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**A programme for the establishment
of a Thai National Standards
Laboratory with the assistance of the
United Nations Special Fund**

by Dr. R. Friedl

(Appendix to the Report »Investigations concerning
the establishment of metrological standards
in Thailand«)

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"Investigations concerning the establishment of metrological standards in Thailand".

A programme for the establishment of a Thai National Standards Laboratory with the assistance of the United Nations Special Fund.

1. This Appendix presents a programme for the establishment of a National Standards Laboratory (NSL) as a consecutive installation to the establishments and standards facilities that will be existing within the Applied Scientific Research Corporation of Thailand until about 1970.

The recommendations given here are based on estimations about the necessary size of a standards laboratory that will be required in 1975 in Thailand.

In the 5-years-programme for a NSL herein recommended, the testing possibilities which may exist within the Corporation before the suggested start of the programme in 1970 are included and have not taken into account separately. Before the beginning of the said programme, the existing means in the shape of buildings, installations and personnel will thus have to be taken into account and to be considered as existing facilities in the different stages of the programme.

2. Accomodation

For the proposed plan for a NSL, 1000 sq.m. of laboratory area will be needed, which means in all 2000 sq.m. comprising offices, stairs, lavatories and accessory rooms. The land for the necessary buildings is already available to the Corporation (annex 1). The necessary area of 2000 sq.m. for the NSL can, according to Dr. Pradisth, Deputy Secretary-General from the National Research Council, and Mr. Nicholls, the UN-Chief Advisor, rather easily be available in the projected double buildings 4 and 5 (annex 1). One third of these premises will require an especially good air-conditioning. For the expansion of the NSL there would be, outside the fenced area shown in the site plan, any amount of disposable ground.

As to the location of acoustic laboratories the nearness of the Don Muang air-port (distance less than 10 km) might prove disturbing. Should in later times the need for such laboratories arise, they should preferably be built somewhere else. A wide by-pass road for the main road that leads to the air-port on the east-side of the area is now being built far away from the Corporation buildings, so that shaking disturbances of the NSL Laboratories are not to be feared (annex 1). However in order to avoid disturbances the "braking beams" for motor-cars set on the roads within the area ought to be replaced by other speed-checking means.

3. Suggestion for the organization of a NSL

The propounded programme represents the smallest size the institute must possess in order to handle, in a normal way, all tasks arising in Thailand.

The planned Thai National Reference Standard Laboratory must be allowed to work as a non-profit independent institute. Its task shall be to serve the country by testing measuring instruments, measuring physical magnitudes and connecting the measuring magnitudes with national and foreign standards. The NSL should, therefore, do its work as a constituent part of the newly formed "Applied Scientific Research Corporation of Thailand" under the management of the "Governing Body". It is proposed to subdivide the NSL into four scientific departments,

Mechanics,
Electricity,
Heat and Pressure,
Optics,

and into a division for general services.

4. Recommended Staff (annex 2)

The least number of required technical personnel amounts to 23 persons. The propounded area for the location and the size of the equipment will easily permit a later increase of the technical personnel up to 60 or 70 persons.

Altogether 3 scientists (masters degree) will be at first required, each of whom should have been trained for 18 months in a foreign standards laboratory for his future work. For each of the divisions "Mechanics" and "Electricity", one of these scientists will be required and for the common management of the divisions "Heat and Pressure" and "Optics" the third one will be required. Later on, altogether seven Technicians with bachelor's degree should be employed.

In addition to these, 11 vocational schools mechanics are needed who have successfully attended one of the following schools:

Thai-German-Technical Vocational School,
Seato Military Technical Training School,
Army or Navy Training Schools.

(The education in most of the other vocational schools seems not to be, at present, extensive enough to supply mechanics with the knowledge required in a NSL).

5. Accomodation

The costs for the required space should, at the most, amount to 70 US- $\text{\$}$ per square meter, which means altogether about 140.000 US- $\text{\$}$. All normal and special installations for the laboratories are included in this price. Further funds amounting to 30.000 US- $\text{\$}$ for garages and a small motor car-workshop should be forseen.

6. Recommended equipment (annexes 3 and 4)

With the help of the equipment enumerated in the annexes, all those technical measurement tasks which may arise in Thailand in industry and applied research for a long stretch of time can be performed.

Some years will pass until the beginning of the realization of the NSL-project. In the meantime necessary purchases for measuring tasks already within the frame of the "Instrument Repair and Calibration Centre" will have to be effected. Part of this equipment will then remain at the disposal of the future NSL.

The cost of the equipment named in the enclosed list (annex 3) has been calculated according to prices 1964, as being 215.000 US \$/. Reckoning on an annual increase of at the most 6 %, the costs for the years 1970 - 1974 will have to be estimated at about 330.000 US \$/. Estimating that the measuring equipment which will be existing in the year 1970 in the Corporation to be worth about 150.000 US \$/, the total of the whole expenditure for the equipment (1970-74) would be reduced to 160.000 US \$/.

Special Fund Contributions (annex 5)

- 7 a) Dispatch of 3 - 4 consultants experienced in the domain of metrology, who will act as advisers, each of them for a short time whilst the project being expanded.
- b) Dispatch of a project-manager with great experience in the organization and the work of metrological laboratories who is at the same time an expert on one of the 4 domains of work. Period of sojourn 4 1/2 years.
- c) Dispatch of further experts who are each qualified specialists in one of the remaining domains. It is planned to provide for the following experts in the different domains (included the project-manager):
- | | |
|--|---------------|
| 1 expert for length, mass, volumes
for a total of | 54 man-months |
| 1 expert for electric measurement
including for time and frequencies
measurements for a total of | 54 man-months |

1 expert for heat and pressure measurements	for a total of	36 man-months
1 expert for optics measurements	for a total of	12 man-months

Thus there will be needed 4 experts for a total of 13 man-years.

The costs will amount to 308.000 US \$.

8. Costs for the training of technical personnel abroad.
The three future managers of each of the laboratories should be prepared for this work, for at least 18 months in an adequate foreign institute (see also No. 4). This means a total of 4 1/2 man-years for fellowships. The costs will amount to 22.500 US \$.

9. Equipment

The expenditure for the measuring equipment will amount, according to annex 4, to 215.000 US \$.

10. Total Special Fund Contributions.

The contribution of the UN-Special Fund would amount, according to the situation in the years 1963 and 1964 and whilst taking into consideration the sum of 50.000 US \$ at hand for the equipment, as well as the usual incidental expenses conformable to annex 5, to 567.000 US \$.

11. The charge falling to the Thai Government during the first 5 years following the start of the establishment will be estimated according to annex 5 and based on actual prices, as 842.900 US \$.

12. Propounded time table

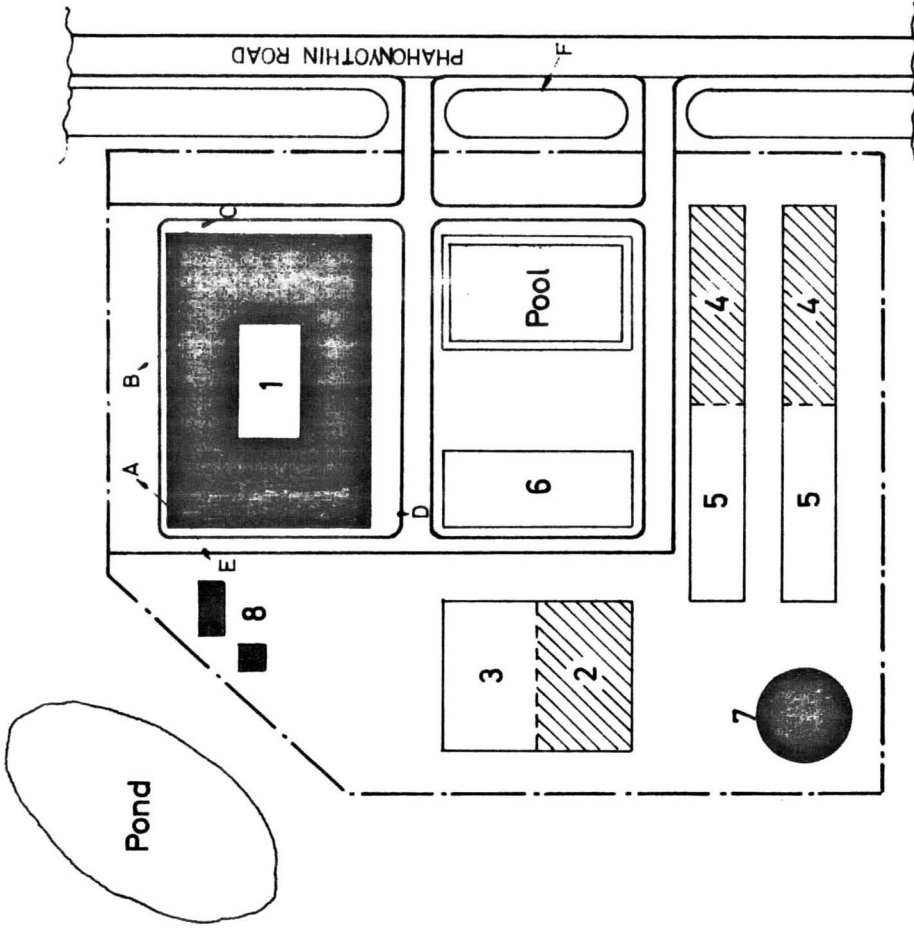
In a final discussion between Dr. Pradisth Cheosakul, Mr. Nicholls and the consultant on 17.12.64, it was agreed that some years would pass until the beginning of the project, all the more as the Institute for Technological Research and the Instrument Repair and Calibration Centre are still in the planning stages, and moreover because the financial means that will have to be found by the Government for the NSL^{are} certainly not yet existent.

Furthermore, the consultant does not have the impression that owing to the provisory lack of a NSL in the coming 5 years, any noticeable prejudice would arise for the Thai Economy, as there will be in reasonable time, for the few interested factories and scientific institutes, the possibility of fundamental tests by the Instrument Repair and Calibration Centre, which is going to be established in the meantime. It will be propounded not to begin before 1970 with the actual construction work for the NSL, as up to that time, there might be gathered, owing to the work of the Technological Institute and of the Instrument Repair and Calibration Centre, valuable practical experiences concerning the demands to be put to the NSL. It will be furthermore suggested to send again an expert to Thailand, at the earliest in the year 1968, who will have to revise the above estimated size for the NSL taking into consideration the then existing institutes and equipment for measurements.

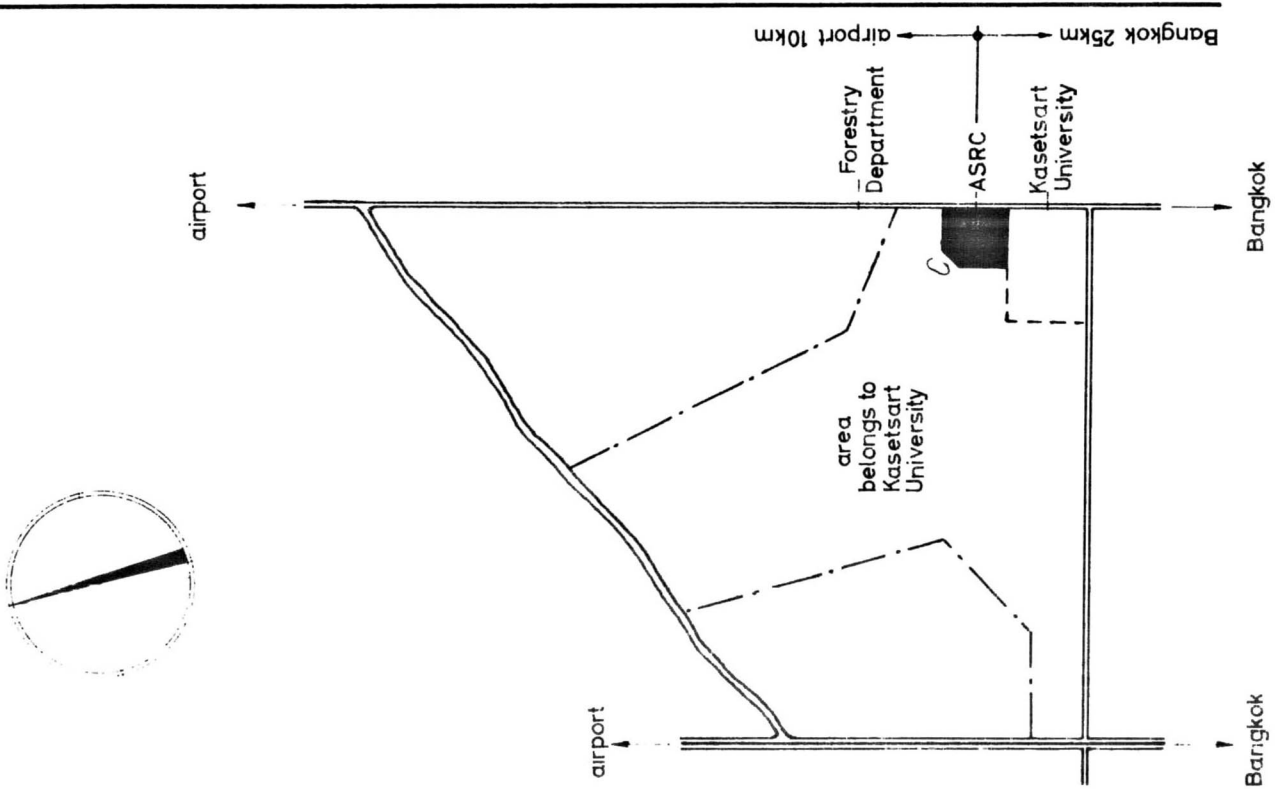
Applied Scientific Research Corporation (ASRC)

Annex 1

PTB 1965



- 1 Documentation Centre (established)
- 2 Heavy Duty, first stage (planned 1965)
- 3 Heavy Duty, second stage (planned 1966)
- 4 Laboratories, including
 - first stage (planned 1966)
 - second stage (planned later)
- 5 Instrument Repair and Calibration (planned later)
- 6 National Research Council Administration (planned)
- 7 Water Reservoir
- 8 Servants



Recommended technical staff of the
Standard Laboratory

Annex 2

(Chief one of the Governing Body of the Corporation)

1. Mechanics

1 scientist, 4 technicians
2 mechanics

2. Electricity

1 scientist, 2 technicians
1 electrical mechanic

3. Heat and Pressure

1 scientist, 2 technicians
1 mechanic

4. Optics

(the same scientist as for Heat and Pressure)
1 technician, 1 mechanic

5. General Duties

1 foreman (mechanic), 1 glass-blower (mechanic),
4 mechanics

Summary

3 scientists (master's degree) with each of them having
18 months training in measuring work
abroad

9 technicians (bachelor's degree)

11 mechanics

Total 23

Cost of equipments (in 1964/65)

<u>1 Mechanics</u>	223.000 DM	DM
1.1	To test instruments for linear measurement	62.000
1.1.1	Standards	<hr/>
	1 steel main standard with calibration (Paris)	
	1 wooden verification-block (length 1 m)	
	1 " " " (length 2 m)	
	1 graduated steel measuring instrument in a wooden case.	
	1 steel measurement stick (length: 1 m) serving as verification block	
	1 foldable measuring stick (length: 1 m, graduated into millimetres)	
	1 steel tape measure (length: 20 m, graduated into centimetres)	
	1 steel tape measure for measuring machines (length: 5 m, graduated in centimetres)	14.000
	1 steel tape measure of special design (length: 1 m, breadth: 7 millimetres and thickness: 0.1 millimetre) for measuring machines for length	
	1 ruler-shaped steel measuring stick of a special design (length: 1 m, breadth: 40 millimetres, graduated into millimetres) for measuring machines for length.	
	1 set slip gages from 1,001 to 100 millimetres (87 pieces) class 0 with calibration abroad	10.000
	1 set slip gages from 200 to 700 millimetres (3 pieces) class 0 with calibration abroad	
	1 set slip gages (87 pieces) class 1	
	1 " " " " class 2	
	1 " " " (3 pieces) class 1	8.000
	1 " " " " class 2	

	DM
1.1.2 Auxiliary means	30.000
1 steel back square, 1 magnifier, equipment for linear measurements for testing tape measures	
1 thickness gage from 0 to 5 millimetres	
1 comparator for slip gages, 1 floating micrometer	
1.2. To test planimeters	1.000
1 set metal standard surfaces (7 pieces) from 10 to 100 square centimetres for leather measuring machines	<hr/>
1.3. To test liquid measures	16.000
1.3.1 Standards	10.000
2 sets class calibrated tubulated flasks, capacity: from 0,01 litre to 10 litres	
1 set metal calibrated tubulated flasks, capacity: from 5 litres to 50 litres	
1 set measuring or graduated cylinders, capacity: from 0.05 litre to 2 litres	
1 set measuring pipettes, capacity: from 5 cubic centimetres to 50 cubic centimetres	
1 set calibrated tubulated flasks, capacity: from 0,01 litre to 10 litres, with measuring cylinders and 3 glass plates in a wooden trunk as portable equipment	
1.3.2 Auxiliary means of examination	6.000
1 set gages for fluid measures (13 pieces)	
1 surface plate 30 times 20 centimetres	
1 hydrostatic balance (water level, length: 20 centimetres)	
1 steel depth gage (fathometer) graduated into millimetres	

ศูนย์ความรู้ (ศกร.)

KNOWLEDGE CENTRE (KLC)

DM

- 1 micrometer caliper
- 1 sliding caliper
- 4 trumpets
- 1 precision balance
- 1 thermometer graduated into 5th and tenth degrees
- 1 barometer
- 2 hygrometer
(one Lambrecht Hygrometer)
- 1 decimal bridge balance, whose fittings and 10 load-carrying-capacity is sufficient for the largest and smallest barrels to be checked for determining the capacity by weighing with the corresponding set of weights.

1.4. To test weights

1.4.1 Standards	34.000
1 set kilogramme (Kg.) main standards calibrated in Paris made from stainless and non-magnetic steel; accuracy 10^{-6}	10.000
1 set Kg.-control standards; accuracy 10^{-5}	8.000
1 set Kg.-verification standards; accuracy 10^{-4}	5.000
1 case from 10 Kg. to 1 Kg. (1/10, 1/5, 2/2, 1/1 Kg.)	1.000
2 cases with general purpose standards from 500 grammes to 1 gramme.	
1.4.2 Auxiliary means of examination	10.000
5 precision and analytical balances with the following weighing range:	
from 10 to 50 Kg.	
from 5 to 20 Kg.	
from 1 to 5 Kg.	

from 50 to 500 grammes	DM
from 1 to 5 grammes	
from 1 milligram to 5 grammes	
1.5. Load indication bridles of mechanical design for testing instruments for tension and pressure, on account of their measuring accuracy and sensibility included verification abroad (Germany) 10-20-30-40-50-75-100 Mpd	<u>30.000</u>
1.6. Testing equipment for measuring instruments in motor cars	<u>40.000</u>
1.7. Work shop	<u>40.000</u>
2 <u>Electricity</u>	405.000 DM
2.1. To test instruments with DC-voltage and DC-current and to measure resistance	<u>84.000</u>
2.1.1 Standards	
1 set international standard cells with thermostat	
2 portable standard cells in portable thermostat	
1 set (10 pieces) standard resistors	
1 set (10 pieces) reference resistors	
2.1.2 Auxiliary means for examination	
1 equipment to compare standard cells	6.000
1 potentiometer to compare resistances and to test DC-instruments	30.000

	DM
1 AC-Voltage-Stabilizer	10.000
1 DC-current source	5.000
1 DC-Voltage-Stabilizer	3.000
different control instruments	10.000
different decade resistors	6.000
2.2. To test instruments with AC-Voltage, AC-current and AC-power (energy)	<u>172.000</u>
2.2.1 Standards	
AC-DC-current and voltage comparator	14.000
AC-DC-power comparator	20.000
4 precision wattmeters	20.000
2 precision-watthourmeters in box	10.000
2 precision-condensators with lever switches	4.000
1 precision-current transformer	2.000
1 digital-voltmeter	12.000
2.2.2 Auxiliary means for examination	
RC-Generator and amplifier 10 c/s to 22 kc/s	10.000
3-phase-meter testing equipment	40.000
several measuring instruments	10.000
several measuring bridges	6.000
several electronic instrument (oscilloscope, tube-voltmeter)	12.000
1 equipment to test insulation	2.000
miscellaneous	10.000
2.3. Laboratory for measuring frequency and time	<u>119.000</u>

DM

2.3.1 Complete equipment for time signals and 3 standard frequencies frequency-controller included receiver 0-100 kHz filter: 0 - 25 kc/s in 100 c/s-steps 25- 100 kc/s in 500 c/s-steps, frequency-standard 100 kc/s - 1 Mc/s-5 Mc/s, frequency-divider clock, programming-equipment, battery-unit, load-unit, miscellaneous	69.000
2.3.2 Auxiliary equipments different electronic instruments different instruments and tools for watch-cleaning and calibration	30.000 20.000
2.4. Workshop with necessary machines and tools	30.000

3 Heat and Pressure 159.000 DM

3.1. To measure temperature	52.000
3.1.1 Standards	
2 set standard thermometers (glass) from - 58 °C to + 600 °C	8.000
2 resistance-thermometer with electrical equipments (testing abroad included)	10.000
1 optical pyrometer	2.000
3.1.2 Auxiliary means for measuring thermometers and clinical thermometers:	32.000

thermostats, ovens, furnace, ice-machine,
ice-mill,
compressor, motors, vacuum pumps,
implements for distillation, cooling,
exhaust, centrifuge, drying and
counting purposes, timers, other
auxiliary means for examinations

3.2. To measure barometers and manometers 20.000

3.2.1 Standards

1 mercury-standard barometer from 650 to
820 mm. 2.000

1 piston-manometer with accessories to
200 kg./cm² 6.000

1 piston-manometer with accessories to
10 kg./cm² 6.000

several control manometer from 1.6 to
250 kg./cm² 2.000

3.2.2 Auxiliary means for measuring barometers
and manometers and to measure instruments
for blood pressure 4.000

3.3. To measure the viscosity of liquids and of
flash points 14.000

3.3.1 Standards

1 set standard viscosimeters 2.000

standards to determine the flash point 1.000

DM

3.3.2	Auxiliary means	
	different viscosimeter	6.000
	Abbe-refractometer to test petrols	
	paraffines, oils a.s.o	2.500
	miscellaneous	2.500
3.4.	To measure the heat of combustion of	
	solids, fluids and gases	<u>15.000</u>
3.4.1	Standard	
	calorimeter equipment	5.000
3.4.2	Auxiliaries	10.000
	solutions, balances, portable hand-calorimeter,	
	drying oven, electrical recorder	
3.5.	To test volume and density of liquids and to	
	test hydrometers	<u>28.000</u>
3.5.1	Standards included verification (Germany)	14.000
	density hydrometer-standards for oils,	
	alcohol, petrols (20 pieces)	
	standard hydrometers for sugar analysis	
	(12 pieces)	
	weight hydrometer-standards for alcohol	
	(16 pieces)	
	standard liquids	
3.5.2	Auxiliaries	14.000
	thermometers, balance, flasks, pipettes,	
	optical tension tester for glass, drying oven,	
	barometer, hygrometer, stop-watch	
	miscellaneous	

DM

3.6. Workshop

30.000

4 Optics 53.000 DM

4.1. Photometry

33.000

4.1.1 standard for testing incandescent lamps

1 photometer ball with accessories

6.000

20 standard lamps (included calibrating)

4.000

4.1.2 Auxiliaries

DC-generator (power 1 kW, 250 V)

7.000

photo-cells, galvanometer, control-lamps
(20 pieces),

electric devices, instruments, calibration-
equipment

16.000

4.1.3 Workshop

20.000

5 General duties 20.000 DM

5.1. General workshop

5.2. Glass-blower-shop

20.000

Total

860.000

Costs for equipments

Annex 4

	costs in DM	costs in US \$	used space sq.m.
<u>1. Mechanics</u>			
linear measurements and planimeters	63.000		200
liquid measures	16.000		
weights	34.000		100
load indication bridges	30.000		
motor-car instruments ¹⁾	40.000		-
workshop	40.000		60
	<u>223.000</u>	<u>55.750</u>	<u>360</u>
<u>2. Electricity</u>			
DC-measurements	84.000		200
AC-measurements	172.000		
frequency + time	119.000		40
workshop	30.000		40
	<u>405.000</u>	<u>101.250</u>	<u>280</u>
<u>3. Heat and Pressure</u>			
temperature	52.000		200
barometers + manometers	20.000		
viscosity	14.000		
combustion	15.000		
density of liquids	28.000		
workshop	30.000		30
	<u>159.000</u>	<u>39.750</u>	<u>230</u>

	costs in DM	costs in US \$	used space sq.m.
4. <u>Optics</u>			
photometry	33.000		60
workshop	20.000		30
	53.000	13.250	90
5. <u>General Duties</u>			
central workshop ²⁾	-		-
glass-blower-shop	20.000		40
	20.000	5.000	40
<u>Total</u> =====	860.000	215.000	1000

1) space within the laboratory for linear measurements

2) will be established within other projects

1. <u>Costs for UN Special Fund</u>		<u>US \$</u>
Consultants	1 man-year	22.000
Experts	13 man-years	286.000
Fellowship	4 1/2 man-years	22.500
		<hr/>
		330.500
Equipments		165.000
Miscellaneous expenses		16.500
Executing agency (charges)		55.000
		<hr/>
		567.000
		=====

II. Costs for Thai Government in the first 5 years

		<u>Baht</u>
3	Scientists	15 man-years
	1 man-year $\hat{=}$ 96.000 Baht	1,440.000
9	Technicians	35 man-years
	1 man-year $\hat{=}$ 48.000 Baht	1,680.000
11	Mechanics	35 man-years
	1 man-year $\hat{=}$ 18.000 Baht	630.000
Other personnel		350.000
		<hr/>
		4,100.000
Building		2,400.000
Special measuring equipment		2,000.000
Electricity and services		1,500.000
Payment to UN Special Fund for Local expenditure (15% of expert salaries)		854.000
Equipment and supplies		4,000.000
Other operating expenses		2,000.000
		<hr/>
		Baht 16,854.000
		=====

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 $\hat{=}$ 842,900 US \$

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