National Aeronautics and Space Administration

Technology, Innovation, & Engineering Committee
of the
NASA Advisory Council

Virtual Meeting
January 27, 2021

Meeting Minutes

G. Michael Green, Executive Secretary **Michael Johns, Chair**

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Meeting Report prepared by
Elizabeth Sheley

NAC Technology, Innovation, and Engineering Committee Meeting
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Virtual Meeting

Welcome and Overview of Agenda/Logistics
Mr. G. Michael Green, Executive Secretary of the NASA Advisory Council (NAC) Technology, Innovation, and Engineering (TI&E) Committee, welcomed the Committee members. He noted that Dr. Bhavya Lal was a new Committee member but had taken a leave of absence while working with the presidential transition team. Future TI&E meetings will take into account the timing of the next NAC meeting and the release of the Fiscal Year 2022 (FY22) President's Budget Request (PBR).

Opening Remarks
Mr. James Free, TI&E Chair, thanked Mr. Green and the Committee members for their time and effort. As one of the NAC committee chairs, he spoke with the presidential transition team and provided them with an update based on the outbrief from the last TI&E meeting. He added that this was the anniversary of the loss of the Apollo 1 crew, a reminder that they should never lose sight of how hard it is to operate in space.

Space Technology Mission Directorate (STMD) Update
Mr. James Reuter, Associate Administrator of STMD, welcomed the meeting participants. He spoke with the presidential transition team as well, and it seemed to be a good discussion. An organizational chart for STMD showed that the Directorate had added a level of division and program directors (PDs). The PDs are: Ms. Niki Werkheiser for Technology Maturation; Ms. Jenn Gustetic for Early State Innovation and Partnerships; and Ms. Trudy Kortes for Technology Demonstration (TDM). Mr. Chris Baker is the Program Executive for Small Spacecraft and Flight Opportunities. There are open positions remaining, and some people are on detail, which enables cross-training.

STMD's enacted budget for FY21 is essentially the same as that for FY20, totaling $1.1 billion. Congressional directions were also similar to those of FY20. There is a loss in buying power that has led to some serious discussions, but Mr. Reuter said that he is pleased overall. In referencing his slide on the PBR vs enacted budgets, he noted that the difference is fairly typical. The Flight Opportunities budget increase is all for STEM engagement covering K-12, university, and early-stage researchers. The PBR had requested a larger budget for the Small Business Innovation Research (SBIR) program, but the reduction is proportional, following a formula, and does not have a real impact. He would like a bit more flexibility with the budget, but this is not new. They are now working on an initial operating plan that has to go to the agency, Office of Management and Budget (OMB), and Congress for approval before release.

Fission Surface Power (FSP) work will be on hold, but the budget will allow STMD to issue a solicitation and begin selections. The impact is several months. Nuclear Thermal Power (NTP) had a similar plan, and the Directorate did not want the two solicitations out at the same time, so NTP is going out first. Mr. Free noted that TI&E had recommended FSP as the higher priority. Mr. Reuter replied that Congress stated that NTP will go first. There is a lot of interest in the community for FSP, but the solicitation is the best they can do in FY21. Dr. Mary Ellen Weber wondered about what drove Congress to make the change, and Dr. Matthew Mountain referred to Congressional language questioning the Artemis campaign. Mr. Reuter explained that those questions related to the 2024 timeline for a lunar mission

and attendant budget increase. The NTP direction has been there for the last several years and is not caught up in the Artemis prioritization. The Alabama delegation has the highest interest in this. Mr. Reuter noted that STMD has never had the PBR as the enacted budget, and the omnibus budget has grown a lot over the years. There are always more ideas than budget, but the Directorate is happy with where it is.

None of these appropriations include COVID-19 mitigations. STMD's programs have experienced some impacts, especially for work that must be done on-site. Though most programs have largely stayed on schedule, they are much less efficient where there is "touch labor" required. The Directorate is tracking the impacts, which may come in as a realized cost, as with the Deep Space Optical Communications (DSOC) project. Other impacts may result in drawing down reserves and causing a schedule delay or costs realized in the out-years. In addition, there may be lost opportunities or an inability to grant extensions to universities.

STMD has more than 2,200 active projects across the portfolio, including about 160 in higher technology readiness level programs, and most of these lead to flight demonstrations. Game Changing Development (GCD) had about 127 projects, up from 42 a couple of years ago. There are about 400 projects with academic partners and STMD has awarded about $700 million to academic institutions responding to solicitations. The Laser Communications Relay Demonstration (LCRD) has been delivered, but the launch has been delayed due to issues at the U.S. Space Force (USSF). The Green Propellant Infusion Mission (GPIM) successfully completed its mission and safely re-entered Earth's atmosphere. DSOC is awaiting delivery of a critical part before entering integration and testing. The Psyche mission is progressing well. The Low-Earth Orbit Flight Test of an Inflatable Decelerator (LOFTID) had its Critical Design Review (CDR) and passed Key Decision Point (KDP) D in December. There are plans for a 2022 demonstration mission, though that could slip. The Made in Space, Inc. mission called On-Orbit Servicing, Assembly and Manufacturing 2 (OSAM-2), formerly Archinaut, will assemble a solar array in space; it had a Preliminary Design Review (PDR) in which some challenges were identified, but it is back on track. On-orbit Servicing Assembly and Manufacturing 1 (OSAM-1) was affected by COVID due to the large amount of hands-on work required, though it did not have a hard schedule; it is now making good technical progress. In the summer, the Solar Electric Propulsion (SEP) scope of work was reduced to the thruster only.

Dr. Weber observed that there are commercial providers of laser communications, and she wanted to know what NASA is doing that is different. Mr. Reuter replied that NASA is planning a geosynchronous orbit (GEO) demonstration that is integrated into other activities and goes from GEO to ground stations.

In October, STMD announced 14 new Tipping Point awards. The selections will have a combined award value exceeding $370 million and STMD will negotiate fixed-price contracts for up to 5 years. The Science Mission Directorate (SMD), through the Commercial Lunar Payload Services (CLPS) initiative, made a selection for a lander for the PRIME-1 drill, which is intended for 2022 as a precursor mission. It makes a nice demonstration with a hopper, drill, and the network. On Cryogenic Fluid Management (CFM), STMD is addressing long-term near zero boil-off in space; there are four flight demonstrations that are complementary to each other. Mr. Reuter noted the 2020 Announcement of Collaboration Opportunity (ACO) selections, which were announced in November, with 20 awards to 17 companies working with 8 different centers. The next solicitation may need to be delayed due to budget concerns, however. Mars 2020 Perseverance will include four STMD technologies.

Ms. Werkheiser was to discuss the Lunar Surface Innovation Consortium (LSIC) meeting later that day. There is a solicitation for a vertical solar array demonstration that will provide a better angle with the Sun. A 2020 Breakthrough, Innovative and Game-changing (BIG) Idea challenge with eight universities was successful on the topic of lunar exploration. This competition will occur again in 2021 for dust mitigation. A 5-year Bionutrients project studying the ability to store and generate nutrients on-orbit is being demonstrated on the International Space Station. Every 6 months, astronauts will activate yeast packets that will be returned to Earth for analysis. The Flight Opportunities program completed its 200th flight and is continuing its pace in 2021. There were two lunar dust innovations tested to help advance sensor technologies. The program also announced 31 flight opportunities and payloads with over $16 million in NASA investment. Recently, SpaceX had a dedicated rideshare mission that included some STMD CubeSats.

Mr. Free asked about management of CFM. Mr. Reuter replied that that is in TDM, with support from propulsion and in-space transportation people, is going into a Marshall/Glenn activity. Mr. Free then said that TI&E had had a big discussion about nuclear propulsion and called for a decision by 2022 on the architecture studies. He asked about the status of this. Mr. Reuter replied that a National Academy of Sciences (NAS) report will come out soon on NTP and SEP. STMD has some technology development on the NTP reactor and would like to move forward on a 2022 test. However, there are funding gaps, and he would like to see more technology development funding. The architecture studies are ongoing and favor a Nuclear Electric Propulsion (NEP) system. Science partnerships are continuing, but with some budget cautions. DSOC is still in good shape. STMD offered a materials capability on the Planetary Sciences Division (PSD) Discovery call, to support a Venus or hot planet effort.

Dr. Michael Gazarik noted that some of the technology development mission selections NASA had planned years ago are taking much longer than initially planned. He wondered if there were any lessons learned for moving faster. Mr. Reuter replied that technology demonstrations in space are difficult. DSAC taught NASA to make sure the technology is really ready to fly. They hope to apply lessons on streamlining. The simpler demonstrations do not take long, and flight opportunities can turn around quickly. But some of these cannot be shorter. There is more access to space now, which enables the launch of some projects that sat in storage; the ride opportunities are key, and the CLPS program is enabling more flights. It will help to have the experience the agency needs to standardize and recognize the interfaces.

Dr. Mountain said that the question remains as to whether the issue was cash, physics, engineering, or access. It is important to determine these things and put them in the reports, especially with a new administration. It helps to articulate what slows things down. Mr. Reuter agreed, adding that it can be readiness as well. For example, on the Deep Space Atomic Clock (DSAC), NASA had to do more technology work than they realized, but some of this is not apparent until integration. Dr. Mountain urged him to be clear about the issues and specify what they need.

Mr. Reuter described some of the Prizes, Challenges and Crowdsourcing efforts, including Centennial Challenges. STMD selected 22 qualifying teams to advance robotic autonomous operations, and there are three new lunar-focused challenges with $500,000 prizes for Phase 1 and possibly multi-million dollar awards beyond that. NASA is collaborating with the Canadian Space Agency (CSA) on the Deep Space Food challenge, with prizes for citizens of both countries.

The Early Career Initiative (ECI) has 17 active projects and released a NASA spinoff in December. They are continuing with the Strategic Capability Framework activities, which will be used to prioritize investments within the four strategic thrusts both throughout NASA and with industry. There is a beta version of a StarPort process for an online system to manage the framework. Mr. Reuter would like to get this out to stakeholders and see it evolve into something like a Decadal Survey. At the moment, the process is defining gaps.

There was a virtual Innovation and Opportunity Conference as a precursor to the SBIR Phase 1 release. That had more than 1,800 participants, where the in-person conferences usually have about 300 attendees. Finally, while the goal is to do one Tipping Point selection per year, STMD will probably take a year off to get the current projects underway and make funding adjustments.

Office of the Chief Technologist (OCT) Update

Dr. Douglas Terrier, NASA Chief Technologist, said that he met with the transition team, which had great questions and a lot of interest. He presented an organizational chart, noting the centers and the importance of engaging with those involved in broader technology developments, both internally and outside the agency. The NASA Technology Executive Council (NTEC) works closely with the mission directors. OCT has asked chief technologists at the centers to look for developments within their regions; the Office is defining roles and requirements. Over the past year, OCT has pushed a deterministic linkage across all mission directorates in order to have an integrated look. A big part of that is having a consistent nomenclature, and the taxonomy is now out for review. The Office has also been working with the centers on the innovation framework. There is a lot of good work in addressing the four key areas: of People, Partnerships, Practices/Processes, and Portfolio. Dr. Mountain asked about quantum technologies, which Dr. Terrier said are captured in several areas.

Dr. Erica Rodgers then spoke about the Science and Technology (S&T) Forum. NASA, USSF, and the National Reconnaissance Organization (NRO) are the key members of the forum, which is very strategy- and future-oriented. They are thinking long-term, which involves low Technology Readiness Levels (TRLs), and are trying to discern areas in which they can partner effectively. One of the Forum goals is enabling interagency collaboration. To that end, the three primary members reach out to the rest of the community, both within and outside of government. Dr. Rodgers noted some of the S&T topic areas and the three strategic thrusts. One of these is data-driven, coordinated investments. Discussing data is unifying and gets everyone on the same page, while bringing in multiple disciplines and perspectives. The S&T Forum has hosted curated virtual forums that share information on a wide range of topics. The Forum is also a technology broker, which involves sharing information and facilitating connections. Space-trusted autonomy serves as an example of how these activities work and come together. The Forum tries to create a lexicon across the participating agencies.

Next steps include investigations on topics that inform national and agency priorities, identifying opportunities for cross-agency technology development, alignment to expand impact, and creating a feedback mechanism that will benefit NASA. Dr. Terrier added that there is a quantitative systems analysis approach to identify the intersections. Mr. Free asked if any of this work has affected budget decisions. Dr. Rodgers said that the information goes to the agencies for their planning, and Dr. Terrier noted that the effect will be seen in out-year planning. The chief technologists at the centers will be involved in coordinating these efforts.

Lunar Surface Innovation Initiative (LSII) Update

Ms. Werkheiser discussed the status of LSII, which works across industry, academia, and government to develop transformative capabilities for lunar surface exploration. There are six capability areas: extreme access, extreme environment, lunar dust mitigation, in-situ resource utilization (ISRU), sustainable power, and surface excavation and construction. The LSIC was facilitated through the Johns Hopkins University Applied Physics Lab (JHUAPL) as a nationwide alliance of universities, industry, non-profit research institutions, NASA, and other government agencies interested in the campaign to establish a sustained presence on the Moon. The kickoff meeting was in late February of 2020, with a virtual consortium in October that had more than 500 participants. Monthly discussions of each of the six capability areas involve representatives from 160 organizations, with leadership from NASA, to identify key priorities and topics. APL will publish the outcomes in a report. There are also focus groups on ISRU and excavation and construction. Industry representatives make up just over half of each group. APL keeps communications strong through monthly newsletters, the LSIC website, a listserv, and other platforms, such as LinkedIn.

APL led the fall LSIC Forum, which was hosted by LSIC partner Arizona State University; the plan is to continue rotating the hosts. APL documents meeting inputs so the participants can use them in moving to tangible results. The ISRU supply and demand workshop is an example of how this effort informs NASA's work. ISRU can be a game changer, but it first requires getting to the lunar surface and testing, all of which will require propellant and other resources. The workshop served in part to connect stakeholders. There were 12 talks provided by industry partners (six demand, six supply) outlining their near-term goals for use of lunar resources. APL published the key outcomes on the LSIC website.

LSII leverages the broad range of STMD programs in order to establish targeted collaborations across industry and academia. Ms. Werkheiser highlighted the many activities currently underway in eight STMD programs. Recent and anticipated selections include:

- Announcement of Collaborative and Tipping Point Opportunities – October 2020
- BIG Idea Dust Mitigation Challenge – January 2021
- Lunar Surface Technology Research (LuSTR) Opportunities (ISRU and Surface Power) – Feb. 2021

The BIG Idea Challenges can lead to technology demonstrations and novel interactions among stakeholders who might not normally connect. The planning slide for CLPS demonstrations showed the collaborations and partnerships, as well as in-house activities, within the six focus areas. Demonstrations span the TRLs. There are 14 approved CLPS providers, and when NASA crafts its budgets, it is important to continue building on this and maintain the relationships. Ms. Werkheiser concluded by noting that in its first year, LSII has engaged 390 organizations across 44 states to advance the technologies needed to explore the lunar surface in new ways and stimulate a lunar surface economy. There will be workshops in each of the six areas, with the possibility of additional workshops as more themes emerge.

Mr. Gerald Sanders then spoke about ISRU and surface excavation and construction. ISRU falls largely within NASA's "Live" strategic thrust. Within that, there are three sub-thrusts:

- Resource Mapping/Estimation, which identifies the location of lunar resources, especially water;
- Oxygen Extraction, which may extract oxygen from lunar regolith with little human involvement; and
- Water Mining, which will help provide water resources and propellant for reusable landers and cis-lunar transportation systems.

Another thrust area is Advanced Materials, Structures, and Manufacturing (AMSM), which encompasses lunar surface construction. In looking at space resources, it is important to consider a broad range of resources. There are some interesting dynamics with the darkness and the reduced gravity. The Moon has two major areas for ISRU: polar water/volatiles, and lunar regolith. ISRU involves the "prospect to product" continuum, which requires multiple technology areas to work together. Mining water has been determined as the leading path, though NASA is still looking at oxygen from regolith. The pilot plant that results from this work will be on a level that can be scaled up to the mission level, and it will demonstrate core capabilities and subsystems.

A primary driver of ISRU is the reduction of mass and architecture, which could in turn reduce the number of launches and result in lower costs. There are also gains in crew safety and security, as well as direct impacts on what we do on Earth. The strategy for ISRU insertion into human exploration is to maximize ground development, using flight demonstrations for critical information and elimination of risk. The CLPS precursor missions are necessary in leading to the pilot plant. ISRU must be demonstrated on the Moon before it can be mission critical. To obtain the full benefits of ISRU, the architecture and mission elements need to include ISRU at the start of the design process. Mr. Sanders described ISRU needs and products in relation to four mission elements: descent/ascent vehicles; in-space/transit vehicles; power systems; and life support systems.

A table illustrated what the demonstration scales might be to reach the long-term visions. There is also the supply and demand issue, which was the subject of a workshop, and this is where the team started to see inputs calling for specific initial processes to meet future needs. A lot of the demand is for oxygen alone. There are four major areas of challenges: space resources, technical, operations, and integration. This will require long-term testing and demonstrations. The team has spent a lot of time looking at capability gaps in five areas: resource assessment, mining polar water, oxygen extraction, excavation and delivery, and surface construction. ISRU technology projects began in these areas in FY20 or were planned as new starts in FY21, contingent on the budget. There has been study of what is needed to enable those capabilities, and the identified gaps are included in the solicitations going out. Mr. Sanders showed charts of the elements for ISRU and surface construction technology development. Many of these have been selected for CLPS. There has been oxygen extraction work in an analog field test, and the next step in that area will be increasing duration.

University and public involvement in these activities is extremely important, as it helps bring in ideas and build the workforce. NASA Centennial Challenges and the BIG Idea Challenge have had activities in this area. Two challenges for universities are the Moon to Mars Ice Prospecting Challenge and the Lunabotics Robotics Mining Competition. These activities all lead to a large-scale demonstration plan throughout the decade. To demonstrate the relevant scale for ISRU on the lunar surface, there will be a pilot plant growing out of one of two paths: the polar water mining path, or the oxygen from regolith path. Mr. Sanders showed the criteria for the pilot plant. The Polar Resources Ice Mining Experiment (PRIME-1) on CLPS and the Volatiles Investigation Polar Exploration Rover (VIPER) will be the first steps toward surface understanding of polar water and volatiles. In summary, the program seeks to reduce the risks of lunar and Mars exploration via a series of demonstrations.

Mr. Free noted the importance of integration. He asked if the plan goes from gap identification to technology development and the missions that are needed. Mr. Sanders said that what was not in the presentation is that they have been creating strategic development plans. The team is now in gap closure efforts, trying to understand how the

data move the technology development forward. Mr. Michael Johns asked if the work of the university teams funnels products into the program, or if it is more about developing future engineers. Mr. Sanders said while they would like to see products integrated into the program, the team would also like to pull engineers from different disciplines to write up their lessons learned. That way, even if there are not products resulting, NASA would get more perspectives and ideas.

Dr. Kathleen Howell noted that one goal of the LSIC was to engage universities, while also working with companies outside the traditional disciplines. She wondered if any of that had actually emerged. Mr. Sanders said that it is beginning, but it has taken time to get non-aerospace companies involved. One of the problems is how realistic it is to have NASA buy their products. That requires convincing them that this is a stable program. Mr. Reuter pointed out that that is another reason behind some of the prizes and challenges. Mr. Sanders added that LuSTR was a significant driver for ISRU ideas. Ms. Werkheiser referred to one of her slides that had information on the Yet2.com technology development platform, which pulls up nontraditional applications. Dr. Howell observed that the value the companies offer may be outsized, but NASA may need to be patient in order to bring them in, and there may be different avenues and sectors within the universities.

Office of the Chief Engineer (OCE) Update

Mr. Ralph Roe, NASA Chief Engineer, listed OCE's major accomplishments from FY20. He was pleased that the teams were able to maintain progress in the face of the obstacles posed by the pandemic. Mr. Free observed that there was a lot on the flight side, much of which began with STMD as technologies on this list. It would help to understand the themes of the successes and the technologies that push through, so that TI&E can reinforce them with STMD to get the cycle time quicker. What needs to grow and what needs to shrink? Mr. Roe agreed. STMD's engagement with a broad spectrum of partners has been helpful. He would like to see that same level of growth with NASA's in-house work. There was a lot of push to the commercial side, but there is a need to grow the agency workforce as well. STMD does a good job of bringing in partners, but NASA needs to keep some activities. NASA Deputy Administrator/Acting Administrator Steve Jurczyk has acquisition strategy councils, and Mr. Reuter does the same kind of thing at a lower level. Mr. Reuter explained that that was behind the ECI, as STMD believes it has a responsibility to grow its workforce.

Mr. Roe praised the NASA Engineering and Safety Center (NESC) for its support. Since its inception in FY03, NESC has initiated more than 1,000 independent technical assessments of NASA's highest risk programs and projects, with 84 new technical assessments started in 2020. This work has supported high priorities related to the ISS, Commercial Crew Program, Artemis, science missions, and space technology efforts.

OCE has done a lot of work on cybersecurity and guidance. Mr. Roe listed program plans for FY21. Despite the likelihood of having to work in the pandemic environment for most of the year, he expects teams to continue making good progress. OCE remains focused on the technical and programmatic readiness of the agency's programs and projects.

Mr. Free raised the issue of the workforce and the constant concern about late and early career people. Mr. Roe explained that there is a lot more flexible hiring, sometimes for terms, at the NASA centers. He would like to see more early career hires, however. Dr. Gazarik said that he sees the same struggles in industry. Mr. Roe said that NASA has been able to do a lot of tailoring, especially with newer programs that can use the help of tiger teams. He is seeing improvement.

Discussion, Findings, and Recommendations

Mr. Green said that there had not been any official meetings of the NAC since the previous TI&E meeting, and it appeared that none were scheduled. He opened discussion to the meeting participants.

Mr. Reuter cited solar array technologies as a success story. STMD had two different types, both of which went on to have applications with ISS and industry. In collaboration with the Human Exploration and Operations Mission Directorate (HEOMD), STMD has a CubeSat mission planned for a near-rectilinear orbit. The project began in mid-2019, and while the launch vehicle is having some development issues, the satellite could launch in late May, which would be less than 2 years from concept to launch.

Mr. Johns asked about the status of the research institutes. Mr. Reuter said that there are four of these university programs active at the moment, and further selections are being made. New topics include advanced Entry, Descent, Landing (EDL) modeling, and analysis and testing of very high-power electric propulsion systems while on the ground. These may be delayed to 2022 due to the budget, but the four ongoing institutes are funded. Mr. Johns asked what will happen with those at the end of their funding. Mr. Reuter replied that there is no automatic path, though there is the option to consider a follow-on. Those discussions are occurring now. Dr. Howell asked if the delay might shift the timing of the next call, given that these have been on a 2-year cycle. Mr. Reuter acknowledged that a shift is possible; he was thinking of moving from a winter award to one in the following fall.

Dr. Gazarik asked if there might be trends that could be analyzed in terms of what is next for STMD. Mr. Reuter explained that the way to grow the portfolio is to be integral to the missions and provide something they really need. STMD tries to keep the early-stage portfolio at a set percentage of its overall budget, so that if the Directorate's funding increases, those programs will grow with it. It is important to deliver and to balance pushing technology development with looking to the next thing. It is still not clear what will happen with the new administration. Climate science will be critical, and that development is done largely within SMD. When STMD sees the priorities, they will be able to react, as there are some strong programs. Dr. Gazarik said that there is some work in calibration that may be relevant and worth consideration.

Dr. Weber asked what projects might be delayed or lost due to STMD not receiving the PBR. TI&E has tried to help the Directorate when needed, and she wanted to know what they might take to the NAC if it were to meet. Mr. Reuter replied that he could not discuss specifics since the operating plan was still being worked out. STMD has not changed the priority of FSP, which was a late-2020 item, but the Directorate must meet Congressional direction. He estimated the loss to be more like 5 months, not a year. That was a large chunk of the deficit. LSII is a new start, and that budget is cut in half. Some of what they want to do will not get done this year. The same is true for NTP and CFM. Small spacecraft is an area in which some things will be done a bit differently. The new space technology institutes are delayed, as noted. There will be some delays in making awards. STMD has the following priorities: Congressional and Administration directions; commitments to other partners, both internal and external; preservation of LSII; and others. He tried to avoid cutting things that are well along. Some of NASA's in-house work is affected by an inability to get into the labs due to COVID, and there may be some small gains from the resulting extensions.

Dr. Weber then asked if there had been any unexpected positive developments arise from the responses to the pandemic. Mr. Reuter answered that the virtual environment has dramatically increased some STMD programs' reach. The interactions might not be as deep, but they bring in many more people. For example, one meeting went from 350 to 1,800

participants, and another doubled from 250 to over 500. It was also easier to pull in the NASA Administrator for virtual events. Finally, Mr. Reuter would never have thought the solicitation schedule would be maintained so well in this environment, but that is what happened. Mr. Green added that there was not much of a schedule loss. Dr. Gazarik asked about budget impacts due to COVID. Mr. Reuter said that there were some cost growth because of workspace limitations. OSAM-1 was hit harder than anything else, and the time lost will show up in the cost growth.

Mr. Free said that at the last meeting, there was an observation on nuclear propulsion, and this has evolved over time, with the Congressional language pushing out FSP. He wanted TI&E to keep that open and highlight it. Dr. Gazarik agreed and asked if the Congressional direction changed the game plan. Mr. Reuter said that it changes the funding, not the priority. STMD wants to continue working with the Department of Energy (DOE) to get contracts in place. STMD has more ideas than budget. Mr. Free emphasized that TI&E is there to serve as another set of voices in elevating issues. The Committee can help Congress understand where some of its actions box in STMD versus where the demands are due to physics or efficiency. Mr. Green added that the Directorate had built up a lot of momentum around LSII, and in not being able to fund it fully, they need to hope it does not dampen that enthusiasm. Mr. Reuter said that there had also been momentum build in FSP, and a lot of interesting partnerships were starting to form. Mr. Johns said that the possible slowing of momentum had not been emphasized in the presentations. He advised bringing this forward in starker terms. Ms. Werkheiser agreed that there had been some promising activities and collaborations emerge, and she expressed concern that delays change the dynamic with some of the non-traditional space companies and others, leading to a loss of confidence in NASA as a partner. Mr. Free thought that was a good point. He said that while adjustments need to be made and there is uncertainty with the new administration and the impacts of the virus, there is a synergy with the small businesses. That message needs to go forward to Congress, possibly by the small businesses conveying to their representatives how these programs help them.

Mr. Green said that in the absence of a schedule for the NAC, he would meet with Mr. Free to modify the previous finding and develop the observation on LSII. He did not expect the NAC to meet again until after the next PBR is released, and TI&E would meet as soon after the PBR release as possible, with a longer meeting. Mr. Free said that he and Mr. Green would send around whatever they developed. He appreciated the time and work everyone put in.

Adjournment

The meeting was adjourned at 3:01 p.m.

Appendix A

Agenda

NAC Technology, Innovation, and Engineering Committee Meeting
January 27, 2021
Virtual Meeting

January 27 – FACA Public Meeting - Virtual

11:00 a.m.	Welcome and Overview of Agenda/Logistics Mr. Mike Green, Executive Secretary
11:05 a.m.	Opening Remarks Mr. Jim Free, Chair
11:10 a.m.	Space Technology Mission Directorate (STMD) Update Mr. James Reuter, Associate Administrator, STMD
12:00 p.m.	Office of the Chief Technologist Update Dr. Douglas Terrier, Chief Technologist
12:30 p.m.	Break
12:45 p.m.	Lunar Surface Innovation Initiative Update Ms. Niki Werkheiser, Director of Technology Maturation, STMD Mr. Gerald Sanders, ISRU System Capability Lead
2:00 p.m.	Office of the Chief Engineer Update Mr. Ralph Roe, Chief Engineer
2:30 p.m.	Discussion, Findings and Recommendations
3:00 p.m.	Adjournment

APPENDIX B

Committee Membership

Mr. James Free, Chair
Mr. G. Michael Green, Executive Secretary
Dr. Michael Gazarik, Ball Aerospace
Dr. Kathleen C. Howell, Purdue University
Mr. Michael Johns, Southern Research Institute
Dr. Rebecca Kramer Bottiglio, Yale University
Dr. Bhavya Lal, IDA Science and Technology Policy Institute
Dr. Matt Mountain, Association of Universities for Research in Astronomy
Dr. Mitchell Walker, Georgia Institute of Technology
Dr. Mary Ellen Weber, Stellar Strategies, LLC

APPENDIX C

Presentations

1) STMD Update [Reuter]
2) Office of the Chief Technologist Update [Terrier]
3) Lunar Surface Innovation Initiative Update [Werkheiser/Sanders]
4) Office of the Chief Engineer Update [Roe]