Lynntech, Inc.
A Technology Development and Commercialization Company

Presented By:
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SBIR Informational Workshop

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Overview/Profile of Lynntech, Inc.

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Profile of Lynntech, Inc.

- **Status:** Privately owned Texas corporation incorporated in 1987

- **Purpose:** To develop new technologies and to commercialize products and services derived from developed technologies

Lynntech, Inc., Product Development Division

Company Profile, continued

- **Technology Development Funded By:** The Federal Government and industrial corporations

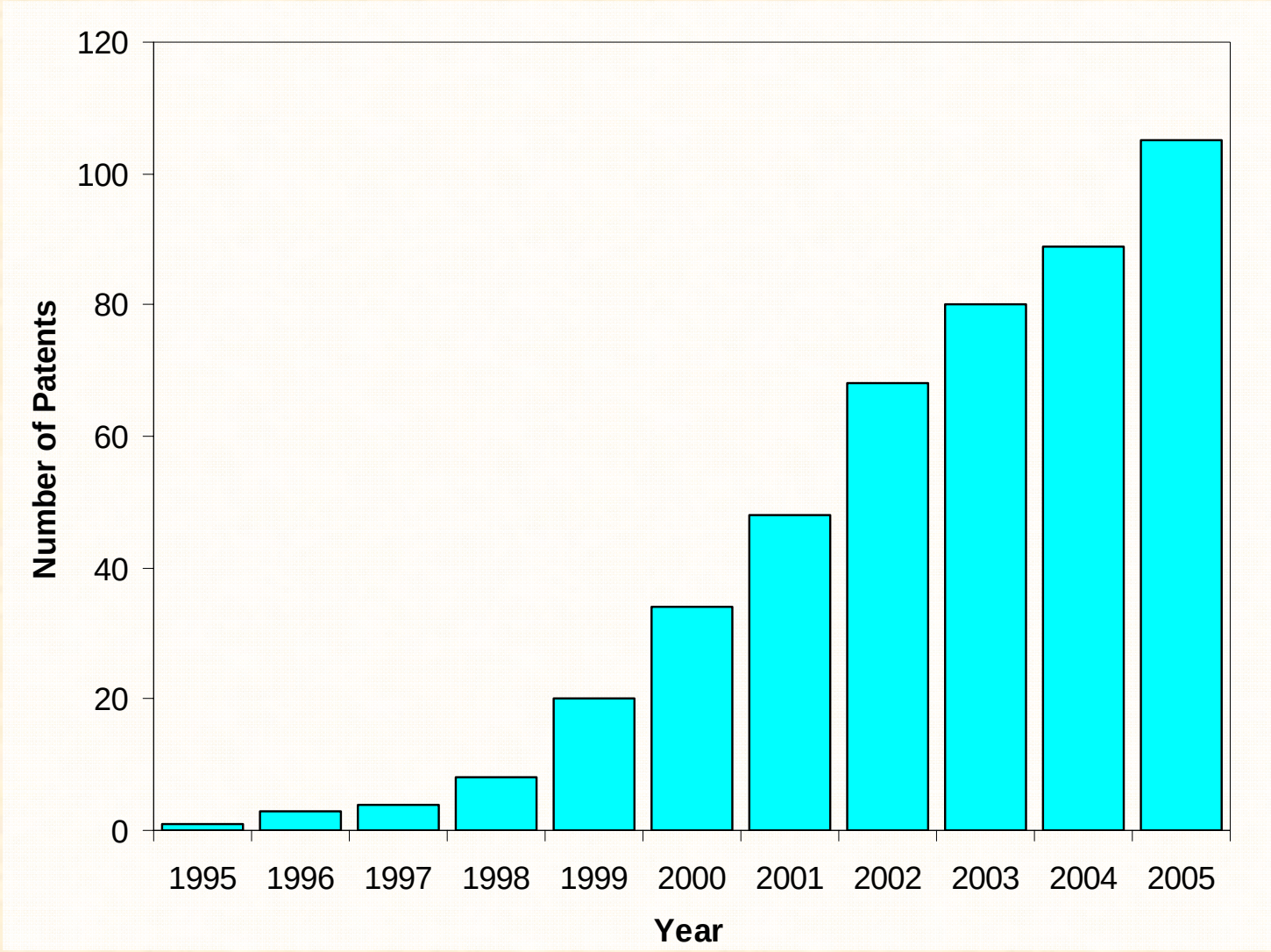
- **Funding Received From:**

- **Commercialization Plan:** Licensing, spin-offs, joint ventures, and manufacturing/sales

Lynntech's Capabilities for Technology Development

- Approximately 130 employees (104 FT & 26 PT) (30 Ph.D.'s)
- Staffed with scientists, engineers, and machinists
- Company is sub-divided into three functional divisions:
  - Technology Development (core technology areas)
  - Product Development (pre-production prototypes)
  - Machining and fabrication center (machined components with high tolerances)
- In-House development activities are combined with outside support (subcontractors, consultants)

Total Cumulative U.S. Patents



Technology Commercialization at Lynntech

- Technology Transfer Through People™/Technology Commercialization Through People™
  - Key principles on which technology commercialization is based on at Lynntech, Inc.
- Multiple SBIR Phase Is and Phase IIs
  - Clusters of SBIRs around a specific core technology (fuel cells, disinfection/ sterilization, radiopharmaceuticals, etc.)
- Demonstrate company staying power
  - Large companies including prime contractors need to be assured that you are going to be in business in the future if they interact with you
  - Facilitates the establishment of a technical team with extensive capabilities within the company

Technology Commercialization at Lynntech, continued

- Build a strong technical team around the technology to be commercialized
  - Identify potential Chief Technology Officer and other key technical staff within the company's technical team for a potential spin off company
- Secure intellectual property position
  - Establish a patent portfolio (U.S. and foreign patents) around the technology to be commercialized
- Establish personal and industry relationships at relevant trade shows, technical conferences, and industry exhibitions
  - Seek out potential licensing opportunities
  - Identify potential CEOs for spin offs
  - Develop relationships with "opinion makers"

Technology Commercialization at Lynntech, continued

- Initiate product assembly and marketing and sales efforts (if possible)
  - Convince yourself first that you truly have a product
  - Validates markets and customers for venture capitalists (where and who are your first customers?)
  - Provides a base for revenue generation for spin off company
- Investigate possible sources of seed funding for a spin off company
  - Angel investors
  - Venture capital groups that concentrate on seed funding
- Recruit a CEO for spin off company
  - Key hire for success of a new venture (experience from relevant industry area – “been there and done that”)
  - Develop business plan for new venture
  - Build management team and close Series A round of financing

Technology Commercialization at Lynntech, continued

- Ownership position in spin off company
  - A three-way negotiation between parent company, spin off company, and lead investor in venture capital syndicate
  - A two-way negotiation between parent company and spin off company prior to receiving venture capital funding
    - Viewed more favorably by venture capitalists since there is one less party involved in negotiations
    - Minimizes risk to new management team that a venture capital deal may not be completed due to the “greediness” of the parent company’s management
    - Reduces the parent company’s legal and auditing costs at closing of funding for spin off
- Establish a business arrangement between spin off (new management team) and parent company
  - R&D arm for spin off
  - Spin off has exclusive rights to improvements in technology developed at parent company for up to five years
  - Viewed very favorably by venture capitalists in seed and Series A rounds

Examples of Lynntech's Technologies in Applications Today

- Fuel cell test systems
- Fuel cell/battery hybrid power sources for portable electronic devices
- Electrochemical ozone generation technology for use in certain consumer and commercial products
- Ozone gas-related sterilization technology for medical, dental, and veterinary instruments

Lynntech Industries, Ltd.

A 2001 Spin-Off from Lynntech, Inc.

- Manufacturer and seller of fuel cell test equipment worldwide
- Achieved $1.5 million in product revenues in 2003
- $5.5 million in Series A equity financing secured in May 2004
- Lynntech Industries renamed Fideris, Inc. in September 2004

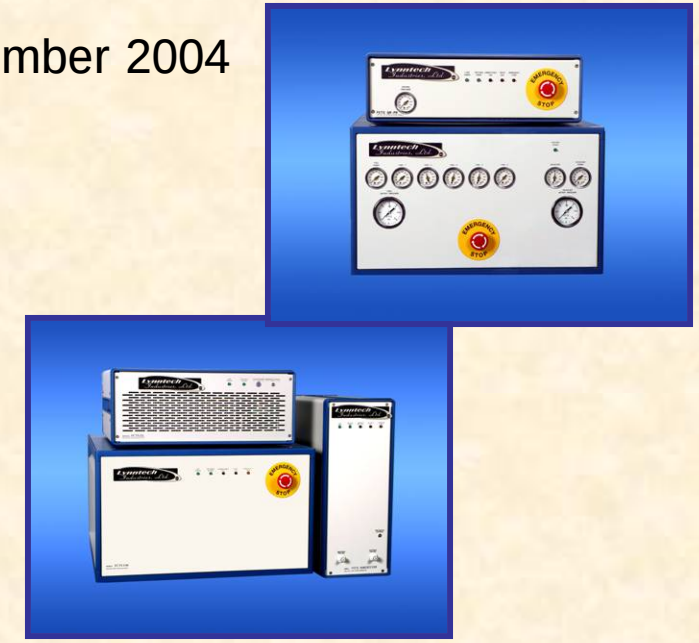
Venture Capital Syndicate

Chrysalix Energy Limited Partnership

YELLOWSTONE

Altira Venture funding for energy technology

BRAEMAR ENERGY VENTURES



Components of Fuel Cell Test Equipment

LYNNTECH, Inc.

HyEnergy Systems, Inc.

A 2004 Spin-Off from Lynntech, Inc.

- Developer of micro fuel cell power sources
- $633,000 in seed funding secured in 2005

STARTech EARLY VENTURES

STARTech is a business accelerator that provides guidance, nurturing and financial support to entrepreneurs who have a technology driven idea and a passion to succeed.

20 W Average (40 W Peak) Fuel Cell/Battery Hybrid Power Supply

LYNNTECH, Inc.

Home Disinfection

In 2000, WaterPik Technologies, Inc., licensed electrochemical ozone generation technology from Lynntech for use in certain consumer and commercial products. Waterpik launched the AQUIA™, a household disinfection product that was awarded the *2001 Best of Show Award - New Products* at the National Hardware Show.

waterpik Technologies, Inc.

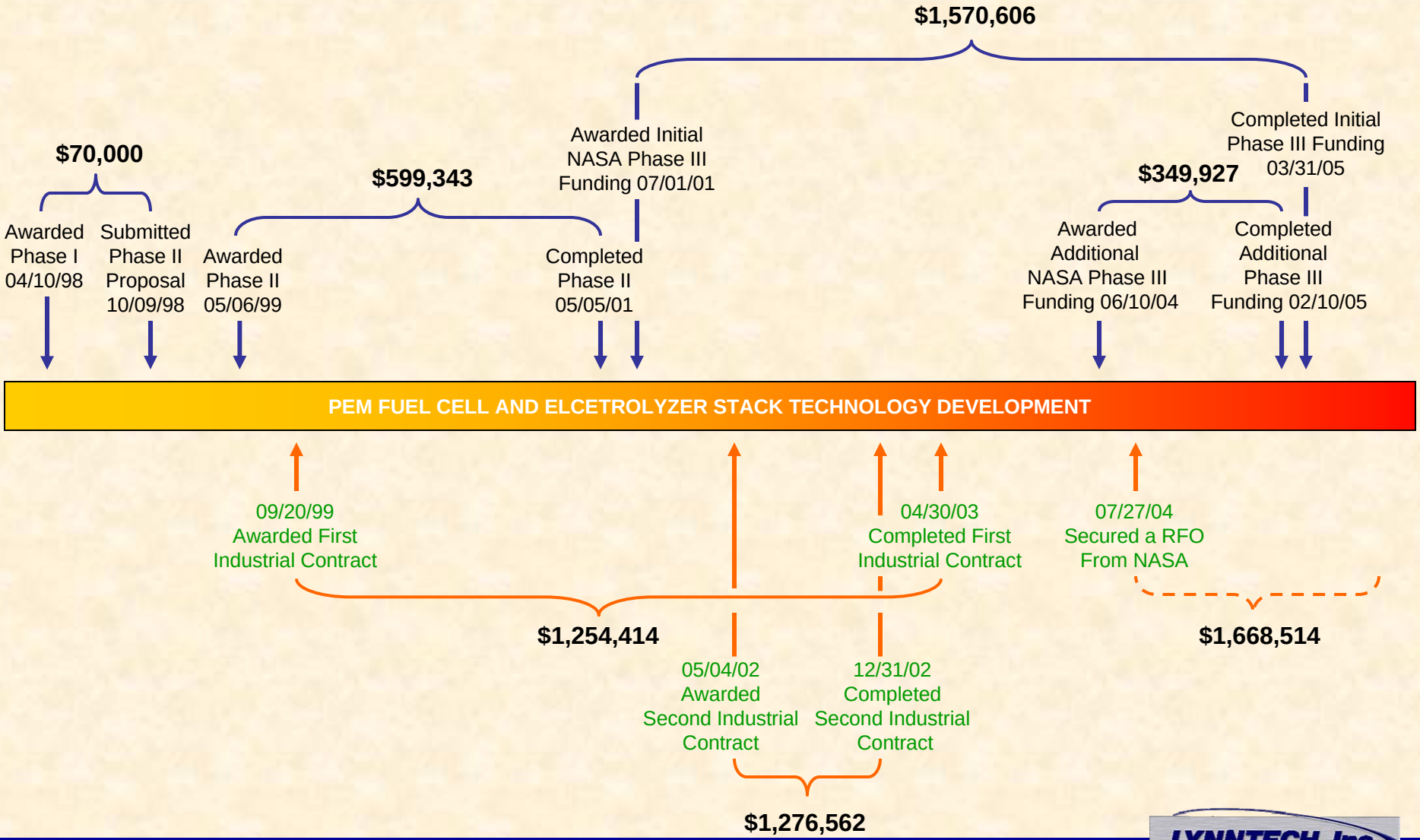
LYNNTECH, Inc.

Infection Control

In 2002, TSO_3 Inc., licensed ozone gas-related sterilization technology from Lynntech. The 125 L - Ozone Sterilizer developed by TSO_3 Inc., is marketed to hospital sterilization centers. This device was approved for marketing by Health Canada in May 2002 and received FDA approval in September 2003. The sterilizer is sold in the US through Skytron.

NASA SBIR Project Timeline:

Phase I through Phase III



LYNNTECH, Inc.

How To Write A Competitive Proposal

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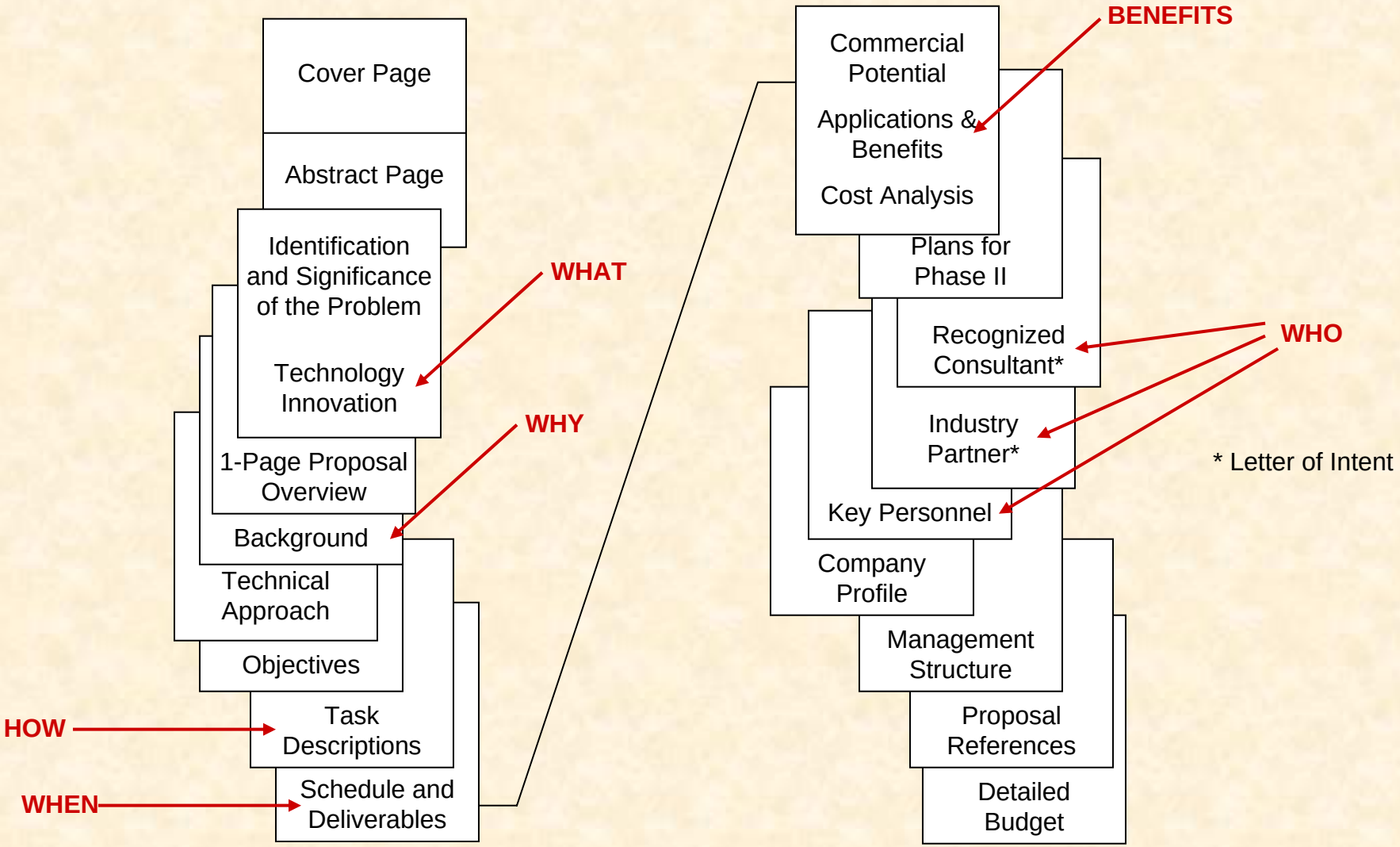
Key Elements Of An SBIR Proposal



LYNNTECH, Inc.

ABSTRACT

Plastic media blast (PMB) is rapidly growing as a coating removal method because it does not damage composite or soft metal surfaces when compared with the effects of chemical stripping solvents or hard abrasives (i.e., sand), however the conventional PMB materials are all highly resistant to biodegradation. A commercially available, biodegradable plastic known as PHBV and manufactured by Imperial Chemical Industries, is proposed as a biodegradable plastic media blast (BPMB). This new class of biodegradable polymers has several unique features which make it an ideal candidate as a BPMB: (1) microorganisms rapidly biodegrade it to CO_2 and water, (2) it is not affected by water or humidity like starch-blast media, (3) like conventional thermoplastics, it can be melted, molded or extruded, and (4) different hardness characteristics can be engineered into the polymer formulations. Lynntech, Inc. has outlined a comprehensive Phase I project for conversion of raw PHBV into 20-30 mesh abrasive, testing and evaluation of coating removal characteristics using established procedures for PMB application, documenting biodegradation features, and performing a cost analysis for transitioning this new material to commercial production and application.

IDENTIFY the Problem

SOLUTION to Problem

WHY Solution Will Work

PLAN to Demonstrate Solution

BENEFITS

Identification and Significance of the Problem

- Revisit the problem
- Introduce basis for the innovation (solution)
- Explain how solution logically merges with the problem
- Introduce an overview of the Technical Objectives
  - List specific “global” points
- Discriminators
  - Boldface one or two thoughts you really want to impress upon the reviewer
- Do all of this on the first page

BACKGROUND

In the post September 11th environment, homeland defense and overseas tactical operations require a new generation of surveillance platforms. Current technologies do not satisfy all the requirements of today's security needs. Ground based radar systems are only capable of detecting targets above their horizon line. Targets hiding behind structures or in valleys and ravines can not be detected. Satellite imagery provides a comprehensive view of targets, however, due to the rotation of the earth, these views only last several minutes. Current UAVs can patrol unlimited locations, but are limited in duration of flight to a matter of hours or days.

HAAs provide a geostationary, reconfigurable, re-taskable surveillance platform that can stay aloft over a target for up to a year or more. These HAAs can be equipped with optical, radar, and other intelligence surveillance equipment capable of surveying a 700 mile diameter area. An HAA can be deployed in the theater (Figure 2) to detect boost-phase weapons and cruise missile attacks, as well as to monitor troop movements for coordination with command. The Department of Homeland Security will also benefit from HAA deployment. A net of HAAs can be positioned to watch the borders of the US. They can be used to perform border patrol tasks such as detecting drug smuggling operations and terrorist incursions.

Figure 1. Illustration of how HAAs can be utilized for battlefield and homeland defense operations. Illustration reproduced from MDA FY03 ACTD.[1]

Lynntech's Advantage

Flightweight fuel cell and electrolyzer stack technology – low cost, lightweight, and previously demonstrated.

Experience – Intellectual property and expertise in high-altitude, long-endurance aircraft energy storage systems, and closely tied development efforts with component manufacturers and end users.

Factors Affecting HAA Energy Storage System

Specific Power (W/kg) – Increased specific power storage leads to lower airship weight and size.

Complexity – Must be autonomous and reliable.

Robustness– Must operate safely and reliably over wide conditions, indefinitely.

Energy Storage

The key to success for developing HAAs that can stay aloft for years at a time is energy storage and energy conversion. For short mission times, those of 36 hours or less, conventional power systems based on the consumption of fuel carried aloft at take-off in ordinary turbine engine or reciprocating engine powered aircraft are adequate, with better fuel efficiency.

2. IDENTIFICATION & SIGNIFICANCE OF THE INNOVATION

Due to the ever-increasing power demands of emerging mission packages, NASA's Earth science observation platforms, Figure 1, have an urgent need for more advanced energy storage and delivery systems. Secondary batteries are the current benchmark for lightweight, high-energy power sources. The primary drawback to using secondary batteries is that doubling the stored energy necessitates doubling the weight of the system. Developing systems in which the electrical functions are separated from the storage functions can alleviate this predicament. Fuel cells are the most efficient means of converting the potential energy stored in a fuel to electrical energy; however, current fuel cell designs fall short of the specific energy density requirements. High temperature proton exchange membrane fuel cells (PEMFCs) offer markedly superior performance, but necessitate external humidification functions. Because water is formed at the anode of an AFC and at the cathode of the PEMFC, an electrochemically synergistic water balance is available to be exploited. ***Lynntech, Inc.'s proton exchange membrane / alkaline fuel cell (PEM/AFC) tandem stack design harnesses the electrochemical synergy between the PEMFC and the AFC by recycling the product water directly back into the reagent streams to permit a high temperature self-humidifying fuel cell stack.***

Figure 1. Illustration of NASA's Earth-observing satellites.

Lynntech Inc.'s regenerative fuel cell/electrolyzer (RFC) technology is capable of superior energy density. NASA and the aerospace industry have already recognized Lynntech's fuel cells and electrolyzers for their high power density and specific power. The development of a high energy density fuel cell and the reduction of the balance-of-plant components will provide significant benefits to the overall energy density of the regenerative energy storage system. Lynntech's novel proton exchange membrane / alkaline fuel cell (PEM/AFC) tandem stack design integrated into the existing regenerative system technology is capable of bringing the necessary leaps in energy density to fruition.

Lynntech will develop a proton exchange membrane / alkaline fuel cell (PEM/AFC) tandem stack that operates on hydrogen and oxygen. This stack will foster an electrochemical synergy between the proton exchange membrane fuel cell and the alkaline fuel cell that allows for self-humidification and concurrent high temperature operation. The system will not only benefit from significant increases in fuel cell performance but also marked reductions in the weight of the peripheral components to present, first, a fuel cell of an energy density exceeding 1500 W/kg, and then the subsequent development of a regenerative system with an energy density exceeding 600 Wh/kg.

IDENTIFICATION AND SIGNIFICANCE OF THE PROBLEM

With terrorist attacks possible within the United States, such as those that occurred on September 11th, there is an urgent need for continuous surveillance of the US border. High altitude airships (HAAs) will have the ability to loiter above stationary targets at altitudes over 70,000 feet, well above the jet stream and out of range of enemy defenses (Figure 1). For HAAs to remain aloft for up to a year at a time, they must have sufficiently sized energy storage systems requiring no refueling. The most promising energy conversion and storage system for HAAs is the combination of photovoltaic (PV) arrays with a regenerative fuel cell energy storage system. This system uses the PV arrays during the day to power the airship and electronics, while utilizing excess power to split water with an electrolyzer, generating hydrogen and oxygen at high pressures. At night, the stored hydrogen and oxygen are fed to a fuel cell where they are converted to electricity, allowing the HAA to continue operation.

Figure 1. Image of the High Altitude Airship.

The electrolyzer has a significant effect on the specific energy (Wh/kg) of the overall system, affecting the size of the reactant storage based on its operating pressure, and affecting the size of PV arrays needed based on its operating efficiency. The conditions at which the electrolyzer operates, such as temperature and pressure, can also dramatically affect the electrolyzer's balance-of-plant mass and parasitic power requirements. Operating at high pressure reduces the amount of water vapor present in the gas phase, reducing and simplifying water knockout systems. The high pressure also allows for operation at high temperature due to the increased temperature for vaporization of water at elevated pressures. The higher temperature increases the efficiency of electrolysis process reducing the size of PV arrays needed. To take advantage of operating at higher temperature and pressure, development of both membrane electrode assemblies and lightweight electrolyzer stack components are needed that can operate at high temperature and pressure. Although there has been much research on high temperature PEM fuel cells, there has been little focus on high temperature PEM electrolysis, especially at high pressures and with lightweight hardware suitable for flight platforms.

Advantages of High Temperature Electrolysis

- Lower operating voltage at higher current leading to lighter weight and lower cost stacks.
- Significantly smaller, lighter, and cheaper thermal management systems.

Advantages of High Pressure Electrolysis

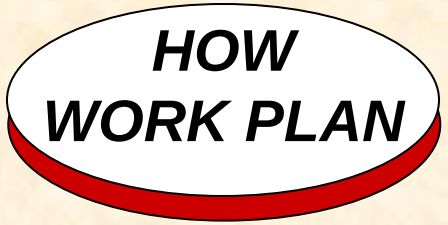
- Simplified removal of water from gas generated.
- Significantly reduced gas storage volume.
- Allows for high temperature operation while maintaining liquid feed.

For Phase I, Lynntech and the Connecticut Global Fuel Cell Center propose to demonstrate the feasibility of an electrolyzer capable of operating at high pressure (>1000 psig) and high temperature (>100 °C). The Connecticut Global Fuel Cell Center will contribute to the project by developing the high temperature membrane electrode assembly to be used in an electrolyzer. Lynntech will develop the flightweight electrolyzer component technology that will be capable of functioning at pressures up to 1000 psig and temperatures greater than 100 °C. Hamilton Sundstrand will contribute by performing a system-level analysis focusing on the affect of high temperature and high pressure on the system efficiency, weight, complexity, and reliability. Phase I will include a demonstration of electrolyzer operation at 1000 psig and a temperature greater than 100 °C leading to a full-size electrolyzer stack development effort in Phase II.

Background

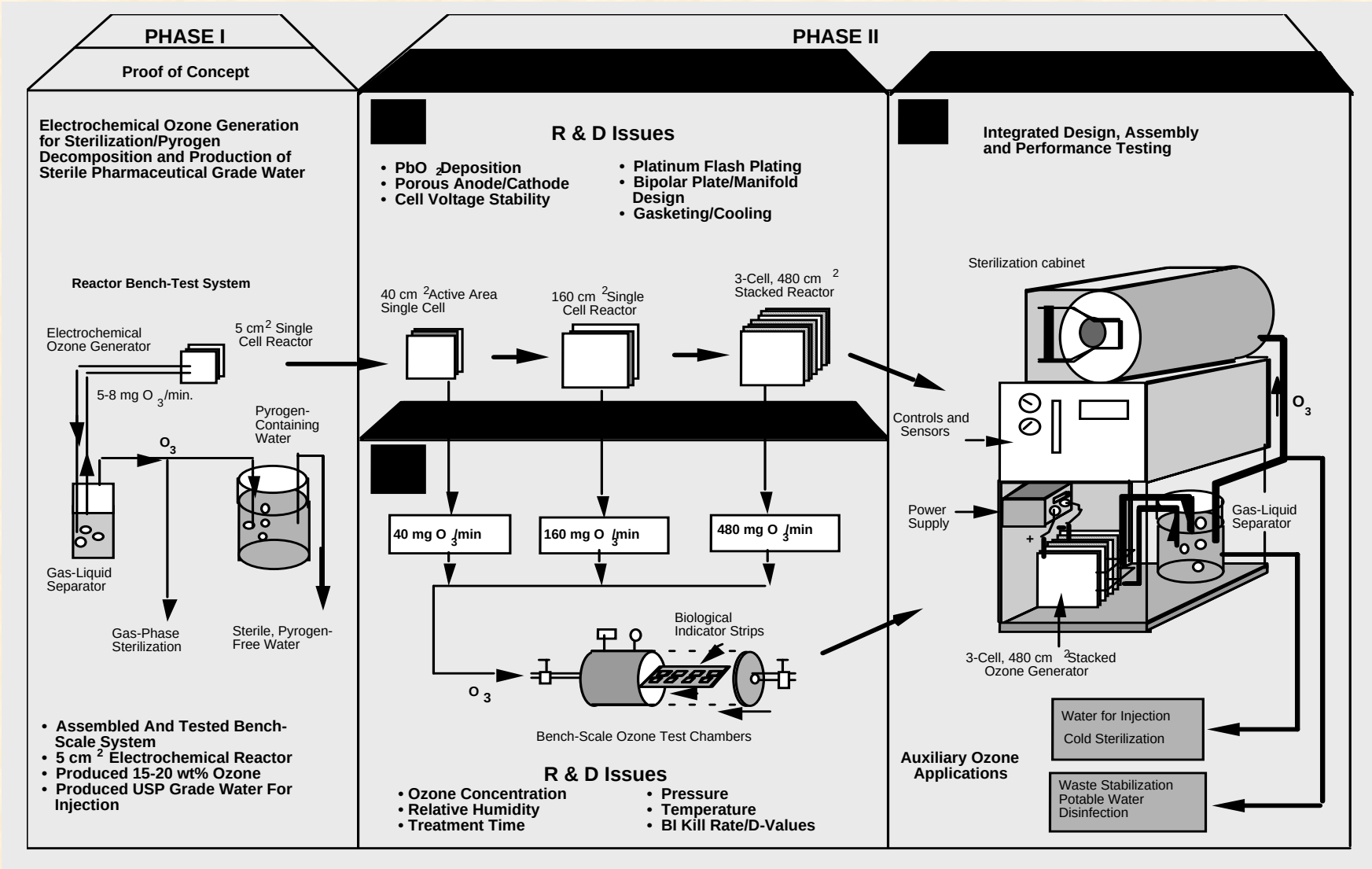
- Develop the framework for merging the innovation with the problem to provide the solution
- Explain the problem in detail
- Explain the innovation in detail
- Develop premise of why innovation will work
- Discriminators
  - How have you positioned yourself using preliminary work or data to start out “ahead” in this project?

Technical Approach



- Walk the reviewer through the project in general terms
- Drawing or diagram of the project components is extremely helpful
- What is stated in the work plan (tasks) will track with specific objectives

Scale-up, Biological Effects Testing, Design and Integration of an Electrochemical Ozone Generator-Sterilizer System



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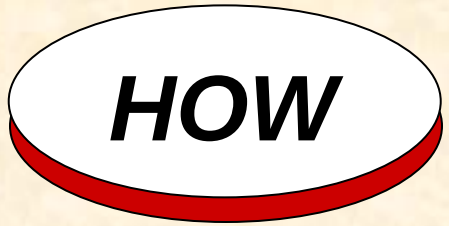
Technical Objectives ⇔ Tasks



- Identify tasks or steps needed to demonstrate the innovation and how it applies to problem solution

- Task Descriptions
  - Give the reviewer a guided tour of exactly (step by step) what you plan to do for accomplishing each task
  - Don't leave any room for assumptions by the reviewer
  - Use recognized procedures or standard methods where possible; this establishes credibility

- Be sure the work outlined answers the questions but is not impossible to accomplish

Technical Objectives

HOW 1A

- Select an available PHBV material with a hardness closest to that of conventional PMB Type V (Moh Hardness = 3.5) and process into abrasive grit (mesh size 20 - 30).
- Conduct evaluation testing (Air Force Mil Std for PMB) using a representative sample (200 lbs) to obtain parametric data on paint stripping characteristics and effectiveness, media reusability, and related information on the performance of this BPMB.
- Evaluate factors influencing the potential for: (1) material reclamation, (2) disposal of waste through conventional methods (i.e., landfill), and (3) use of biodegradation and/or bioremediation processes to prevent environmental impact.
- Prepare a cost analysis based on current market factors (i.e., source material production, processing into PMB, recyclability and disposal cost.)
- Preparation and delivery of a Final Report
- Option: Actual test demonstration (stripping process) negotiable.

Task Specifics

HOW 1B

Task 2. Testing of the selected PHBV media blast samples will be performed to obtain typical Mil Standard data for paint stripping agents.

- Aggressiveness - The ability of the media to remove paint coating. Comparative tests will be conducted using Type V PMB and PHBV. Standard Almen strip coupons will be used in these tests to evaluate stripping levels imparted to the substrates.

- Friability - The speed at which the media breaks down following impact will be measured using ASTM E-11 Specification sieves followed by determining mesh weights.

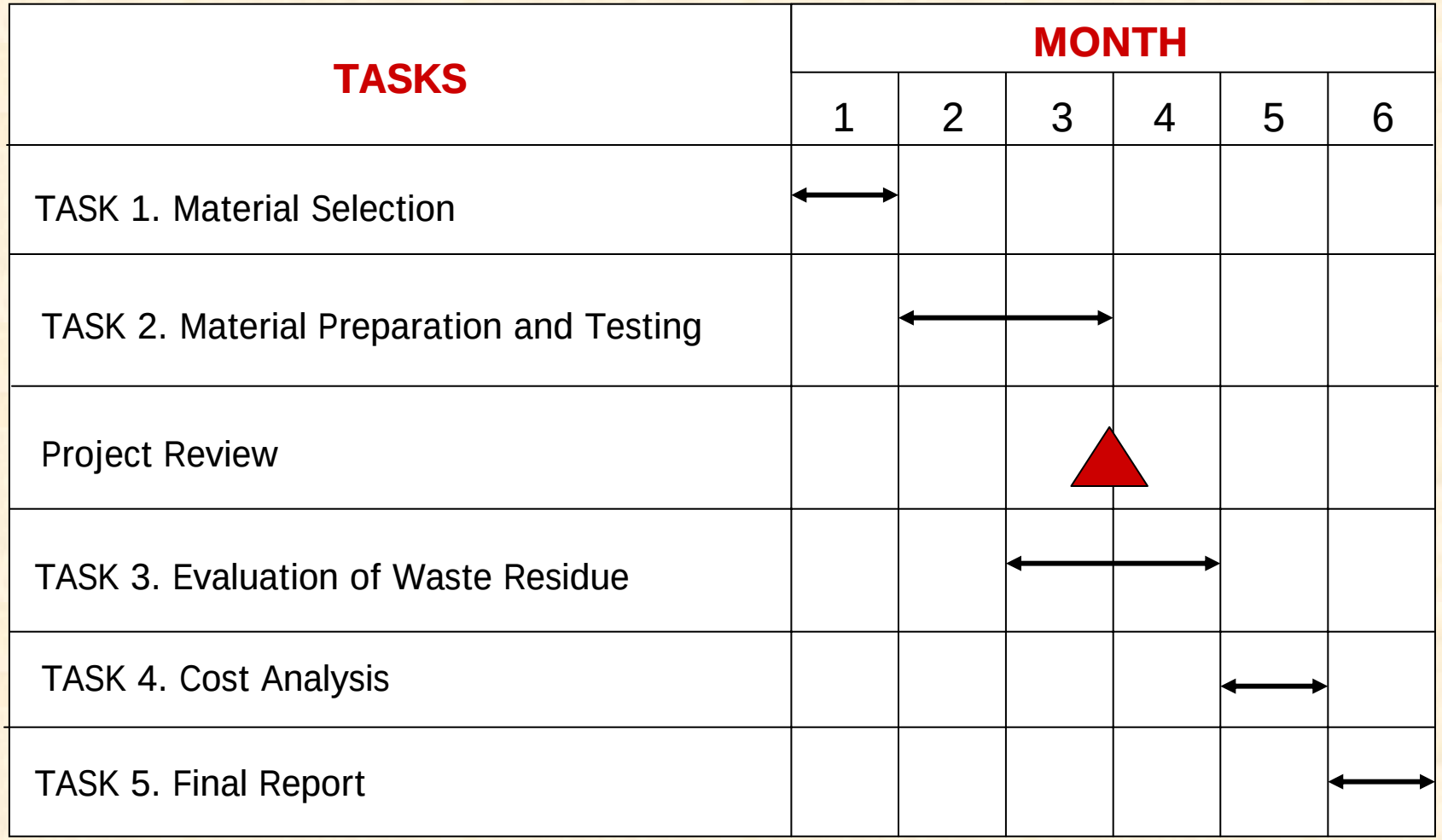
- Hazardous Waste Generation - A Toxic Characteristics Leaching Procedure (TCLP) test (Method 1311) will be conducted on all test samples to ensure that the biodegradable media does not pose an unknown health or environmental risk.

Schedule

OBJECTIVE: Demonstrate that thought and planning has been directed toward this project.

- Schedule is directly related to tasks
- Strive for quick startup
- Show a logical progression of events vs. time:
  - Be reasonable; build in time for Murphy's Law
- Discriminator: This is the key place where you set the reviewers mind that:
  - You have a logical, realistic plan
  - You can pull it off

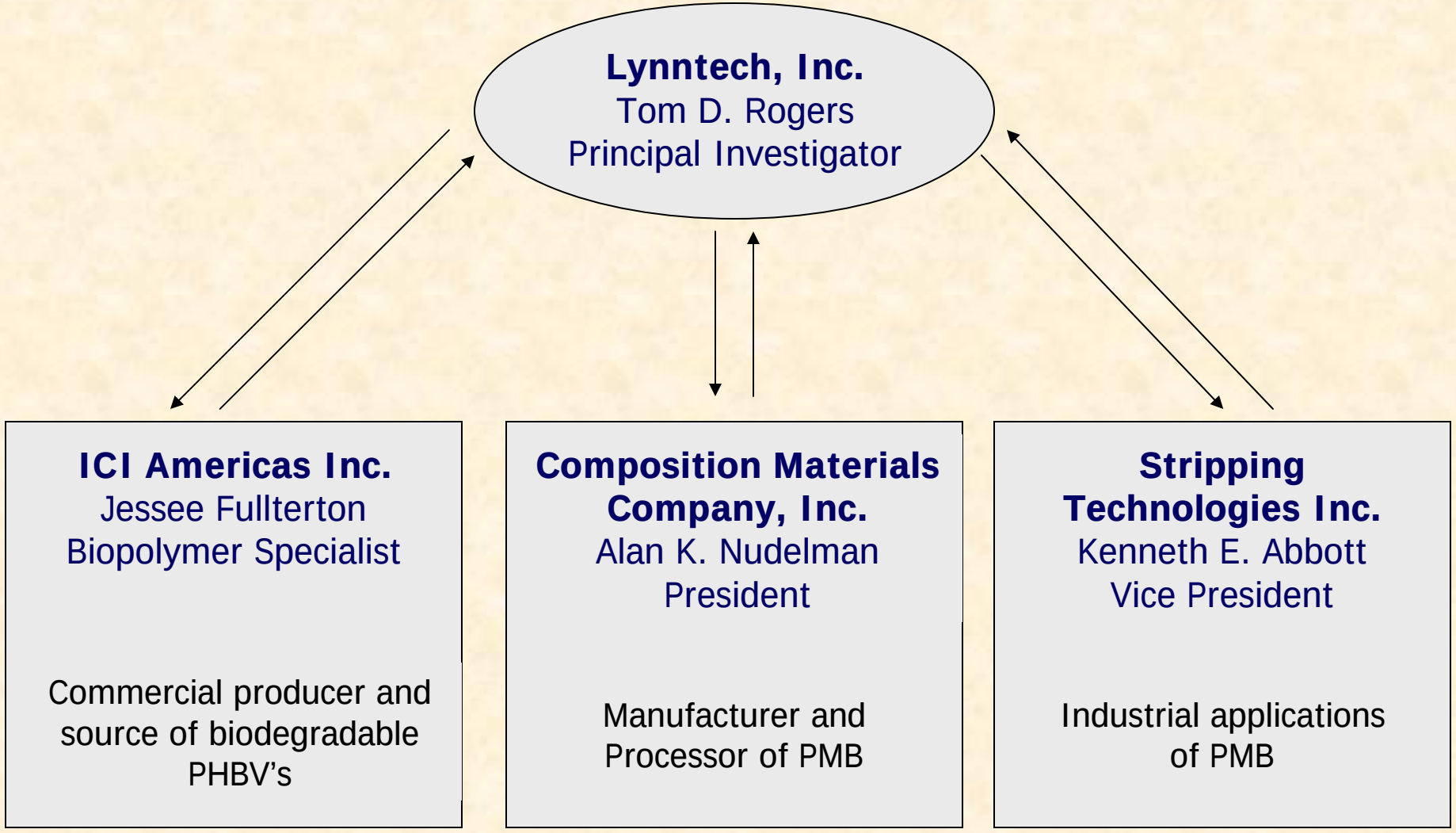
Phase I Project Schedule



Commercial Potential

- Who/What will benefit from the success of this work
- Develop either a general or specific pathway to commercial use
- Provide cost analysis data:
  - Have solid data for the conventional technology
  - Provide an estimate of how new process costs-out
- Introduce future plans
  - Give an outline of where you go after this project
  - Develop a plan of how you will interface with an industry partner

Interfaces With Commercial Business Partners



Key Personnel

Project Personnel Are A Key Ingredient To Success

- Convince the reviewer that you are the best qualified to carry out the project
- Involve one or more expert consultants in your project
- Identify and obtain support from an industrial partner
- Principal Investigator
  - You are responsible for the project
  - How and why you are qualified must be described
  - Provide related work experiences

Equipment/Instrumentation and Facilities

- Briefly describe all equipment and instrumentation that is available to support this project
- If analytical work or other tests are performed outside, tell who and where
- Describe facilities where project will be carried out
- Show how you fit in the management structure if necessary

Proposal Budget To Accomplish Research Plan Must Be Realistic

- One month of PI time on Phase I. Two months in Phase II
- Adequate man-hours of engineering and technical personnel
- Travel must be directly related to carrying out the project
- Must establish Engineering Overhead rate and G&A rate
- All direct cost items must be justified
- Must show ability to capture direct and indirect costs as they occur (time sheets and purchase orders)
- An accounting system appropriate for government contracts must be in place before a Phase II Award can be made
- Pre-award audits and post-award audits are likely to be made

BEST OF LUCK WITH

YOUR

SBIR PROPOSALS

LYNNTECH, Inc.