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## TUFFp Talk

### TUFFP Hires New Staff Engineer

After observing Jerry Wilson's contributions as a part-time temporary staff assistant in TUFFP, it became obvious that the responsibilities assigned to him on a temporary basis should continue permanently. Authorization was approved by The University of Tulsa to make this position a permanent one with the title of Staff Engineer. A job description was written, a search was performed, and a decision was made to hire Jerry as a permanent part-time Staff Engineer of TUFFP.

Jerry, an Architectural Engineering graduate from Kansas State University, had a very successful

career with the U.S. Army Corps of Engineers. He retired from the Corps in 1990 and established his own consulting engineering practice in Tulsa, Oklahoma. As a Registered Professional Engineer with vast experience in design, procurement, contracts, and supervision of large projects, he is an invaluable addition to the TUFFP staff. His primary duties are to interface between Dr. Brill, TUFFP research technicians, and the computer system manager. After experimental test facilities are designed, Jerry will see that they are constructed properly in a cost-effective manner, maintained,

and operated with safe and environmentally sound procedures. Jerry also has significant experience in working with computer networks. Thus, he is ideally suited to supervise the computer system manager to assure that the complex computing networks maintained by TUFFP continue to be modernized and function efficiently.

Jerry is married and has two children and a granddaughter. In his spare time, he enjoys playing the saxophone and clarinet, golf and with Macintosh computers.



**Jerry Wilson**

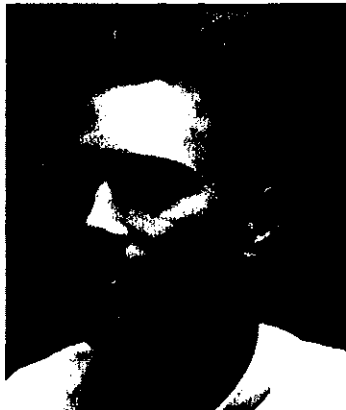
## Visiting Scholars Play Vital Role at TUFFP



Dr. Emilio Guevara, previously Crude Handling Section Head at Intevop, the Venezuelan research affiliate of PDVSA, arrived at TUFFP in August to spend approximately a year assisting us with our plans for conducting research on oil/water and gas/oil/water flow in pipes. Emilio is nearing completion of an exhaustive literature search that will be invaluable in

helping provide guidance for the direction of the TUFFP research project. A report summarizing his work to date will be completed during the first quarter of 1993.

Mr. Fabrice Vigneron arrived at TUFFP in early November to spend approximately one year working in the area of transient two-phase flow. Fabrice holds an equivalent of an M.S. degree from E.N.S.E.E.I.H.T. in Toulouse, France, specializing in Fluid Mechanics under Professor Jean Fabre. During his stay at TUFFP, he will be funded by the three French companies who belong to TUFFP, Elf, TOTAL, and IFP.



Fabrice is reviewing the various projects that have been completed at TUFFP on transient two-phase flow in pipelines. He will then conduct a series of transient tests on the TUFFP 1,400-ft.-long pipeline for the purpose of comparing and evaluating the transient program developed by Minami at TUFFP, and also the commercial codes OLGA and PLAC.

## Growing Problem in TUFFP Financial Status

Preparation of a financial summary to close TUFFP books for 1992 is currently underway. It appears that a positive reserve fund of approximately \$150,000 will exist at the end of 1992. The final figure could be significantly less since it may not include \$60,000 in membership income from three TUFFP members whose 1992 membership fees will not be paid until early 1993. Companies that

have not yet paid their 1992 membership fees have been contacted and assurance has been given that membership fees will be received soon.

The cost of constructing the new test facility for investigating downward two-phase flow and modifying the directional well test facility for safety considerations will significantly erode the reserve fund that has been accumulated in TUFFP. A concerted effort is underway to increase the number of members for 1993. Additional information will be available at the May Advisory Board meeting. At that time, a decision will be made on whether it will be necessary to increase membership fees for 1994.

## Post-Doctoral Research Associates Arrive at TUFFP

Dr. Cem Sarica arrived at TUFFP in September to begin employment as a Post-Doctoral Research Associate. Cem received his Ph.D. in Petroleum Engineering from The University of Tulsa in 1990, working in TUFFP on simulating transient multiphase flow in low-velocity pipelines. For the past two years, he has been an Assistant Professor of Petroleum Engineering at the Istanbul Technical Institute in Turkey. As the most experienced of the new TUFFP Post-Doctoral Research Associates, Cem will assume a variety of important tasks. He will assist Dr. Brill in supervising some of the TUFFP M.S. and Ph.D. students. He has assumed the task of redoing the data and software distribution project that was conducted during 1992. Some of the information distributed to members was incorrect and did not include a user's manual. Cem also will coordinate the graduate seminar that has been underway for many years in TUFFP.



Dr. Dennis Cai arrived at TUFFP in early November to assume a Post-Doctoral Research Associate position. Dennis recently completed his Ph.D. in Engineering Sciences at the Thayer School of Engineering, Dartmouth College, where he worked under the



direction of Professor G. B. Wallis. Dennis's major assignment will be to assist Dr. Brill with the research being conducted on PCB migration modeling for the Gas Research Institute. A progress report on this project appears elsewhere in the newsletter. In addition, Dennis will play a key role in training graduate students on the use of UNIX workstations for the more complex computing requirements encountered in their research projects.

Dr. Xuanzheng Chen has been delayed in arriving from China to fill a third Post-Doctoral Research Associate position in TUFFP. It now appears that all visa and other document requirements have been completed and we anticipate his arrival in late March. Xuanzheng has conducted extensive research on oil/water flow in pipes, and will participate in that project in addition to helping on contract research in the rheology area and helping solve instrumentation problems encountered in TUFFP experimental research projects.

## Data Acquisition Training Program Initiated

Essentially all experimental projects being conducted in TUFFP now involve the use of Macintosh computers for data acquisition purposes. An independent study training program has been initiated that involves most TUFFP staff and students. The initial phase of the program is a study of all electronics instruments commonly used in our research projects. The second phase will involve hands-on experience with these instruments and with a Macintosh computer that uses Labview for data acquisition purposes. Tony Butler, TUFFP's Electronics Technician, is playing a leading role in this training program.

## TUFFP Membership Remains Stable

Membership in TUFFP has declined from 33 members in 1992 to 31 members for 1993. The changes

are a result of Advanced Multiphase Technology and Kerr-McGee Corporation terminating their memberships. A concerted effort is underway to obtain new members and it is hoped that three or four can still be added for 1993.



## Advisory Board Meetings Scheduled

The next Advisory Board meeting will be held May 12 - 13, 1993. The November Advisory Board meeting will be held November 16 - 17, 1993. Recall that the May meeting is scheduled for Wednesday and Thursday and the November meeting is Tuesday and Wednesday, following a decision to alternate days with TUALP.

The May meeting will be held at the Doubletree Hotel at Warren Place in Tulsa and the November meeting will probably be held at the same hotel. Request for Information forms will be mailed to member companies approximately six weeks prior to each meeting to help determine attendance. The forms will be accompanied by information on hotel reservations and travel to and from the airport.

The May Advisory Board meeting will begin at 8:30 a.m. on Thursday, May 13, 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 - 8:00 p.m. on Wednesday, May 12. A tour of TUFFP test facilities will be conducted on Wednesday afternoon from 3:00 - 4:30 p.m.

The May meeting date was selected to immediately follow the Offshore Technology Conference (OTC) in Houston, May 3 - 6, and to precede the TUFFP short course on "Two-Phase Flow in Pipes" that has been scheduled for May 17 - 21. The short course this year has been moved from the Sheraton Kensington Hotel to the Doubletree Hotel at Warren Place.

The above meeting dates also were selected to accommodate persons who attend Advisory Board meetings of other cooperative research programs at The University of Tulsa. Following is a summary of these meetings for May 1993.

Erosion/Corrosion	May 10
TUPREP	May 11
TUDRP	May 11
TUALP	May 12
TUFFP	May 13

TUFFP Advisory Board meeting brochures will be mailed to all members prior to the meeting. 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 meeting but will not be mailed to members.

## Enrollment Period Underway for TUFFP Short Course

Final details have been completed for the TUFFP 1993 Short Course scheduled in Tulsa, Oklahoma, May 17 - 21. For the first time, the course will be held at the Doubletree Hotel at Warren Place.

The purpose of this course is to give participants a well-grounded understanding of the fundamentals of two-phase flow through pipes and restrictions. Completed and current TUFFP research projects permit teaching the latest techniques for designing multiphase flow piping systems for the production and transportation of oil and gas. Upon completion, the participants will be able to apply knowledge gained to design fluid flow conduits encountered in petroleum, natural gas, and chemical engineering operations.

The same pricing schedule that was used for the 1992 course will be retained for 1993 and is given below.

### TUFFP Member Companies:

Per Person \$950

Group Discount - Per Person \$850

### Non-Member Companies:

Per Person \$1,445

Group Discount - Per Person \$1,195

Brochures have been mailed to members and other potential participants.

As of February 5, only three persons were enrolled in the course. We urge member companies to enroll engineers as soon as possible to assist us in planning for the course. If we have not received a sufficient number of enrollments by May 1, 1993, the course will be canceled. Members can enroll by contacting the Continuing Education Department at The University of Tulsa, (918) 631-2347, sending a fax to (918) 631-2154, or by sending a telex to 497543.



## TUFFP Considers Membership Exchange with Stanford University Program

Discussions are underway with the Stanford University Productivity and Injectivity of Horizontal Wells research consortium that could lead to an agreement where SUPRI-HW and TUFFP will exchange some type of membership. This was recommended at the last TUFFP Advisory Board meeting by companies that participate in both research consortia. By monitoring each other's research in the area of flow through horizontal wells, overlap in research efforts could be minimized.

## TUFFP Resumes Graduate Seminar for Spring Term

An excellent group of speakers has been scheduled for the TUFFP Graduate Seminar during the 1993 spring term. Following is a schedule of confirmed speakers. All Graduate Seminars are scheduled to begin at 3:00 p.m.

### Jan. 27

Dr. Michael Adewumi, Penn State University, PCB Migration Modeling Research

### Feb. 11

Dr. Paul Jepson, Ohio University, Gas-Oil-Water Flow Regime Research at Ohio University

### Feb. 18

Yesenia Rincon, Computer Manager/TUFFP, How to Use Apollo System More Efficiently Under Unix Environment

### March 18

Dr. Cem Sarica, Research Associate/TUFFP, Effect of Wellbore Pressure Losses on Productivity of Horizontal Wells

### March 25

Dr. Dan Joseph, The University of Minnesota, Lubricated Transport of Viscous Material and Related Problems

### April 8

Dr. Emilio Guevara, INTEVEP, New Correlations for Eccentricity for Core-Annular Flow

### April 22

Dr. Dennis Cai, Research Associate/TUFFP, The Added Mass Effect of Two-Phase Flow Modeling

### May 6

Dr. Xuanzheng Chen, Research Associate/TUFFP, An Experimental Study on Gas-Oil-Water Flow

## TUFFP Updates Video Capabilities

An increasing number of TUFFP research projects requires capturing a high-speed history of multiphase flow behavior. A new Super Hi-8 video camera, a high-end Super Hi-8 video viewer, and a 31-inch Sony monitor have been purchased for this purpose. The camera is capable of operation at frame speeds of 10,000 per second. Availability of quality videos will greatly enhance our ability to develop predictive models of flow behavior being studied.

## Calendar for Two-Phase Flow Technical Meetings

Several conferences that include technical sessions involving multiphase flow in pipes are scheduled for 1993 and 1994. A calendar for these and other multiphase flow events is given below.

### January 31 - February 4

ASME 16th Annual Energy-Sources Technology Conference and Exhibition - Houston, Texas

### March 21 - 23

SPE Production Operations Symposium - Oklahoma City, Oklahoma

### March 28 - April 1

AIChE Spring National Meeting - Houston, Texas

### May 3 - 6

25th Annual Offshore Technology Conference - Houston, Texas

### May 12

TUALP Advisory Board Meeting - Tulsa, Oklahoma

### May 13

TUFFP Advisory Board Meeting - Tulsa, Oklahoma

### May 17 - 21

TUFFP Short Course - Tulsa, Oklahoma

### June 6 - 11

3rd International Offshore and Polar Engineering Conference - Singapore

### June 16 - 18

BHRG 6th International Conference on Multiphase Production - Cannes, France

### June 20 - 24

ASME 12th International Conference on Offshore Mechanics and Arctic Engineering - Glasgow, Scotland

### June 21 - 25

Short Course on "Two-Phase Flow Through Pipes", Robert Gordon Institute of Technology - Aberdeen, Scotland

### July 11 - 14

SPE Petroleum Computer Conference - New Orleans, Louisiana

### October 3 - 6

SPE Annual Technical Conference and Exhibition - Houston, Texas

### October 14 - 15

PSIG Meeting- Pittsburgh, Pennsylvania

### November 17

TUFFP Advisory Board Meeting - Tulsa, Oklahoma

### November 18

TUALP Advisory Board Meeting - Tulsa, Oklahoma

### January 23 - 26, 1994

ASME 17th Annual Energy-sources Technology Conference and Exhibition - New Orleans, Louisiana

### August 29 - 31, 1994

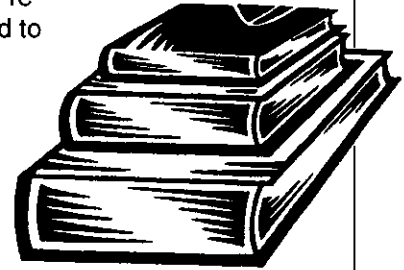
The University of Tulsa Centennial Technical Conference on Petroleum Engineering - Tulsa, Oklahoma

### September 5 - 7, 1994

BHRG/TUFFP Conference on Multiphase Production - Banff Springs, Canada

## TUFFP Participates in Several Technical Conferences

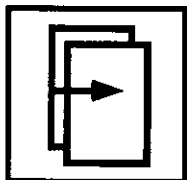
Papers based on TUFFP research have been submitted to various technical meetings since the last newsletter. In addition, TUFFP personnel are involved in planning for several conferences that will include sessions on multiphase flow through pipes. Following is a summary of these activities.



- "Experimental and Theoretical Investigation of Two-Phase Flow in Horizontal Wells," M. Ihara, J. P. Brill, and O. Shoham, presented at SPE Annual Technical Conference and Exhibition, October 4 - 7, 1992, Washington, D.C.
- "An Experimental Study on Two-Phase Slug Flow in Hilly Terrain Pipelines," G. Zheng, J. P. Brill, and O. Shoham, presented at SPE Annual Technical Conference and Exhibition, October 4 - 7, 1992, Washington, D.C.
- "Hilly Terrain Effects on Slug Flow Characteristics," G. Zheng, J. P. Brill, and O. Shoham, submitted for SPE Annual Technical Conference and Exhibition, October 3 - 6, 1993, Houston, Texas.
- "Pigging Dynamics in Two-Phase Pipelines - Experiment and Modeling," K. Minami and O. Shoham, submitted for SPE Annual Technical Conference and Exhibition, October 3 - 6, 1993, Houston, Texas.
- "Simulation of Transient Flow in Gas-Liquid Pipelines Using a Two-Fluid Formulation," Y. Sharma and J. P. Brill, presented at ASME 16th Annual Energy-Sources Technology Conference and Exhibition, January 31 - February 3, 1993, Houston, Texas.
- Dr. Brill serves on the organizing committees for the BHRG 6th International Conference on Multiphase Production to be held in Cannes, France, June 16 - 18, 1993. He will also serve on the organizing committee for a BHRG conference being planned for Banff Springs, Canada, September 5 - 7, 1994.
- Preliminary plans are underway for The University of Tulsa to sponsor a high level technical conference in celebration of its Centennial year in 1994. Preliminary plans are for a three-day conference to be held in August, 1994. At least one technical session would be on multiphase flow through pipes.

# Research Progress

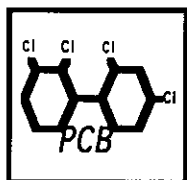
## Reports



### Data Documentation and Distribution

The objective for preparing a data documentation manual is to give guidelines to TUFFP members on how to utilize the 1992 data distribution. The 1992 data distribution included experimental data from the Alves, Daza, Minami, and Zheng studies. A secondary objective is to set standards for future data distributions.

The data documentation manual is scheduled for completion at the end of February 1993, and will be mailed to member companies along with a supplementary data distribution diskette. The PC formatted supplementary diskette will include experimental data and necessary FORTRAN programs to process the raw data missing from the 1992 data distribution.



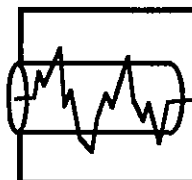
### GRI Liquid Transport Tests

The Gas Research Institute has funded the first phase of a multi-year research project on "Development of the Thermo-hydrodynamic Basis for PCB Transport Modeling in Natural Gas Pipelines." This research project is being conducted jointly by Pennsylvania State University and The University of Tulsa. Principle Investigators for the project are Dr. Michael Adewumi of Penn State and Dr. Brill. TUFFP's focus for 1992-93 is to study transient liquid transport phenomena with very low liquid flow rates through our 1,400-ft.-long loop. The study will be both qualitative and semi-quantitative, with important parameters such as liquid transport time, transport mechanisms, and pressure drop being monitored. Video will be taken with a high speed camera at various measuring stations to help investigate the transport mechanisms.

A second proposal will be submitted soon to GRI for the period 1994-96 to provide improved constitutive equations for the hydrodynamic models that describe this type of flow phenomena. This research also will be conducted at low

pressures in TUFFP's 1,400-ft.-long flow loop.

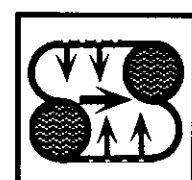
Design changes in the flow loop have been completed, and modification of the existing test facility is underway. Special attention will be paid to installing an accurate metering system for the low liquid inlet flow rate (less than 0.3 GPM) and a smaller, more responsive weighing tank to measure outlet liquid flow rate.



### Transient Two-Phase Flow in Horizontal Pipes

Transient two-phase flow phenomena are frequently encountered in pipelines in the petroleum industry, although they are designed to operate under steady-state conditions. These phenomena occur from changes in operational conditions such as change in flow rates or pressure (imposed transients) or from terrain slugging (natural transients due to the geometry of the pipe). Knowledge of the flow characteristics are very important to properly design two-phase flowlines and fluid treating and separation facilities.

The first objective of this study is to acquire high quality experimental transient data and then compare these data with predictions from the simplified Minami transient model formulated at TUFFP. Attempts will be made to compare the data with predictions from the commercial codes OLGA and PLAC. The data will include measurements of liquid holdup, pressure drop, and visualization of flow patterns. Experimental runs will include imposed transients from increasing or decreasing liquid and gas flowrates and pressure. Also included will be transients caused by accumulation of liquid in a valley. Modifications of the existing 1,400-ft.-long experimental test facility will be completed in April 1993, including a new metering system and installation of a valley.



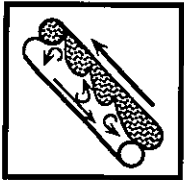
### Flow Behavior in Horizontal Wells

The objective of this project is to investigate, experimentally and theoretically, flow behavior in horizontal wells, especially the interaction between the main flow stream and the influx along the wellbore. The next study planned for this project was to establish a field data bank for flow in horizontal wells, and use this data to evaluate existing methods for predicting flow behavior. This study was

abandoned when it became apparent that either no reliable data were available or that companies were reluctant to share their data with others.

Horizontal wells can have complex flow geometries, depending in part on completion type. In the present study, a small scale test facility will be designed and constructed to simulate single phase liquid flow in a horizontal well. A simple influx geometry, consisting of a pipe with either one slot or one perforation, will be investigated. Subsequent studies will investigate the more complex and realistic effects of multiple slots and perforations, and multiphase flow behavior.

This project will result in a better understanding of the complex momentum transfer that occurs in horizontal wells. One probable outcome is the development of an improved method for predicting friction losses in these wells.

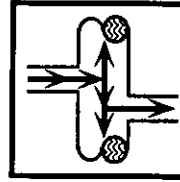


### Oil-Water Flow in Pipelines

The prediction of the hydrodynamics of oil-water (OW) flows in pipelines is a difficult and unsolved problem. Most of the work done in two-phase flow has been related to gas-liquid systems. However, these studies cannot readily be applied to liquid-liquid systems.

The objective of this project is to obtain an understanding of the mechanisms involved in each flow pattern and their transitions. The experimental program will consist of investigating the characteristics of flow patterns for the entire range of inclination angles, from horizontal to vertical, for a particular pipe diameter and different oil viscosities. Pressure drop and holdup measurements will be obtained and mathematical models will be developed for predicting OW flow behavior.

An exhaustive literature survey has been completed. At the conclusion of the research project on gas-liquid flow in extended reach directional wells, that test facility will be converted to a facility for investigating OW flow. This was an OW test facility in the past.

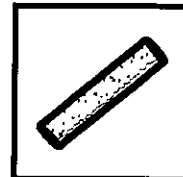


### Two-Phase Flow Splitting at a Tee Junction with an Inclined Side Arm

The objective of this study is to investigate, experimentally and theoretically, two-phase flow splitting at a horizontal tee junction with an inclined side arm. This phase concentrates on stratified flow and considers the entire range of side arm inclination angles.

Modification of the previously existing test facility has been completed. So far, data have been acquired for horizontal, 1° and 5° upward, and -5° and -10° downward inclinations of the side arm. Subsequently, data will also be acquired for 10° and 20° upward and -30°, -60° and -90° downward orientations of the side arm. The new data reveal that the gravity forces are dominant for all inclinations of the side arm at lower gas take off into the branch. At higher gas split ratios into the branch, the gas drag force on the liquid seems to play a very significant role, overcoming the gravity effects.

Data acquisition will be completed by the end of March. Development of a theoretical model will follow, which will be tested against the data taken.



### Annular Flow in Extended Reach Directional Wells

The objective of this project is to investigate, experimentally and theoretically, annular flow in extended reach directional wells. The entire range of inclination angles from horizontal to vertical will be studied. A mechanistic model for annular flow will be developed and tested against laboratory data and, if possible, field data.

The design and construction of the two-inch diameter state-of-the-art conductance multi-probe instrument have been completed. This instrument can hold up to eight conductance probes symmetrically distributed around the pipe periphery. The design allows a very flexible operation of some or of all the probes simultaneously.

Efforts are underway to acquire preliminary data for vertical annular flow utilizing a small scale facility located indoors in the model lab building. Simultaneously, the large outdoor flow loop has been carefully examined to address safety concerns, and maintenance of this facility is underway. We hope to present preliminary results and performance of the conductance probes at the next Advisory Board meeting.



## Downward Two-Phase Flow in Inclined Pipes

The objective of this project is to study, experimentally and theoretically, two-phase flow in downward inclined pipes, including inclination angles from horizontal to vertical downward. The research will investigate flow behavior for all flow patterns and will include measurements of liquid holdup and pressure gradient for different operating conditions. The first goal for this research project is to design and construct a test facility to acquire necessary data. Also included will be development of a preliminary mechanistic model for subsequent evaluation with experimental data.

Design of the support structure has been completed, with construction scheduled to start in late February. Design of the test facility is underway. Most components of the fluid handling system, including piping, storage tanks, meters, pumps, and separator, have been selected.

## TUFFP

Executive Director:	James P. Brill
Staff Engineer:	Jerry F. Wilson
Research Associates:	Stefan Z. Miska Yehuda Taitel
Visting Scholars:	Emilio Guevara Fabrice Vigneron
Post Doctoral Research Associates:	Dennis Cai Xuanzheng Chen Cem Sarica
Administrative Secretary:	Linda Jones
Technicians:	C. Ingle T. Butler
Research Assistants:	P. Ashton R. Paz V. Penmatcha P. Roumazeilles J. Trallero J. Yang H. Yuan
Computer Resources Manager:	Yesenia Rincón
Part-time Employees:	Elizabeth Ahow Robert Marcano

Decisions have been made concerning the instrumentation and data acquisition system. Construction of the experimental test facility should be completed in April, with preliminary tests starting in May. A review of pertinent literature is nearing completion. Development of a preliminary model for predicting downward flow behavior will begin soon.

## 1993 TUFFP Members

Amoco Production Company  
 Arabian Oil Co., Ltd.  
 ARCO Oil and Gas Company  
 British Gas Corporation  
 BP Exploration  
 Chevron Oilfield Research Company  
 Chiyoda  
 Conoco, Inc.  
 ECOPETROL/Instituto Colombiano del Petroleo  
 Elf Aquitaine  
 Exxon Production Research Company  
 Institut Francais du Petrole  
 Instituto Mexicano Del Petroleo  
 INTEVEP  
 JGC Corporation  
 Japan National Oil Corporation  
 Marathon Oil Company  
 Mobil Research and Development Corporation  
 NKK Corporation  
 Norsk Hydro  
 Oil and Natural Gas Commission  
 Pertamina  
 Petrobras  
 Petronas  
 Phillips Petroleum Company  
 Saudi Arabian Oil Company  
 Shell Internationale Petroleum MIJ B.V.  
 Simulation Sciences  
 Texaco  
 TOTAL  
 UNOCAL



# TUFFP CON ALLEY

## TUFFP Computer Network Gets Upgrade

A new Macintosh SE/30 file server has replaced the Mac II, considerably speeding up the TUFFP Local Talk network. Several software upgrades and new software features have also been added to the network. New Apple-Share network software has brought TUFFP into full use of the System 7 operating system and also provides both file sharing and printer serving. The immediate return of individual computers after selecting "Print" has been a welcome addition to the network.

Installation of WorkPerfect Office E-Mail has added another very functional feature to the network. Various groups within TUFFP can be sent messages with one click of the mouse (or trackball). Remote Access has also been added to the network to facilitate logging into the network from any location with a telephone and modem.

## Additional Printers Add Color Quality

In our quest for improved efficiency and quality, new Apple LaserWriter IIg, HP 550C, GCC WideWriter 360, and WriteMove II printers have been added to the hardware inventory. The HP550C is a color inkjet printer with a 300 dpi resolution and is producing some outstanding color graphs. The LaserWriter IIg has some greatly improved (almost photo quality) gray scale printing. The GCC printer enables us to print large 17X22 drawings and graphs in black and white.

## Quodras Get More Horse Power

The power users in TUFFP have welcomed the upgrade to 20 megabytes of RAM in our two Quodras. Seldom is the dialog box seen on these two powerhouses that says "Insufficient RAM to open this Application." This is especially useful when there is a need to keep several programs running at the same time. On numerous occasions, Excel, Cricket Graph, and Word are needed to efficiently move data around. The Quads handle this operation without a hiccup.

## Director Upgrades Powerbook

The addition of a 120 megabyte hard disk, a send and receive fax modem, a WriteMove II portable printer, and Remote Access gives Dr. Brill total network accessibility and portability when travelling. This includes printing, sending and receiving faxes, and accessing E-mail.

## New Printer Makes CAD Size Drawings

A new GCC printer gives Jerry Wilson the capability of making plotter type drawings for contract purposes. Using wide, fan-fold paper, drawings can be 17 inches wide and almost any length. This feature is especially useful when printing PERT and GANT charts, as well as larger graphs and charts for the Research Assistants.

## Technicians "Get on the Network" Via Modem

Charles Ingle and Tony Butler, TUFFP's outstanding technicians, now have access to the Local Talk network through the use of an inexpensive modem. This alternative to hard wiring a network connection has proven to be very successful. Connection to E-Mail, file server, and print server are all possible by merely double clicking the mouse button. Apple Remote Access is the main software package making this connection possible.

## TUFFP Completes Ethernet/Token Ring Hookup

Yesenia Rincon, our Computer Manager, has arranged to install additional Ethernet connections in the Model Lab. Downloading massive amounts of data from the Macintosh data acquisition computers to the HP/Apollo workstations is now a reality. Yesenia also arranged to have the networking software upgraded this winter and has upgraded the operating systems on our data acquisition Macintoshes. Plans are being formulated to connect the Computer Room Quadra to the HP/ApolloToken Ring network, along with placing the Computer Room 486-PC computer on the Local Talk network. This interconnection should make our total network function even better.

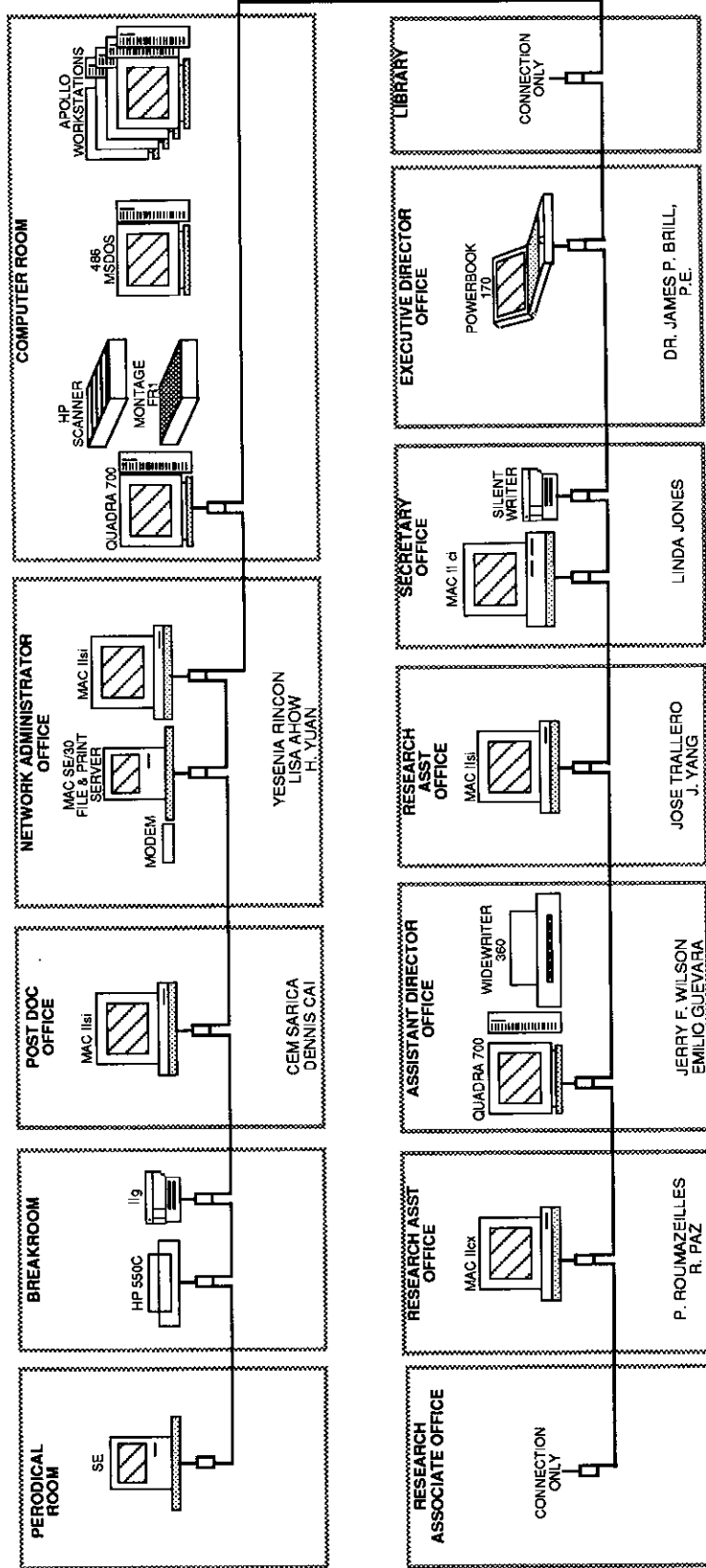
## ARA Greatest Thing Since Sliced Bread

ARA or Apple Remote Access has opened up a whole new world of communications access for TUFFP. This software package, running in conjunction with our upgraded file and print serving software, gives access to the computer network from remote locations. Dr. Brill can now keep track of mail and send mail from any phone, improving our communications and efficiency. This new ability to "Keep in Touch" makes all activities run more efficiently with fewer important items falling through the cracks.

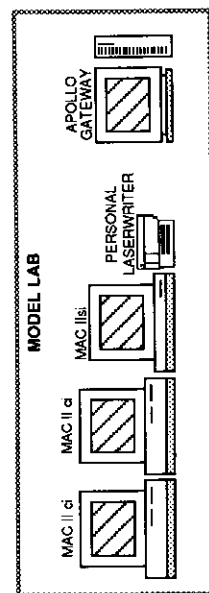
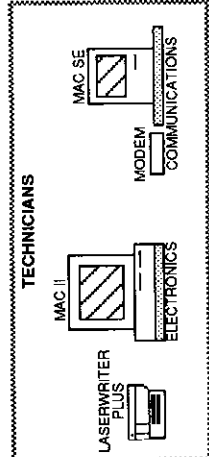
## Multimedia Now a Reality at TUFFP

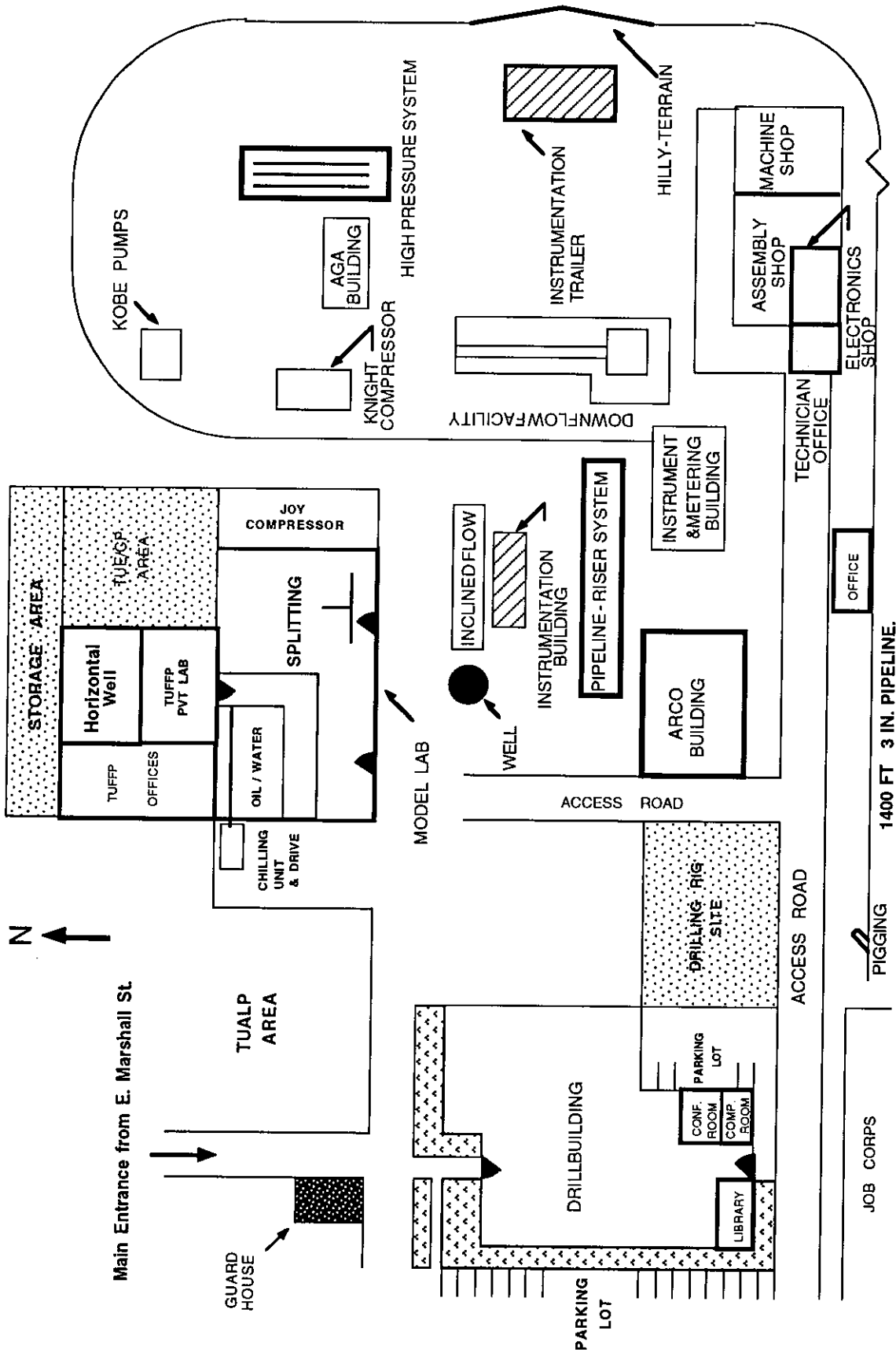
When the last Quadra was purchased, it came with a Multimedia card and software. These will enable TUFFP personnel to transfer video into the computer, manipulate the video into Quick Time spots in presentations, and provide single frame pictures of multiphase phenomena. Test videos taken at 1/10,000 of a second were faithfully reproduced on the Quadra. These could be successfully used in research reports and technical papers. Although in its infancy with regard to implementation, this new visualization capability promises to be a major asset in many research projects.

**TUFFP APPELTALK NETWORK  
WITH  
FILE AND PRINT SERVING CAPABILITIES**



**TUFFP COMPUTER  
LAYOUT DIAGRAM  
SPRING 1993**





# TUFFP Test Facilities

(February 1993)

**The University of Tulsa**  
**Fluid Flow Projects**  
600 South College Avenue  
Tulsa, Oklahoma 74104-3189

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