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Interim Report:

The Petroleum and Petrochemical College
at Chulalongkorn University
Bangkok, Thailand

Association of Big Eight Universities
Arlington, Virginia
and Norman, Oklahoma
January 2, 1992

THE PETROLEUM AND PETROCHEMICAL COLLEGE
at CHULALONGKORN UNIVERSITY, Bangkok

A JOINT ACADEMIC ENDEAVOR WITH:

CASE WESTERN UNIVERSITY, Cleveland, Ohio
UNIVERSITY OF MICHIGAN, Ann Arbor, Michigan
UNIVERSITY OF OKLAHOMA, Norman, Oklahoma

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Association of Big Eight Universities
December 30, 1991

Introduction

This Interim Report is submitted in response to the requirements of Cooperative Agreement No. 493-0000-A-00-1150-00 between the Association of Big Eight Universities and the United States Economic Assistance Mission to Thailand (USAID). The Cooperative Agreement provides for an assessment of the academic partnership proposed between The Petroleum and Petrochemical College at Chulalongkorn University in Bangkok, Thailand, and cooperating universities in the United States (i.e., Case Western University, University of Michigan, and University of Oklahoma). It is important to underscore that the purpose of the assessment is to determine the feasibility of the proposal and not to propose a specific design for its implementation. That will emerge from discussion between Chulalongkorn University and the cooperating universities and is ultimately, of course, the responsibility of Chulalongkorn University alone.

Owen Cylke, president of the Association of Big Eight Universities, and Erle Donaldson, faculty emeritus at the College of Engineering, University of Oklahoma, visited the cooperating universities during October, 1991, and visited Chulalongkorn University during November, 1991. Representatives of the cooperating universities will meet in Chicago in January, 1992, prior to visiting Thailand. Taking into account the findings of the initial work of the Association, the visit of the cooperating university representatives to Thailand, and a subsequent visit by the presidents of one or more of the cooperating universities, the Association will prepare and submit a Final Report to USAID.

This Interim Report is intended to capture a broad range of ideas and issues as an agenda for discussion among the cooperating universities and with The Petroleum and Petrochemical College at Chulalongkorn University. The ideas and issues identified in the Interim Report are not "design" issues, and probably not even "feasibility" issues, rather a guide to discussion as the proposal for academic partnership matures. The Final Report will not rehearse most of these ideas and issues again; rather, it will identify "premises" and "steps" to the realization of the proposal. A finding with regard to feasibility, of course, will be included in the Final Report.

1. Background

a *The Petrochemical Industry:* (See Friel, UNIDO, ID/WG. 336/2)

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. The National Petrochemical Corporation (NPC), a joint venture between the public and private sectors in Thailand, serves both as a pilot company for the development of the industry and the sponsoring company for an associated, and equally ambitious, set of petrochemical complexes. The first complex (NPC1) itself is by far the largest industrial undertaking ever undertaken in Thailand and involves the substantial participation of nearly every large Thai business group and family, the Thai government, and many of the international leaders (including important American firms) in the oil, gas, petrochemical, and chemical industries.

The petrochemical industry is importantly integrated 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 itself for the production of other petrochemicals like propylene, which is then sold to a polypropylene producer. They can be sold to a manufacturer of another industrial product, such as plastic sold to an an auto parts manufacturer supplying an auto maker. And they can also be sold as final products, like resin adhesives and putties. Aside from being used in manufacturing, petrochemicals also play a large role in the agriculture sector 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. Conversely, an inefficient petrochemical industry could seriously handicap the economy which would be forced to support it as well as to inefficiently consume valuable oil and gas reserves.

It is generally agreed that Thailand should have its own petrochemical industry. NPC's domestic market orientation and utilization of surplus ethane and propane make its first project (NPC1) a sound one. The project accomplishes its goal of offering domestic customers a stable supply of reasonably priced products. By relying on the domestic market for its long term viability, and the export market for only initial balancing shipment sales, it is a competitive venture. The economics of NPC2 are less certain. While the doubling of olefins capacity and the introduction of an aromatics capacity are probably justified, feedstocks for the second project will be more expensive than for the first, and export expectations may be too optimistic. But, in any event, NPC1 and NPC2 together define an important human resource and technology challenge for the country.

b. *Human Resource Requirements:* (See Sussangkarn, TDRI/Bangkok)

Over the past several years, the pace of economic development in Thailand has accelerated. With manufactured exports growing at 35 to 40 percent per annum for almost five consecutive years, GDP growth in 1991 was probably in excess of 10 percent. Thailand is clearly among the wave of newly industrializing economies. Success, however, has highlighted a number of problems concerning human resource development and utilization. Manifestations of these problems include shortage in key skill areas, coupled with growing educated open unemployment.

In contrast to the general rise in educated open employment, 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.

With the current rapid growth in Thailand, there are already shortages of science and technology manpower. Indeed, large companies have expressed concern over the situation, and some have even expanded their own training programs to compensate for the lack of appropriate supply from the formal educational system. In the area of petrochemicals, industry suggests they can absorb all of the chemical engineers the country can supply. Many send employees to the United States for the Master's degree (bonded). In discussion, the requirement was defined: a Master's level chemical engineer, with fluent English language facility, with a greater appreciation and understanding of plant operations, and with a more open and participatory professional style. These points were emphasized by managers at Thai, foreign, and multinational companies.

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

Numbers of Research Scientists and Engineers for Every 10,000 Working Population

United States	67
Japan	79
Germany	52
Sweden	44
Switzerland	36
Taiwan	32
South Korean	27
Singapore	27
Thailand	1

Engineering Graduate Requirements
Thailand

	Number of Graduates/Supply			Demand	
Year	MUA	Private	Total	Avg/Yr	Accum
1986	157		157		
1987	168		168		
1988	189		189		
1989	217		217		1,000
1990	230		230	703	1,473
1991	243		243	734	1,964
1992	324	20	344	788	2,408
1993	349	20	369	842	2,881
1994	377	20	397	896	3,380
1995	415	20	435	950	3,895
1996	457	20	477	1,003	4,442
1997	502	30	532	1,072	4,961
1998	552	30	582	1,141	5,520
1999	608	30	638	1,210	6,092
2000	668	30	698	1,279	6,673
2001	735	30	765	1,3477	7,255

c. *Technology, Innovation, and Enterprise* (see Cylke, Association materials)

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. 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 have been replaced by human creative power, a highly educated workforce, 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. Collectively they constitute a country's technological endowment.

Technology, technical change, and technological innovation are, of course, 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 nearly 200 years. Indeed, what distinguishes the past century from earlier periods in human history is that industrialized economies have institutionalized the process of technical change. This institutionalization has occurred mainly in universities and major businesses, usually with only secondary support from government.

The industrialized countries have both conceptualized and institutionalized the technology process. Some of the newly industrialized countries have increasingly secure holds on both the conceptualizations and institutions; but many modernizing countries in the developing world are comfortable with neither their understanding nor their approach to 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 the advanced developing countries. Even if not totally neglected in the development literature, it is, nevertheless, neither yet prominently fixed in the strategies, organization, or programs of the international development community.

How does a nation establish a dynamic technological endowment? What seems to be required is the building of a new technological infrastructure. Historically, governments have been responsible for building the physical infrastructure of roads, highways, and energy systems that provide the basis for economic growth. However, to develop a modern technological endowment for energy and industry, governments must also forge and foster strategic alliance with the knowledge, industrial, and financial sectors to build a new technological infrastructure.

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 of a technology infrastructure 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; others will not.

d. *The Proposal* (See Mongkolkul, Chulalongkorn materials)

Chulalongkorn University proposes to build a new graduate program in the areas of petrochemical and polymer studies. The program will be organized by the University's Petroleum and Petrochemical College as a joint academic endeavor with three cooperating universities from the United States (i.e., Case Western University, University of Michigan, and University of Oklahoma), offer its degree curriculum (initially at the Master's level) in the English language, include an innovative laboratory and research program, and grant advanced degrees at an international standard. The model is based on the now 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 reorganized Petroleum and Petrochemical College is intended to respond to the requirements of the petrochemical industry in Thailand and to define an alternative approach to graduate level engineering education at 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 petroleum and petrochemical industries operate in the international marketplace. Multinational companies are a feature of the industry. Thai petroleum and petrochemical companies are interested to compete in that marketplace, and Thai engineers are interested to work and to have their professional opportunity defined internationally. In this regard, then, University leadership sees The Petroleum College as a prototype for strategic alliance between the academic and technological capacities of Chulalongkorn University with industry in Thailand and with other universities around the world.

2. The View from Thailand

a. Chulalongkorn University (See University materials and Association notes)

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 nine 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 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). As noted above, the University has also organized a joint academic endeavor with cooperating universities from the United states in the area of business administration.

The College of Engineering offers undergraduate and graduate programs relevant to the proposal in the areas of chemistry, metallurgy, and mining. The College 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 most directly 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, and with the cooperation of departments in the colleges of Engineering and Science.

Indeed, some of the related departments present something of a challenge to the proposed reorganization of The Petroleum College. Several of the departments have their own plans to expand and enhance graduate programs, including English language instruction, and are,

therefore, reluctant to join in the proposal for the reorganization of The Petroleum College. This overlap and reluctance can be attributed to institutional tensions frequently associated with interdisciplinary programs in universities. Nevertheless, the University is committed to moving ahead with the reorganization of The Petroleum College on the "Sasin model" because it is seen as a quick and viable way to launch graduate engineering education at an international standard in a strategic economic sector. A similar situation existed at the time the Sasin Institute itself was organized, but those tensions have been largely overcome. After careful discussion throughout the University, the Association's consultant does not see the apparent overlap and reluctance of some related departments at the University to embrace the proposal as a determinative feasibility issue.

It should also be noted that petroleum engineering is not included in the proposal. Part of the reason is related to the emphasis on downstream requirements and value-added, but another part is directly attributable to the tensions suggested above in the area of university coordination. Similarly, it may be that the department of Chemical Technology in the College of Science will be more directly engaged initially with the proposal than the department of Chemical Engineering in the College of Engineering. Again, these early preferences and tendencies are not seen as determinative feasibility issues.

b. Other Universities: (See materials from the Ministry of University Affairs)

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 has been importantly influenced by government and by bureaucratic rather than academic systems of administration.

Thailand's first economic development plan was issued in 1961, although the National Economic and Social Development Board (and predecessors) was organized as early as 1950. The planning process defined a new and different role for the university, and very rapid expansion of the university system was undertaken throughout the 1960s and 1970s. In 1971, the first technological university in Thailand, King Mogkut's Institute of Technology, was organized and has now evolved into three separately administered institutes. The Institute at Thonburi has a well developed chemical engineering program with good research facilities (including a pilot plant facility) and a service orientation towards industry. The feasibility team was unable to visit the Institute at Thonburi, but the subsequent visit by representatives of the cooperating universities in the United States may well benefit form a visit there.

Mahidol University is oriented towards medicine and public health and has maintained an important relationship with Johns Hopkins University in the United States. While not exactly on the "Sasin model", it is an example which may lend insight into the development and maintenance of university linkages in Thailand. Again, the feasibility study team was unable to visit the University, but the representatives of the cooperating universities from the United States may want to add this to their agenda as well.

An important reform of the state university system is currently being debated within the Thai government. It is expected that the universities will be freed up from the ministerial structure and given increased autonomy in the next several years. This development has real significance for the kind of innovation proposed at The Petroleum College (e.g., charging of tuitions, increases in salary levels). It is also important to note the rather rapid expansion of the private university system in Thailand. While many of these institutions have grown up around a business curriculum, their ability to innovate and respond to business and industrial requirements suggests additional insight for the development of The Petroleum College. Assumption College was frequently mentioned as an important private university experiment.

In several meetings with the president of the University, he reiterated a commitment to the kind of reorganization proposed for The Petroleum and Petrochemical College. He seemed well satisfied with the Sasin Institute and has, himself, put forward a proposal for a similar venture and partnership to be associated with the Medical College. At the same time, he is clearly interested in forging a new vision for the University, one more rooted in notions of application, industrial relevance, and national service. In discussion, for example, he inquired why an engineering school shouldn't have an industry associated with it as a medical school has a hospital. He is a champion of several other research centers at the University, each with an industrial mission. CHULASEARCH, an effort to promote collaborative research and technology transfer, is one example of his, and the University's, commitment to a new vision for Thai educational institutions.

The president also argued that partnership with foreign institutions was critical for universities, like Chulalongkorn, defining themselves at 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 president also argued that it was 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 had, and have, a place in building technological infrastructure, he argued 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, and 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 president argued that business and petrochemistry are appropriate starting points.

c. *Asian Institute of Technology:* (See materials from the Institute)

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 the director underscores the criticality of squarely addressing this requirement at The Petroleum College. Indeed, the director, who is by profession a polymer scientist himself, stated that AIT maintains both "pre-curricular" and "parallel" English classes. It is his judgment that English is a very serious issue. Indeed, he argues that the lack of English fluency clearly compromises the quality of engineering education at AIT. Since The Petroleum College is committed to the "course a month" model from Sasin, he expressed worry that students might miss the greater part of the first two courses in the first semester. The director suggests that The Petroleum College consider the possibility of linking English language to a curricular component in the program. As an alternative, he speculated whether The Petroleum College might not better devote its first three or six months to English language and laboratory work (assuming that The Petroleum College had pilot plant facilities and an industrial orientation), then twelve months to curricular work, and the final six to nine months to research. In this way, he argued one might underscore the "new attitude" of The Petroleum College (i.e., directed at

industrial requirements), assure a distinctive hands-on familiarity with the tools of the trade, maintain a directed and integrated English program, and produce a student ready (oriented) to engage in curricular work of a different order.

Indeed, the director also underscores the criticality of an "applied orientation", or "relevant orientation", to the economic and technical requirements of industry in Thailand. He points out that AIT had been able to maintain its standards by requiring the regular production of international quality research and publications by faculty, but by also adding a criterion that the research and publications be relevant to the regional context. In the course of this discussion, the director agreed that the word "applied" perhaps gave the wrong connotation to his point, which is simply that students and faculty alike need to maintain a sense of purpose and relevance which is often absent, he feels, in Asian institutions of higher learning.

Along these lines, the director also challenged the pedagogical basis for the "course a month" model. He argues that engineering education is sequential, requiring some period greater than a month for real understanding, but quickly agreed that he is in no way an expert on the subject at point. And, on that basis, he returned to a discussion of English as an area where AIT had real experience and perhaps something to contribute.

d. *The Petroleum Institute of Thailand:* (See materials produced by the Institute)

The Petroleum 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.

In discussion, the director made the following points. Thailand will not be in a position to develop a sophisticated R&D culture for petroleum and petrochemistry for sometime into the future. While it is important to keep that goal out in front of any educational planning, it should not define the program. Rather, an academic program should be directed to producing 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, the director argued strongly for the incorporation of an industrial-scale pilot plant as a part of the educational infrastructure for the project, 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). The director also stressed her commitment to building on existing foundations rather than building new structures (i.e., an apparent reference to the departments of Chemical Engineering at Chulalongkorn and the programs at King Monghut), but she also indicated that she would give full support to The Petroleum College if it went forward.

e. *Petrochemical and Polymer Industry:* (See interview notes)

In the course of the visit, the assessment team had opportunity to meet with a wide range of professional and administrative staff from the petrochemical and polymer industry. While no formal assessment methodology was used, the definition of requirement was quite clear. In the first instance, everyone agreed that the industry could take up as many engineers as The College could produce. This view from industry is substantiated by the figures presented earlier in this Report.

Most argued that there was only a limited need for the PhD graduate in industry. On the other hand, it was argued that the university system would have a continuing need for PhD candidates for some time to come; and if a commercial analysis, standards, and testing facility were developed, the requirement would probably be long-standing. The essential point is that no firm is yet engaged itself in commercial R&D.

There is, on the other hand, a significant and growing demand for engineers at the Master's level. That demand is reflected in the number of firms sending employees out of Thailand for Master's degrees in chemical engineering. There is general agreement that industry is looking for an engineer capable and confidant with process technologies relevant to petrochemistry and polymers, with the English language, and a more open and participatory professional style. Research may be important as a pedagogical tool, but industry is probably more simply concerned that the chemical engineer have a solid analytic capability, familiarity with unit operations, and sensitivity to important issues of pollution prevention and safety.

Discussions with industry with regard to financial support for The Petroleum College were inconclusive. While the major Thai and multinational companies appear to support a wide range of educational endeavor (e.g., Sasin Institute, scholarships to the United States), there is an equal sense that they are very careful with their discretionary resources available for these purposes. The Petroleum College plans to solicit support for scholarships, faculty chairs, library equipment, etc. If The Petroleum College is properly organized, with apparent concern for the requirements of industry, it is possible that a substantial portion of its financial requirement could be met from these sources. In the United States, this is usually the function and responsibility of specific personnel, identified and engaged for this purpose.

The Sasin Institute relies heavily on its Executive Development programs, modeled on similar programs at both Kellogg and Wharton, for financial support. These programs are directed to in-service training and provide a very high rate of return. With regard to The Petroleum College, it was suggested by several from industry that the appropriate analog to these Executive Programs might be an industrial service laboratory with capability in the areas of analysis, standards, and testing. An industrial service laboratory might fill a useful niche in the growing petrochemicals industry, provide an educational experience for student "interns", and secure the financial base for The Petroleum College. On the pedagogical side, it is also argued that a pilot plant might be to an engineering college what a hospital is to a medical school, building an easy familiarity with equipment and operations, building confidence on the part of the student even before approaching his academic or professional assignment, and assuring coordinated and responsible management for laboratory and research equipment.

f. *Regional Institutions and Capability*

There was little or no information available in Bangkok with regard to institutional capability or development in the area of education for petrochemistry and polymers in the region. It is assumed that there is virtually none in the Indo-China region, and that capabilities in Indonesia and Singapore are not competitive. Before completing the Final Report, we will make an effort to develop what information we can.

3. The View from the United States

a. *Cooperating Universities* (See trip notes)

The assessment team visited the University of Michigan (J.W. Schwank, Professor and Chair, Department of Chemical Engineering, University of Michigan, Ann Arbor, Michigan, on October 1, 1991), Case Western University (Hatsuo Ishida, Professor and Director of the C.R. Newpher Polymer Composite Laboratory, Department of Macromolecular Science, Case

Western University, Cleveland, Ohio, on October 17, 1991), and the University of Oklahoma (J. Harwell, Associate Professor and Acting Chair, Department of Chemical Engineering, University of Oklahoma, Norman, Oklahoma, on October 25, 1991).

A set of common observations and questions drawn from those visits are outlined below:

- The size of the faculties vary but together constitute perhaps only fifty. Compare this with the Kellogg and Wharton faculty base of perhaps some 250. Each university suggested that non-tenured faculty would probably not participate in the program to the extent of tenured faculty, further reducing the faculty base. There is some uncertainty, then, whether the three universities can meet and sustain the required faculty commitment of sixteen each year.

- With individual faculties numbering less than twenty, and the probability that departments will not be able to support absent faculty through sabbatical and faculty pairing, several of the universities suggested they would probably have to incur direct budget costs to engage substitute faculty for courses. Financial support to the university, then, might be an issue.

- There was a sense on all campuses that engineering faculty were fully (or most) committed to their research agendas, a commitment which might tighten-up on time they would be willing to be away from campus, and/or require the development of a substantive research agenda in Thailand. Without these kinds of incentives, the question of sustainability (multi-year commitment and availability) might be at question.

- There was a very real sense that universities in the United States are interested to identify and attract highly qualified students from Thailand to their PhD programs. If some of those students could bring Government of Thailand scholarships with them, then there might be a very real institutional pay-off from participation in the program.

- Questions were raised on each campus with regard to the nature of the proposed partnership. Several faculty at the participating institutions expressed their interest in the design of the program; but they also queried their role in admissions, governance, degree standards, etc. In fact, the question was what there might be to the partnership which would extend beyond the supply of faculty and institutional certification. One possibility suggested was to directly link The Petroleum College's Master's program with the cooperating university's PhD programs (e.g., the Chulalongkorn Degree extending to the PhD, based on work in the United States).

- Several administrators asked how the relationship would work among the participating institutions from the United States. Would one be "lead"? Would one assume responsibilty for faculty recruitment? Would petrochemistry and polymers constitute distinct programs? If so, how do the three universities relate to the two programs?

- And finally, the question of financial compensation was raised, and whether it would or would not be considered to be part of the academic year, or rather would be considered vacation time. Absolute amounts of compensation were also raised.

b. Innovation

Several administrators suggested that their interest in the program was rooted in the perhaps unique opportunity to participate in the building of a different kind of engineering curriculum and program in Thailand (i.e., innovation and profile). Many engineering schools in the United States,

for example, are wrestling with the question of how best to build interdisciplinary, interinstitutional, and international programs. Most engineering schools in the United States do not have an "applied inter-face"with industry, and several administrators indicated that the possibility of working in that kind of intellectual milieu made the project an attractive one. Several faculty also noted that they might be attracted to a facility with an industrial-scale pilot plant, equipment usually found only in industry in the United States.

Indeed, most administrators and faculty argued that without some kind of profile, some dimension of innovation, the more usual opportunity standard (i.e., research productivity) would be applied in determining whether to associate with and/or to support the project.

4. The Sasin Model

a. *The Sasin Institute of Business Administration* (Compared and Contrasted)

The Sasin Institute of Business Administration is the model for the proposal. Sasin offers an academic program (i.e., the MBA) in cooperation with the Kellogg and Wharton schools from the United States. The program works quite simply. The Kellogg School serves as the United States administrative base for the program, and those administrative costs are absorbed by Kellogg (i.e., the half time commitment of a senior faculty member and associated administrative support). All recruitment is centered there, and virtually all courses are taught by faculty from either Kellogg or Wharton. The two-year program operates on a quarter system . There are three teaching quarters to the year, each ten weeks in duration. To obtain maximum mobility of faculties from Kellogg and Wharton to Sasin, the ten week quarter is typically divided into two half quarters of five weeks with the sixth week set aside for examinations. Two courses are taught each half quarter. Students, required to take a total of twenty five courses, are advised to register for two courses each half semester.

All MBA students are required to take a five week accredited 100 hour Business Communications Skills course before the start of their two year program. In this course, students develop the communication skills they will need to take full advantage of their MBA courses and to prepare for future careers (e.g., English language facility). The course concentrates on perception group dynamics and the following skills: writing, listening, oral presentations, problem solving/logical analytical thinking. Upon completion of Business Communication, students are evaluated. They then have the option of continuing tutorial sessions throughout their two year graduate program. In addition, some candidates may be required to take a 40 hour English Usage and Writing course prior to the start of their MBA studies. Students are also required to attend special training courses in the areas of mathematics, computing, and conceptual issues in management.

The Petroleum College proposes to follow the Sasin model. Separate curricula are envisioned for petrochemistry and polymer studies, each program offering eight courses over two semesters. Each semester would be divided into four four or five week sessions with faculty from the United States initially teaching each course session. It is not yet clear whether classes would meet four or five times in a week or whether specific non-teaching time would be allocated for examinations and consultation. Group study will be a part of the teaching methodology, and Thai teaching associates will be assigned to each course session. The visit of the representatives of the cooperating universities is expected to define and clarify curricular offerings, periods for course sessions, course hours, examination periods, teaching and study methodologies, materials, and logistics. It is not yet clear whether there would or would not be a core curriculum for both petrochemistry and polymer studies, the range of electives, or the classification of degree offerings (i.e., MS, ME, etc.). But initial plans call for sixteen faculty from the United States each year over a sustained period. The second year is intended to be devoted to research, but that program is yet to be defined, and specifically the responsibility of faculty from the cooperating universities.

The Petroleum College has suggested that it might also offer a one month English usage course for entering students. As noted earlier from discussions in Thailand, and drawing from the Sasin model, the one month offering may be inadequate. It might also be useful to consider combining an English usage program with a more technical curricular offering directed, for example, to computing and laboratory work and mathematics. Combining English usage and technical subjects might have pedagogical value (i.e., for English), and the introduction of computing and laboratory experience together with mathematics at the very initial stage of the program might also serve to level the playing field between faculty and students in what promises to be a very tight program.

It may also be that in a situation where the Master's degree is seen as a "terminal degree", where the College is put forward in response to the economic development aspirations of the nation, and where an expatriate off-site faculty is contemplated, that it will be important to develop a "distinctive new academic culture" for the program and College. Wrapping all preparative studies into a single combined program might be one device for meeting (or setting the stage for) these distinctive pedagogical and institutional objectives. In this scenario, The Petroleum College might allocate up to three months (or even six months) to preparative studies (with full credit) and still hold a full two semester requirement for research in the second year, and/or reduce the research requirement to one semester, or to one and a half semesters.

In any consideration of the Sasin model, of course, it will be important to keep in mind the fundamental differences between a business and engineering program. The cultures of the schools are quite different, one reflecting a professional orientation and rooted in the social sciences, the other a technical orientation rooted in the hard sciences. In one instance, the terminal degree is most usually at the Master's level, in the other at the PhD. One has typically a very direct connection to and concern for the world of application, the other a more distant connection to industry and a concern for the world of development. While both require some research, business research is more portable than engineering (and where the laboratory requirement for engineering constitutes a real time curricular demand). In all cases, the disciplinary base for business is also typically larger than that for chemical engineering (e.g., say 125 to 15). There may be other differences, best left to the experts, related to learning time for sequential and quantitative courses; but, suffice it to say, there are limits to the reach of the Sasin model. It is clearly an interesting and innovative starting point, but the design for The Petroleum and Petrochemicals College will necessarily be distinctive.

b. *Sasin Extended* (A gratuitous suggestion)

In addition to its MBA program, the Sasin Institute manages a Masters in Management for mid-career executives who are reaching for senior management, senior executives who wish to increase their management skills and effectiveness, and entrepreneurs. The program enables participants to refine skills, acquire new tools and techniques, and implement management strategies under conditions of change in their organization or the business environment. The two-year program meets on weekends and is directed to in-service business people. The program draws on the faculty from Kellogg and Wharton, teaching classes for a full day on Saturday. In point of fact, the Masters in Management is also a very important financial resource for the Institute.

Taking that model, and looking for both points of service to industry and continuing financial support for The Petroleum College, it may be that an industrial service laboratory could be the analog to Sasin's Masters in Management. In discussion with government and industry, no one was able to identify instances of mature laboratory support for the petrochemical industry in Thailand. Multinationals refer regularly to their home organizations for analytic, standards, and testing support. National companies refer some work to the university and other small laboratories, but, in fact, they more frequently fail to undertake the work they might were the

capacity in Thailand. And, looking farther afield, there is clearly no such laboratory capacity in the other parts of Indo China, although there may be some facilities in Hong Kong and Singapore.

It might be possible, then, to structure the procurement of research equipment to meet two needs: that of a research faculty, but also the analytic, standards, and testing requirements of industry. If procurement were conceptualized in terms of a fully equipped industrial service laboratory, rather than in terms of the requirements of particular faculty, The Petroleum College might have the opportunity to meet an important industrial service requirement (responsive to its mandate) and also secure a long-term financial asset. An industrial scale pilot plant, for scaling-up chemical processes from bench to production scale, might form the centerpiece of the laboratory, supported by unit operations (i.e., centrifuge, condenser, heat exchanger, liquid liquid extractor, distiller, filter, ion exchanger, and absorption unit), an analytic laboratory (e.g., for synthesis, characterization, and test production), and a facility for environmental/waste treatment.

Organized centrally, and managed commercially, an integrated laboratory could establish capacity for analysis, standards, and testing for industry, create hands-on "intern" and educational opportunities for students at The Petroleum College, and coordinate faculty/student access to laboratory equipment for research. In a sense, an industrial service laboratory could combine the functions of the University's Equipment Center, UNISEARCH (industrial technology research organization), a computing/communications/information center, and The Petroleum College's preparatory studies programs. And as importantly, the laboratory could become an important revenue center for The Petroleum College. It might also constitute a distinctive new and separate entity qualifying for support from industry, foundations, and A.I.D. If the idea has merit, or finds response, it might be useful to engage a consultant/partner from a not-for-profit research organization like Midwest Research Institute.

5. Issues

a. *The Masters Program* (the question of research)

There are a set of issues which are mixed together in the following discussion. They include: defining a national premise for The Petroleum and Petrochemical College, justifying a Master's level program in an international context usually defined by the PhD, and designing a research program for students at the Master's level. At this stage, I cannot disaggregate the issues and the following discussion seeks to tie the three together.

The Petroleum College proposes to launch its initial academic program at the Master's level. The proposal conforms with the Sasin model, with the interests and requirements of industry in Thailand, and with the faculty structure proposed for the program (i.e., non-resident faculty from the United States). Indeed, a recent study from the University of Wisconsin suggests that Master's degree programs are the "silent success" of higher education in the United States.

Nevertheless, the Master's is still the "stepchild" of higher education in the United States. Most university catalogs still note severely that the Master's is to be obtained only in progress toward the PhD, although the Wisconsin study urges that universities make a formal distinction between the pre-Doctorate and terminal Masters program. There are all kinds of reasons for the PhD preference (e.g., the rise of the science culture within engineering at the major research universities, the interests of university faculty and associated academic peer status, the necessity to associate the degree with a thesis or major project). Interestingly, the Wisconsin study also proposes that more Master's programs require a thesis or major project.

Of course, the issue for The Petroleum College is quite real. If student research is to be at an "international standard", then it probably has to be related to, or to be part of, a longer-term research effort which is most typically under the direction of a faculty member over several years

with support from both Master's and PhD candidates in the United States. It is not at all easy to see how a research program could be organized at an "international standard" if designed for the individual student or if designed as a project to begin and end in a year's time. In other words, if an "international academic standard" is important, it will be important for The Petroleum College to have free-standing research running parallel to its curricular program to incorporate Master's students (i.e., perhaps making the case for a free-standing or associated research institute)

Assuming that one agenda for The Petroleum College is to assure an "international standard", and assuming that The Petroleum College will be a joint academic endeavor with major research universities in the United States (i.e., having both to interest faculty and to secure administrative sanction for the award of the degree), then the issue of a "major research activity" and the PhD must be faced. Alternatively, The Petroleum College could address the interests and real requirements of industry in Thailand more directly, interests which might be satisfied with a more analytic than research student foundation, and/or with a more applied rather than basic research agenda, in effect, defining a new "Thai standard". In a sense, The Petroleum College may have to decide between a national mission and international standing.

Several different perspectives, ideas, and/or options have been discussed and proposed:

- operate a full second year research program under the direction of Thai faculty with some kind of informal collaboration with cooperating faculty from the United States; this option still needs to address the issue of organizing and financing for a free-standing research program;

- launch a PhD program at The Petroleum College after three or four years; this option raises the same issues as above;

- incorporate a PhD program into The Petroleum College concept immediately, by directing promising Master's students from The Petroleum College to cooperating universities in the United States; this option does not fully address the research requirement for the student not meeting or desiring the PhD standard;

- organize Thai research around "applied" problems to be supported by industry; this option raises the possibility of shorter-term research projects and sources of finance, but it does not address the question of "international standing"; and/or

- reorient a portion of the research agenda to laboratory analysis, standards, and testing, reducing the formal research component to something less than a full year; this option begins to define a "unique" or "distinctive" model for the Master's program and puts the research requirement in perspective; it may or may not address the issue of "international standing".

b. *Institutional Incentives*

The proposal for the reorganization of The Petroleum College has the following objectives:

- to produce at Chulalongkorn University postgraduate students in the areas of petrochemistry and polymer studies who are comparable in both knowledge and capability to those from the colleges of engineering at Case Western University, University of Michigan, and University of Oklahoma;

- to make possible the exchange of academic staff between the three cooperating universities from the United States on the one hand, and Chulalongkorn University on the other;

- to make possible the cross-registration of students;

- to encourage collaboration in the fields of research and academic development between the three cooperating universities from the United states and Chulalongkorn University; and

- to ensure high level communication skills in using English, and laboratory and research skills using state-of-the-art equipment and facilities, for students who will find careers in the international petroleum and petrochemistry industry.

To meet these objectives, the four participating universities will agree to the following undertakings. On the part of the cooperating universities from the United States, to provide academic support for The Petroleum College, and in particular to give advice on the curriculum and research program, to make possible the exchange of academic staff, to provide assistance in recruiting staff, to help in formulating research projects, and to give general advice on the degree program, including such areas as equipment specification and procurement, library acquisitions, etc. On the part of Chulalongkorn University, to contribute to the academic support in the area of preparatory studies, including English, and other academic and professional subjects, to provide financial and administrative support, and in particular to provide physical infrastructure, to find adequate funding, and to make available appropriate accommodation for exchange of personnel, as well as generally looking after their welfare.

It is important to underscore that Chulalongkorn University is not proposing to enter into a contractual arrangement with the cooperating universities from the United States; rather, they are proposing a joint academic endeavor. But nor is Chulalongkorn University proposing a simple memorandum of understanding for exchange of faculty. The are proposing real institutional commitments on both sides. Financial overheads for the program are to be absorbed by each participating university. On the other hand, some universities from the United States have suggested they might incur direct costs (e.g., for substitute teaching staff for absent faculty), and they have suggested that these costs probably need to be met externally. And real commitment from real faculty are critical to the feasibility of the program. The model requires sixteen faculty from the United States each year over a sustained period.

Cooperating universities in the United States have also inquired about their role in approving student admissions, participating in the governance of The Petroleum College (as regular faculty do at most institutions of higher learning), and defining standards for the award of degrees. Indeed, several of the cooperating universities have expressed some concern about the placement of signatures and/or seals on the Chulalongkorn degree without approval from regents of their own universities. And finally, several universities have noted that recruitment and administration of faculty will probably be a significant requirement. In the Sasin model, those costs are largely absorbed by the Kellogg School. In this situation, the burden may be greater (i.e., it may be necessary to reach beyond the cooperating universities for staff support), and it is not clear whether one of the three cooperating universities would be willing to absorb the full cost for recruitment and administration, or whether the three cooperating universities would be willing to make actual budget allocations to a common pool for this purpose.

Indeed, recruitment raises additional issues. If recruitment extends beyond the identified cooperating universities, there is an issue of quality control. Which institution will assume the responsibilty for quality control? And this issue moves into the question of whether two distinct

curricular tracks are proposed or a single integrated track. If two, then what are the responsibilities of the several institutions to each program? If one, is it appropriate to consider appointment of a "lead" or "administrative" institution? On the opportunity side, it may be possible (and useful) to make an arrangement with a professional association (e.g., the Society of Petroleum Engineers/SPE, American Chemical Society/ACS, or American Institute of Chemical Engineers/AICHE) to manage recruitment across the full range of accredited institutions in the United States.

These are not necessarily difficult questions, but it is probably important to begin to inch up on them early, particularly since the Sasin model may be sui generis (i.e., the manifestation of a very personal or unique commitment on the part of the Kellogg School) and since recruitment and administration of a program in the field of chemical engineering may suggest costs of a different order to those in the area of business administration.

c. *Faculty Incentives*

This may be a more difficult question. In the first instance, the faculty pool is limited (i.e., perhaps a total of 50 compared with 250 between Kellogg and Wharton). Secondly, experience suggests that the advantage to an international teaching assignment is not as clear to faculties of engineering and science as to faculties in the arts, sciences, and professional schools. Without arguing the merits, this experience relates directly to the feasibility of the project; and each cooperating university should make an honest assessment of its recruitment possibilities, and year-to-year sustainability. Indeed, this is probably the central feasibility issue.

While faculty can undoubtedly be found for the program in the United States over a sustained period, it is not at all clear that their institutional source can be maintained over a sustained period. Some serious discussion of this issue among the representatives of the cooperating universities is necessary. Beyond the relative small size of the faculty base, there are also questions of tenure guidelines, research interests and demands, etc. Financial remuneration is undoubtedly part of the formula, but discussions at the cooperating universities suggest only part. As fundamental are the professional incentives inherent to the activity, and some careful exploration of those incentives is important.

On the remuneration side, the Sasin program pays on the order of $15,000 for a six week commitment, paying up to $16,500 if the faculty member participates in the Executive Management Program, and up to $18,000 if the faculty member has participated up to four times. In addition, plane fare and room are included. The faculty member is responsible for board, utilities, and local taxes. This remuneration is paid on a consultant basis without overheads to the sponsoring university. In the case of The Petroleum College, a shorter period is proposed, and so a base between $10,000 and $12,500 is considered appropriate. Some discussion of this question, including the associated curricular question of time in class, is important for the representatives of the cooperating universities from the United States.

Perhaps as fundamental, it may be useful to explore more carefully the opportunities for research or joint research at The Petroleum College. In discussion, many faculty suggested that this kind of opportunity would probably be the determinative "incentive", more so than financial remuneration.

d. *Curriculum*

It is appropriate here simply to identify topics or issues for discussion. Dr. Donaldson has prepared a separate Report on curriculum which should be discussed with some care. Issues include:

- is an integrated or separate curriculum for petrochemistry and polymer studies proposed, and/or what opportunities are there for a "core curriculum"?

- what are the appropriate credit hour requirements; how can they be arranged in the single/short course format (i.e., how many weeks will be required, what teaching hour requirements etc.); are there issues of "learning time" that are different for engineering and science as for business; what provision can be made for examinations (e.g., providing real study/reflection time for students); and is there another formulation, other than first year curricular/second year research that might be as, or more, appropriate (e.g., see the issues related to preparatory studies below)?

- what are the real requirements for preparatory studies (e.g., English usage, computing, mathematics, laboratory facility, management etc.); is there anything to the argument that direct and programmed attention should be given to building the base for a "distinctive education" (albeit at an international standard) and "distinctive student" (i.e., industrially ready, professionally confidant, and English language fluent), distinguished from the more traditional academic product from both Thai and United States universities; and does this line of inquiry relate in any way to the recent Wisconsin study related to the Master's degree and its free-standing place in the university curriculum?

- what is the best provision for teaching materials (e.g., textbooks) in situations where courses may be taught by different faculty year to year; what are the base requirements for a library; and is there room (or a necessity) to incorporate a television component in the program (e.g., to capture each lecture on tape to enhance student comprehension, as an asset for the library, as the basis for a related continuing education outreach to industry, etc.)?

- how is a laboratory component best built into the program (e.g., as a research program, as an applied laboratory internship, etc); how is a research program best organized in a Master's context (i.e., does one fit the student to the program or the program to the student); what is the period of time required for laboratory/ research (i.,e., how many semesters; and what role will the faculty from the cooperating universities in the United States be expected to play?

- what are the plans for participation of Thai faculty in the program, early on, and over the longer term; will a Thai faculty member co-teach curricular offerings; will Thai faculty take major responsibility for research; what will be the role of faculty from cooperating universities in the United States to the research program; what role will faculty from other departments at Chulalongkorn University play; and will the faculty from the United States play any role in the governance of The Petroleum College, related to admissions, curriculum, research, faculty appointments, scheduling, etc., as might be expected as members of faculty at a university in the United States?

e. *Student Draw*

The proposal calls for a student body of forty, twenty in each year, ten each to petrochemistry and polymers, and five from outside of Thailand. Recruitment of this number shouldn't be an issue, although it is not clear whether, or to what degree, The College will be competitive with alternatives (e.g., direct matriculation at a university in the United States).

A related question will be tuition. At Sasin, the total program consists of 78 credits at the cost of $180 per credit. Whether top students will pay at this level in Thailand for engineering or science is to be determined (and this issue relates back to standards, quality control, and admissions policy).

f. *Buildings, Laboratory Equipment, Libraries, Computers, and Television*

The Government of Thailand has appropriated the funds for, and started construction on, a building for The Petroleum College. The building will be shared with materials science, some seven stories allocated to each. Adequate space provision has been made for laboratory and research equipment.

A similar budget has been set aside for laboratory and research equipment itself. In the United States, and at most institutions, the equipment endowment is most usually the sum of research projects. Rarely is equipment procured at once from a central plan. That opportunity is possible in this instance and raises a set of interesting possibilities. While one approach might be to develop a procurement plan fashioned to the research interests of specific faculty, another might be to develop an integrated laboratory facility, centrally managed, which could support faculty and student research, be used as part of a preparatory studies program, and/or be used as the technical base for a industrial service laboratory (as discussed elsewhere).

No recommendations are made with regard to libraries, other than to underscore the importance and to suggest that a consultant be engaged to shape the development of such a facility. In thinking about the library, some attention might be given to the Office of American Schools and Hospitals Abroad, ASHA, as a source of financial support, an office which has support to American-based libraries as part of its legislative mandate. The Office meets capital costs associated with institutions with direct links to American origins, pedagogy, and support (e.g., the American University in Cairo). It might be possible to think about the library as a separate and distinct unit within The College, and /or to conceptualize an industrial service laboratory with an associated educational mission, and which might be eligible for ASHA funding.

Computers will be critical to the instructional and research program at The Petroleum College. Attention was not given to specification, but it will be important to engage a consultant at an appropriate time to shape the procurement and to suggest a management approach for computing equipment.

Finally, some attention might be given to the role of television and distance learning technologies. Television might be used to record classes at The Petroleum College as a device for student recall (particularly important in a compressed-learning and second-language learning environment), as a device for engaging supplementary high-quality teaching from across the United States, as a device for offering "electives", and eventually as a device for continuing education to industry-based students in Thailand. Dr. Harvey Stone's research for the American Society for Engineering Education is directly to point and supportive. There is no need to make a particular case in this Interim Report, but the possibility to combine the instructional resources of The Petroleum College with flexible television delivery systems is probably important to consider as the project progresses. Together with computing, library, and laboratory facilities, one could envision again a centrally-managed engineering information and research resource center.

6. Budget

a. *Requirements*

The following budget outline is put forward for discussion purposes and as a first approximation of requirements. Costs are estimated in U.S. dollars.

Infrastructure Costs

For the most part, the following figures represent Thai costs and contribution.

a. Building (construction on campus)	$ 4,000,000
b. Research Equipment (initial endowment)	6,000,000
c. Other Equipment (computers, libraries, television, furnitures, etc.)	to be estimated
d. Thai Operating Costs	
* faculty salaries (additional to base)	to be estimated
* administrative staff/operations	to be estimated
Sub Total	10,000,000

Consulting (1992)

These figures are estimated on the basis of one person for one month including honorarium, travel, and lodging; and no overheads payable to cooperating institutions.

a. Petrochemistry	12,500
b. Polymers	12,500
c. Research Equipment/Management	12,500
d. English Language	12,500
e. Library	12,500
Sub Total	62,500

U.S. Faculty (1993-1995)

These figures are based on eight faculty for petrochemistry and eight faculty for polymers each year, for one month, including honorarium, travel, and lodging; no overheads payable to cooperating universities; and campus coordination requiring half time for one faculty member and one administrative staff from a cooperating university.

a. Sixteen faculty x two years	400,000
b. U.S. coordination x two years	100,000
Sub Total	500,000

Team Building (1992-1995)

These figures assume that four senior faculty from The Petroleum College spend a semester at one of the participating universities, visit the others, and have some other consultation in the United States, a visit in each of the first two years by a representative of each of the cooperating universities, and a visit in each of the first two years by a representative of The Petroleum College to the United States.

a. Four Thai visits to the U..S.	60,000
b. Two Supervisory Visits from the U.S.	48,000
c. Two Supervisory Visits to the U.S.	12,000
Sub Total	120,000

Industrial Service Laboratory (1993 - 1995)

These figures assume that an independent or institutionally defined laboratory is organized at The College. At one point, The Petroleum College proposed that two long-term advisors be assigned to Thailand for the first two year's of the project, one for petrochemistry and one for polymers. This is an alternative, suggesting one advisor for the laboratory and research, and one (see below) for curriculum and the teaching program. Thai staff are included for the laboratory. They would not be included if advisory services alone were proposed.

a. U.S. advisor for two years	400,000
b. Thai Manager for two years	70,000
c. Thai Staff for two years	120,000
Sub Total	590,000

Academic Advisor (1992 - 1994)

This figure is based on standard A.I.D. estimates for an overseas resident advisor.

U.S. Advisor for two years	400,000
Sub Total	400,000

Research Matching Grant

This figure is proposed at a $50,000 annual challenge match for five to Thai industry to launch and support an active program of industrially supported research at The Petroleum College.

At $50,000 a year for five years	250,000
Sub Total	250,000

Regional Scholarships

This figure is intended to meet the scholarship requirements for students outside Thailand, five in the first year, ten in the second, and ten in the third. Scholarships for Thai students are expected to be met from local industry support.

Twenty five scholarships over three years	222,500
Sub Total	222,500

Television Laboratory

This figure is based on estimates for a one month consultancy ($12,500) and equipment.

Equipment and consultation	65,000
Sub Total	65,000

Library

This figure is included as probably the bottom-end for an initial establishment procurement.

Materials	250,000
Sub Total	250,000

Team Building (Phase II)

These figures assume that eight more junior faculty from The Petroleum College spend a semester at one of the participating universities, visit the others, and have some other consultation in the United States

Eight Thai visits to the United States	120,000
Sub Total	120,000

Marketing Grant

This figure is for editing and producing initial publications, and for launching funding programs and campaigns.

For local promotion	25,000
Sub Total	25,000
GRAND TOTAL	$2,608,000

Academic Program	1,477,500
Industrial Service Laboratory	590,000
Library/Television	315,000
Regional Scholarships	225,500

b. Source and Application of Funds

The Petroleum College is proposed to be self-supporting (i.e., from tuitions and other revenues). While the Government of Thailand and Chulalongkorn University itself are committed to The College (e.g., meeting start-up capital costs of some $10 million and ongoing faculty costs at current University salary levels), they are also seeking support for a portion of the start-up which are directly related to achieving an international standard; and they have sought support from the cooperating universities and United States government (i.e., the Agency for International Development). This Report defines four separate A.I.D. sources (i.e., the USAID Mission to Thailand, the ASEAN Mission in Bangkok, the University Center, and the Office of American Schools and Hospitals Abroad). Cooperating Universities will not seek overheads, valued minimally at some $370,000 (i.e. some 15 percent of total project costs), and the universities will probably not seek reimbursement for other direct costs (e.g., faculty substitution) which could reach to some $350,000, raising the total contribution from the cooperating universities to 30 percent.

For purposes of discussion, the following distributions might be considered:

USAID	Consulting	$ 62,500
	Team Building	120,000
	Industrial Service Laboratory	590,000
	Academic Advisor	400,000
	Research Program	250,000
	Marketing	25,000
Sub Total		1,447,500
AID (Regional)	Scholarships	222,500
AID (University)	U.S. Faculty	500,000
AID (ASHA)	Television Facilities	65,000
	Library	250,000
Sub Total		312,500
TOTAL		$2,608,000

There are, of course, issues inherent to this distribution. The Regional Office may not share the The Petroleum College's agenda. The University Center may be off-cycle with political changes anticipated in Thailand, and/or may not share The Petroleum College's vision, and ASHA may or may not find The Petroleum College an eligible institution. And alternative formulations might be proposed (e.g., the Industrial Service Laboratory, Television Facility, and Library might be spun out as separate entities with a joint Thai/United States board of directors, or some combination of the above). Indeed, total project costs could be divided into distinct packages for different donors or programs.

It is also possible, of course, to reduce the cost categories against some assignment of priorities: U.S faculty costs ($500,000) are the absolute bottom line requirement for the proposal, together probably with, at least, one resident advisor ($400,000), and initial team building investment ($120,000), for a total of $1,020,000. Second priority might be assigned to the Industrial Service Laboratory ($590,000) and Research Program ($250,000), for a total of $840,000. Alternatively, one might reduce line items against some sense of priority (e.g., reduce consulting by combining petrochemistry and polymers and eliminating the library; reducing U.S. faculty from 16 to 12 by using core courses; eliminating one resident advisor, matching grant program, and second round team building).

Finally, some discussion of funds-flow is probably appropriate. While all grant support could be directed to Chulalongkorn University, it might also be possible/useful to allocate some funds directly to the cooperating universities (e.g., U.S. faculty costs), and/or to organize distinct institutional entities as grantees (e.g. a joint Thai/U.S. Information Center and Library). The possibilities here are rather obvious and best left to direct discussion between Chulalongkorn University and USAID.

Indeed, donor financing might be structured on a matching basis (e.g., $1.0 million unrestricted grant matched to Thai $10.0 capital contribution; $500,000 for U.S. faculty costs matched to industrially supported scholarships and U.S. university contribution; $250,000 research grant matched to industrial contribution; $500,000 for industrial service laboratory concept tied to equipment procurement or engagement of U.S. independent research laboratory; and $225,000 regional scholarships passed to ASEAN; and library passed to ASHA).

7. Agenda

The following agenda is proposed for the Chicago meeting among the cooperating universities and for the Thai visit of the cooperating universities. The agenda should be refined at the Chicago meeting and submitted to The Petroleum College immediately:

a. Program Premise
- academic/degree education (Master's, PhD), technical training, etc.
- petrochemical and polymer engineering (combined or separate), chemical engineering, other engineering, science, management, etc.
- competing/alternative institutions/approaches within the University, in Thailand, the region, and the United States
- outreach or service role with industry

b. Program Plan
- Sasin model
- international standard (i.e., Master's, PhD, research, etc.)
- curriculum (i.e., content, core courses, combined or separate programs, short-course format, short-course periods, electives, examination periods, faculty consultation, degrees, etc.)
- research (i.e., serious ongoing program in Thailand, PhD in the United States, United States dollar financing for Thai research, applied research, affiliated institute, laboratory analysis, industrial service laboratory, central or faculty management of laboratory equipment, a non-university partner, etc.)
- English language preparation (i.e., one month, several months, parallel programs, integrated with other preparatory programs, etc.
- other preparatory requirements (e.g. mathematics, computing, laboratory operations, etc.)
- facilities (e.g., library, television, etc,)
- financial plan

c. United States Engagement
- size and base of cooperating universities (i.e., a fourth partner, Association support, etc.)
- incentives for faculty (i.e., professional, remuneration, etc.)
- incentives for universities (i.e., profile of project, student access, etc.)
- cost recovery: direct and indirect
- sustainability
- faculty and institutional participation (in curriculum, research, admissions, governance, etc.)
- role of television and/or other educational technologies
- administrative or lead institution (i.e., for recruitment of faculty, administrative support, etc.)

d. USAID interests
- with relation to sector, country, and region
- promote university/industrial cooperation
- establish trade and investment base
- entree to the environment
- define a mature or new political/development relationship

e. Recommendations

- Partners (i.e., how many, who, what kinds of institutions, etc.)
- Master's
- PhD
- Research/Institute/Industrial Research Facility
- Financial Plan (i.e., Chulalongkorn, Thai government, Thai industry, cooperating universities, UNDP, USAID, A.I.D., U.S. industry, foundations, etc.)

e. Next Steps

- confirm commitment of the cooperating universities/institutions
- schedule visits to Thailand
- establish agenda for Thai meetings
- agree on costs/financial plan
- fix terms of participation
- define residents/deans engagement (send names and list to The Petroleum College)
- administrative lead/support
- grant applications to USAID, A.I.D./University Center, ASHA, Asia regional Office, Department of Education, foundations, U.S. industry, Thai industry, etc.