



**Idaho State  
University**

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**Disaster Response  
Complex**

**College of Science and Engineering**

**Department of Civil and Environmental Engineering**

**IGEM20-001**

**A Disaster Response Complex for Emergency Responders in Idaho  
3<sup>rd</sup> Year Progress Report**

**July 1 – December 31, 2021**

**December 31, 2021**

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Appendix 1      Sample Media Articles

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## **1.0 Basic Project Information**

### **Funding Agency**

Higher Education Research Council - Idaho Global Entrepreneurial Mission Program

### **Awarded Institution**

Idaho State University, College of Science and Engineering, Department of Civil and Environmental Engineering

### **Grant Number**

IGEM20-001

### **Project Title**

A Disaster Response Complex for Emergency Responders in Idaho

### **Principal Investigator**

Mustafa Mashal, Ph.D., P.E., Associate Professor

### **Co-Principal Investigator**

Bruce Savage, Ph.D., P.E., Professor and Department Chair

### **Report Type**

3<sup>rd</sup> Year Progress Report: July 1 – December 31, 2021

## 2.0 Executive Summary

In the post 9/11 years, the national demand for training of emergency responders from the military and law enforcement branches has grown rapidly. There is a higher demand for training of emergency responders than the current facilities can support. In 2019, researchers at Idaho State University were awarded funding from the State of Idaho under the HERC-IGEM Grant. The focus of the project is the development of a Disaster Response Complex (DRC) for research, certification, and training of emergency responders in collaboration with the Directorate of National & Homeland Security at the Idaho National Laboratory (INL), and the Center for Advanced Energy Studies (CAES). The DRC has three pillars: 1) research, 2) curriculum and certification, and 3) training. All three pillars include the development of new indoor and outdoor complexes with training lanes/simulations to be used in both research, teaching, and training of emergency responders and the instrumentation of a collapsed structure. The training lanes will be used in combination with Chemical, Biological, Radiological, Nuclear, and Explosive (CBRNE) surrogates/markers, the use of robots/small Unmanned Aerial Vehicle (sUAV), Virtual Reality (VR), Augmented Reality (AR), Geographic Information System (GIS), Light Detection and Ranging (LiDAR), and Radio-Frequency Identification (RFID). The curriculum pillar includes offering courses in topics such as emergency response, HazMat, and safety protocols. For the training pillar, the facility can be used to host events for clients such as the Department of Defense (DoD) CBRNE Response Enterprise (CRE), military personnel, Idaho National Guard, and law enforcement agencies/fire departments from Idaho and the region. It is expected that the DRC will be a comprehensive facility that will incorporate natural (earthquakes, hurricanes, flooding) and man-made hazards in the training of emergency responders.

## 3.0 Summary of Project Accomplishments (July – December 2021)

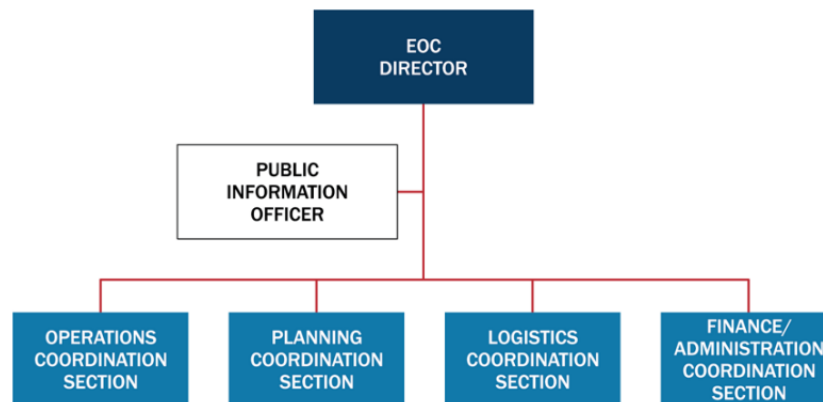
This is the progress report for the third year of the project. The third-year budget for the project is \$283,100. Despite the on-going global pandemic, the project personnel made substantial progress in the first half of the third year toward all three pillars of the DRC as described below.

- i. Since July 1<sup>st</sup>, 2021, more than 280 individuals excluding instructors and role players have participated in exercises and trainings offered through the DRC. From these, about 210 were civilian responders (ISU EMT and other programs, ISU Public Safety, Healthcare professionals, Idaho State Police, Pocatello Police, Fire departments, Bomb squads, Bannock County Coroner's Office, and search and rescue units) and approximately 75 were military responders, primarily Civil Support Teams from the National Guard representing multiples states, including Idaho National Guard. More members of the National Guard from across the country are expected to train at the DRC in 2022. ISU is collaborating with INL and other partners on the training of the National Guard units. Numerous civilian responders are also expected to use the DRC for their training in 2022. One of the highlights from the trainings in the Armory building was the return of the Idaho National Guard after more than half a century for a training exercise in collaboration with the Idaho National Laboratory on September 29, 2021. Several media outlets observed parts of the training and the return of the Idaho National Guard created a sense of pride and excitement for ISU and the surrounding communities (Appendix 1). Most of the National Guard units are training at a former Armory building in Pocatello. The project personnel have made more improvements to the building and added new features to the training lanes in the second half of 2021.
- ii. The DRC has been expanding its collaboration with local, regional, and national stakeholders. There are on-going discussions between ISU and Bannock County Commissioners to have the Regional "Emergency Operations Center" (EOC) for seven counties in Southeast Idaho (Bannock, Bear Lake, Bingham, Caribou, Franklin, Oneida, Power) located in the Armory building within the DRC. Several elected officials, including the Bannock County Commissioners, have shown strong interest in collaborating with ISU and making the EOC a reality for the community of Southeast Idaho. The EOC will provide significant opportunities for everyone, including training, curriculum, and research opportunities for ISU students and researchers. The Director of the Idaho Office of



Emergency Management (General Brad Richy) and some of his colleagues visited the Armory in the fall of 2021 to learn about the DRC and plans for the Regional EOC in Southeast Idaho. The basic operational structure of the Regional EOC is shown in Figure 1. The EOC will be a multidisciplinary unit with an assemblage of more than one function engaged in emergency management. The primary functions of the Regional EOC will be:

- Collecting, analyzing, and sharing information
- Supporting resource needs and requests, including allocation and tracking
- Coordinating plans and deterring current and future needs
- Providing coordination and policy direction



**Figure 1.** Structure of an EOC (after National Incident Management System, 3<sup>rd</sup> Ed., FEMA)

There will be three activation levels for the Regional EOC: Level 3: Normal Operation/Steady State; Level 2: Enhanced Steady-State/Partial Activation; and Level 1: Full Activation. The benefits for the Regional EOC in the indoor DRC (Armory building) are:

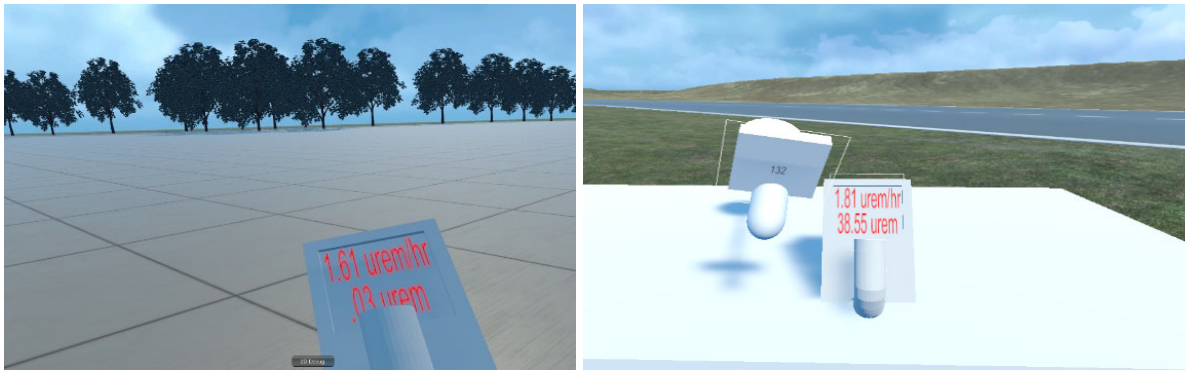
- Centralized location
  - Consolidated resources dedicated to supporting all counties
  - Higher engagement and collaboration among counties
  - Dedicated normal operation area
  - Additional space readily available during activation
  - Excellent collaboration and partnership opportunities with ISU and other stakeholders in the region
- iii. Multiple tours of the DRC were held for the leadership from INL, CAES, Higher Education Research Council, Idaho Global Entrepreneurial Mission, Idaho Office of Emergency Management, elected officials, and others.
  - iv. Several tours of the DRC were provided for the stakeholders and potential partners on the project. There are on-going discussions and collaboration between the DRC and private/public partners on new initiatives and programs. An example of such collaboration is the partnership between the DRC and the Qal-Tek Associates for offering a curriculum in disaster preparedness and response. Another example is the validation of instruments and equipment using the DRC collapsed structure (rubble pile) by a company which is potentially to take place in early 2022.

- v. Additional research funds were obtained from ISU and CAES to engage more students and researchers on the DRC project. Students and researchers participated in scholarly activities in disaster response, such as submission of peer-reviewed journals and presentation of research in a national conference.
- vi. A draft business plan for the long-term self-sustainment of the DRC has been developed and shared with IGEM-HERC.
- vii. Several media articles were published to promote and spread the word about the DRC. A one-year marketing plan has been developed for the DRC. Efforts are also underway to improve the DRC website (<https://isu.edu/cee/research-facilities/drc/>). New fliers, trifold, banners, and other marketing materials were developed to promote the DRC.

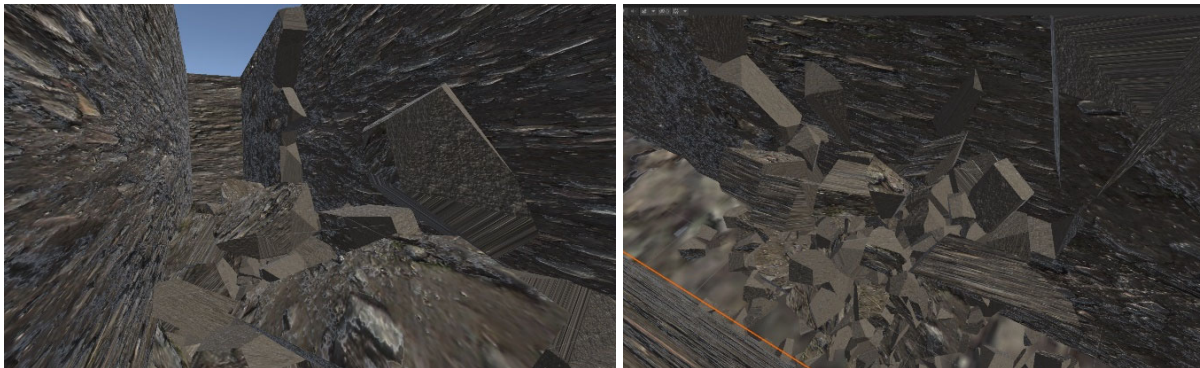
#### **A. Research Pillar**

Efforts were primarily focused on research work and program development (whitepapers) in topics such as the use of robotics, Mixed Reality (Augmented Reality/Virtual Reality), electronic simulations of markers/surrogates for CBRNE training, public health, and disaster preparedness and response. Updates in each area of the research pillar are outlined as follows.

- Robotics:
  - An ISU doctorate candidate from Mechanical Engineering has been working on the robotic aspects of the DRC project in collaboration with ISU and INL researchers. The student has made good progress toward his dissertation focused on the use of robotics in disaster response. The student is expected to graduate in 2022.
- AR/VR:
  - Six students (two doctoral, two masters, and two undergraduates) from various disciplines (Mechanical Engineering, Nuclear Engineering-Health Physics, Computer Science, Pharmacy, and Business Informatics) at ISU have worked under the supervision of the ISU/INL researchers on the AR/VR aspect of the project. The researchers from ISU and INL have been holding regular biweekly meetings to identify further research opportunities in this area. The AR/VR is an emerging area of research interest to many public and private institutions, especially during a pandemic when travel is limited. The project personnel held several demos for the use of AR/VR for the training of emergency responders.
  - In December 2020, Dr. Mashal was awarded \$20,000 for research in AR/VR through Idaho State University – Center for Advanced Energy Studies (ISU-CAES) funding. The project aims to develop AR/VR templates (e.g. exercises) for responders from both military and civil sectors. ISU is collaborating with researchers from INL on this project. The project was successfully completed. Two AR/VR templates have been developed. One template uses VR and focuses on the training of military responders in an immersive environment that simulates the aftermath of a Radiological Dispersible Device (RDD) (Figure 2). The other template uses AR and focuses on training of civil responders in a trench rescue scenario (Figure 3). The trench is currently under construction in the outdoor DRC facility.



**Figure 2.** A volunteer responder is trying the VR set for a simulated RDD training in the GVL



**Figure 3.** Shots of trench collapse template using AR

- New capabilities, space, and equipment were added in the new Gaming and Visualization Laboratory (GVL) which is located in the indoor DRC (Armory building). Several computers and AR/VR equipment were donated by a new faculty at ISU to upgrade the capabilities of the GVL. New students from Computer Science and Business Informatics have joined the GVL. A new “Gaming and Visualization” Club was also started to attract talents and create professional, training, social, and networking opportunities for ISU students. The DRC project principal investigator, Dr. Mashal, is the founding faculty advisor for the “Gaming and Visualization” Club at ISU.

- Chemical, Biological, Radiological, Nuclear, and High Yield Explosives (CBRNE) Simulation:
  - Further discussions and meetings were held between ISU and INL researchers to explore electronic simulations of CBRNE training.
  - In May 2021, CAES funded \$50,000 for program development for a Radiological Dispersal Device (RDD) Training using electronic simulations. The principal investigator from the ISU side is Dr. Mashal. All funding has been transferred to ISU. The majority of the funding is spent to support a graduate student from Nuclear Engineering-Health Physics at ISU on this project. The project has three phases. Phase I of the project was completed in September 2021. Phase II and Phase III are currently underway and will be completed by September 2022.
- Scholarly Activities:
  - A journal paper titled “Virtual and Augmented Reality in the Disaster Management Technology: A Literature Review of the Past 11 years” was submitted for publication in the Frontiers of Virtual Reality journal. The paper is currently being peer-reviewed.
  - A journal paper titled “Should We Offer Disaster Preparedness and Response Training Workshops Across Idaho? A Feasibility Study” was submitted for publication in the Journal of Emergency Management. The paper is currently being peer-reviewed.
  - A journal paper titled “A Disaster Response Complex for Training of First Responders in Idaho” was submitted to “Countering WMD Journal” which is published by the United States Army Nuclear and Countering WMD Agency. The paper is currently being peer-reviewed.
  - An ISU graduate student presented a 35-minute presentation on “Virtual Reality and Augmented Reality as Novel Tools for Training of Emergency Responders” during the 6<sup>th</sup> Annual International Conference of the Campus Alliance for Advanced Visualization (CAAV 2021) hosted by Purdue University, November 1-4, 2021 (virtual presentation).
  - An ISU graduate student presented a 30-minute presentation on “RDD Training Utilizing VR and Live Training” during the 6<sup>th</sup> Annual International Conference of the Campus Alliance for Advanced Visualization (CAAV 2021) hosted by Purdue University, November 1-4, 2021 (virtual presentation).
  - Dr. Mashal Presented a lightening talk at the INL Collaboration with NUC and CAES titled “Disaster Response, High-Performance Concrete, Hydrogen Storage, Industry 4.0: Where Civil Engineering Crosses Other Disciplines” on July 28, 2021.
  - Dr. Mashal was invited by INL to present a webinar on the Disaster Response Complex for the INL Resilience Optimization Center on July 14, 2021.
  - A master’s student from the Department of Civil and Environmental Engineering at ISU successfully completed and defended his Master’s Special Project titled “Design and Construction of a Disaster Response Complex in Idaho for Training of Emergency Responders”.
  - A master’s students from the Department of Nuclear Engineering-Health Physics at ISU has been working toward his thesis in electronic simulation of HazMat in disaster training.
  - A PhD student from the Department of Mechanical Engineering has been writing his dissertation on the use of robotics in disaster response.
  - The DRC in collaboration with ISU’s Department of Community and Public Health, ISU’s Continuing Education Workforce Training, INL, CAES, and other partners from the public

and private industry, is planning to host a two-day conference titled “Disaster Preparedness and Response Conference” in the indoor DRC on April 8-9, 2022. The Conference is expected to be attended by 150 participants. The Conference theme is focused on: 1) innovative technologies in disaster response and preparedness; 2) public health. Targeted audience will be researchers/students; fire department; law enforcement; military; healthcare professionals; non-profit search and rescue; and other responders. The participants will receive Continuing Education Units (CEUs) for attending the conference. The conference will include, but not limited to the following sessions:

- Keynote Speaker: the conference has identified a nationally renowned expert from the Johns Hopkins University as the Keynote Speaker.
- Guest Speakers: the conference invited managers and leadership from several governmental agencies (e.g. military, Bureau of Emergency Medical Services and Preparedness) within the State of Idaho to be speakers. The response for the invitations has been very positive.
- Parallel sessions on different topics (e.g. Introduction to Disaster and Management Cycle; Disasters and Response/Recovery at the US level; Differences in Community Vulnerability and Resilience; Transportation; Military Support; Infectious and Emerging/Reemerging Diseases; Communication/Evacuation Plan; Mitigation/Recovery; Emergency/Pandemic Preparedness; Emergency Preparedness Kits; Networking)
- Student poster session: priority will be given to CAES students
- Researcher poster session: priority will be given to INL/CAES researchers
- Hands-on activities and demonstration by Qal-Tek Associates, Applied Visualization Laboratory at CAES, Southeast Idaho Public Health, and others
- Exhibition area for private/public entities to demonstrate their products/services
- An Award session for best posters (students/other researchers)

Researchers from CAES Universities, INL Resilience Optimization Center, CAES Applied Visualization Laboratory, as well as those from the nearby universities in Utah (e.g. Utah State University) are planned to be invited to present/showcase their research during the conference.

- Discussions, meetings, and tours of the DRC were held to explore and build research collaboration with INL, CAES, ISU, law enforcement, office of emergency management, Southeast Idaho Public Health (SIPH), local fire departments, and private companies.
- Tours of the DRC were held for dignitaries from CAES, INL, ISU, Idaho State Board of Education, and an Idaho Legislator.
- Invitations to tour the DRC has been extended to Members of the Congress representing Idaho.
- The project personnel reached out to several researchers and faculty at ISU from different units, inviting them to explore collaboration on research and curriculum with the DRC.

## **B. Curriculum and Certification Pillar**

- The DRC has partnered with Qal-Tek Associates in Idaho Falls to offer emergency response curriculum. Seven courses in various topics (e.g. HazMat, confined space rescue technician, etc.) have been selected for offering through the DRC in 2022. The courses will be offered for a fee to



the participants. The DRC is working with the Continuing Education Workforce Training at ISU for the advertisement and registration for these courses.

- The DRC, in collaboration with INL, CAES, SIPH, local fire departments, local medical doctors, healthcare professionals, ISU's Continuing Education Workforce Training, and ISU's Department of Public Health, hosted a one-day seminar on "Acute Disaster Response Training" on August 24, 2021 (Figure 4). The seminar was free for the participants (Appendix 1). Based on the participant feedback, the seminar was a success. The curriculum for the seminar was prepared by researchers and healthcare professionals. The curriculum is expected to be utilized for the follow up training and educational events through the DRC.



**Figure 4.** Acute Disaster Response Training in the indoor DRC

- The project personnel have had discussions and tours of the outdoor DRC with potential instructors/partners from local fire departments and the private industry to develop a curriculum for emergency responders in the military, law enforcement, emergency management, and fire departments.

### C. Training and Exercise Pillar

In the third year of the project, despite the COVID-19 restrictions, the project personnel were able to continue training at the DRC while it has been still under construction. More than 280 individuals excluding instructors and role players have participated in exercises and trainings offered through the DRC since July 1<sup>st</sup>, 2021. From these individuals, about 210 were civilian responders and the rest were military responders, primarily Civil Support Teams from the National Guard representing multiple states.

- Between July 1<sup>st</sup> – December 31<sup>st</sup>, 2021, 13 training events were held for the Civil Support Teams from the National Guard and civilian responders. The majority of these training events were conducted in the indoor DRC (Armory building). Some of the training events were highlighted by media outlets (Appendix 1).
- Sample Training Events:
  - In August 2021, 35 individuals participated in a two-day training event. This was organized by the Idaho Regional HazMat Response Team Exercise through Radiological Assistance Program (RAP) (Figure 5). The training included demos by the private industry (e.g. Qal-Tek Associates and other vendors).





**Figure 5.** Training by the Pocatello Fire Department’s Urban Search and Rescue team

- In September 2021, 25 members of the Idaho and Oregon National Guard Civil Support Teams conducted a simulated Radiological Dispersal Device Exercise (Figure 6). This training was in collaboration with National and Homeland Security at INL. The event marked the return of the Idaho National Guard to the Armory building after more than 50 years. The event brought in much sense of pride and excitement to ISU and the community. ISU and INL are working on a media article about the history of the Armory building. Students at ISU conducted interviews with members of the community who remembered the Armory building to gather stories for this article. The students were also able to find documents and other information regarding the building when the National Guard was stationed there between 1939 to 1960s. The article is expected to be published in early 2022.





**Figure 6.** Members of the Idaho and Oregon National Guard training in the indoor DRC

- In November 2021, 15 students along with 6 instructors and 8 roll players from the ISU Emergency medical Technician (EMT) program conducted a workshop at the DRC.





**Figure 7.** EMT Workshop simulating a mass casualty event in the indoor DRC

- In November 2021, there was a “Death Investigator Course” presented through Bannock County Coroner’s Office in the DRC.
- In July 2021, the Local Emergency Planning Committee (LEPC) for Pocatello had their kickoff meeting in the indoor DRC (Figure 8). There were 42 participants from the businesses and public entities in Southeast Idaho.



**Figure 8.** LEPC meeting in the indoor DRC

- Other updates from the third year of the project includes, but not limited to:
  - Design and construction of new training lanes (e.g. trench rescue) at the outdoor DRC.
  - Improved the indoor DRC (Armory building), set up new research space, classrooms, meeting rooms, building signs etc. Purchased furniture, desks, educational equipment and accessories (e.g. projector screens).
  - Development of a draft business plan for the long-term sustainability of the DRC.
  - Development of a one-year marketing plan for the DRC.
  - Development of marketing details, including trifolds, brochures, banners, websites etc. for the DRC.

- Plans for the Regional EOC to be located in the indoor DRC. The EOC will likely occupy parts of the indoor DRC and will be equipped with communications, antennas, and other accessories that can be utilized toward all three pillars of the DRC and benefit everyone. Prior to housing the Regional EOC in the DRC, ISU will likely work on a MoU with Bannock County and other stakeholders in the EOC.

## **4.0 Plans for the Upcoming Reporting Period**

Plans for each pillar of the DRC project are discussed below.

### **A. Research Pillar**

- Continuing collaboration with ISU and INL researchers on the AR/VR research, exploring funding opportunities from the Department of Homeland Security and other entities in these areas.
- Publishing peer-reviewed papers from the research work.
- Hosting the inaugurating “Disaster Preparedness and Response Conference” at ISU.

### **B. Curriculum and Certification Pillar**

- Offering multiple courses in partnership with Qal-Tek Associates.
- Exploring opportunities for offering seminars and educational courses in emergency response.

### **C. Training and Exercise Pillar**

- Completing construction of the basic training lanes for the outdoor DRC.
- Adding more details to the mock-city for the indoor DRC.

### **D. Promotion and Marketing, Business Plan, Development Work**

- Finalize the business plan for the DRC for long-term sustainment.
- Present and attend regional conferences in disaster response, advertise the DRC in the exhibitions.
- Arrange tours for state legislators, members of the U.S. Congress, leadership from the National Guard units, and other stakeholders to the DRC.
- Attract donations and funding to the DRC through various channels (e.g. alumni, donors, federal/state assistance, ISU etc.).

## **5.0 Expenditure Report**

The project expenditure until December 2021 is presented in Table 1. The project is expected to exhaust its budget of \$283,100 for the third year. A breakdown of the budget and expenditure report will be provided in the annual report for the third year of the project in 2022.

**Table 1.** Summary of Budget Expenditures

Salaries & Fringes (faculty, personnel, student employees, research engineer/lab manager)	\$105,567.49
Travel	\$0
Capital Expense	\$15,619.93
Services and Supplies	\$18,267.4
<b>Total</b>	<b>\$139,454.82</b>

## 6.0 Partnerships

Since 2019, the project personnel have had discussions with the interested individuals and entities listed in Table 2 on this project with one or more pillars of the DRC project. The impact of the partnership with some of the entities named in Table 2 has created opportunities for students and faculty at ISU as well as the collaborators.

A full-time Research Engineer/Lab Manager position was created for this project. The position was filled and the Research Engineer/Lab Manager started on November 4, 2019. The Research Engineer/Manager helps with all three pillars of the DRC project, including business plan, marketing, design/construction of training lanes, and supervision of several students working on the DRC project.

**Table 2.** Entities that have toured/visited/briefed/or collaborated on the DRC project

No	Entity Name
1	Idaho National Laboratory <ul style="list-style-type: none"> <li>• National and Homeland Security Directorate</li> <li>• Energy and Environment Science and Technology</li> <li>• Nuclear Science and Technology</li> </ul>
2	The Center for Advanced Energy Studies
3	Department of Energy <ul style="list-style-type: none"> <li>• Idaho Operations Office</li> </ul>
4	Idaho Department of Environmental Quality <ul style="list-style-type: none"> <li>• INL Oversight Program</li> </ul>
5	Idaho Office of Emergency Management <ul style="list-style-type: none"> <li>• Southeast Idaho</li> <li>• East Idaho</li> <li>• Boise Area</li> </ul>
6	Idaho National Guard <ul style="list-style-type: none"> <li>• Homeland Response Force</li> <li>• Civil Support Team</li> </ul>
7	Idaho Falls Fire Department
8	Pocatello Fire Department
9	Pocatello Police Department
10	Idaho State Police



11	Qal-Tek Associates, LLC
12	Technical Resources Group, Inc.
13	Snake River Search and Rescue, Inc.
14	Argon Electronics
15	Preparedness Innovations
16	Eastern Idaho Fire Chiefs Association
17	Eastern Idaho Safety Consultants
18	Bannock County Emergency Services
20	Caribou County Public Safety and LEPC
21	Idaho State University <ul style="list-style-type: none"> <li>• College of Technology               <ul style="list-style-type: none"> <li>- Nuclear Operations Technology</li> <li>- Continuing Education/Workforce Training)</li> </ul> </li> <li>• Kasiska Division of Health Sciences               <ul style="list-style-type: none"> <li>- Institute of Emergency Management</li> <li>- Emergency Services Department</li> <li>- Department of Community and Public Health</li> </ul> </li> <li>• College of Science and Engineering               <ul style="list-style-type: none"> <li>- Department of Mechanical Engineering</li> <li>- Department of Computer Science</li> <li>- Health Physics</li> <li>- Physics</li> <li>- Department of Chemistry</li> <li>- Electrical and Computer Engineering</li> <li>- Environmental Monitoring Laboratory</li> </ul> </li> <li>• College of Arts and Letters               <ul style="list-style-type: none"> <li>- Department of Political Science</li> </ul> </li> <li>• Department of Public Safety</li> <li>• Emergency Management</li> <li>• GIS Center</li> <li>• Idaho Accelerator Center</li> </ul>

## 7.0 Economic Impact

Excluding the research and curriculum pillars, and considering only the training & exercise pillar for the DRC, as of December 2021, more than 630 individuals from across the United States have used the DRC for the world-class and unique training. If a regional multiplier<sup>1</sup> model is used to measure the economic impact, and a conservative estimate of \$500 per participant who trained at the DRC is used, the regional multipliers for Southeastern Idaho based on Idaho's Department of Labor's most recent data from June 2021 for "Professional and Management Development Training" would be as follows:

<sup>1</sup>A multiplier model uses an approach to measure how important one industry is to other industries in the region. For instance, a multiplier of 1.5 means that for every dollar spent on that industry, the regional economy will be affected by 1.5 times the original investment.

Sales Multiplier = 1.48

Jobs Multiplier = 1.12

Earnings Multiplier = 1.31

Regional Economy Impact (Sales) =  $630 \times \$500 \times 1.48 = \$466,200$

Regional Economy Impact (Jobs) =  $630 \times \$500 \times 1.12 = \$352,800$

Regional Economy Impact (Earnings) =  $630 \times \$500 \times 1.31 = \$412,650$

Total Economy Impact (Sales + Jobs + Earnings) = \$1,231,650

In summary, it is estimated that the total economy impact of the DRC so far has been more than the total original budget of the project (\$1,083,600).

## 8.0 Faculty and Student Participation

Through December 31<sup>st</sup>, 2021, the numbers of faculty, students, and other researchers who participated in one or more areas on the DRC project at ISU are listed in Table 3. Appendix 2 provides sample student activities for some of the students working on the project.

**Table 3.** Participating Researchers

Position	Numbers
Faculty	9 (including the PIs)
Graduate Students	9
Undergraduate Students	15
Researchers	6
<b>Total</b>	<b>39</b>

## 9.0 Metrics for Establishing Project Success

Table 4 presents a summary of the metrics for establishing project success. Despite the challenges imposed by the global pandemic, the project is making good progress toward the original metrics. Details about the actual performance will be provided in the annual report.

**Table 4.** Summary of the Criteria for Measuring Success for Year 3

Criteria	Pillars of the Disaster Response Complex		
	Research	Curriculum & Certification	Training & Exercise
<b>Original Proposal (Jul 2021 – Jun 2022)</b>	1. Publication of 3-4 papers. 2. Presenting research findings in a national conference. 3. Hiring two additional graduate students (MS or PhD level). 4. Hiring a permanent receptionist and coordinator. 5. Hiring 1-2 new research/teaching faculty.	1. Development of two additional classes in emergency training in collaboration with INL/CAES. 2. Providing certification to first responders. 3. Offering training courses to 150 students/first responders.	1. Training of 800 responders. 2. Expanded local fire departments and emergency response customers, all hazards including natural disasters.

## **10.0 Future Plans**

Multiple training and exercise events at the DRC are planned for 2022. In addition, work is on-going to offer several courses in collaboration with Qal-Tek Associates and develop new curriculum with INL and other collaborators. There is on-going research in the use of AR/VR, Robotics, Public Health, and other areas. The DRC is planning to host the “Disaster Preparedness and Response Conference” in the spring of 2022. The conference will be the first of its kind in Southeast Idaho and is expected to attract 150 participants with world-class and national/state expert speakers.

One of the milestones for the third year of the project is to work with the elected officials in the region to host the Regional EOC in the indoor DRC. There are on-going discussions between ISU and Bannock County on the Regional EOC as well as funding from the American Rescue Plan Act of 2021 (ARPA) allocation that the County has received. Bannock County is interested to explore the possibility of transferring some funds from their ARPA allocation that can be used to renovate the indoor DRC (e.g. add ADA compliance).

The intent of the DRC was originally to be a self-sustaining entity by the end of three years of funding. However, the pandemic has placed severe limitations on hosting training events in Pocatello and at ISU between February 2020 – May 2021. Several planned training events for 2020 had to be canceled. Additionally, the sizable demand for an indoor training space was unexpected. While the project personnel have responded to the identified changing market demands, in reality, the Armory building has been functional for less than one year. With COVID19 and the identified modified market conditions, the DRC will need more than three years from the start of the project in August 2019 to become self-sustaining. However, current progress shows that the potential exists. Additional funding and opportunities are actively being explored to make the DRC a self-sustaining long-term resource for the training of emergency responders from Idaho and the region. ISU leadership has shown strong support for the DRC and has been working with the project personnel to finalize business and marketing plans for the long-term sustainment of the DRC.

Future improvements and renovations of the Armory building such as: adding ADA compliance, renovating the building and its utilities, introducing new training lanes in the indoor/outdoor facility, partnerships with the private and public industry, hiring new researchers and students to work on different pillars of the project, training more emergency responders, arranging tours for potential partners and stakeholders, and spreading the word about the DRC in Idaho and the Pacific Northwest. Funding opportunities are actively being pursued to further develop the facilities for project continuation and expansion.

## **11.0 Commercialization Revenue**

The project principal investigator (Dr. Mashal) was notified on November 23, 2021 that the US Patent Application Entitled: “Ductile Connections for Pre-Formed Construction Elements”, Application No.: 16/817,042, will be issued by the U.S. Patent and Trademark Office in early 2022. The patent is not directly connected to the DRC project; however, it aims to reduce and eliminate earthquake damage in concrete structures and make the built environment resilient to disasters such as earthquakes.

## Appendix 1. Sample Media Articles

### Disaster Response Complex to Host Acute Disaster Response Training Workshop Aug. 24

*August 19, 2021*

The Disaster Response Complex in the Department of Civil and Environmental Engineering in the College of Science and Engineering, in collaboration with the Department of Community and Public Health in the College of Health, and the ISU Continuing Education and Workforce Training, is offering a one-day training workshop Aug. 24 to prepare ISU students and interested health care professionals to respond in an acute disaster setting.

Speakers from Southeastern Idaho Public Health will train the participants to develop resilience to disasters before they strike and identify the communication needs and challenges during a disaster. Other presenters include expert local physicians who will also train participants to perform triage on the scene and provide field care and casualty management, also focusing on the prevention and management of infectious disease outbreaks amidst disasters.

Researchers from the Idaho National Laboratory will also be presenting and demonstrating augmented reality/ virtual reality for disaster response as an emerging technology for training emergency responders when travel is restricted such as during a pandemic.

### **Disaster Response Training**

#### **Workshop for Healthcare Professionals & Healthcare Students**



- Develop resilience to disasters before they strike
- Identify communication needs and challenges
- Practice on scene triage
- Field care and casualty management
- Prevention and management of infectious disease



**Date:** August 24, 2021  
**Time:** 9am-4:30pm  
**Open Registration:** August 2, 2021  
Register Here: [cetrain.isu.edu/drc](https://cetrain.isu.edu/drc)



**Idaho State University**  
Disaster Response Complex



**Idaho State University**

Continuing Education  
and Workforce Training

Article Link: <https://www.isu.edu/news/2021-fall/disaster-response-complex-to-host-acute-disaster-response-training-workshop-aug-24.html>

## ISU, INL host disaster response training for Oregon, Idaho National Guard



Kalama Hines, EastIdahoNews.com

Local Published at 2:16 pm, September 30, 2021 | Updated at 4:36 pm, September 30, 2021



*Members of the National Guard Civil Support Teams (CST) train in responding to an apparent explosion involving radiation exposure during an exercise at the Idaho State University Disaster Response Complex on Wednesday, Sept. 29, 2021. This training program will continue all week, including some exercises at Idaho National Laboratory. | Kalama Hines, EastIdahoNews.com*

POCATELLO — More than a dozen men and women dressed in radiation suits converged on a building that, until 2020, had been a warehouse serving the Idaho State University diesel tech program.

Those men and women, representing the Idaho and Oregon National Guard Civil Support Teams (CST), underwent disaster response training Wednesday afternoon at ISU's Disaster Response Complex.

The training put the teams through different mass-casualty scenarios, including what Mustafa Mashal called a "dirty bomb" response.

Mashal, an associate professor in ISU's civil and environmental engineering department, said CST teams are trained to respond to all types of manmade and natural disasters, to "control the situation and, at the same time, provide the assistance to civilians."

"Their mission is to save life and property during events that can affect many people," Mashal told EastIdahoNews.com.





*CST team members scan a bus for radiation levels using a Geiger counter. | Kalama Hines, EastIdahoNews.com*



*CST team members scan a mannequin for potential radiation exposure using a Geiger counter. | Kalama Hines, EastIdahoNews.com*

This particular training exercise is part of a week-long training program led by the Idaho National Laboratory Homeland Security group. Similar training exercises are run through INL 15 to 20 times per year, according to INL spokeswoman Michelle Farrell.

“We have a program that works with the National Guard Bureau CST teams,” she said. “We run them through this training throughout the year.”

The training is standard. What is unique is the site.

According to Mashal, the Idaho National Guard has not conducted a similar training exercise on the ISU campus in over 50 years.



*An intentionally damaged bus and a mannequin, prepared for one of Wednesday's training exercises. | Kalama Hines, EastIdahoNews.com*

The building, now serving as the university's Disaster Response Complex, was originally constructed in 1939, Mashal explained, with the purpose of serving the National Guard in mind. But in 1970, the facility was taken over for diesel tech classes.

Then, in 2020, it was vacated. The civil engineering department was prepared for the change and has spent the last four years developing a training facility that will bring events like Wednesday's back to the campus.

Katie Hogarth, a graduate student in civil engineering department, has been part of that entire process.

"We first came up with the idea with INL and in 2017 we started developing concepts," she told EastIdahoNews.com.



*Members of the CST team continue to check a mannequin while other remove their radiation suits. | Kalama Hines, EastIdahoNews.com*

Standing in the facility, watching trainers and trainees work through different scenarios, Hogarth was proud of the work she and her colleagues have completed. But she was also excited about the opportunity.

Earlier this week, she said, she met a woman who assisted in the response to massive floods in the 1960s. The woman told Hogarth that members of the National Guard and area first responders sandbagged the city while working out of the same building that now houses the Disaster Response Complex.

The complex is more than 25,000-square feet, around 75 yards long and wide enough to mimic a two-lane road with space on either side.

“We can constantly change (the layout) to do different scenarios and different mock situations, and train different levels of emergency response,” said Jared Cantrell, ISU Disaster Response Complex Project Manager.

The simulated city block includes false storefronts and, for Wednesday’s training, a bus damaged — in a controlled environment — to mimic an explosion.



*CST team members transport the mannequin from location of the incident to their safe zone. | Kalama Hines, EastIdahoNews.com*

Both Mashal and Cantrell are hopeful that the complex will see constant training exercises similar to Wednesday’s. Both brought up the facility’s usefulness as it pertains to training programs for police and fire units.

“We’re very blessed to see today, the U.S. flag is hanging again (in here) and the National Guard utilizing the facility,” Mashal said.



*The inside of the ISU Disaster Response Complex. | Kalama Hines, EastIdahoNews.com*

Article Link = <https://www.eastidahonews.com/2021/09/isu-inl-host-disaster-response-training-for-oregon-idaho-national-guard/>

## ISU host disaster training

September 29, 2021 6:31 PM



POCATELLO, Idaho (KIFI) - Idaho State University partnered with the Idaho National Laboratory to host a joint training exercise between the Idaho 101st and Oregon 102nd Civil Support Teams.

The collaborative training prepares local first responders for major events and disasters with realistic scenarios.

"The scenario is to replicate a terrorist incident where a device was detonated on the bus creating casualties and causing radiological contamination," said INL Program Manager Bryon Marsh.

Medical Operations Officer Erica Bermensolo says the simulation training has been a real lesson on saving lives.

"I don't get a lot of experience with radiological exposures and to do it in a simulated environment has really broadened my knowledge," Bermensolo said.

It's training that Bermensolo values greatly.

"For us being five or so hours away, I mean that's not something we can get every day," Bermensolo said. "We can simulate it, but to be here and having professional train us. I just think is immeasurable."

The training took place at ISU's Disaster Response Complex

Article link = <https://localnews8.com/news/2021/09/29/isu-hosts-disaster-training/>

Link for Another Article about the training on Idaho State Journal =

[https://www.idahostatejournal.com/news/local/isu-hosts-disaster-response-training-exercise-in-repurposed-facility/article\\_f98d41ec-09cc-514d-873a-17ad35cf8dce.html](https://www.idahostatejournal.com/news/local/isu-hosts-disaster-response-training-exercise-in-repurposed-facility/article_f98d41ec-09cc-514d-873a-17ad35cf8dce.html)



## Idaho State, INL Host Disaster Response Training

*October 4, 2021*



Idaho State University and the Idaho National Laboratory are working together to make sure disaster relief teams are prepared for anything that comes their way.

On Wednesday, teams from the Idaho National Guard's 101st and Oregon National Guard's 102nd Civil Support teams worked together on a practice scenario simulating the aftermath of a bomb explosion on a bus on a busy street.

The teams used radiation detectors and protective gear, and practiced extricating and providing treatment to trapped life-like dummies, or "passengers."

The training was one of many that Idaho State has hosted at its Disaster Response Complex. The complex has room for both indoor and outdoor scenarios. At its outdoor location, teams can practice on scenarios such as earthquakes, rubble pile rescues and more. Indoor trainings, such as Wednesdays, are hosted at the Armory Building on South Second Avenue. There, they can simulate manmade and indoor disasters.

Since opening in 2020, the Complex has hosted hundreds of first responders, who previously had to travel from as far away as Texas, said Director Mustafa Mashal.

"We saw a gap and we wanted to fill it and make sure that we have a long-term asset for our community of first responders in this part of the country," he said.

Article Link = <https://www.isu.edu/news/2021-fall/idaho-state-inl-host-disaster-response-training.html>

## Appendix 2: Sample Student Activities

Date	Katie Hogarth	Mahesh Mahat
6/28/2021	Reviewed DRC Annual Report Meeting a surplus to furnish DRC Tour with Southeastern Idaho Public Health	Moved conex at outdoor DRC site Painted the room on basement of armory to start setting up subway platform scenario
7/5/2021	None	Grinded of big hall space and painted the roadway and sidewalk Painted the basement of armory
7/12/2021	Updated PowerPoint for DRC Attended Web Training for Website DRC Tour with Dr. Rodriguez	Took out the weeds from training lanes at outdoor DRC Hung the sign board in front of armory Moved piles of hollow core at outdoor DRC to make room for the conex Picked the trunk from facilities Moved the foundation block to outdoor DRC
7/19/2021	Set up for Training Event	
8/2/2021	Painted Label on Larger Cylinder	Placed weed blockers on front yard of armory and put rocks on top of it Moved the hollow core stacks and pipes for the trench and moved the conex.
8/9/2021	Researched Equipment for providing distance lectures	Put the signpost up at outdoor DRC Put the signpost up at outdoor DRC
8/16/2021	Attended Railroad training on Friday and Saturday	Painted the road lanes and parking spot at armory Setup for the meetings at armory
8/23/2021	Helped with training on Tuesday	
8/30/2021	Ordered photos for interior armory	Took photographs during training activities at armory and outdoor DRC
9/6/2021	Painted large isolation structure Hung photos in armory	Moved the bus in the armory
9/13/2021	Attended ISU Presidents vist for indoor tour	
9/20/2021	Attend Meeting with local ISU Residents about the history of the Armory Building	
9/27/2021	Attended training for Idaho National Guard and INL	
10/4/2021		
10/11/2021		
10/18/2021		
10/25/2021		
11/1/2021		
11/8/2021	Attended Tour of DRC	
11/15/2021		
11/22/2021		
11/29/2021		

Date	Mahesh Acharya
6/28/2021	Collect Food order and tour at outdoor DRC meeting for Director of CEWT and Eastern Idaho Safety Consultants Collect Food order and tour outdoor DRC meeting for Southeastern Idaho Public Health and Covid-19 Investigator
7/5/2021	
7/12/2021	Collect Food order at outdoor DRC meeting
7/19/2021	Work on DRC Whitepage Work on tri-folder brochure for DRC
8/2/2021	
8/9/2021	Armory History Research Continue update work on Whitepage and tri-folder
8/16/2021	Guest Wifi access information sheet DRC trifold and whitepage finalize
8/23/2021	
8/30/2021	Help with training/workshop at DRC/Armory Armory history research continue
9/6/2021	
9/13/2021	President's visit to armory
9/20/2021	
9/27/2021	
10/4/2021	
10/11/2021	
10/18/2021	
10/25/2021	
11/1/2021	
11/8/2021	
11/15/2021	
11/22/2021	
11/29/2021	

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**Date            Uma Shankar Medasetti**

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6/28/2021 Attended Meeting with Logan and INL folks about the project

7/5/2021

7/12/2021

7/19/2021 Worked with Ellen to get property tag for Microsoft Hololens

8/2/2021 finished working on additional papers for the Journal.

8/9/2021 We went to Merdian to bring the equipment

8/16/2021 Sent the desktops to COSE IT to see if they are working or not

8/23/2021 Worked on a presentation for the lab equipment to INL folks  
Helped with a workshop at Armory building

8/30/2021 Updated CAES progress report. Sent the list of new equipment and their description to Jared

9/6/2021 created a poster for the lab, Worked on abstract for the CAAV conference  
Helped Shishir on the discussion part of the journal  
Had a chat with John regarding need for additional development from INL side

9/13/2021 I had a meeting with shishir related to journal paper. He asked for more information like source, type and keywords for each paper

9/20/2021 Updated the poster and sent to Jared for the review

Worked on starting the new "Gaming and Visualization Club" with ASISU. the finished Application process for CAAV Presentation

9/27/2021 Worked on a quote for upgrades and new equipment

10/4/2021

Dr.Farjana and I worked together over the weekend to finish the draft

10/11/2021 Dropped the both the concordia machines for upgrades. Ordered two new coolers for the machines.

10/18/2021

10/25/2021 worked on the presentation for the CAAV. Had some discussion with INL folks regarding using Blender.

11/1/2021 Gave access to sindi banda. Attended a meeting for the GVL club. Attended the CMS training for the website.

11/8/2021 Did a load testing on the concordia machines. They are failing. Bascailly, I found an issue with the graphic cards on the machines. Need new graphic cards for the machine.

11/15/2021 Worked with Sindi on the website. I provided him a layout of it.

followed up with Jack on the Concordia machines status. The concordia originally had 13 computers and we have only 4 of those. We should be able to work with them as long as we have facilitator or instructor computers.

11/22/2021

11/29/2021 Met with the prof. Caryn Evila. Discussed with her about the possibilities of using VR/AR in her class

We ordered a wire for ADMS machines. I dropped in the COSE it office. 3. Dropped off the second concordia machines as i found issues with its graphic card.

Date	Jack Dunker
6/28/2021	Refactored dose rate code. Implemented placeholder model for dose rate meter. Attended INL RDD survey training. Attended DRC meeting and presented WIP of VR system. Implemented locomotion in VR
	Setup Virtual reality control scheme allowing for objects to be physically carried. Investigated tools to reduce motion sickness in VR. Researched implementation of necessary AR software and toolkits
7/5/2021	Finalized implementation of VR controller. Began setup of second training scenario/VR orientation area. Attended DRC seminar and bi-weekly meeting. Met with INL to demo VR project.
7/12/2021	Met with John Koudelka and INL VR team. Researched continuous redirected movement for VR. Updated VR landscape with higher resolution textures and more environment detail. Refactored shielding calculation in radiation simulation
	Met with DRC visualization team to discuss weekly plans. Met with CAES visualization team. Updated movement system to make smooth accelerated movement. Helped implement teleportation movement
7/19/2021	Met with CAES visualization team. Stayed on to assist/spectate blender tutorial. AR/VR weekly meeting
8/2/2021	
8/9/2021	AR/VR weekly meeting started. Adjusted VR pickup physics and fixed teleportation issue
8/16/2021	AR/VR weekly meeting started. Started working with Grab interactors to create "tool belt" effect
8/23/2021	AR/VR weekly meeting. Started on RDD project abstract. Fixed Grab interactors. Started on adjusted bomb dispersal and wind pattern. Attended INL training detonation and demoed Argon RF equipment. DRC sync up meeting
8/30/2021	AR/VR weekly meetings. Met with Bryan from Argon Electronics to synchronize simulated plumes.
9/6/2021	Updated visual assets for RDD project (windows and cars). Ran debugging check for upcoming demo. Met with INL/CAES visualization team. Met with DRC to discuss demo and white paper deliverables. Uploaded white paper deliverables to Mustafa
	Presented VR RDD demo. Researched trench collapses, particle systems, destructible meshes as they relate to trench collapse. Set out goals for VR and AR projects. Met with INL/CAES visualization team.
9/13/2021	Set up AR soil simulation. Started on power point presentation for CAAV. Attended DRC bi-weekly meeting, discussing plans for AR project. Moved ADMS equipment
9/20/2021	Completed first phase of soil simulation in Unity. Drafting out thesis proposal. Looking into capabilities of Unity to do destructible objects to simulate trench collapse. Attended INL meeting
9/27/2021	Attended INL meeting. Researching destructible meshes for Unity for trench collapse. Worked on setting up demo in Hololens. Started outline story boards for phase II RDD project.
10/4/2021	Drafted CAAV presentation. Retooled AR shaders to run on Hololens. Working on RDD phase 2 white paper. Attended INL meeting discussing INL assistance with environment modeling
10/11/2021	Met with INL discussing GIS data import into project. Reworked CAAV presentation based on white paper draft. Attend DRC sync up. Working on AR controller integration
10/18/2021	Prepared VR project for demonstration for CAAV. Put together video for CAAV. Fixed Hololens app deployment. Met with INL planning for CAAV
10/25/2021	Met with John Koudelka to review presentation slides Presented at CAAV. Rewriting RDD white paper draft. . Attended DRC meeting
11/1/2021	Met with INL discussing trench collapse. Researched blender cell fracturing. Added to RDD outline. Updated AR project with collapsing wall
11/8/2021	Updated and streamlined VR RDD demo. Met with CAES team about improving cell fracture performance. Attended DRC meeting. Planning on EOC paper. Met with Bryon Marsh on RDD phase 2
11/15/2021	Researching plume models, trench failure modes and AR/VR optimization. Starting on outline of EOC document
11/22/2021	Met with CAES team. Received documentation of turning physics calculations into animations. Presented Phase 2 RDD outline to Bryon Marsh, working on assigned improvements. Attended DRC weekly meeting. Received trench rescue document from Dr Savage.
11/29/2021	