

(#H3) Satellite Dreams: Doing Group HPR Projects

- Mark “Bunny” Bundick

Session Description:

Many sport rocket flyers nationwide have done projects as a team, which they never could have accomplished individually. Does that make you want to try a team HPR project? When the Fox Valley Rocketeers decided they wanted to put their own stamp on a group project, they had lots of discussion, struggled at times, but had a lot of fun. Come hear about their adventures and learn from their experience before you and your team embark on one of the most rewarding experiences in high power rocketry, your excellent HPR team project.

Presenter:

Mark “Bunny” Bundick, NAR #19250, is a Level 2 certified, lifetime NAR member and has been flying rockets for 53 years. Bunny was part of the 1976 National Championship Team, the 1979 Reserve C Division Champion and a member of six National Section Champions. A past NAR President, he was the recipient of the 1982 NAR President’s Award, the 2008 G. Harry Stine Lifetime Achievement Award and the 2009 Howard Galloway Spacemodeling Service Award.



(#H7) Safety in High Power Rocketry

- Trip Barber

Session Description:

Our hobby's survival in a litigious society depends on its real and perceived safety. Safety occurs only when responsible people understand the risks of their activities and make mature, informed decisions to manage them. Energy levels of HPR make safety incidents particularly dangerous, so they must not happen. Our hobby's safety is in our hands.

Presenter:

Arthur H. (Trip) Barber III
NAR 4322 Level 3

Trip Barber has been a sport rocket flier and a member of the National Association of Rocketry (NAR) since 1963. He has flown in eight FAI World Championships as a member of the U.S. rocketry team, winning four FAI bronze medals and has competed in over 30 U.S. National Championships. He developed the current version of the Safety Codes which govern the hobby's safety practices. He was a co-founder of the Team America Rocketry Challenge in 2003, and has run the rocketry part of that national student competition each year since. He was the eighth President of the NAR 2008-2012, after fourteen years of service as its Vice President and National Events Committee Chairman. He is currently the NAR representative to the National Fire Protection Association safety rules-making process and a regular flier of rockets of all sizes through Level 3 high power.



Trip graduated from the Massachusetts Institute of Technology with a Bachelor of Science degree in Aeronautics and Astronautics. While a student there he ran the MIT National Rocketry Convention each year, founded the MIT Rocket Society Journal, and was President of the MIT Rocket Society. He later received a Master of Science in Electrical Engineering and an additional subspecialty in weapons system engineering from the U.S. Naval Postgraduate School.

Trip served on active duty in the Navy for 28 years, retiring as a Captain in 2002. His at-sea assignments involved service at all levels in destroyers including command of USS DEYO (DD 989). He also commanded the Norfolk Navy Base, the world's largest naval base. After his military retirement he became a member of the Navy Civilian Senior Executive Service and served as the U.S. Navy's chief operations analyst for twelve years on the staff of the Chief of Naval Operations in the Pentagon. He is currently the Chief Analyst for Systems Planning and Analysis, Inc. in Alexandria, VA.

**(#H6) Developments in Rocketry
Electronics:
Towards Rocketry 2.0**

- **John Beans**

Session Description:

From humble beginnings in the 1950s by fireworks experts and rocket enthusiasts, model rocketry has come a long way. What impact will electronics and software continue to have on its evolution?

Presenter:

John Beans is the founder of Jolly Logic and the inventor of Chute Release.

**(#S6B) Orion spacecraft — NASA's
Multi Purpose Crew Vehicle
(MPCV):**

Update from Lockheed Martin

- **Chelsea Partridge**

Session Description:

Status of the design, construction, and testing of the MPCV as the vehicle progresses toward its first deep-space test flight.

Presenter:

Chelsea Partridge has been a test engineer for Lockheed Martin Space at NASA's Kennedy Space Center for four years, where she conducts environmental control and life support systems testing on the agency's *Orion* spacecraft. Chelsea graduated with a degree in mechanical engineering from the University of North Florida where she conceptualized CubeSat applications for bone density research. Chelsea's bioastronautics work garnered attention from NASA who sponsored her and her team for a Zero-G flight in 2014.

Chelsea is a lifelong advocate for space exploration and has done extensive academic outreach. She loves working with students, such as advising the gifted students of The Weiss School on building and launching a CubeSat of their own. Chelsea is a leader in her community. She is the President of the Missile, Space, and Range Pioneers—a community of engineers, astronauts, military personnel, and space enthusiasts that has been an institution at Cape Canaveral for over 50 years.

(#H8) Wireless Launch Systems for Rocket Clubs

- **Rick Boyette**

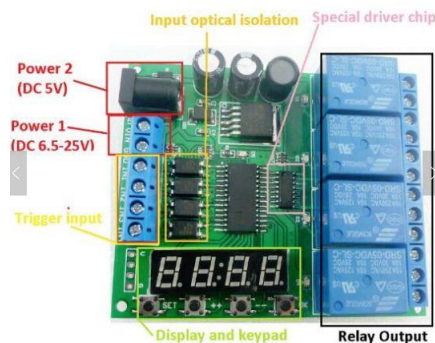
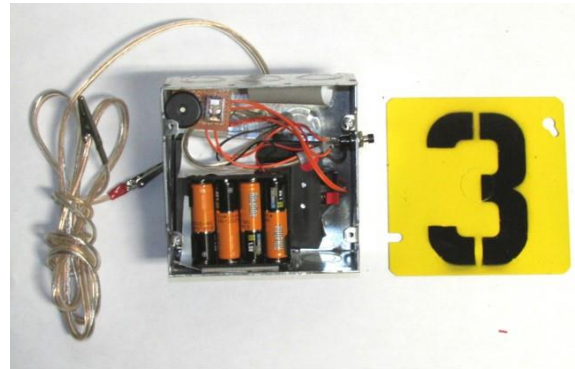
Session Description:

Most model rocket clubs, once they have become established with more than a few members, quickly learn that the individual hard-wired launch controllers they have been using are not well-suited to organized, high-volume launch activities. They also soon discover that dedicated model rocket multiple launch systems are hard to find, expensive and cumbersome to store, maintain and set up. Most clubs eventually end up building their own hard-wired system, which grows in complexity as the need for low-power, mid-power, and high-power expands. They soon find that setting up a modular hard-wired system of multiple cells takes up a lot of time and manpower, which inevitably leads to the question, “Can we make this system wireless?”

This presentation will cover the types of wireless equipment that is currently available, with a focus on adapting fireworks controllers for model rocket range use. The presentation will include the advantages and disadvantages of various systems, where and how to obtain the equipment, how much it costs and recommendations for incorporating relays and continuity check circuits into the systems.

Presenter:

“**Rocket Rick**” **Boyette** has been a NAR member since 1980 and has held a Level 3 certification since 2000. He serves on the NAR Level 3 Certification Committee. He is the founder and president of the Florida Spacemodeling Association (NAR Section



#481), which has been hosting monthly rocket launches in West Palm Beach for over 30 years. His interests include scale modeling, NAR competition, high-power rocketry, aerospace photography and ground-support equipment. Rick’s professional background is civil/structural engineering. His company, Rick Boyette Consulting Inc., provides facilities consulting services to Pratt & Whitney, Aerojet and Lockheed-Martin Sikorsky Aircraft in Palm Beach Gardens, Florida. He can be reached at roketrik@aol.com or roketrik1959@gmail.com

(#H4) BPS.Space Update

- Joe Barnard

Session Description:

Joe Barnard of BPS.space will be presenting updates on the use of thrust vector control and active stability in model rocketry, as well as propulsive landing technology developments at the model scale. The event will include details on development, testing, and analysis of mechanical design, flight software, and control systems. A Q&A will follow the presentation.

Presenter:

Joe Barnard founded BPS.space in 2015 with the goal of propulsively landing a model rocket like SpaceX and Blue Origin. Since then, the company has developed and released a commercially available thrust vectoring kit for model rockets, built a flying 1/48th model of the Falcon Heavy, and is very close to achieving its initial goal of propulsive landing.



**(#S7) Beyond the V-2:
Less-Known Rockets and
Missiles of World War II**

- **Peter Alway**

Session Description:

Most of us know the story of Wernher von Braun and the V-2 missile, but there were significant rocket developments elsewhere during the war. Russian, British, American, German, and Japanese rocketeers all developed rockets using double-base propellants. The American Jet Propulsion Laboratory created composite propellants, and rockets using storable hypergolic propellants. These not-V-2 technologies all had a part in the future of rocketry.

Presenter:

Peter Alway is the author of "*Rockets of the World*," as well as books and booklets on the history of black powder rocketry, 1930's rocket experimenters, the V-2, and assorted other rockets and missiles. He's been flying model rockets since he was a seven-year-old kid in 1967, and teaches astronomy at Schoolcraft College in Livonia, Michigan.

**(#R2) Scale Modeling:
There Are No Secrets**

- **Panel Session with
World Championships USA
Spacemodeling Team**

Session Description:

Ever wondered how the magnificent scale models flown at the World Championships come together? Join six veterans of previous US Scale and Scale Altitude teams as they lift the veil on the dark art of building museum grade models for the toughest model rocketry challenge in the world. Each panel member will share a technique that you can use to help take your project to the next level. Panel members will include **Chris Flanigan, Dr. Bob Kreutz, Jay Marsh, Dr. Mike Nowak, Matt Steele**, and moderator **James Duffy**. Expect a lively discussion of the latest techniques that you can use for scale or sport rockets, model or high power. There will be touching.

(#H1) HPR Staging Techniques

- Gary Dahlke

Session Description:

Multi-staging: it's a very impressive feat—when you can pull it off. A multi-stage flight will typically garner more spectator attention than a single stage flight of equal installed impulse. Here's your chance to learn more about how to successfully “pull it off.”

Different staging modes, types of electronics, placement of electronics, and pros & cons will be discussed. Lots of visuals: flown rockets, stills, video (on-board & ground).

Presenter:

Gary Dahlke is a career aerospace professional. Gary entered the US Air Force right out of high school and was trained in the field of ballistic missile maintenance, and later, in the field of command and control, for a total of eight years on active duty. He attended college on the GI Bill and upon graduation was hired by Martin Marietta Astronautics Group in Denver, Colorado into the Payload Integration team on the Titan IV launch vehicle. After four years, he came to Florida's “Space Coast” and was hired by Pratt & Whitney Space Propulsion and worked in various assignments on the Space Shuttle's Solid Rocket Boosters. He also had assignments at Johnson Space Center in the Flight Crew Training Division, and additional assignments back at KSC in the Orbiter Ground Operations Engineering Division.

Gary has a total of eighteen years working on the Shuttle Program and actually helped prepare all three orbiters for their final trips into space.



After the Shuttle Program, he was brought in to support the KSC Rocket University Program which served to train some of the NASA engineering team on mission operations and management using High Power Rocketry as the learning platform.

Gary's interest in model rocketry came in the 7th grade when a classmate brought a Centuri catalog to school. He and another friend quickly bought “starter sets” and formed a “club of two” to keep them occupied throughout junior high and much of high school. Gary continued to fly model rockets off and on throughout his adult life—until one day—in 1999 when he discovered a copy of High Power Rocketry magazine in a hobby store. That was about all it took. He very quickly got his Level 1 and exactly one year later (to the day) got his Level 2. He earned his Level 3 in 2008 and has since become a member of the NAR Level 3 Certification Committee. He also serves as a Tripoli Prefect and TAP. Gary is a member of three local NAR sections and continues to fly both model and high power rockets on a regular basis.

(#S2) What Were They Thinking? Or, How To Bungle A Space Mission

- Gary Dahlke

Session Description:

There are plenty of examples out there! This discussion will focus on some of the well-known, as well as some of the lesser-known dubious mistakes that have been made along the way in America's space business. Will take a deeper look into the "how" and "why" of some of these events. Guaranteed—some of these will leave you shaking your head!

Presenter:

Gary Dahlke is a career aerospace professional. Gary entered the US Air Force right out of high school and was trained in the field of ballistic missile maintenance, and later, in the field of command and control, for a total of eight years on active duty. He attended college on the GI Bill and upon graduation was hired by Martin Marietta Astronautics Group in Denver, Colorado into the Payload Integration team on the Titan IV launch vehicle. After four years, he came to Florida's "Space Coast" and was hired by Pratt & Whitney Space Propulsion and worked in various assignments on the Space Shuttle's Solid Rocket Boosters. He also had assignments at Johnson Space Center in the Flight Crew Training Division, and additional assignments back at KSC in the Orbiter Ground Operations Engineering Division.

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(#S3) HAMR: A Proof-of-Concept for Hypersonic Flight Test

- Florida Tech Student Capstone Project Team

Session Description:

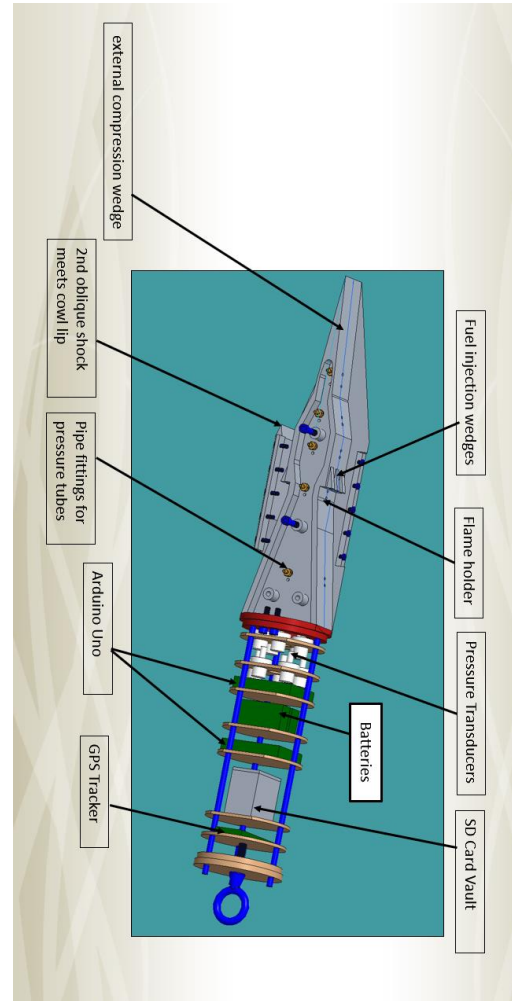
HAMR (High Altitude/Mach Rocket) is a Florida Tech senior capstone project with the goal to flight test an experimental ramjet geometry at the 2019 Spaceport America Cup. The payload is designed to capture pressure and temperature data from more than 20 sensors to evaluate the performance of the geometry against CFD models. The rocket is projected to reach a max airspeed of Mach 3 and an apogee of 50,000 ft. Features of interest include optimizing fins for supersonic flight, the aerothermodynamics within the nosecone, and the design of a low cost DAQ to record more than 20,000 data-points a second while in an extreme G-load and vibratory environment.

Presenters:

Project Manager: **Jesse Nyffenegger**

Electronics Lead: **David Lomonte**

Manufacturing Lead: **Amanda Noori**



**(#R6) G. Harry Stine Collection
Project Update**

- Amy Heidrick

Session Description:

Amy will provide an overview of the G. Harry Stine collection and its transfer to The Museum of Flight, a recap of how the project developed and the funding acquired to do it, and then provide a progress report on the work accomplished in the last six months. Amy will highlight interesting finds in the archival component of the collection thus far, and discuss how the project will proceed over the coming year with processing and cataloging the library and object components. Additionally, Amy will share information about an exciting new component of the project that involves digitizing images from past NAR annual meets and utilizing crowdsourcing for identification and cataloging.

Presenter:

Amy Heidrick, Director of Collections, The Museum of Flight (Seattle, WA)

Amy serves as the Director of The Museum of Flight's Collection department, which includes the library, archives and small objects collections, as well as the dedicated research center. She graduated from Linfield College (McMinnville, OR) with a B.A. in History and completed her master's degree in Museum Studies at the University of Washington (Seattle), and is a certified archivist with the Academy of Certified Archivists. Prior to working at TMOF, she worked in collections at The Henry Art

Gallery, the Burke Museum of Natural History and Culture, and Evergreen Aviation Museum. She was hired as the Lead Photo Archivist at TMOF in 2007 and was promoted to Supervisory Archivist in 2014, then to Associate Director of the Collections department in 2017 and Director of Collections in 2018.

(#R7) Slideshow of the Rocketeer Reunion & NAR History Project

- Jennifer Ash

Session Description:

At the NARAM 60 Rocketeer Reunion, a 90-minute slide show was produced from pictures in the NAR history archive of members from the past 60 years. Jennifer will talk about how she compiled it, what is currently in the NAR History collection, and what work still needs to be done.

Presenter:

Jennifer Ash spent 12 years on the NAR Board of Trustees and became the NAR Historian in 2012. She ran the Old Rocketeer Reunion at NARAM 50, was on the 2008 World Spacemodelling team and is known as “Bulldog” when she is helping to run the range.



(#S6A) Engineering Limitless Possibilities: an Update on United Launch Alliance

- John Gadarowski

Presenter:

John Gadarowski is a Spacecraft Integration Lead at United Launch Alliance and most recently was the project manager overseeing the Mobile Launch Platform construction and pad modifications for our next generation launch vehicle, the Vulcan Centaur.

(#S4) How Did The Cape Get Started?

- John Hilliard

This Presentation will:

- Provide historical background of Cape Canaveral including the Air Force Station and Kennedy Space Center.
- Original inhabitants of Cape Canaveral from Native Americans to the Spanish, French and English explorers and the early settlements on the Cape.
- Background of the Banana River Naval Air Station from the Naval Expansion Act of 1938 leading to the construction of the Air Station.
- Buildup of the Naval Air Station from the early construction of the base to the placing of the base in caretaker status.
- A discussion of the decision leading to Cape Canaveral area for the Joint Long Range Proving Ground and the buildup of Patrick Air Force Base and the Kennedy Space Center.
- The briefing will contain early pictures and maps of the Cape, Banana River Naval Air Station, Cape Canaveral AFS, Patrick AFB and KSC.

Presenter:

John R. Hilliard was born in Morgantown, West (By God) Virginia in 1938. My Dad was in the Air Force, so I attended 17 schools and was the first military dependent to go to Germany in 1946. Moved to Patrick AFB in 1953 and graduated from Cocoa High School in 1956. Worked at Cape Canaveral every summer during college and graduated from the Virginia Military Institute (VMI) in Jun 1960 with BS in Electrical Engineering. Worked a few months with Boeing on *Minuteman* at the Cape. Entered the Air Force in 1960 and was stationed at FE Warren AFB, WY from 1960-1964 as a Missile Combat Crew Commander on the *Atlas E* ICBM. From 1964-1968, I was an Air Force Test Conductor for the *Thor-Agena* office in the

6595th Aerospace Test Wing at Vandenberg AFB, CA launching *Thor Agena*, *Thor Delta* and *Atlas Agena* from SLC-2 & 3. I monitored the booster, *Agena* and Payload processing, integration, testing and launching. Had 31 launches from Vandenberg AFB. Received a MS in Aerospace Management from the University of Southern California in 1968. Was selected to go to Kodak in Rochester, NY in June 1968 by the way of the Pentagon to work the GAMBIT photo reconnaissance program for the System Program Office (SPO).

Arrived in Rochester in July 1968, spent three years overlooking the manufacturing of components, integration, checkout, processing and buying-off of the GAMBIT photo reconnaissance satellite before shipping to Vandenberg AFB for launch. Involved in the processing of 18 GAMBIT payloads (Vehicle 15-32). Went TDY to General Electric in Philadelphia to buy off the Satellite Recovery Vehicle (SRV) before being shipped to Kodak to integrate with the optical system. Monitored the processing and performed the quick look of the film when recovered. Also backed up the development of the Manned Orbiting Laboratory (DORIAN) photo system. Worked with CIA in evaluating the contract to purchase film for all reconnaissance systems.

I departed Rochester in August 1971. My next assignment was at Andrews AFB, DC area. Spent 27 years in DC at Andrews AFB, Pentagon, CIA (Chairman of the Space Subcommittee under the Director of Central Intelligence, Weapon and Space Systems Intelligence Committee), NSA, DIA (Managed the Scientific and Technical Intelligence Foreign Ballistic Missile Branch), and OSD (Served as the Office of the Secretary of Defense Advisor to the U.S. Commissioner of the Standing Consultive Commission on Arms Limitation with the Soviet Union, TDY Geneva, Switzerland) before retiring from Air Force. Work at ANSER for 13 years and retired as Vice President for Aerospace Systems. Moved to Satellite Beach, Florida in 1998. Currently a volunteer for the 45 SW Public Affairs Office and the Air Force Space & Missile Museum and History Center. I tour and escort people for the Air Force on Cape Canaveral AFS (CCAFS). I escort the media for all launches from CCAFS.

(#S5) America's Photographic (Film Systems) Reconnaissance Satellite Programs

- John Hilliard

This Presentation will:

- Provide a brief background of the Intelligence agencies, type of intelligences, and security systems.
- A brief background of photo systems, balloons, aircraft and early space systems. Space systems include Weapon System 117L (SAMOS, MIDAS & Discoverer), ARGON, LANYARD, CORONA, GAMBIT, HEXAGON & DORIAN.
- A more detailed discussion on space boosters, upper stages, spacecraft and technologies in satellite photo systems.
- A discussion of operations, use of imagery, major accomplishments and future.

Presenter:

John R. Hilliard was born in Morgantown, West (By God) Virginia in 1938. My Dad was in the Air Force, so I attended 17 schools and was the first military dependent to go to Germany in 1946. Moved to Patrick AFB in 1953 and graduated from Cocoa High School in 1956. Worked at Cape Canaveral every summer during college and graduated from the Virginia Military Institute (VMI) in Jun 1960 with BS in Electrical Engineering. Worked a few months with Boeing on *Minuteman* at the Cape. Entered the Air Force in 1960 and was stationed at FE Warren AFB, WY from 1960-1964 as a Missile Combat Crew Commander on the *Atlas E* ICBM. From 1964-1968, I was an Air Force Test Conductor for the *Thor-Agena* office in the 6595th Aerospace Test Wing at Vandenberg AFB, CA launching *Thor Agena*, *Thor Delta* and *Atlas Agena* from SLC-2 & 3. I monitored the booster, *Agena* and Payload processing, integration, testing and launching. Had 31

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(#R3) Building Model Rockets - Shrouds

- Hans “Chris” Michielssen

Session Description:

Today’s NARCON session will concentrate on the undoing of many builds - How To Successfully Make Card Stock Shrouds. Questions and giveaways will follow the build portion of the session.

Presenter:

Chris Michielssen’s Model Rocketry obsession started in 1969.

In his teens he won a few designs contests which led to an offer to join the Centuri R&D team.

Chris now heads Odd’l Rockets producing kits and accessories. “I consider myself to be more of a builder and designer than a flyer.” His *Model Rocket Building* Blog has been active with daily posts for nearly 10 years. Worldwide readership averages about 1,000 hits per day.



(#S1) Apollo Myths and Little-Known Facts

- **Wes Oleszewski**

Session Description:

Through mass publication by production companies and news media who have little or no knowledge of the actual events, Project Apollo has grown a series of wart-like myths that seem to never want to go away. Additionally, many interesting and fun facts about the program have been completely covered over in the process. Let's face it folks, we seem to always be confronted by "documentaries" produced by people who think that every Saturn V was painted like 500F. In "Apollo Myths and Little-Known Facts" we are going to scrape off some of those warts and slap on a bandage of actual history and then add some interesting and fun facts. Although you may think you personally know all there is to know about Project Apollo, the odds are good that in this program there will be something new for you.

Presenter:

Best-selling author **Wes Oleszewski** not only published the six-book series "*Growing Up with Spaceflight*" he has also published 18 other books. Known for his meticulous deep research and attention to previously over-looked details his work is also garnished with humor.



He is also the father of Dr. Zooch Rockets which developed and marketed more than 30 "ant scale" kits that were sold world-wide for 14 years. Wes also acts as the Spaceflight Analyst for the Aero-News network. He is a former airline captain and corporate pilot with a Bachelor's Degree in Aeronautical Science from the Embry-Riddle Aeronautical University.

When not researching and documenting historic events he authors the *Klyde Morris* cartoon strip.

Wes is an NAR member in good standing and, in consideration of the 50th anniversary of the Apollo 11 mission, will be giving a talk at NARCON 2019 on the subject of "Apollo Myths and Little Known Facts." Additionally, while attending the event he will be releasing the second edition of his "*Apollo-Part One*" book from the "*Growing Up with Spaceflight*" series and signing books for the attendees.

(#H9) GPS Guided Recovery

- **Tim Van Milligan
and Brian Houghton**

Session Description:

This presentation explores the possibilities of using GPS to guide model rockets to a desired landing location. Using modern GPS to control the decent and landing of model rockets has many advantages over simple ballistic parachute recovery, gliding and helicopter systems, chute releases and dual deployment techniques. An inclusive broad description of both rigid and flexible systems will be presented along with advantages and disadvantages of each type of system. Furthermore, a possible realization of this type of system will be provided. Presented by Brian Houghton and Tim Van Milligan of Apogee Components, this session will cover the current state of technology for this unique recover method.

Presenters:

- **Brian Houghton**, who lives near Denver, Colorado, is the owner of “Fins and Fire Rocketry” which makes specialized components for model rocketeers, like aluminum rocket retainers and the e-match mate ejection charge canisters. He also makes, exclusively for Apogee Components, a simple GPS tracker that makes it easy for modelers to find rockets that fly out of sight.
- **Tim Van Milligan** is a past resident of Cape Canaveral, Florida, having worked as a launch operations engineer on the *Delta II* rocket from 1988 to 1991. He currently lives in Colorado Springs, Colorado and is the owner of Apogee Components, Inc. He has been flying model rockets since 1976.

**(#R5) Centuri Summer:
Adventures of an American
Rocketeer - Part 2: The *Sandhawk*
Story, Centuri, and NARAM-10**

- Michael Poss, NAR 5702

Session Description:

Building upon his well-received prologue presented at NARAM-59, this second part of “Centuri Summer” revolves around researching, designing, and building the world’s first *Sandhawk* scale model rocket that won the 1968 NARAM-10 Junior Division Scale Altitude event; working at legendary Centuri Engineering Co. in Phoenix, AZ for R&D Manager Doug Malewicki; collaborating with Vern Estes and his team to develop the first production *Sandhawk* scale model, Estes Kit No. K-51; and the ongoing friendship with Betty Estes.

Presenter:

As a child of the Space Race, **Michael Poss** aspired to become an Aerospace Engineer while his late World War II U.S. Army Air Corps cadet father was assigned to the U.S. Army Electronic Proving Grounds, Fort Huachuca, AZ in the mid-1960s. After graduating as a California State and Hughes Aircraft Co. Scholar from the University of Southern California School of Engineering in 1973 with a B.Sci in Applied Mechanics, Michael joined the 1974 Hughes Space & Communications Group IR&D Advanced Projects Team developing the HS 361, a prototype three-axis body stabilized communications satellite bus that positioned Hughes to meet next generation commercial and government needs.

Ten years later Michael earned a Master of Architecture degree from UCLA and became a nationally-recognized expert in intelligent

graphics CAD systems at McDonnell Douglas Information Systems Group, and then as a management and technology consultant at Booz Allen Hamilton in the Washington, DC area. From 2007-16, Michael worked on multi-billion dollar NOAA Environmental Satellite Data & Information Systems (NESDIS) programs upgrading IT processing and archiving ground systems to support next generation geosynchronous orbit GOES and polar orbit JPSS weather satellites now in service.

Like many others, Michael began building and flying model rockets after responding to Estes and Centuri 1960s Boy’s Life magazine ads. He won the 1966 Centuri “American Rocketeer” name-the-newsletter contest, was a rocketry Technical Editor for Model Car & Science magazine, and covered Southern California NAR competition for Model Rocketry magazine. He is a more than 50-year NAR member who competed in 1967 NARAM-9 at Mankato State College, MN, 1968 NARAM-10 at Wallops Island, VA, 1969 NARAM-11 at the USAF Academy, Colorado Springs, CO, and was selected for the U.S. Team to compete in the 1970 First World Championships in Vrsac, Yugoslavia. He also founded the Southland Association of Rocketry NAR Section in Los Angeles, and he has flown High Power rockets at East Coast launches since the mid-1990s.

While working now primarily on Mid-Century Modern Architecture historic preservation projects, Michael is also writing several books, including “Centuri Summer: Adventures of an American Rocketeer.” At 2017 NARAM-59, he presented a first-time preview of “Part 1: The New Guys and NARAM-9” reviewed by Museum of Flight model rocketry history champion Pat Fitzpatrick in *Sport Rocketry* magazine November-December 2017 issue.

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(#R4) 3D Printing in Scale Model Building

- Dr. Michael Nowak

Session Description:

3D printing is a rapidly evolving technology that is being used in many applications. This talk will discuss the use of 3D printing in building flying scale model rockets. Types of printer formats, materials, part design, costs and ways to create prints will be discussed. Examples of projects that utilize the unique advantages of 3D printing will be presented.

Presenter:

Dr. Michael Nowak grew up with the NASA manned space program in the 1960's and began building and flying model rockets in 1968. I was active in NAR competition in the 1970's teaming up with Matt Steele and won a National Team Championship with him in 1978. I took a hiatus from the hobby to pursue my career in medicine and raise a family. I returned to the hobby in 2006 and have been active in NAR and FAI competition. My primary interest is organizing and running FAI meets in the US and building and flying scale models and models for any competition event that requires use of an altimeter.



(#S8) Apollo Lunar Module Descent Trajectory Design

- David Mohr

Session Description:

Review of numerous aspects of the Apollo Lunar Module lunar landing problem. Earth Orbit Rendezvous (EOR) and Lunar Orbit Rendezvous (LOR) considerations and how they drove overall vehicle designs. CSM/LM lunar orbit options and how eventual trajectory choices were determined. How the trajectory design had to accommodate the vehicle and how the vehicle design had to accommodate the trajectory, e.g, Lunar Module descent stage design dependencies based on trajectory. Mechanics of the Powered Descent Initiation (PDI) burn.

Presenter:

David Mohr has an international reputation as a rocket engine designer and propulsion systems lecturer. He designs and evaluates thermodynamic cycles for air-breathing, nuclear and rocket powerplant systems; and builds rocket engine components. Mr. Mohr has developed an innovative liquid rocket ignition device for reliable high-altitude-ignition. He provides rocket propulsion design, analysis, fabrication and test expertise to many aerospace companies such as Applied Astronautics, Hybridyne Aerospace, Lockheed-Martin and Aerojet. Early in his career, he assisted Rocketdyne in developing the Space Shuttle Main Engine (SSME). One current project is the

development of a liquid oxygen turbopump for a new, high-pressure propulsion system. Mr. Mohr fabricates and tests rocket engines and fluid pumping machinery in his own facilities. He has lectured at numerous commercial and government facilities including NASA's Stennis Space Center and Italy's FiatAvio. Mr. Mohr has contributed sections to the Handbook of Turbomachinery and the Handbook of Machinery Dynamics.

(#H5) Winning Strategy for the 2018 BALLS Hamster Dance

- Gary Rosenfield

Session Description:

A short history of and a strategy for winning one of hobby rocketry's most unique and whimsical contests, the Hamster Dance (HD). Held annually for the past eight years in Nevada's Black Rock Desert in conjunction with Tripoli Rocketry Association's (TRA) BALLS launch, Hamster Dance is a uniquely TRA event, with peculiarly restrictive weight limits, construction materials and performance requirements. Some of the strategies discussed can be applied to other rocketry contests and endeavors as well.

Presenter:

Gary Rosenfield has been involved in various aspects of hobby and professional rocketry for 50 years. After launching his first rocket in 1969 and quickly advancing through the scope of the available consumer activity at the time, he manufactured and tested his first successful composite propellant rocket motors in 1973.

Gary founded Composite Dynamics (CD) in 1975. CD was one of the first companies to manufacture and sell composite propellant consumer rocket motors after the demise of Enerjet (the first composite propellant consumer rocket company), and one of the first to manufacture commercial rocket motors using Hydroxyl-Terminated Polybutadiene (HTPB) binder.

Gary joined the Bermite Division of Whittaker Corporation in 1980 as an R&D Engineer. He applied his experience with HTPB propellants to such diverse projects as oil well tool gas generators and the Reduced Smoke *Sidewinder*.

From 1982 to 1984 Gary worked for Aerojet Tactical Systems. While at Aerojet, he was responsible for technical assistance and process improvement in all phases of propellant and liner manufacturing operations for a number of missile programs such as *Minuteman*,

Peacekeeper, Harpoon, Hawk, Standard Missile and Sidewinder.



Gary founded AeroTech Consumer Aerospace in 1982 as a part-time endeavor, which by the early '90s had become the second largest consumer rocket company in the U.S. He also co-founded Industrial Solid Propulsion (ISP) in 1985, a manufacturer of rocket motors and propellants for military, industrial and commercial applications. He founded RCS Rocket Motor Components (RCS) in 1995. RCS acquired the assets of Quest Aerospace in 2013.

Gary is the inventor or co-inventor on nine granted and three pending U.S. patents covering technological advances and innovative designs in rocketry and lasers including single-use and reloadable solid propellant motors, propellants, hybrid rocket motors, electronics, igniters and fin mounting systems. He received the National Association of Rocketry's (NAR) Howard Galloway Spacemodeling Award in 1989 for the development of the modern composite propellant commercial rocket motor, and was granted the Tripoli Rocketry Association's (TRA) Lifetime Membership Award in 2001 for significant contributions to high power rocketry. He has served on the boards of both organizations, including simultaneously holding both board positions for three years, and is a current TRA board member. He was more recently awarded lifetime membership status in TRA's Association of Experimental Rocketry of the Pacific (AeroPAC) prefecture, and is a current board member.