ARC

Bridging the Gap of Military Scientists and Engineers to Warfighters

PROGRAM OVERVIEW

Photo by Staff Sgt. Aubree Owens

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Cover Photo by Senior Airman Anabel Del Valle

Photo courtesy of Project Arc team

WHAT IS PROJECT ARC?

Air Force and Space Force operational units need dedicated scientists and engineers who can quickly use their specialized skills and knowledge to solve the technical problems encountered by warfighters in the field. Project Arc works to provide this capability at the point of need, where technicians can work directly with operators, to prepare for conflict before it occurs.

THIS IDEA DRIVES PROJECT ARC.

Launched in July 2020, Project Arc embeds uniformed scientists and engineers, working on temporary duty status, into operational wings. The name itself is derived from the historical scientist, engineer, mathematician and inventor, “Archimedes”, who worked with military operators to solve problems of their time. Combined with this abbreviated homage, “Project” signifies the resistance to the status quo and an ongoing effort for improvement. These technicians work side by side with pilots, logisticians, maintainers, intelligence, surveillance and reconnaissance (ISR) Airmen, and others. Bringing an insurgent mindset to their work, these specialists apply state-of-the-art technology, experimentation, prototyping and rapid adaptation to help United States warfighters outwit and outpace technology wielded by adversaries. They approach the situation with empathy for the day-to-day responsibilities and concerns of the warfighters they seek to help, which yields a more operationally-minded technical cadre and ensures responsive technical support to time urgent problems.

Project Arc’s efforts happen at a local level, with technicians looking for efficient, cost-effective solutions that help the units they’re embedded in. However, in some cases, their work also could have wider implications, with the solutions they develop being scaled for use throughout the Air and Space forces.

Project Arc is currently made up of eight core members and a network of more than 65 members drawn from around the Air and Space forces. Members have a wide range of specialties and backgrounds in such areas as flight test, space launch, research, instructing, program management and coding.

See the Operational Vignettes on page 13 to see how Project Arc Technicians and Airmen Operators are solving real DAF problems at the speed of relevancy in the field

Credit: U.S. Air Force

ARC

Bridging the Gap of Military Scientists and Engineers to Warfighters

Regardless of education or specialized training, Project Arc technicians share core characteristics:

- **Passionate** to develop and deliver tailored disruptive innovations to warfighters
- **Devoted** to exploring the depth of science and technology for solutions
- **Committed** to getting their hands dirty side-by-side with operators
- **Selflessly** going the extra mile to arm the warfighter, not for personal gain, but for victory and defense of our children, families, and nation

PASSION. HUMAN POWER. REAL VALUE. SERVICE INTEGRITY. GRIT.

Project Arc GAMMA cohort members. From left, top row Mr. JD Bales, Capt Jason Goins, MSgt Matt Boland, SrA Nathan Pettit, Capt Adam Bordeau, Lt Jake Geil, Lt Aaron Cox, Lt Aaron Bauer, SrA Andrew Hardy, Capt Jack Bell, Lt Kennith McLoud, SSgt Albert Silvain, SMSgt Joseph King. From left, bottom row Mr. Tom Hill, Major Nathan Opie, MSgt Vincent Olshove, Lt Racheal Wolfgang, SrA Caleb Gonzalez, Lt Kevin Tran, Lt Richard Razon, Capt Tess Grodner, Lt Haley Spletzer. Photo courtesy of Project Arc team.

PROJECT ARC'S ORIGINS

Project Arc began as a grassroots movement focused on addressing limitations highlighted in the U.S. Air Force 2030 Science and Technology Strategy and the executive branch's 2019 National Defense Strategy. It was one of several new programs aimed at growing the number of general officers with advanced science, engineering, technology and math degrees that have cropped up at the Air Force Research Laboratory (AFRL).

While Project Arc began in 2020, its roots lie in an informal discussion in 2016 when several coworkers began talking about their reasons for joining the Air Force. Several said a desire to serve their country while also using their technical skills and degrees drew them to military service.

Prior to joining, they had imagined they would work side by side with operators in the field, fixing problems when and where they occurred, but they weren't provided an opportunity to do this.

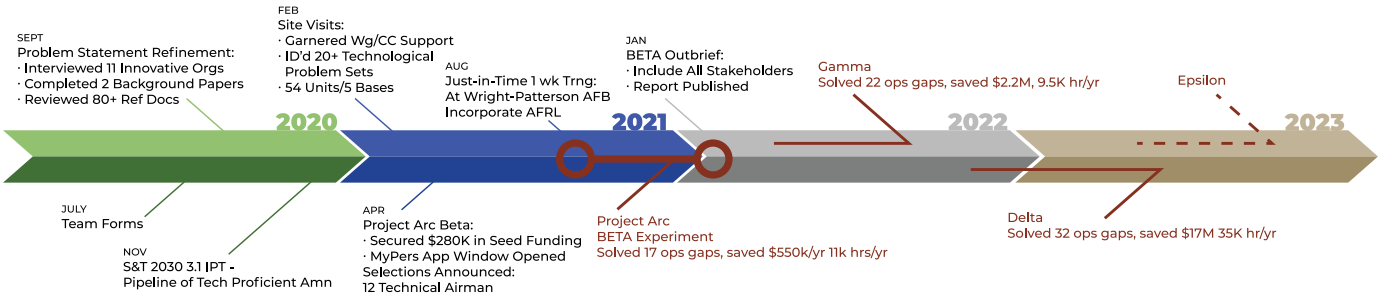
This spurred them to look for ways uniformed scientists and engineers could apply their technical skills and education to make bigger impacts on Air Force operations. Initially, Project Arc's founders worked nights and weekends to get the fledgling program off the ground, a practice the core team still must do today.

After some time, the efforts paid off. Project Arc continued adding volunteers and eventually attracted high-level support under Air Force Chief Scientist Dr. Victoria Coleman and Col. Mario Serna Jr., deputy director of innovation and technology integration, Department of the Air Force Rapid Capabilities Office-Field Support Unit.

Furthermore, continued support from Coleman, Gen. Duke Z. Richardson, Commander, Air Force Materiel Command, the AFRL Chief Technology Office and the CSAF Strategic Studies Group has provided legitimacy to the program for those commanders considering sending their most valuable assets TDY for six months to participate.

Additional support from various AFRL Technology Directorates, including AFWERX, ACT-3, the Small Business Office, and the 711th Human Performance Wing has also boosted Project Arc.

During its brief existence, Project Arc has continued to add volunteers and expand its reach to locations such as Kadena Air Base, Japan; Andersen Air Force Base, Guam; Osan Air Base, Republic of Korea; Joint Base Pearl Harbor-Hickam, Hawaii; Travis Air Force Base, California; Beale Air Force Base, California; Grand Forks Air Force Base,



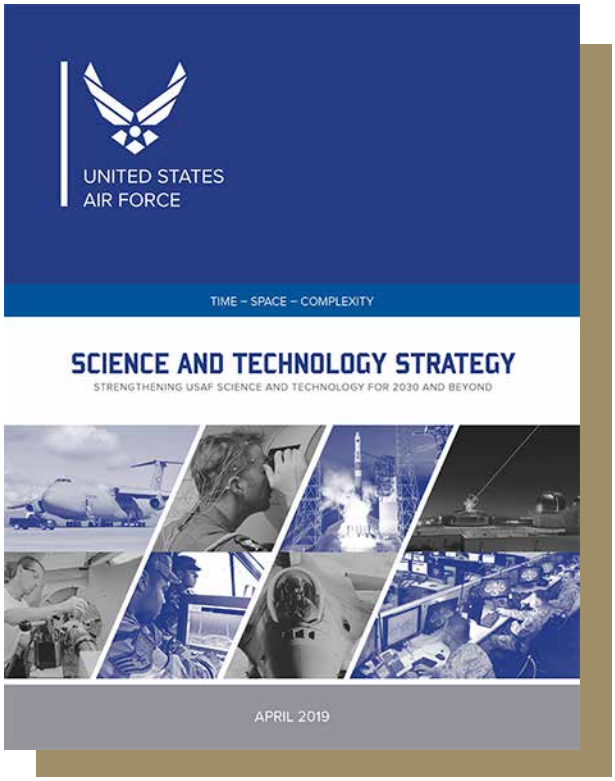
North Dakota; Lackland Air Force Base, Texas; Arnold Air Force Base, Tennessee; Hurlburt Field, Florida; Eglin Air Force Base, Florida; Patrick Space Force Base, Florida; Joint Base Andrews, Maryland; Joint Base McGuire-Dix-Lakehurst, New Jersey; Langley Air Force Base, Virginia; and Al Udeid Air Base, Qatar. Project Arc officials select locations based on the local leadership's support for change as well as the infrastructure and facilities to support engineers on base.

As Project Arc builds up its cadre of field-capable engineers, it will look to send more support to emerging needs in areas of increased competition and conflict such as Eastern Europe and the Arctic.

PROJECT ARC PART OF WIDER EFFORT TO BEEF UP STEM CAPABILITIES

Technological superiority remains critical to winning on the battlefield. Achieving and maintaining that advantage requires robust numbers of STEM-educated and -trained general officers in the Air Force.

However, the number of general officers with advanced STEM degrees lags not only the levels seen among private-sector executives, but also strategic competitors such as China and its military, according to Line of Effort 3.6: Build a Pipeline of Technology Proficient Military Airmen and Guardians. AFRL issued the report as part of the U.S. Air Force 2030 Science and Technology Strategy, which, in an effort to address these limitations, is what prompted the Project Arc grassroots movement.



The Chinese government wants to increase STEM-educated officers in the Peoples' Liberation Army. In 2025, China is expected to graduate double the number of STEM PhDs compared to the US. Moreover, a 4-star general with a PhD in physics heads that country's general armaments division. Project Arc is determined to address some of these deficiencies by stationing Scientists and Engineers at operational units to solve technical gaps "at the edge" through exploitation of state-of-the-art technology, experimentation and rapid adaptation.

Through market research, the team found that operational units need dedicated scientists and engineers to provide tailored, technical solutions for unique operational problems and adversarial technological deployments, now and in future conflict. Project Arc is focused on exploring the impacts of embedded scientists and engineers in operational units to deliver asymmetric technological advantages. The team will accomplish this through exploitation of state-of-the-art technology, experimentation, and rapid adaptation for adversarial technical deployment.

Project Arc is one of several AFRL efforts aimed at reversing this trend by providing technical Airmen an avenue to use their gifts as machinists, fabricators, prototypers, engineers and coders for their personal goal of defending their families and nation. It gives them an outlet that allows them to have job satisfaction and, therefore, stay in the Department of the Air Force. It makes them feel like their work actually matters for the next fight. Other projects include: the AFRL Regional Research Hub, which works with Purdue and Cornell universities to provide more science and engineering

"Project Arc provided me the opportunity to see the other side of the Air Force, the side that allows for agile growth, experimentation, and acceptance of engineering failure."

A1C HANNAH GARWOOD

"While the scale of each technician's impacts can vary widely, I think it is clear that Project Arc has led to a significant improvement in our ability to develop rapid, low-cost, in-house solutions to a wide variety of problems."

2D LT. JACOB H. GEIL

"Project Arc gave me a chance to develop my own technical skills in an immersive environment, while simultaneously applying my studies to actual Air Force problems. I walk away from the program with a network of skilled technical experts in every field, that I won't hesitate to reach out to in the future!"

LT. COL. CHRISTOPHER HANDY

"My experience with Project Arc was literally both career and life changing. I was hired on to the Air Force Research Lab's Center for Rapid Innovation, as a direct result of my work with Project Arc. Project Arc opened a door that did not previously exist and I couldn't be more grateful for the opportunity that the program has afforded."

MASTER SGT. VINCENT F. OLSHOVE III

"Project Arc is bridging the gap between unit level airmen initiatives and Higher HQ. By innovating from the ground up, Project Arc brings together airmen of diverse backgrounds and ranks and gives them the creative freedom to do great things. I have found that other airmen and leaders alike are enlightened by this mission set and support the work being done from failures to successes. STEM does not always mean a degree is needed, just a great idea and some technical assistance to make the idea a reality."

A1C HANNAH GARWOOD

opportunities; various STEM events, which introduce the career fields to the younger generation; and Edison Grants, which promote technical proficiency in military members to provide more science and technology opportunities.

According to the LoE 3.6 report:

> "In 2021, the LAF general officers with STEM advanced degree education stood at 15 percent, a near 30-year low and half that of industry. Less than 2 percent of Colonels and less than 1 percent of Generals have a STEM PhD. The DAF position codings that request leaders with a STEM PhD has dropped by 20 percent since 2010 while LAF authorizations (have) remained flat during the same period.
>
> There are 311 leadership positions specifically designated for developing future technology superior to [that of] our adversaries.
>
> These are called Materiel Leaders for Lt Col (O-5) positions and Senior Materiel Leaders (SML) for Col (O-6) positions. Of these 311 as of summer 2021, only 5 require an advanced STEM degree."

"Project Arc is the driving force behind the future of true innovation in the Air Force. As each Project Arc cohort deploys out across the force, we build a deeper network of trust and innovation that crosses all organizational boundaries. I truly believe that this network, built from technically minded Airmen & Guardians, will play an important role in shaping the way we address challenges in future conflict."

MASTER SGT. VINCENT F. OLSHOVE III

"Project Arc is advancing the ability to deliver technological solutions to operational units when they need it. Based on our current construct by embedding technician's across the DAF, we are also enabling cross pollination across different organizations, bringing unique perspectives and skillsets which then further produce solutions to problems the units didn't think they had."

1ST LT. KEVIN D. TRAN

"During my experience with Project Arc, I saw myself grow exponentially in electronic design and implementation, data analytics, 3D printing, network troubleshooting, project management, BLOS/LOS communication systems, and most importantly....confidence to speak up."

A1C HANNAH GARWOOD

Photo by: Staff Sgt. Aubree Owens

FINDING AND TRAINING TECHNICIANS

The rigorous recruitment process begins with solicitations sent out via MyPers, an online resource for Air Force personnel information, to individuals with certain specialty codes. Those interested in Project Arc fill out an application and take a knowledge, skills and abilities survey. After evaluating the initial responses, Project Arc selects a portion of the applicants who then undergo an interpersonal evaluation interview followed by a skills and experience interview.

Those selected for Project Arc travel to Wright-Patterson Air Force Base, Ohio, for a 3.5-day crash course that examines design warfare, systems thinking, and interpersonal skills; unique software tools/suites, project-specific research; cross-team collaboration; Air Force Institute of Technology Courses; and deliberate continuous mentorship.

Once deployed to their temporary unit, Project Arc technicians and unit personnel work within an operational wing's innovation cell, often referred to as a Spark Cell. The technical Airmen build their expertise through hands-on experience, working side-by-side with the operators. This experience allows them to learn how systems are used and maintained in operational settings. When the prototype is suitable enough for the operator, the Spark Cell will work to integrate it into its designed operational use for the unit.

Once the team evaluates prototypes, the cell will partner with industry to implement any modifications and experiment on future enhancements. Moreover, Airmen will be able to test and evaluate those changes using the Air Force's existing testing capabilities. While success metrics are often determined by the number of problems solved or dollars saved, the **Project Arc program measures success by the number of unit commanders that adopt their model through funding or manning resources.** A million prototypes could be created saving the unit a trillion dollars. But, if the sum impact of those is not enough to prove the effectiveness of this model to the unit commanders, there is no real value to the DAF. Therefore, Project Arc must create such a great impact to the operation's tactical success that an operational commander can't ignore this capability. The Project Arc technicians do this by solving critical, yet overlooked, details that make a commander's unit operationally and tactically more successful and lethal. Then they will advocate the necessity of these

Photo by Jennifer Bryant

technicians on their flightlines. If successful, more pilot programs can be started elsewhere in the Air Force, taking into account lessons learned and best practices from other programs.

Project Arc Beta, which ran from October 2021 to January 2022, included 12 uniformed scientists and engineers, including seven company-grade officers, three non-commissioned officers and two Airmen. These S&E technicians had backgrounds in mechanical-industrial programming, physics, mathematics, electrical engineering, artificial intelligence/machine learning, and software engineering. These volunteers deployed to nine locations including Joint Base Andrews, Joint Base San Antonio, Eglin/Hurlburt Field, Hickam Air Force Base, Luke Air Force Base, Travis Air Force Base, and Whiteman Air Force Base.

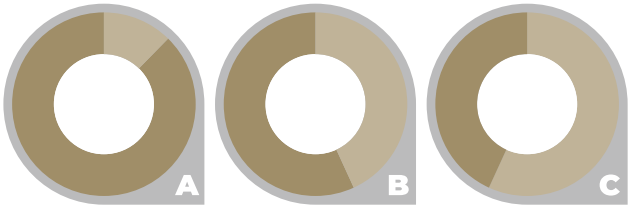
Project Arc recently assembled its third group, or cohort, of volunteers to deploy to operational units. During the first two cohorts, eligibility was limited to certain career fields. However, during the most recent recruitment drive, all enlisted personnel were eligible to apply, regardless of their career field.

LESSONS LEARNED FROM BETA EXPERIMENT:

Project Arc's team learned several things during its early months.

- First, the group's one-week training proved sufficient to mold the 14 individuals into a team while also creating a 'can-do' culture.
- Second, through market research, the group learned operators were experiencing "Innovation Burnout." In other words, operators considered "innovation" a leadership buzzword instead of a call to action. This attitude made some Airmen hesitant to invest in and engage with Project Arc.
- Third, engineers found they needed to devote time to building a rapport with unit personnel by undertaking smaller projects. Project Arc engineers also learned taskings often centered on "fighting a better 1990s fight instead of a future great power competition," with units focusing on modernizing rather than innovating.

BY THE NUMBERS
Project Arc: BETA



14 S&Es
AFSCs: 62E: 7; S100: 4; 17D: 2; 3D: 1

6 Months
July '21 - Jan '22
$450K TDY Cost

5 MAJCOMs
ACC, AFSOC, AETC, AFGSC, AMC, & PACAF

Deploy uniformed S&Es to operational locations to evaluate their ability to execute small adaptations quickly by solving operational problems.

Photo by Lt. Kennith McLoud

PROJECT ARC'S PATH FORWARD

Phase II would mark an expansion period for the program. During its beta phase, Project Arc has relied on 15 volunteers working six-month tours to prove its concept.

Going forward, the group wants to establish full-time leadership to oversee operations and set a threshold of at least six embedded Airmen and Guardians serving one-year tours at up to three beta sites. The longer-term objective would be embedding 18 Airmen and Guardians at nine sites for two- or three-year tours.

Moreover, Project Arc believes collaborating with Air Force Material Command (AFMC) early and often would benefit the program as it expands to rapidly connect to problems with subject-matter experts at AFRL and transition pathways to the appropriate System Program Office.

The program would feature a one-and-one operation and acquisition billet with matching/cost sharing. Additionally, while the group currently relies on Squadron Innovation Funds, future funding would come from the Air Force's Operation & Maintenance budget.

OPERATIONAL VIGNETTES

- Pacific Air Forces Hypoxia Inquiry: At the request of the Office of the Air Force Chief Scientist, a PACAF technician probed past reported physiological events experienced by F-15 pilots at Kadena Air Base, Japan, that could lead to hypoxia. Characterized by lack of oxygen in bodily tissues, this condition can strike pilots flying at high altitudes in poorly pressurized cabins. Symptoms include confusion, bluish skin, difficulty breathing, fatigue and rapid heartbeat. Deploying to Kadena AB, the technician team gathered data with members of the 67th Fighter Squadron, 18th OSS Physiologists, F-15 System Program Office, Air Force Research Lab/711 Human Performance Wing, and 586th Flight Test Squadron. In less than a month, the team presented three courses of action for an aircraft agnostic, flight-test approved and relatively low-cost solution to provide the minimum physiological monitoring capabilities needed to provide real-time warning of hypoxic conditions to pilots in the cockpit. The team is currently working with the AFCS to eventually sponsor an unfunded request to purchase and deploy the solution.

- "Jailbreaking" the F-35: A technician embedded at the Air Combat Command Federal Laboratory worked with the Joint Program Office and a non-traditional contractor to "jailbreak" the F-35 through a proof-of-concept onboarding of STITCHES, a DARPA-developed combat decision aid software. The technician used his coding prowess to prepare the circuit cards for the software. This project, if successful, will secure government-owned and DevOps capable space on the jet and build trust with the Joint Program Office for future government-led technical efforts.

- A Project Arc electrical engineer embedded at the 350th Spectrum Warfare Wing evaluated a machine learning software solution purchased by the Air Force to match unknown signals to known emitter threat profiles in the battlespace. This technician determined that the contractor-provided software–costing $500,000 per year to sustain–did not meet operational mission requirements. This led the 350th to embrace the "fail fast, fail forward" mindset and cancel the contract, resulting in

Photo by Airman 1st Class Derrick Bole

big savings for the Air Force.

► Austere Mesh Radio Networks for Contingency Ops: Technicians embedded with the 621 Contingency Response Wing are evaluating the ability of mesh radio networks to solve the interoperability challenges of austere communication networks. Currently, the team is leading a $1 million field exercise integrating 20 devices from various locations across the US to demonstrate the mesh networks' capability to develop a common operating picture and securely and seamlessly integrate MPU5 radios, Starlink, ATAK devices and other mission comm nodes. If successful, this operational test will inform command requirements and spending to outfit the entire wing with the capability.

► KC-135 Cargo Lift for ACE: Two technicians developed an onboard system to load cargo in the KC-135 without the support of a forklift or scissor truck. Able to be stored in the aircraft within one cargo pallet position and assembled by two crew members in 30 minutes or less, this cargo lift will expand the tanker's cargo-loading capabilities in austere conditions, e.g. hoist a body on a stretcher in medevac missions or load and unload ACE equipment. The team is working with the 92d Air Refueling Wing to demonstrate this capability at AMC's July Exercise, Mobility Guardian.

► Automating Base Contracting: Two technicians at Grand Forks Air Force Base, North Dakoda, worked with the base contracting office to develop tools in the Python programming language that automatically redact sensitive information on contracts and track their status through completion, a process that otherwise would take up to three hours per contract. Augmenting their work with these tools, contracting officials are now able to expedite the timeline for contract approvals while maintaining proper privacy, security, and accountability.

► Improving F-16 Operational Availability: A technician embedded in the 56th Maintenance Group, Luke Air Force Base, Ariz., constructed a removal tool for the F-16 finger brace, a part that connects the wing to the body of the aircraft and when damaged during required maintenance requires a complete replacement of the wing, which costs roughly $1 million. Before the inception of this tool, Luke AFB, was averaging three wing changes a month due to finger brace damages during regular major aircraft inspection. Where implemented, this tool will eliminate recurring causes of damage, saving roughly $9 million and improving aircraft availability by 7 percent annually per F-16 Fighter Squadron

► Pilot POC: Maj Louis "Tron" Bloom. Scenario: For an intercept scenario between one adversary and two friendly jets, develop an autonomous agent to provide actionable recommendations to the pilot following a priority list of Survive, Kill, Mutual Support and Analyze. Once AI is trained to follow this basic flow of priorities, scale to any scenario by adjusting the number of friendly or adversarial jets. Outcome: Project Arc engineer scoped problem with F-16 squadron at Luke Air Force Base and secured agreement with Air Force Research Laboratory's Autonomy Capability Team/Autonomous Air Combat Operations to develop modules in AACO virtual training environment. Project Arc received a programmer from MIT Artificial Intelligence Accelerator Program to work four months full time on developing the agent. The end outcome is to have an agent that executes tactics in a virtual intercept environment to analyze most favorable actions for mission objectives.

ARC

Bridging the Gap of Military Scientists and Engineers to Warfighters

HOW TO GET INVOLVED

Project Arc is redefining the way we employ uniformed Scientists & Engineers (S&Es) in the Air Force and Space Force. Started in July 2020 as a grassroots movement to address limitations highlighted in the U.S. Air Force 2030 Science and Technology Strategy and the 2019 National Defense Strategy, the team found that operational units need dedicated S&Es to provide tailored, technical solutions for unique Operational problems and adversarial technological deployments, now and in future conflict. Project Arc stations S&Es at operational units to solve technical gaps "at the edge" through exploitation of state-of-the-art technology, experimentation and rapid adaptation.

Photo by SSgt Christopher Tam.

"Give me your tinkerers, your dreamers, your hidden geeks yearning to build, the amateur hobbyists awake in the dark hours disassembling their cars and computers. Give me those that don't care if they get the credit as long as the job gets done. Give me those that will find 2000 ways not to make a light-bulb, those that won't give up, that will crawl up the mud-slicked hill in the rain so that America's light will continue to blaze freedom throughout the world." - Project Arc Team

REQUIREMENTS

- ☐ Eligibility Requirements:
  - Officers
  - Enlisted-Any AFSC
  - Civilians (able to apply on a case by case basis)
- ☐ Commander concurrence:
  - Current on all deployment requirements
- ☐ Scientists, Technologists, Engineers (STEs) able to deploy:
  - 6 month TDY
  - Embed within Operational Wing to directly address challenges in the field combating adversarial deployment
- ☐ Tinkerers who love figuring out why things work

Engineers should apply on Project Arc's sharepoint: **https://usaf.dps.mil/teams/ProjectArc967**

Email projectarc@us.af.mil **https://usaf-project-arc.github.io/**