



Center Update: Chemicals, Petroleum, and Natural Gas Target

A Quarterly Progress Report to Target Members

Q1 – Q3, 1999

TP-114657

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Technical Progress, December 1999

EPRI Project Manager

K.R. Amarnath

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ABSTRACT

This document provides the 'work-in-progress' on all activities under the Chemicals, Petroleum, & Natural Gas Target. It is intended to keep the members of the Target informed of all activities being conducted under this Target. The CPNG Center is a Contracted Office in Houston that maintains the progress on the projects cited in this document.

TARGET 23 - Chemicals, Petroleum & Natural Gas

**Progress Report for 1st Quarter, 1999
January – March 1999**

A Report to the Target's Membership

I. Calendar of Future Events (*EPRI Meetings in Italics*)

- 5/10-13/99 Industrial Energy Technology Conference (IETC), Houston, TX – Industry Meeting
- 5/20-21/99 *Gas/Electric Partnership Workshops, Houston, TX - EPRI Meeting*
- 5/26/99 *Petrochemical Industry Overview (in conjunction with C&P Steering Meeting) – EPRI Meeting*
- 5/26-27/99 *C&P Steering Committee Meeting, Salt Lake City, UT – EPRI Meeting*
- 9/23-24/99 *Gas/Electric Partnership Symposium III, Houston, TX – EPRI Meeting*
- 10/4-6/99 Gas Machinery Conference, Houston, TX – Industry Meeting
- 11/7-11/99 International Forum on Electrolysis in the Chemical Industry, Clearwater Beach, FL – Industry Meeting
- 11/17-18/99 *C&P Steering Committee Meeting, Houston, TX – EPRI Meeting*
- TBD *Petroleum Refining Overview (on demand) – EPRI Meeting*

II. Customer Technology Opportunities (Base Budget)

Enhanced Oil Recovery (EOR) Scoping Study –

This project has been previously described in the November 1998 and January 1999 Progress Reports. A contract has been executed with the selected contractor. A number of separate kickoff conference calls with each of the individual electric utility guidance team members, the contractor, an oil company participant, and the EPRI project manager had been held in February. The purpose of these telephone conferences was to convey to the contractor what the utilities expect to get out of the project, while respecting their confidence. A number of good ideas and directions came out of these conference calls.

Continuing and New SS&T Projects -

This is the first time we are reporting activities related to some of the SS&T projects. The background and summary sections are fairly long, and therefore are being detailed at the end of this Report. Project summaries are reported below.

Micellar Systems for Modulating Microwave Heating of Chemical Reaction Processes – MIT

Details of this project will be presented in next quarter's Report.

Microwave Effects on Liquid and Solid State Materials Processing – University of Florida

Program goals for the program under the direction of Dr. David Clark include a study of surface modification in glasses, design of high-temperature hybrid heating susceptors and evaluation of these susceptors through sintering studies on alumina, and combustion synthesis to form composites. See last section for details.

Electrochemical Promotion of Ammonia Synthesis with Electrically Promoted Catalyst Pellets – University of Patras

The objective of this 3-year exploratory research project is to investigate the basic feasibility of achieving substantial increases in the rate of ammonia synthesis through application of electric currents or potentials to ammonia synthesis catalysts deposited on ionically conducting supports. See last section for details.

Liquid Membrane Technology Development Project at Facilichem:

This project has been described previously in the November and December 1998 Progress Reports.

Current activities have been focused on obtaining a strategic relationship with an industry partner. Testing will then be conducted on applications that are relevant to the strategic partner. Focus in the last 2-3 months has been in locating suitable partner(s) for development of the first application. Several end-use companies have expressed interest; most likely, a specialty chemicals company will be chosen as the partner. This is because the need for high quality separation is very prominent in this industry.

In the meanwhile, Spectrum has proceeded to procure the capital equipment required to spin the membrane fibers in an appropriate way for the liquid membrane to be stable. The equipment is expected to arrive shortly.

Spectrum has built prototype membranes; will be shipped to Facilichem shortly. To do the work, Facilichem will be hiring one/two technical people shortly.

Energy Services Kit for the Supply Side of Industrial Facility:

This kit will primarily consist of:

- a. Fuel & Power Procurement
- b. Fuel Switching
- c. Fuel Management
- d. Risk Management for Fuel Procurement
- e. Power House Outsourcing
- f. Cogeneration and Merchant Plant Development

Discussions are in the final stages for putting a contract in place for this work.

Maximizing Process & Waste water Reduction for the Process Industries

The contractor will use internal and external information sources to develop a report that addresses and lists the various evolving technologies in heterogeneous and homogeneous separations utilizing membranes, electrodeionization, electrolysis, mass pinch techniques and other wastewater treatment processes. The report will be provided in both paper and electronic form, and will address the application potential and benefits to EPRI Member Utilities and their customers in the process industries. The report will be organized into sections covering the various technologies, and will include a section on retrofit considerations and will also identify potential slipstream and demonstration locations for potential future utility specific proprietary studies.

The tasks and schedule are summarized below.

<u>Task No.</u>	<u>Duration</u>	<u>Description</u>
1	4 wks	Information gathering and analysis
2	3 wks	Draft report preparation and transmittal
3	2 wks	Incorporating EPRI comments and transmittal of final report
4	<u>4 wks</u>	Final Report produced at EPRI

Total 13 wks

Work is underway to develop a report that addresses and lists the various evolving technologies in heterogeneous and homogeneous separations utilizing membranes, electrodeionization, electrolysis, mass pinch techniques and other wastewater treatment processes. The report will address the application potential and benefits to EPRI Member Utilities and their customers in the process industries.

III. Customer Technology Opportunities (TC Projects)

Pinch Technology Process Optimization –

In order to establish the potential that exists in large industrial facilities for reduced energy cost, a Member Utility and EPRI have sponsored a Site Utility System Analysis of a large US oil refinery. The objective of this activity was to demonstrate that a combination of Pinch Technology, heat and power system analysis and operational improvements provides an effective strategy for significant energy cost reduction.

The project was initiated in April 1998 as a two-phase activity. The objective of the first phase, completed in August 1998, was to identify the opportunity for energy savings through structural changes to the site steam system. Through a systematic analysis of the site steam production

cost and shaftwork generation cost, opportunities were identified to cost effectively transfer a significant amount of shaftwork generation from condensing turbine drives to electric motors.

The second phase of the project quantified opportunities for energy cost reduction in each of the major process units on the site using pinch technology. This information was combined with the results of phase 1 to provide a global strategy for minimizing energy costs. The phase 2 activity is scheduled for completion in April 1999.

Wastewater Problem Solutions Alliance (WPSA) –

We are in the process of forming a strategic alliance with a technology company and an engineering company, to capitalize on the following unique set of circumstances.

1. The technology company has developed pilot plants and skid mounted field demo units for its parent company's needs that would probably not be duplicated (by anyone) in today's business environment.
2. The technology company and the engineering company have a Cooperation Agreement, and have developed a good working relationship to commercialize projects for others.
3. The engineering company can afford to finance construction projects, and can make quick decisions, since it is controlled by one person.
4. EPRI has very broad rang U.S. connections, contacts and knowledge through its involvement with industrial groups, electric utilities, and U.S. Government agencies, and its network of consultants. Also, EPRI has a mechanism in place for obtaining electric utility or combined electric utility/EPRI funding for assisting utility customers in solving their problems (environmental and otherwise). Therefore, EPRI can not only identify opportunities for the alliance, but it can also be instrumental in obtaining seed money to get projects started.

The initial approach that is emerging from the discussions is as follows.

- EPRI locates potential opportunities through its member electric utilities and on its own , and has the process company involved (through its electric utility) fill out a form to describe their problem.
- Based on the content of the filled out form, the technology company makes a preliminary assessment. Then, a one day plant site survey can be conducted for a total cost of \$5,000.
- Based on the site survey information and the original filled out form, a short report/proposal would be prepared for the funding electric utility and its process industry customer, indicating which of two or three technology approaches would be potentially cost competitive for their site specific situation. Initially, the proposal would offer the options of either sending samples (two 55 gallon drums) to be run in the technology company's pilot

plants, or to have the technology company's skid mounted field demo units sent to the site. When a planned completely flexible trailer is built, that would allow for a lower cost trailer option to be added to the proposal in addition to the skid mounted field demo units option. The plan is to build a new trailer with total flexibility capability, so standard commercialized technologies as well as venter technologies (for emerging and newly commercialized approaches) that fit a given site/situation specific opportunity can be put on the trailer and moved to the site for slipstream testing.

4. The next step is conducting one or more of the three proposed demo options for the client. The scale of testing and cost would get progressively larger going from the technology company's pilot plants (\$10,000 to \$40,000 total) to trailer (cost range TBD) to skid mounted field demo units (cost range TBD). The risks in implementation of a full-scale commercial project go down for the process company with larger scale testing. The process company decides what they want (potentially influenced by their utility's willingness to provide financial support through either their EPRI Customer Assistance Account or jointly with EPRI funding through a Tailored Collaboration arrangement).

The pilot plant, trailer, and/or skid mounted field demo costs would include providing completely unbiased preliminary designs and costs for technologies that are cost/criteria competitive for the site/situation specific case, providing your customers with the information they need to make informed decisions relative to further testing and/or implementation of a commercial-scale project. The technology company and the engineering company have the combined capability to carry a project through detailed design, construction, startup and follow-on services for the commercial facility.

Two utility members have expressed interest in promoting this concept with their Chemical Industry customers. The prospectus (TO-111986) "Mobile Trailer for Wastewater Reduction Technologies" which was described last month, will be superceded by a new prospectus (when the alliance is fully implemented). However, you can get the site survey form, and have a site survey done at this point in time. When the other parts of the program become available, we will let you know.

An E-mail Alert on this opportunity was sent out in March. There has been considerable interest, and we have been asked to develop a phased statement of work covering the various aspects of what the Alliance has to offer our Members and their customers.

Market Assessment of Wastewater Management Opportunities: A Collaborative/ Proprietary Project -

The WPSA alliance described above plus the market assessment project described below and wastewater pinch opportunity described after that are designed to find unbiased solutions for your customer's wastewater problems. However, these three programs are also designed to find legitimate homes for electrotechnologies (like freeze concentration, removal/recovery of heavy metals, site remediation of contaminated soil /aquifers, and other promising electrotechnologies that we will identify in the future).

Wastewater management is a major issue for electric utility industrial customers. Not only is it an environmental regulation issue, but it is also a conservation issue, a public relations issue, and a liability issue. Since electric utility industrial customers are spending so much money in this area, and since changing regulations, bad public relations and potentially huge liability issues are causing them to make changes, electric utilities have an opportunity to influence the direction of those changes towards technologies that use more electricity. Electric utilities also have an opportunity to identify new types of business opportunities. The EPRI Chemicals, Petroleum & Natural Gas Center is offering a mechanism for its members (and the members of other Centers) to capitalize on this opportunity. The Prospectus (TO-111894) "Market Assessment of Wastewater Management Opportunities" has issued. It allows you to participate in three phases (overall US, Statewide, and finally in depth and proprietary with your customers to identify their specific problems and business opportunities for yourself). Participation in the Phase I (Overall US) study is required for participation in the second two phases. The Center is now actively seeking participants for Phase I at a cost of \$5,000 to \$10,000 per participant, depending on the number of Members interested in participating. Your EPRI Customer Service Cash Accounts can be used to pay for Phase I, or you can use your TC funds to pre-commit to all or part of the three phases. Levels of commitment can be adjusted later, to account for levels of Members' participation in the various phases and how extensive you would like your proprietary Phase III study to be. Overall TC costs for the entire three phases are anticipated to be in the range of \$25,000 to \$110,000, with half of those amounts being individual Utility Company up front TC commitments, for any Utility that uses the TC pre-commitment approach. For more information on this exciting new opportunity, contact Sam Woinsky at the Chemicals, Petroleum & Natural Gas Center (713-963-9336).

Wastewater Reduction Through Mass Pinch Technology -

This is a new technique for reducing wastewater by source reduction. It determines bottlenecks in the process that result in waste and identifies low cost projects to modify the processes to eliminate these bottlenecks. The technique (which is analogous to thermal pinch) relies on a new methodology and requires application of software.

We are seeking TC projects, including innovative projects in California. UCLA is our partner in this program.

Freeze Concentration of Hazardous Wastewater -

This technology has been applied overseas at the 2 MW level. We recently visited a 3.5 MW unit nearing completion of construction in the Netherlands (should start up in June, 1999). We are looking for opportunities to apply it in the US upstream of existing or soon to be built incinerators or supercritical oxidation units. Likely candidates will be pharmaceutical, pesticide and petrochemical companies. The vendor has a 66 gal/day freeze capacity mobile pilot plant that can be used for slipstream testing in the United States. The cost is about \$30,000 for the first week (including shipping and personnel from Europe), and \$18,000 a week for subsequent weeks. Utility members who have customers with hazardous wastewater problems should contact Sam Woinsky at the Chemicals, Petroleum & Natural Gas Center (713-963-9336).

This program was previously described in the October 1998 Progress Report. We have received interest from one chemical company, and the utility serving the customer, who would like to explore the program in 1999. A number of other chemical companies have asked for information on the technology.

Also, due to a suggestion from the EPRI Chemicals, Petroleum & Natural Gas Center, the Dutch owner of the freeze concentration technology has collaborated with a French sister company to develop a process scheme to remove salts as well as concentrate the hazardous wastewater. This will open up more opportunities for the technology where incinerators are faced with other regulatory problems due to increased salt concentrations resulting from EPA's push to reduce water use and approach or achieve zero water discharge.

Removal/Recovery of Heavy Metals -

This program has been described in the October 1998 Progress Report. We have received interest from a few chemical companies who would like to explore the program in 1999. We need to build partnerships with members and their customers.

Site Remediation of Contaminated Soil and/or Aquifers -

This program has been described in the October 1998 Progress Report. We have received interest from a few chemical companies, who would like to explore the program in 1999.

Higee for Separations and/or Chemical Reaction -

This program has been described in the October 1998 Progress Report. We have received interest from a few chemicals companies who would like to explore the program in 1999.

Also, the vendor is forming another alliance with a company in the boiler feed water deaeration business to accelerate that application. A commercial scale unit will be tested on deaeration of sea water at an oil production site. The site has not yet been selected, so if you are interested in participating, call Sam Woinsky at 713-963-9336, and we will see if we can influence the selection.

Gas Pipeline Compressor Opportunities Project -

To help member utilities work with gas pipelines to bring electric compression projects into their service areas, the EPRI Chemicals, Petroleum, & Natural Gas Center offers an array of market, strategic, and project support services tailored to the needs of the customer. A proposal has been developed for a program of market research, strategic support, and feasibility studies. The Prospectus is at EPRI, and will be published in early 1999. We are also under discussion with several utilities. An electric vs. gas price parity spreadsheet protocol has been created in the Electric Compressor Guidebook project, and it has been reviewed with two pipelines. It is useful for calculating the electric price which a pipeline can afford for a project.

Pharmaceutical Industry Market Assessment SOW –

We developed a Statement of work in March. It is available upon request. Please contact Ammi Amarnath at 650/855-2548; 650/855-8574 (fax), or aamarnat@epri.com (e-mail).

Dioxins in Natural Gas Fired Equipment Off Gases –

We had discussions with Chevron relative to collaborating on a project for the year 2000. The project would cover both industrial equipment and electric power generation equipment.

El Paso Energy Electric Compression Initiative –

This program has been described in the December 1998 Progress Report.

We are on schedule and have completed all our field trips for 1999 projects as of 1/15/99. We are currently reviewing and finalizing the highest priority projects in order to expedite their in-service date. As the projects roll out into February, we expect the remaining projects to be completed and approved by the end of February. The Station 114 project will have to be prioritized against these other projects. We expect that we can make a case for delaying other projects in the 1999 budget to get the experience of the HydroCom system on the Ariel compressor.

We are having a meeting in February with an alliance partner to determine when is the best time to get with Horbiger and the field location to finalize the design and inform the maintenance crew how the HydroCom works. It is still our intent (if the project is approved for installation) to have this project start sometime in March 1999 and completed before the end of July 1999.

The project has been submitted to El Paso's executives for approval.

Mechanical Variable Speed Drives for Natural Gas Compression -

Work has begun on a project to deploy and evaluate Mechanical Variable Speed Drives at Texas Eastern Transmission's Mt. Pleasant, TN compressor station which has capability for 40,000 HP of electric compression, presently using only an old gear box. Utilities interested in participating in a TC project should contact Ammi Amarnath at 650/855-2548; 650/855-8574 (fax), or aamarnat@epri.com (e-mail).

Dynamic Simulation for Natural Gas Transmission Systems -

Work has begun on the next generation evaluation tool for electric compression for gas pipelines, Dynamic Simulation. Electric compressors may be designed into a gas pipeline system, and the flow modeled dynamically to show pressure, temperature, and line pack for the entire pipeline as it varies with time. Various types of drives can be included such as ASD's, VORECON mechanical drives, mechanical VSD's, HydroCom stepless actuators, gear boxes, flow control, and guide veins, so that fuel efficiency and variable costs can be compared. One virtue of this approach is that it illustrates the inherent superiority of electric compression under dynamic control conditions. The model will be an enhancement of an existing computer simulation tool which presently includes only gas drives, but is used by a number of gas pipelines.

EPRI-DOE Roadmapping Workshop on Electrotechnologies and Alternative Reactions Mechanisms -

1) Program Review:

The review of the Electrotechnologies and Alternative Reaction Conditions Roadmapping Workshop was completed this month. Generally speaking the draft workshop report reflected the conclusions and discussions of the workshop quite well. Our review included some recommendations to rectify some imbalance toward the Green Chemistry side, which not reflected in the discussions. Five major conclusions were drawn from the workshop. These are:

- a) A concerted research and development effort should be supported in electroseparations.
- b) Sequestration of greenhouse gases - especially CO₂
- c) Electrochemical bioprocessing - accelerate biotechnology into chemical processing.
- d) Processes that eliminate or reduce the use of toxic solvents.
- e) Hazardous waste recycling.

2) Remaining Tasks:

During the month of April the report will be used to submit a proposed roadmap to DOE, completing the tasks by the end of the April.

3) Other Tasks in progress: The following other tasks, indirectly associated with the program are under way:

- a. Salt Lake Meeting: Preparation of short presentation.
- b. Cresol Eskom: Arrange for Houston trip and possible presentation
- c. Ampere Microwave Conference: Help prepare an abstract.

IV. Technical Assistance, Customer Support, and Business Partnership Opportunities

Petrochemical Industry Overview Course –

In March, we presented this course as well as the Petroleum Refinery Overview Course at a Member Utility's site. We received the following comments back from the Utility Manager who invited us: "I just wanted to take the opportunity to express our sincere appreciation for your efforts in developing and presenting the trainings on the Petroleum Refining and Petro-Chemical Industries. The historic information was really good however, when you moved into opportunities for the electric utility industry I observed a lot of interest. Thanks for a great job!"

The Petrochemical Overview Course will be presented next in conjunction with the Chemicals & Petroleum Steering Committee Meeting on May 26, 1999 in Salt Lake City, UT. See The Advisory Committee Participation section of this Monthly report for sign up information for both the course, and the Steering Committee Meeting.

The course abstract is as follows:

This overview course covers the past, present and future of the U.S. Petrochemicals Industry from an electric utility prospective. The course starts with the emergence of the Petrochemicals Industry in 1920, when Standard Oil of NJ first made Isopropyl Alcohol in large volume, starting with propylene extracted from off gas from the thermal cracking process that was then used to increase Gasoline production yields. It traces the expansion of the industry from this one major chemical byproduct to a worldwide highly technical business (involving major chemical companies as well as petroleum companies) that uses sophisticated conversion processes to make a wide variety of commodity and specialty chemicals (primarily organics, but including some inorganics). This very diverse and changing industry is first covered in summary form, and then attention is focused on the primary petrochemical building blocks that makeup over 75% of all industrial organic chemicals (olefins and aromatics) and the various products that are derived from them in the production train. The objective is to greatly simplify a very complex subject, and provide electric utility sales personnel with information which will help them focus on areas where they can get the best returns for their efforts. In addition, industry trends and their (business and technological) implications for electric utilities are covered.

U.S. Refineries Database –

We have developed a **complete list** of all U.S. Refineries; this includes owner, location, and capacity. It is available upon request. Please contact Ammi Amarnath at 650/855-2548; 650/855-8574 (fax), or aamarnat@epri.com (e-mail).

Plasma Destruction of Wastes –

We started work on a white paper on this subject in March, which should be completed in April.

Chemical Plant Contact Information –

Obtained contact information for 290 chemical plants in one state for a study we will be doing for a Member.

V. Marketing and Communication Tools

Energy Services Kit for the Supply Side of Industrial Facility:

This kit will primarily consist of:

- g. Fuel & Power Procurement
- h. Fuel Switching
- i. Fuel Management
- j. Risk Management for Fuel Procurement
- k. Power House Outsourcing
- l. Cogeneration and Merchant Plant Development

The contract has been issued, and work is underway. The work will be reported at the May 1999 Steering Committee meeting in Salt Lake City.

Center's Publications List -

In March we developed a comprehensive electronic list of all of the Center's publications through 12/31/98. It is available upon request. Please contact Ammi Amarnath at 650/855-2548; 650/855-8574 (fax), or aamarnat@epri.com (e-mail).

Freeze Concentration of Hazardous Aqueous Wastes - TechApplication

Work on a TechApplication on the successful first Commercial application of this technology for hazardous wastewater concentration is progressing. This application is at a 2MW load level.

Membranes for propylene/polypropylene separation – Tech Application

A TechApplication is awaiting end user approval. It describes a new and important technology that is making inroads in the commercial recovery of monomers and other hydrocarbons in polyolefin plants. This technology provides economic and reliable resource recovery , while eliminating pollution problems.

Electrochemical Synthesis – Tech Application

Work is progressing on a TechApplication on the use of electrochemistry in the synthesis of a value-added chemical.

Heavy Metals Removal at a Specialty Chemical Plant – TechApplication

Work on this awaits U. S. plant start up this year. The technology has been successfully employed in this type of application previously in Europe.

Technical Papers & Presentations:

1. *IEEE Paper on Electric Compressor Guidebook:* Details in next month's report.
2. *Electrochemical & Reactive Separations paper:* Will be issued in next month's Separation & Purification Technology Journal. More details next month.
3. *Paper on Process Water Conservation:* We have started work on a paper to be presented at the Integrated Global Water Management Conference. The title of the paper is "Water Conservation Through Recycling of Process and Waste Waters". We will provide more details next month.

VI. One-Stop Access to All Products and Services

Office Move -

In order to improve the efficiency of our operations, we have moved our Center to a new location in the Houston area. The Center's new address and phone/fax numbers are: 47 Quiet Oak Circle, The Woodlands, Texas 77381, Ph: (281) 419-1122, and Fax: (281) 419-0811. The e-mail address for Sam Woinsky is the same as before (epripc1@ix.netcom.com).

Sam will handle all routine member requests. If there are specific questions that can be best answered by our Center Consultants (Dick Schmeal, Jim Kumana, Charles Byers), he will discuss such requests with them, and respond back to you in a timely manner. Please also feel free to contact Ammi Amarnath, for any technical or operational questions. The address is: EPRI, 3412 Hillview Avenue, Palo Alto, CA 94304, Ph: 650/855-2548, Fax: 650/855-8574, E-Mail: aamarnat@epri.com.

Please forward the new address to appropriate people within your Company.

Epriweb –

The site has been updated. In March, we requested additional updates, which have not as yet been incorporated. Please review the site from-time-to-time, and let us have your comments.

Resource Guide –

We also updated The Resource Guide in March. Both paper and electronic versions of the Resource Guide will be issued by EPRI. The electronic version can be accessed through epriweb.

VII. Advisory Committee Participation

CWRT/EPRI meeting on Continuous Particulate Environmental Monitoring (CPEM) –

This informative meeting which was co-hosted by the EPRI Chemicals, Petroleum & Natural Gas Center was held 2/2-3/99 in Durham, NC. The meeting attracted over 80 attendees from the process industries, electric utilities, government and companies that supply monitoring equipment. The subjects covered included Technology Overviews, the Government's Perspectives, Industry's Perspectives, the Status of Demonstration Projects, Vendor Presentations, and The Path Forward. The Path Forward included three break out discussion sessions. These sessions clearly indicated that the consensus was that the following things are needed. (1) A clear and simple way of determining which type of monitoring equipment is best for any given situation. (2) Gathering and review of as much existing information on commercial scale tests as possible, to provide the basis for item one above, and (3) a report that clearly lays out the findings relative to items one and two above. Various attendees will attempt to pull this information together, but collaborative funding may be needed to produce the desired results. Also, while industry likes the idea of lower cost continuous monitoring equipment relative to costly sample and lab testing methods, it is concerned that the Government will use this type of monitoring for enforcement and/or to make regulations more stringent.

DOE Industries of the Future Exposition and Symposium – Feb 7-9, 1999

DOE organized a very successful Expo in Washington DC. Over 1000 industry people attended the Expo. There were in excess of 150 exhibitors. The CPNG Target and the CMP/CMF Targets displayed an EPRI Booth. We were provided the booth space right next to the DOE Booth, and in the entrance hallway of the exposition. In this way, EPRI received a lot of visibility, both by the industry, and by the Government.

EPRI was acknowledged as a powerful partner by all DOE speakers. The DOE's "Industry of the Future Vision", and the subsequent "Roadmaps" have been extremely well received by the industry. The DOE also acknowledged that EPRI has been participating in the development of both the vision and the roadmap (in Chemicals & other industries).

There is opportunity for EPRI to obtain grants from the DOE for R&D on futuristic electrotechnologies.

Gas/Electric Partnership Workshop and Steering Group Meeting -

The workshop on Operational/Economic Synergies will be held May 20-21 at El Paso Energy in Houston. Topics are Electric Compression on Gas Pipelines, Gas and Electric Dispatch, and Power Supply Issues for Gas Pipelines. Lead Underwriters are AEP Resources Service Co., El Paso Energy, and Siemens Energy & Automation, Inc. Lead Sponsors are ABB, Inc., Ariel Corporation, Central & South West Services, Columbia Gulf Transmission Co., New Century Energies, and Reliant Energy HL&P. Presentations will be made by El Paso Energy, Texas Eastern Transmission (Duke Energy), AEP Resources, Inc., TVA, Florida Gas Transmission, and other invited speakers. The Partnership Dinner will be at the Houston Petroleum Club. Gas and electric companies will meet in a steering group meeting held Friday morning, May 21. Contact Dick Schmeal for further information, 713/529-3216.

Chemicals & Petroleum Utility Steering Committee Meeting –

This important meeting will shape the future of the Center. It is being held May 26-27 in Salt Lake City, UT. Two additional highlights of the meeting in addition to helping to shape the future of the Center are the Petrochemical Industry Overview Course (described in a later section of this Monthly Report), and the dinner talk on the Wastewater Problems Solution Alliance (WPSA), previously described in the February, 1999 Monthly Report. Announcements for sign up have been sent out by e-mail in March.

We would greatly appreciate your early sign up to make this meeting as productive as possible, and to insure your convenience. Lynn Stone (lstone@epri.com) needs early information to make appropriate dinner/hotel arrangements. Sam Woinsky (epripc1@ix.netcom.com) needs early information to order the Petrochemical Text Books for the course, and to facilitate obtaining the best speaker for the dinner. Using e-mail for meeting sign ups is in line with our moves to improve the efficiency of our operations. Your assistance in this matter will be greatly appreciated. Thanks for your help in advance.

If you need additional information, please call Sam Woinsky at 281/419-1122.

Center for Waste Reduction Technologies (CWRT) Meeting –

We attended the CWRT Meeting in Houston. One key accomplishment was to influence the direction of a future CWRT Workshop. The original title of the workshop was to be Water Reuse. We were able to get that changed to Wastewater Reuse Solutions. This gives us an opportunity to explore for opportunities for the Wastewater Problems Solution Alliance (WPSA).

Also, we will provide some “sweat equity”, and get to co-host the workshop in exchange. This will enhance our ability to find opportunities for WPSA.

Other topics of interest discussed at the general meeting included: Biofiltration for VOCs control, Total Environmental Cost Assessment, Combined Economic/Environmental Sustainability Metrics, Phytoremediation (use of plants for waste management), Development & Design for combined Inherent Safety/Pollution Prevention, CWRT/EPRI Continuous Particulate Monitoring Workshop (described in February Monthly Report), Novel Reactors, Recovery of Small Molecules from Dilute Solutions, Biomass Management, Improved VOC thermal Oxidation Destruction Technology, Novel Granular Activated Carbon Filtration System for Contaminated Stormwater Treatment, Supported Liquid Membranes, and Biotreater Respirometry (a measure of the health of the bugs to avoid disastrous shutdowns of biotreater systems). These topics give us a feel for the areas that are of interest to electric utility chemical industry customers, and these meetings provide opportunities to make contacts that can lead to TC and business opportunities for utility companies in the environmental end of the Chemical Industry.

A presentation was also given by SUSTECH (a European organization similar to CWRT). Collaboration between CWRT and SUSTECH is under consideration. This would open a window on European opportunities, as well as a window on technologies that have been successfully applied in Europe, but have not yet been applied in the U.S.

CWRT Novel Unit Operations for Source Reduction Workshop –

We attended this meeting following the general CWRT meeting described above. For some time now since the EPA made it clear that it wants industry to avoid making pollutants in the first place rather than have to clean things up at the end of pipe, the buzz words have been source reduction, pollution prevention and waste reduction. They are all the same thing, and you customers are pursuing them with a vengeance since the EPA is willing to cut them some slack on end of pipe requirements, if they show they are making progress in cleaning up their act in the first place. Also, Source Reduction, etc make for both good economics (when applied properly) and good public relations. Hence, the high interest in CWRT and this type of workshop.

The topics covered at the workshop included: Process Intensification (Less Waste for Fewer Dollars - the Hige TC opportunity is an example of this), Novel Temperature Controlled Reactor Technology for Increased Productivity, A Novel Flow Photoreactor, An Efficient Super Capacity Gas/Liquid Contactor (may be useful in expanding the scope of our Advanced Distillation TC opportunity), Advances in Oxidation of Asphalt Fumes, Room Temperature Ionic Liquids as Alternatives to Organic (reaction solvents), Intensive Structuring by Flow Induced Phase Inversion, Good Mixing & Good Design (a plea for more intensive mixing to solve process problems which would lead to more electric load) and Ultrasonic Enhanced Unit Operations.

There was also a talk by SUSTECH on the European experience in obtaining cooperation on process intensification. People were obviously interested in the subject since a workshop that

was held was well attended. However, the attendees were not willing to open up relative to their company's experience, showing how competitive this area is. We were a little more successful at this CWRT meeting, but this still remains a very sensitive and competitive area, since it gets to the heart of a company's competitive edge.

Petroleum Environmental Research Forum (PERF) – Spring 1999 Meeting at Lawrence Berkeley National Lab

PERF is a petroleum industry collaborative group – focus is on environmental issues related to the petroleum industry (oil production & refining). Membership to the group is strictly restricted to oil companies (currently 24 largest oil companies worldwide are members). EPRI has been invited from the past one year to participate in the meetings as an observer. PERF is interested in collaborating on projects with the electric utility industry.

We will provide details of the March 10-11 meeting in a subsequent Monthly Report. Here are some excerpts of the December 1998 meeting that was held at Unocal in Brea, California.

Most of the discussions at this meeting focused on the MTBE issues, and the forthcoming legislature in the State of California to ban the use of MTBE as a gasoline additive in the future. The majority of the discussions were on studies related to the toxicity and health effects of MTBE. Some innovative electrotechnologies, such as Phytoremediation, for the removal/destruction of MTBE were discussed.

For more details of the PERF program, please contact Ammi Amarnath.

1999 Industrial Energy Technology Conference (IETC) –

This annual conference and Energy Managers Workshop will be held in Houston May 11-13, 1999. The conference addresses issues and solutions on energy and environmental concerns affecting industrial facilities. This year's sessions include: Efficient Operation of Steam Systems, System wide approaches to Energy Efficiency, Combined Heat and Power, Best practices, Issues on deregulation, and Equipment Operations.

Since EPRI is on the IETC Advisory Board, we may be able to get you a discounted pass for the meeting. If interested, please contact Ammi Amarnath.

1999 Gas Machinery Conference and Exhibition -

The 1999 Gas Machinery Conference (GMC) will be held October 4-6 in Houston. The GMC attracts a select group of 400 design & operating engineers and technicians responsible for the performance, efficiency, safety and reliability of gas compression equipment. The focus of the Conference is on the operation, maintenance and testing of gas compression machinery. GMC also targets new technology applications that improve both the reliability and cost effectiveness of gas compression.

EPRI, along with other utilities, will be participating in an Electric Compressor Technology Exhibitor Booth, to promote the installation of electric motor drive technology for applications in gas transmission, processing and storage.

We are soliciting your involvement in this important event. Benefits of participation in the Exhibitor Booth include:

- How to increase kilowatt-hour sales for your company by identifying new projects or conversions
- Meet important, new sales and business development contacts
- Educate the gas industry on the advantages of electric drive technology
- Learn the competitors' (engine and gas turbine manufacturers) selling techniques
- Gain visibility for your company's services and capabilities
- Network with key gas industry decision-makers
- Form trade alliances with equipment manufacturers, engineering companies and others with similar interests in electric compression
- Position your company within the gas industry marketplace for new business

For cost information and more program details, contact Ammi Amarnath.

VIII. Details of EPRI SS&T Projects:

Microwave Effects on Liquid and Solid State Materials Processing – University of Florida

Program goals for the program under the direction of Dr. David Clark include a study of surface modification in glasses, design of high-temperature hybrid heating susceptors and evaluation of these susceptors through sintering studies on alumina, and combustion synthesis to form composites.

Surface flaws in glass severely limit its strength (8 to 10 ksi) and its failure is always tensile in nature. The strength can be increased significantly by incorporating compressive stresses into the glass surface through an ion exchange process for surface modification method based on a chemical technique based on ion exchange by diffusion. The glass is immersed in a molten salt bath at a temperature well below the softening point of the glass. When ion exchange takes place, smaller ions are replaced by larger ions in the surface layers (K^+ for Na^+), thus densifying and generating a high compressive stress (50 to 100 ksi). During the course of these experiments, it has been shown that, by using microwave energy as a heat source for ion exchange reactions, the rate of exchange can be enhanced and deeper penetration of the alkali ions into a glass matrix can be achieved. In recent experiments conventional heating and microwave heating (800 watts) at 400C and 500C for 4 hours as well as microwave heating (2400 watts and 3200 watts) at 400C for 30 minutes were studied.

Many ceramic applications require the use of high temperatures to achieve full densification. The objective is to design a susceptor for microwave hybrid heating which will accommodate multiple samples and be capable of reaching and maintaining high temperatures ($\geq 1500^\circ C$) for sintering ceramics. The system being examined for this study is a high-purity alumina. To date the contractor has completed densification study on 15-gram pellets of Coors AD998 alumina powder processed using microwave hybrid heating and conventional furnace firing. He has also characterized Coors AD85 alumina powder using thermal gravimetric analysis (TGA) and differential thermal analysis (DTA).

Microwave Combustion Synthesis, also referred to as self-propagating high-temperature synthesis (SHS), has been used by researchers to form composite materials. A heat source is used to ignite an exothermic reaction between two or more materials to form the final composite composition. Microwave energy can be used to ignite these reactions. However, due to the internal heating mechanism involved in microwave processing, ignition takes place in the center of the sample rather than at a surface. As the combustion wavefront progresses through the material, it spreads radially outward from the center of the compact or powder sample. Additionally, in “sluggish” reactions as those which take place between aluminum, titanium and carbon powders to form an alumina/titanium carbide composite, the rate of the combustion wavefront actually can be controlled by controlling the power and duty cycle of the applied microwave energy. Experiments are being designed and conducted to determine the potential for controlling the porosity of the composite product by controlling the rate of the reaction wave front. Additionally, a relationship between the reaction rate and the extent of reaction is being

established. Microwave processing may provide the first method by which SHS reactions can be controlled without the need for altering the composition of the starting materials. Progress includes preparation and synthesis of stoichiometric ratio samples in a modified home-model microwave oven (800W, 2.45GHz) using both microwave and microwave hybrid heating to study the effects of sample size and microwave duty cycle.

Electrochemical Promotion of Ammonia Synthesis with Electrically Promoted Catalyst Pellets – University of Patras

The objective of this 3-year exploratory research project is to investigate the basic feasibility of achieving substantial increases in the rate of ammonia synthesis through application of electric currents or potentials to ammonia synthesis catalysts deposited on ionically conducting supports.

The scientific basis for this electrochemical promotion effect has been established over the past decade through a series of investigations (many of them directed by Professor Costas Vayenas) which covered a wide range of chemical reactions, catalysts and ionically conducting catalyst supports. If the applicability of this effect to ammonia synthesis can be shown in laboratory experiments, the scientific basis will be established for exploration and development of practical applications in the industrial synthesis of ammonia.

A possible benefit of such a radically new industrial use of electricity could be the possibility to conduct ammonia synthesis under milder process conditions (reduced temperature and pressure) which could reduce process costs. Although the amounts of electricity used in electrochemical promotion are expected to be relatively small and thus not a significant cost factor per unit of (ammonia) product, the total amount of electricity used in ammonia synthesis could nevertheless be quite large because of the very large amounts of ammonia produced in the U.S. and worldwide.

The technical approach taken in this project involves three phases. In the first year (1997), experimental techniques were developed to deposit catalysts typically used in industrial ammonia synthesis on ionically conducting supports and to explore conditions under which a positive electrochemical promotion effect is observed in the decomposition of ammonia, the reaction used in industry to screen catalysts for ammonia synthesis. Although a number of experimental difficulties were encountered in depositing representative iron-based, potassium-promoted catalysts on several different types of proton and potassium ion conductors, small positive effects were eventually observed.

In the second phase (1998), electrochemically promotable catalyst-support combinations were evolved which eventually permitted significant acceleration of ammonia decomposition (above the rates representative for industrial ammonia synthesis catalysts) to be achieved. On that basis, the decision was made to move forward with the third phase: study of electrochemical promotion of ammonia synthesis using the catalyst-support systems and investigative techniques developed for ammonia decomposition. This required construction of a laboratory high pressure ammonia synthesis reactor for study of the promotion effect under representative industrial process temperature and pressure conditions.

The objective of the third and last phase in 1999 is to achieve significant electrochemical promotion of ammonia synthesis under these conditions and, if successful, to conceptualize possible ways of applying the electrochemical promotion effect under industrial process conditions. The team at the University of Patras has now successfully fabricated ion conductor-supported catalysts and established baseline temperature and pressure conditions for ammonia synthesis. Investigation of the catalytic effect(s) of applying currents to the catalyst-support systems under ammonia synthesis conditions is just beginning.

TARGET 23 - Chemicals, Petroleum & Natural Gas

Progress Report for 2nd Quarter, 1999
April – June 1999

A Report to the Target's Membership

I. Calendar of Events (*EPRI Meetings in Italics*)

- 5/10-13/99 Industrial Energy Technology Conference (IETC), Houston, TX – Industry Meeting (COMPLETED)
- 5/20-21/99 *Gas/Electric Partnership Workshops, Houston, TX - EPRI Meeting (COMPLETED)*
- 5/26/99 *Petrochemical Industry Overview (in conjunction with C&P Steering Meeting) – EPRI Meeting (COMPLETED)*
- 5/26-27/99 *C&P Steering Committee Meeting, Salt Lake City, UT – EPRI Meeting (COMPLETED)*
- 7/14-15/99 CWRT General Sponsor Meeting, Granville, OH – Industry Meeting
- 10/4-6/99 Gas Machinery Conference, Houston, TX – Industry Meeting
- 10/12-13/99 PERF Fall Meeting, Chicago, IL – Industry Meeting
- 10/21-22/99 CWRT Separations Workshop – Industry Meeting
- 10/26-27/99 Gas/Electric Partnership Workshop, Houston – Industry Meeting (EPRI Advisory)
- 11/7-11/99 International Forum on Electrolysis in the Chemical Industry, Clearwater Beach, FL – Industry Meeting
- 11/9-10/99 CWRT Fall Meeting Hosted by Monsanto, St Louis, MO – Industry Meeting
- 11/10/99 CWRT/EPRI Water Management Workshop, St Louis, MO – Industry Meeting (open to electric utilities)

11/11/99 C&P Steering Committee Meeting, St Louis, MO – EPRI Meeting (note the change from 11/17-18/99 in Houston)

TBD Petroleum Refining Overview (on demand) – EPRI Meeting

IIA. Customer Technology Opportunities (Base Budget)

1. Enhanced Oil Recovery Scoping Study –

Work continues on this project aimed at identifying current and future technologies and business opportunities for our member utilities. The status is as follows : Characterization of Current Commercial Technologies Completed, Characterization of Emerging Technologies 75% Complete, Characterization of Current EOR Production by State 75% Complete, Characterization of Potential New EOR Production by State 50% Complete, and Characterization of Applicable Reserves by State 75% Complete. The final report should be published in October.

2. Energy Services Kit for the Supply Side of Industrial Facility:

This kit primarily consists of:

- m. Fuel & Power Procurement
- n. Fuel Switching
- o. Fuel Management
- p. Risk Management for Fuel Procurement
- q. Power House Outsourcing
- r. Cogeneration and Merchant Plant Development

The work was reported at the May 1999 Steering Committee meeting in Salt Lake City. The members felt that it is important to maintain the confidential information of utility companies. Therefore, the kit is being redesigned to meet members' needs.

3. Maximizing Process & Waste water Reduction for the Process Industries -

Work is underway to develop a report that addresses and lists the various evolving technologies in heterogeneous and homogeneous separations utilizing membranes, electrodeionization, electrolysis, mass pinch techniques and other wastewater treatment processes. The report will address the application potential and benefits to EPRI Member Utilities and their customers in the process industries. This report is one tool among a number of other tools that we plan to use to help find legitimate homes for electrotechnologies such as freeze concentration, etc.

II B. Customer Technology Opportunities (SS&T Budget)

The following projects are on-going. Details are provided in the Appendix of this report.

- a. Microwave Effects on Liquid and Solid State Materials Processing – University of Florida
- b. Electrochemical Promotion of Ammonia Synthesis with Electrically Promoted Catalyst Pellets – University of Patras
- c. Liquid Membrane Technology Development Project at Facilichem
- d. Micellar Systems for Modulating Microwave Heating of Chemical Reaction Processes – MIT

III. Customer Technology Opportunities (TC Projects)

1. Pinch Technology Process Optimization –

The work under this Pinch study has been completed. We are waiting for the customer's approval, prior to publishing the results. We expect to provide more information in the next report.

2. Wastewater Problem Solutions Alliance (WPSA) & Market Assessment of Wastewater Management Opportunities: A Collaborative/ Proprietary Project (TO-111894) -

An E-mail Alert on this opportunity was sent out in March. There has been considerable interest, and in April, we develop a phased statement of work covering the various aspects of what the Alliance has to offer our Members and their customers. It is available upon request. Please contact Ammi Amarnath at 650/855-2548; 650/855-8574 (fax), or aamarnat@epri.com (e-mail). Also, a presentation on the Alliance was given at the May 26-27, 1999 C&P Steering Committee Meeting. Our members recommended that Pell Frischmann Engineering put one or two people in British Gas' Houston Office to support the Alliance. This option is being discussed with Pell Frischmann and BG Technology.

For more information on the Wastewater Market Assessment, contact Sam Woinsky at the Chemicals, Petroleum & Natural Gas Center (281/419-1122).

3. Wastewater Reduction Through Mass Pinch Technology -

This is a new technique for reducing wastewater by source reduction. It determines bottlenecks in the process that result in waste and identifies low cost projects to modify the processes to eliminate these bottlenecks. The technique (which is analogous to thermal pinch) relies on a new methodology and requires application of software.

We are seeking TC projects, including innovative projects in California. This project is a collaborative effort between the CPNG Target, the MWW Target, and the CMP Target.

4. Enhanced Oil Recovery (EOR) TC Project –

Contracts were signed in April for a TC project which leverages off of our base funds EOR project, to find specific business opportunities for the funding utility in their service territory. The first conference call on this project was held early in May. The opportunity to find specific business opportunities in your service territory through an individual TC is available to you. If you are interested, please contact Ammi Amarnath at 650/855-2548; 650/855-8574 (fax), or aamarnat@epri.com (e-mail).

5. Pharmaceutical Industry Market Assessment SOW –

We developed a Statement of work in March. It is available upon request. Please contact Ammi Amarnath at 650/855-2548; 650/855-8574 (fax), or aamarnat@epri.com (e-mail).

6. Freeze Concentration of Hazardous Wastewater (TO-112201) –

This prospectus went out with the March EPRI Customer Assistance Mailing, and a blurb was included in the March issue of Industrial News Today. If you are interested, please contact Ammi Amarnath at 650/855-2548; 650/855-8574 (fax), or aamarnat@epri.com (e-mail).

6. a Freeze Concentration Statement of Work –

In April, we prepared a statement of work for a member utility, aimed at identifying specific opportunities for introduction of the technology in their service territory. This statement of work can be modified to apply to other members. If you are interested, please contact Ammi Amarnath at 650/855-2548; 650/855-8574 (fax), or aamarnat@epri.com (e-mail).

7. Direct Osmosis Concentration of BioSludge –

This technology was first applied for applications such as concentration of tomato paste and wine. In mid 1998, the technology was commercially applied for landfill leachate concentration at 5 Tons/hr (0.5 MW). The technology is ideal for biosludge concentration due to its high tolerance for free solids. We are currently seeking interest from members, before developing a TC proposal. If you are interested, please contact Ammi Amarnath at 650/855-2548; 650/855-8574 (fax), or aamarnat@epri.com (e-mail).

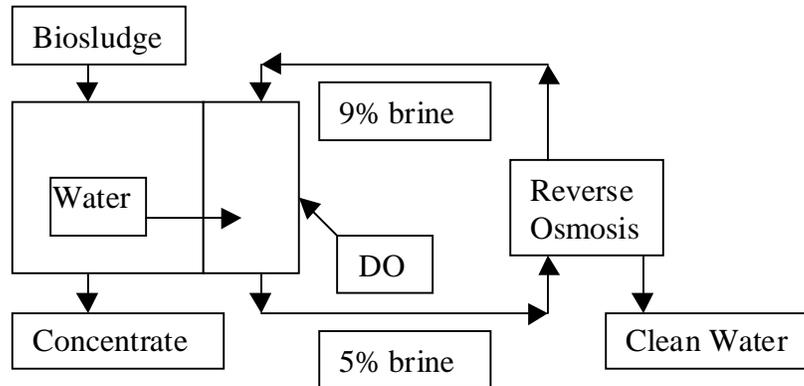


Figure 1: Direct Osmosis System

8. Electrolytic Destruction/Modification of Hydrocarbons in Wastewater –

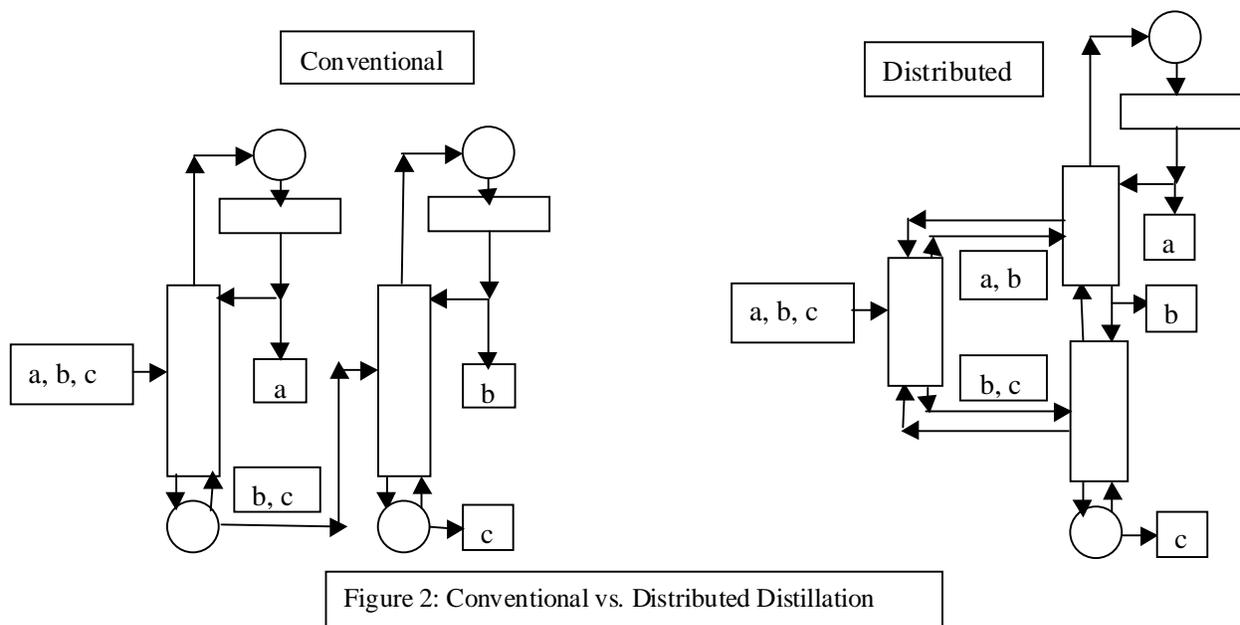
This technology was uncovered by the EPRI FACT Office for removal of color from wastewater. Our Center recognized that it could be applied for benzene ring compounds. We attended the FACT Steering Meeting in 10/98 and learned the following: (1) pollutants successfully destroyed to low PPB levels (aromatics/phenols/nitroaromatics/alcohols/ carboxylic acids/aliphatics /amines/ halogenated compounds/microorganisms), (2) nothing added except electricity (no solids or odors), (3) costs are dependent on conductivity/type of molecule/concentration change/extent of destruction, (4) technology can be applied so pollutants go to CO₂ and H₂ or less toxic material (i.e. benzene to acetic acid), (5) the cost is from \$0.5 to \$2/1,000 gal for some applications, (6) potentially usable upstream of evaporators and biotreaters, and for mixed organic/inorganic streams, (7) successfully demo'ed on textile, food and fine chemicals effluents, and (8) there is an existing 125 gpm pilot unit, and 0.25 gpm desktop unit (available for purchase or lease for proprietary self testing). This technology is a candidate for the WPSA trailer we are planning.

We are currently seeking interest from members, before developing a TC proposal. If you are interested, please contact Ammi Amarnath at 650/855-2548; 650/855-8574 (fax), or aamarnat@epri.com (e-mail).

9. Advanced Distillation –

This technology is making inroads in Europe. The technology has the potential for doubling capacity at half the cost of conventional means in many revamp situations, while halving the energy required per pound of product. The technology also has the potential for increasing electric load in separation of liquids from gases (propylene recovery from cat cracker off gas, natural gas liquids recovery, etc.). EPRI has a contract with a consultant who is probably the most knowledgeable practitioner in the area. An engineering firm is also involved. The consultant holds many patents in the area, which are improvements to a concept called distributed distillation.

We are seeking to develop TC projects using dynamic simulation for proof of concept for specific revamp situations. The member's share of such a project would be in the \$75,000 to \$100,000 range. If you are interested, please contact Ammi Amarnath at 650/855-2548; 650/855-8574 (fax), or aamarnat@epri.com (e-mail).



10. Pharmaceutical Industry Market Assessment SOW –

We developed a Statement of work in March. It is available upon request. Please contact Ammi Amarnath at 650/855-2548; 650/855-8574 (fax), or aamarnat@epri.com (e-mail).

11. EPRI-DOE Roadmapping Workshop on Electrotechnologies and Alternative Reactions Mechanisms -

EPRI comments were provided to the DOE. Based on this, the DOE has announced a Chemical Industry of the Future solicitation

12. HydroCom Field Evaluation Project: El Paso Energy Electric Compression Initiative –

El Paso executives are still yet to make a final decision on the project on how to move it forward.

1. Capacity Control using Voith Mechanical Variable Speed Drives: Texas Eastern Initiative –

A project has been developed with Texas Eastern Transmission to deploy and evaluate mechanical variable speed drives for capacity control at the Mt. Pleasant, TN compressor station. These variable speed couplings require relatively low capital investment and offer superior returns relative to alternative capacity control technology where a moderate range of operating flexibility is needed. Furthermore, the project will increase station capacity by 10,000 HP. There are similar applications in other compressor stations in the Texas Eastern system.

IV. Technical Assistance, Customer Support, and Business Partnership Opportunities

1. Petrochemical Industry Overview Course –

The Petrochemical Overview Course was presented in conjunction with the Chemicals & Petroleum Steering Committee Meeting on May 26, 1999 in Salt Lake City, UT. Work has been completed on preparing an abbreviated version of the course in electronic form for inclusion on epriweb. It should be on the web in July.

The course abstract is as follows:

This overview course covers the past, present and future of the U.S. Petrochemical Industry from an electric utility prospective. The course starts with the emergence of the Petrochemical Industry in 1920, when Standard Oil of NJ first made Isopropyl Alcohol in large volume, starting with propylene extracted from off gas from the thermal cracking process that was then used to increase Gasoline production yields. It traces the expansion of the industry from this one major chemical byproduct to a worldwide highly technical business (involving major chemical companies as well as petroleum companies) that uses sophisticated conversion processes to make a wide variety of commodity and specialty chemicals (primarily organics, but including some inorganics). This very diverse and changing industry is first covered in summary form, and then attention is focused on the primary petrochemical building blocks that makeup over 75% of all industrial organic chemicals (olefins and aromatics) and the various products that are derived from them in the production train. The objective is to greatly simplify a very complex subject,

and provide electric utility sales personnel with information which will help them focus on areas where they can get the best returns for their efforts. In addition, industry trends and their (business and technological) implications for electric utilities are covered.

2. U.S. Refineries Database –

We have developed a **complete list** of all U.S. Refineries in March; this includes owner, location, and capacity. It is available upon request. Please contact Ammi Amarnath at 650/855-2548; 650/855-8574 (fax), or aamarnat@epri.com (e-mail).

3. Plasma Destruction of Wastes –

We completed work on a white paper on this subject in April. It is available upon request. Please contact Ammi Amarnath at 650/855-2548; 650/855-8574 (fax), or aamarnat@epri.com (e-mail).

4. Statewide Chemical Plant Survey –

In March, we obtained contact information for 290 chemical plants in one state for a study we will be doing for a Member. In April, this information was segregated into a short list for a telephone survey, the survey questionnaire was developed, and the survey calls were initiated. In May, a data base was initiated. The draft report on this project should be available to the specific member in July.

We would be happy to provide similar statewide reports to other members, under a TC/CF Contract arrangement.

5. Synthesis Gas Production From Petroleum Coke -

Synthesis gas (syngas) production from green or fuel grade petroleum coke is becoming important in both the U.S., and other parts of the world. The trend to the use of heavier crude oils results in increased production of petroleum coke, increased impurities (sulfur, nitrogen, metals) in that coke, and a higher demand for the use of hydrogen at petroleum refineries. In many instances, the petroleum coke has a negative value, since it can't be sold, and has to be disposed of off site, at considerable cost. Therefore, converting petroleum coke to hydrogen solves these two problems at refineries. In addition, chemical production complexes are usually sited near or within petroleum refineries, providing the opportunity to convert some of the syngas into higher value chemicals. This combination allows for economy of scale, efficiency, and operational flexibility. In addition, the syngas can be used to drive electric turbines, thus resulting in Trigeneration (the combined production of electricity, steam and chemicals – including hydrogen), which further enhances opportunities for economy of scale, efficiency, and operational flexibility. A white paper was prepared on this subject for one Center Member. A nonconfidential version can be prepared for other Center Members. If you are interested, call Sam Woinsky at 281/419-1122.

6. DOE 3rd Industrial Energy Efficiency Symposium & Exposition -

The EPRI Chemicals, Petroleum & Natural Gas Center was a cosponsor of this meeting. In addition, The EPRI Chemicals, Petroleum & Natural Gas Center, The EPRI Center for Materials Fabrication, and The EPRI Center for Materials Production co-hosted a booth at the Expo. The Expo was a notable success. This year's theme of Discover Why 2020 Is Better than Hindsight revolved around what American industry might look like in the year 2020. Nearly 1100 attendees from all over the U.S. came together to share ideas about how to improve energy efficiency and competitiveness and reduce waste. Work has been completed on preparation of a summary of this important meeting for inclusion on Eprweb. The meeting minutes should be on the web in July.

7. 1999 Industrial Energy Technology Conference (IETC) –

This annual conference and Energy Managers Workshop was held in Houston May 11-13, 1999. The conference addressed issues and solutions on energy and environmental concerns affecting industrial facilities. This year's sessions included: Efficient Operation of Steam Systems, System wide approaches to Energy Efficiency, Combined Heat and Power, Best practices, Issues on deregulation, and Equipment Operations.

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- Network with key gas industry decision-makers
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- Position your company within the gas industry marketplace for new business

For cost information and more program details, contact Ammi Amarnath at 650/855-2548; 650/855-8574 (fax), or aamarnat@epri.com (e-mail).

9. *The 13th International Forum on Electrolysis in the Chemical Industry -*

The 13th International Forum on Electrolysis in the Chemical Industry, which will be held in Clearwater Beach, FL on 11/7 through Noon on 11/11/99. For cost information and more program details, contact Ammi Amarnath at 650/855-2548; 650/855-8574 (fax), or aamarnat@epri.com (e-mail).

10. *DOE's Steam Challenge Program –*

The EPRI CPNG Center represented the electric utility interest in the DOE Steam Challenge Program. We will also represented our members' interest in the DOE's new CHP Challenge Program. More information will be available in the next quarterly report.

V. *Marketing and Communication Tools*

1. *Center's Publications List -*

In March, we developed a comprehensive electronic list of all of the Center's publications through 12/31/98. It is available upon request. Please contact Ammi Amarnath at 650/855-2548; 650/855-8574 (fax), or aamarnat@epri.com (e-mail).

2. *Mass Pinch Case Studies - TechApplication*

In April, we obtained detailed information on two mass pinch studies done at Solutia facilities in Illinois and Alabama. Work has started on preparation of both a TechApplication and a TechCommentary on the subject.

3. *Freeze Concentration of Hazardous Aqueous Wastes - TechApplication*

A draft TechApplication on the successful first commercial application of this technology for hazardous wastewater concentration has been prepared for us by Niro, the technology developer. This application is at a 2MW load level. We are reworking the draft, and seeking Shell approval, so that we can then publish.

4. Other Publications (that are in the works at the CPNG Center)

<u>Pub Type</u>	<u>Title</u>	<u>Funding/Client</u>	<u>Due Date</u>	<u>Status</u>
TR	EOR Scoping Study	Base/Dilbert	Oct-99	expect draft 9/15/99
Conf. Report	TC EOR Study	TC/Client	Nov-99	should have draft 10/15/99
TR	WW Scoping Study	Base/Dilbert	Oct-99	expect draft 9/15/99
Conf. Report	Freeze Con Scoping	TC/Client		expect draft 11/15/99
Conf. Report	Freeze Con Scoping	Client		expect draft 11/15/99
TR	Freeze Con Scoping	Base & TC/Dil.	Jul-99	should have draft 12/15/99
TA	Freeze Con Scoping	Base/Dilbert	Oct-99	writing draft
epriweb	Petrochem Overview	Base/Dilbert	Jul-99	http://www.epriweb.com/iat/cp/index.html
epriweb	DOE Conference	Base/Dilbert	Oct-99	http://www.epriweb.com/iat/cp/index.html
epriweb	CWRT/EPRI PCEM	Base/Dilbert	Oct-99	http://www.epriweb.com/iat/cp/index.html
TA	Polyolefin	Base/Extra one		Submitted to publisher
TA	Koch Heavy Crude	Base/Extra one		Submitted for review
TA	Vitamin C from corn	Base/Extra one		Asked end user Eastman to write
TA	BFW Electrodeionization	Base/Extra one		Asked Glegg to write/end user Eastman ok'ed
TC	Sonic Crystallization	Base/Extra one		Asked AEA to write/ users confidential so TC
TA	Microwave Emulsion Breaking	Base/Extra one		Asked developer to write
TA or TC	Advanced Distillation	Base/Extra one		Asked Stone & Webster contact to write
TA or TC	Zenogen Low Sludge Biotreater	Base/Extra one		Asked Zenon Environmental to write
TA	3D Cathode for Heavy Metals	Base/Extra one		Asked developer to write
TC	Ind. Refrigeration, Chilling and AC	Base/Extra one		Asked Vendor to write
TA	Carbon Dioxide EOR	From 1998		On hold

VI. One-Stop Access to All Products and Services

1. CPNG Office Addresses -

As you may be aware, we have moved our Center to a new location in the Houston area. The Center's new address and phone/fax numbers are: 47 Quiet Oak Circle, The Woodlands, Texas 77381, Ph: (281)419-1122, and Fax: (281)419-0811. The e-mail address for Sam Woinsky is the same as before (epripc1@ix.netcom.com).

Sam will handle all routine member requests. If there are specific questions that can be best answered by our Center Consultants (Dick Schmeal, Jim Kumana, Charles Byers), he will discuss such requests with them, and respond back to you in a timely manner. Please also feel free to contact Ammi Amarnath, for any technical or operational questions. The address is: EPRI, 3412 Hillview Avenue, Palo Alto, CA 94304, Ph: 650/855-2548, Fax: 650/855-8574, E-Mail: aamarnat@epri.com.

Please forward the new address to appropriate people within your Company.

2. Epriweb –

EPRI's web activities are undergoing a major overhaul. The EPRI site and the eprweb site will be combined into 1 single home page. The Target will be incorporating a majority of its products on the web. Please review the site from-time-to-time, and let us have your comments.

VII. Advisory Committee Participation

1. Gas/Electric Partnership Workshop and Steering Group Meeting -

The workshop on Operational/Economic Synergies was held May 20-21 at El Paso Energy in Houston. Topics were Electric Compression on Gas Pipelines, Gas and Electric Dispatch, and Power Supply Issues for Gas Pipelines. Lead Underwriters are AEP Resources Service Co., El Paso Energy, and Siemens Energy & Automation, Inc. Lead Sponsors are ABB, Inc., Ariel Corporation, Central & South West Services, Columbia Gulf Transmission Co., New Century Energies, and Reliant Energy HL&P. Presentations were made by El Paso Energy, Texas Eastern Transmission (Duke Energy), AEP Resources, Inc., TVA, Florida Gas Transmission, and other invited speakers. The Partnership Dinner was held at the Houston Petroleum Club. Gas and electric companies met in a steering group meeting held Friday morning, May 21. The meeting was a great success, and was given as an illustration of how we should be interacting with industry at the Chemicals & Petroleum Utility Steering Committee Meeting.

2. Chemicals & Petroleum Utility Steering Committee Meeting –

This important meeting was held May 26-27 in Salt Lake City, UT. Two highlights of the meeting in addition to helping to shape the future of the Center were the Petrochemical Industry Overview Course (described in a previous section of this Report), and the dinner talk on the Wastewater Problems Solution Alliance (WPSA), previously described in the February, 1999 Monthly Report. Minutes for the meeting including action items are shown below

May 26-27, 1999 C&P Steering Committee Meeting Notes

[Action items are marked with an (*)]

- a) Prioritizing activities is key for 1999 and 2000. Usually we prioritize at the Fall meeting, and provide information at the Spring meeting. This Spring, our members were asked to help prioritize because of tight budgets.
- b) (*) Our members need help understanding where the money goes, so it is easier to make fund/no-fund decisions.
- c) Cutting things into smaller and smaller parts makes it difficult for members, and takes away from value.
- d) (*) We need to help our members with their business, but not give them here, this is what we have to sell.
- e) Power quality and reliability are important. Utility customers expect reliable power, but know power will go out. Then, they want to know when it will come back on.
- f) Deregulation savings will not be there until we are through stranded costs.
- g) Low cost power States don't want deregulation.
- h) EPRI is now a matrix organization. Product Managers build the products using expertise from Application Divisions as needed.
- i) (*) Members asked, who tells Product Managers what to build? Members want to help EPRI decide what to build.
- j) Members can call 800-313-3774 for products.
- k) (*) Members want to see specific dollar savings that were achieved by EPRI's cost cutting moves.
- l) (*) Members want to see what paid in 1999 versus what got in 1999, plus what will pay in 2000 and what projects they will receive in 2000.
- m) The new emphasis at EPRI is to do things internally. Overhead restructuring was done towards this end. Members still see an increase in overhead, and warn that this can price us out of some markets.

- n) (*) There were \$16K and \$59K deductions from the budget that were not explained to Ammi, which Ammi has questioned. Ammi to share outcome, when he knows.
- o) (*) Pell Frischmann (PF) has a credibility problem, with no U.S. presence. Our members don't want to be embarrassed if they bring the Alliance to a customer, and PF then pulls out of the U.S. Our members recommend that PF put one or two of its people in BG's office in Houston. Ammi will explain the situation to PF.
- p) (*) In the energy services and water pinch areas, our members are interested in which types of companies would be good targets for which types of services.
- q) (*) For the Supply Side Marketing Kit, our members want knowledge in-flow, but are concerned about knowledge out-flow. They want to know who will do the work, and prefer that an EPRI employee does it. The product in 1999 should be a simple brochure explaining what industries are looking at. In 2000, we should offer courses. Then, possibly one-on-one projects.
- r) (*) Blake Gross is not receiving Industrial News Today. Sam Woinsky to correct that.
- s) (*) Our members want to know how much of our Target's funds go towards each of the EPRICAC product. Dave Rigney to let Bob Jeffress know, so he can come armed with answers for the next Council Meeting.
- t) Our members are in favor of cooperation between different targets.
- u) (*) Our members feel that EPRI has to sell end users, since the utilities can no longer do the selling. We can use base funds as long as it is done properly. Last gas meeting given as good example of how to sell EPRI. Ammi will give a strategy at the next C&P Steering Meeting on how to do this on the Chemicals and Petroleum side of the target.
- v) (*) The April and May monthly reports are to be combined to cover this Steering Committee Meeting.
- w) (*) The date and location of the next C&P Steering Committee meeting is to be changed to 11/11/99 in St Louis, so members can have the opportunity to attend the CWRT/EPRI Water Management: Issues, Technologies and Solutions Workshop to be held on 11/10/99 at Monsanto's facilities in St Louis.
- x) (*) Dave Rigney will provide 2000 pricing sheets to all of our Target's Steering Committee Members
- y) (*) Ammi will provide the 2000 Dilbert list at the November C&P Steering Committee meeting.

*3. Fall C&P Steering Committee Meeting and CWRT/EPRI Water Management Workshop – Important** Please note*

The date and location of the next Chemicals & Petroleum Steering Committee Meeting has been changed from 11/17-18/99 in Houston to 11/11/99 in St Louis, so Chemicals & Petroleum Steering Committee Members can have the opportunity to attend the CWRT/EPRI Water Management Workshop to be held on 11/10/99 at Monsanto's facilities in St Louis. This Workshop which is to be held in cooperation with The Center For Waste Reduction Technologies (CWRT) will focus on water management issues, technologies and problem solutions. There will be speakers from the Government, technology developers, vendors and process industry end users of electricity. Problems and issues will be identified, current and emerging technologies will be described, successes and failures will be described, and a path forward to potential collaborative projects will be developed. For more information, or if you want to participate, contact Sam Woinsky at 281-419-1122.

4. Industrial Energy Technology Conference (IETC) Board Meeting -

The Chemicals, Petroleum & Natural Gas Center participated in this planning meeting for the next IETC meeting, to be held on 4/4-6/00 in Houston. The Center will be chairing the following sessions: (1) Success Stories in Integrated Thermal and Water Management (code for Water Pinch), (2) New and Emerging Energy Technologies (code for electrotechnologies), and (3) Case Studies in Power Quality Successes. The chair of the Combined Heat and Power session (code for cogeneration) has not as yet been selected. The EPRI Chemicals, Petroleum & Natural Gas Center has a high probability of getting the co-chair spot for this session. We will keep you posted as things progress relative to this important meeting, which should be of great interest to you and your customers.

5. CWRT/EPRI Water Management Workshop Planning Meeting -

During the last planning meeting for the workshop, the planning group requested that Jimmy Kumana (EPRI Chemicals, Petroleum & Natural Gas Center consultant) make a presentation on Water Pinch Technology, Sam Woinsky make a presentation on “Why Water Management is Important to the Chemicals & Petroleum Industries”, and Pell Frischmann Engineering (part of the EPRI WPSA Alliance) make a presentation on success stories and the European perspective. In Addition, the following six emerging technology talks identified by EPRI will probably be Included in the workshop: (1) Freeze Concentration Crystallization Expands Into Water Recovery From Hazardous Wastes, (2) Glegg Water Industries High Capacity E-Cell for Electrodeionization of Boiler Feedwater, (3) Zeno Gem Low Sludge Biotreatment Technology, (4) Cooling Water Conservation Through The Use of Advanced Distillation, (5) 3D Cathode Heavy Metals Removal/Recovery, and (6) Microwave Emulsion Breaking. We will keep you posted as things progress relative to this workshop, which should be of great interest to your customers. For more information contact Sam Woinsky at 281-419-1122, at the EPRI Chemicals, Petroleum & Natural Gas Center.

APPENDIX

CPNG SS&T Activities (funded by EPRI SS&T Budget)

a. Microwave Effects on Liquid and Solid State Materials Processing – University of Florida

The goal of this research is to develop a working understanding of microwave interactions with materials that will enable targeted industrial operations to apply microwave technologies to product manufacturing. The project focused on the sol-gel-derived silica system and crystallization of silicate glasses to fabricate glass-ceramics. The three selected research for the current year include: surface modification of glasses, high-temperature hybrid heating susceptor design, and evaluation of these susceptors by sintering studies on alumina, and combustion synthesis to form composites.

Surface Modification Of Glasses: The major objective in this area evaluate the effects of microwave radiation on the ion exchange reaction of K^+ for Na^+ in the commercial glass. This goal is being achieved through the following activities: a) Conduct chemical/heat treatments on Corning glass in a conventional furnace and a microwave oven to draw parallels between the two processing methods. b) Measure the hardness of the as-received glass and samples subjected to chemical/heat treatments in order to study the kinetic effects (temperature and treatment time) as well as microwave power on the microhardness of the glass. c) Use FTIR to evaluate the glass samples subjected to chemical/heat treatments.

Glass is intrinsically a strong material with a theoretical strength in the range of 10^6 psi, but surface flaws reduce the actual to a few thousand psi. "Ion exchange" is a surface modification technique based on incorporating compressive stresses into the glass surface. Glass is immersed in a molten salt bath at a temperature well below the softening point of the glass. Larger ions, such as potassium, in solution are exchanged with smaller ions, such as sodium, in the glass surface. The strength of "ion exchange" glass products produced conventionally is limited by the thinness of the compression layer, which can be penetrated easily by a surface flaw. In addition, the conventional ion exchange process requires long periods of time in the oven, contributing to its high cost.

Microwave energy can be used as a heat source for ion exchange reactions with enhanced rate of exchange and deeper penetration of the alkali ions into the glass matrix. Superior results are achieved in significantly less time than the conventional process. Using a commercial glass

provided by Corning, Inc. (Corning, NY), experiments were conducted using conventional heating, direct microwave heating and microwave hybrid heating. Isothermal conditions can be maintained in the microwave environment at power levels of 1600, 2400 and 3200 watts for soak temperatures of 400° and 500°C. Hardness measurements indicated that microwave process increased the mean hardness of the glass samples. In the microwave environment, hardness increased with increasing applied microwave power, soak times, and soak temperature. An overall doubling of the strength of the glass was achieved.

Susceptors for Microwave Hybrid Heating: The objective is to design a susceptor (microwave susceptible mold) for microwave hybrid heating, which will accommodate multiple samples and be capable of reaching and maintaining high temperatures ($\geq 1500^{\circ}\text{C}$) for sintering ceramics. The system being examined for this study is a high-purity alumina used by government contractors to fabricate armor tiles. This goal is being achieved through the following activities: a) develop an insulated microwave chamber capable of sintering a batch of 15 to 20 alumina bars (0.8 cm x 0.8 cm x 5.8 cm) to 95% theoretical density in less than 1 hour, b) determine a sintering schedule that will optimize the mechanical performance of batches of microwave-sintered alumina test specimens, c) compare the densification, microstructure and mechanical properties of batch-sintered alumina bars produced by microwave (hybrid) sintering and by conventional firing.

To date a densification study on 15-gram pellets of Coors AD998 alumina powder processed using microwave hybrid heating and conventional furnace firing was completed. In addition, Coors AD85 was characterized alumina powder using thermal gravimetric analysis (TGA) and differential thermal analysis (DTA).

Based on a series of designs constructed and tested over the past two years, a final susceptor design was developed that maximized the exposure of the samples to the microwave field, provided a uniform thermal environment for the samples contained within and allowed the researcher to process multiple samples in the same process run. Through this research, it has been shown that the maximum temperature, the heating and cooling rates and the amount of direct microwave absorption by the samples can be controlled through the composition of the susceptor. This fact will make it possible to design microwave furniture to control the process environment. Through density and strength testing conducted on alumina samples processed in the newly designed susceptors, it has been shown that, at soak temperatures of 200° to 300°C lower than those recorded conventionally, microwave hybrid heating can produce materials with densities and mechanical properties equal to or superior to those produced conventionally.

Microwave Combustion Synthesis is also referred to as self-propagating high-temperature synthesis (SHS), has been used by researchers to form composite materials. A heat source is used to ignite an exothermic reaction between two or more materials to form the final composite composition. Microwave energy can be used to ignite these reactions To develop a method for producing composite powders and shapes using microwave energy as a source of ignition and controlled combustion in materials capable of sustaining self-propagating high-temperature synthesis reactions. This objective will be accomplished through the following activities: a) Perform self-propagating high-temperature synthesis reactions to produce alumina/titanium carbide composites using direct microwave energy and microwave hybrid heating. c) Study the

effects of sample preparation and processing variables on ignition temperature, combustion temperature and resulting microstructures. c) Compare and evaluate the differences between microwave heating methods and conventional methods for producing these composites to identify the potential benefits of the microwave process.

In this study, these slow-progressing combustion synthesis systems are being examined. Experiments are being designed and conducted to determine the potential for controlling the porosity of the composite product by controlling the rate of the reaction wave front. Additionally, a relationship between the reaction rate and the extent of reaction is being established. Microwave processing may provide the first method by which SHS reactions can be controlled without the need for altering the composition of the starting materials. Direct microwave heating, microwave hybrid heating and conventional heating have been used to ignite and combust samples of aluminum-titanium-carbon to form alumina-titanium carbide composite materials. The time for ignition/combustion in the microwave oven is reduced significantly when compared to the conventional process. The effects of microwave power on the density of combusted powder compacts are being studied.

b. Electrochemical Promotion of Ammonia Synthesis with Electrically Promoted Catalyst Pellets – University of Patras

The objective of this 3-year exploratory research project is to investigate the basic feasibility of achieving substantial increases in the rate of ammonia synthesis through application of electric currents or potentials to ammonia synthesis catalysts deposited on ionically conducting supports.

Work is progressing well during this quarter. Because of intellectual property issues, a more detailed report will be issued after the next quarter.

c. Liquid Membrane Technology Development Project at Facilichem

Testing of liquid membrane prototypes has commenced at Facilichem. Also, a strategic alliance with a commercial company has been achieved. This company manufactures specialty chemicals.

In the meanwhile, Spectrum has manufactured the prototype membranes and shipped them to Facilichem. As soon as the Research Engineers are hired, work on testing these membranes will begin.

d. Micellar Systems for Modulating Microwave Heating of Chemical Reaction Processes – MIT

Microwave absorption can offer numerous heating advantages in chemical processing. However, their implementation on a more widespread scale requires: (1) targeted production operations that can demonstrate their effectiveness and utility to the industrial user base and (2) access to identified fundamental physical information that is central to combining microwave technology with traditional chemical reaction engineering analysis.

The effort focuses on both of these issues by examining chemical strategies for modulating the dielectric properties of solutions and composite materials, and implementing these methods into real-world processing schemes. The program will concentrate on establishing chemical methods for modulating temperatures and heating rates within homogeneous and heterogeneous chemical systems in tandem with the measurement of these temperatures and the modeling of their temperature profiles within these systems. The goals include both rapid localized heating and rapid uniform heating for various systems, with both extremes having practical industrial utility. The objective is to demonstrate the abilities for microwaves to generate these temperature profiles rapidly and efficiently within model systems in the laboratory and in layered heterogeneous materials in an industrial process. The relationships between local temperatures and global reaction kinetics for chemically reacting systems should also resolve issues surrounding the so-called "microwave effect" in chemical processing.

Some of the earlier accomplishments of the program include: a) Development of a series of temperature-sensitive fluorophores that allow non-invasive temperature measurements over the range 0 to 100 °C within organic solvents. b) Measurement of spatial and temporal temperature variations within a reaction vessel as it is heated by conventional means, using the aforementioned fluorophores. c) Creation of a database of dielectric constants and dielectric loss factors for common solvents at microwave frequencies. Access to these data is paramount in designing a chemical reactor that is to be heated by microwave radiation. d) Examination and formulation of the "mixing rules" for solvent dielectric properties at microwave frequencies that include factors such as composition and temperature. These equations can be readily implemented into a PC-based software package to predict the real and imaginary dielectric properties of solvent mixtures at a user-selected composition, temperature, and frequency of interest. e) Demonstration of the utility of metal suspensions and carbon black dispersions as a means for increasing the microwave absorption characteristics of solvents and polymers without changing the global polarity or solvation properties of the medium.

During the past year work on the use of microwave heating in chemical systems has focused on three areas:

1. *Temperature sensing.* A crucial element in microwave heating, both from a theoretical and practical aspect, is the temperature profile produced within an irradiated cavity. For chemically reacting systems, the temperature and its distribution are at the heart of an ongoing debate about "microwave effects" on chemical reactivity. Various computer simulations are appearing in the literature suggesting what temperature profiles would develop for certain conditions; however, it is noteworthy that not a single experimental

study has yet been available to guide or validate these simulations. In current work, a series of molecular probes were developed that provide information about local temperature through an optical measurement, fluorescence. The goal is the development of a system that allows three-dimensional measurement of temperature remotely using these probes within a microwave-irradiated cavity. To date, the focus had been on the development of the optical system. Its integration with a microwave system will take place later. Using a YAG laser and a commercial grade CCD camera, the first fluorescent images were made showing an ability to optically detect temperature variation. This achievement was made very recently so confirmation and refinement of the system are in progress. The upgrade includes the microwave heat inputs to produce temperature changes. The goal is to expand the system's capability to observe two-dimensional temperature profiles optically and routinely. Of importance here is the fact that these measurements were made without the need to introduce any physical probes into the heated chamber and its use of light for excitation and temperature measurement is compatible with a microwave system. This technology is applicable to many areas where intrusion of a probe disturbs the system, leading to false readings. Expansion of the study into these areas is a primary goal.

2. *Microwave use in industrial processes.* An effort to evaluate the use of microwaves in a high volume process whereby glass fibers were coated with an aqueous solution of a polymer to form a thin protective layer of the polymer upon drying was pursued with mixed success. Presently, this operation occurs using conventional heating and suffers from potential electrical hazards, long start-up times, and the use of very large ovens at a site with limited floor space. Microwaves could provide a more space and energy efficient, safer, and controlled alternative for this process. Using a laboratory microwave unit, the requirements for drying these fibers such as the heat input, the dielectric absorption of the microwaves by the coating, the timescales for drying, were examined. The study demonstrated to an interested company that microwaves could be used to dry the material in the process, reduce the physical size of on-floor drying equipment, and how to alter the process using tailored dielectric adsorption. The program is on hold currently as a result of the company's prioritization.
3. *Dielectric absorption.* Exploration and expansion of the use of dielectric spectroscopy to understand the molecular basis of dielectric absorption and microwave heating has continued. Solvent mixtures, that exhibit Debye behavior, have been successfully modeled using a simple three nonadjustable parameter model. A suitable model to describe non-Debye systems continues to be illusive. The lack of available data of this type in the literature has limited this area of research. Colloidal systems are useful in conjunction with dielectric absorption spectroscopy as both a tool for characterization and as a means to generate structured media with new types of tunable absorptive characteristics. For example, various micellar systems exhibit temperature-dependent phase behavior in terms of their levels of aggregation. Such variances (often changing sharply over quite small temperature regions) could offer a means to limit microwave absorption once a selected temperature was achieved in a system.

For the future, a developing interest and a perceived need by industry is a new method for lyophilization that can be performed more rapidly. In this process, heat transfer is a limiting factor in this vacuum process. Microwaves could provide a means to warm samples to aid in the evaporation of water during this freeze drying process, whereby microwave absorption would stop (as would heating) when the materials become dry. A primary user of lyophilization is the pharmaceutical industry, and discussions with them suggest great interest in such a demonstrated technology. A consortium approach of several key organizations could produce such a technology that would benefit a range of biotech and pharmaceutical companies by greatly reducing the time for a process that is often a rate-limiting step.

e. Electrostatic Ozonation - Dr. Costas Tsouris, Oak Ridge National Laboratory

The goal of this program is to take an ORNL innovation in ozonation and move toward the development of a marketable technology in electro-ozonation. The goal is to have the technology sufficiently advanced to select a company to commercialize the technology. The specific objectives of this fundamental study were to experimentally prove that: a) inverse electro-spraying would have a positive effect upon the efficiency of interphase transport of the gas phase components to the continuous liquid phase. b) Current ozonation practice can be greatly improved and perhaps simplified by the application of the principles of electro-spraying. There is an interest in improving ozonation technology. This can be borne out by the attraction of one or more industrial partners.

An interim report was published on the subject entitled Electroozonation: Experimental Development Program (TR 111681) that covers the accomplishments to the end of the past year.

The results we reported are as follows:

1. By producing fine micro-bubbles through electrostatic spraying, the surface area-to-volume ratio available for mass transfer is increased, leading to enhanced mass-transfer rates.
2. Better hydrodynamic mixing makes an important contribution to the transport from the bubbles. During the formation process a great deal of convection occurs in the transport zone.
3. Oxidation results obtained using the electrostatic ozonation reactor indicate that it is a promising method for removing contaminants from aqueous media.
4. An alternative method to direct ozonation was demonstrated, in which oxidizing agents were produced using corona discharge at a higher applied voltage than that used in simple electrostatic spraying. This method of oxidation is more attractive because it removes the need of ozone generator.

During this year two patent disclosures reflecting these results have been submitted to EPRI and are proceeding through the review process. The first describes the use of electric fields to create masses of tiny bubbles. This process greatly enhances the current generation of water ozonators. The second describes the corona discharge approach to ozonation to make ultrapure water, as is required in the electronics and other applications.

TARGET 23 - Chemicals, Petroleum & Natural Gas

**Progress Report for 2nd Quarter, 1999
July – September 1999**

A Report to the Target's Membership

I. Calendar of Events (*EPRI Meetings in Italics*)

- 7/14-15/99 CWRT General Sponsor Meeting, Granville, OH – Industry Meeting (COMPLETE)
- 10/4-6/99 Gas Machinery Conference, Houston, TX – Industry Meeting
- 10/21-22/99 CWRT Separations Workshop – Industry Meeting
- 10/26-27/99 Gas/Electric Partnership Workshop, TBD – EPRI Meeting*
- 11/7-11/99 International Forum on Electrolysis in the Chemical Industry, Clearwater Beach, FL – Industry Meeting
- 11/9-10/99 CWRT Fall Meeting Hosted by Monsanto, St Louis, MO – Industry Meeting
- 11/10/99 CWRT/EPRI Water Management Workshop, St Louis, MO – Industry Meeting (open to electric utilities)
- 11/11/99 C&P Steering Committee Meeting, St Louis, MO – EPRI Meeting (note the change from 11/11-12/99)
- TBD Petroleum Refining Overview (on demand) – EPRI Meeting*

IIA. Customer Technology Opportunities (Base Budget)

1. Enhanced Oil Recovery Scoping Study –

The study report has been reviewed by the Guidance Team, and submitted to the publisher. It should be available by 10/28/99, as TR- 113836. Some unexpected opportunities have emerged. One involves coalbed natural gas compression to go from 30 psig at the production site to 1,000 psig pipeline pressure. This market is currently 6 % of the US natural gas market. Also, there is an opportunity to use power plant fluegas to enhance coalbed methane production, which could be economic even before a carbon tax is enacted. If you are interested contact Sam Woinsky at 281-419-1122, fax 281-419-0811 or epripcpl@ix.netcom.com.

2. Energy Services Kit for the Supply Side of Industrial Facility:

This kit is being redesigned to meet members' needs. 'Version 1' of the kit (brochures on what we can do with our members, will be available on eprweb in Quarter 4)

3. Maximizing Process & Waste water Reduction for the Process Industries -

The draft report was received from the contractor, reviewed, and recommendations were made for changes by target personnel. These recommendations will be incorporated in to the report, and it will be sent out for a second review by other targets' personnel involved in this pervasive area of the process industries. It is anticipated that all reviews will be completed by the end of October, so that the report will issue in 1999.

II B. Customer Technology Opportunities (SS&T Budget)

The following projects are on-going. They were reported in the 2nd Quarter report.

- a. Microwave Effects on Liquid and Solid State Materials Processing – University of Florida
- b. Electrochemical Promotion of Ammonia Synthesis with Electrically Promoted Catalyst Pellets – University of Patras
- c. Liquid Membrane Technology Development Project at Facilichem
- d. Micellar Systems for Modulating Microwave Heating of Chemical Reaction Processes – MIT

III. Customer Technology Opportunities (TC Projects)

1. Pinch Technology Process Optimization –

The Final Report is expected to be published by 11/30/99. Details will be available in the next quarter's Report.

2. Wastewater Problem Solutions Alliance (WPSA)

We were successful in getting Pell Frischmann/BG Technology an extra 30 minutes (now 50 minutes split between two talks instead of one 20 minute talk) at the CWRT/EPRI Water Management Workshop. PF has recently purchased some of BG's technologies; we expect to have further discussions with them, in order to understand how EPRI and PF can work together.

3. Wastewater Reduction Through Mass Pinch Technology -

Arco has shown specific interest in conducting a Heat and Mass Pinch Analysis study. We are seeking the CEC's support in this activity.

4. Enhanced Oil Recovery (EOR) TC Project –

We are currently finishing up on one project that leverages off of our base funds EOR project.

5. Pharmaceutical Industry Market Assessment SOW –

We developed a Statement of work in March. It is available upon request. Please contact Ammi Amarnath at 650/855-2548; 650/855-8574 (fax), or aamarnat@epri.com (e-mail).

6. a Freeze Concentration Project with a Client –

The project is going well. The report should issue in 2000.

7. Direct Osmosis Concentration of BioSludge –

This was reported last Quarter. We are still looking for participants. If interested contact Sam Woinsky at 281-419-1122, fax 281-419-0811 or epripcpl@ix.netcom.com.

8. Zappi Electrolytic Modification/Destruction of Hydrocarbons in Wastewater –

This technology was described in the 2nd Quarter report. This is a very versatile technology that can potentially solve a number of difficult problems. If you have a difficult organic/inorganic mixture that can't be economically handled with other approaches, just "zap" away all of the hydrocarbons or change them to something that can be handled. If you have something in a

stream that makes it not amenable to biotreatment, just "zap" it to something that can be biotreated. If you need to remove hydrocarbons to protect an evaporator from heat transfer fouling or a membrane system from hydrocarbon induced damage, just "zap" away the hydrocarbons to the PPB level. If you are interested in this very promising technology, contact Sam Woinsky at 281-419-1122, fax 281-419-0811 or epripcpl@ix.netcom.com.

9. Advanced Distillation –

This technology was described in the 2nd Quarter report. In addition to its capacity and energy benefits, it has water conservation benefits. Conventional distillation processes consume more than a quadrillion (10^{15}) BTUs of energy per year in the United States. Cooling water is primarily used to absorb this energy with evaporative losses of more than a trillion (10^{12}) pounds per year. However, recently developed Advanced Distillation configurations may be used to reduce distillation energy consumption approximately in half, with associated cooling water reductions, for virtually any conventional distillation process. Less cooling water means less evaporative losses. In addition, Advanced Distillation is a good technology to be considered after a Thermal Pinch Analysis. The pinch analysis usually doesn't impact the distillation columns themselves, since the reboiler heating duty is balanced by the condenser cooling duty. Advanced Distillation analysis is especially promising after a Pinch study for NGL (natural gas liquids plants) which are found in many oil fields as well as gas fields (due to production of associated gas in many oil fields). For this case, advanced distillation reduces reboiler temperatures, making more pinch suggested moves meet economic hurdles. If you are interested in this very promising technology, contact Sam Woinsky at 281-419-1122, fax 281-419-0811 or epripcpl@ix.netcom.com.

11. HydroCom Field Evaluation Project: El Paso Energy Electric Compression Initiative –

El Paso Energy has executed the EPRI Contract; we expect the work to start 4Q99. More details in the next quarter's Report.

12. Capacity Control using Voith Mechanical Variable Speed Drives: Texas Eastern Initiative –

We will be working with Duke Energy to finalize the scope of work; based on this, we plan to approach TVA, and other interested utilities.

IV. Technical Assistance, Customer Support, and Business Partnership Opportunities

1. Petrochemical Industry Overview Course –

Petrochemical Overview Course presented at the May Steering Meeting put on eprweb.

2. *Westinghouse Plasma Technology* –

We examined the commercialization status of the Westinghouse plasma technology for waste destruction, and waste-to-energy for a member. We would be happy to provide similar technology reports to other members, under a TC/CF arrangement.

4. *Statewide Chemical Industry Report* –

This report was prepared for a member. We would be happy to provide similar statewide reports to other members, under a TC/CF arrangement.

5. *US Water Intake, Wastewater Discharge and Recycle by Sic Code* -

Now available. We would be happy to provide similar reports on other topics of interest and for regions of interest to other members, under a TC/CF arrangement.

6. *Specific Customer Analysis* -

Analysis of opportunities to help a customer in the adhesives and sealants business was prepared for a member. This type of service is available on request.

7. *CWRT/EPRI Water Management Workshop* -

We are heavily involved in the planning for this workshop which will be held at a Monsanto facility in St. Louis on 11/10/99, just prior to our Chemicals & Petroleum Steering Committee Meeting, which is being held on 11/11/99 in the same city. The Water Management Workshop is open to our members, as well as the general public for a nominal fee. The workshop was described (including some preliminary presenter abstracts) in the August edition of Industrial News Today, along with hotel booking information for both meetings. Also, in August, we secured Pell Frischmann's spot on the agenda, which is an important milestone in our effort to forge the Water Problem Solutions Alliance (WPSA) with Pell Frischmann and BG Technology.

8. *CWRT 7/14-15/99 Meeting* -

It was a very good meeting, and EPRI was given a lot of credit: (1) For the PCEM workshop (Its CD ROM is to be the Model for all future CWRT workshops - abstract is on epriweb), (2) The 11/10/99 Water Management workshop to be held in St. Louis, and (3) The WPSA with Pell Frischmann/BG Tech/EPRI. Also, the Pell Frischmann Poster was blown up very professionally looking.

There were a number of things covered that should be of specific interest to our members: (a) There is a program called Bridges which will probably go forward that includes extending sustainable metrics to intangible costs, including deep welling which may help us with freeze concentration, (b) presentation on SAMMS (Tailored Porous Materials for Removal of Heavy

Metals) Indicates that they can get mercury down to the 2 PPT level versus 2PPB for the 3D cathode, but cost and recovery issues suggest that these two technologies might work well together with the SAMMS downstream of the 3D Cathode, (c) Presentation on VOC's control with external electron beam (falsely called plasma) looks interesting, and (d) The presentation on VOC's control with catalytic UV also looks interesting.

Some especially pertinent hand out material from the meeting is shown starting the next page.

Particulate Continuous Emission Monitoring

Workshop Proceedings

February 2-3, 1999 - Durham, NC

Industries that generate stack gases containing particulates have been under increasing pressure from the US Environmental Protection Agency and state agencies to monitor and control the levels of those particulates. These industries include power generators, those operating incinerators and producers and users of large volumes of chemicals.

Several industrial sponsors of the CWRT recognized that the regulatory pressures for continuous monitoring and control of particulates in stacks were leading both the regulators and the regulated industries into a significant technical problem - the instruments available for continuously monitoring particulates were biased or inaccurate. Furthermore, the difficulty in obtaining good data was exacerbated by the presence in the stack of water or other liquid droplets.

The technology employed by one class of instruments causes readings to be lower than actual values, while the technology used in other types of instruments produce readings higher than actual values. Both deviations from actuality lead to problems. Low readings give a false sense of security regarding compliance while high readings may lead operators to implement very expensive control strategies that are really unnecessary. Even worse, erroneous data may not, under law, be ignored under the "any credible evidence" rules.

CWRT and EPRI co-sponsored a workshop held in Durham, NC at the Washington Duke Inn and Golf Club on February 2 and 3, 1999 attended by over 90 persons from chemical and power-generating companies, regulatory agencies, vendors and engineering firms. The workshop gave attendees insight into the regulatory and technological issues associated with the continuous monitoring of particles in stack gases. Major questions addressed by leading experts in their fields were:

- what is the current state of the technology?
- where are the regulations going?
- is industry prepared to comply?
- how are the demonstration projects working?

- what are the latest developments in monitors?
- what should be the path forward?

Assessment of Common, Difficult Wastewater Management Problems

The capabilities of the WPSA Alliance (described below) could be used to identify technology approaches for the solution of common, difficult wastewater problems that various CWRT members have. Prior to, at and after the July CWRT meeting, CWRT members could be considering difficult wastewater problems that they are faced with and compare their problems. We could identify some similar problems, that could form the basis of one or more collaborative projects. For each potential collaborative project, initial free assessments could be made using the Alliance's survey form and possibly one day site surveys at various sites. If based on the Alliance's initial report/proposal, a group of CWRT members decides to pursue a specific collaborative project, a surrogate sample or a sample from the site best suited for slip stream demonstration testing could be sent to the Alliance's pilot facilities for pilot tests. After that first phase of the collaborative project, if the results look promising, the group of CWRT members could expand the collaboration to include larger scale slip stream demonstration testing at one or more of the collaborators' industrial sites.

Overview of Wastewater Problem Solution Alliance (WPSA)

Pell Frischmann & BG Technology (PFBGT) have teamed up to provide access to a range of proven water treatment technologies and know-how, which can be mixed and matched to provide an unbiased, customized and economic solution to process stream problems

PFBGT can supply transportable skid mounted field slipstream demo units for the major commercially proven water treatment technologies, plus smaller scale pilot units for these same technologies at their laboratory. They have the capability to design, finance and construct the commercial facility, as well as the capability to provide various follow on services.

PFBGT works with clients to characterize the problem stream and understand the business and technical objectives using a problem-defining survey form that clients complete and a site visit (free through electric utility support through EPRI). This information provides the basis for selecting two or three technology approaches that are the most likely viable candidates based on preliminary capital and operating cost estimates. If these approaches are deemed to be economically attractive to the client, testing can then be conducted at the pilot, trailer slipstream demo, and/or skid mounted slipstream demo scale, depending on circumstances and the client's tolerance for risk (there is a fee for this part of their services). The tests provide data for more accurate economic projections.

Two Prell Frischmann/BG Technology Projects

BG Tunisia. Amine desalting by a membrane process

Problem: The amine process fluid in the acid-gas treatment plant at the Hannibal terminal contains an accumulation of salts which cause corrosion and reduce the plant capacity. Salts are usually removed using mobile ion exchange units which are expensive and lead to high amine losses.

Objective: (1) Operation of the BG membrane process to desalt the amine at a lower cost than the conventional processes, and with a lower amine loss. (2) To demonstrate the process on site, and prepare plant designs for a fixed side-stream plant.

The BG process was developed by BG Tech at test-rig and full scale. BG Tech's full scale plant was transported to the terminal and operated on site for 3 months.

Result: The full inventory of plant process fluid was successfully treated and the salt level reduced to the required specification. There was also substantial savings to BG Tunisia (about 40% compared with the alternative processes).

The plant data are now being analyzed to design a fixed plant which may be installed on a side stream for continuous operation.

The BG Tech plant is now being operated on a similar problem with the glycol gas dehydration plant.

QV Foods

An effluent from a potato washing site contains herbicides. The EA is to impose a discharge consent which will prevent the company from discharging the effluent by its current route (to a natural watercourse). Alternatives that have been considered are: tankering off-site, installation of the pipe to the public sewer and on-site treatment.

BG Tech was asked to carry out an assessment of treatment processes. On-site treatment was demonstrated from an initial feasibility study to be less expensive than the alternatives, and a BG advanced oxidation process (uv/ozone) was identified as being one of the most cost-effective processes. The client prefers not to install a biological plant owing to operational difficulties. Also biological treatment will not remove the herbicides.

A project was undertaken to demonstrate the treatment efficiency of the BG process at test-rig scale using a small sample of effluent (100 litres). The client then requested a large-scale demonstration (on 20 tons of sample) using BG's transportable plant.

This work has now been completed, and has proven the effectiveness of the process for the effluent.

A plant PID for the clients application and revised budget estimates for the client are in preparation, using the data from the plant trials. The client must install a fixed plant on-site by the end of 1999.

SUMMARY OF ADDITIONAL BG TECHNOLOGY PROJECTS

BG Transco (1)	1996 – 1997	Treatment and disposal to sewer of 1000 m ³ of contaminated gas holder water and leachate in underground vessels (process selection, test-rig measurements and full treatment service).	Treatment of gas holder wastes, transportable plant taken to site giving savings of \$65,000 per site. Treatment costs \$1.50/tonne compared with \$170/tonne for disposal off site.
Mobil North Sea Ltd Bio-Design Ltd (5)	1997 – 1998	Process selection test-rig and on-site pilot plant trials. Removal of metals and oils from water/glycol.	8 month trial transporting BG full scale rig to site to demonstrate process and prepare process design for the customer.
North Barrow onshore terminal (now Centrica plc)	1996	Treatment of 300 m ³ of contaminated water/amine process fluid. Removal of dissolved salts by electro dialysis.	Operation of full scale plant transportable plant at industrial site to regenerate process fluid. Savings of \$900,000 for client.
Cargill Foods Ltd	1999	Catalytic wet air oxidation plant demonstration for the treatment of highly concentrated fruit juice effluents.	Built a plant to treat effluent giving savings of \$400,000/year of sewer discharge charges. Cost of plant construction approximately \$550,000 i.e. payback in less than 2 years.

VHE Construction	<p>1998 Treatment and disposal of the full inventory of contaminated water from underground storage vessels at a former gas works site (Sheffield, UK).</p> <p>Saving of \$100/tonne compared off site disposal using UV Ozone plant developed by BG Technology.</p>
BG Transco	<p>1999 Pervaporation of reclamation (dehydration) of glycols.</p> <p>Demonstration of Glycol dehydration and construction of a mobile plant to be transported between all Transco sites in UK to reclaim glycol. Savings likely to Transco \$250,000/year.</p>

9. *DOE/OIT Texas State IOF Meeting -*

Attended this meeting hosted by the Texas Energy Coordination Council (TECC) at the Center for Energy and Environmental Resources at the University of Texas at the Pickle Research campus. The objective was to develop a path forward for development of a Texas Industries of the Future (IOF) program. There were 43 people in attendance.

DOE's Office of Industrial Technologies (OIT) and State IOF programs already initiated were described. For the State of Texas, a very large segment falls within the EPRI Chemicals, Petroleum & Natural Gas Center's areas as illustrated by the following. Out of the 9 high energy user industry segments considered, chemicals have the highest percentage of the Texas value shipped (48%). Refining has the next highest (38%). So, that is 86 percent for our area, without Oil & Gas production. The consensus was that for Texas, Oil & Gas production should be included, even though it doesn't fall under OIT's area, but under another part of DOE. That would put the value shipped in Texas in our Center's area in excess of 86 percent. For employment, the figure would only be in excess of 20 percent, but still a sizable figure.

The way that programs have gotten off the ground in other states is that there has been both a state agency champion and a contractor (usually a university) champion. The champion's have worked with state industries to understand their needs, and get their buy in. Funding at various stages has come from state agencies, DOE and industry. There is a \$200,000 DOE grant program to help state agencies get started. Some states have waited for this to get started, while others have started on their own, and then got the \$200,000 grant money later to continue. Once things are started, the actual R&D programs are funded by responses to DOE solicitations. The next RFPs will be coming out in 12/99, and proposals will be due in 4/00.

While the upcoming RFPs will be somewhat different than last year's, last year's RFPs can be used to get a feel for what will be coming. Last year's RFPs can be viewed on the web at www.oit.doe.gov/states. There are words on the site that talk about RFPs, and links to the documents.

The action items from the meeting were the following: (1) Meeting minutes to be made up and distributed, (2) The 3 TECC people at this meeting to get the rest of their board (9 more people) to agree that at least for now, TECC will be the Texas state champion. [Philip Schmidt of the University of Texas at Austin is likely to be the contractor champion.], (3) Assuming there is no problem with item 3 above, Jerry Mathhews of TECC is to lead the organization of meetings with both state agencies (so they will know what each agency is already doing in related areas), and industry people to define their needs, and get their buy in, (4) The above is all directed at being able to hit the ground running, when the DOE RFP's issue in 12/99. [Private discussion with Dan Wiley about the importance of getting started early on proposals. He say the Government recognizes the problem, and is working to change the rules so detailed descriptions of proposed RFPs can be released before (a year in advance of the RFP) a project has actually been funded].

V. Marketing and Communication Tools

1. Mass (Water) Pinch Case Studies - TechApplication -

Work is progressing.

2. CWRT VOC Book Update -

We agreed to lend support to the Center For Waste Reduction Technologies' (CWRT's) effort to publish an up dated version of their VOC book first published in 1993. We will be allowing them to abstract information from our Center Report on this subject, "Emerging Technologies for VOC Mitigation", CR-107940, published in 1997. In return, we will be monitoring the progress of the work that Baker Environmental will be doing to update the book. This is a low cost way of getting early access to this information. Also, EPRI will be given appropriate recognition in the book, providing valuable exposure and publicity.

3. Freeze Concentration of Hazardous Aqueous Wastes - TechApplication -

This TechApplication was modified to include the second plant just started up in Europe with a 3.5 MW load. This is in addition to the one started up in mid 1997 in Asia with a 2 MW load. We are now expecting Shell approval any day.

4. Membrane Process to Recover Valuable Feedstocks in Polyolefin Plants TechApplication -

This TechApplication was reviewed, approved and sent to the publisher for layout and printing. The TechApplication covers a new membrane technology that is making inroads in the area of recovering monomers, solvents and additives in the manufacture of polyolefins (polypropylene, polyethylene, etc.). Unfortunately, there was a delay in getting approval from the end user. This report was an extra (not a 1999 deliverable). Therefore, we will pick it up again next year.

5. Blending Light with Heavy Crude Oil To Cost Effectively Move Heavy Crude Oil to Market TechApplication -

We prepared a draft of this TechApplication and sent it out for review (to two of our members that were involved with a well known oil company in the cooperative implementation of this project). We have approval of the end user and publication is proceeding. This one is an extra for 1999 that looks like it will make it.

6. Epriweb Products -

See Epriweb under One-Stop Access to All Products and Services

VII. 1. One-Stop Access to All Products and Services

1. CPNG Office Addresses -

As you may be aware, we have moved our Center to a new location in the Houston area. The Center's new address and phone/fax numbers are: 47 Quiet Oak Circle, The Woodlands, Texas 77381, Ph: (281)419-1122, and Fax: (281)419-0811. The e-mail address for Sam Woinsky is the same as before (epricpc1@ix.netcom.com).

Sam will handle all routine member requests. If there are specific questions that can be best answered by our Center Consultants (Dick Schmeal, Jim Kumana, Charles Byers), he will discuss such requests with them, and respond back to you in a timely manner. Please also feel free to contact Ammi Amarnath, for any technical or operational questions. The address is: EPRI, 3412 Hillview Avenue, Palo Alto, CA 94304, Ph: 650/855-2548, Fax: 650/855-8574, E-Mail: aamarnat@epri.com.

Please forward the new address to appropriate people within your Company.

2. *Epriweb* –

EPRI's web activities are undergoing a major overhaul. The EPRI site and the eprweb site will be combined into 1 single home page. The Target will be incorporating a majority of its products on the web. Please review the site from-time-to-time, and let us have your comments.

Also, the following communication products were put on eprweb, and were mentioned in the September electronic issue of Industrial New Today, with a hot link to their location on eprweb.

- CWRT/EPRI meeting on Continuous Particulate Environmental Monitoring (CPEM)
- EPRI report on DOE Industries of the Future Symposium & Exposition
- Petrochemical Overview Course presented at the May Steering Meeting
- Gas/Electric Workshop I

VII. Advisory Committee Participation

*1. Fall C&P Steering Committee Meeting and CWRT/EPRI Water Management Workshop – Important** Please note*

The Steering Committee Meeting is in St Louis on 11/11/99. Important issues relative to the long term viability of the Target will be discussed. Don't miss this opportunity to participate. Also, Steering Committee Members will have the opportunity to attend the CWRT/EPRI Water Management Workshop to be held on 11/10/99 at Monsanto's facilities in St Louis. This Workshop which is to be held in cooperation with The Center For Waste Reduction Technologies (CWRT) will focus on water management issues, technologies and problem solutions. There will be speakers from the Government, technology developers, vendors and process industry end users of electricity. Problems and issues will be identified, current and emerging technologies will be described, successes and failures will be described, and a pathforward to potential collaborative projects will be developed. For more information, or if you want to participate, contact Sam Woinsky at 281-419-1122.

About EPRI

EPRI creates science and technology solutions for the global energy and energy services industry. U.S. electric utilities established the Electric Power Research Institute in 1973 as a nonprofit research consortium for the benefit of utility members, their customers, and society. Now known simply as EPRI, the company provides a wide range of innovative products and services to more than 1000 energy-related organizations in 40 countries. EPRI's multidisciplinary team of scientists and engineers draws on a worldwide network of technical and business expertise to help solve today's toughest energy and environmental problems.

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