to do them! ◆◆◆ **Pam Overton** has been busy Zooming over the last few months. The quilt guilds she belongs to are all beginning to meet via Zoom. The quilt artists that they hire as speakers are all busy converting to on-line lectures. And then, in her spare time she took on a part time job! Suffice it to say she has been anything but bored during the quarantine, stay-at-home order. ◆◆◆ **Michael Nari-gon** shakes his head and wonders where the time has gone. He retired six years ago and his ToDo list is as long as ever. He has too many projects stacked up in the garage but at least he has cut down on the rate of acquisition of new projects. He still enjoys battling Photoshop, Illustrator, and InDesign to put together the NNG. His wife, **Kim Lewis**, still putters in the yard. She has been spending her time researching native plants and has been slowly transforming the outdoor areas of their house. ◆◆◆ **Mary Ann Chory** has been enjoying her retirement with her husband **John** (45 year anniversary this September), living in Manhattan Beach CA. They have been taking numerous road trips centered around family visits and national parks. A big highlight was in May 2019 when

Mary Ann was joined by retiree **Nancy Andreas**, retiree **Maria Caponi**, and still working **Nanci Shawger** to walk the Camino de Santiago. They completed walking approximately 200 miles from Leon to Santiago de Compestela, meeting people from all over the world. ◆◆◆ **Bob Doll** - While active work in our TRA Archive office has come to a halt due to COVID-19, we encourage any TRW/NG retiree that has any memorabilia or documents they no longer want to consider donating them to our archive effort. This year is the 50th anniversary of Apollo 13 and we have been asked by Space Park corporate to help locate the NASA Apollo 13 plaque. It was delivered to Space Park in December of 1970, displayed in E1, M5/R6, M2, O1, and then returned to E2 lobby for permanent display. If anyone has knowledge of this plaque's location, please contact TRA. ◆◆◆

Mail Pouch Items

Pam and Joan need your help! They need Mail Pouch items! Let us know what you are up to by e-mailing the Mail Pouch at mailpouch@tra-spacepark.org or by mail to Mail Pouch, P.O. Box 1276, Redondo Beach, CA 90278.

Save The Date!

Holiday Party@TBD Friday, December 4, 2020, 11:00 AM