

TULSA UNIVERSITY FLUID FLOW PROJECTS

NEWSLETTER

February, 1986



ADVISORY BOARD MEETING

The Spring, 1986 TUFFP Advisory Board meeting will again be held at the Tulsa Excelsior Hotel on Wednesday, May 14, 1986. The meeting will begin at 8:30 a.m. and adjourn at 4:30 p.m. A pre-meeting cocktail party will be held at the Excelsior hotel from 5:00 - 7:00 p.m. on Tuesday, May 13, 1986. Tours of TUFFP test facilities will be held Tuesday afternoon from 3:00 - 4:30 p.m.

The above meeting date was selected to accommodate those member companies who will also attend Advisory Board meetings for other cooperative research programs at Tulsa University during the same week. Following is a summary of these meetings.

<u>Program</u>	<u>Meeting Date</u>
Rheology Research Projects	May 12, 1986
Erosion/Corrosion Research Center	May 13, 1986
Drilling Research Projects	May 13, 1986
Fluid Flow Projects	May 14, 1986
Artificial Lift Projects	May 15, 1986
Corrosion Fatigue Projects	May 15, 1986

An Advisory Board meeting brochure will be mailed to all members prior to the meeting. It will contain sufficient information to prepare each attendee for active participation in discussions on current and future research projects, financial matters, and operating procedures.

A REQUEST FOR INFORMATION form will be mailed to all members on March 26, 1986 to determine attendance at the meeting. The form will be accompanied by information pertaining to Excelsior Hotel reservations, accommodations, and limousine service to and from the airport.

STATUS OF RESEARCH PROJECTS

Horizontal Slug Flow Modeling and Metering (Kouba)

Since the November Advisory Board meeting much of the dynamic calibration data on the various capacitance sensors has been reduced. More than 400 individual slugs were trapped during 38 dynamic calibration test runs. Despite the difficulties in performing these tests, only 80 slugs were excluded due to abnormally low liquid holdup values. These low holdup slugs resulted from trapping part of the mixing region or slug tail region. The dynamic calibration data show that the ring and helical electrode configurations perform equally well in slug flow.

Two publications have been completed and submitted to the Instrument Society of America (ISA) International Instrumentation Symposium to be held May 5-8, 1986 in Seattle, Washington. Titles of the publications are:

"A Microcomputer Based Data Acquisition System"

"Dynamic Calibration of Two Types of Capacitance Sensors Used in Measuring Liquid Holdup in Two-Phase Intermittent Flow"

Information contained in these publications was not considered to be proprietary. Progress reports over the past two years have contained essentially all of the information in the publications.

Two Phase Flow Splitting
in a Reduced Horizontal Pipe Tee (Shoham)

A supplement to the previous report titled "Two-Phase Flow Splitting in a Horizontal Pipe Tee", which was mailed to TUFFP members on May 2, 1984, is under preparation. The supplement will contain additional data obtained for a reduced tee and modification of the predictive model. A computer program for the modified model following the System 86 criteria will be included in the report.

Two-Phase Flow in a Vertical Annulus (Caetano)

Final corrections are currently being made to the research report on this topic. Duplication and mailing to members is now scheduled for March, 1986.

Transient Two-Phase Flow in Pipelines (Sharma)

A final report titled "Modeling Transient Two-Phase Slug Flow" was mailed to member companies on December 10, 1985. Pending the availability of Dr. Sharma for all of 1986, the following additional topics will be pursued:

1. Couple existing TUFFP models for stratified, annular, slug and homogeneous transient flow into a comprehensive model valid for all flow patterns.
2. Revise the fluid physical property formulation to accommodate compositional fluids.
3. Include conservation of energy to permit temperature prediction.
4. Preparation of articles based on stratified, slug and annular models for submission to technical journals when proprietary period is over.

Flow of Oil-Water Mixtures
in Horizontal Pipes (Martinez)

Duplication of a report on this topic is underway with distribution to member companies scheduled for early March, 1986.

Dynamics of Slug Flow in Pipelines (Scott)

A slug length and growth correlation has been developed from the Prudhoe Bay data. The results of this work are being presented in a paper at the SPE California Regional Meeting in April, 1986. In this paper, two types of slug growth are defined and several mechanisms are proposed to explain this growth. For the remainder of the Spring semester, work on mathematically modeling these mechanisms will begin. Also, reprocessing of some of the raw Prudhoe Bay data will be performed and a report on the Prudhoe Bay data will be completed.

System 86 (Scott and Corcoran)

Work began on the System 86 project in January, 1986. This project involves a major restructuring and documentation of the most important TUFFP computer programs. The ultimate goal of this project is the development of a graphics-oriented and user-friendly system. This system would link the programs developed by TUFFP research into a convenient form for use by member companies.

The progress obtained thus far consists of the development of interactive input data file drivers. A preliminary design specification for System 86 and a time table have also been established. During the remainder of the Spring semester, the restructuring, documenting, and testing of selected files will be undertaken. A series of seminars is being taught for TUFFP research personnel to improve development of future programs.

Two-Phase Flow in Hilly Terrain
Pipelines (Zheng and Bhatia)

Preliminary definitions of objectives for this project are currently being developed. Following this, a design of test facility modifications will be pursued. Initial testing on the effects of uphill slopes on slug flow will be completed during the Summer and Fall, 1986.

Design of Finger Storage Type
Slug Catchers (Arirachakaran)

A comprehensive literature search and tabulation of details pertaining to existing slug catchers of this type are currently underway. Tests on two-phase flow splitting at T junctions in slug flow will be conducted to permit familiarization of

the test facility and expansion of the current TUFFP data bank on this topic. Minor modifications of the existing test facility will then be made to permit testing the effect of elbow location upstream of a dead-end T on the splitting phenomena. It is felt that this is a necessary first stage to study flow splitting in the complex piping arrangement associated with finger storage type slug catchers.

Well Bore-Reservoir Interaction (Serra)

Coupling of a reservoir simulator with a transient well bore model was discussed briefly at the November, 1985 Advisory Board meeting. Since then, it was learned that Mr. Kelsen Serra, a Ph.D. student sponsored by Petrobras, was interested in pursuing a similar topic with major emphasis placed on the reservoir simulation aspect. A decision was made for TUFFP to monitor the progress of this project, provide technical consultation when needed and appropriate, and keep TUFFP members informed of the status.

EQUIPMENT AND FACILITIES

Computer

Tulsa University is currently advertising to sell the Harris 800 computer system. Although the system has provided excellent computing capabilities for TUFFP, it has been expensive to maintain. Additional users willing to share the cost of maintenance have not been found. This is principally due to the location of the computer on the North Campus and the general unfamiliarity and non-standard nature of the Harris system. Any replacement would have to provide TUFFP with equivalent or improved computing power and improved graphics capabilities.

Two HP Vectra personal computers have recently been purchased to supplement the existing two IBM AT personal computers. In addition to providing computing capabilities not available with the Harris system, they can also be used as future data acquisition systems.

Analysis of TUFFP computing needs suggests that the best replacement candidate for the Harris 800 would be either a MicroVAX II system or equivalent. Discussions are currently underway with Digital Equipment Corporation to configure a possible MicroVAX II system. In addition, it was recently learned that Apollo Computers, Inc. will donate two Apollo workstations to the Petroleum Engineering Department. The possibility of one or both of these being utilized by TUFFP is also being pursued.

A new patch panel has been designed and installed in the TUFFP Computer Room. This will eliminate past cabling problems and facilitate easy allocation of any desired computer port to all TUFFP offices and instrumentation buildings.

Remodeling

All remodeling of the TUFFP library, duplication and storage room, and offices for the Director and Administrative Assistant are now complete. Plans are underway to remodel the Associate Director's office during the Spring semester.

A replacement instrumentation building for the pipeline riser pipe facility is currently being designed. The previous building had deteriorated to the point where it was no longer satisfactory for this purpose. The building will be replaced during the Summer, 1986.

Central air-conditioning and heating have been installed in the enclosed test facility area adjoining the Model Lab building. This is the area where the two-phase splitting and oil-water test facilities are located. The previous window units were destroyed when struck by lightning.

Compressor

A portable Ingersol-Rand compressor has now been obtained as the replacement unit for the Chicago-Pneumatic compressor. The new unit has been checked out and appears to be in excellent operating condition. Safety switches will be replaced and the unit will be cleaned and painted in preparation for use during the Summer, 1986.

Miscellaneous

Upgrading of electrical power capabilities to the Model Lab building and other areas is now complete. TUFFP power availability was increased from 150 kva to 300 kva at a total cost of \$2,600.

A used diesel fork lift with a rating of 15,000 pounds was jointly purchased by TUFFP, TUALP and TUDRP. Our share in the purchase price was \$1,033. The new unit will permit moving heavy equipment that previously could not be moved without hiring an outside contractor.

The University of Tulsa is currently in the process of obtaining bids to install a 10 ft cedar fence along the south and east property lines of the North Campus. TUFFP would be the major beneficiary of this addition from both a safety and esthetic viewpoint.

PERSONNEL

Dr. Y. Sharma accepted a post-doctoral appointment as a TUFFP Research Associate for 1986, subject to approval from the Trinidadian government. There is a possibility that he will be required to accept a position with a company or government agency within Trinidad.

Negotiations are underway between Gene Kouba and The University of Tulsa for a Visiting Academic Appointment in the Petroleum Engineering Department for one year following completion of his Ph.D. degree. This would permit temporarily retaining his expertise for TUFFP. He is currently developing a new graduate course on instrumentation and data acquisition to be offered during the Fall semester, 1986.

Mr. Arthur Corcoran, a senior in Computer Science, was awarded a TUFFP Undergraduate Research Internship for the Spring term. He is working with Stuart Scott to implement System 86.

Dr. Pratanporn Arirachakaran continues to work for TUFFP on a part-time basis. She has completed development of spread sheet programs for budgeting and financial analysis of TUFFP accounts, and continues to maintain the TUFFP library.

Distinguished Lecturer seminars were given by Dr. W. Paul Jepson of Herriot Watt University in Glasgow, Scotland on November 22, 1986 on "Two-Phase Slug Flow" and by Dr. Sanjeev Deshpande of the University of Pittsburgh on "Heat Transfer in Two-Phase Slug Flow" on February 21, 1986.

Final arrangements are underway for Dr. Yehuda Taitel to spend a sabbatical period of one semester at TUFFP during the Spring Term, 1987. He would conduct research on stability criteria for severe slugging and assist modeling efforts on all other TUFFP research projects.

MEMBERSHIP

No new TUFFP members have been obtained since the November 1985 Advisory Board meeting. STATOIL joined TUFFP in 1985, bringing our current membership for 1986 to 31 companies. Two new members are needed to meet the 1986 budget. Excellent additional prospects for membership include: China Offshore Oil Co., JNOC, Kerr-McGee, Nippon Steel, and Simulation Sciences, Inc.

FINANCIAL

All members have paid 1985 membership fees. Membership fees for 1986 have been received from 19 members. It is assumed that payment from the remaining 12 members will be received in the near future.

The official TUFFP Reserve Fund balance as of January 1, 1986 is not yet available. Expenditures are on schedule for 1986 and will be monitored closely to prevent a deficit from occurring if income projections are not met.

MISCELLANEOUS

Enrollment in the May 19-23, 1986 TUFFP short course in Tulsa now stands at 10, including 8 from 6 member companies and 2 from non-member companies. Enrollment in the June 23-27, 1986 TUFFP/BHRA short course in London now stands at 2. Members are urged to support these two short courses to prevent a financial loss that would contribute to a deficit for 1986 or require a reduction in research effort.

A request has been re-submitted to Arco Oil and Gas Co. for release of flowing well surveys from the Prudhoe Bay field of Alaska. The request has been approved by ARCO and submitted to other Prudhoe Bay Unit co-owners for their consideration.

The new Letter of Agreement between TUFFP member companies and The University of Tulsa has now been signed by 21 members. An additional 4 members have determined that they will not sign but will continue membership without a Letter of Agreement. No response has yet been received from 6 members.

On February 23, 1984 a magnetic tape containing 17 files was distributed to member companies. Plans to update the tape with programs developed during the past 2 years have been delayed by problems in restoring the program developed by Kunal Dutta-Roy for transient two-phase flow in pipelines. A decision has been made to update the tape without his program. Twenty member companies requested copies of the updated tape in the Summer, 1985 Questionnaire. These tapes will be distributed in March, 1986. The 5 members who have purchased GPA*SIM from the Gas Processors Association will also receive a revised version of this program that was developed by Jean-Claude Goyon.

It was announced at the November, 1985 Advisory Board meeting that a description of two potential new research projects would be prepared and distributed to member companies for their rating. The project on "Well Bore-Reservoir Interaction" is currently being conducted by a non TUFFP student as described earlier. A description of a possible project on "Liquid Holdup in Low Velocity Pipelines" will be included in the Summer, 1986 Questionnaire.

