CERFLEX- North American Study
Phase I
August 2005

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I. STUDY SCOPE, GOALS and OBJECTIVES

1.0 This study is PHASE I of a three PHASE effort:

PHASE I Using primarily secondary research, gain a broad understanding of the North American market in order to prioritize ceramic applications and lighting market segments and potential producers for discussions of cooperation.

- Be able to decide if to proceed and where to focus

PHASE II Draft a three year Business Plan focused on the most attractive segments and a few key producers.

- Create the Business Plan in direct cooperation with the potential leading customers of CERFLEX
- Finalize MOUs (Memorandum of Understanding) with sufficient number of potential producers to meet the volume needed by the potential customers.
- Be able to understand the investment requirements, revenue potential and cash flow implications

PHASE III Partner with the potential customers to secure purchase agreements/contracts and make licensing agreements with potential producers

- May require one or more Pilots to attract customers

II. METHODOLOGY & INFORMATION SOURCES

2.0. Emphasis in PHASE I was on secondary sources, discussion with several ex-senior executives familiar with coatings producers or specific lighting applications.

2.0.1 Efforts were made to confirm published data and anecdotal information from Subject Matter Experts- but was not always possible

2.1.1 Key secondary sources were:

2.1.1.1 Marketresearch.com
2.1.1.2 CSM Worldwide, Inc.
2.1.1.3 Business Communications Company (BCC)
2.1.1.4 US Department of Agriculture (USDA)
2.1.1.5 National Agricultural Statistical Service (NASS)
2.1.1.6 Trade or research associations such as
- 2.1.1.6.1 International Dark Sky
- 2.1.1.6.2 Central Glass & Ceramic Research Institute
- 2.1.1.6.3 International Enamellers Institute
- 2.1.1.6.4 Porcelain Enamel Institute
- 2.1.1.6.5 Whiteware Research Center

2.1.1.7 Magazines and Journals
- 2.1.1.7.1 Greenhouse Growers
- 2.1.1.7.2 Hydro
- 2.1.1.7.3 Living-Learning
- 2.1.1.7.4 Journal of Thermal Spray technology
- 2.1.1.7.5 American Ceramic Society Journal
- 2.1.1.7.6 Materials Science & Engineering

2.1.2 Senior Executives included:

2.1.2.1 Mr. Charles “Chip” Brethen, ex Akzo Nobel No Am COO
2.1.2.2 Mr. Mike Zafirovski, ex-GE Lighting CEO
2.1.2.3 Mr. Rich Chylla, Strategic Business Dev., Johnson & Sons
2.1.2.4 Mr. Bill Pine, ex-Finance Director at Saturn Motors (GM)
2.1.2.5 Ms. Cheryl Chambers, Dir., Bus. Dev., American Environmetal Products
2.1.2.6 GE Lighting Executives:
- 2.1.2.6.1 Mr. Mike Petras, SVP
- 2.1.2.6.2 Mr. Jerry Wood- low pressure applications
- 2.1.2.6.3 Gerry Duffy- high pressure applications
- 2.1.2.6.4 Alan Chambers- Project Manager

III. KEY FINDINGS

3.0 Profits of US lighting producers/resellers is $3.0 billion annually (wholesale) and is dominated by GE, Philips and distant third is Siemens.

3.0.1 Several specialty companies are overall larger than Siemens, for example Guide (spin off from GM/Delphi) and Valeo (Sylvania brand) in automotive lighting

3.1 Each market segment evaluated to date is measured in Billions of dollars of revenue, but growth is generally slower then overall US GDP growth

3.1.1 Market Size or Annual Revenues, by Segment

3.1.1.1 Automotive Lighting Segment

3.1.1.1.1 To OEMs ($750 million annually) has been growing better than 5% since regulations required CHMSL (Center High Mounted Stop Lights)

3.1.1.1.2 The aftermarket (8-10x the size of the OEM market) growth is slowing to <2% annual growth as recent product advances reduces headlight replacement demand

3.1.1.2 Greenhouse Segment

3.1.1.2.1 Limited data and difficult to estimate

3.1.1.2.2 Growth has risen above 2% annually due to the large and increasing number of small entrepreneurial startups

3.1.1.2.3 Still, the annual expenditure on lighting is estimated to be at least $3.5 Billion and could be 10X that amount, depends on adoption rate of Super Spectrum Systems (MH + HPS)

3.1.1.3 Lighting Fixtures & Equipment Segment

3.1.1.3.1 Broad segment that includes all residential, commercial and outdoor lighting

3.1.1.3.2 Market is $16.5 Billion, with Lamps totaling $4.7 Billion of it and growing about 2.5% annually

3.1.1.3.2.1 Street Lamps- there appears to be no source for street Lamps, but based on Tucson, AZ (1 street lamp for every 30 persons), there are 9 million public street lamps in the US. With a two year life on bulbs at a purchase cost of $30, and a ten year life on the fixture at a cost of $100, the annual size of this segment is $235 Million and growing <2% per year.

3.1.2 In short the industry, while large, is primarily a replacement market and attractive to new investors only when a disruptive product can be introduced

3.1.3 Current lighting producers/resellers have significant economies of scale and evaluate new lighting ideas based on styling, space, heat, reliability and costs

3.2 One large non-lighting segment was briefly examined: ceramic coatings as an ingredient for tapes, adhesives, etc. This segment is also large $3.5 Billion annually and growing slower, at 1.2%, than US GDP growth.

IV. CUSTOMER SEGMENT ASSESSMENT

4.0 Automotive Lighting

4.0.1 During 2005, North American automotive production is estimated by CSM Worldwide to be 15.7 million vehicles. This is a 0.3% increase over 2004.

4.0.1.1 At $10.00 average cost for each of five "lamps", the annual OEM lighting market is $785 million ($50 * 15.7 million units produced)

4.0.2 The automotive exterior lighting market consists of three products: Center High Mounted Stop Lights (CHMSL), Headlamps which come most often in a closed assembly, and Tail Lamps. Competition to provide the latter two products is well defined, but with the regulatory change mandating CHMSLs, automotive lighting suppliers have realized top line growth of nearly 5% while improving margins. Of course, as the offerings mature, it is expected CHMSL growth will approximate production trends and margins will settle at same margins as today's Head and Tail Lamps.

4.0.3 These competitive offerings are evaluated on the basis of the following criteria (XXX- highest weighting/consideration):

Criteria	CHMSL	Headlamp	Tail Lamp
Styling		**XXX**	**XXX**
Space	**XXX**	**XXX**	
Heat	**XXX**	**XXX**	
Cost			**XXX**
Reliability	**XXX**		**XXX**

4.0.3.1 Automakers have not settled on a common CHMSL design across their respective vehicle platforms, so economies of scale are low for the suppliers. So product offerings are judged on space configuration (interferes with visibility of driver looking back and with rear seat passengers).

4.0.3.2 Headlamps have always been considered the "jewelry of the car". Their initial designs gave eyes or ears to the front design, and when they eventually were sealed, space, heat were added to aerodynamic styling as key criteria for selection. Cost is no longer a major factor as government regulatory requirements (Motor Vehicle Safety Standards, MVSS) dictate product attributes resulting in little product differentiation and near zero margins for all suppliers. Suppliers get OEM contracts at prices with no or little margin, so they can dominate the aftermarket for replacements.

4.0.3.3 Tail lamps are integral to the design (though not for aerodynamics) of the vehicle. It is important, again for safety, that they not fail/not leak due to environmental conditions (rain, wind, etc) nor can they "spot"- that is, have different brightness within the casing, the brightness must be uniform.

4.0.4 OEM Market Share by Competitor by Type of Lamp (see Exhibit A)

4.0.4.1 The leading supplier of CHMSLs is Guide a former division of GM and Delphi, but now an independent company.

4.0.4.2 As you would expect, Guide and Visteon (former Ford subsidiary) are first and second in both Headlamp and Tail Lamps

4.0.4.3 Guide and Visteon supply nearly 40% of all . American vehicles with their lighting.

4.0.5 There is no reliable market data on automotive aftermarket lighting. Suppliers intentionally blend OEM and aftermarket data to reduce the OEMs influence in setting prices.

4.0.5.1 Still there are nearly 200 million cars registered in the US, or 13x that of annual vehicle production.

4.0.5.2 Automotive aftermarket lighting sales have slowed as a result of improved lighting installed over the past 5-10 years and OEMs increasingly offering free maintenance programs for the term of the financing of a new vehicle, oftentimes for five or more years.

4.1 Greenhouse Segment

4.1.1 Data on Greenhouse use for industrial purposes difficult to find

4.1.2 Historical Greenhouse unit sales, including the smaller hobbyist Greenhouses, have been increasing at less than 1% annually. Growth has increased since 9/11 and is almost all at the Hobbyist level; due to the US recession, continued outsourcing costing fiftysomethings to redeploy- and running nurseries is popular and too capital intensive- and a movement toward more organic foods in the diet.

4.1.3 Estimate of Market Size for Greenhouse Bulbs (see Exhibit B)

4.1.3.1 Based on one large state's experience, Greenhouses cover nearly 570 Million square feet (6.0 Million sq meters or so) of garden

4.1.3.2 If 400 Watt/39,000 Lumen (MH) Light bulbs were to light all of this area, 35,414,000 bulbs would be needed (assumes coverage of 16 sq ft per bulb).

4.1.3.2.1 At a cost of $200 each for the bulb and the fixture, the lighting cost to cover this area is $14.2 Billion

4.1.3.2.2 Assuming the bulbs life is two years, then the annual spend approximates $3.5 Billion

4.1.3.3 If 1,000 Watt/100,000 Lumen (HPS) Light Bulbs were used instead, and they cost $500 each for the bulb and fixture, but cover 64 sq ft, only 8,854,000 bulbs then are needed, and the total lighting cost would be $8.9 Billion, and with a two year life annual spend on bulbs is $2.25 Billion.

4.1.3.4 Since a 400 Watt HPS arrangement is not popular, the closest comparison between MH and HPS is a 500 Watt/51,500 Lumen HPS Light bulb that also covers 16 sq ft.

4.1.3.4.1 If HPS bulbs were used instead, then 35, 414,000 bulbs would be needed for the coverage, but at $500 each for the bulb and fixture, lighting costs would be $35.4 Billion, and annual bulb spend, again assuming a two year life, would be $8.9 annually.

4.2 Lighting Fixtures & Equipment Segment

4.2.1 Definition of this segment is all residential, commercial (interior and exterior) and outdoor lighting

4.2.2 According to MarketResearch.com, this segment is $16.5 Billion, with lamps accounting for $4.7 Billion annually.

4.2.2.1 Marketresearch.com predicts future growth at 2.4% and

4.2.2.1.1 "…pace represents a notable improvement from the declines of the 1997-2002 period during which a sluggish economy of 2001 and 2002 suppressed building lamp demand.

Moreover, the effects of the weak economy combined with increasing import penetration to significantly suppress lamp prices, especially in the fluorescent and HID product segments."

4.2.3 Street lamps are not separated from all outdoor lighting by MarketResearch.com

4.2.3.1 However, extrapolating from one medium-sized US city, Tucson Arizona, an estimate of the number of public street lamps can be made

4.2.3.1.1 Tucson has 20,000 public streetlamps for 600,000 citizens or 1 street lamp for every 30 citizens.

4.2.3.1.2 For a US population of 280,000,000, this would imply US has 9.3 million public street lamps.

4.2.3.1.3 As the cost of a the most popular bulb, mercury vapor, is $30 with an expected life of two years, and a fixture is $100 and is expected to last ten years, the annual size of this segment is nearly $235 Million ($140 million on bulbs and $93 million on fixtures).

V. COATING MANUFACTURERS ASSESSMENT

5.0 The objective here was to identify potential coatings manufacturers that would be open to our approach to discuss a production licensing agreement. GE lighting represents a special case as they are both producer and customer for such coatings (see next Section for discussion of GE Lighting).

5.1 Criteria was established for screening potential producers, as follows:

5.1.1 Size: The manufacturing licensee should have enough size to where they can handle larger as well as smaller batches of CERFLEX. They also have the best chance of already having the physical equipment necessary to process CERFLEX.

5.1.2 Financial stability: investing in a new product line is costly and risky which would cause some companies reluctance to follow through when there was the slightest hiccup in the economy. Therefore, a coatings company with financial substance, perhaps evidenced by willingness to set up and conduct pilot runs, is important.

5.1.3 Geographical diversity: Depending on where the U. S. and Canadian customers will be located, geographical proximity is important for shipping costs and technical service. Shipping chemical substances has become more expensive and more closely regulated. Technical service support is expensive as well and travel costs are steadily rising.

5.1.4 International involvement: Even though the focus now is on North America, international presence and experience making coatings should be recognized as important and be preferred to us, all other things equal, for their existing execution of manufacturing, sourcing raw materials, dealing with equipment anomalies and governmental regulations and laws that exist in the other locations.

5.1.5 Technical support: This involves the quality control of incoming raw materials and finished product as well as the field support that all end users need to launch CERFLEX and to monitor its progress. Commitment to that support is critical.

5.1.6 Ideally, we would like to work with someone experienced with our target customers: Having a company that is familiar with the lighting market would be most useful.

5.2 With these criteria in mind, but without speaking directly to any of the producers, the organizations in Exhibit C should be first approached.

VI. PRELIMINARY TALKS WITH GE LIGHTING

6.0 Contact was initiated to GE Lighting through their ex-CEO, Mr. Mike Zafirovski to Mr. Mike Petras which landed us with three product development engineers.

- 6.0.1 Since the CERFLEX patent is not yet in the public domain, and I was not able to obtain the chemical composition or other technical specifications of CERFLEX, our discussion was limited.
- 6.0.2 The three engineers were: Messrs. Jeffrey Wood, Gerald (Gerry) Duffy and Allen Chalmers.

6.1 GE's guys did not pry about info of the patent, in fact the would like to know immediately when it is going to be in the public domain

6.2 GE's technical evaluation is from several points of view- as marketer, for sale of automotive, HID and halogen lamp applications, for internal use especially in medical imaging, appliances and aircraft engine divisions, and as a coatings producer (at their Louisville, KY plant)

6.3 Technically this team of three wants to know and will evaluate the ease of use of the technology, the materials involved, the optical properties and thermal stability. They are assuming CERFLEX would be fired/ok at 1500-1700 F

6.4 Selected comments:

- 6.4.1 Again, they did not want to hear of CERFLEX until the patent was publicly available, so as not to contaminate any of their current research and development efforts.
- 6.4.2 To change bulbs (say porcelain with coating, energy savings must be at least 25%
- 6.4.3 Is CERFLEX going to be liquid or powder
- 6.4.4 Even if they decide not to produce it themselves, they know the "best" ceramics guy –he used to run American Porcelain Service Engs. Assoc. for five years- and he is also in Louisville, KY
- 6.4.5 One or more of the Team is available to meet in Holland, as one of them is passing though Schipol at least once a month.

VII Way Forward

7.0 Shall we proceed with PHASE II?

APPENDICES