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FINAL REPORT

**ORGANIZATION OF GRADUATE ENGINEERING PROGRAMS
IN THE
PETROLEUM AND PETROCHEMICAL COLLEGE
CHULALONGKORN UNIVERSITY, BANGKOK, THAILAND
AS A JOINT VENTURE
WITH PARTICIPATING U.S. UNIVERSITIES**

United States Agency for International Development

Cooperative Agreement
No. 493-0000-A-00-1150-00

prepared by

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Summary

This final report is submitted upon completion of the assessment of the academic partnership proposed among the Petroleum and Petrochemical College, Chulalongkorn University, Bangkok, Thailand, and three cooperating universities in the United States (Case Western Reserve University, The University of Michigan, and The University of Oklahoma). The partnership would undertake to develop graduate programs in Petrochemical Technology and Polymer Science in the Petroleum and Petrochemical College.

The purpose of the assessment was to determine the feasibility of the partnership and not to propose a specific design for implementation. The design and implementation of the partnership and the academic programs arising therefrom were the responsibility of Chulalongkorn University and the cooperating U.S. universities. However, the cooperative efforts among the parties involved in the feasibility study led directly to establishment of an academic partnership and plans for implementation of the graduate programs. These plans included a request for support of the partnership program through the USAID, University Development Linkages Project (UDLP).

With support provided by the university partners, USAID, and industry and government in Thailand, the graduate programs in Petrochemical Technology and Polymer Science were initiated. The first classes began in May of 1993.

Background

Cooperative Agreement No. 493-0000-A-00-1150-00 was established between the Association of Big Eight Universities and the United States Economic Assistance Mission in Thailand (USAID) in 1991. Mr. Owen Cylke, President of the Association of Big Eight Universities, served as project director. Mr. Cylke and Dr. Erle Donaldson, an emeritus faculty member at the University of Oklahoma, visited the potential cooperating U.S. universities in October 1991 and Chulalongkorn University in November 1991. Representatives of the U.S. universities met with Mr. Cylke and Dr. Donaldson in Chicago in January 1992 for a briefing prior to a scheduled visit to Thailand. Dr. Hatsuo Ishida, Case Western Reserve University, Dr. Johannes Schwank, The University of Michigan, and Drs. Jeffrey H. Harwell and Raymond D. Daniels, The University of Oklahoma, visited Chulalongkorn University in late January 1992.

At meetings in Bangkok in January 1992 with Dr. Kamchad Mongkolkul, Director, Petroleum and Petrochemical College, and other Chulalongkorn University representatives and with Mr. Peter Deinken, Director of Human Resource Development, USAID/THAILAND, program concepts and feasibility were explored in some depth. These meetings led to a conference in

Norman, Oklahoma in May 1992 at which specific plans for the academic partnership were formulated. A plan of action was developed which included project milestones and an income and expense analysis to demonstrate the long-term viability of the partnership program.

A draft final report for the feasibility study was submitted by Mr. Cylke in May 1992.

Subsequent Developments

In June 1992 a proposal was submitted by The University Oklahoma to the competitive USAID, University Development Linkages Project program to seek partial support for start-up of the academic partnership program. The proposal was ranked high among the proposals considered for FY92 UDLP funding, but it was not funded immediately because of restrictions then imposed on funding of programs in Thailand. The program was funded in April 1993, with five-year funding in the amount of \$1 million from USAID, with matching funds of an equal amount from non-Federal sources.

Mr. Owen Cylke resigned from the Association of Big Eight Universities effective 30 June 1992. The Association requested that administrative responsibility for the Cooperative Agreement be transferred to The University of Oklahoma, with Dr. Raymond D. Daniels, Professor of Chemical Engineering and Materials Science, as project director. This was done.

Plans went forward to start the graduate programs in Petrochemical Technology and Polymer Science at Chulalongkorn University with the 1993-94 academic year which begins in May 1993. In November 1992 officials of the four partnership universities (Chulalongkorn University, Case Western Reserve University, The University of Michigan, and The University of Oklahoma) met in Bangkok, Thailand, to formally launch the Academic Partnership with the signing of a Memorandum of Understanding (MOU). The MOU outlines the scope of the graduate programs and the participation and responsibilities of the universities participating in the Academic Partnership.

In March 1993, Dr. Daniels visited Bangkok to complete the course schedules for the 1993-94 academic year and assist in interviewing student applicants for the first classes in the new graduate programs. His visit was also the occasion to celebrate the award of USAID UDLP funding in support of the program and the award of thirty-six full-tuition scholarships by Thai industry for the incoming class of students.

Instruction in the graduate programs began in May 1993, with ten courses scheduled for the 1993-94 academic year. All of the courses in this first year are being taught by faculty from the U.S. universities.

The Academic Partnership

The organization and implementation of the graduate programs in Chulalongkorn University's Petroleum and Petrochemical College as a joint academic venture with the three participating U.S. universities is spelled out in detail in the proposal submitted in June 1992 to the USAID UDLP program. This proposal is a product of the feasibility study and constitutes an integral part of this final report. What follows as Appendix I is the body of that proposal. Appendix II is a copy of the Memorandum of Understanding among the partner universities.

Appendix I

UNIVERSITY DEVELOPMENT LINKAGES PROJECT PROPOSAL

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EXECUTIVE SUMMARY

Rationale

Thailand has made an extraordinary commitment to develop a sophisticated national petrochemicals industry. The industry is based on domestic oil reserves of about 1.1 billion barrels and gas reserves of about 19 trillion cubic feet. Investment could reach to \$2.0 billion by the end of the decade. Petrochemicals are of great importance to an economy. This is especially true in Thailand. An efficient petrochemical industry could give a real boost to the economy, enabling Thailand to increase the value of its oil and gas reserves.

Over the past several years, the pace of economic development in Thailand has been impressive. With manufactured exports growing at 35 to 40 percent per annum for five consecutive years, GDP growth in 1991 was just under 8 percent. Thailand is clearly among the wave of newly industrializing nations. Success, however, has highlighted problems of human resource development and utilization. Manifestations of these problems include shortages in key skill areas, coupled with growing educated open unemployment. The underlying reason is the apparent slow response of the educational system to market demand. Key skills in the science and technology fields are in very short supply. More engineers, computer scientists, and scientific personnel are needed while there is less demand for the social and political sciences and humanities.

Leaders at Chulalongkorn University, Thailand's premier university, have adopted an aggressive strategy to build technology infrastructure in Thailand. They recognize that there was a time when a country's economy could be described by identifying its resource endowment (i.e., physical, human, and capital). The model was static. Newly industrialized countries have demonstrated that the fixed elements of the classic model can be replaced by human creative power, a highly educated work force, organizational talent, and the ability to adapt. These attributes are not conceived of as natural endowments, but as qualities to be achieved through public policies in support of education, organized research and development, and market-oriented, competitive economies.

The Linkage

Chulalongkorn University intends to reorganize the Petroleum and Petrochemical College at the University to establish an academic partnership with the University of Oklahoma, the University of Michigan, and Case Western Reserve University to offer graduate programs in petrochemical technology (chemical engineering) and polymer science.

Beyond the specifics of these particular graduate programs, the participating universities have set a common goal:

--to test, authenticate, and promote new models for international technological collaboration in the areas of energy, environment, and advanced materials, and specifically to establish a center of engineering excellence in Thailand.

The purpose of the University Development Linkages Project follows directly from that goal:

--to fashion a collaborative venture among Chulalongkorn University, Case Western Reserve University, the University of Michigan, and the University of Oklahoma as the essential institutional foundation for a new graduate engineering college in Thailand.

Under the agreement the three U.S. universities will provide instructional faculty for graduate level courses to be offered in Thailand. All instruction will be in the English language. In addition, U.S. faculty will

work with Thai faculty and students to establish research programs in the respective disciplines.

Two-year master's degree programs will be offered, and the first classes will be enrolled in the academic year beginning in May 1993. The goal of the new program is to produce 20 M.S. graduates in polymer science and 20 M.S. graduates in petrochemical technology per year to help meet the needs of Thailand's fast growing petrochemical and petrochemical-based industries. A product of the partnership will be engineering graduates of first rank, fluent in English, with an open and participatory professional style characteristic of engineers educated in the United States.

This joint venture (academic partnership) among Chulalongkorn and its U.S. partner universities is an ambitious undertaking, involving not only instructional programs, but an aggressive development program and a strong research base supported by grants and contracts. Since the degree programs will have a thesis research requirement, a substantial, on-going research enterprise is required if the College is to operate at an international standard.

The proposed University Development Linkages Project (UDLP) will assist in the start-up and development of the joint venture and promote a common goal of the participating universities: to test, authenticate, and promote new models for international technological collaboration and, specifically, to establish a center of international engineering excellence in Thailand.

The linkage addresses three of the four A.I.D. priority areas for developing countries. By strengthening the technical and management skills of the work force in Thailand, the linkage will help in: (a) promoting private sector economic growth, (b) human resource development, and (c) environment and natural resource management. Strengthening the technical manpower base in Thailand is one of the three priorities specifically addressed by the A.I.D. Mission in Thailand in its development plans for the nineties.

The master's degree programs will be 36 semester credit hours, including 12 hours of credit for thesis research. Courses (typically 3 credits) will be offered in four-week modules. Students will average four courses per year and will be encouraged to initiate thesis research early in the first year. U.S. faculty will teach all of the courses offered in the first two years (10 courses per year). In the third and successive years, U.S. faculty will teach about one-half of the courses and Thai faculty will teach the other half.

While in Thailand as an instructor each U.S. faculty member will work with Thai faculty and 3-5 graduate students to initiate thesis research projects. Initially, the research activities in Thailand will be closely integrated with research work ongoing at the participating U.S. universities.

As a start-up and team building activity, Thai faculty members will spend a semester in residency at one of the U.S. universities. This will foster collaborative research among Thai and U.S. faculty and help build personal, professional, and institutional bonds.

Also as part of the start-up and team building activities, there will be a series of design and developmental missions to Thailand in which U.S. faculty will assist in facilities development at the College, including equipment selection for petrochemical and polymer research laboratories, computer facilities, etc. The Thai government has allocated \$6 million (\$1.2 million per year over 5 years) for equipment acquisitions for the College.

A graduate student exchange program will be initiated after the graduate program has been in operation two years. In the exchange, 6 U.S. students per year will spend 3 months at Chulalongkorn University and 6 Chulalongkorn students will spend 3 months at one of the U.S. universities.

Sustainability

The joint academic endeavor was first proposed by Chulalongkorn university in 1989. Development work on their part was undertaken for almost two years (1991) before the University engaged a United States collaborator (Association of Big Eight Universities) and finalized agreement on partner universities (1992). The Association completed a feasibility study for the proposed joint venture in 1992. The conclusions were favorable.

A comprehensive business plan has been developed for the first five years of the joint venture. The plan captures all costs, direct and indirect, and shows the offsetting revenue streams. With continued institutional commitments and modestly successful development, research, industrial service, and continuing education activities, the venture is sustainable at the level proposed.

Activities for UDLP Funding

UDLP funding is requested to help support the following linkage activities in the developmental phases of the joint venture:

1. Meetings and administrative travel expenses of the steering committee, which will have overall programming and management responsibility for the linkage, and the UDLP project director.
2. Personnel and travel expenses of start-up design and development missions to Thailand.
3. Travel, housing, and living expenses for Thai faculty residences at participating U.S. universities.
4. Personnel and travel expenses specifically related to program evaluation.
5. Travel, housing, and living expenses for student exchanges.

SECTION I - THE LINKAGE

A. RATIONALE

Background

1. Technological Infrastructure: There was a time when an economy could be described by identifying its resource endowment (i.e., physical, human, and capital). The model was static. Japan, South Korea, and other newly industrializing countries have demonstrated that a nation's economic prospects can be dramatically enhanced in a relatively short time. The fixed elements of the classic model can be replaced by human creative power, an educated work force, organizational talent, and the ability to adapt. Collectively these factors constitute a technological infrastructure.

Technology, technical change, and technological innovation are integral parts of the social and economic systems of industrialized economies. The systematic application of human and financial resources toward the development of useful knowledge, the basis for technical change, has been present for 200 years. Some of the newly industrialized countries have a hold on both the ideas and institutions; but many modernizing countries are not yet comfortable with technology, technical change, and technological innovation. The technology process - what it is, how it works, what influences it, and what is necessary for its strength - suggests a new agenda for them.

To develop a modern technological infrastructure, governments must foster strategic alliance with the knowledge, industrial, and financial sectors. Several factors comprise the new infrastructure: accessible technology; skilled, flexible, and motivated human resources; available financial capital; entrepreneurial management; quality assurance; and a competitive economic environment. The components must be promoted, largely through new forms of public/private cooperation and new types of organizational arrangements involving governments, universities, research laboratories, and industry, on a national and international level. Countries that can effectively promote these key components will be competitive in the new global economy.

2. Petroleum, Petrochemicals, and Polymers: Thailand has made an extraordinary commitment to develop a sophisticated petrochemicals industry. The industry is based on domestic oil reserves of about 1.1 billion barrels and gas reserves of about 19 trillion cubic feet. Investment will reach to \$2.0 billion by the end of the decade. The National Petrochemical Corporation serves both as a pilot operation and sponsoring company for an associated, and equally ambitious, set of petrochemical complexes. The organization of the Corporation itself is the largest industrial undertaking in Thailand and involves nearly every large Thai business group, the Thai government, and many international leaders in the oil, gas, petrochemical, and chemical industries.

The petrochemical industry is importantly linked with the economy in both developed and developing countries. Petrochemicals constitute industrial products sold to a wide variety of industrial customers. They can be sold within the industry for the production of other petrochemicals like propylene, which is then sold to a polypropylene producer. They can be sold to manufacturers of other industrial products, such as plastic sold to an auto parts manufacturer supplying an auto maker. And they can be sold as final products, like resin adhesives and putties. Aside from use in manufacturing, petrochemicals also play a large role in agriculture as fertilizers.

Petrochemicals are of great importance to an economy. The products permeate every sector, and the industry is also closely related to oil and gas, which themselves have great importance as the major sources of energy. This is especially true in Thailand. An efficient petrochemical industry could give a real boost to the economy, enabling Thailand to increase the value of its oil and gas reserves.

3. Human Resource Constraints: Over the past several years, the pace of economic development in Thailand has accelerated. With manufactured exports growing at 35 to 40 percent for almost five years, GDP growth in 1991 was just under 8 percent. Thailand is clearly among the wave of newly industrializing economies. Success, however, highlights a number of problems concerning human resource development and utilization. Manifestations of these problems include shortages in key skill areas, coupled with growing educated open unemployment.

Key skills in the science and technology fields are in short supply. The underlying reason is the apparent slow response of the educational system to changes in market demand. With the reduction in the growth of government employment, and the expansion of the industrial sector, there is a change in the skills demanded in the labor market. More engineers, computer scientists, and scientific personnel are required while there is less demand for the social and political sciences, and humanities.

Large companies express concern over the shortage of science and technology manpower, and many have expanded their own training programs to compensate for the lack of supply from the educational system. In the area of petrochemicals, industry can absorb all of the chemical engineers the country can supply. The requirement is straightforward: a Master's level chemical engineer, fluent in the English language, comfortable with plant operations, and an open and participatory professional style. Indeed, many send employees to the United States for the Master's degree (bonded). These requirements are defined by managers at Thai, foreign, and multinational companies alike.

The output of technological manpower from the university system is declining relative to the university total while the output of technical manpower at the secondary and vocational level is increasing. Yet, there is a shortage of technological manpower at the university level and oversupply at the vocational level. Analysis suggests that for the more rapidly growing industries in Thailand, the labor intensive ones require a large number of semiskilled workers, while others, based on advanced technology, require advanced levels of university trained manpower.

4. U.S.A.I.D. Strategy: The Agency for International Development has supported economic development programming in Thailand for almost thirty years, and over that time has invested some \$1.0 billion in a wide range of human and institutional development programs. The Agency is increasingly sensitive to the rapid changes in Asia, and particularly to the emergence of a set of advanced developing or modernizing countries, each with an impressive economic infrastructure and growing technological sophistication. Assistance is no longer the premise for a continuing relationship between these countries and the United States. Rather, the Agency is fashioning its programming for the 1990's around the word "partnership", reflecting the mutual advantage to long-term institutional collaborations and relationships in the areas of trade and technology.

Illustratively, President Bush launched the United States-Asia Environmental Partnership (AEP) earlier this year. The Partnership proposes to organize a coalition of U.S. and Asian businesses, governments, technology-based institutions, and community groups working together to enhance Asia's environment and to promote economic progress. U. S. government field posts in Asia and a broad range of U. S. government agencies are already working together to articulate strategies and to develop and implement programs. USAID is participating in the AEP and is supporting a wide range of institutional collaborations and relationships with private sector engineering and construction organizations, professional associations, and universities. USAID has already provided support for this proposed University Development Linkage by providing a \$100,000 grant to the Association of Big Eight Universities for the feasibility study.

Proposed Graduate Program

1. Petroleum and Petrochemical College: Chulalongkorn University proposes to build new academic strength in the areas of energy, the environment, and advanced materials. Its initial program is directed to the requirements of the petrochemical industries in Thailand. The University's Petroleum and Petrochemical College will be organized as a joint academic endeavor with three cooperating universities from the United States (Case Western Reserve University, the University of Michigan, and the University of Oklahoma). The College will offer graduate engineering and science curricula of international standard in the English language and support an innovative laboratory and research effort. The institutional model is the long-established Master of Business Administration program of the Sasin Graduate Institute of Business Administration at Chulalongkorn University. That very successful program is a joint academic endeavor with the Kellogg Graduate School of Management at Northwestern University and the Wharton School at the University of Pennsylvania.

The initial program is specifically directed to petrochemical technology and polymers with strong emphasis on pollution prevention technologies. As a joint academic endeavor, the Petroleum and Petrochemical College defines an innovative approach to graduate level engineering education in Thailand and constitutes an important building block in Thailand's new technology infrastructure. Over time, the University will develop additional graduate programs in the areas of energy, the environment, and advanced materials.

The opportunity for the United States is defined by the intent of the Thai government and Chulalongkorn University to engage three leading universities from the U.S. in their effort to establish a center of international engineering excellence, with a view also to long-term international technological collaboration, and to enhancing the returns to the natural resource endowment of Southeast Asia. Objectives include the organization of a core academic program at Chulalongkorn University's Petroleum and Petrochemicals College, development of complementary programs to enrich both the academic programs of the Petroleum College itself and those of the cooperating universities (e.g., area studies and business, university/industry research partnerships, etc.), and initiatives to extend the reach of the College's academic programs through continuing education. The initiative reaches beyond the familiar technical assistance contract and faculty exchange agreement to a longer-term mutual responsibility for the development of a new technology center and engineering college, directed to both national and multinational enterprise, and supporting a high-quality academic curriculum and research agenda.

2. The Academic Program: Master of Science degree programs will be offered in petrochemical technology and polymer science. All class instruction will be conducted in the English language. Both programs will be organized around engineering principles with emphasis on process technologies relevant to downstream operations and manufacture in a petroleum-based industrial economy. The degree programs will be organized as full-time, two-year programs. Continuing education and distance learning options will be examined only after the full-time programs are successfully launched.

The Master's program will include both course work (24 credit hours) and thesis research (12 credit hours). Courses (3 credit hours each) will be offered in four-week modules. The academic year runs from May through February. Students will normally take four one-month courses the first year and three the second, with additional credit for seminars and preparatory studies. In each curriculum there will be 4 core courses (3 credits), equivalent to the core courses required for master's degree work in chemical engineering and polymer science in U.S. universities.. In addition, there will be several elective courses (3 credits). A seminar will also be offered in each curriculum in each academic year (1 credit). Students will be required to take at least 2 of the 4 core courses in a curriculum (i.e., Petrochemical

Technology or Polymer Science), 2 courses (core or electives) from the other curriculum, and two seminars to qualify for graduation. Finally, each student will participate in a preparatory studies program (1 credit), tailored to meet the requirements of each student. This may include intensive English language study.

The first classes for these new programs are scheduled to begin in May 1993. For the first two years all courses will be taught by faculty from the U.S. universities. This will average 10 courses per year. From the third year on about 50% of the courses will be taught by U.S. faculty and 50% by Thai faculty. This will average 12 courses per year as more electives are added.

Thesis research will be emphasized. By the end of the first summer, first year students will have finalized a course of study, explored research opportunities, and be assigned a Thai and United States faculty thesis committee and advisor. Student research projects should be under way well before the end of the first year. Satisfaction of the thesis research requirement is in two parts: a written proposal for research and a final examination based on, but not limited to, the thesis research itself. To receive the Master's of Science degree, a student must complete preparatory studies, two seminars, seven technical courses, and a thesis research project. Normally, a student can complete the requirements in two years, but all work must be completed within four years if a degree is to be conferred.

The new engineering college will produce graduate engineers (initially at the Master's level) with competence at an international standard in the areas of petrochemical technology and polymer science, with an open and participatory management style, cultural adaptability, and heightened sensitivity and concern for the environment.

3. The Service Program: The Petroleum and Petrochemicals College will support an ambitious service program. Central to the graduate program is a strong research capacity at the college, to be developed in collaboration with participating centers and departments at the U.S. partner universities. To further relate the college to industrial requirements, it is also planned to launch an industrial service laboratory which will provide analysis, standards, and testing to industry in Thailand and southeast Asia. The College's new fourteen story facility and \$6.0 million equipment endowment distinguish it in Thailand and the region and constitute the basis for a successful, commercially-based, service and revenue operation. The service laboratory will also add an element of applied relevance to the academic program akin to the role a hospital plays in relation to a medical school. This element is modeled on CHULA UNISEARCH, a contract laboratory and research arm of Chulalongkorn University, but also on independent research organizations in the United States such as Battelle Memorial Institute and Midwest Research Institute. Indeed, there has been some discussion with these organizations about potential long-term joint venture opportunities.

The College will also examine the potential for continuing education programs directed to the training requirements of the petrochemical and polymer industries in Thailand and southeast Asia. Training represents again a broader mandate for the college, a more direct and applied concern for industry, but also an important potential revenue source. That has certainly been the case with the Sasin Graduate Institute of Business Administration and has been a key point in discussion with industry.

4. Benefits to Chulalongkorn University: A strong case is made by the leadership of Chulalongkorn University that reorganization of The Petroleum College on an international standard, and engaging universities and faculty from the United States in the program, is entirely appropriate for the University and Thailand. The University is committed to an ambitious vision, one more rooted in notions of application, industrial relevance, and national service. The petroleum and petrochemical industries operate in the interna-

tional marketplace. Multinational companies are a feature of the industry. Thai petroleum and petrochemical companies want to compete in that marketplace, and Thai engineers want to work and to have their professional opportunity defined internationally. In this regard, then, University leadership sees the College as a prototype for strategic alliance between the academic and technological capacities of Chulalongkorn University and industry in Thailand and with other universities and industries around the world.

Chulalongkorn University argues that partnership with foreign institutions is critical for universities like Chulalongkorn that are attempting to establish programs meeting an international standard. While some view the Sasin model as a device for strengthening Chulalongkorn University, Northwestern University itself views the partnership as key to its own aspirations for international standing. Fully twenty-five percent of the student body at Sasin today are from the United States. The University also argues that it is timely for colleges of engineering in Thailand to develop an international resource base just as the major oil, gas, and petrochemical companies themselves have done. While notions of national self-sufficiency have a place in building technological infrastructure, the University argues they should not be used to sustain an autarchic infrastructure, apart from important research centers and universities in other countries. Traditional linkages are defined by faculty and student exchange and collaborative research, the proposal for The Petroleum and Petrochemical College moves the linkage up a notch to the level of institutional partnership, with real commitment and responsibility on both sides, defining a new international standard commensurate with the level of international technology and requirements of an international industry. While not necessarily appropriate for all departments and colleges at Chulalongkorn University, the University argues that business and petrochemistry are appropriate starting points.

5. Benefits to U.S. Partner Universities: For the participating universities in the United States, the proposal is equally strategic. It represents an important opportunity to respond to the global requirements of their own state and regional petroleum, petrochemical, polymer, and technology-based industry. Where each of the universities once focused on the requirements of their state, indeed were founded to so focus, they subsequently followed the lead of state enterprise, extending their reach to the region and nation. Increasingly, today, they must respond to the global reach of state and regional industry.

Participation in the joint academic endeavor goes to the very core of the modern technological university, to its departments of engineering and science. The incentives for international engagement by faculty here are quite different from area studies, agriculture, and business administration, departments which earlier led most universities to international engagement. The centrality of the research program in the agenda of the new college, and the opportunities for joint research endeavors for both students and faculty, go to the heart of the incentive structure for engineering and science faculties at U.S. universities. Research at Case Western Reserve, Michigan, and Oklahoma reaches even further to the university's most important constituencies; technological research being an important joint endeavor for the universities, state and regional industry, and state and federal governments.

B. IMPLEMENTATION AND MANAGEMENT

Goals and Purposes

The participating universities set a common goal:

... to test, authenticate, and promote new models for international technological collaboration in the areas of energy, the environment, and advanced materials, and specifically to establish a center of international engineering excellence (i.e., education, research, and industrial service) in Thailand.

The purpose for the Linkages Project follows directly from the goal:
 ... to fashion a collaborative venture among Chulalongkorn University, Case Western Reserve University, the University of Michigan, and the University of Oklahoma as the essential institutional foundation for a new engineering college in Thailand.

Objectives

The objectives for the Linkage Project are straight forward:

1. Establish a sustainable collaborative venture involving an academic partnership among Chulalongkorn University, Case Western Reserve University, the University of Michigan, and the University of Oklahoma.
2. Establish innovative graduate programs for a new engineering college at Chulalongkorn University, specifically, programs in petrochemical technology (chemical engineering) and polymer science.

Activities and Desired Outcomes (see ANNEX II, WORKPLAN, for summary)

1. Establishing a Sustainable Collaborative Venture

a. Engaging the partnership universities: In January, 1991, the Director of the Petroleum and Petrochemical College visited the United States to assess the range of interest in collaboration. Working with the Association of Big Eight Universities, he visited some 20 university campuses, finally settling on Case Western Reserve University, the University of Michigan, and the University of Oklahoma. The Association followed up with return visits to the three universities in October, 1991 and subsequently sent representatives to Thailand, in November, 1991 to undertake a detailed feasibility study. The study was supported by a grant from USAID. In January, 1992, representatives of the three participating universities visited Bangkok for more focused discussions, meeting again in Norman, Oklahoma in May, 1992 to finalize a workplan and Memorandum of Understanding (MOU).

To build further common ground, the participating universities will sign a Memorandum of Understanding outlining the commitments of the parties to the collaboration. A draft of the MOU is included in Annex I of this proposal. To draw the participating universities into the program at an institutional level, it will be necessary to engage the deans of engineering, academic vice presidents, and presidents.

Even before the instructional and research programs are launched, it will be important to engage the faculty of the participating universities in the program to develop interest and ownership. The faculty resources of the participating universities will be engaged through a series of design and development missions and exchange visits; and the participating universities have agreed to place each member of the faculty from the new engineering college in Thailand at one of the participating universities in the United States as a visiting scholar for a full academic semester.

A concern for women in the engineering profession in Thailand has been carefully considered in the development of the new engineering college and UDLP proposal. In fact, part of the impetus for the project has come from an interest on the part of Thai industry to increase the number of women graduate engineers. Experience with the Sasin Institute has demonstrated that a full one-half of the student body will more than likely be women. More than one-half of the Petroleum College's current faculty are already women. An aggressive policy of student and faculty recruitment from among women will be pursued.

b. Managing the collaborative venture and linkages project:

Chulalongkorn University is responsible for the governance of the Petroleum and Petrochemicals College, and the degrees granted from the college will be under the signature of the president of Chulalongkorn University. The University Development Linkages Project (UDLP) will be the responsibility of the University of Oklahoma, as lead institution, with Case Western Reserve University, the University of Michigan, and Chulalongkorn University as participating institutions. The leadership of each participating university from the United States is committed to the project, as reflected in the allocation of financial and institutional resources and in the academic and public identification with the project.

Programming and management responsibility for the UDLP will be assigned to a steering committee drawn from the participating universities and comprised of Dr. Kamchad Mongkolkul, Director, Petroleum and Petrochemicals College, Chulalongkorn University; Dr. Hatsuo Ishida, Director, C.R. Newpher Polymer Composites Laboratory, Department of Macromolecular Science, Case Western Reserve University; Dr. Johannes Schwank, Chairman, Department of Chemical Engineering, the University of Michigan, and Dr. Jeffrey Harwell, Director, School of Chemical Engineering and Materials Science, the University of Oklahoma.

Industrial advisory committees will be organized in Thailand and the United States with a view to providing guidance to the steering committee for the development of academic and research programs and to securing financial support through grants for endowment, scholarships, and research, and contracts for industrial services and continuing education.

Dr. Raymond Daniels, Professor and former Director, School of Chemical Engineering and Materials Science, University of Oklahoma will be responsible for the administration of the UDLP, supported, in turn, by members of the steering committee and the administrative staffs at their universities. The University of Oklahoma, as lead university, will exercise institutional and financial responsibility for administration of the UDLP on behalf of the participating universities. Dr. Daniels will also provide central project support for the United States components of the overall academic program through the life of the linkage grant. Dr. Daniels' functions will be absorbed by the participating universities at the end of the linkage grant.

A full-time Associate Dean will be appointed at the College in Thailand from one of the participating universities in the United States for a two-year period. Responsibilities of the Associate Dean will include faculty recruitment and placement, administrative support for U.S. faculty in Thailand, and teaching one course per year. Recruitment is in process. The Associate Dean will be replaced by a Thai after the second year.

The steering committee has already negotiated and agreed on the Memorandum of Understanding; completed technical, financial, implementation, and evaluation plans for the new graduate programs at the College and the joint venture; appointed Dr. Kamchad Mongkolkul as chairman of the committee and Dr. Raymond Daniels as administrator for the linkages project; and agreed to recruit an Associate Dean for the new engineering college from the United States.

The steering committee will hold one face-to-face meeting in the United States each year. This meeting will be held in conjunction with Dr. Kamchad's visit to the U.S. partnership universities each year. Also, each steering committee member from the U.S. will visit Chulalongkorn University each year. The steering committee will establish and implement the evaluation plan for the venture and the UDLP.

c. Start-up design and development missions: While operating premises and workplans are already established, design and development tasks remain (e.g., selection and specification of laboratory equipment, identification and specification of library materials and systems, design and specification of computer systems, identification and specification of instructional technologies, etc.). Tasks will be identified by Dr. Kamchad in Thailand, reviewed and approved by the steering committee, and administered by Dr. Daniels at the University of Oklahoma. Dr. Daniels will develop task orders and itineraries for each approved task, support the visits of Thai faculty to the United States, and/or identify appropriate faculty (or, where necessary, other technical resources) from the United States to carry out work in Thailand. Six missions are scheduled throughout the period from July 1992 through June 1994.

d. Thai faculty residencies at U.S. universities: The participating universities have also agreed to place each member of the faculty (twenty) from the new engineering college in Thailand at one of the participating universities in the United States as a visiting scholar for a full academic semester over a three year period commencing in September 1992. The Thai faculty will move in groups of four through five consecutive semesters (September 1992 - January 1995). No university will host more than two Thai faculty at one time. The idea here is to identify collaborative research opportunities (i.e., collaborators and topics); to transfer pedagogical methodologies; and to build personal, professional, and institutional bonds. Exchange faculty will be nominated by Dr. Kamchad, approved by the steering committee, and placed by Dr. Daniels. Individual programs will be developed for each Thai faculty at one of the participating universities in the United States and support will be provided for travel and living expenses. Host university faculty will work with the Thai faculty to develop research topics sustainable in Thailand.

e. Solidifying institutional commitments to the partnership venture: Two high-level delegations will be sent to Thailand from the participating universities in the United States. The three academic vice presidents or deans of engineering from these universities will visit Bangkok in late July 1992 to deliver the executed MOU and to reinforce relationships at the institutional level. The presidents of the three universities will visit Bangkok in January to participate in the dedication of the College's new building and to launch the new engineering program. This occasion will also provide the platform for start of a major development campaign in Thailand. These activities constitute no cost to the UDLP, but reflect the strong institutional commitment to the venture by the participating universities in the United States.

It is intended that the academic programs of the collaborative venture be incorporated in the regular course offerings and programs of the participating departments at the participating universities. Courses offered in Thailand will be the same content, rigor, and expectations as courses offered in the U.S. Scheduling of faculty to teach in Thailand will be part of the regular class assignment process. This activity is segregated from the preceding to underscore the breadth of vision captured in the goal, purpose, and objectives of the UDLP: to build a long-term permanent joint academic endeavor as the essential institutional foundation for increasingly internationalized centers, departments, and colleges of engineering in the participating universities in both Thailand and the United States. Implementation and management responsibility here again is with the steering committee, supported by evaluation.

The partnership universities have agreed that specific reference to their long-term participation and identification with the College at Chulalongkorn University may be included in all information and public relations materials published by the College, publicly identifying the United States universities with the College; and they will similarly publicly identify with Chulalongkorn University in their own catalogs and other published materials.

Even more significantly, the participating universities from the United States have agreed to certification of degree standards at the engineering college in Thailand.

f. Actions to assure sustainability of the venture: While the UDLP will help with the start-up of this collaborative venture, sustainability beyond the UDLP grant period depends on development of revenue streams to support the graduate and research programs long term. These revenue streams include tuition and industrial scholarships, research grants and contracts, income from an industrial service laboratory and continuing education activities, and unrestricted developmental grants from Thai and multinational companies with interests in Thailand. This list does not include the substantial investment already made in the College by the Thai government, which includes over \$4 million for building construction and \$6 million more for laboratory equipment. Continued strong Thai government support can be expected with demonstrated success of the program.

Reaching outside the academic community in both Thailand and the United States, the participating universities have agreed to organize industrial advisory boards for the College, and to organize an aggressive development program, including solicitations for endowment, scholarships, and research, and by offering new industrial support services and continuing education opportunities. The steering committee will take responsibility for organizing industrial advisory boards in each country. The target date for organization is January, 1993. The boards will be made up of industrial representatives from companies engaged in petrochemical or polymer industries in, or with interests in, Thailand and/or throughout southeast Asia. Industrial advisory boards will meet, at least, annually, perhaps coincident with steering committee meetings in the United States, or with visits of steering committee members to Thailand, and will provide guidance and feedback on the academic programs; financial support to endowment, scholarships, and research; and contract demand for industrial service and continuing education. Administrative support for the advisory boards will be assigned to the Associate Dean for Thailand and to Dr. Daniels at the University of Oklahoma for the United States.

An aggressive program will be organized, including solicitations for endowment, scholarships, and research, and offering new industrial support services and continuing education. This activity will be shared with the industrial advisory boards. Major responsibility rests with Dr. Kamchad, Director, Petroleum and Petrochemical College, Chulalongkorn University, supported by the steering committee and the participating universities in the United States. The industrial advisory board in the United States will be organized before the visits of the presidents of the participating universities in the United States to Thailand in 1993. The presidents will join the leadership at Chulalongkorn University to solicit endowment, scholarships, and research, and to offer industrial support services and continuing education.

g. Program evaluation: Evaluation of the collaborative venture and the UDLP is an integral part of the program plan and is discussed under the Section C. Monitoring and Evaluation.

2. Establishing Innovative Graduate Programs

a. U.S. faculty instructors in the graduate programs in Thailand: The core idea, of course, is to place faculty from the participating universities in the United States at the new engineering college to develop and teach a complete academic course -- initially, 100 percent of curricular offerings but tapering off to 50 percent after two academic years. The participating universities will authorize release time for this purpose. Thai faculty will be assigned to assist U.S. faculty instructors, at least for the first two years. This will introduce the Thai faculty to the courses and help the U.S. instructor and students with any communication problems.

Together, the faculty from each of the participating universities will seek to develop research and industrial service projects in Thailand, promoting collaboration among faculty at the participating universities.

Courses (3 credit hours) will be taught in four weeks. Students will only take one course in a given four-week period. This scheduling provides enough flexibility for U.S. faculty to participate through most of the Chulalongkorn academic year (May - February). U.S. faculty will be compensated through a stipend on an off-cost basis; Thai faculty will also be paid an incentive.

Appropriate faculty will be identified for each course by Drs. Kamchad, Ishida, Schwank, and Harwell at least one full semester before the scheduled offering. The Associate Dean, in consultation with Dr. Daniels at Oklahoma University, will notify the chair of an appointment and provide local administrative support (i.e., local housing, team teaching assignment, etc.). Dr. Daniels will provide support to each participating U.S. university for travel, stipends. These instructional costs are not part of the UDLP budget.

b. Development of research programs: A substantial on-going research program is required if the new college is to operate at international standard. A real connection to industrial requirements is necessary if the research is to be at an international standard. However, most Thai industry is not yet at an R&D stage. The premise, then, is that Thai faculty, at least initially, will rely heavily on collaborative projects with faculty from participating universities in the United States. And, most importantly, continuing faculty interest in the venture probably rests on engaging their driving research priorities. It will be essential, then, to engage each participating department, as a department, in the research activity, and to assure opportunity for follow-up in Thailand by each participating faculty member from the United States.

Since research will be an integral part of the academic program of the new engineering college, teaching faculty from the United States will be selected partly on the relevance of their research activity to Thailand. In Thailand, during each teaching assignment, the Associate Dean of the Petroleum and Petrochemical College will seek to pair the faculty member from the U.S. with a Thai partner, perhaps but not necessarily with the teaching partner, for research. Indeed, teaching faculty from the United States will also take responsibility for research supervision for four students. At least one follow-up visit should be made by the U.S. faculty member over the two-year period of a student's research. Funds are not budgeted for this in the UDLP because of the funding limitation, so they must be sought elsewhere.

Engineering research programs are expensive. To support a quality engineering graduate program with thesis requirements, the College must build a substantial level of continuing, externally-funded research projects. The opportunities are there in Thailand. The venture participants are determined that sponsored research will become one of the major revenue streams. This is one reason why early development of close working ties among faculty participants in the venture is so important.

c. Student exchanges: In addition to university, department, and faculty engagement, it will be important to engage students in the linkage program. Why? From the program's perspective, student engagement will work in the direction of continuing demand or pressure to sustain the program, will help to internationalize the most internally-focused centers and departments of the university, and will shape participating centers and departments in direct support of international and multinational employment requirements (e.g., the increasing interest in enrollment in Sasin programs by students from both the Kellogg and Wharton schools). Support for the joint academic endeavor will have to come from the administration, faculty, and students of

the participating universities, as well as from industry, if the linkage is to be effectively launched and sustained.

A student exchange program will be initiated in the third year of the UDLP program. Funds are included in the budget for 6 U.S. university students to go to Thailand and 6 Chulalongkorn students to come to the United States each year, 2 students to each of the U.S. participating universities. The students will spend three months at the university working in research. The steering committee will define competitive standards; department chairs will make selections; and the Associate Dean and Dr. Daniels at the University of Oklahoma will finalize programs (e.g., arrange for transportation, housing, and living expenses). The program will begin in July 1994 and continue through the linkage program.

Sending U.S. students to work in research in Thailand is a departure from the usual track wherein foreign students come to the U.S. The U.S. students will in all probability be doctoral students nearing completion of their dissertation research. They will bring with them experience in a highly-ordered research environment. They will learn and profit from working in a developing research environment, within a different cultural framework. This will be a teaching/learning situation, certain to promote internationalization and cultural maturation of U.S. engineering students.

C. MONITORING AND EVALUATION

Monitoring (see ANNEX III, IMPLEMENTATION PLAN, for time lines)

The steering committee has already established the premises for a monitoring and evaluation plan. Activities will be monitored by Dr. Daniels at the University of Oklahoma who will issue a quarterly progress and financial report to the steering committee. Activities are outlined in the workplan and specified in the budget and implementation plan attached. Milestones include:

<u>Major Milestones</u>	<u>Time Frame</u>	<u>Participants</u>
a. organization of steering committee	May, 1992	Drs. Kamchad, Ishida, Schwank, Harwell, Daniels
b. execution of MOU	July 1992	Presidents of universities
c. visit of academic vice presidents to Thailand	July, 1992	three participants
d. visit of three presidents to Thailand	January 1993	three participants
e. design and development missions	July 1992/ May, 1993	participants to be determined
d. Thai faculty residencies in U.S.	September 1992/ December 1995	four faculty for five semesters
e. Instruction begins in new college	May 1993/ February 1997	10 U.S. faculty per yr, first 2 yrs, 5 thereafter
f. Associate dean in place	May 1993/ April 1995	individual to be determined

g. U.S. faculty research exchanges	September 1994 January 1997	26 faculty for 3 years
h. student exchanges	July 1994/ January 1997	18 U.S. students 18 Thai students
i. university engagement	July 1992/ June 1997	brochures, catalogs, degrees
j. appoint/engage industrial advisors	January 1993/ annually	appointments and meetings
k. development initiatives	January 1993/ continuous	research grants, scholarships, endowments, etc.
l. steering committee	May 1992/ annually	annual visits, meetings
m. evaluation	May 1992/ continuous	reports, and plan revisions

Evaluation

As noted above, the Association of Big Eight Universities has been identified with the venture and UDLP proposal from the beginning. The association completed a feasibility study in February 1992 and organized the steering committee meeting in May 1992. Based on this early involvement, the Association uniquely qualified to develop an evaluation plan against planned outcomes for the linkage program and against the broader institutional and development objectives described in the rationale section. The Association's evaluation officer will attend steering committee meetings annually and visit Thailand during the fourth year of the linkage program. A formal evaluation protocol will be presented at the meeting scheduled for May 1993.

The associate dean to be assigned full-time in Thailand will provide on-site evaluation during the critical first two years of instruction and when research collaborations are developing. He will be responsible for evaluation of instructors and monitoring student progress in course work and research.

An evaluation committee will also be organized. It will include the international programs director from each participating university as a device for feeding in, and drawing out, lessons and opportunities for an even broader internationalization impact. The committee will be asked to critique the evaluation protocol and review all reports.

D. SUSTAINABILITY

The joint academic endeavor was first proposed by Chulalongkorn University in 1989. Development work on their part was undertaken for almost two years (1991) before the University engaged a United States collaborator (the Association of Big Eight Universities) and finalized agreement on partner universities (1992). The Association completed a feasibility study for the proposed joint academic endeavor in 1992, a study based on careful discussion with administrators, faculty, and students at each participating campus in the United States, a visit to the Kellogg School of Management, careful discussion with a wide range of administrators, faculty, and departments at Chulalongkorn University, and interviews with representatives and officers at some thirty different public and private related organizations in Thailand.

The proposed joint academic endeavor and university development linkage has strong institutional support in both Thailand and the United States.

Institutional Base in Thailand

1. The University in Thailand: Early development of the university system in Thailand was directed to training for political leaders and civil servants. As a result, university administration in Thailand was importantly influenced by government and by bureaucratic rather than academic systems of administration. Thailand's first economic development plan was issued in 1961, defining a new and different role for the university; and very rapid expansion of the university system was undertaken throughout the 1960's and 1970's. An important reform of the university system in the 1980's permitted the organization of independent educational institutions (e.g., private universities or independent schools within larger government supported universities); and in 1990, even further autonomy was authorized for government supported universities. This development has real significance for the kind of innovation proposed at the new engineering college (e.g., charging of cost-based tuition, increases in salary levels for faculty).

2. Chulalongkorn University: Founded in 1917, Chulalongkorn University is the oldest and best known university in Thailand. It is an internationally recognized institution with more than 200 programs, 2,300 full-time faculty, 13,000 undergraduate students, and 4,500 graduate students. The distribution of academic qualifications of the full-time faculty members is PhD 27 percent, MA/MS 64 percent, and BA/BS 9 percent. The University is currently under the jurisdiction of the Government of Thailand's Office of University of Affairs. However, like other government universities, Chulalongkorn is an autonomous institution. Currently there are proposals to separate university administration even more fundamentally from government control and direction.

The University's highest governing body is the University Council and the Rector is its chief administrator. At present, the University is composed of 128 academic departments grouped into fifteen faculties, a Graduate School, a Language Institute, five research institutes (i.e., Institute of Population Studies, Institute of Social Research, Institute of Health Research, Institute of Environmental Research, and Institute of Biotechnology & Genetic Engineering), and three supporting centers (i.e., the Central Library, the Audiovisual Center, and the Thailand Information Center). The University has also organized a joint academic endeavor with cooperating universities from the United States in the areas of business administration and medicine.

The Faculty of Engineering offers undergraduate and graduate programs relevant to the proposal in the areas of chemical engineering, metallurgy, and mining. The Faculty of Science offers undergraduate and graduate programs relevant to the proposal in the areas of chemistry, chemical technology, and materials science. These programs are directed mainly to undergraduate education, but the colleges also sponsor graduate programs in the Thai language. Research activity is limited by both the undergraduate orientation of the University and serious limitations in research equipment and funding. The existing interdisciplinary program in the areas of petrochemistry, petrochemical technology, polymer science, and polymer technology are offered under the auspices of The Petroleum and Petrochemical College, as currently organized, with the cooperation of departments in the Faculties of Engineering and Science.

3. The Sasin Model: The Sasin Graduate Institute of Business Administration was chartered as an independent institution of higher education in Thailand in 1982. The Institute is a joint academic endeavor among Chulalongkorn University, the J.L. Kellogg Graduate School of Management of Northwestern University, and the Wharton School of the University of Pennsylvania, two of the leading business schools in the United States. The Institute offers two major programs: the Master of Business Administration and the Master of Management. These programs are taught almost exclusively by faculty members from Kellogg and Wharton. The Institute is totally self-supporting from tuition and grant and contract income from continuing education.

The proposed engineering college will be different from Sasin in two important respects: virtually one-half of teaching responsibility will be Thai after year two, and the college will support an important research component, necessary for graduate education in engineering and the sciences, necessary for international standing, and necessary to attract the quality and numbers of faculty from Thailand and the United States to sustain the college. The Sasin model is important, nevertheless, in substantiating the institutional viability of a long-term joint academic endeavor among high quality universities, the pedagogical feasibility of intensive four-week courses, the English readiness of Thai students, and the financial feasibility of the venture. The Director of the new engineering college was the responsible officer at Chulalongkorn University for the conceptualization and launching of the Institute in his capacity at that time as Academic Vice President, Chulalongkorn University.

4. Asian Institute of Technology: The Institute (AIT) was organized in 1959 to help meet the growing need for advanced engineering education in Asia. In November 1967, AIT became an autonomous international institution empowered to award degrees and diplomas. AIT's academic programs focus on the problems of the region and their engineering, scientific, and management solutions. Advanced education in engineering, science, planning, and management is provided through a range of activities at levels and intensities from doctoral research to short-term training. AIT itself does not offer a curriculum in the area of chemical engineering. This is because the Institute does not maintain an adequate science infrastructure. Instruction at AIT is in English, and it has demonstrated that an internationally-based engineering school can maintain an international standard in Thailand and Southeast Asia.

4. The Petroleum Technology Institute of Thailand: PTIT was established in 1985 with support from the government, academic, and private sectors. It operates as a private foundation. Under the direction of a Council of Trustees and an independent Advisory Board, PTIT functions as an independent organization working with various other organizations to promote education and training through scholarships, public education programs, specialized courses, and industry internships; the development of a petroleum and petrochemical database and information services, in the forms of publications and computerized information services; and the provision of support in technical services and research and development. PTIT will provide guidance and important support for the new engineering college.

PTIT has already had a profound impact. Specifically, PTIT argued to university leadership that Thailand is not yet in a position to develop a sophisticated R&D culture for petroleum and petrochemistry. It argued that while important to keep that goal out in front of any educational planning effort, it should not define the program. Rather, an academic program should produce an engineer comfortable with technology and ready for operations, maintenance, rehabilitation, safety, and the environment (i.e., an engineer who can understand the range of appropriate technologies, use them, sustain and support them, and improve them). In this regard, PTIT argued strongly for the incorporation of an industrial-scale pilot plant as a part of the educational infrastructure for the college, suggesting that it would give the student a sense for the "soul of the process industry" and might also add a *raison d'etre* to the mission of the proposed College (i.e., as laboratory support to industry for analysis, standards, and testing). Its influence and thinking is already reflected in both the philosophy and workplan for the college.

Institutional Base in the United States

1. Participating Universities: Case Western Reserve University has an internationally recognized program in the area of polymer science, organized within the C.R. Newpher Polymer Composite Laboratory, Department of Macromolecular Science. The Laboratory is a designated National Science Foundation center of excellence and is operated with important support from the private

sector. The University of Michigan's Department of Chemical Engineering is also internationally recognized, with long-established collaborative research and exchange agreements with several major industrial and technological research institutions around the world. The University of Oklahoma's energy and petroleum programs define an international standard. The University, located in the oil and natural gas belt of the southwestern United States, also has a distinguished international experience. For example, the University of Oklahoma's Kellogg Center for Continuing Education has pioneered distance-learning degree programs in Asia, and the College of Engineering has important faculty exchange and collaborative research activity in other important oil and natural gas regions, including Bolivia, Columbia, and Saudi Arabia. The three universities, together with industry and state government, are seeking longer-term, more permanent, and sustainable vehicles to integrate and internationalize their technology and knowledge-based programs.

2. Association of Big Eight Universities: To draw support for this agenda from a broader base, the University of Oklahoma joined with seven other research universities in 1989 to found the Association of Big Eight Universities. The chancellors and presidents of the member universities are committed to inter-disciplinary programs, to inter-institutional partnership, and to an international agenda. The posture and institutional strength of the membership has enabled the Association to play an important catalytic and management role in the organization and implementation of the linkage proposal.

Incentives

Incentives to engage administrators, faculty, and students to the joint academic endeavor have been carefully considered. In discussion at each participating university, the issues of tenure and research have repeatedly been raised by faculty. Chulalongkorn University itself has put research at the very center of project objectives, begun construction of a new sixteen story state-of-the-art laboratory building, half of which is assigned to the new engineering college, and has allocated some \$6.0 million for the procurement of laboratory equipment for the College. The University has also sent two faculty members to visit each participating campus for a third time (as recently as May 1992) to discuss collaborative research and publication opportunities with United States faculty. Interest in the endeavor is significantly higher than just a year ago, and the problem now may be oversubscription by faculty.

The steering committee believes that the research component is the key device to sustain faculty interest and participation over time, distinguishing the college from the Sasin experience where the one-time teaching assignment is common. The willingness of Chulalongkorn University to allocate financial resources to each participating university for the research component, reflected in the business plan up to and through steady-state, reflects further commitment to incentives. As noted earlier, each participating faculty member from the United States will be given release time and paid a competitive teaching stipend for participation in the program; and funding is provided for research return follow-up and center and departmental support.

With regard to students, it is agreed by all parties that without interest and pressure from students to participate in the program, internationalization objectives will not be achieved. Indeed, student interest and pressure could constitute an important continuing incentive to sustain the program (note, for example, that the Sasin Institute now counts fully 25 percent of its student body from Kellogg and Wharton). And, finally, the steering committee has designed a very careful engagement of each participating university at the institutional level, engaging the leadership of each university, capturing the new engineering college and proposed linkage in public presentations of each university.

Business Plan

The steering committee has developed a comprehensive business plan, capturing all costs, direct and indirect, and including a "structural deficit". See Table I. In the 5th year of the program, Phase V, operating costs are about \$3,000,000. This is a reasonable cost for a program with 80 graduate students. Revenue streams include Chulalongkorn and U.S. university contributions, UDLP support, and income from tuition, contracts and grants, and continuing education. Contract and grant and continuing education income are modest by U.S. standards, and growth in these areas should eliminate the structural deficit in the 6th and successive years.

The structural deficit is by design, intended to create the incentive to mount aggressive development, research, industrial service, and continuing education programs. At Case Western University, fully 85 percent of departmental revenues are raised through such programs, 75 percent at the University of Michigan, and 60 percent at the University of Oklahoma. Industrial service, for example, was vigorously debated by the steering committee over the last year in terms of its relevance to curricular, research, and service objectives (i.e., in terms of academic mission), but it was only agreed upon when put in the context of revenue requirements. Based on a very careful review with government and industry, the feasibility study concluded that the estimates for revenue from such a program was realistic. The study also argued that a structural deficit was absolutely necessary to create the environment within which Chulalongkorn University could take the steps necessary to create a modern, internationally competitive, research program and engineering school.

Activities for UDLP Funding

UDLP support is shown as an integral part of the business plan. Linkage funding will be used to help support the following activities in the development of the joint venture:

1. Meetings and administrative travel expenses of the steering committee and the UDLP project director.
2. Personnel and travel expenses of start-up design and development missions to Thailand.
3. Travel, housing, and living expenses for Thai faculty residences at U.S. universities.
4. Personnel and travel expenses related to program evaluation.
5. Travel, housing, and living expenses for student exchanges.

Management Plan

The participating universities have organized a process which has brought them together and along on a steady path. A steering committee has grown out of the professional camaraderie of repeated interaction. University commitment has grown out of campus-based engagement and is now reflected in a Memorandum of Understanding to be signed by the presidents of the participating universities. What was once portrayed as a project, or an international exchange, is now seen as a strategic investment by each of the participating universities, reflected in the "match". A realistic assessment of the financial requirements has been completed, and the business plan incorporates those requirements at steady state (i.e., after a period of grant support from international development agencies), supported by tuition, endowment, scholarships, research grants, and contracts for industrial service and continuing education. With regard to industrial service, for example, it is proposed that the laboratory at the new engineering college be organized in such a way as to provide contract service support to the petrochemical and polymer

TABLE I

CHULALONGKORN UNIVERSITY
GRADUATE PROGRAMS IN PETROCHEMICAL TECHNOLOGY AND POLYMER SCIENCE

COSTS AND REVENUES BY PHASE

COST CATEGORY**	Phase I	Phase II	Phase III	Phase IV	Phase V	Total
** All costs except Thai Government equipment grants adjusted in phases II-V for estimated 5% annual inflation rate.						
A. Instruction						
Thai Faculty						
Assistance Supplement	\$0	\$15,750	\$16,538	\$8,682	\$9,116	\$50,086
Instructional Supplement	\$0	\$0	\$0	\$49,199	\$51,659	\$100,858
English Language Instruction	\$0	\$10,500	\$11,025	\$11,576	\$12,155	\$45,256
U.S. Faculty						
Instruction	\$0	\$151,200	\$158,760	\$92,610	\$97,240	\$499,810
B. Research						
Materials & Supplies						
Thai Faculty - Thesis Supervision	\$0	\$0	\$68,150	\$69,458	\$72,930	\$208,538
U.S. Faculty Research Linkage	\$0	\$207,900	\$218,295	\$152,807	\$160,447	\$739,449
C. Student Exchange						
Travel and Per Diem						
Faculty Supervision - Thailand	\$0	\$0	\$9,261	\$9,724	\$10,210	\$29,195
Faculty Supervision - U.S.	\$0	\$0	\$26,460	\$27,783	\$29,172	\$83,415
C. Program Management						
Administrative and Technical Staff						
U.S.						
Chulalongkorn - Program	\$0	\$254,625	\$267,356	\$49,199	\$51,659	\$622,839
Chulalongkorn - College*	\$195,000	\$270,000	\$297,675	\$312,559	\$328,187	\$1,403,421
D. Infrastructure Development						
Equipment*						
Library*	\$1,286,000	\$1,200,000	\$1,200,000	\$1,200,000	\$1,200,000	\$6,086,000
Distance Learning*	\$0	\$21,000	\$49,813	\$0	\$0	\$70,813
E. Team Building						
Startup/Developmental Exchanges						
Steering Committee	\$89,100	\$93,555	\$0	\$0	\$0	\$182,655
International Travel						
U.S. Travel	\$16,000	\$25,200	\$23,460	\$20,837	\$21,879	\$110,376
Thai Faculty Visits	\$3,000	\$3,150	\$3,308	\$3,473	\$3,647	\$16,578
Travel and Per Diem						
Thai Faculty Salaries	\$120,000	\$126,000	\$68,150	\$0	\$0	\$312,150
U.S. Faculty Salaries	\$60,000	\$63,000	\$33,075	\$0	\$0	\$156,075
F. Development Activities						
Industrial Liaison						
Continuing Education	\$35,000	\$36,750	\$27,563	\$28,941	\$30,388	\$158,642
Industrial Service Laboratory	\$0	\$0	\$27,563	\$28,941	\$30,388	\$86,892
Industrial Service Laboratory						
Industrial Service Laboratory	\$0	\$99,750	\$104,738	\$109,974	\$115,473	\$429,935
Subtotal	\$1,945,100	\$2,977,380	\$3,227,391	\$2,633,025	\$2,678,879	\$13,461,775
Indirect Costs						
U.S. Universities						
On-Campus (50% MTDC avg.)	\$102,800	\$220,290	\$194,040	\$142,388	\$136,744	\$796,262
Off-Campus (25% MTDC avg.)	\$0	\$91,875	\$114,660	\$42,253	\$44,368	\$293,154
Chulalongkorn University (20% MTDC)	\$51,700	\$109,410	\$139,113	\$133,335	\$140,002	\$573,560
* No indirect costs charged to College Administration or Infrastructure Development						
Total	\$2,099,600	\$3,398,955	\$3,675,204	\$2,951,001	\$2,999,991	\$15,124,751
REQUIRED MINIMUM REVENUES						
A. Chulalongkorn University						
Chulalongkorn University	\$1,801,700	\$1,651,860	\$1,679,125	\$1,655,618	\$1,678,399	\$8,266,702
B. U.S. Universities						
U.S. Universities	\$182,800	\$650,265	\$468,563	\$274,936	\$275,920	\$1,852,484
C. Tuitions						
Thai						
Thai	\$0	\$210,000	\$420,000	\$420,000	\$420,000	\$1,470,000
Foreign						
Foreign	\$0	\$30,000	\$60,000	\$60,000	\$60,000	\$210,000
D. Research Grants and Industrial Services						
Research Grants and Industrial Services	\$0	\$0	\$50,000	\$150,000	\$335,672	\$535,672
E. Continuing Education						
Continuing Education	\$0	\$0	\$0	\$0	\$30,000	\$30,000
F. Development Grants						
1. University Linkages, USAID						
University Linkages, USAID	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$1,000,000
2. Other						
Other	\$115,100	\$656,830	\$797,516	\$190,447	\$0	\$1,759,893
Total	\$2,099,600	\$3,398,955	\$3,675,204	\$2,951,001	\$2,999,991	\$15,124,751

industry in Thailand and southeast Asia for analysis, standards, and testing, in addition to more traditional university research support. Industrial service laboratories grew up in the petroleum belt in the United States alongside industry, and the steering committee believes that a university-based service laboratory could become an important revenue component of the engineering college. CHULA UNISEARCH at Chulalongkorn University already reflects a willingness of university administration to move in that direction.

And finally, the administration and management of the program will rest only partly on the in-kind contribution of the participating universities. A serious long-term professional institution of the complexity proposed will require sustained long-term salaried support. Those costs are captured in the business plan (e.g., Associate Dean and United States-based administrator) and reflect realistic assessments of real world requirements.

Industrial Advisory Boards

Industrial advisory boards will be organized in Thailand and the United States. The purpose is to secure a close working partnership with industry, both as a source of development support and for guidance and feed-back on the academic program. Initial discussions have been organized with industry in both countries, and there is willingness to proceed (even if financial commitments are not yet in hand). In Thailand, a proto-board has already recommended the possibility of a major joint initiative between the new engineering college and industry to launch an environmental program for the Eastern Seaboard, the center of petrochemical and polymer industries in Thailand. The initiative is organized around the theme of "pollution prevention" and might dovetail with similar initiatives at the universities in the United States. For example, Case Western Reserve University has a major state-wide initiative with industry directed to recycling, the University of Michigan with the Environmental Protection Agency and state industry directed to environmental training, and the University of Oklahoma with EPA and industry for prevention of infiltration of oil into regional aquifers and remediation of contaminated soils and ground water. In short, the careful engagement of industry will be critical to the long-term relevance and financial support for the new engineering college.

Internationalization

The most important incentive may be the degree to which the university development linkage can spur a broader engagement of international interest on the campuses of the participating universities. Chulalongkorn University is working with the Thai government to organize the new college as a regional center of excellence, and active discussions are already underway with the other countries of Indo China, countries with significant oil and natural gas reserves, but with little or no institutional structure in the sector. The steering committee believes that the careful staged approach to the project and program holds significant promise for expanding the reach of the proposal to engage the universities with other developing countries of Southeast Asia.

SECTION II - USIHE CHARACTERISTICS AND CAPABILITIES RELATED TO THE LINKAGE

The University of Oklahoma

The President of the University of Oklahoma is committed to the further internationalization of the institution and has spoken emphatically about the University's responsibilities regarding international education and the importance of cultivating the intellectual and cultural relationships among peoples from all nations. Within this context, the mission of the University's Office of International Programs (OIP) is to enhance the scope and quality of the international dimensions of the academic, research, and public service programs of the University of Oklahoma.

To achieve the above aims, the OIP coordinates faculty, research, and student exchanges with 51 universities in Latin America, Europe, and Asia with which the University has signed agreements of institutional exchange. Two hundred-fifty exchange students and more than a two dozen faculty participated in short term, semester, or year long programs of exchange during the 1991-92 academic year.

The International Student Services Office (ISSO) offers assistance to international students and scholars in all matters concerning their daily life at the University.

The University, in its' plan for this decade, is focusing on three principal components of its international dimension: 1) the presence of international students and scholars on our campus; 2) opportunities to teach, do research, and study abroad; and 3) an international focus throughout the curricula. The A.I.D. University Development Linkages Project contributes to all three of these objectives through the planned faculty and student exchanges and the shared responsibility for development of a truly international academic joint venture.

1) International Students and Scholars: Currently, 1,500 international students from more than 80 nations attend the University of Oklahoma, and thousands of Oklahoma alumni occupy important positions throughout the world. The current Director of the Office of International Programs established and refined the institutional policies and practices to serve OU's international faculty, student, and scholar community. She, herself, was an international student in U.S. institutions as well as other international universities.

In addition to assistance with arrival matters; housing; immigration concerns; and financial, personal or social situations, there are on-going programs of orientation to assist students in their adaptation to the U.S. university community. Culture-specific meetings are held to foster understanding of the values by which Americans live as compared to Asian, Latin American, European, and African values.

One of the most important support programs for international students at OU is the host family program. Also, assistance is provided by nationality clubs and the Study Abroad Alumni Association. The International Advisory Council (IAC), an umbrella organization for 26 international student associations promotes programs and activities throughout the year. International Awareness Month is celebrated from March 15 to April 15 with a series of dinners, exhibitions, cultural programs, etc. that bring the community, faculty, staff, and students together to recognize the multi-cultural richness of the environment.

2) Educational Exchanges: The University offers a world of opportunities for those wishing to study, teach, or conduct research abroad. Programs include reciprocal exchanges; nonreciprocal OU Study Abroad Programs; summer programs; external programs; and work, teach, and research abroad programs.

A student at OU can choose from 51 reciprocal exchange programs with universities in Asia, Europe, and Latin America. There are relationships being negotiated with universities in Sub-Sahara Africa and universities in post-communist countries.

For faculty members, OIP offers coordination of programs of teaching and research abroad and assistance with documentation and linkages. The University is at present focusing on linkages with five countries: Thailand, France, Japan, Mexico, and Venezuela.

3) International Perspectives in Curricula: The university of Oklahoma now offers 110 credit courses with an international focus, excluding those in foreign languages. This is part of the University's effort to "internationalize" the curricula. Particular emphasis has been placed on development of courses with content and focus on non-western cultures. Models of internationalization of the curriculum are maintained in OIP's library and the director works closely with foreign faculty/experts in presenting models of internationalization to deans, chairs, and key faculty.

The University of Oklahoma has had a considerable international involvement throughout its history, particularly in the petroleum and petrochemical industries. One-fourth of all petroleum engineers in the world are OU graduates; and OU has produced more petroleum geologists than any other school in the nation. OU alumni are working world-wide in the petroleum and petrochemical industries.

The School of Chemical Engineering and Materials Science, the academic department through which OU will participate in the UDLP, has over the years engaged in a number of international collaborations. Presently, the faculty of the school are collaborating in research with individuals or institutions in the following countries: Japan, Venezuela, France, and Bulgaria.

The University of Michigan

The University of Michigan is a public-assisted university with an enrollment in 1991-92 of over 50,992 students, of which 14,617 are graduate students. The University's full-time instructional staff numbers 4,003, and the non-instructional staff 18,015.

Research is central to the University's mission and permeates its schools and colleges. Total University research expenditures for 1990-91 were \$324,088,970. In addition to hundreds of satellite research organizations within the academic schools, colleges, and departments, the University has more than a dozen large-scale research institutes outside the academic units that conduct, in collaboration with those units, full-time research usually focused on long-term interdisciplinary problems. These institutes join numerous research museums, libraries, laboratories, centers, bureaus, and other units to form a vast network of research resources.

The University of Michigan has put internationalization on the agenda as a major objective in education and research. Several formal programs are in operation, in addition to many international exchange programs at the departmental level. Major centers with an international focus include: Center for South and Southeast Asian Studies, Center for Chinese Studies, Center for Japanese Studies, Center for Russian and East European Studies, Center for Middle Eastern and North African Studies, and Center for Afroamerican and African Studies.

The Center for South and Southeast Asian Studies is the most important producer of professional-level experts on South and Southeast Asia in the United States. Over the years, a large number of students from Southeast Asian countries have come to the University and been associated with the Center. In 1983, the Center initiated the Southeast Asia Business Program.

It makes academic resources relating to Southeast Asia more accessible and relevant to the business community.

The University of Michigan has one of the best library collections relating to Southeast Asia in the Western World. A particularly valuable collection is the Gedney Thai library, more than 17,000 volumes published in the Thai language, many of them rare or unique items.

The Department of Chemical Engineering, the academic unit through which the University of Michigan will participate in the linkages project, has a formal Master's Level Exchange Program in place with Nagoya University in Japan. It also has research collaborations with the French Petroleum Institute (Institut Francais du Petrole) and Warsaw University of Technology. The collaboration with the French Petroleum Institute includes exchange of professors and students at the graduate level.

Case Western Reserve University

The "Plan for Case Western Reserve University 1990-1995," sets forth several goals and institutional priorities, among which is "global and international orientation in teaching, research, and scholarship." CWRU is taking a proactive stance to internationalize the campus. Initiatives being taken include: developing stronger resources for language instruction; increasing international content in core courses, and emphasis on cross-cultural patterns in many disciplines; increased attention to the global dimensions of issues being addressed by international centers; greater openness to opportunities for direct cooperation with institutions or governments in other nations in connection with teaching and research programs; expanded exchange programs with institutions in other nations for faculty and students; and increased emphasis on opportunities presented to CWRU by the presence of students, faculty, and staff from other nations.

These initiatives are reflected in a number of programs in-place or being developed. One example is a large-scale project in Romania for redevelopment of medical, social work, management, and child development disciplines in the universities there. The program involves linkages with the corresponding academic programs at CWRU. The Weatherhead School of Management at CWRU has established a joint Romanian-Weatherhead Center for Management Excellence in Bucharest.

The Center for International Health in the School of Medicine seeks to link the international health resources of CWRU and affiliated institutions in a multidisciplinary program of research, training, and application related to global health. Since its inception in 1987, the Center has been involved in development programs in Thailand, China, India, Mexico, Uganda, Eastern Europe and the former Soviet Union.

The Department of Macromolecular Science at CWRU has the premier polymer science and engineering program in the nation and enjoys a world-wide reputation. It will be the department through which Case Western Reserve University participates in the linkages project.

**SECTION III - DCIHE CHARACTERISTICS AND CAPABILITIES
RELATED TO THE LINKAGE**

Chulalongkorn University

Founded in 1917, Chulalongkorn University is the oldest and best known university in Thailand. It is an internationally recognized institution with more than 200 programs, 2,300 full time faculty, 13,000 undergraduate students, and 4,500 graduate students. The distribution of academic qualifications of the full-time faculty members is PhD 27 percent, MA/MS 64 percent, and BA/BS 9 percent. The University is currently under the jurisdiction of the Government of Thailand's Office of University Affairs. However, like other public universities, Chulalongkorn enjoys a large degree of autonomy.

An important reform of the university system in the 1980's permitted the organization of independent schools and colleges within larger government-supported universities. In 1990, even further autonomy was authorized for the government-supported universities. This has real significance for the innovative joint venture with U.S. universities. The new Petroleum and Petrochemical College is authorized to award advanced degrees (independent of the Graduate School), and it has the ability to charge cost-based tuition and set higher base salary levels for faculty. Currently, there are proposals to separate the university administration even more fundamentally from government control and direction.

The University's highest governing body is the University Council and the Rector (president) its chief administrator. At present, the university is composed of 120 academic departments grouped into 15 faculties, a Graduate School, a Language Institute, five research institutes (Institute of Population Studies, Institute of Social Research, Institute of Health Research, Institute of Environmental Research, and Institute of Biotechnology and Genetic Engineering), and three supporting centers (Central Library, Audio-visual Center, and Thailand Information Center). The University has joint academic endeavors with cooperating universities in the United States in the areas of business administration, medicine, and health.

The Sasin Graduate Institute of Business Administration at Chulalongkorn University is a model for successful international collaboration. The Institute was chartered as an independent institution of higher education in Thailand in 1982. The Institute is a joint academic endeavor among Chulalongkorn University, the Kellogg Graduate School of Management at Northwestern university and the Wharton School at the University of Pennsylvania, two of the leading business schools in the U.S. The Institute offers two major programs, the Master of Business Administration and the Master of Management. The courses in this program are taught almost exclusively by faculty members from Kellogg and Wharton. The Institute is now totally self-supporting, from tuition and grants and contracts for continuing education. Dr. Kamchad, Director of the Petroleum and Petrochemical College, was the responsible officer at Chulalongkorn University for conceptualization and launching of the Sasin Institute in his capacity at the time as Academic Vice President, Chulalongkorn University.

ANNEX 1

INSTITUTIONAL CONCURRENCES

Case Western Reserve University

The University of Michigan

Chulalongkorn University



CASE WESTERN RESERVE UNIVERSITY

May 26, 1992

Dr. Richard L. Van Horn, President
The University of Oklahoma
Norman, OK 73019

Reference: University Development Linkages Project
United States Agency for International Development

Dear Dr. Van Horn:

This letter serves to acknowledge the agreement of Case Western Reserve University to serve with The University of Michigan and The University of Oklahoma as a consortium of U.S. universities proposing developmental linkages with Chulalongkorn University in Bangkok, Thailand.

The linkages will assist Chulalongkorn University in developing graduate and research programs in petrochemical technology and polymer science. The U.S. universities and Chulalongkorn University will benefit through planned faculty and student exchanges and other internationalization activities.

We will participate in the U.S.A.I.D. University Development Linkages Project (UDLP) under the terms set forth in our consortium proposal being submitted in response to the RFP for this program, including the requirement for cost sharing.

We look forward to a mutually beneficial partnership in this development activity.

Sincerely,

Richard A. Zdanis
Provost

Office of the Provost

MAILING ADDRESS
Case Western Reserve University
10900 Euclid Avenue
Cleveland, Ohio 44106-7004

LOCATION
Crawford Hall
7th Floor

Phone 216-368-4348
Fax 216-368-3842



JAMES J. DUDERSTADT
PRESIDENT

THE UNIVERSITY OF MICHIGAN

2074 FLEMING ADMINISTRATION BUILDING
ANN ARBOR, MICHIGAN 48109-1240
313 764-6270 FAX: 313-487-773

May 22, 1992

Dr. Richard L. Van Horn
President
The University of Oklahoma
Norman, Oklahoma 73019

Reference: University Development Linkages Project,
United States Agency for International Development

Dear Dr. Van Horn:

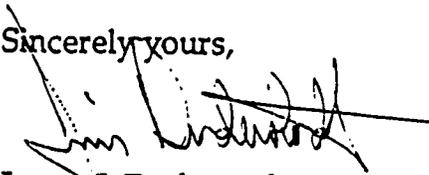
This letter serves to acknowledge the agreement of the University of Michigan to serve with Case Western Reserve University and The University of Oklahoma as a consortium of U. S. universities to establish an academic partnership with Chulalongkorn University in Bangkok, Thailand.

These linkages will assist Chulalongkorn University in developing graduate and research programs in petrochemical technology and polymer science. The U.S. universities and Chulalongkorn University will benefit through planned faculty and student exchanges and other international activities.

We will participate in the U.S.A.I.D. University Development Linkages Project (UDLP) under the terms set forth in our consortium proposal being submitted in response to the RFP for this program, including the requirement for cost sharing.

We look forward to a mutually beneficial partnership in this development activity.

Sincerely yours,


James J. Duderstadt

/st

CHULALONGKORN UNIVERSITY

No. 0301/ 5099

May 15, 1992

President's
Office

Dr. Richard L. Van Horn
President
The University of Oklahoma
Norman, OK 73019

Dear Dr. Van Horn:

Reference : University Development Linkages Project,
United States Agency for International Development

This is to acknowledge the agreement of the University of Michigan, the Case Western Reserve University and the University of Oklahoma as a consortium of U.S. Universities proposing developmental linkages with Chulalongkorn University in Bangkok, Thailand.

It is envisaged that the linkages will assist Chulalongkorn University in developing graduate and research programs in petrochemical technology and polymer science. The U.S. universities and Chulalongkorn University will benefit through planned faculty and student exchanges and other internationalization activities.

We are willing to participate in the U.S.A.I.D. University Development Linkages Project (UDLP) under the terms set forth in the proposal being submitted, including the requirement for cost sharing.

We look forward to a mutually beneficial partnership in this development activity.

Yours sincerely,

A handwritten signature in cursive script, appearing to read 'Charas Suwanwela'.

Charas Suwanwela, M.D.
President

ANNEX II - WORKPLAN OUTLINE

University of Oklahoma/University of Michigan/Case Western Reserve University/Chulalongkorn University

GOALS & PURPOSE	OBJECTIVES	ACTIVITIES	DESIRED OUTCOMES	RESOURCES REQUIRED	NEEDED INPUTS
<p>GOAL To test, authenticate, and promote new models for international technological collaboration in the areas of energy, environment, and advanced materials, and specifically to establish a center of engineering excellence in Thailand.</p> <p>PURPOSE To fashion a collaborative venture among Chulalongkorn University, Case Western Reserve University, the University of Michigan, and The University of Oklahoma as the essential institutional foundation for a new graduate engineering college in Thailand.</p>	<p>1. Establish a sustainable collaborative venture involving an academic partnership among Chulalongkorn University, Case Western Reserve University, the University of Michigan, and the University of Oklahoma</p>	<p>(a) Engage the partnership universities through a series of exchange visits and meetings. Organize a steering committee to direct the venture and the proposed Linkages grant.</p>	<p>Identification of participating universities. Completion of a feasibility study. Design of the academic program. Negotiation of a Memorandum of Understanding.</p>	<p>None. This work completed prior to preparation of Linkage program proposal.</p>	<p>Memorandum of Understanding to be signed in July 1992. Visit of U.S. university presidents to Bangkok, Thailand planned for January 1993.</p>
		<p>(b) Management of the collaborative venture and Linkages project</p>	<p>Strong bonding among the participating universities. Model for similar projects.</p>	<p>Support for administrative and steering committee meetings and travel.</p>	<p>Investment by the departments and individuals involved.</p>
		<p>(c) Start-up design and development missions</p>	<p>Specification of laboratory equipment for instruction and research in new building being constructed to house the college. Design and specification of computer systems and assessment of library needs.</p>	<p>Chulalongkorn University is building a 16-story building, 8 stories of which will house the college and its instructional and research laboratories. Completion date is February 1993. Thai government is allocating \$6 million for purchase of research and instructional equipment over a 5-year period. Support for design and development missions.</p>	<p>Selected faculty from participating universities will serve as consultants for equipment acquisition for graduate research laboratories in chemical engineering and polymer science and the computer systems for the college. Consulting on library resource needs and instructional technologies. To be accomplished in 1992-93 and 1993-94.</p>
		<p>d) Thai faculty residencies at U.S. universities</p>	<p>Identification of collaborative research opportunities (i.e., collaborators and topics). Transfer of pedagogical methodologies. Building personal, professional, and institutional bonds.</p>	<p>Commitment of Chulalongkorn University to paid leaves of absence. Funding to support 20 Thai faculty residencies in U.S. over a two and one-half year period.</p>	<p>U.S. partner university expertise in chemical engineering and polymer science graduate education and research. Mentoring of Thai faculty residents in U.S. universities, 1992-93, 1993-94, 1994-95.</p>

ANNEX II - WORKPLAN OUTLINE (continued)

University of Oklahoma/University of Michigan/Case Western Reserve University/Chulalongkorn University

GOALS & PURPOSE	OBJECTIVES	ACTIVITIES	DESIRED OUTCOMES	RESOURCES REQUIRED	REQUIRED NEEDED INPUTS
	1. (CONTINUED)	<p>(e) Actions to solidify institutional commitments to the partnership venture, including: incorporation of collaborative offerings in programs at the participating universities, specific reference to partnership institutions in all information and public relations materials published by the college.</p>	<p>Commitment to the partnership at the highest levels in the participating universities. Broad identification of each partner university with this international collaborative venture. Identification of other international collaboration opportunities arising from this program.</p>	<p>Support for development activities. Academic and industrial advisory boards with U.S. and Thai participation. Funding to be sought from other sources.</p>	<p>An aggressive development program to secure industry and government support for endowment, scholarships, and research. A strong public relations program in Thailand and the U.S. Activity continues throughout the project.</p>
		<p>(f) Actions to assure sustainability of the program through development of revenue streams, including scholarships, endowments, research grants, industrial support services, and continuing education.</p>	<p>A level of industrial support to build and maintain research programs of international caliber. Recognition of the college as a regional (Southeast Asia) center of excellence.</p>	<p>Aggressive industrial advisory boards both in Thailand and in the U.S. High level exposure to potential industrial sponsors.</p>	<p>Collaborative relationships among Thai and U.S. faculty. Access and working relationships with industry in Thailand and U.S. companies with interests in Thailand and other countries in Southeast Asia. Activity continues throughout the project.</p>
		<p>(g) Program evaluation.</p>	<p>Validation of academic program format, staffing, and curriculum content to meet an international standard. Demonstration of sustainability of the partnership.</p>	<p>Support for steering committee activities and consultant evaluator. Associate dean position to be funded from other sources.</p>	<p>Joint Thai/U.S. involvement in academic program administration through steering committee. Full-time Associate Dean from U.S. to be resident in Thailand for 2 years, 1993-95. Faculty consultant to evaluate program, 1995-1997.</p>

ANNEX II - WORKPLAN OUTLINE (continued)

University of Oklahoma/University of Michigan/Case Western Reserve University/Chulalongkorn University

GOALS & PURPOSE	OBJECTIVES	ACTIVITIES	DESIRED OUTCOMES	RESOURCES REQUIRED	NEEDED INPUTS
	<p>2. Establish innovative graduate programs for the new engineering college at Chulalongkorn University, specifically graduate programs in petrochemical technology and polymer science.</p>	<p>(a) Faculty from the partnership U.S. universities will teach a complete academic program in the college -- 100 percent of curriculum offerings for the first two years 1993-95, tapering off to 50 percent in subsequent years.</p>	<p>Engagement of U.S. and Thai faculty in collaborative teaching. Testing/verification/revision of curricula and teaching materials. Confirmation of 4-week course format. Introduction of international case materials into courses at Chulalongkorn and U.S. universities.</p>	<p>Tuitions and other income to support instructional program.</p>	<p>U.S. faculty to teach 10 courses per year in Thailand 1993-94 and 1994-95 and 6 per year thereafter.</p>
		<p>(b) Development of research and industrial projects at Chulalongkorn University involving faculty among the participating universities.</p>	<p>Start-up of long-term collaborative research activities, initially based on established research programs at the U.S. universities, but moving toward projects with an international dimension and to the prevailing problems and industrial needs of Thailand and Southeast Asia.</p> <p>New projects meriting support by the Thai government and industry. Increased opportunities for research funding and for publications at the college.</p>	<p>Support for Thai faculty residencies in U.S. Support for instructional and follow-up research visits by U.S. faculty in Thailand. Sponsored research support for joint research projects. Support for Thai and U.S. graduate research exchanges.</p>	<p>U.S. and Thai faculty research collaboration through shared responsibility for direction of student thesis research. Reearch involvement of U.S. instructors while in Thailand. Continued participation in student research supervision, including follow-up trips to Thailand. Process initiates with first Thai faculty residencies at U.S. universities and U.S. faculty start-up consulting visits in 1992-93 and continues through the project period.</p>
		<p>(c) Student exchange program for research collaboration. Competitively selected U.S. students will work at Chulalongkorn University and Thai students will work at U.S. universities.</p>	<p>A more global dimension to the learning environment. Cross-cultural appreciation and maturation. Closer linking of instructional and research activities among the partner universities. Graduate engineers with competence at an international standard, with a participatory management style, cultural adaptability, and heightened environmental sensitivity and capability.</p>	<p>Travel and living expenses for the exchange students.</p>	<p>Six U.S. students to work in Thailand and six Thai students to work in U.S. each year for three months, starting in 1994-95.</p> <p>Supervision and mentoring in the U.S. and in Thailand by participating faculty.</p>

ANNEX III

IMPLEMENTATION PLAN

University of Oklahoma/University of Michigan/Case Western Reserve University/Chulalongkorn University

No.	Objective/Activity	Start Date	End Date	FY 1993 Quarters				FY 1994 Quarters				FY 1995 Quarters				FY 1996 Quarters				FY 1997 Quarters			
				1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1.	Objective 1. -- Establish a sustainable academic partnership venture	7/1/92	6/30/97																				
2.	-- Engage partnership universities in the venture	7/1/92	3/31/93																				
3.	-- Manage the venture and UDLP	7/1/92	6/30/97																				
4.	-- Design and development missions to Thailand	10/1/92	3/31/94																				
5.	-- Thai faculty residencies at U.S. universities	9/1/92	12/31/94																				
6.	-- Actions to solidify institutional commitments	7/1/92	6/30/97																				
7.	-- Develop revenue streams to assure sustainability	7/1/93	6/30/97																				
8.	-- Program evaluation	4/1/93	6/30/97																				
9.	Objective 2. -- Establish graduate programs in petrochemical technology and polymer science	4/1/93	6/30/97																				
10.	-- Instructional programs	4/1/93	6/30/97																				
11.	-- Graduate research programs	7/1/93	6/30/97																				
12.	-- Student exchange programs	7/1/94	6/30/97																				

Key	Summary		Scheduled Item	
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ANNEX 4

PERSONNEL QUALIFICATIONS AND UTILIZATION

The University of Oklahoma

Dr. Jeffrey H. Harwell, Professor and Director
School of Chemical Engineering and Materials Science

Dr. Raymond D. Daniels, Professor
School of Chemical Engineering and Materials Science

Dr. Millie C. Audas, Director
Office of International Programs

Case Western Reserve University

Dr. Hatsuo Ishida, Director
NSF Center for Molecular and Microstructure of Composites
Department of Macromolecular Science

The University of Michigan

Dr. Johannes W. Schwank, Professor and Chairman
Department of Chemical Engineering

Chulalongkorn University

Dr. Kamchad Mongkolkul, Director
Petroleum and Petrochemical College

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KEY PERSONNEL

Project Director -- Dr. Raymond D. Daniels

Dr. Daniels has served on the faculty of the University of Oklahoma for 34 years. During that time he has directed numerous research and education projects and served in a number of administrative positions. From 1986-92 he served as Director of the School of Chemical Engineering and Materials Science. Currently he is Director of the Oklahoma Mining and Mineral Resources Research Institute. Positions held in past years include: Associate Dean of Engineering, Associate Dean of the Graduate College, Director of the Office of Research Administration, and Executive Director of The University of Oklahoma Research Institute. He is co-author of a book on research administration in universities. Dr. Daniels will devote about 0.33 FTE to UDLP and joint venture.

**Steering Committee -- Dr. Jeffrey H. Harwell
Dr. Johannes W. Schwank
Dr. Hatsu Ishida
Dr. Kamchad Mongkolkul**

Drs. Harwell, Schwank, and Ishida represent the academic departments in the participating U.S. universities. They all have distinguished records as academics, researchers, and administrators. They, along with Dr. Kamchad, will be responsible for policy matters in the UDLP and joint venture, and they will be responsible for faculty and student participation from their respective universities.

Dr. Kamchad, has held major administrative posts at Chulalongkorn university, including: Vice-President for Academic Affairs, Vice-President for Development and Planning, and Vice-President for International Affairs. As Director of the Petroleum and Petrochemical College, he is responsible for Thai faculty and students and the academic programs in the College. He will coordinate UDLP activities in Thailand. He will be assisted in 1993-95 by a full-time Associate Dean. This individual has not yet been selected.

Office of International Programs -- Dr. Millie C. Audas

Dr. Audas, Director of the Office of International Programs, University of Oklahoma, will work with Dr. Daniels and her counterparts at the University of Michigan and Case Western Reserve University to facilitate student and faculty exchanges between the United States and Thailand.

None of the time of these key administrative personnel is budgeted in the UDLP proposal.

Appendix II

MEMORANDUM OF UNDERSTANDING

MEMORANDUM OF UNDERSTANDING

among

Chulalongkorn University, Bangkok, Thailand
Case Western Reserve University, Cleveland, Ohio, U.S.A.
The University of Michigan, Ann Arbor, Michigan, U.S.A.
The University of Oklahoma, Norman, Oklahoma, U.S.A.

The above universities agree to work together in partnership to develop graduate programs in the Petroleum and Petrochemical College, Chulalongkorn University leading to Master of Science degrees in Petrochemical Technology and Polymer Science. Participation of the U.S. universities in this program with Chulalongkorn University is desired to further cooperation between the U.S.A. and Thailand and to develop the academic and research programs of the College to international standards of excellence.

Course instruction in the graduate programs will be in the English language and students will be required to complete a thesis research project. Instructors for courses offered in the first two years of the program will be recruited from the faculties of the U.S. partner universities. In the third and successive years it is intended that U.S. faculty teach about one-half of the program courses.

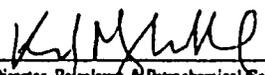
Thai faculty will be responsible for supervision of thesis research. U.S. faculty will assist in identifying research topics and in development of cooperative research projects between Chulalongkorn University and its U.S. university partners.

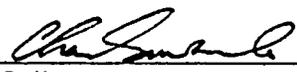
The degree programs will be administered by the Petroleum and Petrochemical College, Chulalongkorn University and degrees will be granted by Chulalongkorn University. In recognition of U.S. university participation, diplomas will be co-signed by department heads of the partner universities. Courses offered by U.S. faculty will be equivalent to semester courses offered on their own campuses, and instructors will be solely responsible for course content, maintenance of academic standards, and grading of courses.

This Memorandum of Understanding prescribes the more general aspects of the graduate programs and partnership participation. The participating academic departments will develop mutually agreeable organizational and operational procedures. These arrangements are subject to refinement and modification in accordance with needs and experience as the program evolves. Financial arrangements for U.S. partner university participation will be negotiated and will depend on the availability of funds.

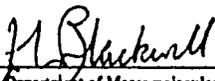
This Memorandum of Understanding becomes effective on the date of signing by the authorized representatives of the partner universities. It shall remain in effect for a period of five (5) years and is renewable. A partner may withdraw from the program upon giving one-year advance notice and fulfilling remaining obligations.

Chulalongkorn University

by  12-1-92
Director, Petroleum & Petrochemical College Date

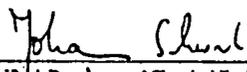
by  12-1-92
President Date

Case Western Reserve University

by  11/20/92
Head, Department of Macromolecular Science Date

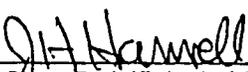
by  11/25/92
President Date

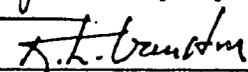
The University of Michigan

by  11-12-92
Head, Department of Chemical Engineering Date

by  11-8-92
President Date

The University of Oklahoma

by  11-10-92
Director, Chemical Engineering & Materials Science Date

by  11-10-92
President Date