MINUTES
of the
THIRD MEETING
of the
SCIENCE, TECHNOLOGY AND TELECOMMUNICATIONS COMMITTEE

September 3, 2019
Sunspot Solar Observatory
Highway 6563
Sunspot

September 4, 2019
New Mexico State University-Alamogordo
The Tays Center
2235 N. Scenic Drive
Alamogordo

The third meeting of the Science, Technology and Telecommunications Committee (STTC) was called to order by Senator Ron Griggs at 10:06 a.m. on September 3, 2019 at the Sunspot Solar Observatory (SSO) in Sunspot.

Present
Sen. Michael Padilla, Vice Chair
Sen. William F. Burt
Rep. Christine Chandler (9/3)
Rep. Daymon Ely (9/4)
Rep. Kelly K. Fajardo (9/4)
Rep. Jason C. Harper
Rep. Melanie A. Stansbury (9/4)

Absent
Rep. Debra M. Sariñana, Chair
Sen. Mark Moores
Sen. Bill B. O'Neill
Sen. William P. Soules
Rep. Linda M. Trujillo

Advisory Members
Rep. Abbas Akhil
Sen. Craig W. Brandt
Sen. Ron Griggs
Sen. Mary Kay Papen (9/3)
Sen. Bill Tallman (9/4)

Sen. Jacob R. Candelaria
Sen. Carlos R. Cisneros
Sen. Richard C. Martinez
Sen. William H. Payne
Sen. Nancy Rodriguez
Rep. Joseph L. Sanchez
Sen. Peter Wirth

(Attendance dates are noted for members not present for the entire meeting.)

Staff
Mark Edwards, Legislative Council Service (LCS)
Ralph Vincent, LCS
Sara Wiedmaier, LCS

Guests

The guest list is in the meeting file.

Handouts

Handouts and other written testimony are in the meeting file.

<u>Tuesday, September 3</u> — SSO, Sunspot

Welcome and Introductions

Senator Griggs welcomed the committee. Members of the committee and staff introduced themselves.

SSO Welcome, Status of Research Projects and Overview

John Floros, Ph.D., president, New Mexico State University (NMSU), welcomed the committee to Sunspot and introduced Dan Arvizu, Ph.D., chancellor, NMSU. Dr. Floros noted that NMSU is 131 years old and still seeks to create a balance of basic and applied research. Highlights of this research include the hundreds of agriculture research projects around the state developed through the Agricultural Experiment Station and the Cooperative Education and Internship Program, as well as critical science, technology, engineering and mathematics (STEM) projects in areas such as water, energy, biofuels and space. He said that the goal of NMSU's research and service activities is to serve all residents of the state, the region and beyond by addressing critical needs. Dr. Floros offered the following information: NMSU is ranked by the Carnegie Foundation for the Advancement of Teaching as "R2: Doctoral Universities — High Research Activity"; NMSU's research expenditures were $110,118,461 in fiscal year (FY) 2016; and according to the most recently available statistics from the National Science Foundation (NSF), NMSU ranks eighth in research expenditures among high-Hispanic-enrollment institutions. Governor Michelle Lujan Grisham recently named a new center of excellence on sustainable food and agricultural systems at NMSU, he added. NMSU's Physical Science Laboratory partners with other research laboratories and federal agencies to advance research in many areas, Dr. Floros said, and he highlighted the further development of STEM education in the College of Education, extensive work with industries and communities across the state and accomplishments of the Arrowhead Center. In addition to the student entrepreneurship program, he said, the Arrowhead Center has programs for business creation and growth, intellectual property and technology commercialization and regional economic development collaboratives.

Dr. Floros pointed out that the four percent compensation increase that was authorized for NMSU staff during the 2019 legislative session actually resulted in budget cuts in some areas of the university. Only one-half of the raise is paid out of the General Fund appropriation and the other one-half would normally come from tuition income, but because NMSU administration decided not to increase tuition again, he explained, budgets had to be cut in other areas.

Senator Padilla arrived at 10:20 a.m. and assumed the role of chair.

Dr. Floros introduced James McAteer, Ph.D., director, SSO; and associate professor, NMSU. Dr. McAteer welcomed the committee members and staff to the facility and introduced Heidi Sanchez, education and public outreach coordinator, SSO, and Sean Sellers, graduate student, SSO.

Dr. McAteer explained that the SSO's goal is to lead a consortium for the operations of this 200-acre solar astronomical research facility, which includes the Dunn Solar Telescope and a visitor center. The Association of Universities for Research in Astronomy (AURA) manages the grounds, buildings and safety aspects on behalf of the NSF with 3.5 full-time-equivalent employees (FTEs), and another 6.5 FTEs from NMSU manage the science aspects of the research, telescope and education and the public outreach from the visitor center, he said.

Dr. McAteer said that NMSU manages the facilities through the state's research and public service project funds and grants from the NSF. A grant of $1.2 million was provided by the NSF in 2016 for transitions to operations. In 2017, he said, two partners joined the consortium and contributed $300,000, and four partners joined and provided equipment and instruments. In 2018, the SSO received $273,000 in research and public service project funds from the state. The state amount appropriated in FY 2019 was $273,000, $100,000 of which was designated as recurring. Dr. McAteer noted that the projections for FY 2020 include a $600,000 grant from the NSF, state recurring funds of $273,000 and $115,000 from the partners.

Dr. McAteer observed that the importance of SSO research and data has grown. Space weather research is a global challenge, and the SSO offers some unique capabilities to gather solar data. The SSO has built a website to provide data for research by its customers, he said. Additionally, the facility is integrated into graduate education at NMSU and serves as another venue for graduate research. Because of this facility, NMSU has benefited from over $2 million in NSF grant money for increased faculty members and student research. Additionally, he said, there are nine new students entering the graduate astronomy program at NMSU.

Dr. McAteer explained that by using data from the telescope, scientists are able to directly image the magnetic field of the sun's atmosphere, which allows the scientists to model the entire solar system. Because of this data from the SSO, scientists are now able to predict eclipses more accurately. The National Aeronautics and Space Administration (NASA) is also interested in this research because of the electromagnetic effects in space, he said.

Ms. Sanchez described the SSO visitor center and the role it plays in public education and outreach. Last year, 14,206 people visited the SSO visitor center from all over the United States and the world, and this summer alone, the total number of visitors grew 22 percent, from 3,881 in 2018 to 4,744 in 2019. She said that the facility is also marketed for school groups and public tours and that the SSO offers monthly family STEM days for various programs that include science workshops as well as stargazing and solar viewing.

Responding to questions from committee members, the presenters said that:

- phase 2 of the SSO's transition implementation will begin in 2021 and will include new instruments and continued work with consortium members; research will include the study of exoplanets and flares on other stars;
- the SSO will continue to model the background to more fully understand the sun and its effects on the universe;
- the SSO is of great value to New Mexico and to the rest of the world, providing partnerships in solar research and data; having this facility allows NMSU to work collaboratively with other research facilities through NSF grants;
- the SSO has researchers coming from other research facilities for collaboration and use of the facility and its data; a researcher from California State University-Northridge has completed a visit to the SSO; currently, a researcher from the University of Colorado is visiting, and a visiting research professor from the University of Hawaii system is scheduled;
- the SSO has received some private funding from individuals but no private companies to date;
- the SSO will continue its working relationship with the New Mexico Museum of Space History in Alamogordo;
- the AURA, which provides the facilities management for the SSO, is a very large consortium with over $1 billion of federal money to build and run telescopes at 450 sites; the SSO is a small project for the AURA, but the AURA can use this facility to design new telescopes for other sites;
- the Very Large Array uses radio telescopes instead of optical and, from space, these telescopes use infrared and gamma rays;
- the change in language regarding gross receipts tax and exemptions for prime-contractor-run laboratories does not affect the SSO; it is still exempt from the gross receipts tax;
- the SSO is one of the phase 1 teams working with NASA, with the hope of moving into phase 2 because of the SSO's ability to detail magnetic data and effects of solar weather;
- researchers from NMSU are collaborating with other researchers in many different technologies; the SSO provides opportunities through specialized equipment and knowledge; SSO research is not commercial at this time but will be more important to future space travel;
- research professors from the University of Colorado will bring graduate students for teaching experience; and
- the SSO visitor center charges $5.00 per car, rather than a per-person admission fee.

Several committee members expressed an interest in providing recurring funding for the SSO through the legislative appropriation process. The members noted that General Fund money could be used to ensure that NSF grant money is available.

Tour: SSO

Mr. Sellers led a tour of the SSO facilities, including the Dunn Solar Telescope.

Economic Development Initiatives — Commercialization of Space-Based Technologies

Dr. Steven Stochaj, interim department head, Klipsch School of Electrical and Computer Engineering, NMSU; Melissa Moreno, student, School of Engineering, University of New Mexico (UNM); Dr. Laura Boucheron, associate professor, Klipsch School of Electrical and Computer Engineering, NMSU; Casey DeRaad, chief executive officer, New Space New Mexico; and Craig Kief, director, Configurable Space Microsystems Innovations and Applications Center (COSMIAC), School of Engineering, UNM, discussed the potential for creating a center for the development and commercialization of technologies for space-based applications.

Dr. Stochaj described the evolving space industry by contrasting "old space" and "new space". He described old space as the government-operated space exploration in the decades of the last century. This space exploration was basically the "race to space" featuring the United States versus the Soviet Union. New space has been led by private investments with a culture of innovation reminiscent of the 1970s computer revolution. This new research involves rocketry and satellites with an enormous number of telemetry systems, he said, and examples include the work of SpaceX, Orbital Sciences, Virgin Galactic and many others. New space brings a demand for a well-trained workforce and, therefore, investment by the state is worthwhile. Dr. Stochaj said that NMSU is requesting $300,000 in funding for FY 2021 to develop a center for the development and commercialization of technologies for space-based applications that would support the emerging commercial space sector. He explained that the objectives of this center are to grow the staff at NMSU for these new technologies; to train faculty, staff and students in the commercialization process; to connect researchers with partners in the industry and the national laboratories; and to provide hands-on training for students in the development and commercialization of technologies for space.

Dr. Stochaj also described the work of NMSU's NanoSat Laboratory, which is working with NASA's Goddard Space Flight Center and Northrop Grumman Corporation on an ionospheric neutron content analyzer (INCA). This work also includes collaboration with the Air Force Research Laboratory (AFRL) for both interplanetary space and low-orbit satellites. Northrop Grumman Corporation has sponsored a $110,000 grant for this program. In five years, the program has had participation from 77 undergraduate students, five master's degree program students and one Ph.D. candidate. Dr. Stochaj stated that two companies have been started by these students; one is slightly profitable, while the second company is searching for capital funding.

Dr. Boucheron discussed her research work at NMSU in solar image analysis, signal and image processing and applications of signal and image processing across various disciplines. She explained that her research has included the prediction of solar flares using data to describe the photospheric magnetic field. This research is important, she said, because of the significant effects of these phenomena on satellites, power grids and telecommunications infrastructure.

Ms. Moreno, who is working on an electrical engineering degree with an emphasis in space engineering and a minor in astronomy, discussed her experience as a student working in the INCA group for a few semesters. She described it as a great learning experience that provided opportunities to work on projects with NASA.

Dr. Kief described the COSMIAC research center at UNM. COSMIAC is an innovative space research center occupying 21,000 square feet of office and research space and housing approximately 30 full-time faculty, staff and consultants and 30 undergraduate and graduate students. He added that customers include the United States Air Force, NASA, Lockheed Martin Corporation, Northrop Grumman Corporation and Blue Origin, LLC.

Dr. Kief noted that because of the strong growth in space research in the Albuquerque area, COSMIAC will be submitting proposals of more than $60 million in the next five years. The 2019 budget is $20 million. Current projects include the following:

- global positioning systems;
- radiation assessment, testing and mitigation;
- a compact environmental anomaly sensor;
- satellite communications;
- small spacecraft design, manufacturing and testing;
- W-band and V-band frequency atmospheric propagation;
- virtual reality and augmented reality;
- machine learning; and
- antenna design and radio frequency propagation.

Dr. Kief explained that COSMIAC uses engineering and computer science students with United States citizenship who can obtain security clearances. One example is a small satellite intern program where 11 students worked on integrating small satellites into a FlatSat communications system. Rather than having summer internships, the students work year-round and are paid.

While Albuquerque is experiencing the strongest growth in the space industry with organizations actively working in the industry, Dr. Kief noted that the demand for space research and business is insatiable. The COSMIAC group could be doing more work but is limited by the lack of availability of engineers with security clearances, he said, as well as work space.

Ms. DeRaad discussed the vision of New Space New Mexico to develop opportunities in the global space industry. New Space New Mexico is a not-for-profit company that fosters an entrepreneurial, business-focused commercial space ecosystem in New Mexico. The group focuses on business alliances in the space industry; tools to help connect people, ideas and resources for commercialization of space projects; and access to investment money for these projects, she explained.

Ms. DeRaad said that current initiatives for New Space New Mexico are to:

- build an alliance between the 80-plus companies in New Mexico working in the space industry;
- contract with the Economic Development Department as authorized by House Bill 617 (2019); and
- work with the legislature to develop long-term support for the space industry in New Mexico.

New Space New Mexico has commitments from NASA and the AFRL but also needs funding from the state to continue collaborations and support, Ms. DeRaad said, noting that over the past 10 years, there has been a cumulative investment of $16 billion in the space industry in New Mexico. She said that New Mexico has a number of factors that bode well for the space industry, including:

- three United States Department of Energy laboratories — Sandia National Laboratories, Los Alamos National Laboratory and the AFRL;
- Spaceport America;
- direct technology transfer activities;
- a STEM workforce supported by three major universities;
- a growing private sector in space technology;
- three key United States Air Force organizations working in space technology; and
- affordable cost of living and cost of doing business.

Committee members commented that New Mexico has significant resources for the growth of space research and industry. New Mexico should be a leader in this industry, committee members said, and they expressed encouragement at collaboration efforts.

Responding to questions from committee members, the presenters stated that:

- New Mexico can be the leader in new space if collaboration efforts continue;
- a group is beginning work with the Economic Development Department;
- a CubeSat satellite measures from 10 centimeters cubed up to 60 centimeters cubed;
- these satellites are aligned with the earth's magnetic field;
- an attitude control system costs $150,000;
- these small satellites do not pose a threat to space stations or other satellites;
- each satellite has a plan to remove it from orbit before it is implemented; the lighter ones last only about one year and drop and burn up when they hit the atmosphere;
- the NSF has many small facilities, and larger facilities tend to replace smaller ones; the SSO is a good example of how a facility can find a new purpose;
- the funding from the 2019 legislative session was meant to be recurring but was classified as nonrecurring; and
- requests for funding from the legislature include: support for a $300,000 appropriation for NMSU to develop space programs; support for a $200,000 recurring

appropriation for New Space New Mexico; and support for capital expenditures for additional physical space for COSMIAC.

Committee members noted that the laser industry started in New Mexico but the industry was not nurtured here. New Mexico has a number of good aspects for the space industry, they reiterated, which should be nurtured here in New Mexico. It was noted that a group is being formed to discuss synergies within this industry.

A committee member also noted that Sandia National Laboratories hires 800 new staff annually and that is just the tip of the iceberg in terms of the STEM workforce.

Public Regulation Commission (PRC) Report: Review of the New Mexico Telecommunications Act and Implications for Statewide Build-Out of Broadband Infrastructure

Stephen Fischmann, commissioner, District 5, PRC, discussed the status of the requirements specified in Senate Bill (SB) 53 (2017). PRC commissioners and staff are still in the process of making rules to comply with these new requirements. The PRC is conforming to the New Mexico Telecommunications Act and is moving through the process to approve the new rules. As part of this process, he said, a public meeting is scheduled for September 20, 2019 between the PRC and the regulated industry to discuss the proposed rules.

Commissioner Fischmann noted that the PRC deals with a number of issues concerning the regulation of New Mexico's broadband infrastructure and power infrastructure. Because of the inherent rural nature of New Mexico, the broadband infrastructure is largely covered by the New Mexico Universal Service Fund (NMUSF) and state allocations. Of the total annual revenue of $100 million, only $35 million was from customers. The rest came from other state and federal sources, he said.

Michael Ripperger, chief, Telecommunications Bureau, PRC, and Jason Montoya, chief of staff, PRC, presented on the current status of the new regulations. SB 53 changes to the New Mexico Telecommunications Act went into effect on June 16, 2017 and replaced the mid-size and large carrier provisions with a new form of regulations for incumbent local exchange carriers (ILECs) with over 50,000 access lines. CenturyLink is the only carrier that falls under these new ILEC provisions. He explained that the new provisions added language that sets out the rights, duties and limitations of regulations while also setting the obligations for those carriers to establish quality of service standards, provide access to enhanced 911 emergency services and telecommunications relay services and to adhere to the NMUSF obligations.

Mr. Ripperger discussed the July 31, 2019 report that was provided to the legislature with a letter to the STTC. The PRC was requested to report to the legislature on the impact of the legislation on residential and business consumers. This report was due two years after SB 53's enactment and every three years thereafter. The report notes that at the two-year mark, there are no clear trends in the areas of review — employment, investment in telecommunications infrastructure and the availability and deployment of high-speed data services. In the area of rates, the PRC has seen several notable rate increases since the legislation went into effect but

also some decreases, such as extended area service rates. Mr. Ripperger stated that the two-year time frame was too short to see any trends in the investment in telecommunications infrastructure and also stated that it is too early to see any trends in the availability and deployment of high-speed data services.

Mr. Ripperger discussed the PRC's role in determining effective competition in any of the wire centers. CenturyLink filed a petition on September 19, 2018 to determine effective competition for retail residential telecommunications services. That petition has been assigned a docket number of 18-00295-UT and is currently scheduled for hearing with regard to its first phase on September 25 through 27, 2019.

Mr. Ripperger noted that the rulemaking proceeding is currently pending before the PRC to repeal existing rule 17.11.24 NMAC, "Quality of Service Standards Applicable to Mid-Size Carriers", and to replace it with quality of service standards applicable to CenturyLink under the amended New Mexico Telecommunications Act.

A Carrier's Perspective on the New Mexico Telecommunications Act and Rural Access to Broadband Services

Leo Baca, director, Government and Regulatory Affairs, CenturyLink, and Tim Goodwin, associate general counsel, CenturyLink, discussed the current status of CenturyLink in light of the new regulation discussed above. Mr. Baca and Mr. Goodwin outlined the activities since SB 53 went into effect on June 16, 2017. CenturyLink filed a petition for the new rulemaking and, in the fall of 2017, the stakeholders met with proposals for discussion. These proposals did not advance past December 2017. The PRC has now proposed a set of rules as of May 2019, which have been advanced through two comment periods. A decision on this rulemaking should be forthcoming, they said.

Mr. Goodwin noted that telecommunications companies in addition to CenturyLink have asked for rules to be rolled back to those in place in 2009.

Mr. Baca and Mr. Goodwin provided some statistics to describe the current landscape of telecommunications in New Mexico:

- CenturyLink has just over 240,000 telephone access lines, down from 600,000 in 2009;
- CenturyLink has used federal and state funding to broaden the scope of broadband coverage in the state; and
- there are almost two million wireless subscribers in New Mexico, and 60 percent of adults in New Mexico live in a wireless-only household.

Mr. Baca continued with additional information:

- there are many gaps in both urban and rural areas in the state that have limited or no broadband services;
- two initiatives have been successful in filling these gaps:

    - the federal Connect America Fund — CenturyLink accepted $66 million over six years to address rural broadband needs, and at the midpoint, 16,000 homes and businesses have been connected; and
    - the PRC's rural broadband fund — CenturyLink accepted $450,000 for broadband in Angel Fire, Eagle Nest, Santa Teresa, Las Vegas and Tucumcari and the pueblos of Laguna and Acoma in 2019 and has applied for over $820,000 for 2020;
- CenturyLink is working with the Department of Information Technology to use $10 million in funds allocated during the 2019 legislative session; and
- CenturyLink is working with the governor on other initiatives for deployment of broadband.

Mr. Goodwin noted that rural broadband deployment is typically subsidized by revenues from other customers and the government because of the low density of population in the rural areas.

Responding to questions from committee members, Mr. Goodwin and Mr. Baca stated that:

- regulators in Colorado spent three years changing the regulation; New Mexico is only two years into the process;
- CenturyLink is the only mid-level company in New Mexico that has service-level standards for quality of service; it typically meets the standards;
- Albuquerque is divided into 17 wire centers, and service statistics are reported by wire center;
- other telecommunications companies are smaller and are regulated under the Rural Telecommunications Act of New Mexico;
- effective competition is defined as the competition that results when customers have comparable alternatives to the service being provided; this is important since regulations are reduced if an area is deemed to have effective competition;
- effective competition is determined separately for residential and commercial services;
- there are 65 wire centers in the state, and effective competition is decided by each wire center;
- CenturyLink filed in 2011, and a ruling was issued in 2013, that bundled and packaged call services in most of the wire centers that met the standard for effective competition; and
- CenturyLink is working with the Governor's Office to develop proposals for the next legislative session.

In response to a question, Mr. Goodwin stated that broadband services are regulated at the federal level and not the state level but that there are resources where the reporting is available to compare service levels. He also said that the Federal Communications Commission has rules for meeting service-level requirements.

When asked about the rollout plan for Connect America funding, Mr. Goodwin said that there are already over 16,000 subscribers, with a goal of 25,000 customers.

Matejka Santillanes, executive director, New Mexico Exchange Carrier Group, spoke briefly to the committee about the group's goals for telecommunications in the more rural areas of the state and the need for funding sources.

Committee members invited attendees to the November meeting of the STTC in Santa Fe.

Recess

The meeting recessed at 4:10 p.m., and the committee received a meal and private tour of the New Mexico Space History Museum in Alamogordo.

Wednesday, September 4 — NMSU-Alamogordo

Reconvene

Senator Padilla reconvened the meeting at 9:10 a.m. in the Tays Center at NMSU-Alamogordo.

NMSU-Alamogordo Welcome and Overview

Dr. Ken Van Winkle, president, NMSU-Alamogordo, welcomed the committee to the Alamogordo branch of NMSU and provided an overview of the university. The average age of the student body is 25.5 years, and 76.4 percent are part-time students, he said. Over 13 percent of students are taking courses for dual credit with high school studies, he added, and said that NMSU has an emphasis on an allied health program that consists of courses and programs of study in health care to prepare students for entry-level positions or for entry into a four-year college program. He said that the university has 24 placements available in the nursing program and has a waiting list. The university also offers a bachelor's degree program in early childhood learning, he said.

NMSU-Alamogordo has a strong online education initiative, including online degree programs and many additional online courses, he said, and all faculty teaching online courses have had training in online education theory. The courses have had an extensive review using the 42 Quality Matters Specific Review Standards, he said.

Dr. Van Winkle described the university's strong relationships with the community, particularly with Holloman Air Force Base (AFB). Online courses are offered at Holloman AFB from a number of institutions, and NMSU-Alamogordo works closely with base personnel to provide relevant courses, he said.

Responding to questions from committee members, Dr. Van Winkle stated that:

- NMSU-Alamogordo has evolved from offering only two-year traditional education courses to providing occupational-technical programs and courses for personal

enrichment, as well as selected bachelor's degree completion programs through NMSU-Las Cruces distance education;
- NMSU-Alamogordo offers a two-year associate's degree in science with an emphasis on mathematics and science; and
- coordination with the community and Holloman AFB is key for the university to maintain enrollment numbers.

Holloman AFB Mission Brief

Colonel Bryan "Squeeze" Callahan, vice commander, 49th Wing, Holloman AFB, and Major Brian Revak (retired), 704th Test Group, Holloman AFB, provided an overview of Holloman AFB. The base is the third largest base in terms of land at 103 square miles and has $5 billion in assets, they said, adding that the base includes four runways that intersect. The number one mission of Holloman AFB is to provide aircrew training for F-16 and MQ-9 squadrons, they said, and the base is home to the largest fleet of F-16 planes and the largest fleet of MQ-9 planes in the world. They added that the base trains 84 F-16 pilots annually with a nine-month training program and also trains 360 pilots and sensor operators annually for the MQ-9 through a five-and-one-half-month training program.

Colonel Callahan discussed other missions to deploy combat-ready forces and to provide testing and material maintenance. The base is home to the 54th Fighter Group, the 49th Operations Group (F-16 pilots), the 49th Maintenance Group (MQ-9 aircrew), the 49th Mission Support Group and the 49th Medical Group, he said. To support these groups, there are over 11,000 military and civilian personnel on base, and this number includes about 1,500 civilian personnel and contractors, he said.

Holloman AFB currently has 240 vacant civilian positions, Colonel Callahan said. These vacant positions represent over $13 million in annual salaries and include positions in all ranges from engineers, medical personnel, technicians and mechanics to administrative and secretarial, he said, adding that even without additional missions, the base is backlogged with the hiring process and struggles to fill many positions. Current open positions include 49 engineering, 19 medical, 16 technician, 31 mechanical and 12 secretarial, Colonel Callahan said, adding that the availability of a good workforce is a major topic for base realignment discussions.

Major Revak stressed the importance of growing the workforce for the future. Holloman AFB has had testing wings or groups since 1949 and continues to be a critical asset for the nation's security, he said, and he stressed the importance of protecting the unique aspects of the Tularosa Basin for future testing and evaluation operations. The 704th Test Group has resided at Holloman AFB since 2016 and provides testing and expertise in guidance and navigation systems, advanced avionics, munitions and missile performance, aircraft survivability and directed energy devices, he said. The directed energy work is a bridge between the research and development of the technology and the testing and evaluation of devices, and the work includes the testing and evaluation of high-powered lasers and microwaves, he added.

Major Revak explained that the 846th Test Squadron at Holloman AFB tests weapon lethality, aircrew escape systems and guidance and navigation systems. Some of this testing

uses the test track, which is the longest and most precisely aligned track in the world at 50,788 feet, or about 10 miles. As an example, he said, testing on this track reached the hypersonic speed of Mach 8.6 in 1996. He added that current testing includes bunker busters and hypersonic weapons.

Major Revak provided an overview of other testing that is connected to Holloman AFB:

- aerospace survivability and safety testing;
- a national radar cross-section test facility that includes stealth technology;
- advanced avionics and weapons development;
- navigation solutions for global positioning inertial systems; and
- navigational warfare.

Major Revak stressed the importance of protecting the area from encroachment to maintain the vast airspace available for testing. The SunZia Southwest Transmission Project power lines going across the north end of the basin along Highway 380 is an issue, he said. Underground lines have been proposed and are being considered, he added, but putting the lines underground would triple the cost. There is also a need to protect the western ridge of the Sacramento Mountains from any developments that will adversely affect testing from the base, he said.

Responding to questions from committee members, Colonel Callahan and Major Revak stated that:

- the MQ-9 can fly 15 to 30 hours with no one in the cockpit; this is the primary remote control aircraft for the United States Air Force;
- vacancies and the lack of a sufficient workforce are a large concern; Holloman AFB is considered a remote and isolated area, and support functions nearby are limited;
- the skill sets needed are just not available in this area;
- the school system is very important, and some personnel are not willing to transfer to the area because of schools, etc.; transfer decisions are often made based on the local schools, so there is a need to prove that the local schools are exceptional to attract the workforce;
- there has been some formalization of the work between the Alamogordo Public School District and the base;
- Holloman AFB has both elementary and middle schools and has a commitment to build a new elementary school on base;
- after the elementary school is replaced, the United States Department of Defense has funding to replace the middle school; the state needs to remove from the square footage calculation the middle school that is not being used;
- the area needs to hire the right teachers and raise the bar on teaching;
- teachers who transfer to Holloman AFB are able to use reciprocity agreements to obtain teacher licensure relatively quickly, which is an advantage;
- the United States is not doing enough in the area of hypersonic weapons testing and mitigation and will need to increase research and testing in this area; as an example,

the United States has one hypersonic weapons testing and mitigation facility while China has 40 facilities;
- Sandia National Laboratories has some technology that uses wind tunnels, but Holloman AFB test centers do not use wind tunnels;
- there is some collaboration in research with Sandia National Laboratories;
- base personnel are working on "Holloman 2025" to reorient the base with construction of new facilities for its new directions; and
- transfers to the base stay in the area only for a few years.

In further discussions regarding schools and education, there was disagreement on the effectiveness of changes for teachers and what path the state should take. It was noted that New Mexico ranks thirty-fourth in spending per student. One factor is the rural nature of New Mexico, and the state should focus more on reducing poverty and obstacles in the home environment, committee members said.

Requests

A request was made by those present for the chair to send a letter on their behalf to the Department of Finance and Administration regarding the recurring funds that were appropriated for the SSO in House Bill 548 (2019) and to have Senator Padilla sign the letter on behalf of the committee.

An additional request was made for the chair to send a letter to the PRC regarding issues with the presentation on the implementation of SB 53 and to have Senator Padilla sign the letter on behalf of the committee.

Preparing the Workforce for a Science- and Technology-Based Economy Through Robotics Challenges: How to Capture Student Interest in STEM Education and Keep It Through Graduation

Debbie Martinez, sponsor, For Inspiration and Recognition of Science and Technology (FIRST) Robotics Competition, briefly described the program and introduced some of the students who participate, including Abby Sherwood, Gwen Payton, Brian Kangas, Dallas Holcomb, Katelynn Weaver, Ezra Cadwallader and Bryson Kangas, captain of Aviation, Science, Technology, Robotics, Outreach (ASTRO) Vikings 6682.

The FIRST program in Alamogordo is run by volunteers and has been in existence for about 10 years, Ms. Martinez said and noted that in Texas, any school can get funding to run a robotics program and that Texas has made robotics a state sport where students can obtain a "letter".

Over 570,000 students from more than 100 countries participate in the FIRST program, Ms. Martinez said. The core values of the FIRST program are discovery, innovation, impact, inclusion, teamwork and fun, she said. Ms. Martinez and each of the students emphasized the teamwork and fun involved in the program and the competitions. The FIRST program begins at age six with the FIRST Lego League Jr. teams building models that move, Ms. Martinez said. Students in grades four through eight can participate in the FIRST Lego League and build robots

using LEGO Mindstorms technology, she added, and students in grades seven through 12 can participate in the FIRST Tech Challenge, where students build robots from a reusable kit of parts and compete in challenges. Students in grades nine through 12 can also participate in the FIRST Robotics Competition and build larger robots for competition, she said.

For the 2019 season, Ms. Martinez said that almost 4,000 teams with almost 100,000 student members from 33 countries competed in the Destination: Deep Space competition, presented by the Boeing Company, with remotely controlled robots weighing up to 140 pounds. There were 145 local kickoff events, 62 regional events, 11 district championship events, 100 district events and two championship events, she said, and the Alamogordo program participates in the Texas/New Mexico District.

The captain of the ASTRO Vikings 6682 team, Bryson Kangas, demonstrated the team's latest robot and talked about his involvement with the program. He has been in the program for eight years, starting with the FIRST Lego League. The first years were similar to science fair projects and aimed at building a good science base, he said. From there, he progressed to the FIRST Tech Challenge and built medium-sized robots and competed through various challenges. The team also does public outreach to show off its work and to encourage others to get involved, he said, and he discussed the robotics competition program that he is in now. In this program, students learn more about developing a business plan and how to work as a team, he added.

Other students discussed their experiences and highlighted their growth in knowledge and confidence from the program. They emphasized the teamwork and fun aspects of the learning environment. Heather Kangas, a volunteer and coach for the FIRST program, said that there are 24 local teams from the four levels. She touted some of the benefits as:

- improved ability to resolve conflicts;
- likelihood of students to take more STEM courses and enter a STEM field;
- improved problem-solving skills;
- improved time management skills; and
- strengthened communications skills.

Ms. Martinez said that the state could fund the program for 65,000 students across the state for an initial investment of $12 million.

Responding to questions from committee members, the group said that:

- the participation rate for girls is very good, and the numbers are fairly equal by gender;
- the program has provided direction for many students, whose plans vary from studies in engineering, veterinary science and other sciences to enrollment in the United States Naval Academy;
- a first-year rookie team needs about $6,000 to get started; there are some grants available for the first team in an area;

- the cost to build a larger robot for the robotics competition includes a $5,000 registration and kit fee plus several thousand dollars for additional parts, such as gear boxes and spark motors, and some travel; and
- the robot is designed and built over a six-week period for the specific challenge.

Committee members made additional comments as follows:

- funds were appropriated to provide more physics teaching for girls before seventh grade; this program was piloted in 25 middle schools, and the hope is to bring it back;
- Senator Gay G. Kernan brought forward a capital outlay request for a robotics program and hopes that others could allocate some capital outlay funds for their communities;
- a challenge was put forward to define a renewable industry for the future as the reliance on oil and gas tapers off in New Mexico, and it was asked how robots and other tools could be used in this industry;
- in Albuquerque, a different path was taken: mentoring for computer programming that turned into robotics programming; Sandia National Laboratories has a willing workforce to volunteer and mentor; and
- members were excited to see so many girls in STEM projects.

Adjournment

There being no further business before the committee, the third meeting of the STTC adjourned at 12:14 p.m.

Tour

Members who wished to stay were provided a tour of the Brackish Groundwater National Desalination Research Facility (BGNDRF) by Randall Shaw, facility manager, BGNDRF, United States Bureau of Reclamation, and the Alamogordo Municipal Water Desalination Facility by Brian Cesar, acting city manager, City of Alamogordo.