STRATEGIC PLAN
FY 2010 – FY 2020

A BOLD AGENDA FOR THE NEXT DECADE

Mining Engineering  Nuclear Engineering

Missouri University of Science and Technology
226 McNutt Hall, 1870 Miner Circle
Rolla, MO 65409-0450
Executive Summary

Expansions in domestic and global mining industry and a renewed interest in nuclear power generation in the United States have fueled greater interest in mining, minerals, explosives and nuclear engineering research and education. Missouri S&T has strong and leading programs in these strategic areas and, is therefore, positioned to play a vital role in meeting the global demand for technological innovations and the production of highly qualified personnel in these disciplines. Over the next 10 years, the Department of Mining and Nuclear Engineering has laid down strategic objectives, goals and action plans to expand and grow its research and education initiatives. Enrollment capacity is expected to grow significantly to 450 in Mining, Minerals and Explosives Engineering and 300 in Nuclear Engineering. Along with this capacity growth, it is expected that the FTE faculty will grow from the current 18 to 25. Major facilities are being built to expand research and education efforts. These facilities include the new Missouri S&T Experimental Mine, Joint Missouri S&T-UM Thorium Research Center, the new Explosives Research Facility and the expansion in the Nuclear Reactor.

Significant investments are also being made to build new laboratories in mining, minerals, explosives and nuclear engineering. These laboratories include Surface and Underground Virtual Facilities, Rock Mechanics Lab, Mining Survey Lab, Mine Ventilation Facility, Mine Safety and Health Facility, and the Mineral Processing Facility in Mining, Minerals and Explosives Engineering. Nuclear Engineering laboratories include Neutron and X-ray Tomography, Hydrogen Storage and Mass Spectrometer Lab, Nanotechnology and Radiochemistry Lab, Neutron Generator, Radiation Detection and Measurement Lab, Advanced Radiography and Tomography Lab, and Multi-phase and Multi-scale Processes. The Department is also expanding its global outreach to develop research and education partnerships. Guided by a collective vision, with leadership and strength of our faculty, staff and students, and the support from the campus, our Boards, industry, Academy, and our great alumni, we will reach our destination of excellence in the next decade. The FY2010 – 2020 Strategic Plan outlines the strategic objectives, strategic goals and action plans required to attain the 2020 VISION for both Mining and Nuclear Engineering programs.

Samuel Frimpong, PhD, PEng
Professor and Chair
Robert H. Quenon Endowed Chair
Department of Mining and Nuclear Engineering
## Strategic Plan Content

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Summary</td>
<td>2</td>
</tr>
<tr>
<td>Strategy Statement</td>
<td>4</td>
</tr>
<tr>
<td>Governance and Leadership</td>
<td>4</td>
</tr>
</tbody>
</table>

### Mining Engineering

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>5</td>
</tr>
<tr>
<td>Mission, Vision, Core Values</td>
<td>5</td>
</tr>
<tr>
<td>Themes</td>
<td>6</td>
</tr>
<tr>
<td>Theme 1 (S&amp;T’s Themes 2 &amp; 4)</td>
<td>6</td>
</tr>
<tr>
<td>Theme 2 (S&amp;T’s Themes 1 &amp; 4)</td>
<td>9</td>
</tr>
<tr>
<td>Theme 3 (S&amp;T’s Theme 2)</td>
<td>12</td>
</tr>
<tr>
<td>Theme 4 (S&amp;T’s Themes 2 &amp; 3)</td>
<td>14</td>
</tr>
<tr>
<td>Theme 5 (S&amp;T’s Themes 2 &amp; 3)</td>
<td>16</td>
</tr>
</tbody>
</table>

### Nuclear Engineering

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>19</td>
</tr>
<tr>
<td>Mission, Vision, Core Values</td>
<td>19</td>
</tr>
<tr>
<td>Themes</td>
<td>21</td>
</tr>
<tr>
<td>Theme 1 (S&amp;T’s Themes 2 &amp; 3)</td>
<td>21</td>
</tr>
<tr>
<td>Theme 2 (S&amp;T’s Themes 1, 2, 3 &amp; 4)</td>
<td>23</td>
</tr>
<tr>
<td>Theme 3 (S&amp;T’s Themes 2 &amp; 3)</td>
<td>23</td>
</tr>
<tr>
<td>Theme 4 (S&amp;T’s Theme 2)</td>
<td>24</td>
</tr>
<tr>
<td>Theme 5 (S&amp;T’s Theme 2)</td>
<td>26</td>
</tr>
</tbody>
</table>
Strategy Statement

Missouri S&T will establish by 2020 unparalleled environments with resources for executing our research and education mandate that produces highly qualified graduates, researchers, technology and service for industry, academia, technical and professional and other organizations.

Governance and Leadership

The Department Chair is the Chief Executive Officer for the Department of Mining and Nuclear Engineering. The Chair receives his/her mandate from the Provost and Executive Vice Chancellor for Academic Affairs and is authorized to lead the Department towards excellence in education, research and service. The Chair has also delegated responsibilities to Associate Chairs and Directors to provide leadership to other sections in the Department. These sections include Nuclear Engineering, the Saudi Mining Polytechnic, Distance and Continuing Education, the Missouri S&T Experimental Mine, the Missouri S&T Nuclear Reactor and Explosives Engineering. The Department’s support staff also reports to the Department Chair through the Administrative Associate and the Program Support Specialist. The strategy for success is for leaders to remain faithful and adhere to our core values of excellence, ethics, experience, exposure, leadership, passion and tradition at all levels in the organization.
Mining Engineering

Introduction

The “Mining Industry of the Future” will continue to face tough challenges, whose solutions will require highly qualified graduates and advanced research initiatives. The expanding global mineral markets will continue to increase the demand for highly qualified graduates. Missouri S&T must position itself at the frontier of Mining Engineering education and research to provide relevant solutions to industry needs. *The “State of Excellence” that should guide our collective effort must focus on excellence in education and research, availability of resources and facilities, and strong networks of alumni and industry, and our global partners.* This strategic plan reflects considerable reach, and aspires for program pre-eminence in the U.S. and the global community.

Mission

Mining Engineering at Missouri S&T provides superb education and training to undergraduate and graduate students for the mining and construction industries of Missouri, USA and the global mining companies with strategic interests in USA. *The programs provide students with total quality education and research capabilities to make a difference in our State and the technological world.*

Vision

Missouri S&T will be recognized as the global university of choice for mining engineering education, research and graduate employees for the mining industry.

Core Values

Our vision of global leadership will be achieved through the following seven core values that form the basis of Missouri S&T’s tradition of excellence in Mining Engineering education and research.

*Excellence:* The efforts of faculty, staff, alumni, industry partners and related organizations create an environment that promotes excellence in education and research.

*Ethics:* We value truth, honesty, integrity and hard work as abiding principles for professional excellence.

*Experience:* Through its experimental mine facilities, internships, cooperative education and field trips, students receive hands-on experience, which is vital to the practice of the profession.
**Exposure:** S&T reaches out to global frontiers through its Board of industry executives, alumni, research and professional societies, and our global partners.

**Leadership:** S&T provides opportunities for students to lead various societies, such as, SME, NSSGA, WIM, and ISEE and competitions like the mine design, mucking and mine rescue competitions.

**Passion:** S&T educates graduates with a passion for the mining industry’s growth and competitiveness.

**Tradition:** S&T maintains the tradition of excellence, unity, collegiality and family that have been the bedrock of its mining engineering programs.

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**Themes**

In the pursuit of excellence and global leadership in Mining Engineering education and research, the following strategic objectives will provide impetus as guiding principles.

1. *Maintain & Expand Outstanding Mining Engineering Education Portfolio (S&T's Themes 2 & 4)*
2. *Enrich the Student Experience (S&T’s Theme 1 & 4)*
3. *Broaden Mining Engineering Research (S&T’s Theme 2)*
4. *Expand S&T’s Mining Engineering Capacity (S&T’s Theme 2 & 3)*
5. *Strengthen National and Global Partnerships (S&T’s Theme 2 & 3)*

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**Theme 1 (S&T’s Themes 2 & 4)**

**Maintain and Expand outstanding Mining Engineering Education Portfolio**

Missouri S&T will pursue initiatives that will strengthen Mining Engineering as the global program of choice. Toward this goal, Missouri S&T will create and maintain a well-diversified Mining Engineering program and establish the MS in Mineral Process Engineering. S&T will also expand the ME (Online) and the Explosives Engineering programs to Industries and communities.
**Lever 1.1 (S&T’s Levers 2.1/2.3/2.6/4.2/4.3/4.4): Maintain and Strengthen Missouri S&T Mining Engineering as a top Program of Choice in the US and the Globe**

Action 1.1.1: *Maintain ABET Accreditation*: S&T shall maintain currency in the ABET Program Educational Objectives and Student Outcomes, appropriate assessment and continuous improvements that meet accreditation standards. *(Program is accredited and will continue this status)*

Action 1.1.2: *Maintain Our Brand KEA88 (Knowledge-Experience-Attribute)*: S&T shall ensure that the average 3-D Job Readiness Factor of 88% is maintained for all its graduating seniors. *(Base S&T Average is 92%)*

Action 1.1.3: *Achieve 100% Freshmen Internship*: S&T shall work with its Development Board and industry leaders to ensure the achievement of 100% freshmen internship opportunities. *(Base is 10%; 20% per year till 2018)*

Action 1.1.4: *Increase Competitive Scholarship*: S&T shall provide opportunities, encourage and sponsor our students to increase competitive scholarship by 20 percent per annum by 2018. *(Base is 30%; 4% per year till 2018)*

Action 1.1.5: *Increase Teaching Resources*: The number of faculty will increase 15; number of staff by 6 and GTAs by 100% by 2016. *(1 Assistant Professor in 2015; 2 Endowed Chairs in 2017 and 2018; and 2 Assistant Professors in 2017 and 2019)*

Action 1.1.6: *Minimize Attrition Rate*: Undergraduate attrition rate will reduce for all years to almost zero percent by 2016. *(Current Rates are freshmen – 4%; sophomore – 2%; junior and senior ~ zero percent)*

<table>
<thead>
<tr>
<th>Enrollment</th>
<th>FS06</th>
<th>FS07</th>
<th>FS08</th>
<th>FS09</th>
<th>FS10</th>
<th>FS13</th>
<th>FS20 F</th>
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<tbody>
<tr>
<td>Freshmen</td>
<td>35</td>
<td>38</td>
<td>40</td>
<td>40</td>
<td>35</td>
<td>33</td>
<td>50</td>
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<tr>
<td>Upper Class Majors</td>
<td>85</td>
<td>95</td>
<td>100</td>
<td>105</td>
<td>135</td>
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<tr>
<td>Total Undergraduate</td>
<td>120</td>
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<td>140</td>
<td>145</td>
<td>170</td>
<td>218</td>
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<td>Master of Science</td>
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<td>3</td>
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<tr>
<td>Doctor of Philosophy</td>
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<td>15</td>
<td>18</td>
<td>20</td>
<td>11</td>
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<tr>
<td>Master of Engineering</td>
<td>25</td>
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<td>32</td>
<td>35</td>
<td>45</td>
<td>63</td>
<td>125</td>
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<td>Total Graduate</td>
<td>40</td>
<td>45</td>
<td>53</td>
<td>60</td>
<td>70</td>
<td>117</td>
<td>200</td>
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<tr>
<td>Total All Students</td>
<td>160</td>
<td>178</td>
<td>193</td>
<td>205</td>
<td>240</td>
<td>335</td>
<td>450</td>
</tr>
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FS20 F – forecast for FS 2020

**Action 1.1.7: Attract Significant Number of HS Students**: Freshmen in Mining Engineering from high school will increase by 60% by 2016
Action 1.1.8: *Attain Appropriate Levels of Enrollment:* Undergraduate enrollment will increase to 250, graduate students will increase to 75 and Online ME will grow to 125 students by 2020 (see Table 1). *Base annual enrollment (82) and graduation (50); projected annual enrollment (67) and graduation (50)*

**Lever 1.2 (S&T’s Levers 2.3/4.2/4.3/4.5): Create and Maintain a Well-Diversified Mining Engineering Program at Missouri S&T**

Action 1.2.1: *Combined BS/MBA for S&T Mining Engineering:* Create a combined program by FS 2015 to expand the knowledge of management, accounting and finance by graduating seniors. *(Completed)*!!

Action 1.2.2: *Combined BS Mining Engineering and MS Minerals-Energy Economics:* Create a combined program by 2015 to expand the knowledge of economics and project finance by graduating seniors. *(MS in Minerals-Energy Economics in progress)*

Action 1.2.3: *MS in Mineral Process Engineering:* Develop the MS in Mineral Process Engineering by 2015 to expand knowledge and frontiers in minerals, coal and materials processing. *(Program in Review)*

Action 1.2.4: *PhD in Explosives Engineering:* Expand the MS in Explosives Engineering to incorporate a TT faculty and the PhD program by 2015. *(Approved by Curators and the expected final approval in 2014)*

Action 1.2.5: *Emphases in Mine Automation and Maintenance Engineering:* Create emphases by 2016 in these two areas to provide mining engineers with expertise in automation and equipment maintenance. *(In progress)*

**Lever 1.3 (S&T’s Levers 2.3/4.2/4.3/4.5): Establish the MS in Mineral Process Program by 2015**

Action 1.3.1: *The Botswana Minerals Opportunity:* The program will provide an opportunity to further nurture our relationship with UB and the mining industry of Botswana in the processing of diamonds, coal, base and ferrous metals. *(In progress)*

Action 1.3.2: *The Tianfu Mining University Opportunity:* Strengthen the mineral processing capacity for research and education in rare earth minerals. *(In progress)*

Action 1.3.3: *The Saudi Mining Opportunity:* Establish the mineral processing potential to assist the Saudi minerals sector. *(In progress)*
Action 1.3.4:  *US Industry Demand:* Play a Significant Role in developing mineral process engineers for the US mining industry. *(In progress)*

**Lever 1.4 (S&T’s Levers 2.2/2.5/4.1/4.3): Expand the ME (Online) Program to the Global Mining Industry and Communities**

Action 1.4.1:  *Program Marketing:* Put in place a strategic marketing plan, strategy and focus for North and South America, Africa, Asia and Australia. Develop comprehensive website, brochures and relevant materials for these markets by 2015. *(In progress)*

Action 1.4.2:  *Graduate Courses:* Increase the graduate course offerings for the ME (Online) Program to 30 courses by 2015. *(In progress)*

Action 1.4.3:  *Additional Instructors:* Build the Mining Engineering faculty strength to 15 by 2020 and recruit at least 15 instructors from industry and academia by 2015. *(See Action 1.1.5)*

Action 1.4.4:  *Doctor of Engineering (DE) Online:* Create and deliver the DE in Mining Engineering Program by 2015. *(In progress)*

Action 1.4.5:  *Advanced Distance Education Technology:* Transfer the delivery of 70% of the ME (Online) Program courses to the current state-of-the-art technology of video communication by 2015. *(In progress)*

**Lever 1.5 (S&T’s Levers 2.2/2.3/4.5): Expand Explosives Engineering Program by 2015**

Action 1.5.1:  *Additional Faculty:* Add one TT Faculty to the program in 2015. *(Faculty position created to be filled by 2015)*

Action 1.5.2:  *Program Expansion:* Develop the PhD in Explosives Engineering by 2015. *(Awaiting CBHE’s approval after Curators’ approval)*

**Lever 1.6 (S&T’s Levers 2.1/2.2/2.3): Increase Number of Mining Engineering Faculty by 2020**

Action 1.6.1:  *FTE Faculty Increase:* Add 5 T/TT faculty members to the program. *(See Action 1.1.5)*

Action 1.6.2:  *Endowed Chair:* Endow a $3M Chair in Mining Engineering with emphasis on fossil fuel Energy. *(See Action 1.1.5)*

**Theme 2 (S&T’s Theme 1 & 4)**

*Enrich the Student Experience*
S&T will provide well-diversified environments, with currency in technology, to produce highly qualified graduates for industry, academia and other employers.

**Lever 2.1 (S&T's Lever 4.2): Renew and Expand Laboratory Capacity**


Action 2.1.2: *New Laboratories:* Two new virtual laboratories in surface *(completed)* and underground *(in 2015)* mining methods and equipment will be added to the program.

Action 2.1.3: *Laboratory Maintenance Fund:* Endow a $240K maintenance fund for maintaining laboratory facilities and equipment by 2020. *(In progress)*

Action 2.1.4: *New Experimental Mine Building:* Complete the new Mine Building by 2015. *(Chancellor is leading the effort to secure a 50% State match for a $1.2M private-sector donation for the facility with a decision in 2014)*

Action 2.1.5: *Additional Technical Staff:* Hire an additional technical staff specifically for maintaining teaching and research laboratories by 2015.

**Lever 2.2 (S&T's Levers 1.4/4.9): Increase Students Exposure to the Mining Industry Community**

Action 2.2.1: *Freshmen Internship:* Attain 100% internship opportunities for all Mining Eng. freshmen by 2018. *(Base is 10%; 20% per year till 2018)*

Action 2.2.2: *Internship Opportunities:* Attain 100% internship opportunities for all Mining Eng. students by 2016. *(Base is 85%; 5% per year till 2016)*

Action 2.2.3: *Industry Mentorship:* The program will ensure that at least 60% of the undergraduate students in Mining Engineering will enroll in the SME Mentorship Program by 2018. *(Base is 35%; 5% per year till 2018)*

Action 2.2.4: *Exposure to Conference:* The program will ensure that at least 60% of the students in Mining Engineering will attend at least one conference before graduation by 2018. *(Base is 35%; 5% per year till 2018)*

Action 2.2.4: *Exposure to Extra-Curricular Activities:* The program will ensure that at least 95% of the students will participate in one of the four chapter societies (ISEE, NSSGA, SME and WIM) and the three competitive
teams (SME-NSSGA Design, Mine Rescue and Mucking) by 2016. 
(Base is 85%; 5% per year till 2016)

**Lever 2.3 (S&T’s Levers 1.1/1.2/4.4): Increase Faculty-Student Interactions**

- **Action 2.3.1:** *Academic Advising*: Attain 100% student academic advising by faculty by 2014. *(Almost there and will maintain this target of excellence)*
- **Action 2.3.2:** *Student Career Advising*: Mining Engineering faculty will intensify their efforts in advising at least 95% of the student on career issues by 2015. *(Base is 85%; 5% per year till 2015)*
- **Action 2.3.3:** *Faculty Supervision of OURE Students*: Increase the number of OURE students in the Mining Engineering program to 15 by 2020. *(Base is 3; 2 per year till 2020)*

**Lever 2.4 (S&T’s Levers 1.1/1.3/4.4/4.8): Increase Students Research Exposure**

- **Action 2.4.1:** *Faculty Supervision of OURE Students*: Increase the number of OURE students in the Mining Engineering program to 15 by 2020. *(Base is 3; 2 per year till 2020)*
- **Action 2.4.2:** *Involvement with Faculty Research*: At least 20% of the undergraduate students will be involved with faculty research by 2016. *(Base is 5%; 5% per year till 2016)*
- **Action 2.4.3:** *Graduate Student Publication*: The program will ensure that all graduate students will publish at least 2 refereed journal papers before graduation by 2018. *(Base is 60%; 8% per year till 2018)*
- **Action 2.4.4:** *Exposure to Conference*: The program will ensure that at least 60% of all students will attend at least one conference before graduation by 2018. *(Base is 35%; 5% per year till 2018)*
- **Action 2.4.5:** *Undergraduate Conference Presentations*: The program will ensure that at least 20% of undergraduate students will make one conference presentation by 2016. *(Base is 5%; 5% per year till 2016)*
- **Action 2.4.6:** *Graduate Conference Presentations*: The program will ensure that 100% of graduate students will make three conference presentations before graduation by 2018. *(Base is 75%; 5% per year till 2018)*
Lever 2.5 (S&T's Levers 1.4/4.1/4.2/4.3/4.6/4.9): Provide Environments for Students to Develop Professional Behavior Attributes

Action 2.5.1: Exposure to Extra-Curricular Activities: The program will ensure that at least 95% of the students will participate in at least one of the four chapter societies (ISEE, NSSGA, SME and WIM) and the three competitive teams (SME-NSSGA Design, Mine Rescue and Mucking) by 2016. (Base is 85%; 5% per year till 2016)

Action 2.5.2: Exposure to Conference: The program will ensure that at least 60% of the students will attend at least one conference before graduation by 2018. (Base is 35%; 5% per year till 2018)

Action 2.5.3: Internship Opportunities: Attain 100% internship opportunities for all Mining Eng. students by 2016. (Base is 85%; 5% per year till 2016)

Action 2.5.4: Industry Mentorship: The program will ensure that at least 60% of the undergraduate students in Mining Engineering will enroll in the SME Mentorship Program by 2018. (Base is 35%; 5% per year till 2018)

Action 2.5.5: Undergraduate Conference Presentations: The program will ensure that at least 20% of students will make one conference presentation by 2016. (Base is 5%; 5% per year till 2016)

Action 2.5.6: Graduate Conference Presentations: The program will ensure that 100% of students will make three conference presentations by 2018. (Base is 75%; 5% per year till 2018)

Theme 3 (S&T’s Theme 2)

Broaden Mining Engineering Research

Mining Engineering research will be advanced using fundamental and applied research initiatives via individual efforts and collaborative partnerships.

Lever 3.1 (S&T’s Levers 2.1/2.2/2.3): Increase the Number of Research Faculty

Action 3.1.1: Research Faculty: Increase the number of research faculty by 50% by 2020. (See Action 1.1.5)

Action 3.1.2: Endow Three Chairs in Mining Engineering: Endow three $3M Chairs in Mining Engineering with emphasis on Heavy Mining Machinery, Underground Mass Mining, Mine Safety and Health and Energy from Coal, Oil Sands or Oil Shale by 2020. (See Action 1.1.5)
Action 3.1.3: Emerging Areas: Build research strength in mineral processing, carbon capture and sequestration, synthetic fuels, automation and robotics, and intelligent maintenance engineering by 2020. *(In progress)*

Action 3.1.4: Botswana Collaboration: Strengthen collaborative research with the faculty at the University of Botswana in emerging research areas outlined above. *(See Action 3.1.3)*

Action 3.1.5: Industry Collaboration: Develop collaborative research partnerships with industries represented on the Board. *(In progress)*

Action 3.1.6: Global Partnerships: Develop global collaborative opportunities in North and South America, Africa, Asia and Australia. *(In progress)*

**Lever 3.2 (S&T’s Levers 2.3/2.6): Expand Graduate Program**

Action 3.2.1: Graduate Enrollment: Increase the number graduate student enrollment by 100% by 2020. *(In Action 1.1.8)*

Action 3.2.2: Graduate Courses: Develop additional graduate courses to increase the graduate courses to 30 by 2016. *(See Levers 1.2 and 1.4)*

Action 3.2.3: Graduate Quality Metrics: Develop and put in place quality measures to ensure sustainable graduate program quality by 2015. *(Completed)*

Action 3.2.4: Graduate Internship: Create opportunities to allow at least 60% of graduate students to obtain industry internships by 2018. *(Base is 10%; 10% per year till 2018)*

Action 3.2.5: Graduate Scholarships: Increase competitive graduate scholarships by 50% in 2018. *(Base is 10%; 8% per year till 2018)*

**Lever 3.3 (S&T’s Levers 2.5/2.6): Expand RMERC Research Initiatives**

Action 3.3.1: Center Funding: Increase the Level of Funding from Mining Engineering Faculty by 50%. *(The 50% Increase has been exceeded)*

Action 3.3.2: Research Faculty: Continue to expand the research faculty associated with RMERC to 50% above current levels by 2015. *(Almost complete)*

Action 3.3.3: Emerging Research Areas: Build stronger research strength in mineral processing, carbon capture and sequestration, and synthetic fuels by 2020. *(In progress)*
**Lever 3.4 (S&T’s Levers 2.5/2.6): Play a Leading Role in S&T Energy Research**

Action 3.4.1: *Energy Faculty:* Hire at least 2 additional faculty with research focus in synthetic fuels (oil shale/oil sands, coal-to-liquids), and carbon capture and sequestration by 2020. *(See Action 1.1.5)*

Action 3.4.2: *Energy Organizations:* Identify at least 2 energy research organizations for partnership in research and development by 2020. *(In progress)*

Action 3.4.3: *Energy Consortium:* Develop an energy research consortium with the coal industry to expand energy research by 2020. *(In progress)*

**Lever 3.5 (S&T’s Levers 2.5/2.6): Strengthen Mining and Nuclear Engineering Collaboration**

Action 3.5.1: *Collaborations with Nuclear Engineering:* Provide environments for Mining and Nuclear Eng. faculty to collaborate in radioactive waste storage, forensic tools for tagging explosives and counter-terror initiatives for nuclear power plants by 2015. *(In progress)*

Action 3.5.2: *New Synergies:* Create new synergies in alternate energy research, and environmental risks mitigation of nuclear wastes with national and international research organizations by 2016. *(In progress)*

**Lever 3.6 (S&T’s Levers 2.5/2.6): Strategic Research Consortium in Mine Health and Safety**

Action 3.6.1: *Strategic Consortium:* Create a nationally recognized research consortium with the University of Utah and Colorado School of Mines in mine health and safety by 2015. *(In progress)*

Action 3.6.2: *Consortium Expansion:* Identify and include as members S&T’s researchers with capacity and capability to contribute to this consortium by 2015. *(In progress)*

**Theme 4 (S&T’s Themes 2 & 3)**

**Expand S&T Mining Engineering Capacity**

S&T will expand and create additional resources and facilities to match capacity expansion initiatives.
**Lever 4.1 (S&T’s Levers 3.3/3.9): Complete the New Experimental Mine Building by 2015**  

**Action 4.1.1:** *Classroom Capacity:* Develop classroom capacity to seat about 180 people. *(See Action 2.1.4)*  

**Action 4.1.2:** *Laboratory Capacity:* Develop capacity for the Mine Atmospheric Control, Mineral-Materials-Coal Processing, Mine Health and Safety, and Mine Survey laboratories. *(See Lever 2.1)*  

**Action 4.1.3:** *Office Capacity:* Create adequate office space for faculty, staff and Students. *(In progress)*

**Lever 4.2 (S&T’s Levers 3.3/3.9): Expand Existing Laboratory Capacity by 2015**  

**Action 4.2.1:** *Rock Mechanics:* Expand the Rock Mechanics Laboratory in McNutt by renewing and recalibrating instruments and expanding capacity. *(See Lever 2.1)*  

**Action 4.2.2:** *Mine Atmospheric Control:* Expand the Mine Atmospheric Control Laboratory at the new Mine Building by renewing and recalibrating instruments and expanding capacity. *(See Lever 2.1)*  

**Action 4.2.3:** *Mineral Processing:* Expand the Mineral Processing Laboratory in RMERC by renewing and recalibrating instruments and expanding capacity. *(See Lever 2.1)*  

**Action 4.2.4:** *Energetic Materials Research Facility:* Complete the Energetic Materials Research Facility. *(See Lever 2.1)*  

**Action 4.2.5:** *Mine Survey:* Develop the Mine Survey Laboratory with appropriate instrumentation. *(See Lever 2.1)*

**Lever 4.3 (S&T’s Levers 3.3/3.9): Develop New Laboratories by 2015**  

**Action 4.3.1:** *Virtual Surface Mining Laboratory:* Establish the new Virtual Surface Mining Laboratory in McNutt. *(Completed)*  

**Action 4.3.2:** *Virtual Underground Mining Laboratory:* Establish the new Virtual Underground Mining Laboratory in McNutt by 2015. *(In progress)*

**Lever 4.4 (S&T’s Levers 3.5/3.6/3.9): Create Endowment Opportunities by 2020**  

**Action 4.4.1:** *Endowed Mining Engineering:* Endow the S&T Mining Engineering Program at $10 million. *(In progress)*
Action 4.4.2:  **Endowed Chair in Energy:** Endow a $3 million Chair in Mining Engineering with emphasis on Energy form Coal, Oil Sands or Oil Shale. *(See Action 1.1.5)*

**Lever 4.5 (S&T’s Levers 2.1/3.4): Increase Personnel Resources**

Action 4.5.1:  **Research Faculty:** Increase the number of research faculty by 50% by 2020. *(See Action 1.1.5)*

Action 4.5.2:  **Staff Levels:** Hire an additional technical staff specifically for maintaining teaching and research laboratories and 2 administrative staff to support faculty and students by 2015. *(In progress)*

Action 4.5.3:  **Program Support:** Hire a Program Support Specialist to support the marketing, recruiting, website development and maintenance and the publication needs by 2013. *(Completed)*

**Lever 4.6 (S&T’s Lever 3.7): Maintain Strong Enrollment and Recruiting Efforts**

Action 4.6.1:  **Undergraduate Enrollment:** Increase undergraduate enrollment to 250 by 2020. *(See Action 1.1.8)*

Action 4.6.2:  **Campus Graduate Students:** Increase on-campus PhD and MS graduate students to at least 50 and 25, respectively, by 2020. *(See Action 1.1.8)*

Action 4.6.3:  **Distance Graduate Students:** Increase distance enrollment capacity to at least 125 by 2020. *(See Action 1.1.8)*

Action 4.6.4:  **Explosives Summer Camp:** Sustain and strengthen explosives summer camp for marketing and recruiting students.

Action 4.6.5:  **Mining Industry Night:** Maintain a permanent annual Mining Industry Night for marketing and recruiting freshmen and sophomores.

Action 4.6.6:  **Enrolment Management:** Establish a marketing and recruiting program for sustainable enrollment in Mining Engineering by 2013. *(In progress)*

**Theme 5 (S&T’s Themes 2 &3)**

**Strengthen National and Global Partnerships**

S&T will engage national and global universities, industries and research organizations as partners in education and research.
**Lever 5.1 (S&T’s Levers 2.4/3.2): Maintain a Strong Development Board**

- **Action 5.1.1:** *Strong and Active Board:* Maintain a strong, diversified and active Development Board with top industry executives. *(Complete)*
- **Action 5.1.2:** *Counsel of the Board:* The Chair and the faculty will always seek and use the counsel of the Board for important decisions that affect the direction of Mining Engineering at Missouri S&T.

**Lever 5.2 (S&T’s Levers 2.4/3.7): Enhance Missouri S&T-UB Partnership**

- **Action 5.2.1:** *Faculty-Faculty Interactions:* Missouri S&T will pursue initiatives that will enhance faculty-faculty interactions within the two organizations.
- **Action 5.2.2:** *Research Partnership:* Launch the “Research Partnership for Growth” Initiative in 2011-2012 to spur research collaboration among Missouri S&T-UB faculty/staff and the Botswana mining industry. *(In progress)*
- **Action 5.2.3:** *Faculty and Students Exchanges:* The two universities will exchange faculty and students periodically. *(In progress)*
- **Action 5.2.4:** *Continuous Improvements:* The two universities shall seek ways to improve the partnership periodically. *(In progress)*

**Lever 5.3 (S&T’s Levers 2.4/3.7): Develop S&T-Saudi Initiative on Mining Education**

- **Action 5.3.1:** *NTT Faculty:* Hire a minimum of 5 NTT faculty members in Mining Engineering for the Saudi Mining Program by 2015. *(3 NTT has been recruited and 2 NTT will be recruited by 2015)*
- **Action 5.3.2:** *Leadership and Administrative Personnel:* Hire a minimum of 2 leadership and 2 administrative personnel for the Saudi Mining Program by 2015. *(Hired the Program Director and a Program Support Specialist; remaining to be hired by 2015)*
- **Action 5.3.2:** *SMP Strategic Plan:* Develop a 5-year strategic plan for the SMP Mining Program by 2014. *(In progress)*
- **Action 5.3.3:** *S&T Mining Engineering – Saudi Mining Program Relationship:* Develop synergistic relationship to attain a strong relationship between Missouri S&T and the Saudi Mining Program by 2014. *(In place)*
- **Action 5.3.4:** *Graduate Assistantship Portfolio:* Hire at least 10 PhD students to provide instructional assistantship per year over the 5-year program duration by 2014. *(Complete)*
Lever 5.4 (S&T’s Levers 2.4/3.7): Develop Other S&T International Initiatives

Action 5.4.1: Asia/Pacific Region: Strengthen strategic alliances with existing academic agreements with institutions in Australia and China. Develop new academic agreements with universities in Indonesia and Mongolia. (Director of China Programs appointed; MOU signed with UIN Indonesia and Mongolia University of Science and Technology)

Action 5.4.2: Africa Initiatives: Strengthen strategic alliances with the University of Botswana (UB), Botswana International University of Science and Technology (BIUST), the University of Mines and Technology (UMaT) in Ghana and the African University of Science and Technology (AUST) in Nigeria. (Strong partnership with UB; MOU with BIUST and UMaT; Ongoing discussions on partnership with AUST)

Action 5.4.3: Latin American Initiatives: Strengthen existing relationship with universities in Brazil. Develop new academic agreements with universities in the Dominican Republic and Peru. (Partnership with Universidade Federal de Rio Grande do Sul of Brazil and ongoing with discussions with universities in the Dominican Republic and Peru)
Nuclear Engineering

Introduction

The Nuclear Engineering (NE) program at MISSOURI S&T offers B.S., M.S. and Ph.D. degrees in Nuclear Engineering. Currently, the NE program has seven T/TT faculty members, all with PhD in Nuclear Engineering and extensive academic and research experience. The program has the following facilities: A 200 KW swimming pool-type reactor, commissioned in 1963, an Internet Accessible Hot Cell facility, a Subcritical Assembly, a Neutron Generator, an Advanced Radiation Imaging Facility, a CLC, a Radiation Measurements Lab, a Two-Phase Flow and Thermal-Hydraulics Lab, a Mass Spectrometry Lab, a Radio-Chemistry Lab, a Lab for the study of Advanced Multi-phase and Multi-scale Processes, and a Nuclear Resource Center.

The demand for NE graduates currently far exceeds the graduation rate of nuclear engineers nationwide. According to Nuclear Energy Institute (NEI's) website (http://www.nei.org/careersandeducation/careersinthenuclearindustry/bepartofagrowingworkforce/), 50% of the nation's nuclear workforce will retire within the next 10 years. Even maintaining the 20 percent electrical generation share of nuclear energy will require building more nuclear power plants as demand for electricity grows. Furthermore, it is anticipated that nuclear technology will also be used increasingly in the future for nuclear medicine, space exploration, and hydrogen production.

Mission

The Nuclear Engineering Program has a primary mission to provide an outstanding and comprehensive undergraduate and graduate education in nuclear engineering. The program provides well-educated nuclear engineering professionals and leaders to Missouri and the nation, in the commercial nuclear industry, national laboratories, and the nation's defense and federal agencies. The objectives of the Bachelor of Science program are to provide each student with fundamental knowledge of nuclear engineering and related technologies, analytical and problem solving ability, ability for technical communications, professional ethics, leadership and interpersonal skills, capability to conduct research, and the ability to recognize the value of and pursue life-long learning. NE graduate program provides each graduate with an in-depth knowledge in a specialized area related to current or future nuclear technologies. Nuclear Engineering is committed to a strong engineering program administered by highly motivated and
active faculty. The program interacts with professional societies, and the nuclear industry to promote continuing education, research opportunities, and public dissemination of information about issues and advances in the field.

**Vision**

MISSOURI S&T will be an internationally recognized leader in Nuclear Engineering research and education.

**Core Values**

The NE program will pursue its vision while fostering professional ethics, accountability, excellence in teaching and research, and fairness to all. The NE program is committed to:

**Excellence:** Faculty, staff, alumni, and industry create an environment that collectively is conducive to excellence in teaching and research as measured against national standards.

**Integrity:** Integrity is ingrained in all aspects of NE education and research. Students are apprised of their ethical and social responsibilities through seminars and the Senior Design project.

**Comprehensive Education:** In addition to receiving an in-depth technical knowledge, NE students receive a broad education including reactor operator experience, challenges associated with current and next generation nuclear reactors, and the integration of social and ethical issues associated with the development of various nuclear technologies for the benefit of society.

**Outreach:** NE program is committed to the enhancements in female enrollments as well as the enrollment of under-represented groups. In addition, the program actively pursues the dissemination of nuclear-related knowledge to the community at large.

**Collaboration:** In order to bring stat-of-the-art knowledge to our students, NE program collaborates with nuclear utilities and national laboratories in the areas of summer and co-op employment and joint research opportunities.
**Themes**

1. **Increasing Enrollment (S&T’s Themes 2 & 3):** NE program will increase its enrollment by increasing diversity, increasing retention, providing additional scholarships and raising appeal of the nuclear engineering profession amongst high school students nationally by means of NE summer camps.

2. **Maintain High Quality NE Undergraduate and Graduate Programs (S&T’s Themes 1, 2, 3 & 4):** The NE program at MISSOURI S&T is one of the top-rated programs in the nation. The quality of the program will be maintained by continually upgrading the curriculum and laboratory facilities with input from alumni and the NE Development Board.

3. **Enhancing Industry, Government and National Laboratory Partnerships (S&T’s Themes 2 & 3):** NE program will create opportunities and develop resources by partnering with nuclear industry (Ameren UE and Exelon Nuclear Corp.), national laboratories, U.S. Nuclear Regulatory Commission, and U.S. Department of Energy.

4. **Expanding Research Performance and Reputation (S&T’s Theme 2):** NE program will expand its research activity and performance by hiring quality faculty, rewarding research productivity and focusing on interdisciplinary collaborations which will have the largest impact on our reputation.

5. **Enriching the Student Experience (S&T’s Themes 1 & 2):** NE program will promote academic excellence, diversity, teamwork, and leadership skills. To this end, NE will emphasize state-of-the-art technical knowledge, communication skills, hands-on reactor laboratory, thermal-hydraulics laboratory and reactor operations training, interaction with nuclear industry, and a student mentoring program.

**Theme 1 (S&T’s Themes 2 & 3)**

**Increasing Enrollment**

*NE program will increase its enrollment by increasing diversity, increasing retention, providing additional scholarships and raising appeal of the nuclear engineering profession amongst high school students nationally by means of NE summer camps.*
Lever 1.1 (S&T's Levers 2.2/2.6/3.4): Continue to increase enrollment to 80 Freshmen, 160 upper class majors and 60 graduate students, as follows in the Table 1

- Increase female undergraduates to 30%
- Increase minority undergraduates to 15%

<table>
<thead>
<tr>
<th>Enrollment</th>
<th>FS 10</th>
<th>FS 11</th>
<th>FS 12</th>
<th>FS 13</th>
<th>FS 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshmen</td>
<td>51</td>
<td>61</td>
<td>52</td>
<td>52</td>
<td>80</td>
</tr>
<tr>
<td>Upper Class Majors</td>
<td>94</td>
<td>105</td>
<td>119</td>
<td>137</td>
<td>160</td>
</tr>
<tr>
<td><strong>Total Undergraduates</strong></td>
<td><strong>145</strong></td>
<td><strong>166</strong></td>
<td><strong>171</strong></td>
<td><strong>189</strong></td>
<td><strong>240</strong></td>
</tr>
<tr>
<td>Master of Science</td>
<td>15</td>
<td>16</td>
<td>9</td>
<td>18</td>
<td>35</td>
</tr>
<tr>
<td>Doctor of Philosophy</td>
<td>5</td>
<td>11</td>
<td>18</td>
<td>21</td>
<td>25</td>
</tr>
<tr>
<td><strong>Total Graduates</strong></td>
<td><strong>20</strong></td>
<td><strong>27</strong></td>
<td><strong>27</strong></td>
<td><strong>39</strong></td>
<td><strong>60</strong></td>
</tr>
<tr>
<td><strong>Total All Students</strong></td>
<td><strong>165</strong></td>
<td><strong>184</strong></td>
<td><strong>198</strong></td>
<td><strong>228</strong></td>
<td><strong>300</strong></td>
</tr>
</tbody>
</table>

Action 1.1 a: Recruit quality high school students for NE Summer Camp.
- Increase female students and minorities to 30% of campers. (*Base is 24%; 2% per year till 2016*)

Action 1.1 b: Recruit high-caliber African-American students from Tuskegee University (*Base is 0%; 1-2 student per year till 2020*)
- Invite students to MISSOURI S&T for nuclear reactor tours.
- Invite students to MISSOURI S&T campus for learning principles of radioactive decay and shielding.

Lever 1.2 (S&T's Levers 2.5/3.3/3.4/3.6): Maintain a second-to-third year retention rate of 90% (*Base is higher than 90%; will maintain 90% or above*)
- Encourage and facilitate mentoring and tutoring of sophomores by upper class students

Lever 1.3 (S&T's Lever 2.2/2.4/3.6/3.7): Conduct a reactor-based summer workshop for High School and Community College teachers (1 Continuing Education credit) (*Base is 0%; develop workshop by 2016, thereafter summer workshop every year till 2020*)
- Reactor Operations
- Half-life experiments
Lever 1.4 (S&T’s Lever 2.2/2.4/3.6/3.7): Conduct a summer workshop for High School and Community College Teachers in Radiation Measurements (1 Continuing Education credit) (Base is 0%; develop workshop by 2016, thereafter summer workshop every year till 2020)

- Radio-nuclide identification
- Dose rate measurements
- Shielding of radiation

Theme 2 (S&T’s Themes 1, 2, 3 & 4)

Maintain High Quality NE Undergraduate and Graduate Programs

The NE program at MISSOURI S&T is one of the top-rated programs in the nation. The quality of NE program will be maintained by continually upgrading the curriculum and laboratory facilities with input from alumni and the NE Development Board.

Lever 2.1 (S&T’s Levers 1.1/1.4/2.5/3.1): Upgrading NE curriculum and courses

Action 2.1 a: Offer a course in radiation-based techniques for oil well logging, non-destructive testing, analysis of geological media, and environmental trace element analyses. (In progress)

Action 2.1 b: Continue to emphasize fundamental concepts and its applications in nuclear technology. (Almost there and will maintain the superior quality)

Action 2.1 c: Modify course contents in NE curriculum using input from alumni and employers. (In progress)

Action 2.1 d: Continue to interact with industry and invite guest lecturers from industry to make presentations on current topics. (Base is 1 speaker per year; 4 per year till 2020)

Action 2.1 e: Continue to encourage undergraduate students to work in industry or national laboratories during the summer. (In progress)

Lever 2.2 (S&T’s Levers 2.6/3.3/3.9/4.2/4.3): Enhance and maintain existing research and teaching laboratories

Action 2.2 a: Maintain the teaching and research capabilities of Nuclear Reactor Laboratory. (In progress; submitted a proposal for lab expansion in Jan. 2014)
Action 2.2 b: Enhance and maintain the teaching and research capabilities of Two-Phase Flow and Thermal-Hydraulics Laboratory.  (*Base is 30%; 20% per year till 2017*)

Action 2.2 c: Enhance and maintain the teaching and research capabilities of Radiation Measurements Laboratory.  (*Completed*)

**Theme 3 (S&T’s Themes 2 & 3)**

**Enhancing Industry, Government and National Laboratory Partnerships**

NE program will create opportunities and develop resources by partnering with nuclear industry, national laboratories, U.S. Nuclear Regulatory Commission, and U.S. Department of Energy.

**Lever 3.1 (S&T’s Levers 2.4/3.2): Maintain existing partnership between MISSOURI S&T and Exelon Nuclear Corporation**

Action 3.1 a: Exelon provides $50,000 per year to MISSOURI S&T NE to perform research on issues related Nuclear Power Engineering and to support faculty development, undergraduate scholarships and graduate assistantships, upgrade of equipment and student research initiation grants. Part of this support is used match faculty development grants from USNRC. The partnership should be maintained.  (*In progress*)

**Lever 3.2 (S&T’s Levers 2.4/3.7): Enhance and Maintain existing partnership between MISSOURI S&T and National Laboratories (Argonne, Idaho, Oak Ridge, Sandia and Los Alamos National Laboratories)**

Action 3.2 a: National Laboratories have provided Graduate Research Assistantships to our graduate students in the past. This relationship should be enhanced to find new resources for supporting graduate students.  (*In progress*)

**Lever 3.3 (S&T’s Levers 2.4/3.4/3.7): Maintain existing partnership between MISSOURI S&T and Tuskegee University**

Action 3.3 a: This partnership is very important since it is a valued criterion for getting faculty development grants from USNRC. We invite Tuskegee students to tour the nuclear reactor and perform experiments in radiation measurements on the S&T campus.  (*See Action 1.1 b*)
Theme 4 (S&T’s Theme 2)
Expanding Research Performance and Reputation

NE program will expand its research activity and performance by hiring quality faculty, rewarding research productivity and focusing on interdisciplinary collaborations which will have the largest impact on our reputation.

Lever 4.1 (S&T’s Lever 2.1): Attain additional faculty to match the projected growth effectively
Action 4.1 a: Match the MISSOURI S&T standard ratio of 15 students per faculty.

Table 2 Projected Faculty Growth

<table>
<thead>
<tr>
<th>Semester</th>
<th># of Students</th>
<th># of Faculty</th>
<th>New Faculty</th>
<th>Student/Faculty Ratio</th>
<th>Missouri S&amp;T Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>FS 10</td>
<td>165</td>
<td>6</td>
<td>1</td>
<td>28</td>
<td>&gt; MISSOURI S&amp;T Ratio</td>
</tr>
<tr>
<td>FS 12</td>
<td>198</td>
<td>7 (+1)</td>
<td>1</td>
<td>28</td>
<td>&gt; MISSOURI S&amp;T Ratio</td>
</tr>
<tr>
<td>FS 14</td>
<td>217</td>
<td>7</td>
<td>0</td>
<td>31</td>
<td>&gt; MISSOURI S&amp;T Ratio</td>
</tr>
<tr>
<td>FS 16</td>
<td>239</td>
<td>8 (+1)</td>
<td>1</td>
<td>30</td>
<td>&gt; MISSOURI S&amp;T Ratio</td>
</tr>
<tr>
<td>FS 18</td>
<td>271</td>
<td>9 (+1)</td>
<td>1</td>
<td>30</td>
<td>&gt; MISSOURI S&amp;T Ratio</td>
</tr>
<tr>
<td>FS 20</td>
<td>300</td>
<td>10 (+1)</td>
<td>1</td>
<td>20</td>
<td>&gt; MISSOURI S&amp;T Ratio</td>
</tr>
</tbody>
</table>

Additional faculty will be hired in the following priority areas of relevance to undergraduate and graduate education and research. These areas include: (i) Reactor Physics; (ii) Nuclear Fuel Cycle; (iii) Radiological Engineering; (iv) Nuclear Fusion; (v) Nuclear Materials.

Lever 4.2 (S&T’s Lever 2.1/2.3): Maintain high standards in the hiring, promotion, and tenure of faculty (Expanding Research Performance and Reputation)
Action 4.2 a: Review tenure and promotion criteria to effectively evaluate contributions in teaching, scholarship, and service. (Completed)

Lever 4.3 (S&T’s Levers 2.1/2.2/2.3/2.6): Perform research in areas of national need
Action 4.3 a: Identify areas of national need and write proposals for funding by Department of Education (GAANN). (Base is 0%; apply whenever funding opportunity is announced)
Action 4.3 b: Identify areas of interest to USDOE and write proposals for funding. (Submit proposals every year)
Action 4.3 c: Identify areas of interest to US Nuclear Regulatory Commission and write proposals for funding in the areas of Nuclear Forensics, Radiochemistry, and Nuclear Materials.  *(Submit proposals every year)*

Action 4.3 d: Identify areas of interest to Callaway Nuclear Plant and write proposals for funding in the areas of Nuclear Plant Life Extension.  *(Apply whenever funding opportunity is announced)*

**Lever 4.4 (S&T’s Lever 2.5/2.6): Strengthen Mining-Nuclear Engineering research collaborations. (Balancing the Academic Portfolio)**

Action 4.4 a: Expand existing collaborations between Mining and Nuclear Engineering in radioactive waste cleaning and storage, forensic tools for tagging explosives and blast-resistant barricades for nuclear power plants.  *(In progress)*

Action 4.4 b: Develop new synergies in alternate energy research environmental risks mitigation of nuclear wastes.  *(In progress)*

**Theme 5 (S&T’s Themes 1 & 2)**

**Enriching the Student Experience**

NE program will promote academic excellence, diversity, teamwork, and leadership skills. To this end, NE will emphasize a state-of-the-art technical knowledge, communication skills, hands-on reactor laboratory, thermal-hydraulics laboratory and reactor operations training, interaction with nuclear industry, and a student mentoring program.

**Lever 5.1 (S&T’s Lever 1.1/1.2/1.4/2.3): Provide research experience to 60% of undergraduates**

Action 5.1a: Increase undergraduate participation in MISSOURI S&T’s OURE.  *(Base is 0; 2 per year till 2020)*

Action 5.1b: Increase student participation in authorship of technical papers at both undergraduate and graduate levels.  *(Base is 5%; 10% per year till 2019)*

Action 5.1c: Encourage students to present their research work locally to their peers as well as at national and international conferences of American Nuclear Society (ANS).  *(Base is 5%; 10% per year till 2019)*
Lever 5.2 (S&T’s Lever 2.3/2.5): Enrich student knowledge about current research topics

Action 5.2 a: Encourage students to attend local as well as national professional meetings of American Nuclear Society (ANS) to enrich their technical knowledge on current and active research topics. *(Base is 10%; 5% per year till 2017)*

Lever 5.3 (S&T’s Lever 1.1/1.2/1.4/2.5): Provide opportunities for Peer Mentoring

Action 5.3a: Encourage students to hold study sessions with senior students to enhance learning. *(Base is 10%; 10% per year till 2017)*

Action 5.3b: Increase student participation as teaching assistants in Lab classes and nuclear reactor operations to enhance learning. *(Base is 5%; 1% per year till 2018)*