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Executive Summary

I have been employed with the Klipsch School of Electrical and Computer Engineering at New Mexico State University since August 2003. I started as Assistant Professor, and was promoted to Associate Professor in August 2004. Prior to my present appointment I had worked from August 2000 to August 2003 as Assistant Professor at the Department of Electrical and Computer Engineering in North Dakota State University, Fargo, and from May 1997 to July 2000 as Senior Consulting Engineer with LCG Consulting, Los Altos, California. I provide here the highlights of the nine years of my career as a professional since the completion of my Ph.D. in May 1997.

My activities throughout my professional career, both during and prior to my tenure at NMSU, have contributed to the mission of the College of Engineering to achieve national recognition and uphold the University's land grant mission through education, research and service. In this document I describe these contributions.

In my career I have taught thirteen different courses, including two laboratory courses. Throughout my career in academia, I have continuously striven to improve and strengthen my teaching abilities and effectiveness. To this end, I have participated in numerous workshops and seminars. I have also received several teaching awards and honors: at NMSU, I am a member of the Teaching Academy; at NDSU, I was awarded Fellowship of the Faculty Institute of Excellence in Learning; as a graduate student at Texas A&M University, I received the Outstanding Assistant Lecturer Award. I have graduated five M.S. students and am advising three Ph.D. and two M.S. students. One Ph.D. student will graduate in Spring 2007, one has passed his qualifying exams, and I am actively trying to recruit more.

I have been active as an educator even at the national and international level. I organized and chaired a tutorial on Electric Delivery System Reliability Evaluation at the IEEE-PES Annual General Meeting 2005 in San Francisco. This was a very successful event, and was offered at two more IEEE-PES conferences in 2006. I have also team-taught three short courses.

I have made significant contributions to research in the Power and Energy Systems area. As a Senior Consulting Engineer with LCG, I performed proprietary cutting edge research on energy market modeling and simulation. Right from the beginning of my academic career, I have been working toward building a strong and independent research program. I have authored, individually or in collaboration, twelve research proposals of which seven have been funded, totaling \$605,000 in federal and industrial grants. This includes the NSF CAREER Award, which I received while I was with NDSU, but I transferred this grant to NMSU, and this has played a key role in consolidating our research program in the areas of grid reliability and distributed generation. Some of my contributions in these areas constitute pioneering research in my field. I have disseminated my research findings by publishing 38 research articles in eminent journals, prestigious conferences such as the PSCC, and several IEEE conferences.

My professional service, outreach and leadership activities have been no less significant. At the national level, I am Senior Member of the IEEE and member of several committees and subcommittees in the Power Engineering Society (PES). As Chair of the IEEE-PES Student Activities Subcommittee, I have organized, and am still organizing Student Programs at several IEEE-PES conferences. I am also Vice-Chair of the Reliability, Risk and Probability Applications Subcommittee. I participated in the Working Group that developed the IEEE Standard 762-2005, and am on the Working Group for IEEE Standard 859. At the Department and College levels, I have served on several committees, both at NMSU and at NDSU.

I serve as Associate Director of the Electric Utility Management Program and work with the Director, Prof. Ranade, not only toward maintaining Program funding, improving the Program and organizing several outreach activities. In December 2003, Prof. Ranade and I organized the Distributed and Renewable Energy Symposium here at NMSU. This provided networking opportunities for NMSU faculty and students as well as the other speakers and attendees. It also provided immediate and measurable benefits in the form of research opportunities and several employment offers to EUMP students. Prof. Ranade and I are also going to jointly Chair the North American Power Symposium 2007. This has been approved by the NAPS Steering Committee. This will be the first time the conference will be hosted by NMSU, and will offer an excellent opportunity to showcase our Program.

Through the professional activities described above, I have brought national recognition to NMSU. I have pursued excellence in education, research and public service. I have received recognition for teaching excellence. I have performed pioneering research and attracted over \$600,000 in federal and industrial funds. I have authored or co-authored over 45 publications, including books, technical articles and research reports. I have demonstrated leadership in my field. I have served my profession and have been recognized as a Senior Member of the Institute of Electrical and Electronics Engineers. I continue to strive for excellence in the areas of education, research, outreach and public service, thereby contributing my utmost to the land grant mission of the University.

Teaching (May 1997–November 2006)

8.1 Contributions to Teaching

As an educator, I have contributed in many ways. I have contributed in the academic workplace, and at the national and international levels. I describe here the various contributions I have made in power engineering education.

At the Annual General Meeting of the IEEE Power Engineering Society at San Francisco in June 2005, I organized and chaired a tutorial on Electric Delivery System Reliability Evaluation. This was a very successful event, and was subsequently offered at two more conferences in 2006—the IEEE-PES Transmission and Distribution Conference and Exposition at Dallas in May 2006 and at the IEEE-PES Annual General Meeting at Montreal in June 2006. These tutorials were attended by a total of 175 delegates from all over the world, and have brought national and international recognition to NMSU.

At the invitation of the Alumni Foundation of the Indian Institute of Technology, Kharagpur, I team-taught a short course on Electric Power System Reliability at IIT Kharagpur in January 2006. It was attended by twenty graduate students. In August 2006, the EUMP offered two short courses right here at NMSU, one on Power Systems Fundamentals, the other on Life Extension of Substations, and I instructed in both of these courses.

My classroom experience has spanned three land grant institutions. While a Ph.D. student in Texas A&M University, I taught for a year (Summer 1994 to Spring 1995) as an Assistant Lecturer. From Fall 2000 to Spring 2003, I taught at North Dakota State University, and from Fall 2003 I have been teaching at NMSU. In all, I have taught thirteen different courses, including two laboratory courses. Five have been graduate courses, the rest undergraduate. Even while working as a consulting engineer, I imparted instruction to attendees during the seminars, workshops and training sessions that our company conducted. My presentations at these sessions covered topics on power system modeling and energy and ancillary service market modeling.

As a teacher and instructor, I have continuously striven to improve and strengthen my teaching abilities and effectiveness. I have participated in numerous workshops and seminars. Since coming to NMSU, I have attended most seminars and workshops for teaching improvement offered by the Teaching Academy and NSF Advance. I attend several conferences every year to keep myself abreast of developments in my field, and integrate this knowledge as well as my research into my instruction. I have also received several teaching awards and honors: at NMSU, I am a member of the Teaching Academy; at NDSU, I was awarded Fellowship of the Faculty Institute of Excellence in Learning; as a graduate student at Texas A&M University, I received the Outstanding Assistant Lecturer Award. I have been actively involved in advising students, both graduate and undergraduate. I have graduated five M.S. students and am advising three Ph.D. and two M.S. students. One Ph.D. student will graduate in Spring 2007, one has passed his qualifying examination, and I am actively trying to recruit more.

As Associate Director of the Electric Utility Management Program, I work with the Director, Prof. Ranade, to raise funds for the Program and provide advice and mentoring to the EUMP Fellows and other graduate students in the Power and Energy group. I have worked with our industry partners on improving the EUMP curriculum. I also actively seek career opportunities for our students, in the form of internships, cooperative or permanent employment. I have provided advice, support and assistance to students not only at my academic workplace, but also as Chair of the IEEE-PES Student Meetings Subcommittee, as described later in this document, in the sections on professional services.

In the following sections I provide details of my contributions to teaching and education, as well as my own professional development in my quest to become an outstanding educator.

Research (May 1997–November 2006)

10.1 Contributions to Research

As with my efforts in education, even in research I have made significant contributions to my field and thereby brought national recognition to NMSU. The bulk of my contribution has been in the area of grid reliability and distributed generation, and I have performed pioneering research in this field. Much of my work has been supported by the **Faculty Early Career Development (CAREER) Award** that was granted to me by the National Science Foundation in 2002. In 2005, I also received two grants from Sandia National Laboratories for research projects on distributed generation.

Within the area of power and energy systems, my research interests are broad and diverse. My specialization has been in power system reliability, and the bulk of my publications are in this field; however, I have conducted research in, and published in, diverse areas in power systems, such as optimal power flow, stability, solar energy, power system architecture, demand management, distributed resources, and transient modeling of transformers. As a consulting engineer, I have conducted research in production simulation, modeling and simulation of energy and ancillary service markets, and risk management. Since this research was proprietary, I have not published any of this work.

I have actively pursued opportunities for sponsored research, supported by federal agencies and industry. I have worked on establishing a relationship with neighboring utilities. I authored, individually or in collaboration, twelve research proposals of which seven were funded. The total amount was \$605,000.00 in federal and industrial grants, and included the NSF CAREER Award, as well as grants from Bonneville Power Administration and Sandia National Laboratories. I received the CAREER Award while I was with NDSU, but I transferred this grant to NMSU, and this has played a key role in consolidating our research program in the areas of grid reliability and distributed generation. Some of my contributions in these areas constitute pioneering research in my field. I have disseminated my research findings by publishing 38 research articles in eminent journals, prestigious conferences such as the PSCC, and several IEEE conferences. Several more such articles are in preparation.

10.1.1 Power Grid Reliability Research

A colleague (Prof. Ranade) and I are in the process of establishing expertise in several areas of grid reliability. We are conducting some pioneering work in the identification of grid vulnerabilities and evolution of catastrophic failures. Responses to the unfolding of cascading failures can be of two types: strategic and tactical. At this time, we are also contributing to development of strategic responses. Our work in distributed resources and microgrid reliability also fits within the framework of strategic responses. This work consists of developing reliability-stipulated, cost-optimal microgrid architectures. In the last twelve months, we have published ten research articles on these topics, and are working on several more. More work in this broad area is in progress. We look forward to acquiring some recognition and visibility for expertise in this important field.

10.1.2 Proprietary Work, Not Published

As stated above, the research I performed as a Consulting Engineer was proprietary in nature, and therefore not published. However, the projects performed are very briefly outlined below. Much of the work was centered on the development of the commercial package known as “UPLAN-E”, which is a utility planning and resource management program.

1. Developed a model to determine optimal bidding strategies in competitive markets for both energy and ancillary services.
2. Developed a data verification model to identify suspicious data in generation, transmission and load databases.
3. Developed a response surface model for rapid estimation of electricity prices.
4. Participated in the development of an energy market risk management model. This model optimizes portfolios consisting of electricity futures and transmission contracts and recommends optimal transaction quantities and suitable hedging strategies.
5. Built and integrated the uncertainty module, which enables UPLAN-E to simulate random variations in demand, fuel costs, fuel cost escalations, hydrological conditions, unit availability and transfer capability.
6. Incorporated in UPLAN-E the ability to assess wheeling charges and take these charges into account while performing the optimization and while determining the market clearing prices and nodal spot prices.
7. Developed and integrated in UPLAN-E improved models for unit commitment and dispatch, by implementing a linear programming (LP) formulation that incorporates a linearized approximation of the power flow problem as well as suitable compensation for system losses. The resulting optimization module consists of LPs for unit commitment and dispatch, integrated with an LP-OPF for AC power flow optimization and redispatch.

10.1.3 Significance of Research Contributions

I have stated before that I have made research contributions in diverse areas within power and energy systems. That these contributions have been published in respected peer-reviewed forums is testimony to their significance. However, it is appropriate to briefly mention those bodies of my work that are of particular significance in their impact on the field.

I have made significant contribution to the emerging field of distributed energy resources and microgrids. I have conducted cutting-edge research on microgrid architecture. The cutting-edge nature of this work is evidenced by the fact that only 2-3 years ago, my ideas met with considerable opposition, but now the very same ideas are being accepted, and in fact an IEEE standard (IEEE Std. 1547-2003) which originally precluded the architectures that I proposed is soon going to have an extension (Std. 1547.4, now under preparation) that will accommodate some of the proposed architectures. A further testimony to the significance of this work is that I was invited to make presentations on this work at the plenary session of a WSEAS conference in November 2006 and at a panel session of an IEEE conference in May 2006.

I have also made several fundamental contributions to the established field of power system reliability analysis. The most significant is the method of state space pruning that I invented. This method accelerates the convergence of non-sequential Monte Carlo simulation by an order of magnitude or more, while traditional methods produced accelerations in the order of 5-15%. Other fundamental contributions in this area include the following. (1) I developed a method for determining frequency indices using the method of state space decomposition; prior applications of decomposition focused on probability and expectation indices, and frequency indices were considered too difficult to determine from this method. (2) I was also the first to develop a practical means of implementing the DC flow model to represent network flows in the framework of state space decomposition for reliability analysis of power systems. The recognition achieved through some of this work has paved the way for other contributions to the profession, such as leadership in the RRPA subcommittee of the IEEE Power Engineering Society and organizing and chairing a highly successful tutorial on reliability at three IEEE-PES conferences.