NON-CIRCULATING

TEXAS STATE
DOCUMENTS COLLECTION

Energy Studies

Volume 15 Number 6
July/August 1990

Newsletter of the Center for Energy Studies of The University of Texas at Austin

Energy Studies reports on activities of the Center for Energy Studies and other energy-related news from The University of Texas at Austin. Subscription is free upon request (six issues a year). ISSN: 0743-829X.

The Center for Energy Studies is a multidisciplinary research center, the central liaison for energy research, education, and public service at The University of Texas at Austin. Dr. John R. Howell is director.

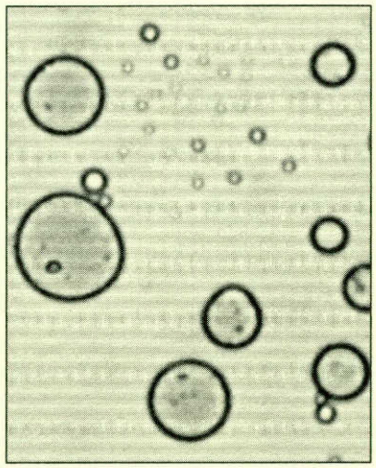
Editor: Jennifer Evans

CO_2 method shows promise for cleaning oil-field brine

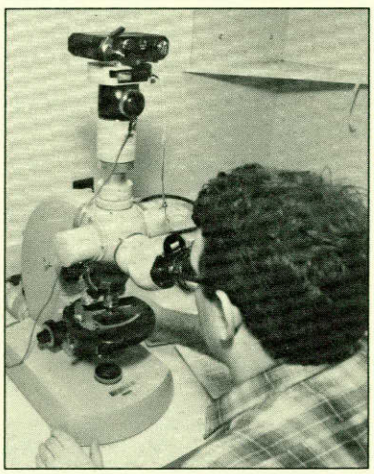
When petroleum is extracted from the ground, a great deal of water, sometimes salty and usually oil-contaminated, is pumped out along with it. The US Environmental Protection Agency's rules on the disposal of this water are strict and expected to become stricter.

Separations researchers have tested a new method of cleaning oil-field brine: high-pressure treatment with carbon dioxide. Early results show that in some applications the technique may eventually be more effective and lower in cost than current cleanup methods.

The main participants in the research, funded in part by Texaco, are James R. Fair, head of the center's Separations Research Program; José Luis Bravo, program manager; Frank Seibert, research associate; Chester Little, graduate student, and Diane Bauer, undergraduate student.



Emulsified oil dropets in oil-field brine must be removed before the brine is returned to the environment.



Researcher Chester Little examines brine before it is treated with carbon dioxide under pressure.

In oil-field production, most of the oil and water separates easily. A small quantity of oil, however, remains in the water in two forms—emulsified and dissolved. These portions are the most difficult to remove.

In the treatment process under study, a gas, in this case carbon dioxide, bubbles up through the water in a column-shaped tank. Pressurizing the carbon dioxide increases its density and improves its performance, said Mr. Bravo.

Using a 4-inch-diameter, high-pressure extraction column, the researchers performed experiments on oil-field brine supplied by Texaco. The brine contained on the order of 1,000 parts per million (ppm) of oil.

The results showed that treatment of these brines with carbon dioxide at room temperature and 250–1,000 psig (pounds per square inch gauge) pressure reduced the oil in the water from about 1,000 ppm to less than 30 ppm. The EPA currently requires that the brine contain no more than 30–50 ppm before disposal.

These results are significant because they show the process reduces the oil concentra-

(Continued)

U OF NT DEP. LIBRARIES 76203

90 - 201
OCT 06 1990

tion to below the oil solubility limits of the water. This fact means that the treatment removes dissolved as well as emulsified oil, Mr. Bravo said.

A preliminary economic study by Dr. Seibert of high-pressure treatment with carbon dioxide indicates it would be more cost effective than the conventional approach of gas flotation paired with adsorption.

The experiments surprised the researchers in one way, said Mr. Bravo. They had expected most of the removed oil to be found in the carbon dioxide leaving the column, and it was not. Instead it accumulated on top of the water in the column.

The researchers believe that the carbon dioxide causes the minuscule droplets of emulsified oil to lose their repulsive force and flocculate, coalesce into bigger droplets, and rise to the top of the water.

The reason the gas has this effect, Dr. Fair said, is that the gas makes the pH of the mixture more acid. This change in pH reduces the repulsive force of the oil droplets. The rising gas bubbles also agitate the droplets and sweep them toward the surface.

"The beauty of carbon dioxide is that it's so easily removed," said Mr. Bravo. In other oil removal processes, a liquid such as sulfuric acid is mixed in the water, then a neutralizing chemical. This approach is expensive and creates a solid waste. The carbon dioxide, on the other hand, is removed simply by reducing pressure so that the gas boils off. No neutralizing chemicals are required.

The process is also unusual because several operations—extraction, flocculation, coalescence, and sweeping—occur in a single step in a single piece of equipment.

The ratio of emulsified to dissolved oil in oil-field brine can vary from 1:1 to 9:1. The more alkaline the brine, the higher the carbon dioxide pressure required to remove the oil. With fresh (nonsalty) brines, pressures as low as 200 psig will succeed, said Mr. Bravo.

The experiments show that some oil-field brines can be cleaned effectively without costly supercritical pressure or heat, he said. The process can be done in a continuous mode, with a residence time on the order of minutes.

An advantage of high-pressure treatment with carbon dioxide, Dr. Seibert said, is that the required equipment would take up roughly half the space of a conventional system, a significant factor for offshore oil rigs. He said the first application of the technique is likely to be offshore. In fact, the treated water is clean enough to be released into the sea rather than reinjected below ground.

Devices such as trays and packings that increase gas-liquid mixing can be placed inside a treatment column to improve performance. In the experiments, metal sieve trays performed better than other devices.

In the future the UT researchers plan to continue to experiment on high-pressure extraction with different gaseous solvents, Dr. Fair said. ■

UT center wins $500,000 from state for tech transfer of energy research

The UT Austin Center for Technology Development and Transfer (CTDT) will undertake a $500,000, two-year project aimed at helping to get the results of energy research by Texas universities to the marketplace.

The 71st Texas Legislature provided that the effort could be funded from the state of Texas's Energy Research in Applications Program (ERAP), which is in turn funded by oil overcharge settlements. Dale E. Klein, CTDT director and associate dean for research of the UT Austin College of Engineering, will lead the project.

According to the project proposal, the priorities for the CTDT effort will be energy-related inventions developed from (1) ERAP research at UT Austin; (2) other ERAP research; (3) UT Austin energy-related research funded by two other state programs, the Advanced Technology Program and the Advanced Research Program (ATP and ARP); and (4) other energy-related ATP and ARP research.

Priority also will be given to technologies closest to being market ready and those having the largest energy-savings impact. Dr. Klein said it's unlikely that the Center for Technology Development and Transfer can assist with all the promising technology in all four categories, under the present funding allotment. While the project does have a focus on UT Austin, he said he hopes to help researchers at other universities as well.

ERAP awarded $15 million for energy research in early 1989, and about one-third went to UT Austin researchers. Another $6 million is expected to be awarded by the Texas Higher Education Coordinating Board in October.

"We will be contacting the ERAP principal investigators and taking a look at the opportunities for commercialization," Dr. Klein said. "Probably in early September we'll be up and running."

The CTDT will hire a market analyst, a "technical snooper," who will discuss with faculty the potential for commercial application of their research and assist in finding such opportunities. A few student researchers will participate as staff or for academic credit. Part of the funding may be used to develop and demonstrate prototypes, which must be for use primarily in research rather than commercialization.

"The Center for Technology Development and Transfer will try to make a communication link between the investigator who has a good concept and a commercial entity," Dr. Klein said. "In most cases we'll have confidentiality agreements on both sides so we can have in-depth technical discussions." The center will then aid the researcher and his or her university in negotiating with the companies that have an interest in a license.

"UT Austin does not take a direct role in commercial activities," said Patricia C. Ohlendorf, an attorney and UT Austin associate vice president. "We license out basic technologies that result from research so that they can be commercialized by other organizations."

Under UT System policy, a private company generally pays royalties to the university for a license to an invention. At UT Austin the inventor of the technology receives 50 percent of the royalty income, a substantial incentive.

"There have been all kinds of arrangements formulated when the university has licensed technology," Dr. Klein said. "The university might be a part owner of a spin-off company. The faculty member might be a

(Continued)

part owner, too. An approval process is required, which includes a review of potential conflicts of interest. The part ownership might be active or passive. The faculty member might serve on the board of directors. Everything's on a case-by-case basis."

UT Austin is preparing a guidebook for faculty and other researchers on protecting their inventions. The book will explain the UT System's policies on intellectual property and how the UT Austin Intellectual Property Committee works.

Interest in UT Austin is building among venture capitalist and industrial firms, Dr. Klein said. "Just a few weeks ago I met with a major venture capitalist who wanted to find out what's happening in Texas, particularly at The University of Texas, that they should be made aware of. I'm now getting a better understanding of who to go to.

"It's a slow process. You don't just come up with a good idea and immediately have someone kicking down the door."

The Japanese are very active in technology transfer. Dr. Klein pointed out that last year more than 60 percent of the visitors at Oak Ridge National Laboratory were Japanese.

"Nationwide, universities are playing a much more active role in technology transfer than they have in the past," according to Dr. Klein. "If you looked at UT ten years ago, we did very, very little licensing." Mrs. Ohlendorf said the number of UT patents and licensing agreements has been increasing each year. The Texas Legislature has encouraged the state's universities to step up their efforts.

"Some legislators were concerned that the University was giving away technology as opposed to licensing it and returning money to the state and to the University," said Dr. Klein. "That's why I think technology transfer is much more important now at all universities than in the past." ■

CES Update

Office of Director

Steven P. Nichols, deputy director of the center, has been appointed to the board of governors of the newly formed National Institute for Engineering Ethics. He was appointed by E. Walter LeFevre, president of the National Society of Professional Engineers.

Building Energy Systems

Bruce D. Hunn, head of the center's Building Energy Systems Program, has been appointed to chair a committee that will revise standard methods of calculating the energy performance of buildings. The results will be adopted in the next edition of the ASHRAE (American Society of Heating, Refrigerating, and Air Conditioning Engineers) *Handbook of Fundamentals*. The committee, TC 4.7, also monitors developments in the field of energy calculations for ASHRAE.

Environmental Solutions

The kickoff meeting June 26 for the Environmental Solutions Program (ESP), a new research effort at The University of Texas at Austin, attracted 57 representatives from 32 companies.

"The meeting was extremely successful in terms of transmitting information and mutual enthusiasm between the potential sponsors and the researchers," said Raymond C. Loehr, head of the program.

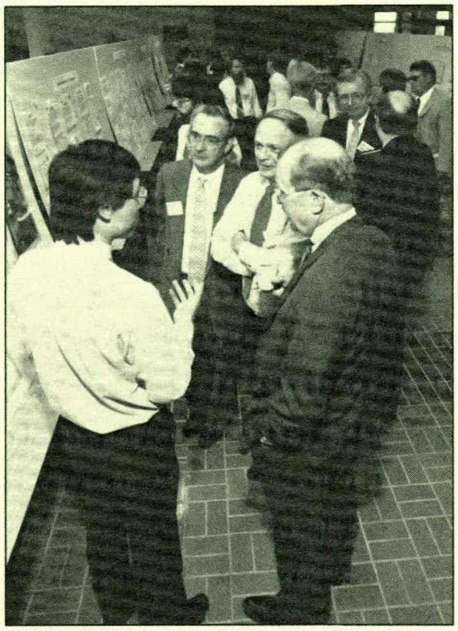
"Several companies have already made a commitment to join. The program doesn't officially start until January 1991."

The focus of the Environmental Solutions Program is on performing technical environmental research in the main areas of waste minimization, treatment of sludges, air pollution control, treatment of water and wastewater, site remediation, waste containment and isolation, environmental assessment, and energy-environment interactions.

The program leaders are soliciting companies to join as sponsors. Cost of sponsorship is $20,000 a year. Through documents, meetings, and informal contact, sponsors will receive early information on nearly all the environmental research of the researchers, not just that funded through the program. The group is now conducting more than $2 million worth of environmental projects.

To date, 15 faculty and staff researchers and more than 50 graduate students from five disciplines are participating. The program is being developed jointly by the UT Center for Research in Water Resources and the Center for Energy Studies.

Many of those at the informational meeting praised the new program.



Representatives from 32 companies attended a June 26 meeting to investigate becoming sponsors of the Environmental Solutions Program. Researcher Li-Xiong Li (left) speaks with three.

Among the benefits of sponsorship that attendees mentioned in written comments were:

"Window on technology," "Leveraging of research," "Information/collaboration on emerging technologies of mutual interest," "Opportunities for training staff," "Patent rights," "A great deal of important information."

"Access to leading edge technology development," "Access to graduate students for possible recruitment," "Opportunity to see a wide spectrum of research activity and

(Continued)

chat with folks doing work," "Chance to meet people with expertise in relevant areas."

"Access to academic excellence," "Mutual technology exchange," "Good ideas for new approaches in environmental research," "Improved technologies, chance to discuss technologies with experts, and the chance to see, firsthand, the work of potential job candidates."

At the meeting the president of UT Austin, William C. Cunningham, and the dean of the College of Engineering, Herbert H. Woodson, welcomed the industrial audience and pointed out the strengths of The University of Texas at Austin in the environmental area, such as the recent survey by *US News & World Report* ranking UT Austin fifth among the nation's universities in environmental engineering.

Attendees talked with researchers at 25 poster presentations (photo) and were briefed on research on destruction of industrial hazardous wastes and hazardous waste land disposal and containment.

"The ESP meeting went extremely well. The poster session served exactly the purpose we hoped it would. There were very active discussions in front of the posters," said Steven P. Nichols, deputy director of the Center for Energy Studies.

"This kind of exchange is the beginning of commercialization of those technologies."

Dr. Loehr said he welcomed those who are interested in learning more about the Environmental Solutions Program to telephone or write him at the Center for Energy Studies, The University of Texas at Austin, 10100 Burnet Road, Austin, Texas 78758, 512/471-7792.

Separations

A major new conference on gas separations will be cosponsored in Austin April 22–24, 1991, by the journal *Gas Separation & Purification* and the Center for Energy Studies.

James R. Fair, head of the Separations Research Program, will serve as one of the two conference chairmen, and José Luis Bravo, SRP manager, will be the local coordinator.

"It's an international effort," Mr. Bravo said. The organizing committee represents five countries. "We're very honored the journal chose us as their cosponsor to inaugurate the meeting." A sponsors meeting of the Separations Research Program will be held April 25–26, directly after the conference.

Major topics of the conference will include adsorptive separations, membrane separations, distillation, pervaporation, fundamentals of separations, purification of gases, absorption, and cryogenic separations.

Those who wish to submit papers must mail an abstract to arrive in England by August 31. For further information, contact Lynne Clayton, Conference Organizer, Butterworth Scientific Ltd., Box 63, Westbury House, Bury Street, Guildford, Surrey GU25BH, UK. Telex: 859556 SCITEC G. Fax: (0483) 301563.

■

Keith P. Johnston has been named to receive the 1990 Allan P. Colburn Award from the American Institute of Chemical Engineers. The award honors outstanding research by a university faculty member. Dr. Johnston is a separations researcher and an associate professor of chemical engineering. ■

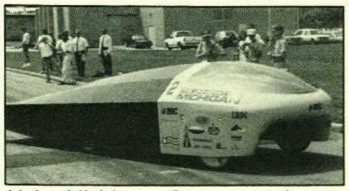
UT Austin Energy

Short courses offered for energy and environmental professionals August–March

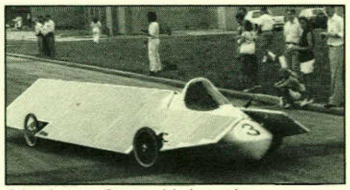
Several short courses for those in energy and environmental professions will be offered over the next eight months by Continuing Engineering Studies of The University of Texas at Austin:

- Rock Properties and Reservoir Heterogeneity, August 14–16, Larry W. Lake
- Hazard Assessment and Risk Analysis Techniques for Process Industries, September 24–27, William G. Lesso
- Clay Liners and Covers for Waste Disposal Facilities, October 10–12, repeated February 6–8, David E. Daniel
- Power Distribution Conference, October 22–24, William C. Duesterhoeft, Jr.
- Selection and Preparation of Witnesses for Environmental Litigation, October 25–26, Davis L. Ford, Raymond C. Loehr
- Collection, Treatment, and Disposal of Liquid Wastes from the Petroleum and Petrochemical Industries, October 30–November 1, Davis L. Ford
- Contaminated Soil Bioremediation, December 5–7, Raymond C. Loehr
- Biomonitoring Laboratory Procedures, January 21–23, Neil Armstrong
- Advanced Water Pollution Control: Physical and Chemical Waste Treatment, Sludge Handling, and Disposal, January 28–February 1, Joseph C. Malina, Jr.
- Separation of Fluid Mixtures, February 4–8, James R. Fair and other faculty
- Groundwater Contamination from Petroleum Hydrocarbons, February 11–14, Randall J. Charbeneau
- Engineering Calculations in Air Pollution Control, February 25–March 1, Joe Ledbetter and Howard Liljestrand
- Advanced Water Pollution Control: Biological Wastewater Treatment, March 4–8, Joseph C. Malina, Jr.

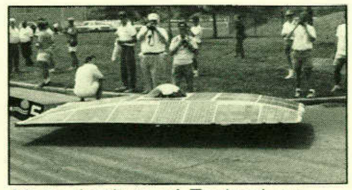
Each course is taught by a member of the UT engineering faculty. For information, contact Continuing Engineering Studies, The University of Texas at Austin, Austin, Texas 78712, 512/471-3506. ■



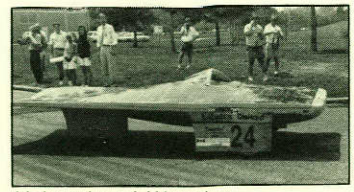
Univ. Michigan, Sunrayce winner



Mankato State University



Mass. Institute of Technology



University of Waterloo

Racing on sunshine

UT Austin students finish 22nd in 1,600-mile solar race; celebrityhood, sleeplessness, and kabang, kabang

Battling and overcoming setbacks from the beginning, a team of UT Austin students finished 22nd in a 1,600-mile solar car race with a car they designed and built.

The UT team competed against 31 other university teams in Sunrayce USA, a Florida-to-Michigan race sponsored by General Motors July 9–19. The UT entry, a sleek car named Texas Native Sun, powered only by sunlight, completed the race with a time of 113 hours.

The winning car, the University of Michigan's Sunrunner, finished in 73 hours. Western Washington University and the University of Maryland placed second and third.

The UT car was built largely at the Center for Energy Studies. John R. Howell, center director, said he was proud of the students.

"From last April until July of this year the team built a vehicle that traveled over 1,000 miles. They got no pay for their work. They put a lot into fund raising. What they put together was just outstanding and shows pride of workmanship throughout."

Interviewed by Jennifer Evans after the event, three participants told the story of the solar race. Matt Cranor, a recently graduated mechanical engineering major, is captain of the UT team. Jonathan Lusky, a mechanical engineering sophomore, is the team's youngest member. Gary Vliet, mechanical engineering professor, is a faculty advisor to the project.

Evans: The UT team left Austin with its car several days before Sunrayce bgan July 9 in Orlando, Florida, right?

Cranor: Yes. Before we left Austin, we found a few little things wrong with the car, all electrical stuff, a few hours before we left. We figured out what the problems were, ordered a bunch of parts, had them shipped to New Orleans, made these corrections to the car on the way to the race, and were raced it Monday. It was a trial by fire.

Cranor: A death march [laughs]. We qualified the car at EPCOT Center instead of at Daytona, but that wasn't a problem. We were in the race. The first day of the race was sunny and nice. A mile from the finish line, the transmission broke. We got the problem fixed in about an hour and a half. We put in a replacement system, a straight shaft, which is basically what ev-

Photos by John R. Howell

The UT solar race team at the end of the race: (Standing, l-r) Nancy Cranor, Matt Cranor, Pierre Guilloteau, Jonathan Lusky, Gary Vliet, Jeff Cloud. (Kneeling, l-r) Franck Guilloteau, Greg Nudd, Paul Roeber. (Not shown) Jean Bossert, Jim Koughan, Bruce Wallis, Mauricio Trevino.

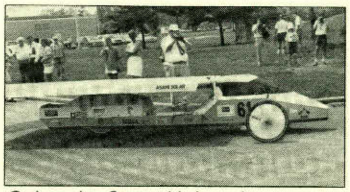
literally working on the car in the parking lot of the hotel the night before the race.

Vliet: *All* night before the race. They were working 18 hours a day *before* they left, then they worked for three or four days pretty much around the clock at Baton Rouge, then they drove straight to EPCOT Center [the race starting point], worked all night Saturday night, qualified the car Sunday, and

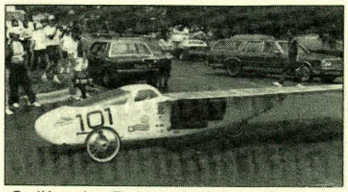
eryone else had. We finished 23rd that day.

The rain came in, and for the next three days hung over the race—real nasty weather. All the cars were going slowly. Very few cars were finishing the stages of the race. We couldn't figure out why our car was going much more slowly than we thought it should be. It took us two to three days to

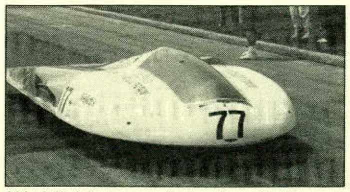
(Continued)



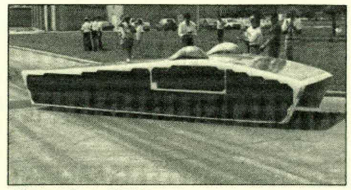
Colorado State University



California Polytechnic Institute



W. Michigan and Jordan College



Crowder College

figure it out. We found some of the electrical connections were crimped, and they should have been crimped and soldered.

As soon as we changed that, all of a sudden the car, instead of going 12 or 15 miles per hour, was going 30 or 35. It made a huge difference. No longer were people in other cars just zipping by us.

For the next seven days in the race, the car ran reliably. As we drove north, we began to tear up the wheels, which are very light bicycle wheels, because the roads are potholed from the frost heaves. We began to just eat wheels. We tore up about four in one day and

"I prayed that one would land in our yard."

only had eight to begin with. We changed to a stronger type of wheel at Indianapolis and had no more problems with them.

The only other mechanical problems we had were minor, and we fixed them on the road. They didn't cost a great deal of time.

We could compete from that point on. We placed eighth in the daily standings a couple of times. We ended up overall 22nd. It's unfortunate that the first few days of the race were a development and testing program.

There were teams like Michigan [the winner] which had the high-dollar solar cells. Maryland had 1,200 watts, Michigan had 1,300 watts, Western Washington had about 1,400. We were pushing about 630 watts. Maryland spent $180,000 on their solar cells, Michigan spent $250,000, and we spent about $4,000.

Some of the more successful teams had more people raising money than we had on our whole team.

Evans: How large is the UT team?

Cranor: The core team at the race was 12 people. We had about 30 to 35 involved in the project. I have to say the College of Engineering came through. They supported us, and they blocked for us. We had a very poor time trying to get support from the university as a whole, and that was critical.

University of Michigan had 100 or 150 people on their team, and 20 to 30 were business, finance, marketing majors. I applaud them. They might have won the race several months before it started, raising money. Racers seek dollars like water goes downhill.

We're very proud of what we did with what we had. I have no regrets. There are things we would try to do differently, of course, if we could do it over.

Evans: What was a typical day like on the race?

Lusky: We'd get up about 5 a.m., wait in line to take a shower at the motel, take the car out of impound, set it up for photovoltaic charging for two hours, and try to squeeze in whatever repairs we could. Then we'd climb in the van and run the car. We'd either cross the day's finish line and put the car in impound, or, if we didn't make it, we'd stop at 6:30 p.m. [as required by race rules] and charge for two hours at the side of the road, then load the car in the truck, drive in, and try to find someplace to eat, if we'd missed the GM meal. After 8:30 p.m., we weren't allowed to work on the car. We'd finally get to the hotel and go to sleep at 12 or 1 a.m., usually.

Evans: What's it like to drive the Texas Native Sun?

Cranor: It's not like anything I've ever driven. It's got very little power, to begin with.

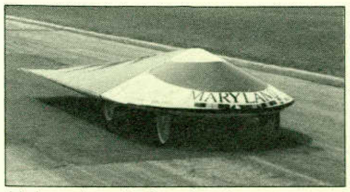
It's very, very loud inside that car. The body is thin skins of graphite, which resonate like a drum. Every time you hit a bump, it's kabang! kabang! kabang! for hours at a time. It's almost like banging on the car with a hammer. You literally couldn't hear over the headset on rough roads. You'd have to shout. The heat wasn't too bad when you're rolling. Of course some days were hotter than others. Waiting for a red light to change, you could feel the sweat rolling off your head.

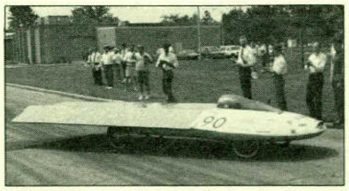
As you're driving this car, you can use your foot on a throttle, or you can use a little hand throttle. You have the other hand on the wheel, and you have this headset on with a little boom microphone and a push-to-talk button, and you have a bunch of gauges around you. Your posterior is probably 8 inches off the ground. The windshield slopes away from you at a radical angle. The view is somewhat distorted, but it's not really bad, like it is on some of the other cars.

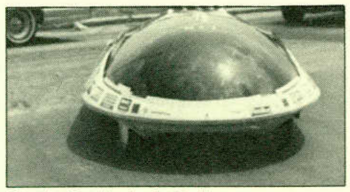
This little black box, the amp-hour meter, is your lifeline. It's made by a company called Brusa in Switzerland, so we call it the Brusa. If its green light is blinking, that means charge is going into the batteries; if the red light is blinking, that means charge is going out of the batteries. As you drive, the guys in the chase car are figuring out at what point in the race we should be at such-and-such a number on the gauge. We came up with a method of getting over hills we called a slingshot. It was a real mental challenge to control the flow of power to the car without driving wastefully. I thought it would probably be easy, but it wasn't.

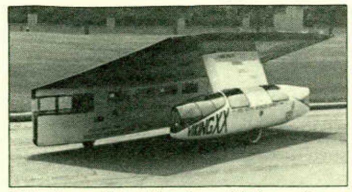
The steering on the car is very, very quick. By the time I got used to driving the car, I was holding the wheel with one hand, firmly wedged into the seat. I would flex my wrist a little bit, and the car would veer. You didn't even think about turning the wheel a quarter of an inch, or you'd be a ditch.

The seat was not made to fit my contours. In fact, even the guy we molded it off of didn't fit it very well, because in the process of finishing the seat, it ended up getting some bumps. The suspension was fairly


University of Maryland


Worchester Polytechnic Institute


Stark Technical College


Western Washington University

stiff. By the time you got out of the car, ooow, you could hardly move.

Evans: What was the worst part of the race and what was the best?

Cranor: The fact that we didn't have enough test time before the race was the worst. We were all exhausted, and the car wasn't working right. Once we resolved that, everything got better. The best part of the race was the second half. We could enjoy it. The last six months were very intense, the last three months were extremely intense, and the last month was so intense that we worked on the car practically whenever we were awake. I have really fond memories of the whole thing. The cameraderie.

One of the things that the GM race director noticed on a visit was that we actually liked working together. He said that wasn't the case with a lot of the teams he'd visited. Of course we had friction. That's par for the course. His comment made us feel better.

Lusky: The worst part for me was the first couple days of the race, when the car wasn't running well. The entire team was getting to be in a really bad mood. Once we figured out what the problems were and started doing well with the car, it relieved a lot of tension. The best part was not having to get up at 5 a.m. any more.

Evans: What were the people like along the way?

Lusky: We had people on the sides of the road from Orlando to Michigan, taking pictures and waving. When we stopped at the side of the road to make a repair or at the end of the day, we'd always attract a pretty good crowd.

Cranor: And it seemed like the smaller the town, the bigger the crowd. We stopped in one little town when the race day was over, and there was a traffic jam by the time we were done and ready to load the car. Everybody pulling over, coming out. "I'll go get the kids! I'll get my wife!"

So many times you'd drive by a house with ten chairs on the front porch, people just lined up, sitting back, drinking lemonade, and waving. They'd ask us for autographs. I couldn't believe it. We had glossy color pictures of the car, printed by the Mechanical Contractors Association of Austin, to hand out.

A guy on the Drexel team told me that they pulled up in someone's front yard, and two little girls came running out, four years old, who'd heard about the race, and one said, "I prayed that one would land in our yard!"

If you want to be successful in a game like this, raise a lot of money early.

Vliet: One gas station put up a marquee that said, "WE SERVICE SOLAR CARS." At another place, the whole family was sitting out in the front yard with a wheelbarrow and a big sign on it that said, "MAN-POWER."

On another day, we had stopped and were handing out pictures and met this old fellow who must have been almost 80 years old. He knew one of the Wright brothers. He had written down every car that had passed and the number of the car.

Evans: What was the most common question people asked?

Cranor: "How fast does it go?"[30 mph average]

Vliet: And, "How fast *can* it go?" [60-65 mph]

Cranor: Every once in a while in the middle of nowhere, someone would ask you a really technical question that cut to the heart of some issue, and you just couldn't believe it. You're in the middle of a cornfield, and this guy gets out of his car and asks you about some chip in the power trackers. You'd go, "God, where did this guy come from?"

Vliet: And you'd find a lot of people who had absolutely no idea that the cells on the car produced direct-current electricity that powered the motor.

Evans: Has the solar car project changed your view of engineering?

Cranor: Maybe I now see the importance of the *people* end of a project. The engineering was the easy part, the fun part. Working together with a group of people is a lot more difficult. No good idea will ever come to fruition just through good engineering. That's one thing I take home from it. And another thing: If you want to be successful in a game like this, raise a lot of money early.

Evans: Michigan was the top money raiser and the top finisher, correct?

Cranor: As far as I know. They had a good car, support from every direction. They deserved to win.

Evans: Is there a possibility the Texas Native Sun may race in the World Solar Challenge in Australia in November 1990?

Cranor: There is a possibility. It's too late to enter. We're working on a joint venture with the Puerto Rico team, which has entered. At this point there's not much more I can say. We've heard all the stories about the Japanese teams coming to the Australian race. Any time Honda enters a competition, there's nothing second-class about anything they do. They typically have 30 engineers at each formula race.

Evans: Do you think we'll someday have solar cars?

Cranor: Not in this embodiment. Electric cars in urban centers are a real possibility in the very near future. I'm surprised more hasn't happened sooner, like in Los Angeles, where it's against the law to barbeque with charcoal. You can't even walk outside without choking.

(Continued)

U OF NT DEP. LIBRARIES 76203

The University of Texas at Austin
Center for Energy Studies
Balcones Research Center
10100 Burnet Road
Austin, Texas 78758

ADDRESS CORRECTION REQUESTED

Nonprofit Organization
U.S. Postage
PAID
Austin, Texas
Permit No.
391

In Los Angeles they're trying to outlaw gasoline engines in less than ten years.

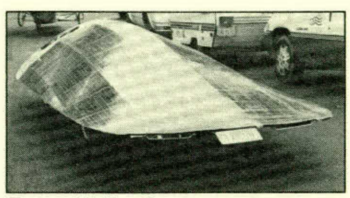
Lusky: Solar cars like the cars we've built probably never will be feasible because they're race cars. I do see electric cars becoming a lot more common in the next few years. Motors are getting efficient enough and batteries light enough to have a good range and drive to highway speeds.

Vliet: I tend to agree. You wouldn't want to build a car like these because the solar cells are very fragile and very expensive. It's conceivable to do it differently. You'd have a solar array on the house, maybe one at work. You'd drive in to work, plug your car in, drive home, plug it in. I view it as more feasible than when I left before the race—maybe in the next 10 to 20 years. In Europe and Japan there's a significant number of manufacturers building little commuter cars, electric vehicles with maybe a small solar array on them. In Europe you pay $2, $3, $4 a gallon for gasoline so solar is more competitive.

Evans: After the race the cars were invited to Washington, DC, by the Department of Energy, correct?

Cranor: Yes. Part of the UT team went. The cars drove in a procession through the city and then were displayed on Capitol Hill, in front of all the politicians and cameras.

Vliet: I think one of the things that was impressive about the whole race was that we went over 1,000 miles and we were 22nd. What that means is two-thirds of the cars completed two-thirds of the race. Basically these are all prototype cars built by students. I think that's impressive—especially considering the second through sixth or seventh days were overcast and rainy. Nobody quit and went home. ■



Texas Native Sun

Solar race team

Jean Bossert
Jeff Cloud
Matt Cranor, project leader
Nancy Cranor
Franck Guilloteau
Pierre Guilloteau
Jim Koughan
Jonathan Lusky
Greg Nudd
Paul Roeber
Mauricio Trevino
Bruce Wallace

Other project members

Scott Berry
Ricardo Chan
Julie Conrad
Dwayne Dunaway
John Evert
Jose Garza
Scott Helton
Mike Mai
Joe Thoennes
Randy Twedt

Faculty advisors

Ron Matthews
Steven Nichols
Gary Vliet

Donors and sponsors

Bell Helicopter
Gleasman Corp.
GTE Spacenet
IBM
Tex Star, LTM
Advanced Plastics
Ad-Tech Plastics
Vickers AMD
Mechanical Contractors Association of Austin
Austin Sheet Metal Association
Local 67 Sheet Metal Workers
Local 286 Plumbers and Pipe Fitters
City of Austin Electric Department
Rhone-Poulenc
National Energy Management Institute of Texas
Lower Colorado River Authority

UT Austin:
College of Engineering
Bureau of Engineering Research
Department of Mechanical Engineering
Center for Energy Studies
Center for Electromechanics
Center for Research in Water Resources
Mechanical Engineering faculty