PROPOSAL FOR A LENR RESEARCH LABORATORY

LOS ALAMOS (STAGE 1) AND SANTA FE (STAGE 2)
NEW MEXICO

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SFLL

Executive Summary

The ability to generate energy using the Low Energy Nuclear Reaction Process (LENR or Cold Fusion) is now well enough understood and sufficiently demonstrated to justify investment to determine how this energy can be used in commercial applications. This proposal describes creation of a research laboratory in Santa Fe, NM for the study of LENR. The intent is to obtain basic information about how to create conditions required to initiate the nuclear reactions, how the nuclear reactions function, and how the rate of the nuclear reactions can be increased with control. This information would be used to obtain patents that would be used to return the investment funds and eventually support laboratory operations in the future. The laboratory would collaborate with other laboratory and university programs to increase the productivity of the research.

The proposal describes the justification and objectives followed by an overview of how the laboratory would be organized. The process starts by using laboratory space presently operating in Los Alamos, NM under the direction of Dr. Claytor, where LENR studies are successfully underway. Once the staff and equipment have been acquired, the operation will move to a larger laboratory space in Santa Fe, NM. The details of this process are described. Resumes of key personnel, publication lists, and current assets that will be transferred to the Santa Fe laboratory are included.

The Santa Fe Laboratory is being proposed by top investigators in the LENR field, including a lead scientist who literally “wrote the book” on current knowledge of the field. The research is based on a well-established and broadly accepted explanation of LENR involving very small nuclear active environment (NAE) locations. A proven method of laboratory development using a staged approach to minimize risk is provided in the proposal. The new facility will have a solid foundation in already-existing laboratories that have had success in achieving LENR. The time has arrived to realize the energy potential of LENR using the power of incentive-based laboratory investigations.

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SUMMARY

Cold fusion, now commonly referred to as low energy nuclear reactions (LENR), was made known in 1989 by Profs. Fleischmann and Pons.[1-11] The claim for energy production from a nuclear fusion reaction was promptly rejected by mainstream science. Over the past 23 years, the claim has been demonstrated by research in 12 countries around the world, with much of this work published in the open literature using peer review, as described in the book[12] and review[13] by Storms. Significant energy production has also been made public in numerous demonstrations. This work shows that nuclear reactions involving hydrogen isotopes can be initiated in special materials to produce energy without application of significant external energy and without production of significant radiation, thereby promising an unlimited source of clean energy. The challenge now is to understand and master this process as a practical energy source.

The LENR field has advanced to the point that a major laboratory with sophisticated instruments and a highly qualified interdisciplinary staff is needed to fully develop LENR science and technology. The approach is best done using private investment with anticipation of a return on investment. This proposal describes how such a laboratory might be organized and funded. The proposed laboratory will be developed in two stages with the final installation located in Santa Fe, New Mexico, which is designated as "Santa Fe LENR Laboratory" (SFLL).

At the present time, the research efforts at various independent sites in the US are too scattered and are being done at too low a level of funding to be effective. The SFLL will seek to coordinate and support these efforts, make available the needed additional tools and information, and provide a mechanism for realizing a return on investment.

Additionally, information and experience about the phenomenon is currently in the hands of relatively few people. These professionals need to be encouraged to share their experience and teach more people about the unique aspects of the LENR phenomenon. This effort can now only be effective in a central laboratory. Similar laboratories are being created in other countries, which will give these countries great benefit when this technology is eventually applied. The US needs to create a similar focus for research and training to remain competitive.

1 INTRODUCTION

1.1 Economic and Political Justification

Now that LENR has been established as a real phenomenon and a few efforts are underway to commercialize the resulting energy, the consequences must be acknowledged and a response made. This response is necessary if the US is to be able to take advantage of this unique energy source for civilian and military use. At the present time, too few people understand LENR well enough to make future exploitation possible in the US. This situation needs to change, but LENR requires an approach to achieve understanding that is different from the one normally used. This new approach is required because the phenomenon involves a nuclear process being initiated in a novel chemical environment on a nanoscale. Many accepted laws of nature seem not to apply.

Effective study therefore requires training in materials science and nuclear physics with a willingness to explore novel ideas, which is a rare combination. Failure thus far to employ this unique combination of perspectives and skills has slowed understanding, sent many studies down unproductive paths, and created conflict between the proposed explanations and well-known laws of nature. This problem results from LENR being produced by a combination of chemical and nuclear interaction, a combination that is very unusual, generally rejected as impossible, and about which present training in science provides very little understanding. Indeed, conventional training may prove to be a handicap. An approach to solve this challenge is described in this proposal for a new research facility, the Santa Fe LENR Laboratory (SFLL).

Meeting this challenge is important because if the cold fusion method can be understood and controlled, it would be an ideal source of energy, without much cost, and with significant benefit to mankind. For example, the low cost could make large amounts of potable and agricultural irrigation water available using desalination of seawater. The high energy density and absence of harmful radiation could provide power that would make long-duration space exploration possible. Absence of harmful products could greatly reduce or eliminate damage to the environment caused by current sources of energy. Because the energy comes from hydrogen, any source of water could give access to the energy without interruption. And because the generator could have many different sizes, local in-home or in-business generators could become practical, thereby eliminating the need for centralized generation and the associated complex and inefficient electrical distribution systems. Such an energy source would give a country using this source great advantages. Not only would the energy be less expensive than that obtained from conventional sources, it would be more reliable with respect to weather, local disaster, international conflict, and location of the energy use. In addition, manufacture, sale and service of the generators world-wide would provide a significant source of income to the country supplying the technology. Military use is obvious because ships would be floating in their fuel, drones could be kept aloft for long periods, and fuel for battle-field use could not be interrupted. Consequently, development of this energy source has important national security implications.

LENR requires only knowledge about the process for it to be implemented quickly and on a world-wide scale. Unlike the very complex and expensive hot fusion effort, large, complicated installations are not required to produce the energy. Generators from a scale suitable to power a cell phone to a size able to power an aircraft carrier can be expected. Obtaining the required (and still missing) knowledge is the challenge this proposal addresses.

1.2 Scientific Justification and Objectives

LENR produces energy by nuclear fusion using isotopes of hydrogen and unique materials. However, the method continues to be unreliable because the critical variables controlling the process have not been identified, the nature of the unique material has not been sufficiently characterized, and the nuclear mechanism is not yet fully understood. Consequently, success in making energy currently results mostly from luck, improved on occasion by experience. This situation has resulted in the commonly experienced difficulties in replicating the effect, which contributes to general rejection. Even when success is claimed, the magnitude is variable, and control is insufficient.

Although several successful efforts at making commercial level energy have apparently been empirically demonstrated, the underlying science appears not to be well understood, and the methods involved have not been revealed. Consequently, other explorers of this process either need to discover a successful method or wait until the apparently successful empirical methods are revealed. If or when the methods are revealed, this information would be useful to the SFLL because it could be used to quickly advance understanding and create new applications. Even when practical generators become available as a result of empirical development, general use will require detailed knowledge about the process – if for no other reason than to satisfy legal requirements commonly applied to consumer products. These considerations give support to the creation of a laboratory as soon as possible with a goal of acquiring basic understanding needed for commercialization rather than trying to improve the engineering behavior of poorly understood methods.

In addition, an educated workforce will be required to develop, manufacture, and service the energy generators. This rare and unique knowledge needs to be made known to the investigators who are needed to carry this technology into the future. This education can only result from interactions with people who already have the limited and unique knowledge about the phenomenon. This proposal rests on the belief that investigators having this expertise can be best accessed through a leading laboratory where they are employed and engaged in active research.

Such basic studies are guided by a theory, which the resulting observations will either support or modify. These studies will be based on work published by Dr. Storms[14-19]. He has identified the deficiencies in other theories[20-25] and has provided an explanation that is consistent with all observations and not in conflict with known laws of nature. In contrast to other explanations, the nuclear reaction is not the main focus, but instead the nature of the special site required to initiate the nuclear process in the material – called the nuclear active environment (located in very small cracks) –is emphasized. Present experience shows that once this special condition is created, the nuclear reaction occurs without any help or additional understanding being required. Of course, once the nuclear reaction can be initiated reliably, details of its unique nature can be obtained as part of future studies.

Based on the above discussion, the following four objectives of the SFLL Laboratory have been adopted:

- Study the LENR phenomenon in order to achieve a basic understanding of the conditions required to initiate the nuclear reactions and the nature of the reaction itself;
- Use this basic understanding to develop designs able to provide a practical source of energy;
- Develop the commercial prospects of LENR through application of investment funds; and
- Educate the next generation of scientists, technicians, and policy makers so that they can make this source of energy available on a large scale and meet manpower requirements for future LENR energy products.

1.3 Laboratory Development Overview

A stepwise approach will be used to minimize risk, create the laboratory with the least initial cost, and provide a potential for significant return on investment. Because funding the laboratory lab is based on entrepreneurial investment, focus is placed on clear demonstration of potential returns on funds invested. The primary product of the lab will be in-depth understanding of the LENR processes, especially for energy production. The experimental strategy, summarized in Table 1-1, takes advantage of Dr. Storms' work with nanocracks described above. Initial studies utilize an established LENR method, gas discharge, followed by detailed investigation of the nanocracks and nuclear active environment.

A portion of the research results may go into the public domain, mostly as peer-reviewed publications. However, the research findings that have potential to help achieve LENR commercialization will remain proprietary and will be developed into patent applications to ensure that intellectual property is protected. Thus, it is planned that successful patents for LENR commercialization would generate revenue to provide returns on investment and pay for current and future lab expenses. Revenue from patents may be generated in one of three ways – lease, sale, or by using the patent as the basics for a new company owned by the investors that would manufacture energy generators.

Table 1-1. Experimental Strategy Overview

<u>Gas Discharge Methods for Guiding Investigations of Nanocrack Functions in LENR Phenomena</u> The presently successful gas discharge method developed by Dr. Claytor provides a window into understanding how the nuclear process operates. Measurement of the nuclear products, consisting of helium, tritium, radiation and energy, allows the mechanism to be understood. This investigation will continue during Stage 1. However, this information does not reveal the conditions required for the nuclear reaction to occur or the rare location in the material where the nuclear reactions take place.
<u>Investigation of the Role of Stress-Induced Nanocracks in Achieving LENR in Solid Materials</u> An extensive study of the literature has suggested the location and conditions required for the nuclear reaction to occur. The present belief is that stress induced cracks of a critical size are required. These cracks are produced by random processes in certain materials when stress is created by various chemical processes. Stage 2 will focus on mastering the process of their creation by applying conventional material science. The cracks will be identified using high- resolution SEM and TEM methods. These methods are not presently available because of their high cost.
<u>Determination of Methods for Creating Nanogaps for Consistent LENR Energy Production</u> If gaps of a critical dimension are required, these can be created using nano-machining to achieve large numbers of active sites in a material with total reproducibility and at low cost. This method will be explored once access to the required tools has been obtained during Stage 2. Once the method for producing artificial nanogaps having the optimal LENR inducing properties has been refined, nanogap production methods will be developed for the commercial application of LENR-based energy.

The situation regarding patents for LENR is very unusual because the US Patent and Trademark office is reluctant to grant patents for claims based on energy production from LENR. Consequently, such claims either need to be hidden in a patent claiming something else or the patent must describe only a limited but essential aspect of the process that does not make such a claim. Many of the granted parents only describe a recipe for producing energy without a description that would allow replication by a person skilled in the art or any useful insight about how the recipe applies. Consequently, the effect is presently poorly covered by patents, which allows room for controlling patents to be submitted once the effect is fully understood.

The laboratory will be developed in two stages. Stage 1 will include research of high-priority topics and preparation for Stage 2. The second stage will expand the research effort based on what is discovered during Stage 1. Education programs will be set up through various universities including the University of New Mexico. Both stages will take advantage of, and build upon, ongoing research efforts and existing laboratories of Edmund Storms and Thomas Claytor, two of the foremost researchers in the LENR field. Stage 1 will take place in Claytor's existing lab in Los Alamos, and Stage 2 will take place at the proposed laboratory in Santa Fe. A multidisciplinary staff of physicists, chemists, materials scientists, and professionals with experience in nanotechnology will work in teams to enhance communication and understanding of LENR from several technical perspectives. It is anticipated that two methods – gas loading and gas discharge – will be employed at least initially. These methods are described below.

During Stage 1, gas discharge will be used to study production of tritium, radiation, and heat, which are presently being produced as part of ongoing studies. The applied conditions, composition of target, and other variables will be explored to maximize the nuclear reaction rate. The active targets will be examined at the nanoscale-level to identify the required unique conditions. Because the active regions are expected to be few and randomly distributed on the material, such an examination is expected to require significant effort to locate the small active sites using a high-resolution scanning electron microscope (SEM).

Direct reaction between metals and hydrogen gas without discharge will be explored to determine the most effective ways to generate nano-scale gaps having the expected correct dimensions to support the nuclear process, which is also part of an ongoing study. These nano-scale gaps can be created by stress relief and/or by using nanotechnology to create the gaps directly on a surface with uniform dimensions. Generation of radiation will be used initially to determine when the process is successful. As success is increased, heat and nuclear products will also be measured. The occasional success achieved so far will be improved and amplified by using tools only available at the sophisticated laboratories such as SFLL where a large number of variables can be rapidly explored.

Stage 1 is expected to achieve the following: 1) a better understanding of conditions required to initiate the nuclear reactions 2) creation of samples that show unambiguous nuclear activity; and 3) a clear path to obtaining more detailed understanding of the nuclear process, which will be explored in more detail during Stage 2.

Research at the laboratory will be performed in the context of well-established organization management methods. Overall management will be by the Laboratory Director in collaboration with appointed consultants. The Laboratory Director will also have responsibility for establishing collaboration with individual researchers working at other locations including national laboratories, university researchers, and educators. The initial minimum staff will be expanded as the need and funding permit.

1.4 Current Research and Facilities

The SFLL will be directed initially by people who have extensive experience and solid accomplishments. The backgrounds of these principals are described below. Dr. Storms will have overall management responsibility. Dr. Claytor will manage the Stage 1 lab in Los Alamos, and Dr. Grimshaw will provide organization development expertise and oversight.

Drs. Storms and Claytor had been actively investigating LENR at their former employer, LANL, and independently at their private labs near Santa Fe and Los Alamos, respectively. Dr. Grinshaw has a broad background in business as well as considerable knowledge of LENR. Resumes are provided in Appendix A, and a list of LENR publications of the principals is in Appendix B. Eventually, a team consisting of scientists and business advisers knowledgeable about LENR will conduct the research under the guidance of Dr. Storms and Dr. Claytor.

Edmund Storms, Ph.D.

Dr. Storms is widely regarded as one of the foremost LENR researchers in the world. His 2007 book[12] on the topic is currently the standard reference work for the field. He has authored more than 100 papers on LENR. Of particular significance are four complete scientific reviews of the field, the latest in 2010.[13] He has testified before the US Congress on LENR, and he has been honored by Wired Magazine as one of 25 people in the US making a significant contribution to new ideas. He was recently awarded the Preparata Medal by the International Society of Condensed Matter Nuclear Science, and the Distinguished Scientist award by the University of Missouri for his contributions to the field.

After he received a PhD in radiochemistry at Washington University in St. Louis, he began employment (1955) at Los Alamos National Laboratory (LANL), where he was involved in basic research of materials used in nuclear power and propulsion reactors. While at LANL, he also conducted research on LENR, with emphasis on tritium production and later published a successful study of heat production. After a 34-year career in LANL, Dr. Storms retired and has continued his LENR research at his private laboratory in Santa Fe for the past 20 years. His LENR publications are in addition to about 100 publications describing the properties of high-temperature compounds used in nuclear reactors published before he retired from LANL.

Dr. Storms has conducted many types of LENR investigations in his laboratory, and a substantial collection of experimental equipment has been assembled including a complete library of the literature on a computer, all of which will become part of the SFLL in Stage 1. His LENR investigations have employed most of the methods for achieving the effect, including the Fleischmann-Pons method (electrolysis), gas discharge, and gas loading approaches. He has designed and constructed many kinds of calorimeters for measuring excess heat. Among the assets in his laboratory are a scanning electron microscope (SEM) with energy dispersive x-ray (EDX) analysis capability, power supplies, mass spectrometers, an optical microscope, and a sensitive balance (±0.01 mg), as well as a complete shop for constructing experimental apparatus, including metal machining and glass working, A list of the assets in Dr. Storms' private laboratory is presented in Appendix C.

Dr. Storms also possesses the most complete collection of LENR publications in the world, consisting of 4600 entries. The library uses keyword search of EndNote, with full-text copies available for most papers. He works closely with the LENR-CANR website manager (Jed Rothwell) to keep as much of the LENR literature in the public domain as possible.

Thomas Claytor, Ph.D.

Dr. Claytor has worked at Los Alamos National Laboratory and Argonne National Laboratory for the past 34 years in various levels of responsibility. For the past 22 years he has led the experimental research effort at Los Alamos directed at LENR. Progress has been made under Laboratory Research and Development funding as well as Directors Discretionary funding and special funding from Technology Transfer awards. He was one of the first (if not the first) investigator to attempt non-equilibrium gas loading of nano-powders in search of LENR effects, which were described at the earliest cold fusion conference, which took place in Santa Fe, NM. He also initiated one of the first investigations of LENR effects from plasma loaded metals, and electrostimulated wires and powder.

Dr. Claytor graduated from Purdue University with a Ph.D. in solid-state physics. He began working at Argonne in the area of hydrogen detection for liquid metal reactors. While there, he received an R&D 100 award and two patents for high temperature sensors and detection systems that have been used subsequently in reactors. After he moved to Los Alamos, he was the leader of the systems development unit that greatly contributed to the stockpile safety and rebuild mission and received an R&D 100 award and two patents as well as DOE and Laboratory Distinguished Performance awards. During this time, he also worked with about 10 students on LENR as he collaborated with Steve Jones, the Naval Research Laboratory, SRI, International, and others to improve neutron and tritium detection from solid state gas loaded cells. Since his retirement, Dr. Claytor has maintained his connections at Los Alamos as a Guest Scientist and has set up a 2500 ft^2 private laboratory to further research and commercialization, as well as offer independent confirmation of LENR effects.

Since he began working full time on LENR in his private laboratory, Dr. Claytor has made significant progress that would have taken years to realize at Los Alamos. The laboratory has two gas ion chambers with gas handling equipment, a high sensitivity RGA, a Packard 1900CA liquid scintillation counter, a high resolution HPGE detector, two SSB detector chambers, a NaI gamma detector as well as an alpha beta detector and a multi-tube ^3He neutron detector. A large high sensitivity calorimeter is on loan from another laboratory and there are precision balances, a TIG tube welder, a high temperature furnace as well as various high-vacuum pumps, large vacuum vessels, an optical spectrum analyzer, lasers, power supplies and miscellaneous lab supplies. The equipment generally complements that of Edmund Storms' laboratory.

Thomas W. Grimshaw, Ph.D.

Dr. Grimshaw has been working in the LENR field for over eight years. His primary interest has been in the energy policy arena, but he has worked on a number of related topics as well. His LENR activities have included assessment of LENR demonstrations, development of experiment plans and reports of investigations, networking with investigators to improve the prospects of LENR success, and definition of new initiatives and facilities for LENR research. Dr. Grimshaw is also a highly experienced manager of both organizations and individual projects. He has managed a number of organizations for environmental and geological research, including an academic research entity and portions of private sector consulting firms. He has managed many types of projects for environmental research, systems implementation, and energy policy analysis.

Dr. Grimshaw received M.A. and Ph.D. degrees in Geology from The University of Texas at Austin. After graduate school, he enjoyed a successful career in environmental research and consulting before moving to his current academic position for energy policy development. Dr. Grimshaw obtained a masters degree in public policy (mid-career option) at the LBJ School of Public Affairs in order to shift his career to energy policy research cleanup. His masters thesis was on evidence-based public policy for research support of LENR for the public benefit. He has continued this research and publication, including a paper and poster at ICCF-17 in Daejeon, South Korea in August 2102.

In his current position as Research Fellow at The University of Texas at Austin, Dr. Grimshaw is developing the case for changing attitudes and improved prospects for LENR as a potential source of energy. A major part of this effort is proactive planning and policymaking to deal with the secondary impacts and unintended consequences of large-scale deployment of

LENR as a major supply of energy. Most recently, Dr. Grimshaw has supported LENR-related initiatives at National Instruments.

Prior to changing to energy policy development, Dr. Grimshaw managed many organizations and projects, both in an academic setting and for private consulting firms. For example, he held the position of Associate Director for Environmental Programs at the Bureau of Economic Geology at The University of Texas at Austin. Dr. Grimshaw's diverse project management experience has included large environmental baseline and cleanup programs for major energy companies such as Shell, Chevron, ExxonMobil, and Phillips.

1.5 Advantages of Los Alamos and Santa Fe Locations

Los Alamos and Santa Fe are ideal choices for the SFLL because the area has a large population of scientifically trained workers as a result of the two national laboratories – Los Alamos National Laboratory in Los Alamos and Sandia National Laboratory in Albuquerque. Santa Fe, in particular, is considered a very desirable city that attracts the rich and famous as well as many tourists. Access to other parts of the world is available using the airport in Santa Fe or the international airport in Albuquerque. Driving time between Santa Fe and Los Alamos is about 40 minutes, which is a commute taken by many people living in Santa Fe and working in Los Alamos. About 60 minutes are required to reach the airport in Albuquerque from Santa Fe.

An arrangement between the state and the national laboratories makes these facilities easily available to small businesses in NM, as would be the case with the SFLL organization. In addition, working professionals and highly qualified retirees from the national labs may become interested in working at SFLL.

2 STAGE 1. INITIATION AT THE LOS ALAMOS LOCATION

Stage 1 is designed to allow the infrastructure and work force of the final laboratory to be assembled at modest cost with maximum speed. The private laboratory owned by Dr. Claytor in Los Alamos will function as the Stage 1 location of the SFLL, the meeting site for operation of the organization, and as a site of active research. Initial research will be undertaken as described in Section 2.3. The research will include on-the-job training, testing of equipment as it is acquired, and planning for the next stage in the process.

The tasks that will be performed in Stage 1 are described below. Additional details on several aspects of the laboratory functions are provided in a separate volume, the Operations Plan.

Task 1-1. Establish Laboratory Legal Entity

A legal structure will be formed having the form of an LLC that would receive and disburse the funds to operate the laboratory. The legal entity and ownership are described in the Operations Plan. Decisions about the experimental path taken will be made by a team of advisers of no less than five, who will be chosen for their scientific competence, rationality, and integrity. Financial decisions will be made by a lab director as described in the Operations Plan. The choice of the director and advisors will be made in collaboration with the funding sources. The SFLL will work with other organizations and laboratories for the purpose of advancing understanding of the effect and development of the technology.

Task 1-2. Assemble Laboratory Staff

As the SFLL is developed, staff will be hired to conduct the research. Emphasis will be placed on full-time or part-time employees, but staff may also be engaged on a contract basis where necessary to meet research requirements. Initial positions that are expected to be filled during Stage 1 are shown below and are described in more detail in the Operations Plan:

- Research Director
- Senior Scientist
- Scientists (2)
- Technician
- Office Manager

Scientific consultants and business support personnel and organizations have also been identified in the Operations Plan for the SFLL operations, including the following:

- Scientific Consultants (2)
- Business Consultant
- Legal Representation
- Certified Public Accounting Firm
- Financial Consultant

Staff in these positions will continue as the SFLL transitions to its permanent location as Stage 2 is implemented. Additional staff will be brought into the lab up to an anticipated level of 15 research scientists at full strength.

Task 1-3. Conduct Stage 1 Selected Research

As noted above, the goal of SFLL research is to understand the basic conditions required for the nuclear reactions to occur and then apply this knowledge to increasing the rate of reaction and to achieve control of the process. Research conducted in Stage 1 will focus on critical aspects of these conditions.

At least five methods have been found to cause the nuclear process in a variety of materials when using any isotope of hydrogen. Identifying the combination of these methods and materials that results in the most effective production of nuclear energy has been a major goal and challenge of the LENR field. Use of the electrolytic method, when applied to deuterium and palladium, was first used to discover the effect and is the source of most understanding about the process. Nevertheless, this method has severe limitations that make a basic investigation difficult. Consequently, other methods will be explored.

Drs. Storms and Claytor have explored most of the known methods and have determined the best methods to study the basic process. These methods involve exposing activated material to hydrogen gas and using gas discharge to initiate the nuclear process. As is characteristic of all methods to initiate LENR, the process is very sensitive to the nature of the material and its treatment during preparation. In the case of direct exposure to hydrogen, the material can be either in the form of a powder or as a solid piece of material. The powdered form can produce greater power while the solid material is easier to study to determine the nature of the process. Gas discharge can be applied to both forms. Consequently, Stage 1 will focus primarily on exposing various materials to hydrogen gas and/or subjecting the material to gas discharge.

Use of these methods is guided by the theory developed by Dr. Storms as described in an earlier section. This theory proposes a material must first be activated by creating what is called a nuclear active environment (NAE). This environment is thought to be cracks having a very small width that are produced by stress relief in the material. The ability of the material to form such cracks while absorbing a significant concentration of hydrogen are major considerations. Alloys of Pd and Ni with other elements have been favorite materials used to initiate the process, which in both cases are found to generate cracks. While all isotopes of hydrogen can be involved in the fusion process, they may be expected to produce different fusion products, including helium and tritium.

Palladium is a favored material for study because it reacts easily with hydrogen and can acquire a high concentration of hydrogen. Nickel is less able to achieve a high hydrogen concentration. Nevertheless, both metals require complex modification and treatment for nuclear reactions to be initiated. Deuterium is favored because it produces significant energy and detectable helium. Ordinary hydrogen is easier to use and apparently produces radiation with greater energy than the reaction produced when deuterium is used. A mixture of H and D can apparently produce easily detected tritium as a nuclear product, which provides clear evidence for a nuclear process. All of the expected nuclear products will be sought and measured.

The magnitude of the nuclear reaction is not as important in Stage 1 as it will become subsequently because the goal is to understand the basic mechanism, not to solve engineering problems of how to increase the power. Only after the basic process is understood can engineering studies be undertaken to increase the rate, achieve control, and apply the process to commercialization. This approach is the opposite of the present efforts to commercialize the effect. Engineering studies will be undertaken in Stage 2 after basic understanding has been achieved.

The Stage 1 methods will focus on palladium expansion with uptake of hydrogen and formation of stress cracks. Because palladium expands by 13% when H_2 is added to form the beta phase at H/Pd = 0.7, this condition will be chosen in Stage 1 and used to cause cracks in deposits placed on the surface. The amount of hydrogen reacted can be controlled, thereby changing the amount of stress applied. The nature of the deposit can be varied, thereby changing the way cracks are formed in the deposit and their dimensions.

These variables have a complicated relationship that needs to be understood before the process can be controlled in a predictable way. The initial studies will focus on understanding this relationship as follows:

- A thin sheet of Pd metal or its alloys will be coated with thin layers of material expected to produce cracks.
- The sample will be exposed to H_2 while measuring any radiation that would be generated by a nuclear reaction.
- The surface will be examined using SEM and EDX to determine the conditions present and the effect of stress.
- Based on the examination, the surface conditions will be changed and the amount of reaction with H_2 will be modified to create a large number of cracks having the expected dimension.
- A thin sheet of Ni or its alloy, especially the Ni-Cu alloy, will be treated in the same manner as the Pd metal.

Once the expected radiation is detected, the conditions will be explored to maximize the reaction rate. After the method of activation used during currently recognized empirical methods [26, 27] is revealed, this method will be used and explored to make it more effective.

Many of the tools and methods that will be used in Stage 1 are available at Dr. Claytor's and Dr. Storms' existing laboratories. Photos of the laboratories are presented in Appendix C. The equipment required for Stage 1 is summarized below with their anticipated sources.

- System in which the material can be heated to 400° in vacuum or H_2 pressure (currently owned)
- Radiation detectors of various kinds, including GM, NaI, and Ge (currently owned)
- SEM with EDX for general survey (currently owned)
- High resolution SEM for special use (LANL, SNL, and University of Missouri)
- Thermal Emission Microscope (purchase)
- Sputtering (currently owned)
- Electroplating (currently owned)
- Plasma deposition (purchase)
- Vapor deposition (purchase)
- High resolution IR camera (University of Missouri)
- Surface X-ray diffraction (University of Missouri)

For gas discharge experiments specifically, the following equipment will be used:

- Four small vacuum chambers so experiments on materials can be run in parallel (have one, purchase 3)
- High voltage power supplies for above (currently own one, purchase 3)
- Inexpensive computers for data collection (currently owned)
- High voltage switch (have one, purchase and construct 3)
- In situ radiation detectors (purchase)
- Multilayer samples (purchase raw materials and fabricate)
- Small "calorimeter" for quick testing of samples (fabricate)
- Larger vacuum vessel for holram heat containment (purchase fabricate)

Task 1-4. Prepare for Stage 2

Preparation for Stage 2 implementation of the SFLL will be accomplished as Stage 1 is completed. Stage 2 research will be planned based on the results obtained in Stage 1.

Configuration of the Stage 2 laboratory will be finalized, and the experimental equipment and supplies will be determined. Stage 1 staffing will be completed, and the training required for Stage 2 will be conducted. The Operations Plan will be updated as required based on the Stage 1 operating experience.

3 STAGE 2. IMPLEMENTATION AT THE SANTA FE LOCATION

Stage 2 planning and activities will be initiated in the latter part of Stage 1, with many of the details established in the Operations Plan. Many of the tasks will be determined at that time, with the scope and type of activities being based on experience gained during Stage 1

Task 2-1. Arrange for Santa Fe Facility

A search will be made in Santa Fe for a suitable building for the final laboratory to occupy. It is anticipated that the lab will be set up in an existing building. A floor plan will be prepared to accommodate anticipated equipment, office space, conference room, and other required facilities. A build-out plan will be prepared to reconfigure the pre-existing setup as necessary, and a general contractor will be engaged to supervise the build-out using subcontractors and vendors as needed.

Task 2-2. Secure Necessary Equipment

Stage 2 research will be finalized, and a list of required experimental and related equipment for each research project will be developed. The equipment will be obtained and installed in the reconfigured lab space during the final stages of construction. It is anticipated that a substantial portion of the required equipment will be available from the Stage 1 laboratory in Los Alamos.

Task 2-3. Conduct LENR Research Program

After the equipment is installed and the move-in is completed, research will be started immediately. A period of transition is anticipated from the Stage 1 Los Alamos laboratory to the Santa Fe lab, depending on staff and individual project needs. Staff hired (and professional contractors engaged) during Stage 1 will make the transfer, and staff identified for Stage 2 will be brought on board. Many of the ongoing research projects will continue, and plans for additional projects will be prepared as needed. Once basic LENR understanding is achieved, procedures will be developed and applied to create a potential commercial source of energy. Full development of this energy source will not be done at the SFLL but would be licensed to a suitable company. Alternatively, a new company may be created to bring the device to market.

Task 2-4. Make National Laboratory Arrangements and Establish University Relationship

Existing connections of Drs. Storms and Claytor with LANL and SNL personnel will be contacted to use equipment available at these laboratories as described in the Operations Plan. Funded programs of research undertaken at these national laboratories will also be created where possible. These opportunities may be enhanced by existing contacts of Storms and Claytor, both of whom are previous employees of LANL.

Also as described in the Operations Plan, a scholarship will be created at universities such as the University of New Mexico to support students interested in studying LENR. This relationship may also include a regular lecture series to educate the students, staff, and community about LENR.

Task 2-5. Collaborate with Other Labs and Researchers

The SFLL will collaborate with other laboratories that are willing to share information and access to equipment for the purpose of advancing understanding of the effect and development of the technology. The SFLL will take advantage of the connections at Los Alamos National Laboratory (LANL) and Sandia National Laboratory (SNL) (Albuquerque, NM, USA) provided by being a small business in New Mexico. In addition, small laboratories such as Coolesence in Boulder, the laboratory created by P.J. King in Los Angeles, and the LENR laboratory at the University of Missouri (Sidney Kimmel Institute for Nuclear Renaissance, SKINR) will also be included in the extended collaboration. Other laboratories in the US will be considered when they offer benefits to SFLL.

4 SCHEDULE

Stage I activities will begin within 30 days of receipt of funding award and will continue for approximately one year. When Stage 1 is well underway, detailed planning will be initiated for Stage 2. Full implementation of SFLL will occur after funds have been committed in annual increments. It is estimated that the transition from Stage 1 will last approximately three months. Stage 2 will continue for a minimum of five years. At the end of this time, the success of the effort will be reevaluated and agreed upon changes in the approach will be made.

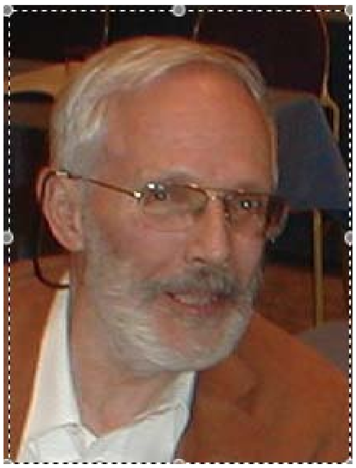
5 FUNDING STRATEGY

As set forth in the Operations Plan, initial funding for Santa Fe laboratory will be for a minimum 6-year period, 1 year for Stage 1 and 5 years for Stage 2. The level of required funding will depend on the number of projects and experiments that are conducted. The number of and intensity of each effort will depend on the amount of funding available. A minimum of $250,000 is required for setup during the first few months in Stage 1, with an amount of $2,000,000 being the ideal and most effective level of initial funding for the first year. Stage 2 funding will be require a minimum of $5,000,000 per year that is committed each year for two years and $10,000,000 per year committed for 3 years. This investment is expected to be returned at the end of 5 years, with additional return being provided during subsequent years as the LENR technology is developed. Additional funding may be needed to create companies for the purpose of engineering development and the manufacture of operating generators.

APPENDIX A. Resumes of Key Personnel

The following provides descriptions of the accomplishments for the principals who will initially guide scientific planning and research at SFLL.

Edmund Storms, Ph.D.



M.S. and Ph.D. in Radiochemistry from Washington University in St. Louis, MO. (1954 and 1955).

Dr. Storms worked at LANL from 1955 to 1991, and then for a few years following retirement as a consultant. During this time his research focused on materials used for nuclear power production and nuclear propulsion in space. Because these applications required very high temperatures, the applied field of study is called high temperature chemistry. Sabbaticals from the laboratory allowed him to teach this subject at UCLA (1967), the University of Washington in Seattle, WA (1965), and the University of Vienna, Austria, (1984). This work was published in many papers and lectures listed in Appendix B, including a book “The Refractory Carbides” that is still being used. Before retiring from LANL, he successfully explored LENR demonstrating first the production of tritium and then production of heat.

Thomas Claytor, Ph.D.

M.S. and Ph.D., Solid State Physics, Purdue University (1976, 1972)

Dr. Claytor recently retired from LANL as a staff member and team leader in the area of advanced instrumentation for materials evaluation. Prior to joining LANL, he was a staff member at the Argonne National Laboratory for 10 years in the Materials Science and Technology Division, where he was active in the development of various types of instrumentation for nuclear power. In his capacities at both Laboratories, he mentored over 34 undergraduate and graduate students and sponsored Ph.D. research at Johns Hopkins University, Brigham Young University, and Utah State University. He taught at the Los Alamos Summer School Institutes for several years. He has served on DOE review panels for the nondestructive evaluation (NDE) centers at Ames, Iowa. and Johns Hopkins.

While at Los Alamos he was responsible for development an instrument that is used to verify the integrity of every nuclear trigger in the stockpile. He is also the inventor of an instrument used to ensure the safe disassembly of all Los Alamos produced nuclear weapons. He has been the primary investigator on two LDRDs (Laboratory Directed Research and Development awards) and a collaborator on several others. His research has been highlighted in two laboratory director seminars. In his capacity as team leader, he organized a successful demonstration of a-Si spallation neutron detector, which led to a technology transfer

(Cooperative Research and Development, CRADA) to a company (Hytec) in Los Alamos that was subsequently sold to 3M Corporation.

Since 1989 Dr. Claytor has been pursuing LENR research funded primarily from LANL discretionary funds because of the potential for tritium production. In 1989 he was one of the first researchers to realize that LENR could be triggered outside an electrochemical cell. Since then, his main focus in this area has been gas loaded, nano materials excited under non equilibrium by plasma or electrostimulation. He has collaborated with Steve Jones at Brigham Young University, Naval Research Laboratory, SRI International, and others to improve tritium and neutron detection from solid state gas-loaded cells.. He has received a number of awards, including two R&D 100 awards, a DOE defense programs award of excellence, and two LANL distinguished performance awards. He has over 67 first author reports or publications, and has four patents and two disclosure cases pending.

Thomas W. Grimshaw, Ph.D.

Masters in Public Policy, LBJ School of Public Affairs (2008)
M.A., and Ph.D., Geology, The University of Texas at Austin (1970, 1976)

Dr. Grimshaw is a highly experienced professional with a broad background. He is now focusing on energy policy, with emphasis on emerging technologies, such as LENR (aka cold fusion). He has a solid technical and management performance record in both academic and private sector settings. He has held a large variety of positions, including energy policy analysis and development, senior technical consultation, program development and management, academic course instruction, and energy and environmental research programs. Throughout his career, Dr. Grimshaw has balanced his career among technical contributions, project management, and organization development.

As a Research Fellow at the Energy Institute at the University of Texas, Dr. Grimshaw is implementing his career shift from environmental services to energy policy development by serving as co-principal investigator for projects on emerging and unconventional hydrocarbon-based energy sources. His current focus is on dealing with policy and regulatory issues of shale gas and shale oil development.

In his position of Visiting Researcher at the Center for International Energy and Environmental Policy at the University of Texas, Dr. Grimshaw is working on development of rational public policy toward cold fusion. The initiative addresses both policy toward public support for cold fusion development in the public interest and addressing secondary impacts. To address the potential need for policy development for such unintended consequences, technology assessment is being evaluated as an appropriate method for mitigating the impacts.

Dr. Grimshaw became a member of the Adjunct Faculty at the LBJ School of Public Affairs after completing the M.P.Aff degree (Mid-Career Option). He served as co-instructor on two Policy Research Projects, both of which included LENR as a potential energy source: a) “Shaping the Energy Technology Transition”, which addressed policy issues related to alternative energy technologies and movement to a low-carbon, renewable-energy based energy economy; and b) “Building the Bridge to an Energy Secure Future”, which used five criteria (technology, economics, regulations, environment, and politics) to evaluate established and emerging energy technologies within a framework of energy security. He was also instructor for a course on Environmental Policymaking, which covered both US and international framework for policy development and implementation.

Before shifting to energy policy, Dr. Grimshaw had a lengthy career in managing projects for environmental protection and cleanup. He worked primarily as a technical consultant, providing professional services while employed at several of the foremost environmental companies in the U.S. Much of his environmental work was for energy-related facilities, including oilfield waste sites, coal mines, petroleum refineries, coal-fired power plants, and synthetic fuels (coal gasification and liquefaction) plants. He managed environmental compliance, site cleanup, and related projects for many clients and at a variety of sites such as municipal infrastructure projects, commercial facilities, and government installations.

As Associate Director for Environmental Programs at Bureau of Economic Geology, Dr. Grimshaw was responsible for program development for environmental component of the second largest research unit at the University of Texas. He successfully developed programs with many federal and state agencies in support of their regulatory and research missions in Texasee. He also accomplished international initiatives for Environmental Programs in Belize, Venezuela and on the border with Mexico. And he conducted Washington, D.C.-based and in-country sales program, including the World Bank and the Inter-American Development Bank.

APPENDIX B. Publication Lists

Ed Storms has arguably published more papers and other works in the LENR field than any other investigator, as well as many papers about a variety of subjects before he studied LENR. Tom Claytor has also published extensively on LENR research, but mostly in the classified literature. Tom Grimshaw has prepared papers and reports on public policy and several other types of LENR investigations. Publication lists are shown below.

Edmund Storms, Ph.D.

Shown below are Dr. Storms' publications in two categories: LENR and non-LENR studies.

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APPENDIX C. Claytor and Storms Laboratory Photos

Dr. Thomas Claytor Laboratory

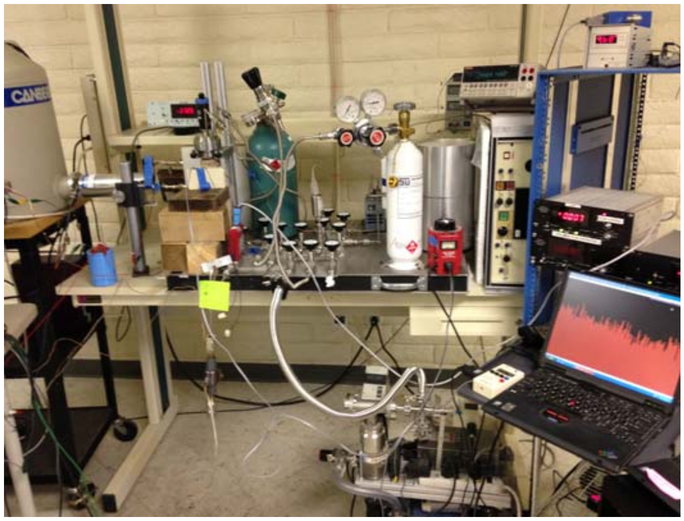

Figure C-1. Experiment Table and Data Acquisition Instruments

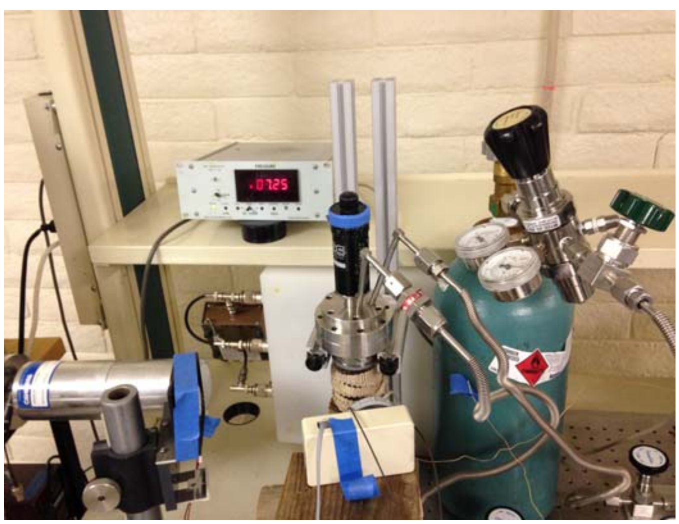

Figure C-2. Test Cell Closeup

Figure C-3 Claytor Lab – Shop Area

Figure C-2. Outside View of Claytor Lab, White Rock, NM

Dr. Edmund Storms Laboratory

Figure S-1. Experimental Cell and Data Acquisition Instruments

Figure S-2. Storms Lab – Assembly Area

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