THE UNIVERSITY of TULSA

TUFFP

TULSA UNIVERSITY FLUID FLOW PROJECTS NEWSLETTER

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TUFFp Talk

Paraffin Deposition JIP Project Officially Begins

After an 18-month period of planning and organization, the JIP on "Paraffin Deposition Prediction in Multiphase Flowlines and Wellbores" officially began on May 1, 1995. The first Advisory Board meeting for this new JIP was held on May 8, 1995. Thirty-one persons from twenty-two companies attended this first organizational meeting.

The JIP was launched with a projected budget of more than $3.4 million over the next four years. Membership fee per company is $90,000. The Alberta Research Council and Petro-Canada will be granted free membership in the JIP in return for a flow loop that would be transferred to Tulsa from Canada. The U.S. Department of Energy and the Gas Research Institute will each contribute $800,000 and the U.S. Department of Interior's Mineral Management Service will contribute $90,000. Confirmed industry members include:

Agip
Alberta Research Council
Amoco Production Company
BHP Petroleum (Americas) Inc.
BP Exploration Operating Co., Ltd.
Chevron Petroleum Technology Company
Conoco Inc.
Elf Aquitaine Production
Exxon Production Research Company
Japan National Oil Corporation
Kerr-McGee Corporation
Marathon Oil Company
Norsk Hydro
Mobil Exploration and Production Technical Center
Petro-Canada
Petronas Research & Scientific Services
Phillips Petroleum Company
Shell Exploration and Production Company
STATOIL
Texaco Group Inc.
TOTAL
Union Oil Company of California

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Jim Brill and Mike Volk, Manager of Research and Technology Development at TU, will serve as co-directors of the JIP.

Negotiations are underway with more than ten additional companies, many of which will probably join.

Although the new JIP will utilize a portion of the time of many of the TUFFP staff members, the programs will be maintained as totally separate entities. The JIP will function with extensive input from five committees, established at the initial Advisory Board meeting, in the areas of: Flow Loop and Deposition Studies; Thermodynamics and Fluid Characterization; Heat Transfer; Operational Issues; and Technology Transfer. An industry person serves as the chairman of each of these committees and a University of Tulsa representative will be included on each of the committees. Although final decisions on most issues rest with The University of Tulsa, recommendations from committees and the Advisory Board will be the basis for technical decisions.

Significant progress has already been made in establishing the research team that will be responsible for the JIP. Jim Brill and Mike Volk, Manager of Research and Technology Development at TU, will serve as co-directors of the JIP. Jerry Wilson will serve as Staff Engineer. Research Associates will include Cem Sarica, Tom Chen, Kraemer Luks, Keith Wisecarver, Christi Luks and possibly one more person. Technicians for the JIP will include Charles Ingle, Tony Butler and possibly one to be added. Two or three students will be involved in the project. Elissa Wise and Linda Jones will share secretarial, purchasing and project control activities.

At this time it appears that two different test facilities will be constructed. The first facility will be the flow loop that would be moved from its current location at the Alberta Research Council in Canada. It would permit the earliest possible acquisition of single-phase flow data. Simultaneously, a high pressure two-phase flow loop will be designed and constructed that would eventually utilize some of the components from the single-phase flow loop. Initial site planning and preparation has already begun.

TUFFP Short Course - Another Big Success!

Once again, a very successful short course on two-phase flow in pipes was held May 15-19, 1995, in Tulsa, Oklahoma. The course was attended by twenty-one engineers and scientists, including fifteen from five TUFFP member companies and six from four non-member companies. Income from the course was sufficient to pay all expenses incurred. A tentative date of May 20-24, 1996, has been established for the next TUFFP short course.

TUFFP Evaluating Possible Cooperative Database Project with Stanford University

Stanford University's Petroleum Engineering Department has established a multiphase flow database that uses Microsoft Access 2.0 on a Windows platform. Already included in the database are the TUFFP well databank, and a modified University of Calgary pipeline databank. Stanford has approached TUFFP about including other experimental data in the database. Participation in this project would enhance archiving of TUFFP data and would also make the data more convenient for distribution and use of members. At present we envision possibly submitting a joint TUFFP/Stanford proposal to DOE to accomplish this work, taking advantage of DOE's expressed interest in funding technology transfer projects. This project has been included in the TUFFP Questionnaire to determine member companies' interest levels.

Advisory Board Meetings Scheduled

The next TUFFP Advisory Board meeting will be held November 15-16, 1995, at The Doubletree Hotel at Warren Place in Tulsa, Oklahoma. A Request for Information Form will be mailed to member companies in advance of the meeting, together with information on hotel reservations and travel to and from the airport. Persons attending the Advisory Board meeting should complete the form and return it to us as soon as possible.

The TUFFP Advisory Board Meeting will begin at 8:30 a.m. on Thursday November 16 and will adjourn at 4:30 p.m. A pre-meeting cocktail party will be held on the 19th floor of the adjacent Two Warren Place Building from 6:00 to 8:00 p.m. on Wednesday, November 15. A tour of TUFFP and Paraffin Deposition test facilities will be conducted on Wednesday afternoon from 3:00 to 4:30 p.m.

Following is a summary of the dates for Fall 1995 Advisory Board meetings of research consortia at The University of Tulsa.

Paraffin Deposition	October 26 (At Mobil Oil Corp. in Dallas)
TUDRP	November 13-14
TUALP	November 15
TUFFP	November 16
TUSTP	November 17

At this time it appears that the spring Paraffin Deposition JIP Advisory Board meeting will be held in April, possibly in conjunction with the SPE/DOE Enhanced Oil Recovery conference in Tulsa. The spring Advisory Board meetings for other Tulsa University research consortia will be held the week following the Offshore Technology Conference to accommodate persons traveling from outside the United States who wish to attend both conferences. The TUFFP Advisory board meeting will be held Wednesday, May 15 with the tour and cocktail party on May 14. The TUFFP Short Course on Two-Phase Flow in Pipes would then be held during the week of May 20-24, 1996.

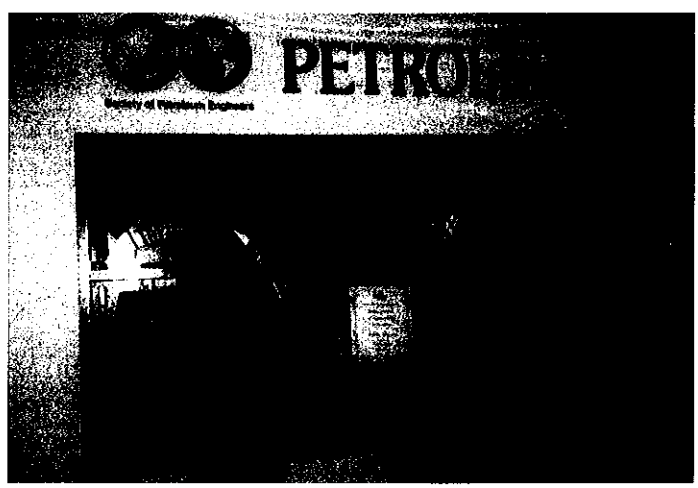
TUFFP Advisory Board meeting brochures will be mailed to all members prior to the meetings. The brochures will contain sufficient information to help each attendee actively participate in discussions on current and future research projects, financial matters, and operating procedures. Brochures containing slide copy for all presentations will be distributed at the meetings and will not be mailed to members unless requested.

TUFFP Benefits from BDM/ TU Partnership

Included in the final 1995 U.S. government budget for the Department of Energy was a one-time $1.1 million grant to The University of Tulsa to be used on a cost-sharing basis with various TU research consortia. $400,000 of this amount was allocated as DOE's 1995 funding for the new JIP on Paraffin Deposition. An additional $71,000 was allocated to TUFFP to cost-share our research project on "Investigation of Single-Phase Liquid Flow Behavior in a Multi-Perforation Horizontal Well."

1995 TUFFP Questionnaire

The 1995 TUFFP Questionnaire was distributed to the Official Advisory Board Representative with this newsletter. Members were asked to express their relative interest on existing and possible future research projects. A request was made that the questionnaire be returned by September 15, 1995. Results will be tabulated and summarized in the November Advisory Board meeting brochure.



TUFFP student Robert Marcano recently received the Tulsa University Outstanding Petroleum Engineering Student Award for 1994. Robert is shown with Dr. Stefan Miska, Chairman of Petroleum Engineering.

New Research Assistants Planned for TUFFP

Two new research assistants will join the TUFFP research staff during 1995. As a result of an advertisement seeking Ph.D. students for TUFFP and related research projects, a research assistantship offer has been provided to Mr. Meng Weihong from The University of Petroleum in China. Mr. Weihong has accepted our assistantship and will begin his Ph.D. program in August.

TUFFP has agreed to fund the research for Mr. Eissa Al-Safran from Kuwait beginning in the Fall semester 1995. Mr. Al-Safran received a B.S. degree in Petroleum Engineering from The University of Tulsa in May. His salary and tuition would be completely paid by The University of Kuwait.

An expression of interest has been received from Mr. Nobutoshi Shimizu of the Technology Research Center at Japan National Oil Corporation to pursue an M.S. degree in Petroleum Engineering at The University of Tulsa. If approved, he would begin his graduate program in January 1996 and is interested in working in the area of transient two-phase flow in pipelines.

Wisecarver Becomes Involved in TUFFP Research Activities

Dr. Keith Wisecarver, Chairman of Chemical Engineering at The University of Tulsa, has become a Research Associate in TUFFP. Keith has extensive experience in two-phase flow dealing with the chemical processing area and has expressed an interest in becoming more involved in TUFFP and related research activities. He will devote one month of his time to TUFFP during the summer of 1995, becoming familiar with all past TUFFP research, and will become extensively involved in the oil-water flow project.

TUFFP Membership Remains Stable

At this time it appears that TUFFP could experience a slight growth in membership for 1996. Verbal or written confirmations of interest in membership have been received from Agip and The University of Petroleum in China. No existing members have indicated that they plan to cancel their membership for 1996. Thus, we anticipate entering 1996 with at least 27 member companies. A list of 1995 members appears on a following page.

Plans Underway For New Slug Tracking JIP

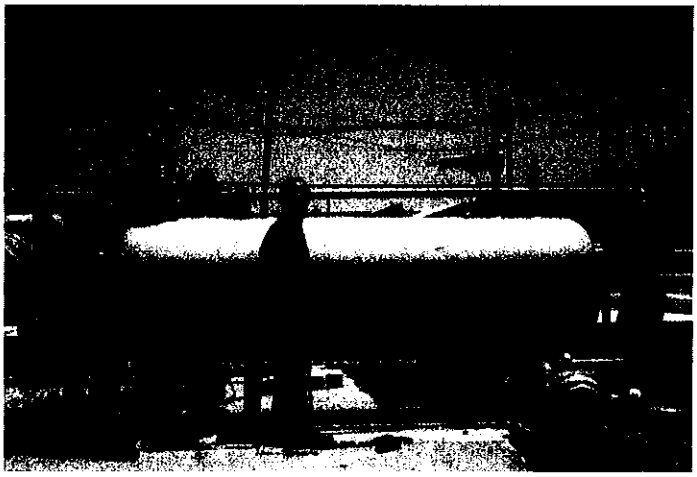
Cem Sarica is working carefully with Dr. Gene Kouba of Chevron Petroleum Technology Company to develop a proposal to form a new Joint Industry Project on Slug Tracking in Hilly Terrain Pipelines. Chevron has been approached to fund a feasibility study on the subject to assess the ability and applicability of an existing slug tracking model and demonstrate the importance of slug tracking in developing a reliable design of production and transportation systems. The existing slug tracking model is an outgrowth of a TUFFP research project completed by Zheng in 1991 and subsequently extended by Zheng, Brill and Taitel in an article published in the International Journal of Multiphase Flow in 1994. Current plans call for distributing a proposal worldwide in October and initiating the project in early 1996.

Yehuda Taitel Returns to TUFFP

Dr. Yehuda Taitel, professor of Mechanical Engineering at The University of Tel Aviv, will again spend a period of approximately six weeks at TUFFP in August and September as a consultant on a variety of research projects. He will lend his unique expertise to assisting TUFFP researchers in their modeling problems and design of experimental test facilities. In addition, he will work with Cem Sarica on some preliminary modeling of slug tracking phenomena in preparation for a proposal to form a new JIP dealing with this topic.

BHRG Conference in France Another Big Success

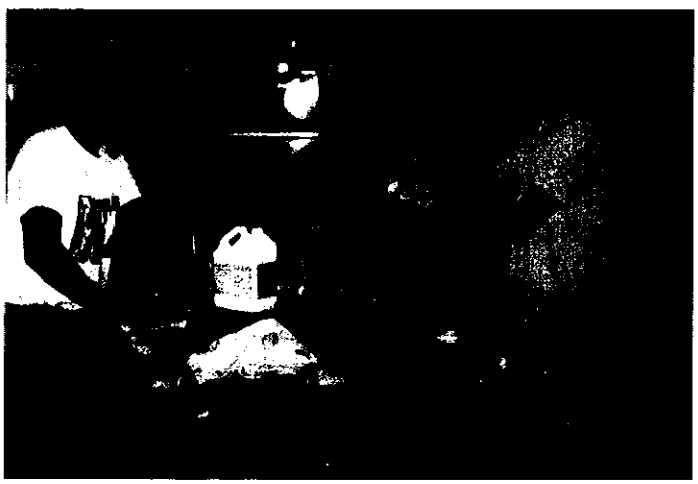
An exciting array of technical papers on the subject of multiphase flow in pipes was presented at the BHRG Seventh International Conference - Multiphase 95, titled "Where Are We on the S-Curve?" in Cannes, France on June 7-9, 1995. Over 120 people from some fifteen countries and sixteen companies, government agencies and universities worldwide, were in attendance. Eight different organizations, including The University of Tulsa, were exhibitors, and the conference was jointly sponsored by BHR Group Limited, The Institut Francais du Petrole (IFP), and TUFFP. Thirty-one technical papers were presented on field and experimental laboratory investigations, corrosion, emulsions, hydrates, separation phenomena, severe slugging, multiphase pumping, multiphase metering, transient flow and modeling of flow patterns and other specific multiphase phenomena. TUFFP had one paper at the conference that was presented by Cem Sarica. Six Tulsa University personnel attended the conference. Dr. Brill again served both as a corresponding member and a session chairman.



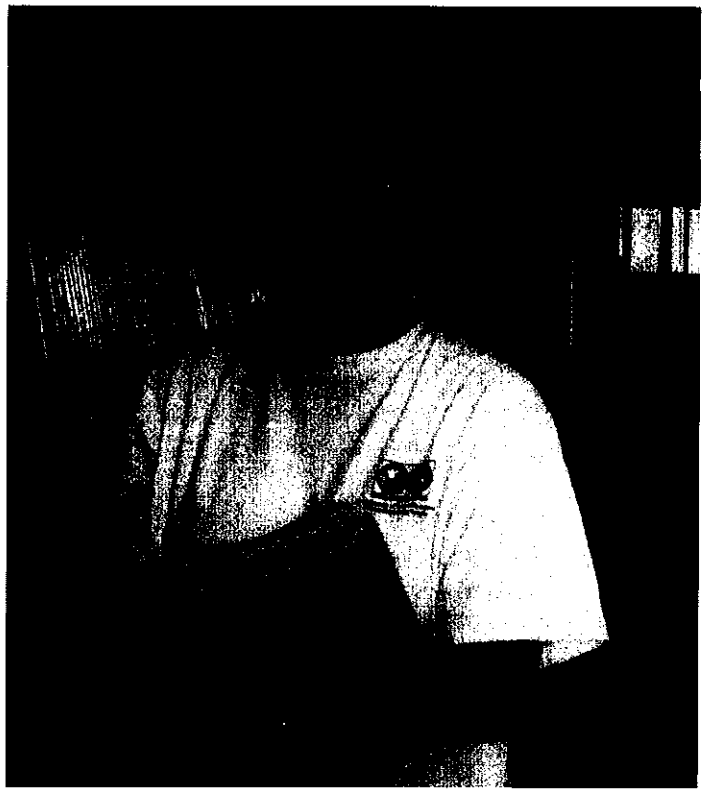
Mohd R. Johar, Mohd Che-Mat-Dali, Thad Andrews and Abdullah Osman assist in maintenance of TUFFP test facilities.

TUFFP Acknowledges Part-Time Student Work Contributions

A significant amount of support help on various research projects for TUFFP is provided by students who are hired part-time during the academic year and full-time during the summer. Typical activities include oilfield roustabout work, electronic wiring, assisting graduate students and research associates with data acquisition, organizing and maintaining the TUFFP book and periodical libraries, etc. Students involved in these activities in 1995 have included Mohd Che-Mat-Dali (Senior in Electrical Engineering from Malaysia), Johan Johan (Senior in Chemical Engineering from Indonesia), Mohd R. Johar (Senior in Electrical Engineering from Malaysia), Abdullah Osman (recent graduate in Mechanical Engineering from Malaysia), Imelda Sutanto (Senior in Petroleum Engineering from Indonesia), Thad Andrews (Junior in Chemical Engineering from Bixby, Oklahoma), Vijay Dakshinamoorthy (Graduate Student in Chemical Engineering from India), Khairul Ahmad (Senior in Chemical Engineering from Malaysia) .



Abdullah Osman and Johan Johan fabriate test loop pipe stands.



Imelda Sutanto at work in TUFFP library.

TUFFP Considers Staff Expansion

With the start of the new Paraffin Deposition JIP and possible other future JIP's, it has been necessary to allocate a significant part of selected TUFFP staff members' times to these other ventures. As a result, a shortage of available research associate and technician time for TUFFP projects has begun to occur. In anticipation of this situation, an advertisement for a research associate position was published near the beginning of 1995 and an evaluation of applications is currently underway. A decision will be made in the near future as to whether or not additional staff personnel will be hired.

TUFFP Increases Annual Membership Fee for 1996

TUFFP's projected reserve fund balance at the end of 1995 is approximately $100,000. Projected 1995 membership fees total $648,000 and projected expenditures for 1995 total $636,000. Expenditures for 1995 would have been significantly higher except for opportunities to shift some salary and related expenditures to other research projects, and also since several current TUFFP students were funded by their employers. A preliminary analysis of anticipated expenditures for 1996 confirms that the reserve fund balance would completely disappear by the end of 1996 unless membership fees are increased or research activity is reduced. Consequently, a decision was made to increase TUFFP membership fees to $27,000 for 1996, with the probability that an

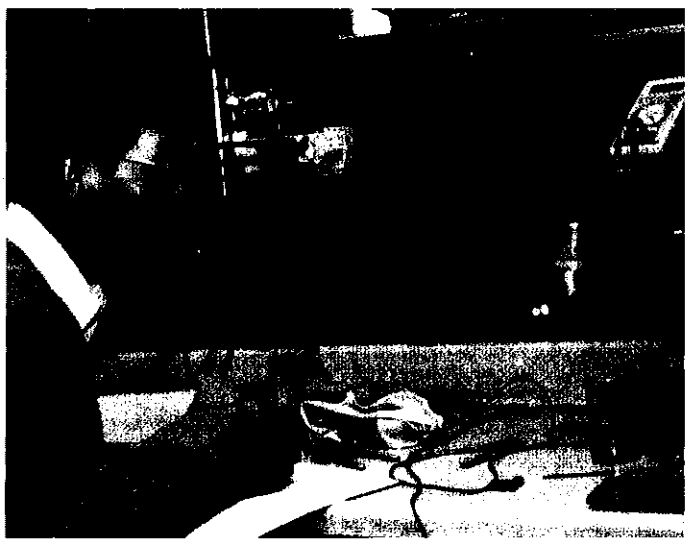
additional membership increase will not be necessary for several years if membership level is sustained.

We are pleased to report that all past due membership fees for 1993 and all but 2 1/2 membership fees for 1994 have now been paid. At the present time ten member companies have not yet paid their membership fees for 1995. Invoices for 1996 membership fees will be sent to members in mid-October to accommodate those companies who prefer to pay 1996 membership fees from their 1995 budgets.

GRI Project Nearing Completion

TUFFP's involvement in the GRI research project on PCB migration in gas transmission and distribution systems officially ended June 30, 1995. A final report is nearing completion and will be sent to Penn State University after The University of Tulsa receives a subcontract from Penn State that has just been authorized by GRI. The final report will provide Penn State with improved closure relationships for predicting both interfacial and wall shear stresses for the low liquid holdup stratified flow conditions that often exist in horizontal pipelines.

We anticipate continuing this research under TUFFP sponsorship. The project will be included in the summer TUFFP questionnaire.



Research Associate Tom X. Chen is finalizing the GRI project report.

Brill to Assume Technical Editorship of ASME Journal

On January 1, 1996, Jim Brill will become the technical editor for the American Society of Mechanical Engineer's Journal of Energy Resources Technology. He served as an associate editor of the JERT for a period of ten years from 1982-1992. This 15-year old quarterly journal has a subscription base of about 1,000, publishes over 40 technical articles per year, and is the primary publication source for ASME's Petroleum Division and Advanced Energy Systems Division. Brill plans to significantly expand the number of scholarly articles published in the JERT dealing with petroleum engineering subjects, including multiphase flow through pipelines and wellbores. It has become increasingly difficult to publish industry-specific scholarly technical papers in existing society journals. Taking on this editorship should help alleviate this situation. TUFFP members are urged to consider personal subscriptions to the JERT, and verify that their company libraries are subscribers.

TUFFP Schedules Data Distribution

Preparation is underway for the distribution of experimental data obtained in various TUFFP projects over the past three years. Included will be slug flow and annular flow data for directional wells, two-phase splitting data, downward slug flow data, transient horizontal flow data, and data for single-phase liquid flow in a single-perforation horizontal well. Preparation of a user's manual for the data distribution is about 50 percent complete . Current plans call for distributing all data on a CD-ROM with a distribution target date of mid-September 1995.

TUFFP To Distribute Volume 4 of Recent Publications

A large number of TUFFP and related research projects result in preparation of scholarly technical articles for various meetings and technical journals. Compilations of these articles into "Recent Publications" have been distributed to TUFFP members in 1986, 1988, and 1991. A large number of technical articles has been prepared since the 1991 distribution. A fourth volume of "Recent Publications" is now scheduled for distribution to member companies in August.

Calendar for Two-Phase Flow Technical Meetings

1995

September 5-8	SPE Offshore Europe	Aberdeen, Scotland
October 9-11	International Symposium on Two-Phase Flow Modeling and Experimentation	Rome, Italy
October 19-20	PSIG Meeting	Albuquerque, New Mexico
October 22-25	SPE Annual Fall Meeting	Dallas, Texas
October 26	Paraffin Deposition Advisory Board Meeting	Mobil Oil Corp in Dallas
November 16	TUFFP Advisory Board Meeting	Tulsa, Oklahoma

ICON ALLEY

HP WORKSTATION

TUFFP's Hewlett Packard Apollo 9000 Series 700 Model 715-50 and Model 700/RX terminal are getting more and more usage. In view of increased usage and data storage requirements, we are checking out additional hard disk capacity. A program called eXodusII™ enables Macintosh computers to access the workstation and operate as an X-Station giving all TUFFP personnel the benefit of using their Mac to work on the workstation.

COMPUTER NETWORK EXPANSION

This spring, we finally completed our network expansion to include the shops, model lab, and all data acquisition buildings. How sweet it is to have everyone on the network and be able to easily access their EMAIL and server files. In conjunction with this upgrade we have added a new Macintosh Power PC 8150 server. This machine has a 4X CD ROM drive, a DAT tape backup drive and two one gigabyte hard drives. RAM has been bumped to 32 megabytes. The machine came loaded with the latest AppleShare server and backup software. With the inclusion of the DAT tape backup, we are now able to set up timed backups of all our computers. With proper scheduling, all TUFFP computers will be backed up a minimum of once a week. Although we have not had any significant problems losing data it will be reassuring to know the backup is there.

NEW HARDWARE AND SOFTWARE

In our quest for a better data distribution method, we have purchased a CD ROM mastering drive. The new FWB drive will master CD ROM's which can be read by most computers. With the proliferation of CD ROM drives, this should make data distribution very accessible to all member companies and be very cost effective for massive data storage

One major software upgrade has been to LabView 3.0 which now comes on CD ROM. We have upgraded several other software packages and have made the transition to Microsoft Office. One quandary we have now is whether to shift from Persuasion to Microsoft PowerPoint. PowerPoint comes with the "Office" package and is a very good presentation software, however it does have some limitations that Persuasion does not have. We have also upgraded to the latest versions of Adobe PageMaker 5.0, Adobe Premiere™ 4.0.1, Adobe Photoshop™ 3.0, HyperCard 2.3, and Microsoft Project 4.0. System software has also been upgraded to version 7.5.1. We are studying Apple PowerTalk and QuickDraw GX but have elected to not install them until we can fully evaluate these new system additions. A number of new utilities have also been added to the arsenal. Stuffit Deluxe, Conflict Catcher, and QuickKeys have all been purchased and are being evaluated at this time

The Quadra 700 which has been utilized as a server for the past year will be moved into a student office. One new Macintosh 7100 has been ordered for Computer Master Jaime Garces and as a utility and network diagnosis machine.

VIDEO LCD PROJECTOR

Our InFocus LitePro 550LS projector has been utilized for presentations at the Advisory Board meeting with considerable success. The projection quality Is very near that of slides and eliminates the imaging process. You will probably be seeing more presentations utilizing this projector at future Advisory Board meetings. This method of presentation projection will open up access to multimedia, QuickTime movie clips and many other new presentation methods.

TRAINING

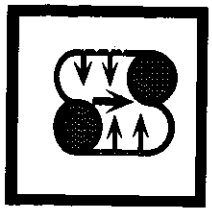
Jerry Wilson, our staff engineer, will be attending the Interex Expo in Toronto Canada in August. Numerous seminars on connectivity, networking, software and hardware of the Hewlett-Packard nature will be attended. Of course many vendors and experts will be on hand for an updated view of the state of the art in workstations.

Staff Engineer Jerry Wilson

SURPLUS COMPUTERS

A number of our older computers were becoming quite inadequate when using the latest operating systems and software. It would not have been cost effective to upgrade many of our old Macintosh II series (RAM and hard disks) so we decided to trade them in to help fund upgrading of the network. We received market value for these old computers based on the latest MacWeek and MacUser pricing guides and eliminated the administrative costs of going through the surplus property drill. One old Mac II and three IIsi's were included in this transaction. The only 68030 machines we now have include three II ci's, an SE30, a Powerbook 170 and a Duo 250. All new computers purchased this past year have been the Power PC vintage and our 68040 computers are being utilized more and more for data acquisition.

Research Progress REPORTS

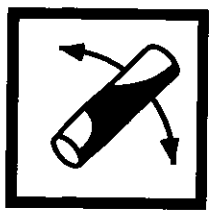


Flow Behavior in Horizontal Wells

Horizontal wells can have very complex flow geometries, in part due to interaction between the main flow stream and the influxes along the wellbore, and also due to completion type. In the first phase of this project, a new generalized friction factor expression for a single perforation horizontal well was developed using the principles of conservation of mass and momentum. A simple correlation for the horizontal well friction factor was then developed by applying experimental data to the generalized friction factor expression.

In the second phase of this project, the research on single phase liquid flow behavior in a horizontal well with a single perforation has been extended to the study of multiple perforation cases to simulate the completion effect.

The test facility used for the single perforation case has been modified to permit a constant influx through multiple perforations. Data acquisition for a 1.0 in. pipe with five perforations per foot has almost been completed. Data analysis is underway using the method proposed at the May Advisory Board meeting.



Downward Two-Phase Flow in Inclined Pipes

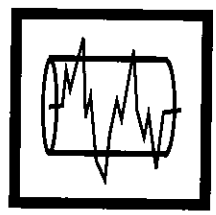
Following completion of the initial project on Downward Inclined Intermittent Flow by Roumazeilles, a decision was made to introduce several modifications to the experimental test facility before continuing the investigation of downward intermittent flow. These modifications were described in the May 1995 Advisory Board meeting Brochure and all have been completed.

Since the May Advisory Board meeting, the following tasks have been completed:

- Calibrated all pressure, temperature and capacitance sensors and mass flow meters;
- Commissioned the test facility.
- Updated the data acquisition system.
- Finished data acquisition for 3 out of 10 inclination angles (0°, -3°, -5°). The acquired data will give the following characteristics for intermittent flow: liquid holdup profile along a slug unit; slug translation velocity; slug length distribution; and, pressure drop.
- Began development of a data processing program.

During the next few months, all planned experiments for inclination angles from horizontal to downward vertical will be carried out, and the data processing program will be developed. After processing all data, an improved mechanistic model for downward slug flow will be validated against the experimental data. Experimental and theoretical results will be presented at the November 1995 Advisory Board meeting.

Jiede Yang and Miguel Paz check calibration of new Micro Motion mass flow meters.

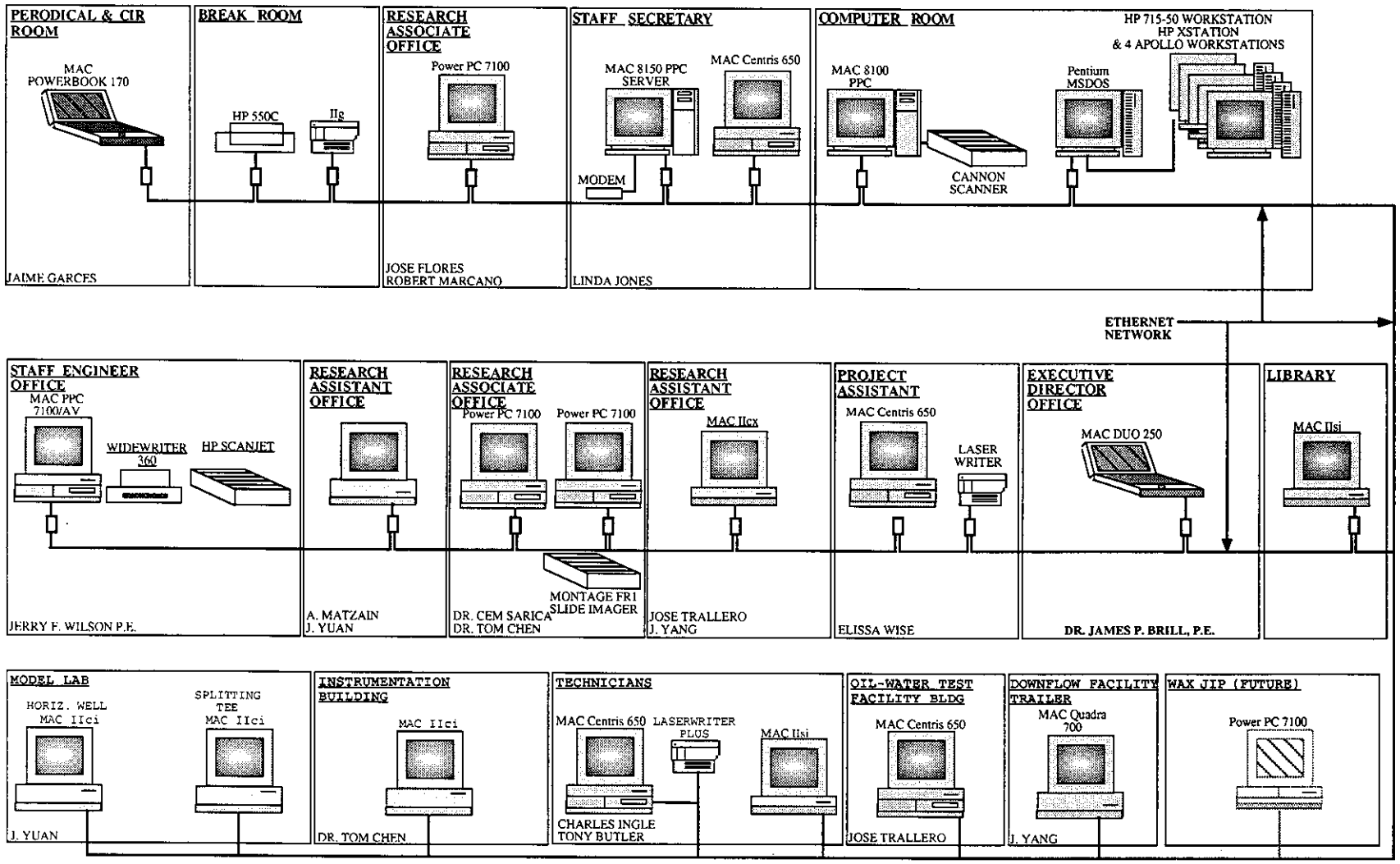


Transient Two-Phase Flow in Horizontal Pipelines

A report describing experimental data obtained for a variety of two-phase flow transient tests in the 1,400-ft long TUFFP pipeline was distributed to member companies in March. A progress report was given at the May Advisory Board meeting in which comparisons of simulation results for PLAC, OLGA and the TUFFP simplified model were presented for five tests.

Following the meeting, it was learned that inappropriate options were used for the PLAC simulations, and that incorrect mass flow rates were used for the OLGA results. Also, results are now becoming available for TACITE simulations. New or corrected simulation results will be generated and a second report comparing these results with experimental data is now scheduled for distribution in late 1995.

TUFFP COMPUTER NETWORK



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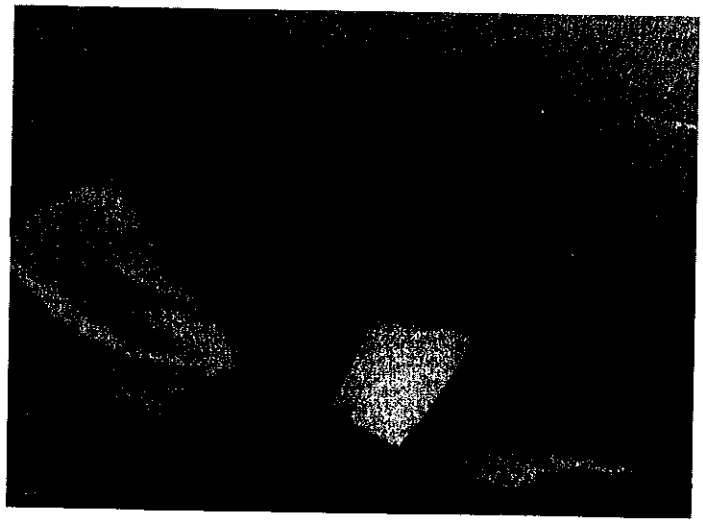
COLLEGE OF ENGINEERING AND APPLIED SCIENCES
PETROLEUM ENGINEERING DEPARTMENT

TUFFP COMPUTER LAYOUT DIAGRAM SUMMER 1995



Jose Flores has developed the database for oil-water flow pattern transition in deviated wells.

TUFFP Staff

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Research Associates	X. Tom Chen
	Stefan Z. Miska
	Cem Sarica
	Yehuda Taitel
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	Tony Butler
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	Robert Marcano
	S. Marti
	Bazlee Matzain
	Miguel Paz
	Jose Luis Trallero
	Jiede Yang
	Hong Yuan
Computer Resources Manager	Jaime Garces-Perez
Part-time Employees	Khairul Ahmad
	Thad Andrews
	Mohd Che-Mat-Dal
	Vijay Dakshinamoorthy
	Johan Johan
	Mohd R. Johari
	Abdullah Osman
	Imelda Sutanto

1995 TUFFP Members

Amoco Production Company

Arabian Oil Co., Ltd.

ARCO Oil and Gas Company

Baker Jardine & Associates

British Gas Corporation

BP Exploration

Chevron Petroleum Technology Company

Conoco, Inc.

ECOPETROL/Instituto Colombiano del Petroleo

Elf Aquitaine

Exxon Production Research Company

Institut Francais du Petrole

Institute of Oil & Gas Production Technology Oil & Natural Gas Commission

Instituto Mexicano Del Petroleo

INTEVEP

Japan National Oil Corporation

Mobil Research and Development Corporation

Norsk Hydro

Pertamina

Petrobras

Petronas

Saudi Arabian Oil Company

Shell Internationale Petroleum MIJ B.V.

Simulation Sciences

Texaco

TOTAL

UNOCAL

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