COVER PAGE

1. **PROJECT TITLE:**
   Smart Lighting Technology Project

2. **APPLICANT CONTACT INFORMATION:**
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3. **PARTNERS:**
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4. **TOTAL PROJECT COST: $1,495,327**
   Grant funds requested: $1,383,657
   Match committed: $111,670

5. **PREVIOUS PROJECT/APPLICATION TITLE(S) AND/OR NUMBER(S) FOR GRANTS FROM THE RENEWABLE ENERGY FUND OR DENALI COMMISSION EMERGING ENERGY TECHNOLOGY GRANT PROGRAM:**
   NONE

6. **PREVIOUS PROJECT TITLE(S) FOR ABSTRACTS SUBMITTED TO THE RENEWABLE ENERGY FUND, IF APPLICABLE:**
   Emerging Smart Lighting Technology Project, AEA 11-027

ABSTRACT

1. Project Summary

a. Project Description: The *Smart Lighting Technology Project* will combine technology with design application to demonstrate a new consumer product called *TrimLight* that is energy efficient and highly marketable. The proposed nanotechnology concepts provide opportunities in alternative methods for fabricating lighting technology that can be transferred to large scale processing. Proposed objectives will confirm the commercial potential of the technology for targeted markets and sustain high tech R&D programs in Alaska. This project will be the first R&D collaboration effort between University of Alaska Fairbanks (UAF) and a local commercial venture in solid state device technology and nanotechnology areas. The project team will consist of an Alaskan business, IllumiTek, and its technology partner, the Advanced Materials Group (Alaska's only Nanotechnology and Microelectronics research center) at the Institute of Northern Engineering, University of Alaska Fairbanks (UAF). The three-year project is designed to *test an emerging technology that will conserve energy* and will focus on generating and converting light for a market-disruptive product for the residential and commercial marketplace. Funding will be used to advance TrimLight from TRL 4 to implement activities in TRL 5-6 during a three-year project.

b. Project Eligibility: The *Smart Lighting Technology Project* is an eligible emerging energy technology demonstration project, designed *to promote the expansion of energy sources available to Alaskans through demonstration projects of technologies that have a reasonable expectation to be commercially viable in the next five years.* The proposed project will 1) test an emerging energy technology that will conserve energy; and 2) enhance the efficient use of energy in Alaska.

c. Project Innovation: Inefficient use of electricity has become a significant concern to Alaskans - to small and large businesses, to families, and to U.S. government establishments. Existing technologies employed in lighting are inefficient and have fundamental limitations when it comes to efficiency by virtue of the high energy process to indirectly generate light. Existing technologies tend to be bulky and the lifetime of displays depend largely on the environmental conditions, power fluctuations, and are expensive. Concerns are increasing about the mercury vapor released into the environment from the fluorescent lamps at disposal sites, causing huge environmental remediation issues. This is especially a concern in Alaska's rural communities, where recommended options for saving energy result in polluted landfills. It is interesting to note that compact fluorescent lights cannot be used in subzero temperatures due to ballast issues – thereby reducing these options for many Alaskans. It is the project team's contention that based on preliminary studies, *TrimLight* is a viable innovation for Alaska that will save power, and last much longer than currently available alternatives.

The goal of the *Smart Lighting Technology Project* is to demonstrate new nanoelectronics and new nanostructures that utilize unique properties of nanoscale components and features to enable new functionalities. Proposed research will address the innovative use of light for residential or commercial lighting which is multicolor emitter based on nanocrystalline hybrid display materials. Research will combine technology with a design application that will address energy independence and is unique to Alaska's extreme climate conditions. TrimLight will increase performance by offering a convenient, energy efficient lighting solution that is very different from lighting systems currently on the market. It has the potential to modernize lighting systems for venues such as hospitals and public transportation. Project results will offer a high technology commercial initiative in Alaska that would jump-start businesses based on the unique arctic innovations and hence create local job opportunities and eventually nationwide. It will encourage teaming between entrepreneurial businesses, the Department of Defense, the University of Alaska campuses, and other research institutes. The gains from this new technology, especially for the State of Alaska, would follow in the form of technical prowess to compete in the national technology arena for programs, projects and entrepreneurial activity.

d. Priority: Under AS 42.45.375(d) the *Smart Lighting Technology Project* qualifies for priority considerations because: 1) IllumiTek is an Alaskan owned eligible business holding Alaska Business License # 941222, and all Project participants are Alaskan residents; 2) The Project will demonstrate a partnership with the University of Alaska Fairbanks (UAF), an Alaska postsecondary institution; 3) The Project is supported by an in-kind partnership; 4) The resulting Smart Lighting Technology has the potential for widespread deployment in Alaska. *Proof of Eligibility documents are included with this Abstract.*

2. Technology Validation and Research Methodology

a. Objectives:

Objective 1 will optimize the process types and their associated capabilities in terms of device dimensions, temperature requirements, throughput rate, and layer-to-layer registration. The project team will measure the optical properties such as peak light emission wavelength and quantum efficiency and evaluate the ability of the active display material to provide at least 30% of light proposed (150-200 Lumen/Watt) output. This will be accomplished through device simulation for maximizing the light output and selection of flexible substrates. Objective 2 will determine the path forward for future R&D, to estimate if TrimLight is commercially viable, its true market potential, and that TRL 7, TRL 8 and TRL9 are viable. This will be achieved through synthesis of active materials, selection of barrier layers, commercialization planning, and development and testing of the prototype model. Objective 3 will provide a means to sustain high tech R&D programs in Alaska, accomplished through active collaboration with students and faculty of engineering with University of Alaska Fairbanks.

b. Methodology: Proposed research will demonstrate device configuration, material suitability, synthesis methods to incorporate organic and inorganic active materials, and address fidelity of device configuration for testing. As part of the technology validation and research component, data collection (including O&M, R&R, and performance data) is included in the scope and budget for the project. The specific parameters that will be gathered and reported will be technology and project specific. Quarterly reports will be submitted as required for the project and will include all information outlined in the grant agreement.

Work has been outlined for the applicant, IllumiTek, LLC, to perform administrative, contract management, planning, monitoring, reporting, and support activities at its Anchorage offices, and research to be performed in Fairbanks at the *University of Alaska-Fairbanks Advanced Materials Group* (AMG) facility. AMG-UAF has the requisite infrastructure and technical resources to accomplish the project goals and objectives. AMG's facility has the capacity to provide the needed information to prove the effectiveness of TrimLight for the proposed market. AMG houses over 15,000 square feet of Class 100 and Class 1000 clean room facilities; it has a highly rated research division with its state-of-the-art clean room, materials development, and advanced level characterization facilities to carry out research and technology development for Military, Aerospace, Space and Homeland Security (MASH) applications. AMG leverages numerous other resources on the UAF campus, such as the centralized materials analysis lab, machine shops, and the laboratories in the electrical and mechanical engineering departments.

Alaska Project Solutions, Inc., (APSI) will provide IllumiTek office space and furnishings for the project in its Anchorage based offices. APSI's management staff and support staff will work part time for IllumiTek for the duration of the project. Grant administration, finance, commercialization planning, travel planning, and project planning will be accomplished at the APSI office in downtown Anchorage. The office is conducive for all activities; it is fully furnished in each of its three offices and conference room and is equipped with updated technology including computers, copiers, scanners, fax machine, and telephones.

3. Summary of Project Schedule and Summary of Project Budget: Funding will be used to advance TrimLight from TRL 4 to implement activities in TRL 5- TRL 6 over a three-year project. An additional 1-2 years is estimated to be needed for testing the system prototype in its final form and to complete TRL 7 through TRL 9 under actual deployment conditions.

Summary of Project Schedule

(TRL 4) August 2012-December 2012; Activities will optimize processes and capabilities in terms of device dimensions, temperature requirements, throughput rate and layer to layer registration; device simulation for maximizing the light output; project financing finalized; siting and site control activities completed; completion of TrimLight research plan; monthly meetings.

(TRL 5) January 2013-March 2013; Selection of flexible substrates; research plan put into effect; monthly reports; update financial plan; preliminary commercialization planning; attend industry conference; preliminary patent application; establish requirements for smartboard controls; monthly meetings; annual audit.

January 2013-October 2013: Synthesis of active materials; smartboard technology development; update commercialization plan; attend industry conference; monthly meetings.
August 2013-March 2014: Selection of barrier layers; complete smartboard technology; full patent application; attend industry conference; monthly meetings; annual audit.

(TRL 6) April 2014-July 2015: Technology validation; complete and test prototype model in simulated operational environment; complete commercialization plan to reflect project results; monthly meetings; annual audit; analyze and report on technology validation.

Summary of Project Budget

The total project budget request is $1,383,657 for the three-year project. In-Kind matching funds total $111,670, provided by Alaska Project Solutions, Inc. for salaries, supplies, and office space that will be needed for the project. The total project cost is, $1,495,327, which includes the funding request and committed match.

a) Direct Labor and Benefits, $355,888: IllumiTek Personnel and Fringe, for Project Manager (.5 FTE), Business Operations Manager (.5 FTE), and Office Assistant (.25 FTE). In-Kind match commitment for Project Manager position: $81,070.
b) Travel, Meals, or Per Diem, $52,740: Travel for meetings in Fairbanks and industry conferences in L-48.
c) Equipment $0: None requested.
d) Materials and Supplies, $35,670: Office technology, project supplies, materials for purchase of nanotechnology laboratory supplies. In-Kind match for computers, meeting and office technology is $3,600.
e) Contractual Services, $212,500: Consultants for commercialization planning, legal services for patent applications; smartboard systems developer; annual audit services; general non-litigation legal services.
f) Construction Services, $0: None requested.
g) Other Direct Costs, $726,859: UAF Sub-award for Principal Investigators' and student research assistants' salaries and fringe benefits, F & A costs for research; patent fees; professional and general liability insurance. In-Kind match commitment for furnished project offices is $27,000.

4. Project Team Qualifications: *IllumiTek* staff is experienced in grant administration and business management, and have established processes for research, data management, and record keeping procedures. IllumiTek will engage AMG for the proposed technical research; AMG employs professionals for running the facility, R&D, and pilot production. Multiple opportunities for interdepartmental collaboration will offer graduate students participation in the project. The project team includes staff from IllumiTek, Alaska Project Solutions, Inc. (APSI), and AMG.

Project Manager, *Joan Herrmann, Founder and CEO of IllumiTek*, has worked closely with AMG since 2005 for the development of the TrimLight technology and business model. Joan is also the founder of Alaska Project Solutions, Inc. (APSI) a professional grants consulting firm that will be providing in-kind resources to the project. Her 20 years of business experience has equipped her for this project, and has raised a strong awareness of the vital need for alternative energy resources and technologies in rural Alaska. Joan has established a credible relationship with UAF scientists, who support the scientific merit of the technology and have committed to partner with IllumiTek for this project. She will maintain the overall supervision of the project, coordinate budget management, regulate project scope, hire and work closely with contractors, legal support, and technology developers; submit required reports and manage the development of the commercialization plan. The company has professional support staff through APSI, an attorney and CPA. Phone: 907-334-9212 Email: joanh@gci.net

Principal Investigator for Technology Validation and Research: *Shiva Hullavarad, Ph.D., Assistant Professor, Advanced Materials Group, INE – UAF*, presently heads Microelectronics and Photonics DARPA funded program at AMG, UAF. Shiva has published more than 60 peer-reviewed international publications, has full copyrights, and 2 patents pending on nanotechnology processes and applications. As Principal Investigator for the technology, he will be responsible for ensuring valid scientific and economic data and other technology validation and research activities; providing the aforementioned information in the format reasonably specified by the Authority for all phases of the Project. Phone: 907-455-2017 Email: shiva.h@alaska.edu

Co-Principal Investigator for Technology Validation and Research: *Nilima Hullavarad, Ph.D. Research Assistant Professor, Advanced Materials Group, INE - UAF,* is leading nano fabrication DARPA funded program to synthesize semiconductor-metal nanoparticles, nanowires and composite materials for advanced device miniaturization technology applications. She has published more than 35 peer-reviewed international publications, has full copyrights, and 2 patents pending on nanotechnology processes and applications. As Co-Principal Investigator, she will work closely with the Principal Investigator to ensure valid scientific and economic data and other technology validation and research activities from the Project. Phone: 907-455-2021 Email: nvhullavarad@alaska.edu

5. Discussion of Commercialization of Funded Technology: Basic and applied research in nano-materials and advanced electronics is being avidly pursued in government, industry, and academic laboratories for efficient light production. In the lighting area of technology and research, in the conventional solid state lighting (SiC, GaN and white LED's) and compact fluorescent lighting based systems. Recent work has encouraged participation of its project partner, AMG-UAF, students, and researchers in nanotechnology activities. TrimLight complements these ongoing efforts of materials development and provides opportunity for leveraging the core competence of AMG.

The proposed technology has the potential to become a breakthrough, market-disruptive new product that is energy-efficient and appropriate for decorative and safety purposes in both residential and commercial applications. Its potentially diverse applications present numerous possibilities for significant economic impact. It is expected that the product testing process will yield ideas for increased uses and its marketability.

In the U.S. alone, about 1100 companies make up the lighting equipment industry, with combined annual revenues estimated at about $16.5 Billion. This industry includes residential, commercial, industrial, and outdoor lighting fixtures, as well as portable electric lamps and electric and nonelectric lighting equipment using their own power source. According to the U.S. Department of Energy, Alaskan consumers pay among the highest rates for electricity in the country—50% higher, on average. Nevertheless, electricity consumption is growing much faster in Alaska than in the United States as a whole. Alaska is endowed with abundant renewable energy resources, but ranks almost last in electricity production from renewable resources because of the lack of a transmission grid to transport power to population centers. [1] The only solutions currently on the horizon of are CFLs, which present an unspoken problem with environmental pollution and impacts on human health when exposed. According to the Renewable Energy Alaska Project,[2] (REAP), artificial lighting is almost 15% of an Alaskan household's electricity use, and they recommend the use of more efficient lighting, such as compact fluorescent light bulbs (CFL), high-intensity discharge (HID) lamps, and light-emitting diode (LED) lights. However, each of these presents its own unique challenges for sustainable long term use; for example, the waste disposal of mercury found in CFLs is becoming more of an environmental concern.

The advantage of the proposed process is that it will use fewer materials, and does not cause industrial pollution as compared to competing technologies. The technology will also provide alternative methods for fabrication that can be transferred to large scale processing; manufacturing methods are also promising due to less material and energy consumption, and less waste and pollution from the production processes. It is the project team's contention that the proposed technology will save power and last much longer than alternatives currently available.

6. Signed Applicant Certification:

By signature on this application, I certify that we are complying, and will comply with the amount of matching funds being offered.

Joan Herrmann

Joan Herrmann, CEO, IllumiTek, LLC Date: March 9, 2012

[1] http://apps1.eere.energy.gov/states/energy_summary.cfm/state=AK
[2] alaskarenewableenergy.org