As with DemoSat I & II, DemoSat III can be accomplished in one year. Several valuable lessons were learned about scheduling during DemoSat I & II and will be implemented on DemoSat III. There will be monthly teleconferences with all members. Each affiliate’s campus will be visited at least once during the program to help students with their preparations for launch. Each campus has a slightly different academic schedule making one launch opportunity challenging for some, therefore DemoSat III will have two launches. This will create two separate DemoSat III groups and schedules. Group A [A] will be for those affiliates wanting to launch on April 16, 2005 and Group B [B] for those wanting to launch on August 6, 2005. Figure 1 shows a milestone schedule for both Groups A and B.

**Schedule Highlights:** In January, the solicitation of technology tools and concepts will be completed from NASA scientists and engineers to be prototyped by the students as well as the affiliate Training Workshop. In April, the Launch Readiness Review will be held for Group A and the Critical Design Review for Group B. These reviews will be held in conjunction with the Annual CSGC Undergraduate Research Symposium. In August, Group B will have their Launch Readiness Review. Scientists and engineers from JPL, ARC, GSFC, KSC, and JSC will be invited to attend these reviews and the launch. Also in August, one student from each school will travel to one of the NASA centers to present their final results to their advisors. This is new to DemoSat III and is expected to take place at JPL on August 11-12, 2005. Students will be given a tour of JPL following the presentations. In October, both groups will reconvene to share data and experiences. This meeting will be held in conjunction with our annual CSGC Fall Affiliate meeting. Affiliates and their students will receive guidelines on the final report at this meeting. The DemoSat III report will be submitted to NASA Headquarters in December 2005.

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**Figure 1: DemoSat III Milestone Schedule**
NASA/university partnerships to “train the next generation of explorers.” With this in mind, they go on to explain that, “at present, there are insufficient methods for students to acquire hands-on experience in the scientific and technical disciplines necessary for space commerce and exploration.”

DemoSat I, II, and III are helping solve this situation. College students involved in DemoSat missions are engaged in hands-on, discovery learning with mentors from NASA Centers, interacting with the cutting edge technologies of today. They are presented with problems and are challenged to come up with unique ways to solve them. By having NASA scientists and engineers from JPL, ARC, GSFC, KSC, and JSC working with students from CSGC to address the challenges in NASA’s future missions and to develop technology prototypes for these missions, this proposed program will help NASA while providing an exciting hands-on training, technology-focused environment for these students. In the end, DemoSat I, II, and III will involve over 700 students directly working on innovative solutions to actual challenges in NASA’s future programs and evaluating these solutions with prototypes flown on balloons.

The DemoSat project also fulfills another of the challenges put for in the Commission’s Report. “Given the breadth and operational complexities presented by the vision, this next generation workforce will need significant inter-disciplinary experience as well.” The DemoSat project is designed to engage students from varieties of backgrounds. As each BalloonSat team is in charge of all aspects of their mission, many disciplines greatly benefit every payload. In past DemoSat projects, students have come from backgrounds including: Aerospace, Mechanical, and Electrical Engineering, Computer Science, Physics, Applied Mathematics, Mechanical Industrial Engineering, Astrophysics, and Astronomy. Each student brings her or his unique background to each mission and collaborates with peers and faculty and NASA mentors through design, build, test, launch, data analysis, and reporting. DemoSat III provides scientific and technological hands-on experience that spans disciplines.

College students involved in DemoSat are excited to share their experiences with K-12 students in their regions. These students, therefore, help to fill the pipeline, while the college students are preparing to move through the pipeline into industry and NASA centers. Students graduating from this program will be inspired to and have the confidence to pursue these challenges and more. These experiences can be put on student résumés creating more opportunities form them in NASA centers and support industries. DemoSat III students will work with NASA scientists and engineers that they may some day work with again. It will also give them insights into their future while they still have many career decisions ahead.

The students working on DemoSat III will have an experience of a lifetime – an experience that will shape their future and prepare them to join the workforce with the experience needed to ensure their success and their positive contribution to NASA and the Nation’s space exploration vision. As part of this experience, a student from each school will go JPL to present their findings. The relationships formed during DemoSat III will help these students when attempting to join NASA. The history of CSGC has demonstrated this as the numbers of alumni working at NASA centers continues to grow as well as the number of students coming to CSGC saying, “I want to work at NASA.”
1.0 Project Description

Consortium Participation:
The CSGC is strong and is staffed with talented faculty members who are well established in their home institutions. CSGC is comprised of 14 active member institutions around the state, 13 of these are academic institutions. Ten members will be participating in DemoSat III. CSGC always looks for projects and programs that involve multiple member institutions and many of our inner city and rural affiliates need interactive and exciting programs for their students. DemoSat fulfills this need and will continue to bring space programs to campuses across Colorado. Affiliates are looking for ways to sustain the DemoSat program through partnerships with local companies and departments on their campuses. Several affiliates are receiving matching funds for their DemoSat program. CSGC has a long tradition of building successful student space payloads. Over the last 15 years, CSGC students have launched three sounding rockets, three Space Shuttle payloads, and over 120 BalloonSats. In addition, students are currently building and testing four satellite systems: the Citizen Explorer (CX), the Three Corner Satellite constellation (3CS – scheduled for launch on 11/18/04), the Deployment and Intelligent Nanosatellite Operations (DINO) satellite, and the Magnetic field Investigation of Mars through Interacting Consortia (MIMIC) satellite. CSGC has hosted three “Starting Student Space Hardware Programs – A How-To Workshop” in 2002, 2003, and 2004. One hundred and sixty Space Grant Directors and educators from 42 states came to learn simple ways to start student space programs in their own state. The workshops were an enormous success and culminated with simultaneous balloon launches carrying over 50 participant-built BalloonSats. DemoSat III will draw upon the successes and lessons learned from these workshops when DemoSat III is implemented across Colorado.

2.0 Project Relationship to NASA

DemoSat III is a great way for a gender, cultural, and geographically diverse group of students to work with NASA scientists and engineers in a direct and meaningful way giving these students valuable hands-on experience in NASA technologies.

CSGC has strong ties with many of the NASA centers, especially JPL, ARC, KSC, and GSFC. On DemoSat III, CSGC will try to add JSC and GSFC engineers and advisors to the program. Many CSGC alumni are working directly at JPL, ARC, KSC and many others are working for companies that support these centers. Students are actively recruited by these NASA centers. Over the last 15 years, the CSGC has collaborated on a multitude of different projects with these centers and others. DemoSat III will continue to build upon and increase these ties. Many of the advisors for DemoSat I & II are excited by the opportunity to serve as advisors and mentors again on DemoSat III. The following individuals have agreed to join DemoSat III and contribute their time and ideas to the project: from JPL are Robert Shotwell, Rob Sherwood, Steve Chien, Joel Rademacher, Brad Clement, Danny Tran, Caroline Chouinard, E.J. Wyatt, and Steve Matousek; from ARC is Anthony Colaprete; and from KSC is Michael Freeman. Letters of support were not included due to Announcement guidelines but are available at [https://spacegrant.colorado.edu/demosat](https://spacegrant.colorado.edu/demosat). Contact has been made with GSFC through Pat Kilroy and Sherri Gurls from JSC.

In *A Journey to Inspire, Innovate, and Discover*, the Report of the President’s Commission on Implementation of United States Space Exploration Policy, the Commission encourages
**1.0 Project Description**

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<th>Objectives</th>
<th>Expected Outcomes</th>
<th>Potential Impacts</th>
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| **>125 students involved** | • >125 students gain hands-on experience  
• Interaction with NASA experts  
• Self confidence to continue in space projects | • >125 students with increased talents in SMET  
• >125 students with insight in NASA programs, missions, and technologies | • DemoSat I&II involved over 575 students  
• 15 DemoSat II students will help lead new students on DemoSat III |
| **>3,000 students reached through outreach** | • >3,000 K-16 students and adults informed of NASA missions, programs, and technologies | • >3000 individuals become more interested in following in the footsteps of the 575 involved students | • DemoSat I&II reached over 7,000 students through outreach.  
• CSGC outreach programs reach 4,000 people/year |
| **10 campuses and affiliates** | • Campuses without strong aerospace, NASA, and industrial opportunities will be able to work with NASA and industry experts | • More non-traditional campuses and more diverse students will be prepared to be part of the NASA workforce | • DemoSat I&II involved 11 affiliates, creating a new program on their campus  
• Sounding rocket program had a similar impact |
| **40 academic advisors** | • 40 faculty members across the state able to participate in an exciting, new program | • 40 faculty will be motivated to continue and grow this experience | • DemoSat I&II involved 50 academic advisors  
• Many advisors agreed to work on DemoSat III |
| **10 NASA advisors from JPL, ARC, and KSC** | • Student programs are based on NASA’s future missions, programs, Enterprises, and vision  
• Brings NASA personnel to the students and promotes interaction with NASA experts | • Students are better prepared to join the NASA workforce  
• NASA experts are better tuned into capabilities of students  
• NASA experts are motivated | • 13 JPL, ARC, & KSC advisors on DemoSat I&II  
• Contacts made with GSFC and JSC  
• CSGC has worked with JPL, ARC, GSFC, KSC, and JSC experts with similar outcomes. |
| **13 Technologies** | • 13 NASA technologies will be demonstrated | • Students will work on current & future NASA mission technologies | • 26 NASA Technologies were demonstrated on DemoSat I&II |

*Table 1: DemoSat III Metrics: Objectives, Expected Outcomes, and Potential Impacts*
1.0 Project Description

Specific recruiting efforts will continue to be made to attract and retain students from underserved and minority backgrounds. Affiliate members and former DemoSat students will present the DemoSat III program to students involved minority programs such as Multicultural Engineering Program (MEP) and Women In Engineering Program (WIEP) on their campuses. Many of our affiliate members are minority serving institutions. The target audience is undergraduate students but it is expected to involve a few high school students and graduate students. For more information on the assessment of the DemoSat III specific objectives, expected outcomes, and potential impacts, please see Table 1.

The workforce development goal of DemoSat III is to continue to develop, prototype, and test new technologies and innovative concepts that have been suggested by scientists and engineers at JPL, ARC, and KSC. DemoSat III will start immediately upon award with a planning meeting with these scientists and engineers, where technologies and concepts will be solicited and finalized. Working with these scientists and engineers, student teams involved with DemoSat III will design and build BalloonSats, around one or more of these suggested NASA technologies. The students will launch their BalloonSats to 100,000 feet on a high altitude balloon. At least 13 new technologies will be demonstrated. If it is determined necessary, a workshop will be offered to the DemoSat III affiliates and their faculty members to provide them with materials to support activities at their home intuitions. Each affiliate leader will be given advice on how to recruit students and faculty.

**Measurable:** The goals and objectives of the DemoSat III are measurable and will be reported to NASA, the scientists and engineers, and the faculty involved. A final report will be written and distributed by December 2005. In this report, the technologies demonstrated at each of the schools will be discussed. This report was generated on DemoSat I and is currently available via the website. The DemoSat II report will be completed and distributed by December 2004.

**Achievable and Realistic:** The goals and objectives of DemoSat III are both achievable and realistic based on the successful DemoSat I & II programs. This basis was used in determining the goals and objectives for DemoSat III and can be found in Table 1.

**Time Bound:** DemoSat III is a one year program that can be completed in one year. DemoSat I and II have both been completed in 9 to 12 months. More details on the schedule can be found in Section 3 of this proposal.

The DemoSat program has been very successful in Colorado and can be a model for other consortia to follow. Like Colorado, many Space Grant Consortia do not have a NASA center in their state but do have many students that are interested in NASA. Also, many Consortia now have started student hands-on programs through their participation in Starting Student Space Hardware Programs workshops in Boulder that could be used to demonstrate technologies for NASA. With the assistance of the University Affairs office at each of the NASA centers, other consortia could get the NASA engineers and scientists involved with their program. Using DemoSat is a great way to provide valuable hands-on experiences to a large number of students by working with NASA ideas, engineers, and scientists.
1.0 Project Description

Background:
The DemoSat III project is a continuation of the Colorado Space Grant Consortium’s (CSGC) successful 2002 and 2003 Workforce projects DemoSat I and DemoSat II. The DemoSat I & II projects demonstrated 26 different NASA technologies using 24 student-designed and built miniature satellites called BalloonSats. DemoSat II BalloonSats were launched on April 17, 2004 and August 7, 2004 on high altitude balloons to 100,000 feet and recovered on the same days. On DemoSat I & II, success was measured by quantitative and qualitative means. On the quantitative side, DemoSat I & II involved 11 CSGC member institutions, over 575 students, over 50 academic advisors, and 13 engineers and scientists from NASA’s Jet Propulsion Laboratory (JPL), Ames Research Center (ARC), and Kennedy Space Center (KSC). In addition, over 7,000 students and teachers were indirectly involved with DemoSat I & II through outreach efforts. On the qualitative side, DemoSat I & II continued to motivate the entire CSGC network. Student hands-on projects created during DemoSat I were continued during DemoSat II, continuing to bring new students into Space Grant. These students were able to interact with other students around the CSGC during reviews, teleconferences, and launch activities as well as with engineers and scientists from NASA. Students, academic advisors, NASA engineers and scientists, and the CSGC affiliate leads had great things to report on their DemoSat I & II experiences. Many students and faculty have already expressed a great interest in a possible DemoSat III, which would be enabled by the 2004 Aerospace Workforce Development Competition award. DemoSat III would be a collaborative effort between the members of the CSGC, JPL, ARC, KSC, and numerous Colorado students. During DemoSat III, it is expected that additional engineers and scientists will be added from the Goddard Space Flight Center (GSFC) and Johnson Space Center (JSC).

DemoSat III Meets The Need:
Students in Colorado hear about space often in Colorado and many would like to be involved in the space industry. Since the beginning of DemoSat I in January 2003, Colorado students still say, “I want to work at NASA” when asked why they want to become involved with the CSGC’s range of different and on-going programs. Even though there is not a NASA center in Colorado, space in Colorado is big. Over $4.8 billion is spent on aerospace in Colorado. Due to the “graying of the workforce,” Colorado and NASA need to have qualified workforce to recruit from. DemoSat I & II have helped in this area and so will DemoSat III. A significant number of the CSGC’s alumni are working for NASA and many others have found employment in the aerospace industry in Colorado and nationwide. Now over 575 current students are also on track do the same due to their involvement in DemoSat I & II, and other on-going CSGC programs.

DemoSat III Goals and Objectives are SMART:
Specific: DemoSat III will involve 10 active academic affiliates of the CSGC and is expected to involve over 125 students directly and to reach over 3,000 students indirectly through outreach over the next year. DemoSat III also expects to involve nearly 40 academic advisors and educators as well as at least 10 NASA scientists and engineers from three NASA Centers.
The Colorado Space Grant Consortium is made up of 14 affiliate institutions, 13 of which are academic. The 10 academic affiliates listed here, are interested in participating in this proposal. Their concurrence is indicated by their signature on their budget sheet found in Appendix B. The participating affiliates and points of contact include:

- University of Colorado at Boulder  Chris Koehler
- University of Colorado at Colorado Springs  Jason Rooney
- Colorado State University Pueblo  Wolfgang Sauer
- Colorado School of Mines  Bob Knecht
- University of Northern Colorado  Bob Walch
- Western State College  Ted Violett
- Metro State College of Denver  Mingli He & Keith Norwood
- Pikes Peak Community College  David Esker
- Colorado State University  Paul Wilbur
- Mesa State College  Phil Kavanagh and Warren MacEvoy
Augmentation to Colorado Space Grant Program:
Developing NASA’s Future Workforce through
Student Demonstrations of NASA’s Advanced Technologies

“DemoSat III”

In Response to the

Aerospace Workforce Development Competition

Office of the Chief Education Officer
September 21, 2004

Colorado Space Grant Consortium

Interim Director, Chris Koehler
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Boulder, Colorado 80309-0520

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November 1, 2004