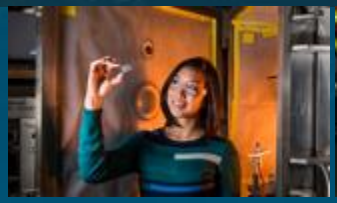
2022 Sandia Engineering Design Award

Informational Slides



Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia, LLC., a wholly owned subsidiary of Honeywell International, Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA-0003525. SAND2022-2484 O **Equal opportunity employer/Disability/Vet/LGBT** **03/2022**

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

Overview

1. Award overview
2. What is Sandia National Laboratories?
3. Sandia's Mission Areas and NAE Grand Challenges
4. Design Award Criteria
5. Important Deadlines
6. Past Project Examples

Jim Schaaf, Sandia Judges, and 2019 Design Award Winners

Award Overview

1. Open to all undergraduate students in the College of Science & Engineering
2. Teams will have **less than 10 members** on them. Teams that are larger may split into sub-teams and apply separately
3. Teams will submit a **5 page written report**.
4. Teams will **attend the UC Davis Engineering Design Showcase**
5. Finalists will give an **oral presentation** to Sandia Judges during or after the showcase
6. Winning entry of competition will be recognized at the Design Showcase and team members will share a **$1300 award** to be split equally by all members
7. Projects should show alignment with **Sandia's Mission Areas** or the **National Academy of Engineering's Grand Challenges**

Jim Schaaf, Sandia Judges, and 2016 Design Award Winners

U.S. National Laboratories

Sandia's Impact

Sandia is often called upon to respond to high-profile events

Mars Perseverance rover

NASA's Perseverance rover landed safely on Mars after a seven-month journey through space. The event could only take place following a safe launch that had been vetted by Sandia scientists.
(Courtesy of NASA/JPL-Caltech)

Cleanroom invented 1963

As the birthplace of the modern cleanroom, Sandia helped revolutionize manufacturing in electronics and pharmaceuticals and advance space exploration. $50 billion worth of cleanrooms built worldwide.

COVID-19 Pandemic

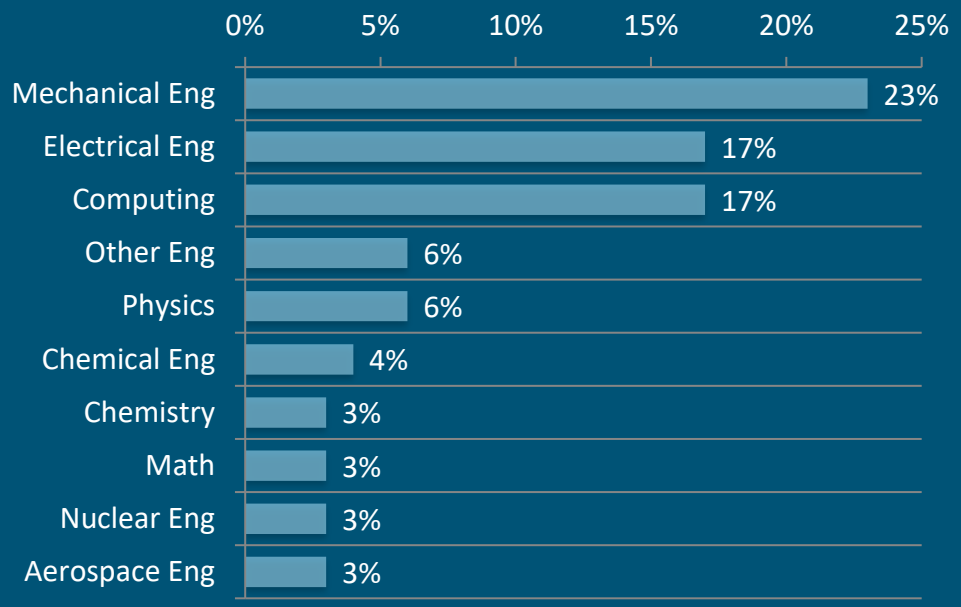
Sandia researchers are using CRISPR based technology to genetically engineer a deployable antiviral countermeasure for COVID-19. Their goal is to create an antiviral that will be customizable to respond to many different viruses.
(Image by Loren Stacks)

Sustainable Energy

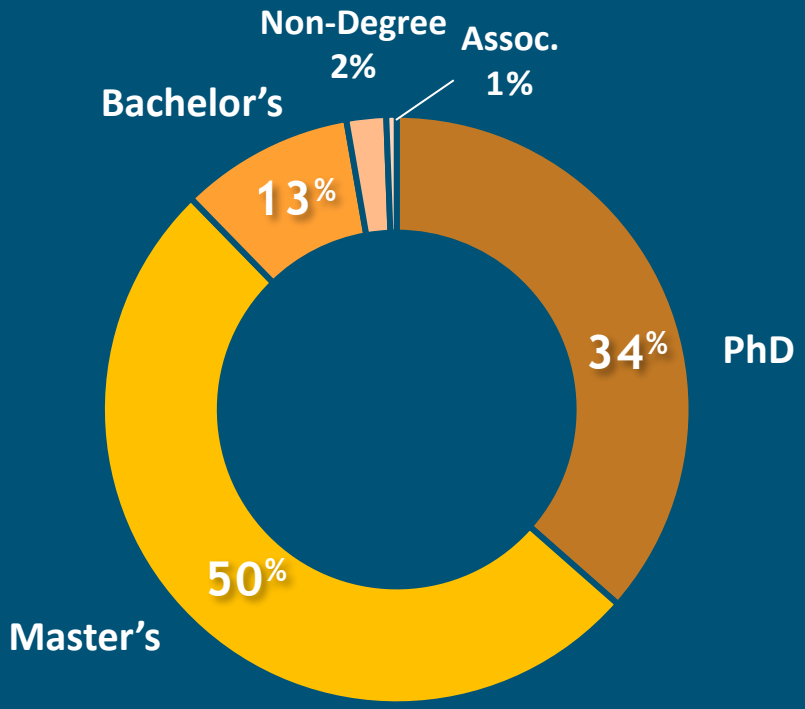
Sandia seeks to support the creation of a secure energy future for the US by using its capabilities to enable an uninterrupted and enduring supply of energy from domestic sources, and to assure the reliability and resiliency of the associated energy infrastructure.

Learn the 70 ways Sandia has impacted our nation

R&D by Discipline & Degree



Top 10 job descriptions shown, Regular exempt non-management employees only



Data as of July 2021

Quality of Work-Life

Flexible Work Schedules

- 9/80 and 4/10 workweek options *
- Generous Paid Time Off
- 11 paid holidays – includes a winter shutdown at the end of each calendar year
- Telecommuting arrangements*
- Part-time options*
- Vacation Buy Plan

* *with management approval*

Family Life

- Paid family leave
- Resource and Referral services
- Adoption assistance
- Family recreational activities
- Expectant Parent Program

On-site Amenities

- On-site Medical Clinic
- Sandia Laboratory Federal Credit Union
- On-site Café
- On-site Fitness Center
- Access to group exercise classes, clubs and sports activities
- Employee self-formed sports teams

Available at NM & CA sites

Health & Benefits

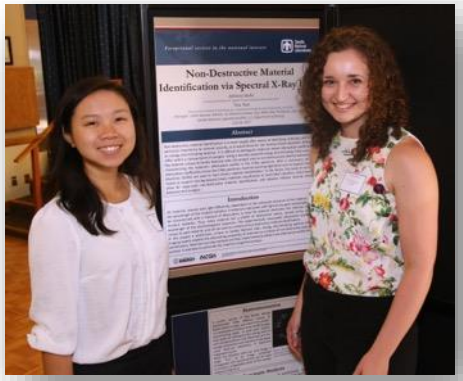
- Robust medical, dental & vision plans
- Life, accident, and disability insurance
- Healthcare and dependent care spending accounts
- Exceptional 401(k) Plan
- Employee discounts
- Voluntary benefits like pet, auto, and home insurance as well as identity theft protection
- Tuition assistance

Internships

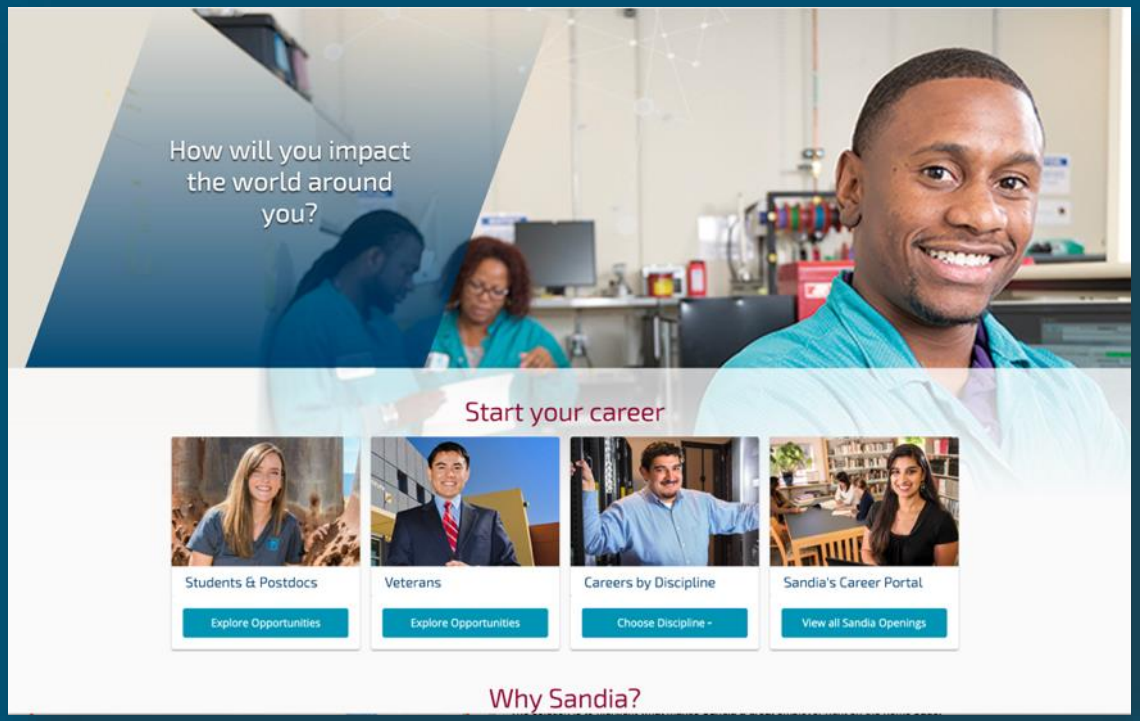
Encourage qualified students to develop interests in critical skills areas related to our mission, with the ultimate objective of developing our pipeline for our future. Available for Summer, Year Round and Co-op.

Eligibility Criteria

- Full-time enrollment status at an accredited school during the academic school year
- Undergraduate equivalent of 12 hours per semester
- Graduate equivalent of 9 hours per semester
- Must have a minimum cumulative GPA of 3.0 on a 4.0 scale for Technical, R&D, and Business interns; 2.5 on a 4.0 scale for Clerical and Labor interns
- Have U.S. citizenship for positions that require a security clearance or as stated in the job posting
- At least 16 years of age

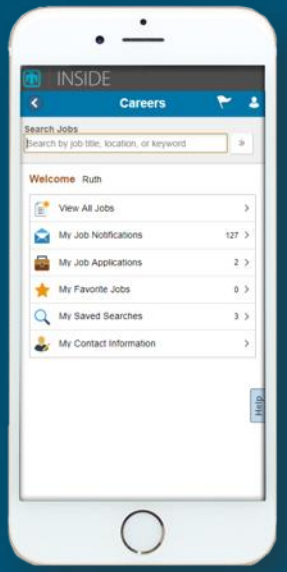


Apply Online! sandia.gov/careers



Sign up for Automated Job Notifications!

Mobile Job Applications



Fulfilling Our National Security Mission

Global Security

We protect the United States from strategic threats at home and abroad. We focus on developing and implementing technical solutions to address global security challenges.

Nuclear Deterrence

Sandia's primary mission is ensuring the U.S. nuclear arsenal is safe, secure, and reliable, and can fully support our nation's deterrence policy.

National Security Programs

Sandia provides advanced defense, deterrent and intelligence technology, and analysis to strengthen our nation's defenders.

Energy & Homeland Security

We secure the nation's critical infrastructures and environment against attacks, threats, and climate change by performing world-class research and development.

Advanced Science & Technology

Sandia delivers use-inspired basic research that combines foundational science and science-based engineering to solve the nation's greatest security challenges, today and in the future.

National Academy of Engineering Grand Challenges

With input from people around the world, an international group of leading technological thinkers were asked to identify the Grand Challenges for Engineering in the 21st century. Their 14 game-changing goals for improving life on the planet, announced in 2008, are outlined here. The committee suggested these Grand Challenges fall into four cross-cutting themes: SUSTAINABILITY, HEALTH, SECURITY, and JOY OF LIVING.

NAE Grand Challenges

ADVANCE PERSONALIZED LEARNING

A growing appreciation of individual preferences and aptitudes has led toward more "personalized learning," in which instruction is tailored to a student's individual needs. Given the diversity of individual preferences, and the complexity of each human brain, developing teaching methods that optimize learning will require engineering solutions of the future.

MAKE SOLAR ENERGY ECONOMICAL

Currently, solar energy provides less than 1 percent of the world's total energy, but it has the potential to provide much, much more.

ENHANCE VIRTUAL REALITY

Within many specialized fields, from psychiatry to education, virtual reality is becoming a powerful new tool for training practitioners and treating patients, in addition to its growing use in various forms of entertainment.

REVERSE-ENGINEER THE BRAIN

A lot of research has been focused on creating thinking machines—computers capable of emulating human intelligence— however, reverse-engineering the brain could have multiple impacts that go far beyond artificial intelligence and will promise great advances in health care, manufacturing, and communication.

PROVIDE ACCESS TO CLEAN WATER

The world's water supplies are facing new threats; affordable, advanced technologies could make a difference for millions of people around the world.

PROVIDE ENERGY FROM FUSION

Human-engineered fusion has been demonstrated on a small scale. The challenge is to scale up the process to commercial proportions, in an efficient, economical, and environmentally benign way.

PREVENT NUCLEAR TERROR

The need for technologies to prevent and respond to a nuclear attack is growing.

ENGINEER BETTER MEDICINES

Engineering can enable the development of new systems to use genetic information, sense small changes in the body, assess new drugs, and deliver vaccines to provide health care directly tailored to each person.

ADVANCE HEALTH INFORMATICS

As computers have become available for all aspects of human endeavors, there is now a consensus that a systematic approach to health informatics - the acquisition, management, and use of information in health - can greatly enhance the quality and efficiency of medical care and the response to widespread public health emergencies.

RESTORE AND IMPROVE URBAN INFRASTRUCTURE

Infrastructure is the combination of fundamental systems that support a community, region, or country. Society faces the formidable challenge of modernizing the fundamental structures that will support our civilization in centuries ahead.

SECURE CYBERSPACE

Computer systems are involved in the management of almost all areas of our lives; from electronic communications, and data systems, to controlling traffic lights to routing airplanes. It is clear that engineering needs to develop innovations for addressing a long list of cybersecurity priorities

MANAGE THE NITROGEN CYCLE

Engineers can help restore balance to the nitrogen cycle with better fertilization technologies and by capturing and recycling waste.

DEVELOP CARBON SEQUESTRATION METHODS

Engineers are working on ways to capture and store excess carbon dioxide to prevent global warming.

ENGINEER THE TOOLS OF SCIENTIFIC DISCOVERY

In the century ahead, engineers will continue to be partners with scientists in the great quest for understanding many unanswered questions of nature.

http://www.engineeringchallenges.org/cms/challenges.aspx

Grading Criteria

1. Demonstrate competency with the engineering design process
2. Illustrate connection to/impact on a Sandia Mission Area or NAE Grand Challenge (e.g. defense, natural resources, economic security, energy security, cyber defense)
3. Illustrate consideration for or impact on diverse communities
4. Demonstrate innovation in design
5. Written and oral communication proficiency

https://www.sandia.gov/ucd-design-awards/

Sandia Judges and 2015 Design Award Winners with the Winebot

Sandia National Laboratories

2022 Sandia Engineering Design Award Rubric

How to use this rubric: Judges will evaluate the 5 page (not including appendix/references) report, and assign raw scores (i.e. 3, 2, 1, 0) to each category except for Oral Communication (evaluated in a separate rubric). The teams with the highest Report Score will advance to an oral presentation round. After the oral presentation, judges will assign an oral communication score to the project and the Overall Score will be calculated. The project with the highest Overall Score wins!

	Exceeds (3)	Meets (2)	Approaches (1)	Does Not Meet (0)
Demonstrate competency with the engineering design process	• Clear problem statement with all relevant contextual factors • Identifies multiple approaches to solving problem • Down selects to a single concept and identifies reasoning • Evaluate solution via modeling, prototyping, and/or testing • Verification that design meets requirements • Identifies areas of improvement	• Contains all elements but does not elucidate it clearly and logically OR • Missing one major element but thorough discussion of other categories	• Missing a few major elements	• Missing multiple major elements and fails to elucidate completely
Illustrate connection to/impact on a Sandia mission area and NAE grand challenge (e.g. natural resources, economic security, energy security, cyber defense)	• Clearly shows connection to a Sandia mission area and/or NAE grand challenge and shows design consideration efforts made towards it • Demonstrates potential impact of project as a solution	• Shallow connection to mission area but shows strong impact	• Shallow connection to mission area/grand challenges	• No mention or consideration taken for Sandia mission areas/NAE grand challenges

Illustrate consideration for or impact on diverse communities	Provides a statement that: • Frames problem from the perspective of more than one worldview • Describes how solution reflects multiple cultural perspectives • Articulates how your project or team initiates and develops interactions with culturally different others	Provides a statement that: • Recognizes multiple worldviews • Articulates how your project or team initiates and develops interactions with culturally different others	Provides a statement that: • Identifies own cultural rules and biases • Identifies components of other cultural perspectives but responds in all situations with own worldview	Provides a statement that: • Provides minimal awareness for other worldviews • Project or team does not develop interactions with culturally different others
Demonstrate creativity and innovation	• Breakthrough • Represents a meaningful change over the methods presented in the problem statement that would result in a substantial competitive edge between the current state of the art and the proposed solution. As measured through quality, speed, cost, or complexity	• Incremental improvement • Represents an improvement over the method provided in the problem statement • Fundamentally relies on the current standard as a baseline	• Alternative • Presents an alternative to the methods provided in the problem statement but does not clearly represent a discernable improvement on quality, speed, cost, or complexity	• Not innovative • Is a rehashing of the methods provided in the problem statement with no discernable improvement on quality, speed, cost, or complexity
Written communication	• Writing style is clear, logical, and concise • Contains meaningful figures • Work is cited when appropriate • Report is organized logically and flows • Contains no grammatical errors	• Writing style is clear and logical • Contains meaningful figures • Most work is cited when appropriate • Report is organized logically • Contains few grammatical errors	• Writing style is generally readable • Most work is cited when appropriate • Some ideas are not presented in a logical order • Report contains several grammatical errors	• Writing style is difficult to read or illogical • Work is not cited when appropriate • Report contains many grammatical errors

Section	Raw score	Weighting factor	Total = Raw score x weight
Demonstrate competency with the engineering design process		4	
Illustrate connection to/impact on a Sandia mission area and NAE grand challenge		1	
Illustrate consideration for or impact on diverse communities		2	
Demonstrate creativity and innovation		3	
Written communication		2	
Oral communication (evaluated in a separate rubric)		4	

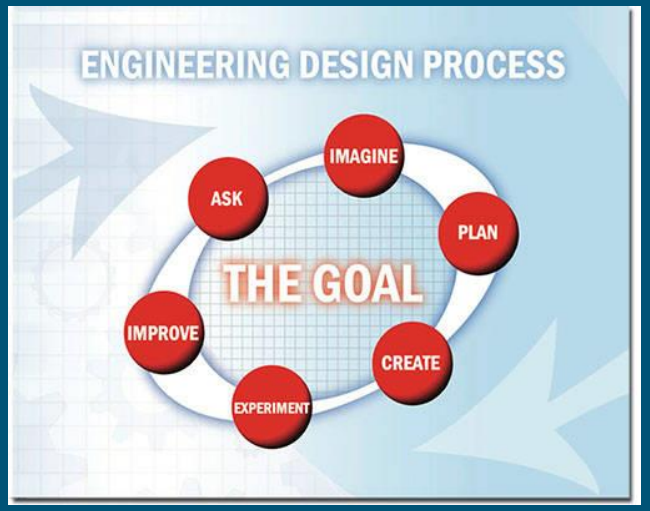
Report Score (total first 5 categories): _____

Overall Score (total all categories):_____

Rubrics are available at the competition website!

Engineering Design Process

1. Identification of the problem, requirements, and constraints
2. Concept creation and early development
3. Concept down-selection and further development
4. Modeling, prototyping, and/or development testing
5. Verification that design meets requirements
6. Identify areas of improvement and repeat



https://www.nasa.gov/audience/foreducators/best/edp.html

Important Deadlines

April 15th, 2022: Registration deadline for the UC Davis Design Showcase

May 18th, 2022: Deadline for submitting a written, five-page technical report

June 2nd & 3rd, 2022:

- **Engineering Design Showcase**
- **Oral Presentations from Finalists**

2017 Design Award Project Examples

Acrylic Acid Plan Design

Sandia Mission Area: Energy

- Chemical Engineering
- Team members: Alejandro Martinez, Hritey Werede, Lili Tong, Yaeir Halfon
- Designed an acrylic acid production plant to use excess glycerol from biodiesel manufacturing processes and performed economic feasibility study to determine if it should move forward to the development phase

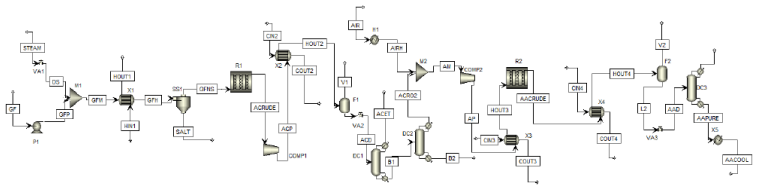


Fig 1 shows the overall flow sheet of the plant design. Enlarged in Appendix C.

Excelerate: Low-cost Lower Limb Prosthetic Solution

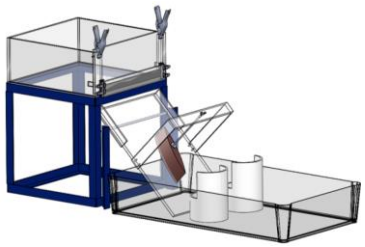
- Biomedical Engineering
- Team members: Gurdeep Sullan, Claire Sasse, Sean Maroney, Bonnie Lee
- Developed a low cost prosthetic solution for lower limb amputees in developing countries using a representative population of six children in Nepal

Figure 1: Blown-up view of prosthetic device

NAE Areas: Engineer Better Medicines, Engineer the Tools of Scientific Discovery

Inclined Water Table for Aerospace Studies

- Mechanical & Aerospace Engineering
- Team members: Nicholas Aikawa, Emma Inman, Marisela Miramontes, Kinsey Mead
- Designed and built an inclined water table for compressible flow visualization around airfoils and through nozzles

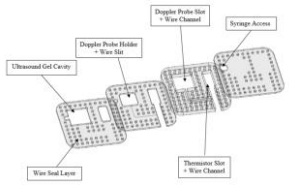


Sandia Mission Areas: Defense Systems & Assessments, Nuclear Weapons: Engineering Sciences (experimental validation)

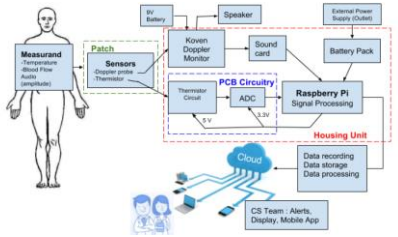
Remote Monitoring of Free Flaps

Sandia Mission Area: Defense Systems & Assessments
NAE Areas: Engineer Better Medicines, Engineer the Tools of Scientific Discovery

- Biomedical Engineering
- Team members: Stephanie Chee, Jeffrey Ma, Michael Nguyen-Truong, Connie Yuan, Annie Zhou
- Developed a remotely accessible, non-invasive, low-cost method to monitor post-surgery flap (skin, fat, and muscle tissue) health and detect flap hypoxia



Patch design to monitor flap metrics

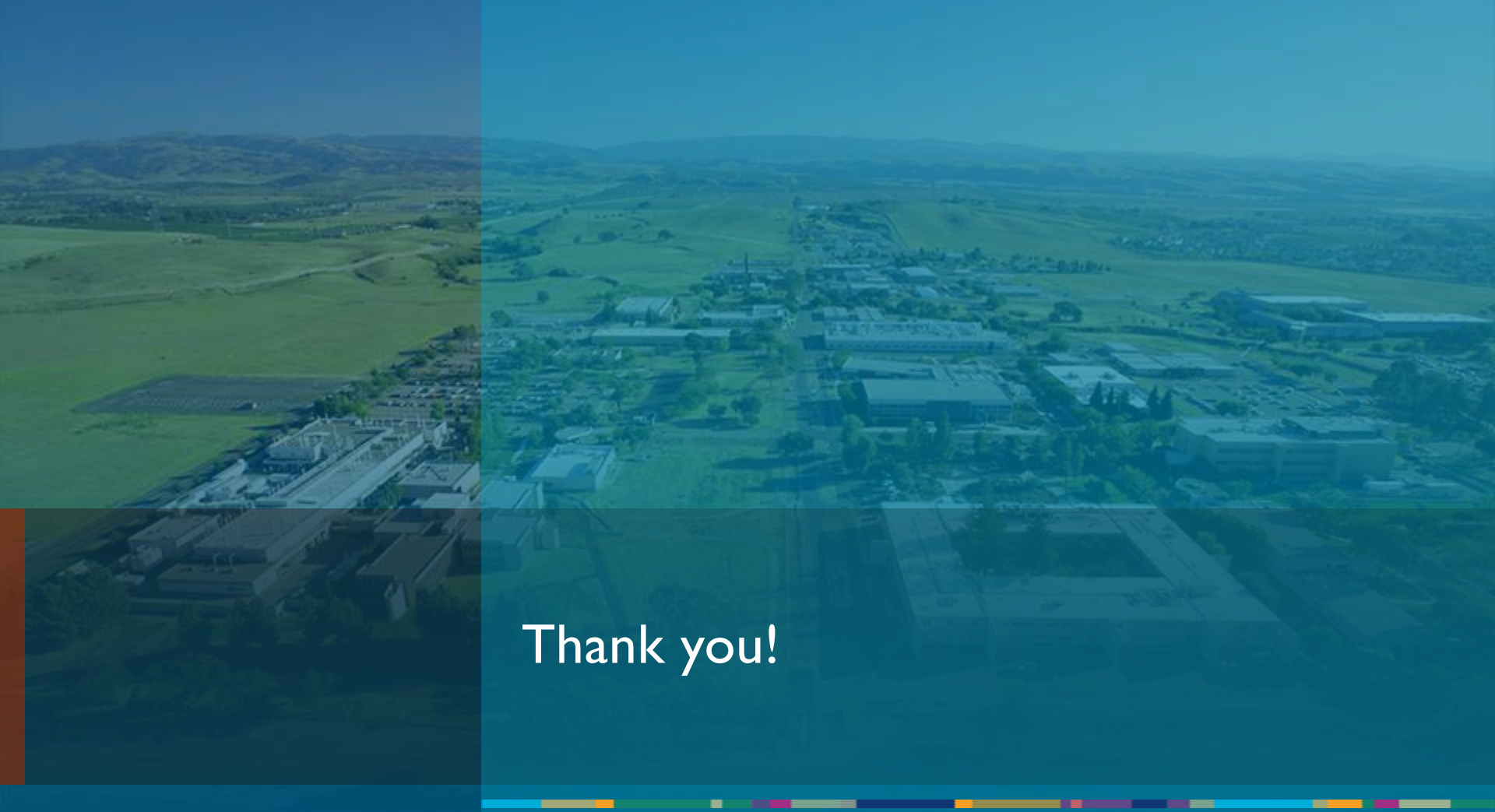


Overall system diagram

Questions?

Website: https://www.sandia.gov/ucd-design-awards/

Email: designaward@sandia.gov



Thank you!

Available Videos

Sandia Videos
Sandia Mission Video (4:36)
Sandia Our Roots (3:05)
Sandia Life (2:44)

Intern Videos
2019 Sandia Student Symposium(2:43)
Sandia's Center for Cyber Defenders(2:59)
Internships at Sandia Labs(19 Videos)

Location Videos
Sandia New Mexico Location (3:23)
Sandia California Location (3:41)

Diversity & Inclusion Videos
Abilities Champions of Sandia
American Indian Outreach
Asian Leadership Outreach
Black Leadership Outreach
Employee Resource Groups
Exceptional Warrior Video
Hispanic Leadership Outreach
Sandia Women's Action Network
Sandia Pride Alliance Network

*For more Sandia Videos refer to Sandia's YouTube Channel

For dowloadable video files, visit our Video library