Minutes of the Research, Outreach and Economic Development Committee

The University of Tennessee
Board of Trustees

June 22, 2011
Knoxville, Tennessee

The Research, Outreach and Economic Development Committee of the Board of Trustees of the University of Tennessee met June 22, 2011, in Hollingsworth Auditorium on the UT Institute of Agriculture campus in Knoxville.

I. Call to Order

Mr. Don Stansberry, Chair, called the meeting to order at 3:25 p.m. Mr. Stansberry asked Dr. David Millhorn, UT Executive Vice President, to call the roll.

II. Roll Call

Dr. Millhorn called the roll and the following voting members were present:

Mr. Don Stansberry, Chair
Dr. Toby Boulet
Mr. Crawford Gallimore
Ms. Monice Moore Hagler
Mr. Doug Horne
Mr. Jim Murphy
Ms. Carey Smith
Ms. Betty Ann Tanner

The following non-voting members were present:

Dr. Joe DiPietro
Ms. Teresa Fowler
Dr. Dick Gourley
Commissioner Julius Johnson
Ms. Sharon Rollins
Mr. Glenn Turner
Dr. Janet Wilbert

Commissioner Kevin Huffman and Dr. Richard Rhoda were absent from the meeting.

Dr. Millhorn declared a quorum present for the meeting.

III. Approval of Minutes of the Last Meeting

Mr. Stansberry asked for any amendments or corrections to the minutes of the February 24, 2011, meeting in Chattanooga. Mr. Wharton inquired if the statement "UT's agreement with DuPont is the most favorable agreement DuPont has with another company" was accurate and Dr. Millhorn noted it was "one of the most favorable agreements DuPont has with any company." The minutes will be amended to reflect this clarification. Mr. Murphy moved the minutes as revised be approved and Dr. Gourley seconded this motion. No other discussion took place. Mr. Stansberry announced the motion carried.

IV. Governor's Chairs

Mr. Stansberry recognized UTK Chancellor Jimmy Cheek to address the Committee's first agenda topic of Governor's Chairs and to introduce Dr. Brian Wirth, UT-ORNL Governor Chair's Professor of Computational Nuclear Engineering, to give the subject presentation. Dr. Cheek noted UTK is home to eight of the nine Governor's Chairs. Dr. Wirth was attracted to UT from the University of California, Berkeley to become a Governor's Chair, Dr. Cheek noted, because he believes the Nuclear Engineering Department at UTK can become the #1 nuclear engineering department in the country. Dr. Wirth will be a significant part of this quest, Dr. Cheek said.

Dr. Wirth said he is pleased to be the 9th Governor's Chair at UT, coming to UT in this role in July 2010, and he believes there is no better faculty line in the country than the Governor's Chair faculty found at UT Knoxville. There is tremendous opportunity here, as well, in being partnered with the Oak Ridge National Laboratory. As he has expressed to Dr. Cheek, Dr. Wirth believes there is no better place to be than at UT and ORNL for the work he does related to nuclear fuels performance and structural materials performance in extreme radiation environments. These opportunities, a growing UTK campus, and the support, leadership and vision of the University's administration to reach the Top 25 Public Research universities in the nation make this a most exciting place to be, Dr. Wirth said, and he believes the University is doing a better job in taking advantage of its joint management of ORNL than is being done at the University of California in its relationships with Lawrence Livermore or Los Alamos National Laboratories.

Dr. Wirth discussed his research objectives and presented illustrations demonstrating his work to improve knowledge of the dynamic evolution of materials behavior in extreme environments to improve predictive performance (lifetime) models and to develop advanced, higher-performance materials for current nuclear reactors and future fission and fusion power. Dr. Wirth's slides illustrated the pellet-clad interaction and axial cracking of light-water reactor nuclear fuel elements and the formation of nano-fuzz on a tungsten surface exposed to low-energy He plasma. His research, Dr. Wirth stated, tries to improve understanding of the exposure and impact of such

elements on materials to prevent degradation and failure of these materials in service. This knowledge can be used to improve models which predict the precise lifetime of components, for instance, in nuclear power plant facilities. The idea is to remove, replace or refurbish such components to prevent failure and to perform this process when it is most likely needed and not too early, as this process has serious economic considerations as well. Dr. Wirth discussed and presented power-point slide illustrations of the physics involved in his field of nuclear engineering and nuclear power research. A motivation for his work, Dr. Wirth said, can be placed in the context of the nuclear reactor accident at Fukushima, Japan, following the March 11, 2011 earthquake and tsunami, and the prevention of such catastrophic reactor failure occurrences. Dr. Wirth reiterated his commitment to the fine caliber of UTK's nuclear engineering department and the strong connection and partnership at ORNL to provide a broad range of research opportunities for his work in this important area.

Dr. Wirth discussed the strengths and weaknesses of nuclear power and power generated by fossil fuels. Dr. Wirth believes that now, as opposed to the Three Mile Island era where a downturn occurred in the nuclear industry, nuclear power is on the upturn. This is due in large part to the marked contrast between nuclear power and fossil fuels power. The strength of splitting the uranium atom and getting nuclear energy is put into perspective by noting it takes 3Kg or 7 pounds of uranium to provide power to a 1000MW electrical plant for a one-day supply of electricity needed by a large town. The disadvantage is that, when the uranium splits, fission products are given off which are radioactive and decay for a long time. Radioactivity is a concern from both public-health and risk-assessment perspectives and, in addition, a tremendous amount of radioactive heat is generated which must be safely removed. When fossil fuels (coal) are consumed by a 1000MW fossil fuel plant to produce enough energy for a one-day power supply needed by a large town, 7M Kg or 7300 metric tons of fossil fuel are needed to meet this demand. As coal (CH molecules) is burned with oxygen, approximately 160 electron volts are created, which is about six orders of magnitude less-energy release than splitting one uranium atom. Further, with annual global coal consumption around 7B tons, there are significant environmental concerns and consequences with carbon dioxide emissions, greenhouse gas accumulation, air and water pollution, ground-level ozone, damage to land surface, and natural disasters such as East Tennessee saw happen with the Tennessee Valley Authority Kingston fossil plant ash slide in December of 2008.

Dr. Wirth showed a graph of greenhouse gas emissions from electricity production from burning grams of CO2 equivalent released per KW electricity using coal, gas, hydroelectricity, solar, wind and nuclear sources, with nuclear energy showing extremely favorable results in releasing fewer emissions. Nuclear life-cycle emissions drop even further, Dr. Wirth noted, when nuclear electricity is used to enrich uranium rather than burning coal.

Inherent to the use of nuclear energy, engineers must design systems to ensure the ultimate safe disposal and reuse of nuclear fuel and to make sure there are significant safety systems in place to remove the decay, heat and release of fission products in the case of dual natural disasters such the earthquake and tsunami which occurred in Fukushima, Japan. Dr. Wirth stated when neutrons, released when uranium fissions, escape the nuclear reactor itself and go through the fuel and cladding and into the structural materials, degradation of the mechanical performance of the materials occurs. Neutrons passing through steels and alloy cladding make it stronger; however, this process also makes materials more brittle and prone to failure, somewhat similar, Dr. Wirth said, to bending a paperclip back and forth, initially making the paperclip harder to bend as this movement continues but the paperclip then becomes brittle and breaks. This weakening or degradation is a significant concern, Dr. Wirth said, and he and other researchers are trying to better understand this process in order to make materials adjustments, to prolong life of the materials and to prevent disasters and failures.

Dr. Wirth noted one of his attractions to UT and ORNL was the announcement last year of ORNL as home of the Consortium for Advanced Simulation of Light Water Reactors (CASL), one of three DOE energy innovation hubs. As with his own research, CASL is using ORNL's high-performance computing capabilities to simulate nuclear fuel performance and the performance of nuclear reactors within a virtual reactor to help assess safe operating limits of the current fleet of nuclear reactors and to ensure the improved safety and economics of future generations. Fuel performance is also linked to economics—an operating reactor of 1000MW is generating around $1M a day of electricity—determining the precise timeframe of longevity and other critical factors is a significant aspect of the research enterprise, Dr. Wirth noted. CASL will permit proactive evaluation to enable critical performance enhancements.

Dr. Wirth's research approach involves integrating computational multi-scale materials modeling with experimental processing, environmental exposure and micro-structure and property characterization to elucidate the dynamics of materials. Dr. Wirth presented a slide showing steps in this process. Another slide showed an example of integrated experiment-modeling investigation of defect evolution physics.

Dr. Wirth presented a summary of research activities and noted strengths of UT administration support and the coupling of UT with ORNL to provide a strong environment for conducting inter-disciplinary collaborative research. Dr. Wirth stated he is most impressed with the caliber of faculty hired by UT and he has confidence, along with UTK Chancellor Cheek, these factors will enable UT, within the next couple of decades, to reach its goal of becoming one of the top nuclear engineering departments in the nation. Dr. Wirth noted his research of understanding how research materials degrade and behave will help develop much better-performing materials for future application in the nuclear field. Some of this effort, Dr. Wirth stated, parallels the research focus of another UT-ORNL Governor's Chair, Dr. Howard Hall, also in UTK's

nuclear engineering department, whose research is involved in studying and detecting radiation of smuggled illicit nuclear materials.

Dr. Wirth believes UT has many excellent opportunities to reach its goal of becoming one of the Top 25 public research universities in the country and to rank as a premier nuclear engineering department. Dr. Wirth noted UT is at the nexus of nuclear energy research in that nuclear power is centered in the Southeast with 2 national laboratories (Oak Ridge and Savannah River), 7 nuclear-generating companies (TVA, Dominion, Entergy, Southern, Duke, Progress, FP&L), 40 of 104 operating national power plants (NPPs) having 40 percent U.S. nuclear capacity , 2 power plants currently under construction in Georgia and SC, 7 nuclear suppliers (NSF, BWXT, GE, Westinghouse, AREVA, USEC, ALSTROM), 18 universities, 3 research reactors (HFIR, NCSU, Univ. of Florida), EPRI (Charlotte and Knoxville), and NRC (Region II office in Atlanta and TTC in Chattanooga).

Dr. Wirth concluded his presentation with discussion of the impact of the Fukushima, Japan reactor accident and the importance of the knowledge to be gained from this disaster. Along with scientific knowledge, there is also opportunity as researchers and professors at UT, especially through the Howard Baker Center for Public Policy, for public-policy outreach and to be in the forefront in addressing energy issues. Energy demand is expected to increase world-wide to support growing world populations (China and India have a 2B population) and a certain expected standard of living within many nations. It is most important to put this thirst for energy in the context of environmental impacts. In recent history, there have been numerous significant energy disasters: several nuclear energy explosions, a coal mine explosion in West Virginia, a natural gas pipeline explosion in San Bruno, CA which took 6-12 blocks of a city with it, and the Deep Water Horizon oil rig explosion in the Gulf of Mexico which killed at least 10 workers and spoiled the quality of water in the Gulf area. The reality is no energy technology is failsafe, Dr. Wirth stated, and this fact must be carefully balanced with the rewards, consequences and risks in the energy equation. There are significant opportunities at UT to drive this national debate to a more balanced perspective of the rewards and risks of the U.S. energy policy.

Mr. Stansberry extended his thanks to Dr. Wirth for a fine report and said he was pleased Dr. Wirth selected the University of Tennessee, as he seconds many of the things UT is anxious to have the world believe. Dr. Wirth said, as he has remarked to Dr. Cheek, he has never regretted his decision to move to Tennessee and he is most enthusiastic about the opportunities found here for his work in energy-related fields.

V. Annual Report of UT Research Foundation

Mr. Stansberry recognized Dr. David Millhorn, UT Executive Vice President and Vice President for Research and Economic Development, to provide the annual report for the University of Tennessee Research Foundation (UTRF). Dr. Millhorn noted the annual

report of the UTRF is normally given by its president; however, the recent president, Dr. Randy Gentry, stepped down from this position last May to return to his own research endeavors and to other UT duties. Dr. Millhorn said, in preparation for the annual report, the time was right to take an analytical approach in reviewing the functions and performance of the UTRF organization.

Dr. Millhorn stated the Bayh-Dole Act (Patent and Trademark Law Amendments Act) changed the landscape of technology transfer and ushered these kinds of institutions into a new era. This U.S. legislation adopted in 1980 deals with intellectual property (IP) arising from federal government-funded research and gives U.S. universities, small businesses and non-profits intellectual property control of their inventions and other intellectual property (IP) resulting from such funding. Essentially, this legislation says institutions can own the IP discovered using federal dollars; this concept influences the mission of the UTRF, which is: The UTRF promotes the commercialization of the University's intellectual property resulting from research activity. In doing so, UTRF encourages an entrepreneurial culture, contributes to state and regional economic development, and promotes research and education to benefit the people of Tennessee and beyond.

His report, Dr. Millhorn noted, focuses on three categories of *How Are We Doing?* in regard to the UTRF mission. The first area relates to research funding and the discovery pipeline, which is closely tied to the amount of research funding taking place. If there is significant research funding available, UT researchers should make discoveries leading to IP. Secondly, does this research lead to novel ideas and, in turn, do these ideas lead to IP capable of being protected and commercialized. And, thirdly, is there adequate marketing activity to fund the technology transfer activity leading to increased license activity, start-up companies and revenue to the University. To address these three points, Dr. Millhorn said, data from a third party, the Association of University Technology Managers(AUTM) licensing survey of 2009, has been used and from which identification of UT's national peer group (public universities with $150-500M in research funding) has been made. In addition, a group of 10-peer institutions was selected to enable closer comparisons with UT data. Clemson University was also added as a peer in this group because it is near the peer group benchmark and its mission is similar to UT's mission.

Dr. Millhorn showed a power-point slide of research (pipeline) funding for UTRF and for UT's peer group of 10 institutions in categories of total research, federal research and industry research in each category for these institutions. UT's peer group includes North Carolina State University, Rutgers University, University of Georgia, University of Iowa, University of Kentucky, University of Missouri, University of South Carolina, University of Utah, University of Virginia and Clemson University. The average totals of the three categories were highlighted; UT's statistics where shown using UT reporting data defined as the "big orange" component of the UT System: Knoxville, UTHSC, UTSI and UTIA. Dr. Millhorn noted UT had approximately $284M in annual total research

expenditure funding in comparison to the average of $280M for UT's national peer institutions (public universities with $150-500M) and to the average of $285M for the group of 10-peer institutions. Federal research funding totaled $148M for UT, the national peer average totaled $167M and the 10-peer group average totaled $167M. Industry annual research funding for UT was $34M, national peer group average was $16M, and the ten-peer group average was $22M. These statistics indicate UT has the potential to successfully compete for research funding, Dr. Millhorn said.

In looking at the second category used for analyses (intellectual property--do we have novel ideas), Dr. Millhorn noted this measure can be viewed through the number of disclosures and related data, and he presented a listing of AUTM 2009 average totals for UT, the 10-peer group institutions, and the national peer group average of disclosures, patents filed, U.S.-issued patents, and cost of legal expenses. Dr. Millhorn said the disclosure process begins during the performance of a research project when a novel idea or invention is determined to have value and is disclosed to an institution's technology transfer office. After disclosure, a determination is made as to whether or not the disclosure is of significant value to warrant filing a patent. Not insignificantly, the disclosure and patent process involves legal expenditures and this factor is an important aspect in the disclosure process. The AUTM 2009 survey listing showed an average of 115 disclosures for the UT 10-peer group (with standouts University of Missouri at 161 and University of Utah at 200), the national peer average was 110 disclosures, and UT had 84 disclosures. These figures indicate that, although UT had approximately the same research dollars and activity, UT had significantly fewer disclosures. The number of patents filed also revealed a fairly-wide distribution within the average for the UT peer group of 115 patents filed (ranging from 37 at the University of Kentucky to 131 at the University of Virginia); however, within the national peer group, there was an average of 60 patents filed and UT filed 59 patents. Reviewing the average number of U.S. patents issued during 2009, UT is also close at 16 U.S. patents to the national peer average of 18 (the average for the UT 10-selected universities peer group was 22.3 U.S. patents filed). The most revealing disparity in this review, Dr. Millhorn said, was found in the amounts of legal expenditures. UT is appropriating much less in this area with its spending level at $717,000 than either the national peer group at $1.7M or the selected 10-peer group institutions at $2.2M. A bottom-line result, Dr. Millhorn stated, is the reduced spending level for UT limits the number of patent applications for submission and the opportunities for generating revenue.

The next category (technology transfer-licensing activity—are we capitalizing on our novel ideas) looked at the number of cumulative licenses, new licenses, start-ups, revenue, reimbursed patent fees, and licenses greater than $1M, again using AUTM 2009 data. The average of the 10-peer group for cumulative licenses was 304.5, the national peer group average was 221, and UT had a total of 138 licenses. UT also had about half as many new licenses at 16 as the other groups in 2009, with 57 for the 10-peer group and 38 for the national peer group. Start-up statistics showed a broad range within the 10-peer group with 19 start-ups at the University of Utah and zero at

Clemson; UT had a total of 2 start-ups in 2009, and there was an average of 6.1 start-ups for the 10-peer group and 4.4 start-ups for the national peer group. There were licenses, start-up companies, and revenue dollars generated in technology transfer activity, Dr. Millhorn said, and revenue levels are critical markers. Average revenue for 2009 for the 10-peer group was $12M, the national peer group had a revenue average of $11M--and UT had revenue of $1.6M, indicating a dramatic difference from both peer groups. When a patent for IP protection is being processed for either a start-up or established company, Dr. Millhorn said, it is desirable to turnover a portion of the expenses in this process to the company and this is designated "reimbursed patent fees." In 2009 reimbursed patent fees were just over $1M for both peer groups and UT had patent reimbursement fees of $206,000. Again, there is a marked difference in this category for UT in comparison with both its 10-peer institutions and national peer groups.

These analyses, Dr. Millhorn stated, highlight critical areas in the differentials of UT's technology transfer program and entrepreneurial status in comparison to its peers. Overall, Dr. Millhorn said, he gives UT a C- grade in its technology transfer activities. A result of the analyses was to take a hard look at the differentials to see what other institutions were doing to create better results, i.e., to see what other institutions are doing that UT is not. After a thoughtful review of the statistics and after numerous interviews with technology transfer leaders, one of the most glaring facts to surface was the fewer number of individuals UT has working in its technology transfer efforts—individuals working with scientists and faculty in identifying IP, taking the IP through the patent process and helping to market the IP. Dr. Millhorn showed a power-point slide with identical technology transfer information as the previous slide; however, the new slide indicated one new category designated "License FTE," indicating the number of full-time employees serving as licensing associates who closely work with faculty to help identify, protect and market IP. For UT's 10-peer institution group, there were 10.25 FTE for the University of Utah, 8.5 FTE for the University of Iowa, 9 FTE at the University of Missouri, 7 FTE at Rutgers, and an average of 5.9 FTE for the 10-peer group and 6.0 FTE for UT's national peer group of public universities with $150-500M research funding. UT, Dr. Millhorn said, has 3 FTE for the entire University System, including Knoxville, Memphis, UTIA, UTSI, Chattanooga and Martin. This is a major deficiency identified within the UTRF technology transfer organization, Dr. Millhorn stated. In the past, UTRF was seen as having top-down organizational structure; however, a bottom-up structure organization is how to succeed in technology transfer activities. Structural changes will be proposed to help begin promoting revenues other universities are generating. The University of Georgia has licensing revenues of over $40M per year, Utah is averaging (over the last 5 years) around $40-60M; UT is averaging $1.5-2M per year in revenues.

Close attention is now being directed to several key areas to improve UTRF revenues generation and performance. One important focus area is to build a strong staff, Dr. Millhorn said, in which service and faculty support are emphasized. There is not

sufficient time for faculty inventors to manage the technology transfer process for themselves. There must be people working hand in hand with faculty to help identify and begin the process of protecting IP. Another key focus area is the creation of a business-like entity to provide a valuable service to UT with promoting Return on Investment (ROI). UTRF is a 501(c)3 not-for-profit organization; it functions to increase business opportunities presented to UT within its business structure. A third area is to look at successful models to see what is being done to generate revenue; additionally, how are these organizations recruiting and attracting the best people in this effort and how can UT recruit such individuals and establish a successful technology transfer culture at UT. A fourth focus area will be to grow UT beyond traditional technology transfer. UTRF at present is a "plain vanilla" technology transfer organization, Dr. Millhorn said. The traditional process starts with getting a grant for a particular research activity, within which a novel idea is identified and then work is done to protect the IP and to license it out—but, Dr. Millhorn stated, UT should and must do much more to get beyond this ordinary framework.

Dr. Millhorn noted within the plan to increase UTRF research and IP holdings from its current level of $1.6M up to $5-10M over the next five years or so, three stages have been identified: stabilize (1-4 months), energize (5-12 months), and maximize (12-60 months). Stage 1 (stabilize) has involved evaluating the FY12 budget and performing reallocations to ensure proper spending takes place for success. New licensing associates for "boots on the ground" work with faculty and a Multi-Disciplinary Office (MDO) vice president must be hired. The VP MDO search is underway; there are over 50 applications for the position and final candidates will be brought to campus soon for interviews. Modification of the UTRF structure must take place and metrics must be defined to ensure a successful organization; in addition, Dr. Millhorn said, UTRF must be held accountable for achieving these metric success goals. UT must also develop entrepreneurial partnerships to increase success in these efforts.

Stage 2 of the plan (energize) to create a stronger UTRF organization is to establish technology transfer best-practices procedures for the MDO office in Knoxville; these practices are already established in the Health Science Center (HSO) office in Memphis, Dr. Millhorn noted. Implementation must be made at UTRF of a "we are here to serve" customer-service model for its interactions with faculty and industry. Further, UTRF must aggressively market UTRF and UT technologies and capabilities. The Anderson Center within UT's College of Business Administration is helping UTRF develop strategies to promote entrepreneurship and to generate new company start-ups. Often, the worst person to start a new company, Dr. Millhorn noted, is the inventor. The inventor needs to join forces with people who know how to run the actual business of the new company the IP has generated, and this is an area UTRF is now refining.

The third stage of the plan (maximize) continues implementation of the technology transfer best practices begun in stage 2. In addition, in this stage efforts are made to identify opportunities to enhance deal flow (royalties, licenses and income), to enhance

and refine marketing strategies to broaden UTRF's scope, and to measure indicators of success and modify the UTRF revitalization plan as appropriate.

Dr. Millhorn presented a power-point slide depicting the current UTRF organizational structure. The current structure is not user-friendly, Dr. Millhorn stated, as it actually inhibits interactions promoting deal flow and other IP benefits. The current organization is a standard sponsored-research pathway of invention disclosures leading to patents to protect IP, which often lead to licensing agreements and/or start-up companies, which lead to income to the University (milestone and royalty payments). In the last few years there have been several special projects for UTRF, such as the solar and biofuels initiatives. UTRF then establishes subcontracts for the actual performance of the projects and UTRF receives payment in the form of management fees. An important aspect to recognize in the historical UTRF structure, Dr. Millhorn noted, is the basic firewall between special projects and licensing activities in that they are not instituted to be mutually beneficial--no horizontal interaction activities are incorporated into the activity flow--and this is a major flaw in the current UTRF organizational structure.

A new slide was shown by Dr. Millhorn illustrating the new UTRF organizational model to be implemented this summer. Within the new model there is the flow of standard sponsored-research activities (disclosures, patents, licensing agreements, milestones and royalty payments), but now strategic opportunities have been incorporated wherein UTRF, with its 501(c)3 structure, can negotiate with private industry to bring revenue into the University for activities in which the University cannot as readily compete due to proprietary data restrictions and related limitations. UTRF is exempt from such contract restrictions and can engage in subcontracting relationships with UT faculty with the potential of IP, management fees and other funding opportunities.

The new UTRF organizational plan, Dr. Millhorn said, also targets robust entrepreneurship activity. Recently, Governor Haslam reported only seven companies were formed last year in the state of Tennessee from IP-generating universities. Frankly, Dr. Millhorn said, the University alone should be producing 10-15 IP companies a year and there must be a way to make this happen. A partnership has recently been formed with the UT College of Business Administration's Anderson Center to assist UTRF in identifying IP that looks attractive and then in building a team of technology and business experts around the IP business. The new company will be incubated and new funding sources sought. When this process is functioning properly, Dr. Millhorn stated, revenue should be generated and the $1.5-$1.6M revenue UTRF is now generating should increase to the $5-10M level within the next several years. This revenue is income that comes into UTRF and then can be allocated to the campuses for other projects. The mission is to create a ROI for the University and to create new companies and new high-tech jobs. UT research is heavily subsidized by the federal government, Dr. Millhorn said. It is important to make these research dollars work for us to create

not only new knowledge but for the creation of new business opportunities and new funding sources.

Looking at where UTRF can be in the next few years, Dr. Millhorn said, as a result of full staffing of licensing associates and how this increased staffing affects the number of active licenses, a graph was shown listing 25 top U.S. commercializing universities and the corresponding number of active licenses for each university based on 6-8 new licenses annually for each licensing associate. The list included the University of Washington, University of Minnesota, University of Georgia, University of Florida, Iowa State University, NC State University, University of Virginia, UNC Chapel Hill, Penn State University, Ohio State University, Auburn University and Clemson University, among others (indicating 0-1200 active licenses). It is important to note, Dr. Millhorn said, each active license has the potential to generate income. UT in 2011 has 138 active licenses; it is believed, with the new organization plan, UT will create up to 200 licenses by 2013 and by 2015 there will be almost 250 active licenses.

Increasing the UTRF license portfolio will result in increased revenue, Dr. Millhorn stated, and he showed a graph depicting the straight-line correlation of licensing revenues with the corresponding number of active licenses. The more licenses, the more opportunities to make money, Dr. Millhorn said. If the plan is successful, by 2013 it is believed UTRF can be at $4-5M in licensing revenues and by 2015 at even higher. The plan has been proven at other universities; UTRF must implement the principles proven to be successful at other institutions and it must have really good people working at this implementation, Dr. Millhorn stated.

Dr. Millhorn discussed the University of Utah's commercialization programs in relationship to UT and noted Utah is statistically quite similar to UT; there is slightly more research funding at Utah but not to a significant degree. Dr. Millhorn showed a graph indicating total revenue income from multiple sources (royalty and equity income, private clinical trial revenue, and commercial-sponsored research—note this is not federal or government research income, he said, but income from the commercial or private sector) that flowed through the Utah foundation for FY 2004 – 2010. In FY 2004 about $40M in revenue income was received; from FY 2005 – 2010 revenue income has been in the $50-70M range. Dr. Millhorn showed a graph of Utah invention disclosure activity, with approximately 160 average disclosures in FY 2006-2009 and up to over 200 disclosures for FY 2010. Dr. Millhorn reminded members that (info shown on a previous graph) the University of Utah had over 10 licensing agents; in comparison, UTRF has 3 licensing agents trying to cover technology transfer activities for the entire state of Tennessee. Having a larger number of licensing agents (LAs) means the agents can familiarize themselves with research at associated laboratories, know the investigators, know how to identify IP, know how to handle the disclosure and to start the process. UTRF has a large back-log of technology transfer activity at the present time, Dr. Millhorn said; he believes UT's potential to generate novel ideas is just as great as Utah,

but UT's ability to cultivate and harvest is not nearly as strong due to the lack of boots-on-the-ground capacity.

Another graph was shown indicating the number of Utah new and repeat inventors. Interestingly, the number of Utah repeat inventors continues to climb and far exceed the number of new inventors; this means, Dr. Millhorn said, an inventor has already made an invention, made a disclosure, and now the inventor is excited and enthusiastic and continues to look for more ideas to turn into business opportunities.

Dr. Millhorn showed a bar graph of University of Utah start-up companies over time from 1970 – 2010. He noted the 30-35 years where the number of start-ups was relatively the same with approximately 3-5 new companies each year. In 2005, Dr. Millhorn said, there was a change in leadership and an emphasis was put on technology transfer; the average number of start-ups has been around 20 new companies each year since that time. The University of Utah now is ranked first in the country along with the Massachusetts Institute of Technology (MIT) in creating new start-up companies from research-based inventions. Utah does not have an incredibly large annual research portfolio; it's around $300M in annual research, and UT has $280M in annual research funding. Dr. Millhorn said UT has high-quality research; however, UT is not successfully making the transition from research/creation of knowledge into the commercialization phase of the process. This lack of success must change, Dr. Millhorn said, and the new plan will create better opportunities for success to take place.

The last power-point slide shown by Dr. Millhorn illustrated the organizational chart of UTRF. Changes have been made in UTRF structure over the last few years, Dr. Millhorn stated, which have enhanced its operation. The Health Science Center Executive Committee (HSCEC) office in Memphis "pays attention to Memphis," Dr. Millhorn said; there are two licensing agents on the ground and Richard Magid, Vice President, is doing a good job in his position. Dr. Millhorn said the same could not be said about the leadership at the Multi-Disciplinary Executive Committee (MDEC) office in Knoxville; and, Dr. Millhorn noted, this deficiency was not the particular fault of any one individual but, rather, was due in large part to the lack of resource commitments needed to ensure the necessary workforce to manage and focus on MDEC technology transfer processes. MDEC licensing associates work on IP with personnel at UT Knoxville, UTIA, Chattanooga, and, occasionally, at the UT Medical Center in Knoxville. Currently, there is one individual at MDEC handling licensing matters—for a similar geographical region Utah had 10 licensing associates on the ground involved in this process. There must be more boots on the ground to assist inventors who are bringing IP to the technology office in taking IP down the commercialization pathway to protection, patents, marketing and licensing, Dr. Millhorn said.

Dr. Stacey Patterson will follow his remarks, Dr. Millhorn said, with information concerning the UTRF FY2012 operating budget. Dr. Millhorn said he has asked Dr. Patterson and others to focus budget efforts to get boots on the ground at UTRF.

Dr. DiPietro asked Dr. Millhorn if the University of Utah targeted a particular business sector in initially growing their IP. Dr. Millhorn noted Utah did something along the lines of the new UTRF plan in taking their technology transfer office out of the research office and closely aligning it with a school of business, to provide a high level of business expertise. Dr. Millhorn noted he had not been exaggerating earlier in his remarks when he said the inventor is the worst person to manage his own start-up company. Technology expertise coupled with business expertise creates much better decision-making leadership in determining if certain IP should move forward, if the company can compete in particular markets and other such analyses. The University of Utah has created this successful level of technology-business environment, and this is the kind of environment UT is creating in collaboration with UT's Anderson Center in the College of Business Administration, Dr. Millhorn said.

Mr. Talbott noted there had long been discussion in the local business community about UT's technology transfer capabilities and one of the key issues is lack of venture capital in the area. Dr. Millhorn noted he believed East Tennessee has equivalent of Salt Lake City venture capital; Mr. Talbott said he disagreed due to what he knows about that area. Dr. Millhorn stated there could be some differential; however, UT is in a populous region of the country and there are ample opportunities for UT to go outside the immediate business community to seek venture capital partnerships. If a company is brought to UT and sees well-structured business organization that has technology IP with market opportunities, investors can be found, Dr. Millhorn stated. This is not an easy enterprise, Dr. Millhorn continued, and significant effort must go into finding venture capital opportunities; investors likely won't seek us out—we'll have to go find them and this is a huge challenge. UT must convince investors our science and joint discoveries with ORNL and others warrant taking a good look at what we have to offer. Mr. Talbott noted success is not possible without venture capital; Dr. Millhorn said he fully agreed and noted private investment is key to the technology transfer process at UT and it is his belief that, with effort and hard work, investments can be brought to UT for start-up companies.

Mr. Stansberry noted the new UTRF plan should help attract investors; Mr. Talbott said he hoped this would occur but this attraction had not occurred with past strategies. Dr. Millhorn said the Governor recently funded a program which put $75-100M venture capital funds into the state. Dr. Millhorn said UT must seek these funding opportunities; and, he believes, with a good scientific base and sound business plan, investors will be found. Mr. Talbott noted the venture capital business is a people business; Dr. Millhorn concurred and said this is the major emphasis he had tried to put in today's remarks—the "people" emphasis is critical from discovery to forming partnerships and in marketing IP and UTRF needs more boots on the ground to accomplish these important steps in the technology transfer process. Mr. Stansberry stated the "people" feature is what the new UTRF plan will hope to accomplish in taking a good idea and combine it with a good business approach at the Anderson Center which will help educate and staff

the IP business and thus will attract investors. Mr. Talbott said all ingredients seem to be in place except for venture capitalists and this ingredient is imperative to the enterprise. Dr. Millhorn noted UT personnel frequently participate in gatherings with venture capitalists to foster relationships and UT also hosts venture capitalists located within a 400-500 mile radius to Knoxville to establish partnerships; the primary weakness in this strategy is the lack of UTRF staff essential to nurture and seek out these opportunities. The 10.5 Utah officials likely do a good deal of traveling to reach out to and to work with investors, Dr. Millhorn said. Mr. Talbott asked if UT could invest in its own venture capital out of University investment funds--UT could potentially be its own start-up company and assist in this capacity. Dr. Millhorn noted, in addition, fund-raising activity could be used to invest in IP. Dr. DiPietro noted the University of Iowa had significant technology transfer revenues and asked what is being done at that institution to generate this kind of enterprise. Dr. Millhorn said much of the success has to do with the level of resources; UT is one of the lowest-funded technology transfer operations in the country at this time. If the UT research program continues to grow, faculty members and researchers will demand a mechanism to allow commercialization of their findings. Dr. Millhorn said a question he is usually asked by Governor's Chair recruits and others is, "How successful is your technology transfer plan?" It is not as good as it should be, Dr. Millhorn said; to make technology transfer work, you must have excellent scientists, excellent business minds, and you must get out and attract money to invest in IP—then the start-up companies must be helped in promoting their companies to grow and return money back to the University. There are many universities making over $10M per year with their IP process, Dr. Millhorn said.

Mr. Hall asked when UT might hire someone from Utah; Dr. Millhorn said a search process is in progress now for the VP of the MDEC and the quality of candidates is very good. Candidates will soon be on campus for interviews. In the past, faculty members have been put in UTRF leadership roles; this isn't the best approach. An experienced, professional individual who has developed technology transfer as a career and who knows how to make a research foundation successful is the best person for this role, Dr. Millhorn said. In addition, a look is now being taken at rebranding UTRF. It has been confusing to have both a UT Foundation and a UT Research Foundation. UT is committed, Dr. Millhorn stated, to making its technology transfer enterprise successful in generating good return on investment for the University to invest in other research programs.

Dr. Millhorn noted the next presentation by Dr. Patterson will allow members to see how funds have been reallocated for more UTRF boots on the ground.

VI. Review of UT Research Foundation Operating Budget for FY 2012

Dr. Millhorn recognized Dr. Stacey Patterson, UT Director of Research Partnerships, to present a review of the UT Research Foundation (UTRF) operating budget for FY 2012. Dr. Patterson noted the FY 2012 UTRF budget she was presenting via power-point at the

ROED meeting is the same budget submitted to and approved by the UTRF Board of Directors' meeting on June 9, 2011. She and Dr. Millhorn, in the absence of former UTRF President Randy Gentry, have worked closely with Richard Magid (Vice President of UTRF at the UT Health Science Center) and Samantha Jeffers (Business Manager, UTRF) to put in place a FY 2012 budget that is balanced and which implements the activities needed to happen in the next year for UTRF.

The overall UT funding contribution to UTRF has been a flat budget over the last few years with no changes reflected in the funding amount, Dr. Patterson said. Of note to the FY 2012 budget, however, is an added contribution by the UT Institute of Agriculture (UTIA) of $45,500. UTIA is highly supportive of greater "boots-on-the-ground" presence for UTRF and is funding half a licensing associate position dedicated to UTIA. It is important to note, Dr. Patterson said, 40 percent of disclosures received by UTRF come from UTIA. Iowa State and Georgia institutions similarly derive large portions of their support from agricultural technologies.

The UTRF FY 2012 is heavy in salary support largely for using UT's budget to fund "boots-on-the-ground" work and modest amounts are used for operational office needs. Dr. Patterson noted the item of $125,000 "incubator management fee" is specifically designated for an MOU with the Anderson Center to implement a portion of the entrepreneurial activities previously discussed by Dr. Millhorn. UT officials have been working with Anderson Center directors Alex Miller and Lynn Youngs to get the Anderson Center programs operational.

Dr. Patterson showed a power-point slide of UTRF projected FY 2012 revenues and expenditures. UTRF funds all its patents and legal expenses through the revenue-generation of on-going licenses. Last year UTRF surpassed budget projections for revenue. A $350,000 patent budget is in place for FY 2012 for the Multi-Disciplinary Office (MDO) in Knoxville and $180,000 for the Health Science Center Office (HSCO). Also included in both the MDO and HSCO budget for FY 2012 are royalty distributions (largely distributions going to faculty and inventors) of $150,000. A slide was also shown of the overall UTRF budget for FY 2012 of approximately $2.7M and expected expenditures are balanced within the budget. Pass-through monies reflecting 501(c)3 grants ($884,000) and GTx Incubator payments (rental payments of $845,000) were returned to UTHSC and these amounts were removed from the overall UTRF budget.

The last slide presented by Dr. Patterson was an organizational chart of the UTRF. The chart supported Dr. Millhorn's earlier comments, she said, of the lack of sufficient staff to generate greater revenues for UTRF. The chart represented positions the FY 2012 budget will fund. The MDO segment of the outline revealed two unfilled licensing associate positions (as well as a licensing assistant position), the vacant MDO vice president position and an unfilled marketing manager position. Much effort is being focused on filling these positions for additional "boots-on-the-ground" momentum to drive more revenues into UTRF. The MDO Vice President and two licensing associate

searches are currently underway. Approximately 60 applicants have applied for the two licensing positions.

Dr. Patterson concluded her presentation and asked if anyone had questions. Mr. Cates asked if $1.7M was correct for the total out-range for fees earned, including the payments of the University, in that UT underwrote UTRF in the amount of $1.7M. Dr. Millhorn responded that the underwriting amount was in the $1.5-$1.66M range. The model whereby funds are appropriated by UT for UTRF is not optimum, Dr. Millhorn stated. He prefers a model whereby UTRF services performed for the University are identified and fees are charged for specific services—a fees-for-services format rather than an appropriations format. For example, if 600 patents are maintained in some state of activity and disclosure work is provided, fees would be charged for those services on behalf of the University and UT ultimately would hold UTRF responsible and accountable for its operational funds. Mr. Cates noted he understood the benefits of royalty payments to faculty and inventors and Dr. Millhorn said the revenue-sharing program to faculty is a generous plan and offers a high degree of stimulation for disclosure activity. Mr. Wharton inquired if UTRF had seriously considered engaging a development officer to work on the Research Foundation's behalf and Dr. Millhorn noted discussions had recently taken place on this issue, including direct-giving towards technology development and commercialization. Mr. Wharton noted potential major gift opportunities with entities such as the Gates Foundation and Dr. Millhorn said such gifts at all levels, with organizations and individuals, should optimally be accessed by UTRF. Currently there is not a good mechanism in place to handle such transactions.

Mr. Stansberry thanked Dr. Patterson for her presentation.

VII. Institute of Agriculture Update

The next item for consideration, Mr. Stansberry said, is a report on the Institute of Agriculture and he recognized Mr. Buddy Mitchell, Interim UTIA Chancellor, to make this presentation. Mr. Mitchell noted it is the third time he has served as Interim Chancellor for the UTIA and he hoped he eventually would get this role right! Mr. Mitchell noted the Institute of Agriculture is a remarkably diverse organization comprised of the College of Agricultural Sciences & Natural Resources, the College of Veterinary Medicine, Ag Research and Extension. UTIA is not just about agriculture; it is about many things: forestry, wildlife and fisheries, food science and technology, companion animals and food animal care, horticulture, nutrition, and a multitude of other enterprises. In today's presentation, Mr. Mitchell said he would focus his remarks on what some consider UTIA's core mission: serving agriculture to the world and how this makes an important difference for everyone. In the quest to discover additional resources, you must talk about why this resource exploration is important. The Malthusian Doctrine developed many years ago postulated that the earth's population would simply grow so rapidly it would outgrow food supply. This has certainly not been the case in the developed part of the world. Mr. Mitchell showed several power-point

slides illustrating the dramatic display of the rapidity of progress in American agriculture from 1900-2010. From the middle of the 20th century, for instance, hybrid corn varieties were developed and corn yield today is up to four times what it was prior to this biological systems advancement. The corn price line showed price has stayed relatively low in comparison to yield (increasing from mid-century of about 40 bushels per acre to about 160-180 bushels per acre today), staying in the $1.50-$3.00 per bushel range. Mr. Mitchell noted dips shown in the corn yield chart were weather-related and/or due to environmental conditions such as blights. Agricultural production is still highly dependent on these elements of nature. Mr. Mitchell also noted the inverse relationship of supply and cost—as market supply goes down, price reacts and increases.

Mr. Mitchell showed a chart illustrating prices farmers have received from 1975 to 2010 compared to U.S. Consumer Price Index (CPI) and Medical Care CPI. Prices received by farmers have stayed fairly flat-lined (97 percent growth) compared to all items' CPI (305 percent increase) and medical care CPI (718 percent increase). Prices received by farmers have remained dramatically low compared to their input costs for fuel, labor, fertilizer, equipment and technology. Farmers have responded to this vast differential by increasing yield-per-acre production with the help of modern technologies and more efficient operations, and they have been most successful with this strategy. The number of farmers is too great to formulate cut-back production and price-setting strategies like organizations such as OPEC (Organization for Petroleum Exporting Countries) would do. Farmers have very limited control over price and consumers have benefited from this pure competitive market in that the percentage of income consumers spend on food has declined over the last several decades (27 percent in 1920 to around 10 percent in 2000). This means greater savings and disposable income for the U.S. consumer to be spent in areas such as education, recreation and any area of their choosing and it provides extra disposable income which benefits the economy and society. This picture is beginning to change, however. Mr. Mitchell noted on the initial graph he showed of corn yield and price (1900-2010), corn price is beginning to accelerate significantly from $5 per bushel to $7 per bushel. This increase is due to a combination of factors such as unfavorable weather, an increase in the amount of corn used for ethanol, a rapid increase in demand for corn by the emerging middle class in countries such as China and India, and higher energy input costs. The corn crop on the same acre of ground must now feed the world's population and in addition to supply part of our energy needs. To keep up with this demand, corn yield must accelerate or the increase in corn price will certainly show up for consumers in grocery stores. The answer for this situation is to continue to invest in research and to maximize every acre of crop production. Here in Tennessee we want to obtain the maximum sustainable utility of every acre of forest and farmland to benefit the consumer, the farmer and the taxpayer in our state.

Research is thus more important than ever and we must continue to drive agricultural productivity to the highest level. Mr. Mitchell noted UTIA has 21 invention disclosures and 9 patent applications so far this year through the UT Research Foundation. The

driving force of this success is an educated workforce out of the UT College of Agricultural Sciences & Natural Resources and an aggressive Ag Extension Service to deliver research findings from the laboratory to the user. Over 4.5M personal contacts to the people of Tennessee were delivered by UTIA. There have been over 50 economic analysis studies conducted which show an approximately 50 percent annual return to dollars invested in Ag Research and Extension and an 8-1 return over the life of the technology, which is a superb investment. Investment is slowing, however, because federal funds which have been flat for years are now down. The near-future outlook appears grim with both federal and state budgets. The activities highlighted today are too important not to do them well for the benefit of everyone. Hard work and wise adjustments to the models discussed will be applied to continue the vital services needed by the people of Tennessee and for people around the globe. Mr. Mitchell thanked members for their support of these initiatives.

Mr. Stansberry thanked Mr. Mitchell for making his presentation and for serving in his role as Interim Chancellor of UTIA.

VIII. Memphis Research Consortium

Mr. Stansberry recognized Dr. Steve Schwab, Chancellor of the UT Health Science Center (UTHSC), to give a presentation on the Memphis Research Consortium (MRC). Dr. Schwab noted, as he said Dr. Millhorn had described earlier, one of the goals of the University of Tennessee is to dramatically increase its research portfolio. Most of UT's research funding comes from the federal government and over the next few years a major down-turn is expected in the availability of federal grant funding from the National Institutes of Health and other such agencies. Added to this expected drop in funding, Dr. Schwab said, is the extremely high cost of the research enterprise in general. On average, for each research dollar received by an institution from external funding, between 25-45 cents per dollar is spent by the institution of its own money. With the University's goal to grow its research portfolio and become a national contender, aggressive mechanisms must be utilized to secure research start-up funds to keep growing UT's research enterprise until the federal budget recovers. That is the thought process which initiated the Memphis Research Consortium (MRC).

Research strategists in West Tennessee saw the tremendous success occurring in East Tennessee with collaborations between the University of Tennessee, Knoxville and the Oak Ridge National Laboratory, one of the wisest leverages UT has ever developed. The western part of the state looked for a leverage of its own to generate opportunities to create knowledge and to promote and fund research collaboration and commercialization. Dr. Schwab presented a power-point slide listing the institutions joined together in 2010 to sign a memorandum of understanding uniting them to a policy of collaboration as the Memphis Research Consortium: The University of Tennessee Health Science Center, the Memphis Bioworks Foundation, St. Jude Children's Research Hospital, the University of Memphis, FedEx, Wright Medical, Smith

& Nephew, Medtronic, Baptist Memorial Health Care, LeBonheur Children's Hospital and Methodist LeBonheur Healthcare. The four charter members—UT Health Science Center, the University of Memphis, St. Jude Children's Research Hospital, and the Memphis Bioworks Foundation—are the four executive members. UT Trustee George Cates serves as the first and current Chair of the MRC. MRC is a consortium, not an administrative unit or corporation, and is designed to strengthen relations between Memphis research institutions and to facilitate collaboration in research, education, institutional strategy, and other activities of mutual interest.

In its early stages MRC competed successfully for seed funds, aggressively pursued avenues of funding, and procured a lump sum $10M grant in state funding for public university faculty startup (UT Health Science Center and the University of Memphis) to conduct two specific research projects. It is MRC's goal to use this funding platform to conduct aggressive research and generate lump-sum grant benefits from the state on a regular basis to stimulate and to grow MRC resources.

Dr. Schwab highlighted the MRC mission: perform great science, grow annual research spending past $1B, build new blockbuster ventures, and educate the next generation of scientists and healthcare professionals. Enhancing MRC's standing in the Memphis area by growing annual research spending past $1B will mean increasing research spending of over $300M from the current spending level. Maintaining and growing a coordinated approach to entrepreneurship and technology transfer to commercialize academic research into Tennessee's next generation of breakthrough science is part of the MRC plan for accomplishing its key objectives. Dr. Schwab presented a graph illustrating the strong foundation for Memphis research and development growth with $694M research expenditures in 2010: $161M university (UTHSC and UM), $236M industry (Medtronic, S&N, Wright, etc.), and $297M St. Jude.

MRC strengths of UTHSC research and clinical practices and core partner hospitals, University of Memphis research, St. Jude, the Memphis medical device industry, FedEx focus on biologistics, joint MCAN 10BG fiber optic network (allowing access of Oak Ridge National Laboratory (ORNL) and other such facilities), and robust startup and incubator community organized with Bioworks were discussed by Dr. Schwab. MRC is ideally positioned to build on these strengths and grow its programs, Dr. Schwab noted.

One of the chief projects of MRC enabled by the $10M state grant employs a combination of computational science and informatics and translational genomics. The strengths highlighted previously will empower and leverage MRC to drive this project forward, Dr. Schwab said. Dr. Schwab commented to Dr. Thomas Zacharia, ORNL Deputy for Science and Technology, that the computational science and translational genomics project is an ideal fit for a UT-ORNL Governor's Chair. Other priorities for MRC include population health, advanced biomaterials, pediatric cardiology, pediatric infectious disease, and pediatric neurodevelopment. As an example of a MCR partner strength, Dr. Schwab noted St. Jude Children's Hospital was recognized in the 2010-2011

U.S. News & World Report national rankings for pediatric heart disease, neuroscience, orthopedics, and nephrology.

Dr. Schwab outlined the MRC Plan: build on existing partnerships and assets (leverage the excellence of private institutions: St. Jude: genetics of childhood disease; Memphis orthopedic companies Smith & Nephew, Medtronic, Wright Medical: bone and cartilage science; and develop the strengths of the state's universities); promote productive inter-institutional collaborations; promote aggressive tech transfer and commercialization; recruit new scientists to existing science strengths and form teams of cross-institution science to drive projects; universities provide lab space, salary support and recruit the scientists; MRC provides start-up funds for projects; and supporting organizations provide resources, facilities and expertise to help drive research and commercialization.

In conclusion, Dr. Schwab stated MRC is off to a grand start and its goal is to deliver the goods. With the Memphis Research Consortium, the mechanism to continue to drive more research into Memphis and to leverage assets already there for successful resource and grant competition is established.

Mr. Stansberry thanked Dr. Schwab for his excellent report on this vital topic and noted he and the ROED Committee looks forward to hearing more about it.

IX. Annual Overview of Oak Ridge National Laboratory

Mr. Stansberry recognized Dr. Thomas Zacharia, ORNL Deputy for Science and Technology, to present an annual overview of the Laboratory. Dr. Zacharia greeted the Committee and noted that the last time he addressed the group was in October 2009. He stated that his past service as ORNL Associate Lab Director for Computing and Computational Sciences (and as Vice President for Science and Technology at the University of Tennessee for about a year and a half) had provided him with an extensive experience and knowledge that he is applying in shaping the direction of science at ORNL.

Dr. Zacharia said that, despite difficult budget times, ORNL is well positioned for the future. ORNL is the largest science and energy laboratory of the U.S. Department of Energy (DOE), with an annual budget of $1.65B and approximately 4,600 employees. Each year about 3,000 guests visit ORNL to perform research, staying from a period of a few weeks to a few years. Over the last 12 years $500M has been invested in modernization and lab revitalization. ORNL is the model other countries wish to replicate for their own laboratory research enterprises, Dr. Zacharia stated. Other ORNL assets include the world's most intense-pulsed neutron source and a world-class research reactor, the world's most powerful open-scientific computing facility, the nation's most diverse energy portfolio, and management of the billion-dollar U.S. ITER project for DOE.

UT-Battelle, LLC began its contract management of ORNL in 2000, Dr. Zacharia noted. Management is critical to a national laboratory's success—it matters who is partnering

and how management operations are conducted. In 2000 over a dozen key leadership changes occurred at ORNL as Lab management changed from Lockheed-Martin to UT-Battelle. The Lab has come from being almost forgotten on the national laboratory scene to a leading-edge laboratory, and it is a striking example of what the University of Tennessee has brought to the table in managing the ORNL. Over the last 10 years the Lab has grown from roughly a half-billion dollar laboratory to over $1B in research. DOE recognizes and appreciates this extraordinary growth. In March 2010, Energy Secretary Steven Chu came to Oak Ridge to announce a five-year extension (to 2015) of the UT-Battelle management contract at ORNL. In the next couple of years, DOE will consider whether to extend the contract again or open it to competition. The best strategy to encourage a contract extension is to execute the Laboratory's business in the best possible way. Dr. Zacharia believes UT-Battelle is doing an excellent job in its laboratory management.

The ORNL mission, Dr. Zacharia outlined, is to deliver scientific discoveries and technical breakthroughs that will accelerate the development and deployment of solutions in clean energy and global security, and in doing so create economic opportunity for the nation. Not only does ORNL focus on research in its partnership with UT, there is also a new emphasis in driving research and scientific innovations to the marketplace. This mission is achieved by integrating and applying ORNL's signature strengths goals to achieve key science and technology initiatives (deliver forefront science using neutrons; enable discovery and innovation with high-performance computing, data infrastructure, and analysis; develop and demonstrate advanced materials for energy applications; and develop and virtualize advanced nuclear energy systems); deliver solutions to pressing energy challenges (accelerate biomass production and conversion for energy and materials; deliver sustainable transportation solutions; and advance the understanding of climate change impacts); and protect the nation and the world (provide science and technology to solve challenges in global security). It is incumbent upon ORNL to invest its $1.6B budget in executing these major science and technology initiatives to deliver mission outcomes.

Two of the world's foremost tools for developing and applying neutron scattering are found at ORNL in the High Flux Isotope Reactor (HFIR) and the Spallation Neutron Source (SNS). These two facilities (valued at ~$3B) make ORNL the leading provider of neutrons to a growing user community. ORNL is also leading the development of ultra-scale scientific computing. In the last 10 years ORNL has gone from relative insignificance on the national scene to being truly a national and international leader in high-performance computing. UT has the nation's fastest academic computer at ORNL with Kraken, the National Science Foundation (NSF) supercomputer. Japan and China now have the world's fastest computers but a plan is in place with DOE to deploy ORNL's computers to over 10x the present power over the next few years and by 2018 to have machines over 1000x more powerful than present computers.

Integrating distinctive capabilities for nuclear science and technology is clearly a priority for the long term in finding future world energy solutions and resources. In light of the recent nuclear reactor disaster in Japan, careful design, operation, control and safety of reactor systems are receiving increased attention. In addition to its historical role in nuclear development, ORNL has exceptional talent and expertise in the nuclear arena and is well positioned in this important field, Dr. Zacharia noted. The Consortium for Advanced Simulation of Light Water Reactors (CASL) is a strong component of ORNL's strategy to develop a virtual reactor to enable advances in nuclear energy. Key areas of focus are to: reduce capital and operating costs per unit energy by enabling power uprates and life extension, reduce nuclear waste volume generated by enabling higher fuel burnups, and enhance nuclear safety by delivering high-fidelity predictive capability for component and system performance from beginning of life through failure. CASL brings the best people in the field under one roof to develop tools to determine ways to run nuclear reactors and to develop the next-generation of reactors as well.

Advancing fusion science and technology is another key area in development at ORNL, Dr. Zacharia noted. Fusion is the "holy grail" in terms of producing clean energy and the next step is the international ITER project in Cadarache, France, which will cost roughly $20B. ORNL manages the U.S. contributions to ITER and is also engaged in developing advanced materials and components for the fusion environment and in delivering theory, modeling, and simulation for current and planned experiments. ITER is another example of the large projects in which ORNL has a major role in supporting the national agenda.

Dr. Zacharia noted sustainable biofuels and bioproducts is a particularly exciting area at ORNL, which leads DOE's BioEnergy Science Center (BESC). BESC is focused on understanding and modifying plant biomass recalcitrance; delivering new tools and processes for biomass processing and conversions; leveraging connections to the UT Biofuels Initiative, addressing the social, economic, and environmental components of bioenergy sustainability; and developing and assessing bioproducts. In particular, BESC researchers are working with the UT Biofuels Initiative to explore the production of lignin-based carbon fiber. The conversion of lignin, a by-product of cellulosic biofuels production, into a much higher-value carbon fiber product with a variety of commercial applications has the potential to transform the bioproducts marketplace. ORNL researchers are also testing intermediate ethanol blends to determine their effects on vehicles and engines.

Delivering sustainable transportation solutions is also high on ORNL's list of activities. Dr. Zacharia was invited to participate in President Obama's March 2011 forum at Georgetown University where, among other things, the President challenged university students to buy hybrid motor vehicles and where he announced a goal to reduce fuel oil importation of 30 percent within the next ten years. This goal can be achieved only through accelerating electrification and strong biofuels research and production, producing efficient vehicles, and implementing intelligent systems and operations for traffic management and communications, resulting in new technologies and processes for

safe, secure and affordable vehicles for passengers and freight, domestic production of transportation fuel, reducing environmental impacts of transportation and ensuring predictable, reliable transport schedules. UT and ORNL can be leaders in developing and delivering these sustainable transportation solutions.

ORNL's strong science programs are also evident in the Climate Change Science Institute which explores and models global environmental impacts, particularly in looking at energy challenges and in studying extreme climate events. Recent regional and global weather disturbances clearly illustrate the need for advanced exploration and modeling, Dr. Zacharia noted. ORNL's high-performance computing facilities and infrastructure are assisting with this endeavor.

Delivering science-based solutions to solve global security challenges is another major ORNL initiative. Approximately $400-500M in national security research activity is drawing on ORNL's distinctive capabilities in science and technology and producing innovations.

Dr. Zacharia stated he is excited about the growth of the strong university partnerships that are critical to ORNL's success. Approximately 70 percent of ORNL publications in 2009-2010 had a university coauthor, with 321 publications including a coauthor from UT or one of the UT-Battelle core universities. There are 98 joint faculty with 13 universities (65 with UT) and there are 9 UT-ORNL Governor's Chairs (3 appointed in 2010). Dr. Zacharia noted ROED members had heard today from one of these Chairs, Dr. Brian Wirth. The individuals filling the Governor's Chair positions are top-notch scientists who are attracted to the UT-ORNL positions because of academic freedom and the proximity to good students to work with them and by the access to major scientific tools and research facilities--the best of both academic and scientific worlds. In 2010 there were 336 postdoctoral researchers at ORNL and 466 undergraduate research participants through Oak Ridge Institute for Science and Education (ORISE), up 80 percent in 5 years. ORNL seeks to further expand its university partnerships because of the success it has experienced in these relationships.

One of the best manifestations of ORNL's partnership with UT is through the UT-ORNL Joint Institutes. Dr. Zacharia noted he is particularly proud of the UT-ORNL Joint Institute for Computational Sciences (JICS) and the UT-ORNL partnership that successfully competed for the NSF National Center for Computational Sciences (NICS). UT-ORNL competed against top universities such as the University of California, the University of Pittsburgh, and the University of Texas to win the NSF grant. In the last four years JICS has attracted $110M from NSF, an indication of the tremendous success of the UT-ORNL partnership and its computational sciences programs. UT and ORNL have unique strengths and capabilities, Dr. Zacharia noted, and--when marshaled in partnership--significant and meaningful accomplishments occur. Other Joint Institutes are the Joint Institute for Biological Sciences, the Joint Institute for Neutron Sciences, the Joint Institute for Advanced Materials, and the Joint Institute for Heavy Ion Research.

Dr. Zacharia noted members had previously heard Dr. Millhorn point out that from the University's perspective its partnership with ORNL is a $1.6B engine to drive innovations to the marketplace. In the past, for a variety of reasons, ORNL has not facilitated such dynamic entrepreneurial activity for itself and it is now endeavoring to find new ways to build a successful entrepreneurial culture and provide access to venture capital. The first Science & Technology Park on a national laboratory campus has been constructed at ORNL, and ORNL is building new partnerships with universities, industry, and state and local governments. Dr. Zacharia reviewed commercialization outcomes and metrics and noted that ORNL is now tracking such metrics (patents, research agreements, licensing, new companies) as part of a new emphasis on driving its innovations to market via university partnerships, local and regional economic development, technology portfolios, industry partnerships and entrepreneurial support. Dr. Zacharia said his own personal goal is to see a $1B spin-off over the next five years for the Laboratory.

A critical key to continue building UT and ORNL's successful partnership is developing the next generation of scientists and engineers. Providing educational and research experiences for students and faculty at all levels, investing in facilities and teachers for area schools, and participating in regional education and workforce development efforts are areas to be addressed in this important process. The ORNL vision for graduate research and education includes offering multidisciplinary research opportunities in energy-related sciences and engineering, incorporating entrepreneurial experiences (including opportunities to develop business plans for accelerating technology deployment), and providing transformational opportunities to engage students in large-scale, problem-oriented programs, enabling scientific discoveries and innovative solutions to energy-related challenges. An important program within this vision is the new Center for Interdisciplinary Research and Graduate Education (CIRE), a UT Knoxville and ORNL program with two main focus areas: UTK-ORNL distinguished graduate fellowships and the Energy Science and Engineering (ESE) Interdisciplinary Ph.D. program. ORNL and UTK moved quickly to bring CIRE to fruition, Dr. Zacharia noted, starting with its establishment in June 2010, a proposal developed for a new ESE Ph.D. in July 2010, approval of the ESE Ph.D. curriculum by the UTK Graduate Counsel and the start of a recruiting campaign for Fall 2011 class in September, approval of the ESE Ph.D. program by the UTK Faculty Senate and the UT Board of Trustees in October, the initial CIRE faculty appointments in December 2010, and approval by the Tennessee Higher Education Commission in January 2011. Dr. Lee Riedinger, professor of physics at UTK and formerly ORNL Deputy for Science and Technology, was appointed CIRE Director in August 2010. CIRE will welcome its first class of Ph.D. students this fall, and 38 faculty members have been appointed (18 ORNL and 20 UT faculty).

Dr. Zacharia noted he is most excited about the CIRE program. In August 2011, classes will begin for 18 students selected from a strong applicant pool (101 initial applications, 43 of whom visited UT and ORNL in March 2011). CIRE extended offers to 28 students, 10 of whom had perfect GRE quantitative scores. Those who did not accept their offers from CIRE are going to such prestigious institutions as Johns Hopkins, MIT, Michigan, Purdue,

Texas A&M, UC Berkeley, UC Santa Barbara, and Vanderbilt, demonstrating that CIRE is competing for top-quality candidates. Also available through CIRE is a traditional Ph.D. with a concentration in energy science and engineering. Dr. Zacharia noted the students who chose not to accept CIRE offers were recruited by other high-caliber, well-established institutions and feedback indicated they felt the CIRE program was of tremendous value and quality. Both UT and ORNL have made this program a priority and the JICS building at ORNL, where space is being made available for CIRE activities, is a visible marker of the importance of the program.

Dr. Zacharia noted his presentation had been a brief overview of the Laboratory and he would like to note again the remarkable UT-Battelle leadership which has brought great growth and improvement to the Lab.

Mr. Stansberry thanked Dr. Zacharia for his insightful presentation and said the relationship of UT and ORNL is fascinating and members should visit or revisit ORNL to see the immense progress being made.

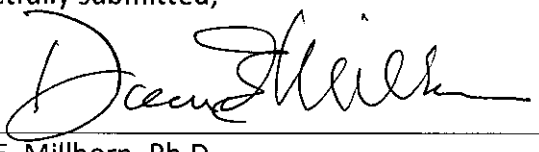
X. Other Business

Mr. Stansberry recognized three members whose terms were expiring. Mr. Stansberry thanked UT Ag Extension agent Dr. Glenn Turner, Dr. Sharon Rollins and Dr. Dick Gourley for their service. He said he particularly wanted to thank Dr. Gourley for his work with the UT Research Foundation.

XI. Adjournment

Mr. Stansberry thanked members for their participation in the meeting and called for the meeting to be adjourned. The meeting adjourned at 5:25 p.m.

Respectfully submitted,



David E. Millhorn, Ph.D.
Executive Vice President