Section 1.  Publications on behalf of CAES
None compiled (ISU faculty are currently off-contract and were not asked for their publication lists)

Section 2.  Conferences Attended on behalf of CAES
None compiled (ISU faculty are currently off-contract and were not asked for their conference lists).

Sections 3.  Submitted Proposals Related to CAES Activities

<table>
<thead>
<tr>
<th>Lead PI</th>
<th>Admin Unit</th>
<th>Title</th>
<th>Sponsor</th>
<th>Status</th>
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<tbody>
<tr>
<td>Chad Pope</td>
<td>Nuclear Eng/Health Physics</td>
<td>U.S-Brazil Joint Study to Assess Market ...</td>
<td>BEA</td>
<td>Submitted</td>
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<tr>
<td>Michael McCurry</td>
<td>Geosciences</td>
<td>INL SSHAC Level 3 PVHA: Participatory Pe...</td>
<td>BEA</td>
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<tr>
<td>Mostafa Fouda</td>
<td>Electrical Engineering</td>
<td>ERI Designing A Non-intrusive Smart Sens...</td>
<td>NSF</td>
<td>Submitted</td>
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<tr>
<td>Rene Rodriguez</td>
<td>Chemistry</td>
<td>Synthesis, Characterization and Testing ...</td>
<td>BEA</td>
<td>Funded</td>
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<tr>
<td>Mostafa Fouda</td>
<td>Electrical Engineering</td>
<td>Toward Privacy Preserving Machine Learnin...</td>
<td>ISBOE</td>
<td>Funded</td>
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<tr>
<td>Jon Stoner</td>
<td>Idaho Accelerator Center</td>
<td>133mXe Isotope Beam Time</td>
<td>BEA</td>
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<td>Leslie Kerby</td>
<td>COSE Informatics / Comp Sci</td>
<td>Develop an effective artificial intelli...</td>
<td>BEA</td>
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<tr>
<td>Shannon Kobs</td>
<td>Geosciences</td>
<td>PVHA Tectnt Team</td>
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<tr>
<td>Shannon Kobs</td>
<td>Geosciences</td>
<td>Eastern Snake River Plain Volcanic Event...</td>
<td>BEA</td>
<td>Funded</td>
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<tr>
<td>Amir Ali</td>
<td>Nuclear Eng/Health Physics</td>
<td>CAES ATHeRM Training Update</td>
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<td>Funded</td>
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<tr>
<td>Leslie Kerby</td>
<td>COSE Informatics / Comp Sci</td>
<td>Bootcamp</td>
<td>BEA</td>
<td>Funded</td>
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<tr>
<td>Andrew Chrysler</td>
<td>Electrical Engineering</td>
<td>Far-Field Detection of Rogue and Malicia...</td>
<td>UIdaho</td>
<td>Funded</td>
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<tr>
<td>Andrew Chrysler</td>
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<td>Internship for Far-Field Detection of Ro...</td>
<td>UIdaho</td>
<td>Funded</td>
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<tr>
<td>Amir Ali</td>
<td>Nuclear Eng/Health Physics</td>
<td>Molten Salt Nuclear Battery Design and D...</td>
<td>UIdaho</td>
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<tr>
<td>Courtney Jenkins</td>
<td>Chemistry</td>
<td>Radiation-Generated Radicals for Chemica...</td>
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<tr>
<td>Mostafa Fouda</td>
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<td>Privacy-Preserving Health Monitoring Sys...</td>
<td>Qatar Na</td>
<td>Submitted</td>
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<tr>
<td>Mostafa Fouda</td>
<td>Electrical Engineering</td>
<td>Reliable Biomedical Image Reconstruction...</td>
<td>Qatar Na</td>
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Section 3.5.  Funded Awards related to CAES Activities

<table>
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<tr>
<th>Lead PI</th>
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<tr>
<td>Rene Rodriguez</td>
<td>Synthesis, Characterization and Testing ...</td>
<td>BEA</td>
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<tr>
<td>Shannon Kobs</td>
<td>PVHA Tectnt Team</td>
<td>BEA</td>
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<td>Shannon Kobs</td>
<td>Eastern Snake River Plain Volcanic Event...</td>
<td>BEA</td>
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<td>Jon Stoner</td>
<td>133mXe Isotope Beam Time</td>
<td>BEA</td>
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<tr>
<td>Leslie Kerby</td>
<td>Develop an effective artificial intelligence</td>
<td>BEA</td>
</tr>
<tr>
<td>Amir Ali</td>
<td>CAES ATHeRM Training Update</td>
<td>BEA</td>
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<td>Mostafa Fouda</td>
<td>Toward Privacy Preserving Machine Learnin...</td>
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<td>Internship for Far-Field Detection of Ro...</td>
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<tr>
<td>Andrew Chrysler</td>
<td>Far-Field Detection of Rogue and Malicia...</td>
<td>UIdaho</td>
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<tr>
<td>Leslie Kerby</td>
<td>Randomized Computing for Multiphysics</td>
<td>BEA</td>
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<tr>
<td>Leslie Kerby</td>
<td>Bootcamp</td>
<td>BEA</td>
</tr>
<tr>
<td>Mustafa Mashal</td>
<td>Bulk Storage of Hydrogen Energy</td>
<td>BEA</td>
</tr>
<tr>
<td>Mustafa Mashal</td>
<td>Radiological Dispersal Device Training</td>
<td>BEA</td>
</tr>
<tr>
<td>Amir Ali</td>
<td>Nuclear Microreactor Heat Pipe Modeling</td>
<td>BEA</td>
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</table>
Section 4. Patents, Licenses, other IP
None

Section 5. Other Awards
None

Section 6. Outgoing CAES Personnel
None compiled (ISU faculty are currently off-contract and were not asked for their student lists)

Section 7. Incoming CAES Personnel
None compiled (ISU faculty are currently off-contract and were not asked for their student lists)

Section 8. New Joint Appointments
None

Section 9. New Equipment
None compiled (ISU faculty are currently off-contract and were not asked for their equipment lists)

Section 10. Collaborative Research:

(1) CAES Visiting Faculty Program, Summer 2021

<table>
<thead>
<tr>
<th>Idaho State University</th>
<th>INL Collaborators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mostafa Fouda</td>
<td>Kurt Derr</td>
</tr>
<tr>
<td>Andrew Chrysler</td>
<td>Lloyd Landon</td>
</tr>
<tr>
<td>Justin Wood/Marcus Burger (withdrawn)</td>
<td>Ron Fisher</td>
</tr>
<tr>
<td>Mustafa Mashal</td>
<td>Chandu Bolisetti, Som Dhulipala</td>
</tr>
<tr>
<td>Irene van Woerden</td>
<td>Rajiv Khadka</td>
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</table>

(2) INL Collaboration Fund Program, Spring/Summer 2021

<table>
<thead>
<tr>
<th>INL Investigator</th>
<th>ISU Investigator</th>
<th>Research Topic</th>
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</thead>
<tbody>
<tr>
<td>Joshua Hansel</td>
<td>Amir Ali</td>
<td>Nuclear Microreactor Heat Pipe Modeling and Simulation Database</td>
</tr>
<tr>
<td>Kunal Mondal</td>
<td>Mustafa Mashal, Bruce Savage, Rene Rodriguez, Kavita Sharma</td>
<td>Bulk Storage of Hydrogen Energy</td>
</tr>
<tr>
<td>Bryon Marsh</td>
<td>Mustafa Mashal</td>
<td>Radiological Dispersal Device Training</td>
</tr>
<tr>
<td>Som Dhulipala</td>
<td>Leslie Kerby</td>
<td>Randomized Computing for Multiphysics Modeling and Simulations</td>
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</table>
### (3) Idaho I-Corps Summer 2021 (co-sponsored by CAES)

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
<th>Venture/Initiative</th>
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<tbody>
<tr>
<td>Donna Delparte</td>
<td>Geosciences</td>
<td>Potato Crop Virus/Imaging</td>
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<tr>
<td>Jared Barrott</td>
<td>Pharmacy</td>
<td>Hydrogen therapy/CPAP</td>
</tr>
<tr>
<td>Amir Ali</td>
<td>Nuclear Engineering</td>
<td>Heat Exchanger</td>
</tr>
<tr>
<td>Nirajan Bhattarai</td>
<td>Pharmacy</td>
<td>Hearing Loss</td>
</tr>
<tr>
<td>Anish Sebastian</td>
<td>Mechanical</td>
<td>Automated Rouging</td>
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</table>

### (4) ISU-CAES Seed Grant Program (Ongoing Research in FY21Q3)

<table>
<thead>
<tr>
<th>ISU PI</th>
<th>ISU Department</th>
<th>ISU co-PIs</th>
<th>University co-PIs</th>
<th>INL co-PI</th>
<th>Project</th>
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</thead>
<tbody>
<tr>
<td>Ali, Amir</td>
<td>NE</td>
<td>David Arcilesi (UI)</td>
<td>Piyush Sagharwall</td>
<td></td>
<td>Small-Scale Heat Exchanger Thermal Performance Facility</td>
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<tr>
<td>Jenkins, Cori</td>
<td>Chemistry</td>
<td>Josh Pak</td>
<td>Chris Zarzana</td>
<td>Britanny Hodges</td>
<td>Urethane degradation analysis for upcycling and designing sustainable plastics</td>
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<tr>
<td>Leung Solomon</td>
<td>CE</td>
<td>Yaqiao Wu (BSU MaCS)</td>
<td>Don Wood</td>
<td></td>
<td>Sorption Removal of Gaseous Fission Products in Nuclear Fuel Reprocessing by MCM-41, TiO2, and their Functionalized Derivatives</td>
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<tr>
<td>Mashal, Mustafa</td>
<td>CE</td>
<td>Bruce Savage Jared Cantrell</td>
<td>Rajiv Khadka</td>
<td></td>
<td>The Use of Emerging Technologies for Training of Emergency Responders</td>
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<td></td>
<td></td>
<td>Roy Dunker</td>
<td>Xingue Yang</td>
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<td>Murray, Kendra</td>
<td>Geosciences</td>
<td>Nick Bulloss (BSU MaCS)</td>
<td>Xiaofei Pu</td>
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<td>Pashikanti, Srinath</td>
<td>Pharmacy/ Chemistry</td>
<td>Rene Rodriguez</td>
<td>Robert Fox Donna Baek</td>
<td></td>
<td>Synthesis of Conformationally-Rigid Tetralkyl phosphonium based Ionic Liquids for extraction of critical element Cobalt</td>
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<tr>
<td>van Woerden, Irene</td>
<td>Community &amp; Public Health</td>
<td></td>
<td>Rae Moss</td>
<td></td>
<td>Perceptions of INL and Nuclear Energy in the local community</td>
</tr>
</tbody>
</table>
In May 2020, researchers from Idaho State University (ISU) began investigating a unique detection system that could be implemented in storage canisters for used fuel plates from the Advanced Test Reactor (ATR) at the Idaho National Laboratory (INL). Under guidance from the Office of Environmental Management (EM) within the Department of Energy (DOE), INL was tasked with evaluating sensor technologies that could provide in situ measurements of moisture and hydrogen content within extended dry storage canisters used to house aluminum-clad used nuclear fuel.

A prototype of the remote, canister-monitoring system (RCMS) for determining and monitoring environmental conditions within dry fuel storage canisters was constructed by INL for testing the first sensor candidate at the Center for Advances Energy Studies (CAES), in Idaho Falls. The collaboration between ISU and INL focused on a combined sensor system capable of acquiring a point measurement of information within the canister, including temperature, relative humidity, and hydrogen gas concentration (Figure 1).

For the experimental campaign performed at CAES, the research team (from INL – Evans Kitcher (PI), John Buttles, Michael Fanning, Nancy Johnson, Phil Winston; from ISU – Daniel LaBrier (co-PI), Eslam Ali) investigated the performance of sensors chosen by the INL team, along with feasible use of wireless transmission of collected data to a remotely-located data acquisition system. This project was successfully completed in May 2021.

---

**Section 11. Research Highlight: Integrated Sensor Development for Used Fuel Storage Canisters**

In May 2020, researchers from Idaho State University (ISU) began investigating a unique detection system that could be implemented in storage canisters for used fuel plates from the Advanced Test Reactor (ATR) at the Idaho National Laboratory (INL). Under guidance from the Office of Environmental Management (EM) within the Department of Energy (DOE), INL was tasked with evaluating sensor technologies that could provide in situ measurements of moisture and hydrogen content within extended dry storage canisters used to house aluminum-clad used nuclear fuel.

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---

**Table 1: Active Laboratory Projects in the CAES building**

<table>
<thead>
<tr>
<th>PI</th>
<th>Project title</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dan LaBrier</td>
<td>Integrated Sensor Development for Used Fuel Storage Canisters</td>
<td>Completed</td>
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<tr>
<td>Dan LaBrier</td>
<td>Chemical Interaction Studies between Molten Sodium and Standard Insulation Types</td>
<td>Work Control Approved; will be combined with project below</td>
</tr>
<tr>
<td>Dan LaBrier</td>
<td>Molten Salt Migration in Nuclear Grade Graphite</td>
<td>Work Control Approved; will be combined with project above</td>
</tr>
<tr>
<td>Dan LaBrier</td>
<td>Heat Treatment and Autoclave Testing</td>
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</tr>
<tr>
<td>Amir Ali</td>
<td>Scaled Heat Exchanger Performance Loop</td>
<td>Focused Review completed</td>
</tr>
<tr>
<td>Amir Ali</td>
<td>Goniometer Tensiometer</td>
<td>Installed</td>
</tr>
</tbody>
</table>

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**Figure 1. Combined sensor installed on an Arduino board (left), RCMS mock canister for CAES testing (center), and installed multi-component sensor system (right).**

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