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A Development Approach for Cold Fusion

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Abstract

A plan is presented for investigation and development of the cold fusion effect, ultimately leading to implementation of commercial devices. The plan represents a methodical approach for identifying and addressing theoretical, scientific, engineering and economic concerns.

The plan is presented from the perspective of a large architect/engineering corporation which performs work in established energy industries and which is not currently involved in cold fusion. The plan consists of a number of phases designed to establish the corporation's level and method of involvement in the field.

The phased plan provides a number of decision points; at each decision point a commitment to a higher level of funding is made on the basis of additional information which has been generated by the plan to that point. In this way the corporation can control its financial outlay, yet funding is appropriate so that pursuit of the plan is not hampered.

1. Introduction and Premise

Successful development of commercial cold fusion devices has the potential to substantially impact a corporation which is presently involved in traditional energy markets. This impact could be negative, if the corporation ignores cold fusion developments and finds itself reacting to fundamental changes in its market. Energy companies have already been buffeted in the United States by deregulation of the electric utility industry, a declining market for new energy production facilities, and falling prices for new construction due to intense competition. The impact of cold fusion could be much greater.

The impact could also be very positive, if the energy company were to position itself properly for future developments. This requires involvement early (i.e. now) to assist in the development of the technology, to establish what a profitable future corporate position is, and to prepare accordingly. This paper presents a plan for an energy company to do these things.

There are two premises upon which this paper is based. The first is that the cold fusion effect in its various forms is real. There exists sufficient experimental evidence at this time that this issue no longer needs to be addressed. It is not justified to devote additional resources to demonstrate the existence of the effect.

The second premise is that it is not in the company's interest to try to develop cold fusion by itself, without cooperation from others who are already working in the field. Commercial cold fusion will come to fruition more quickly if cooperative arrangements can be made with those who are knowledgeable in the field, and if joint ventures are established with individuals and companies which have the requisite expertise.

2. Background

It is well known that the involvement by large corporations in cold fusion research and development is very limited. Nevertheless, there are a variety of strong reasons for an established energy company to become involved with cold fusion at this time. These reasons are all economical, and deal both with current market conditions as well as those which may come to pass in the future. The discussion which follows is presented from the viewpoint of an architect/engineering (A/E) corporation.

In general, an A/E does not build hardware, such as boilers, pumps, or electronic control systems. An A/E specifies the requirements for these components and designs their interconnection (civil foundations, piping, cabling and electrical distribution, etc.). In short, an A/E does all the design and engineering work required to assemble the many thousands of different components which make up a power plant or other large industrial facility. In general the A/E will purchase all the equipment and will oversee the manufacture of this equipment by its vendors. Finally, the A/E will construct the facility or will provide construction management.

From the perspective of the energy-related A/E, energy use can be broadly classified into four categories. The type of work the A/E performs in each area, and the changes which could occur to the respective markets are discussed below.

a. Electricity generation and consumption

In support of electricity generation and consumption, a typical A/E designs power plants, mining and fuel processing facilities, waste disposal facilities, and environmental remediation projects. The economics of cold fusion electric power generation devices may dictate that they are large-scale facilities like the central generating stations which exist today. This would support a traditional A/E role of system integration and construction.

On the other hand, economics may indicate that the preferable method of implementation is smaller-scale devices either located in neighborhoods or individual homes and businesses. This would disrupt the traditional A/E involvement in this market and would suggest that a different, non-traditional approach is necessary.

In either case, if cold fusion power generating devices are developed and they are economically attractive in comparison with other methods of electricity generation, an energy-related company would want to be involved in a positive manner. This industry is ferociously competitive around the world. There is an oversupply of engineering and production capacity for producing power plants, and establishing a competitive advantage is essential for a company's survival.

b. **Propulsion (internal combustion engines, gas turbines, etc.)**

An energy-related A/E is typically involved in projects required to produce and process fuel for propulsion. For almost all propulsion the fuel is petroleum, and example projects would consist of oil production facilities, refineries, and pipelines.

If cold fusion devices can be developed that are sufficiently compact and powerful that they can economically replace the internal combustion engine, petroleum use will drop precipitously. Existing industrial capacity will be sufficient to supply chemical, lubrication and plastics use of petroleum for the foreseeable future. The market for large facilities in this energy sector may virtually disappear. This suggests that a substantially different approach would be required by an A/E interested in staying involved in this market.

c. **Industrial uses**

Industrial energy use typically consists of electricity and heat. Often these are supplied by fossil-fueled power plants which produce steam; some of the steam is used for heating purposes and some of the steam is used to generate electricity. A typical A/E role is to design and construct the steam and electric generation plants. The same changes which cold fusion devices will make to electric power production will occur to industrial energy facilities.

d. **Home use (heating, air conditioning, and electrical loads)**

A/E's are typically not involved directly in this area. Instead the involvement is with the industrial base required to supply energy to the home. Again this consists of electricity, petroleum and natural gas. If self-contained home heating and/or generating units are developed, the need for external energy supply to the home will decrease. The impact on the industrial energy supply structure is obvious.

An A/E would have to adopt a very non-traditional posture to continue to generate revenue from this energy market sector.

So, the impetus to become involved in the cold fusion field, should it ultimately prove successful, is obvious.

3. The Important Questions

As has been mentioned previously, the important question is not, "Does cold fusion occur?" Instead, for a company interested in becoming profitably involved in the cold fusion field, the important questions which require answers are:

- Can cold fusion be used as the basis for useful, practical energy producing machinery?
- Will that machinery achieve widespread use?
- Can the machinery be made available in the foreseeable future?
- If the first three questions can be answered in the affirmative, how can and

should the company become involved?

To answer these questions, a phased approach to investigation and development is recommended. The phases, their purpose, and the methods used to accomplish them are described in the following.

4. Phase 1 -- Survey the Field

This purpose of this phase of the investigation is to develop a solid corporate understanding of the state of the cold fusion field. This phase of the plan is intended to generate the following information:

a. A detailed understanding of the different techniques known to produce the cold fusion effect.

b. The state of development of each of the cold fusion techniques, including:

- Method and apparatus
- Level of excess heat or energy production
- Known parameters and unknown factors requiring additional investigation
- Materials involved

c. An understanding of the theoretical explanations for the effect, along with supporting evidence for each theory.

d. An acquaintance with the researchers in the field; an understanding of their capabilities, funding, and plans; and an understanding of their willingness to participate with a large corporation.

To the maximum extent possible this phase of the investigation will be performed on a first-hand basis. Researchers will be visited at their laboratories, and their experimental apparatus will be observed. Theoreticians will be contacted, and their theories will be discussed in depth. A corporate cold fusion library will be established, and a systematic review of key publications will be performed.

5. Phase 2 -- Establish the Broad Parameters of Practical Machinery, Economic Attractiveness, and Timetable

The purpose of this phase of the investigation is to make educated guesses concerning the form commercial cold fusion devices may take. The cost of commercial devices will be estimated based on these guesses. Approximate timetables for the development of each technique will be generated, based upon the state of development the technique. This will involve performing the following steps for each of the techniques known to produce the cold fusion effect:

a. Select a device configuration. A reasonable approach would seem to be to choose an existing experimental cold fusion device which has demonstrated high levels of excess heat in a repeatable manner.

b. Estimate the size of the device needed to produce power at usable levels. A prudent approach would be to examine three sizes which will cover the range of possible devices: Electric power plant size (hundreds of megawatts), home heater/generator size (tens of kilowatts), and an intermediate size.

c. Estimate the cost of the devices if they were to be commercially produced. There is the possibility of large errors in this step, but one approach would be to identify existing industrial machinery for which a production cost is known and which is similar in form to the cold fusion device under study. The production cost could then be adjusted to account for differences in the materials of construction, difficulty of manufacture, and expectations of production volume.

d. Estimate the life-cycle cost of the device. This would include replacement of materials, operating costs, fuel costs, etc. Again, the most promising approach would be to make comparisons with similar machinery in use today.

e. Perform economic sensitivity analyses. These would examine the impact on device costs of changes in the parameters which are presently uncertain. This would include:

  - **Performance of the device:** For example, how would the cost of the machine vary if a higher level of excess power were achievable? Is there a minimum level of excess power which makes the machine economically viable?

  - **Cost of materials:** For example, if increased demand for palladium were to substantially increase its cost, what impact would this have on the cost of the total machine?

  - **Size of the Device:** The machine may be most economical in a particular size range. This will impact the way the device is ultimately implemented in the marketplace.

f. Based on the above estimates, compare the cold fusion device with energy sources available today. Determine the implications for the ultimate economic attractiveness of the device.

g. Make a realistic estimate of the size of the market.

h. Establish an approximate timetable for development of the device. This timetable would be based upon the current state of development and the amount of additional work and research required to bring the device to a state of commercial viability.

6. Phase 3 -- Examine the Legal Implications

The purpose of this phase of the plan is to attempt to define the legal arena in which the company will be operating.

The sorry state of the cold fusion patent situation is well known. Almost no patents have been granted, and most researchers are operating without patent protection. This has probably had the effect of limiting communication among researchers to some extent. But this is not likely to be a corporation's major concern.

To a corporation interested in becoming involved in this field, securing patent rights will be an important aspect of that involvement. Several hundred patent applications have been prepared for cold fusion devices, and they undoubtedly have many overlapping claims. Detailed legal research will be necessary to attempt to understand the legal necessities of operating in this field.

7. Phase 4 -- Identify the Work Remaining

There are many issues which must be addressed before practical cold fusion devices are developed. The purpose of this phase of the plan is to identify the issues, determine what work remains to be accomplished to address them, and determine what talents must be assembled to perform that work. Some of the more critical issues are discussed below.

a. **Theoretical Basis**

A sound theoretical basis for the cold fusion effect will ultimately be required. Without it, improving the performance of devices will be a trial-and-error affair. A theory with predictive capabilities would be extremely helpful. A series of experiments is required to test the more promising theories.

b. **Configuration**

Configurations which produce higher rates of excess heat generation need to be examined. Examples include electrode surface area and volume, and the role of grain boundaries. A systematic examination of configuration effects will need to be devised.

c. **Temperature**

Most experimentation to date has been at low temperatures. Producing practical devices at these temperatures will most likely be difficult. The extent to which more thermodynamically useful temperatures can be achieved requires investigation.

d. **Repeatability**

In terms of much cold fusion research to date, repeatability means the ability to reliably produce the cold fusion effect. This in itself will not ultimately be sufficient. A practical device will need to reliably produce the cold fusion effect at a power level which is known and repeatable.

e. **Throttling**

To be truly useful as a practical machine, it will be necessary to have a mechanism to throttle a cold fusion device. This means the ability to turn it on and off at will, and to vary its output. Mechanisms to accomplish this will need to be explored.

f. **Radiation**

The general attitude in the cold fusion community is that radiation generated during experiments is good, because it demonstrates that a nuclear process is at work. The business perspective is exactly the opposite. Concerns about radiation (whether those concerns are rational or not) have severely affected the development of fission power in the United States and other parts of the world. Even if the radiation emitted from cold fusion devices is very low, irrational fears could be very damaging. The levels of radiation which can be expected from practical devices needs to be well examined.

g. **Long-term Performance**

Many cold fusion experiments have been short-term. Longer term testing is required to determine what periodic maintenance and replacement will be necessary with a commercial device. In other words, will the electrodes or some other parts of the devices "wear out" with time? How often will these parts need replacement or replenishment? How will this be done and how much will it cost?

A series of long-term experiments will be necessary to examine this issue.

h. **Power Conversion**

Methods must be developed for converting the excess heat generated by cold fusion devices into electricity. Reasonably high conversion efficiencies are likely to be required. It is not sufficient to say that the source of energy is cheap and plentiful and therefore conversion efficiency is not an issue. Solar energy is cheap and plentiful, yet low conversion efficiencies have so far made widespread implementation of solar power uneconomical.

So, potential power conversion technologies will have to be identified. Modifications required to match them to the output characteristics of cold fusion devices will have to be explored.

8. Phase 5 -- Establish Working Relationships

Phase 4 described above will identify the areas requiring work. Based on this, the talents and resources required to perform the work will be established. The purpose of Phase 5 will be to establish relationships with other organizations. In its traditional role as systems integrator for large, complex projects involving many different organizations, the A/E may be particularly suited to establishing consortium and joint venture arrangements.

Participants would include researchers in the field, companies and laboratories with the necessary expertise to perform the work, and companies with an interest in sharing costs and risks.

9. Phase 6 -- Perform Directed Experimentation

The purpose of this phase is to perform experimentation and research in a logical manner to address the issues raised in Phase 4. The work would be performed by the organizations assembled in Phase 5.

10. Phase 7 -- Develop Prototypes

Once a sufficient number of the outstanding technical and economic questions have been addressed, it will be possible to build and test prototype devices. By this time in the process, the information which has been generated will probably have narrowed the candidate configurations to a small number. The most promising will be constructed.

11. Phase 8 -- Initiate Commercial Implementation

If all the earlier phases of this plan achieve success, and the economic outlook is positive, the ultimate goal of all the cold fusion efforts will be possible: commercial implementation. It is not possible at this time to describe the form this implementation will take; generating that information is the goal of the first seven phases of the plan.

12. Summary

The potential impact of cold fusion on a company currently involved in the energy industry is too great to ignore. If a phased approach is used, in which each phase represents an increment of financial and technical involvement, the company can minimize its financial exposure while still establishing a favorable competitive position. The benefits of such a plan are further enhanced if the company pursues this work in cooperation with others already involved in the field.