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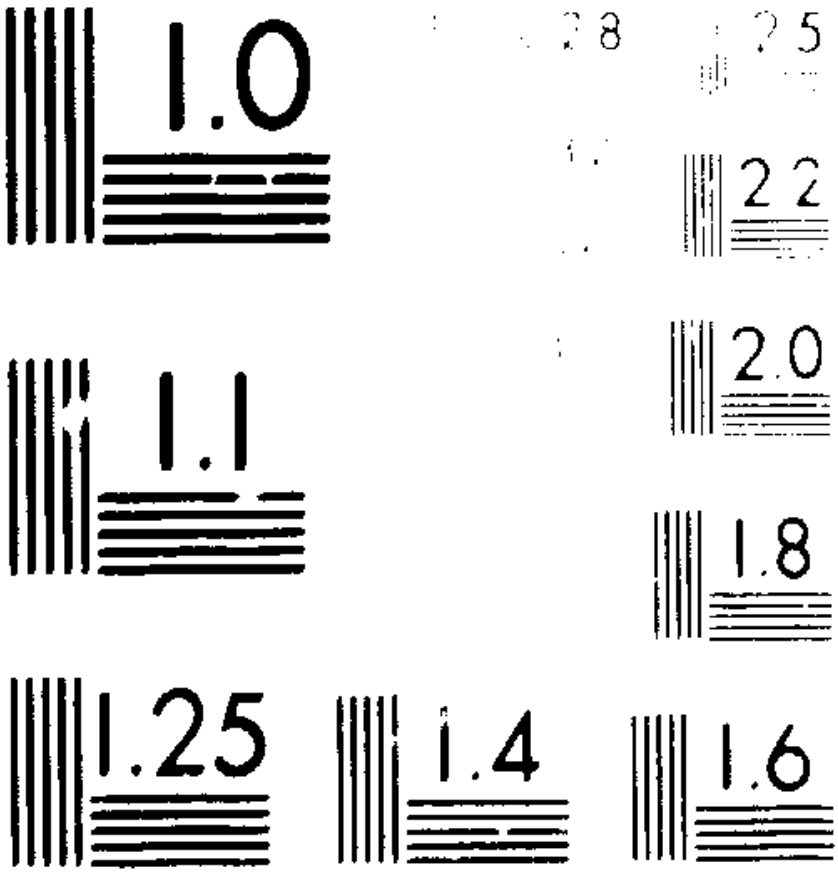
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FACT-FINDING MISSION FOR THE ESTABLISHMENT OF A LABORATORY FOR TESTING AND QUALITY CONTROL OF TOBACCO PRODUCTS

SI/LAO/79/801

LAO PEOPLE'S DEMOCRATIC REPUBLIC

Terminal report

Prepared for the Government of the Lao People's Democratic Republic
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Erich P. Weinzinger, expert
in tobacco technology and laboratory outfit

United Nations Industrial Development Organization
Vienna

V.82-30657

Explanatory notes

A comma (,) is used to distinguish thousands and millions.

A full stop (.) is used to indicate decimals.

A slash between dates (e.g. 1970/71) indicates a crop year, financial year or academic year.

Use of a hyphen between dates (e.g. 1960-1965) indicates the full period involved, including the beginning and end years.

References to dollars ($) are to United States dollars, unless otherwise stated.

The monetary unit in the Lao People's Democratic Republic is the new kip (NK). During the period covered by the report, the value of the NK in relation to the United States dollar was $US 1 = NK 29.70.

The following abbreviation is used in this report:

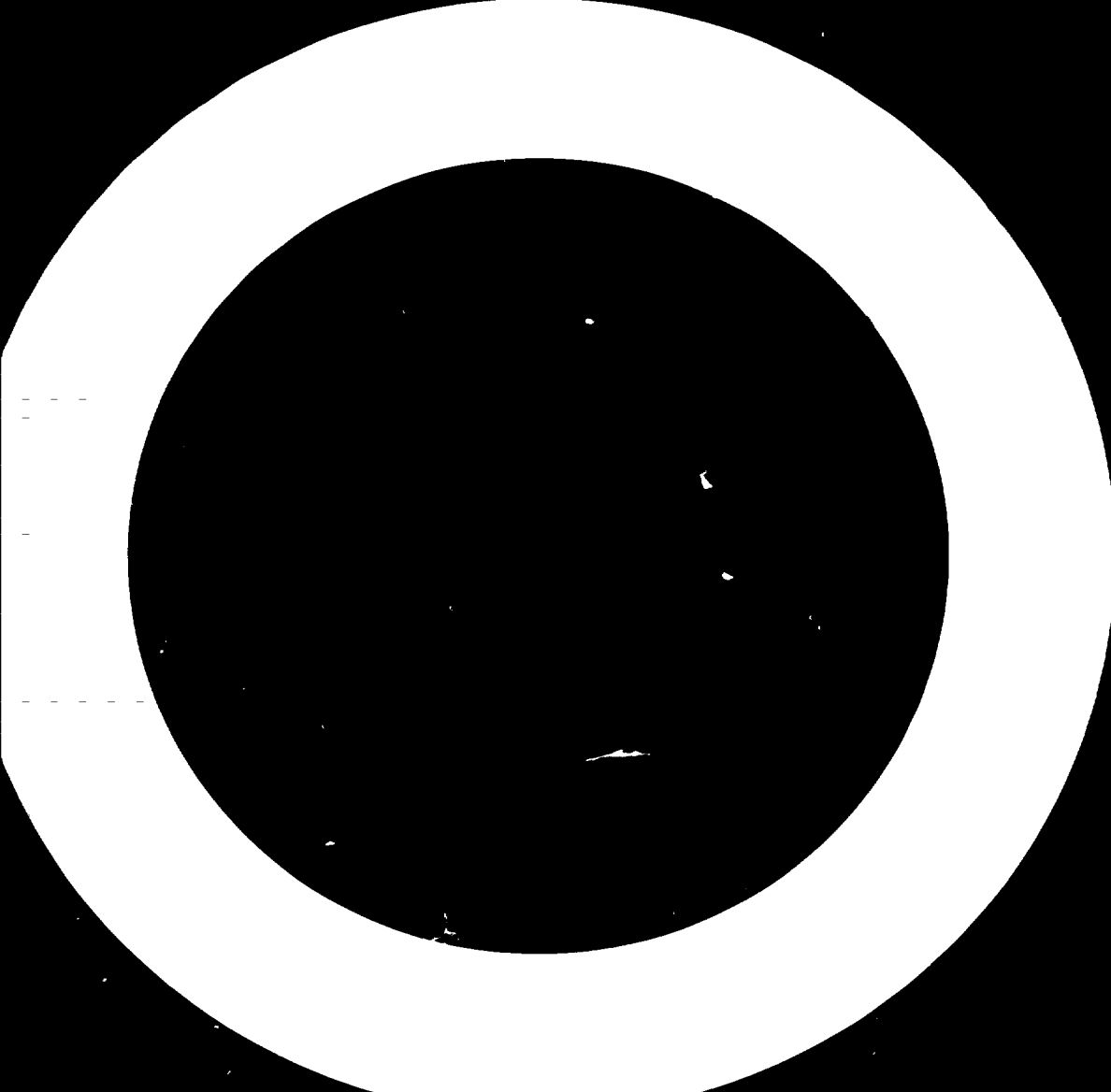
BYL Bolisat Yasoub Lao (Lao Government Tobacco Monopoly)

ABSTRACT

The "Fact-finding mission for the establishment of a laboratory for testing and quality control of tobacco products" (SI/LAO/79/001) arose from a request submitted by the Lao People's Democratic Republic in September 1979 and approved by UNIDO in October 1979. The one-month mission began on 15 August 1981.

The objectives of the mission were to improve the quality of locally manufactured cigarettes, to increase tobacco production and to advise the Government on the establishment of a testing and quality control laboratory.

The expert confirmed the urgent need to improve the quality and quantity of local tobacco and cigarette production. Among the measures recommended to achieve this goal are the following: the import of essential agricultural and laboratory machinery, equipment and spare parts; the establishment of a training camp for tobacco specialists, farmers and plantation workers; and immediate planning for the construction of a testing and quality control laboratory.



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The "Fact-finding mission for the establishment of a laboratory for testing and quality control of tobacco products" (SI/LAO/79/801) arose from a request submitted by the Lao People's Democratic Republic in September 1979 and approved by UNIDO in October 1979. The one-month mission began on 15 August 1981.

The general objective of the mission was to improve the quality of locally manufactured cigarettes for sale on both domestic and overseas markets, and to bring about an increase in the use of locally grown tobacco. The immediate objective was to provide the Government with urgently needed advice in connection with the introduction of new methods of controlling the quality of the cigarettes being manufactured, and with the establishment of an in-plant laboratory for the testing and quality control of cigarettes and other tobacco products.

The tropical climate of the Lao People's Democratic Republic is very favourable for the growing of tobacco. This crop is grown more or less everywhere throughout the country, especially along the rivers, where the land is particularly fertile. The best-known growing zones are at Vientiane and in the provinces of Champassak and Saravane.

Up to the present time, annual production of dry tobacco leaf has been as high as 2,000 tons. But since the problems of transport have yet to be resolved, not all the tobacco produced is sent to the cigarette plants. The two established plants, with an annual capacity of 50 million packets (1,000-1,200 tons of dry tobacco), use only tobacco grown near Vientiane. During the 1978/79 crop year, tobacco production in the Vientiane area was approximately 200 tons, well below the processing capacity of the two cigarette plants, which depend on imported tobacco.

The cigarette factory near Vientiane, which is rather modern, and which already manufactures four different types of cigarettes using a combination of local and imported tobacco, urgently needs technical assistance to introduce new methods of controlling the quality of the cigarettes produced, and also advice on the establishment of an in-plant laboratory for the testing and quality control of cigarettes and other tobacco products. Advice is needed about the machines

and equipment required for such a laboratory, and about methods of conducting health, consumer-oriented, quality-control and organoleptic tests, smoke analysis, and the establishment of smoking panels.

The specific duties assigned to the expert were as follows:

(a) To visit each of the two existing cigarette factories to determine the problems encountered in connection with the testing and quality control of the cigarettes being manufactured;

(b) To the greatest possible extent, to provide on-the-spot assistance in the solution of the above-mentioned problems and prepare recommendations for their long-term solution;

(c) To prepare a proposal for the establishment of a modern laboratory for the testing and quality control of cigarettes and other tobacco products;

(d) To specify the equipment needed for such a laboratory, estimate equipment costs, and suggest possible suppliers;

(e) To recommend a scheme for quality control to ensure compliance with health requirements and the maintenance of consumer-oriented standards;

(f) To consider whether laboratory cigarette-making facilities would be appropriate and, if so, to specify the equipment required and its cost;

(g) To consider whether outside expert assistance would be required for the implementation of recommendations and the establishment and initial operation of the laboratory and, if so, to formulate a proposal for such assistance, including a job description specifying the programme of work to be carried out by the expert.

I. PROJECT ACTIVITIES

Cigarette production is carried out in the Lao People's Democratic Republic under the control of Bolisat Yasoub Lao (BYL), the government tobacco monopoly, in two established factories designated as I and II. Factory I, the main BYL plant, is located outside, and Factory II inside, Vientiane, the capital city.

The findings of the expert were based on observations made during visits to the two cigarette factories and to leaf-tobacco cultivation areas near Vientiane. A description of the project activities may therefore be divided into two parts, one dealing with the factory visits, the other with visits to the cultivation areas.

A. Factory visits

Although the activities of the expert centred mainly on Factory I, a brief review will first be presented of the results of his visit to Factory II.

Factory II

Factory II is devoted exclusively to the annual production of approximately 4 million packages (20 cigarettes each) of a relatively cheap, filterless cigarette, 70 mm long and 8 mm in diameter, called "Phou Kut". By European standards the Phou Kut is a very poor cigarette. The tobacco used is low-grade and excessively dry, and the methods of preparation of leaf tobacco for the cigarette blend are wholly inadequate. Moreover, most of the manufacturing and packing machinery is in urgent need of repair, replacement or spare parts, but no funds are available to pay for the necessary imports. Facilities are also required for on-the-spot physical control of the humidity content, weight, diameter etc. of the manufactured cigarette. However, no suitable site exists on the factory premises for the construction of the proposed testing and quality control laboratory.

On the whole, therefore, both the equipment used and the quality of production at Factory II need to be considerably upgraded.

Factory I

Factory I, where the expert carried out most of his work during the mission, suffers from a lack of spare parts and replacement machinery similar to that

observed in Factory II. The estimated value of urgently needed spare parts for both factories together is at least $US 163,500. This sum does not include the recommended purchase of essential new primary lines, up-to-date packing units and several other machines, and the acquisition, for the first time, of a complete leaf-threshing plant with a capacity of 850-1,000 kg/h.

Factory I currently produces the following five brands of cigarettes totalling 14.5 million packages per year:

Red A (Rouge), king-size, filter-tipped American blend, 83 mm in length, 8.5 mm in diameter, soft packing; 9 million packages produced per annum; price, NK 12 per package

SLEIGH, mentholized, filter-tipped king-size cigarette, 83 mm in length, 8.5 mm in diameter, soft packing; 1 million packages produced per annum; price, NK 15 per package

That Louang, king-size cigarette without filter, 83 mm in length, 8 mm in diameter, soft packing; 1 million packages produced per annum; price, NK 11 per package

Number One, American blend without filter, 73 mm in length, 8.0 mm in diameter, soft packing; 3 million packages produced per annum; price, NK 10 per package

FUJII, "miracle-size" cigarette in new crush-proof box, 80 mm in length, 8.0 mm in diameter, filter-tipped; 500,000 packages produced per annum; price, NK 18 per package

At present, the manufacturing programme does not include the Manchester brand of small cigar with or without filter, made with brown wrapping paper, 85 mm in length, 8.0 mm in diameter, with soft packing. A small amount remains in stock. The once-famous Virginia brand of 555 cigarette has also been removed from the manufacturing programme of Factory I. The licence agreement for the production of the 555 was cancelled in 1975, and the various kinds of Virginia tobacco required for the blend are no longer imported.

B. Cigarette analysis

An analysis was made of the six brands of cigarettes produced in the Lao People's Democratic Republic. The analysis, which was carried out in Europe because of the lack of suitable laboratory facilities on the spot, was based on the ISO regulations (Coresta standard of Paris). The regulation tests require the use of the following equipment:

1. Automatic smoking machine type RM 20/CS (Coresta standard) with smoke-catcher and central Cambridge filter, 92 mm in diameter, for producing and collecting smoke condensate.

2. Distilling apparatus, type BTR (for tobacco cut rag and dust) and BFI (for glass fibre filters), suitable for steam distillation of collected condensate in order to prepare the saturated liquid for its later injection into the spectrophotometer apparatus.

3. Spectrophotometer, type SP 6 - 550, with digital reading of the resulting values, used for easy determination of nicotine in tobacco and smoke condensate.

4. Titration apparatus for correct determination of humidity content in tobacco and cigarettes.

5. Carbon-monoxide-measuring apparatus, type C 08, with receiver cell, for determination of CO or CO_2 content of cigarette smoke, puff by puff and as average values.

Additional equipment used includes an air-conditioning chamber to establish uniform temperature and humidity for examination of the cigarettes, and electronic and analytical balances.

The laboratory ambient temperature and atmospheric pressure were carefully measured and taken into account in the calculation of the carbon monoxide content per cigarette. The calculation was based on the following Coresta-standard draft formula, which is used everywhere but not yet internationally binding:

$$\text{ml of carbon monoxide} = \frac{C \times V \times N \times p \times 273}{S \times 100 \times 1013 \times (t + 273)}$$

$$\text{mg of carbon monoxide} = \frac{C \times V \times N \times p \times 273 \times 28}{S \times 100 \times 1013 \times (t + 273) \times 22.40}$$

where

C = Volume per cent of CO, or 5.5 in the case of the SLEIGH cigarette

V = Volume of 1 puff, or 35 ml of air according to the Coresta standard

N = Total puff number plus "dead travels". For the SLEIGH brand,

$\frac{249.60 \text{ (total puffs)}}{20 \text{ (number of cigarettes)}}$ = 12.48 puffs per cigarette

In the formula, N = 249.6 + 3 = 252.6

p = Atmospheric pressure (average of 1,031 mb for SLEIGH)
273 = Temperature of standard atmosphere (273 K = 0°C)
S = Number of cigarette smoked during one test course (= 20)
1,013 = Standard barometric pressure in the laboratory (mb)
t = Ambient temperature in °C

Using the above-mentioned values, the formula yields the following results:

$$\text{ml of CO per cigarette} = \frac{5.50 \times 35 \times 252.60 \times 1013 \times 273}{20 \times 100 \times 1013 \times 291} = 23.21$$

$$\text{ml of CO per cigarette} = \frac{5.50 \times 35 \times 252.60 \times 1031 \times 273 \times 28}{20 \times 100 \times 1013 \times 291 \times 22.40} = 29.02$$

The results of the analysis of six brands of BYL cigarettes are presented in table 1. All six brands are characterized by extreme dryness and unusually high nicotine content compared with milder and lighter European brands. Without laying down firm rules, the following average values may be taken as a suitable standard of comparison:

Dry condensate: generally less than 16 mg per cigarette
Nicotine in smoke: maximum of 0.8-0.9 mg per cigarette
Carbon monoxide: less than 20 mg per cigarette
Water content: minimum of 9 mg and maximum of 13 mg per cigarette
Weight per cigarette: 0.85-0.95 g per cigarette (maximum: 1 g).

The high levels of nicotine and dry condensate may be the result of the higher weight of BYL cigarettes and the characteristics of the materials used. The analysis provided useful data on the quality of the tobacco used, its blend value and the ability of the cigarette paper and filters to hold back the harmful contents of the cigarette smoke. Experience has shown that a cigarette paper manufactured mainly from rag pulp and wool and cotton textile pulp produces when glowing much lower CO values than paper made from wood cellulose alone. Poor tobacco cut has similar noxious effects, producing excessive nicotine and condensates and, in combination with low-quality paper, the dangerous carcinogen benzpyren-3,4, a substance belonging to the group of polycyclic hydrocarbons. Better-quality cigarette paper and higher grades of raw tobacco are therefore essential for the improvement of BYL cigarette production.

Table 1. Analysis of BYL cigarettes

Brand of cigarette	Weight[a/] (grams per cigarette)	TPM[b/] (milligrams per cigarette)	Water[c/] (milligrams per cigarette)	Nicotine[c/] (milligrams per cigarette)	PMWNF[d/] (milligrams per cigarette)	Carbon monoxide			Puffs	Laboratory temperature (centigrade)	Atmosphere pressure (millibars)
						(volume percentage)	(millilitres per cigarette)	(milligrams per cigarette)			
Factory I											
Red A (Rouge)	1.07	35.53	4.04	0.963	30.53	6.22	21.61	27.02	10.34	21	1 032
SLEIGH	1.21	39.89	4.60	1.490	33.80	5.50	23.21	29.02	12.48	18	1 031
That Louang	1.19	32.45	4.11	1.063	27.28	4.68	18.93	23.66	12.02	20	1 032
Number One	1.21	29.68	2.20	1.297	26.18	5.44	18.05	22.57	9.81	19	1 031
FUJII	1.04	40.92	5.17	2.130	33.62	6.47	24.70	30.87	11.29	19	1 033
Factory II											
Phou Kut	0.91	32.10	2.97	1.302	27.83	4.60	16.93	21.16	10.90	19	1 031

Note: Data represent average values for 40 cigarettes of each brand tested.

a/ By international standards, cigarettes of normal length and diameter weigh on the average less than 1 g.

b/ Raw condensate, which, among international brands, averages 18-24 mg per cigarette.

c/ Water content is low, but nicotine, normally ranging from 0.3 to 0.9 mg per cigarette, is too high.

d/ Dry condensate without nicotine, which, like CO levels, is well above the international average.

C. Testing and quality control laboratory

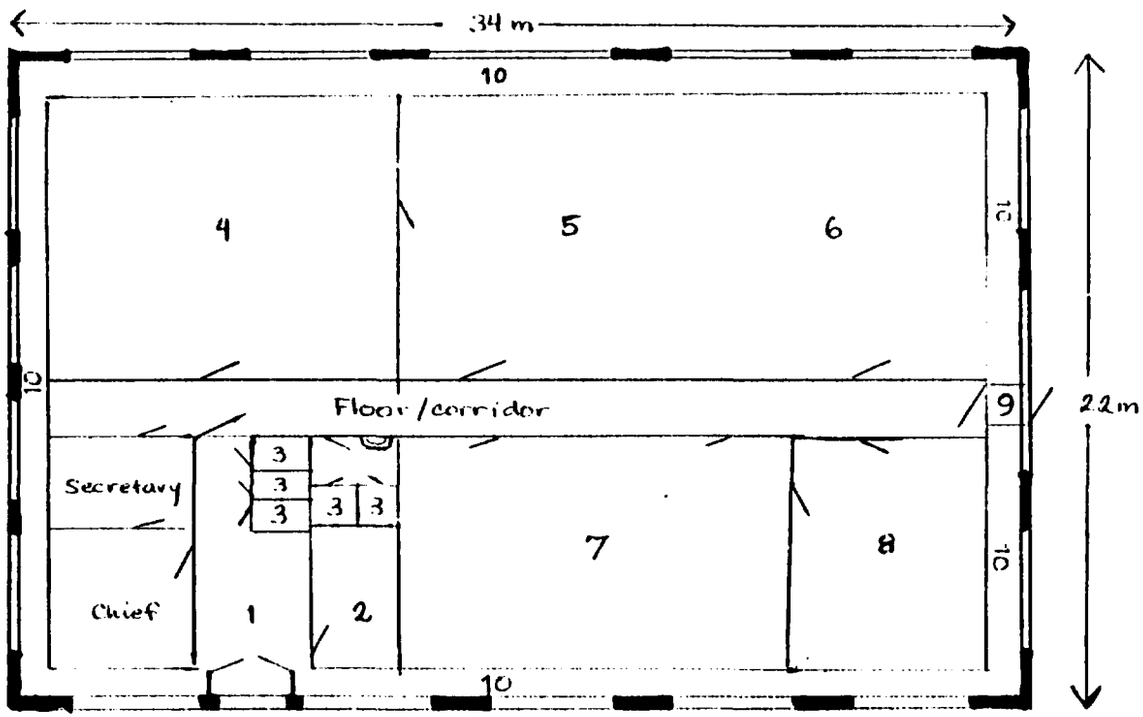
There is also an urgent need for a well-equipped testing and quality control laboratory. A proposal for the establishment of such a laboratory was drawn up by the expert and submitted to officials of the Lao Ministry of Trade and Industry and to the BYL management. Potential suppliers were also requested to provide information concerning the supply of the necessary laboratory equipment and furniture. A pro forma invoice received from one supplier has been submitted as a separate annex to this report.

A suitable site for the construction of a laboratory covering approximately 770 m^2 was found within the Factory I compound. Although not an architect, the expert, at the request of Lao officials, prepared a building scheme for the laboratory based on his long years of experience in the field of tobacco production. The suggested layout is presented in the figure.

Lao officials have expressed a desire for a laboratory building with a ground floor and first floor, but without an underground store-room because of the fear of ground-water seepage. The air-conditioning system may consist of either a central conditioning plant on the ground floor with a pipe distributing network to all rooms, or individually regulated conditioners in each room.

In the expert's view, another prerequisite for progress in the tobacco industry of the Lao People's Democratic Republic is the establishment of a guidance and training centre for tobacco production. Admission to the centre should be open to qualified candidates who have successfully completed their secondary school studies. In this connection, the expert conducted an informal training session for a group of trainees designated by the Ministry of Trade and Industry. The session dealt with the subjects of laboratory equipment, tobacco chemistry, and cigarette testing and quality control. Concern was expressed about the limited field of application of laboratory cigarette-making equipment and its extremely high price compared with the labour costs of the relatively underemployed BYL workers. It is hoped that the session, despite its short duration, provided the participants with some of the basic training that will be necessary for the future operation of the proposed testing and quality control laboratory. However, in order to make the most efficient use of the new laboratory, the technicians would need a further 6- to 12-month period of intensive training in a leading foreign laboratory (see annex).

Draft layout of tobacco laboratory
(Scale of 1:200)



Legend: 1 Entry 2 Small office and reception 3 toilets

4 Testing and quality control unit: cigarette paper, filter rods, plugs and control of the glue

5 Testing and quality control unit: cut rag

6 Testing and quality control unit: cigarettes

7 Smoke analysis and tobacco chemistry

8 Sample production and tobacco agriculture (research)

9 Entry (especially for tobacco samples)

10 Surrounding floor as an aid screen for the air-conditioning unit

The laboratory must be able to provide the following services:

(a) Physical testing of cigarette paper, filters and various other cigarette manufacturing materials;

(b) Physical control of cut rag (that is, cut tobacco and blends);

(c) Physical testing and control of cigarettes to be packed;

(d) Smoke analysis, tobacco chemistry and health research;

(e) Sample production and control of tobacco agriculture.

It must be large enough to house all necessary equipment and at least a two-years stock of spare parts, while leaving sufficient space for the laboratory personnel to move about freely without disturbing each other. The permanent staff of the laboratory should consist of about 14 technicians and three administrative workers.

Lao government officials have indicated quite clearly that they must rely heavily on international assistance, especially from UNIDO, for the construction and equipment of the laboratory. The assistance should cover detailed architectural planning, the supply of building machinery and materials, electrical and telephone installations, and the heating and air-conditioning systems.

In addition to general laboratory equipment such as glassware, gas burners, immersion batteries, powder boxes and flasks, the laboratory should be supplied with the following equipment (see figure for room arrangement):

Room 4: Control of paper, filters etc.

Item	Space required	
	Length (cm)	Width (cm)
1 paper porosity measuring apparatus	40	30
1 paper testing apparatus (tensile strength)	50	40
1 quadrant balance (g/m^2)	30	30
1 densimeter for filter rods	40	30
1 draw resistance meter	40	50
1 pneumatic calibre measuring unit	40	40
1 viscosimeter	30	30
1 sealing apparatus for cellophane	40	20
1 cellophane and paper foil cutter	15	20

Rooms 5 and 6: control of cut rags and quality control

2 drying ovens with calculators for measuring the moisture content	50	40
5 measuring magnifiers	10	10 (each)
1 test screening machine	30 (Ø)	30 (Ø)
1 semiautomatic densimeter and accessories	40	30
1 air-conditioning chamber for cut rag	60	70
5 durotherm-hygrometers and accessories	8 (Ø)	8 (Ø)(each)
2 electronic precision balances	25	30

Room 6: Quality control of cigarettes

1 tobacco moisture meter and accessories	80	50
1 draw-resistance and ventilation degree meter, with 1 calculator and accessories	50 40	50 30
2 electronic balances plus cigarette containers	70	40 (each)
1 semiautomatic densimeter and accessories	40	30
1 air-conditioning chamber for cigarettes	60	70
5 durotherm-hygrometers and accessories	8 (Ø)	8 (Ø)(each)
1 pneumatic calibre measuring unit	40	40
1 cigarette-ends tester or 1 sismelatophor	80	40
1 electronic analytical balance	30	30

Room 7: Smoke analysis and tobacco chemistry

1 air-conditioning chamber (for cigarettes and cut rag)	60	60-70
1 electronic precision balance	30	30
1 electronic analytical balance	30	30
1 smoking machine for 20 cigarettes, including checking device, time counter and accessories	100	50
1 dead-stop titration apparatus and accessories	50	40
2 nicotine-distilling apparatus	35	35 (each)
1 nicotine-distilling apparatus	35	35
1 spectrophotometer UV	50	40
1 carbonoxide (CO) measuring apparatus	40	40
1 set of laboratory glassware	200	50 (in drawers)

Enough space for spare parts must be provided in laboratory cupboards and drawers. The furniture should include two wall-stands for equipment, such as the baro-thermo-hygrograph, to control and measure ambient conditions

Room 8: Sample production, research, tobacco agriculture

1 water-bath with temperature control	25	25
1 tobacco sample cutter	50	30
1 air-conditioned chamber (special design)	60	60
10 cigarettes (plain or Privileg design) hand-makers and enough space for prefabricated hulls and working area	200-250	60
1 spray-gun for tobacco flavours and working space	150-200	60
1 spray-gun for tobacco casings and working space	150-200	60
1 smoking machine for 4 or 5 cigarettes and accessories	100	50-60
1 sealing apparatus for PVC foil	40	30
2 wall-stands for control equipment (baro-thermo-hygrographs)		
20 petri dishes	200	50
Separate table for vibration-free apparatus		
1 Warburg apparatus (measuring of assimilation)	100	50-60
1 rigidly fixed stereomicroscope (with eyepieces 10 x)		

A list of potential suppliers of tobacco laboratory furniture and equipment is included in the original version of this report on file with UNIDO.

The cost of establishing a new tobacco laboratory with at least four departments and other necessary assistance to BYL is currently estimated as follows:

Item	Cost (US dollars)
Construction of laboratory building within Factory I compound	260 000
Laboratory apparatus, technical equipment and glassware	352 000
Laboratory furniture and motor vehicles	510 000
Reconstruction of 92 leaf driers and solar heating	712 500
Spare parts and new machinery	163 500
Agricultural machinery for tobacco cultivation	1 200 000
Total	3 198 000

The above estimate does not include the cost of delegating three experts to the Lao People's Democratic Republic for one year each.

D. International assistance

In addition to the international assistance required for the detailed planning and construction of the testing and quality control laboratory, expert assistance will be necessary for the establishment and initial operation of the laboratory. The qualifications and duties of the expert are outlined below for inclusion in the job description.

Qualifications

Industrial chemist with extensive experience in the establishment and initial operation of a new laboratory for tobacco research and the testing and quality control of cigarettes.

Duties

1. Assembly, installation and arrangement of apparatus, equipment and furniture for a new tobacco testing and quality control laboratory.

2. Establishment and initial operation of the tobacco laboratory.

3. Schooling, training and supervision of the laboratory staff.

4. Providing guidelines to the chief of the laboratory concerning the proper exercise of supervisory authority, without interfering with administrative functions.

5. Providing practical guidelines to the laboratory staff, especially the skilled workers, concerning the physical testing and chemical control of the quality of leaf tobacco, cigarettes and other tobacco products manufactured at BYL.

6. To the greatest possible extent, provision of on-the-spot assistance in the solution of initial problems in the laboratory regarding the use of different chemicals, glassware etc.

7. Preparing recommendations designed, on the one hand, to ensure a more efficient execution by laboratory staff of orders to carry out special investigations and, on the other, to achieve long-term solutions of problems encountered in the laboratory work.

8. Teaching a clear scheme for identifying pathological symptoms of tobacco and controlling the quality of raw tobacco, cigarettes and other smoking products.

9. Promoting compliance with health requirements.

10. Specification of additional equipment requirements, estimation of equipment costs and preparation of list of potential suppliers.

11. Preparation of a report setting out the results of the mission and recommended follow-up action.

Duration: One year divided between the new laboratory in Factory I (10-11 months) and the physical testing of cigarettes in Factory II (1-2 months).

II. TOBACCO AGRICULTURE

In the course of his mission the expert visited the leaf tobacco cultivation areas surrounding Vientiane. The plantations, covering approximately 2,500 ha, supply BYL with green leaf. The principal tobacco stations are located near the following villages:

Village	Number of leaf curing barns in use at tobacco station
BAN HOME 1	10
BAN HOME 2	18
BANTHAKHEK	20
BAN BACNAD	20

An additional tobacco drying station has been built within the agricultural centre located opposite Factory I.

Other tobacco plantations exist in other parts of the country, but because of poor roads and transport facilities, an estimated 200 to 500 tons of leaf tobacco may not reach the existing cigarette factories in and near Vientiane each year. From 1,400 to 1,800 t/a of green leaf are produced and dried by BYL in the existing, very old-fashioned flue-curing barns. However, the quantity of dried tobacco delivered to Factories I and II amounts to only 220-250 t/a, although they have a capacity of approximately 1,000 t/a. The factories must therefore supplement their insufficient local supplies by the use of imports.

A. Production increases

Despite the inadequate production levels, climatic conditions in the cultivation areas, mostly alongside rivers and in fertile valleys, meet all the requirements for abundant tobacco crops and commercial success. The essential efforts required to achieve those aims are described below.

Improvement of seeds

The seeds currently in use produce an unacceptably high quantity of defective plants because of the incorrect method of renewal and increase of the seed granules. Their replacement by suitably acclimatized imports of Virginia and Burley seed is therefore necessary. The cultivation of seeds of Bulgarian, Greek, Yugoslav or Turkish oriental tobacco should also begin as soon as possible.

Agricultural machinery

Another urgent requirement is the import of suitable agricultural machinery for tobacco plantations and at least a two-years' supply of spare parts. International assistance will be required for the supply of both machinery and plant seed, as well as for the supervision of cultivation and harvesting over a two-year period. A list of some of the possible suppliers of agricultural equipment has been filed with UNIDO.

Export promotion

An improvement in tobacco production will make it possible to achieve another important goal - the promotion of Lao tobacco exports. Tobacco with bright-coloured leaf, low nicotine content and minimum condensate in burning tests could be sold to western countries for valuable hard currency. Moreover, because of the higher selling price per kilogram, the tobacco should be offered in the form of threshed tobacco - that is, leaf lamina, or leaf without stems pressed in jute packing - and not as leaf pressed in bales or packed in hogsheads.

B. Training camp

The establishment of a training camp for tobacco specialists, farmers and plantation workers would contribute substantially to the improvement of Lao tobacco agriculture. At the camp, tobacco planters and BYL employees would receive theoretical and practical training in the activities described below, under the supervision of an experienced Lao agricultural expert, with the initial assistance, for a period of 4-6 months, of an expert made available through international co-operation.

Ploughing and fertilizing

Artificial fertilizers, natural liquid manure or dung salts would be suitable for tobacco cultivation.

Sowing

Tobacco seed grains must be sown in nursery beds in order to obtain well-formed seedlings in the plastic-covered hothouses, starting already in September of each year in the Lao People's Democratic Republic, at open-air ambient temperatures ranging from +10°C to +28°C. If plastic barn cloches are temporarily unavailable, a strong transparent linen material must be used as a cover.

Transplanting

The transplantation of seedlings to the precultivated fields takes place mostly in October and November. It must be done without damaging the sensitive young plants, by hand if necessary, but preferably with four-row mechanical planting machines, which ensure that the plants are set at the correct distances apart. The use of mechanical means to prepare the soil, for example four-row rolling cultivation, is also preferable.

Harvesting

Because of climatic conditions in the Lao People's Democratic Republic, plant leaves are ready for harvesting earlier than in other tobacco countries. The picking of ripe leaves starts about mid-December and the last crop is harvested in March. Harvesting can be carried out only in stages, according to the ripeness of the individual leaves.

Drying

First, fresh green leaves are predried by hanging them on wooden sticks or bamboo stems in sheds or open barns in order to reduce the natural moisture content of the leaves and to turn their colour yellowish orange.

Second, bundling and bulk fermentation of the leaves takes place. This treatment is very important for the chemical decomposition of the tobacco and nicotine in the leaves.

Third, the drying of the leaves is done in barns or kilns with permanently circulating preheated air. For this treatment, the leaves are hung on wooden sticks which are hoisted on rope ladders to heights of 6-8 m to make the most efficient use of the available barn space. The barn must be large enough to receive all the harvested leaves of a few days, and have several openings or ventilation windows to provide sufficient light and air circulation. The air inlets should preferably be equipped with electric blowers to regulate the air flow.

In order to save valuable firewood, a suitable heating system should be used in the barns. According to inquiries made during the mission, approximately 7,000 m^3 of firewood was burned in 92 leaf-curing barns - or 76 m^3 per barn - for 1,500-2,000 kg of dry leaf during only one drying period.

Because of the lack of sufficient fuel supplies apart from firewood, a combined system of solar convectors for air heating plus a number of auxiliary

electric heating fans for cloudy or rainy days would seem to make the most efficient use of existing resources to meet the heating requirements of the drying barns. The electric energy required for the fans may be obtained from the available hydroelectric power stations, and investment in the converters and related equipment would involve one-time cash payments.

The value of the proposed system is borne out by the experience of a relatively cool country such as Austria, where, with only 16 m^2 of solar collector surface, 11,640 kg of freshly-harvested, green Burley leaf, with a natural water content of approximately 10,190 kg, may be dried down to 1,455 kg of dry leaf during a 12-day period of sunny weather (average temperature: 24°C). A minimum applied energy of 540 kcal of heat, or 1,546 kWh, is needed per kilogram of evaporated water.

Redrying

The processes of redrying (artificial aging) and leaf fermentation by the activity of enzymes and micro-organisms are an important part of tobacco farming. Mechanical redrying offers numerous advantages, and is worth the investment if funds are available for the purchase of the necessary machinery.

Packing

Tobacco packing and aging would also be a subject of special consideration at the training camp. The usual size of jute-wrapped bales of great leaf (Virginia, Burley etc.) is approximately 80 cm x 40-60 cm, with a weight of 80-90 kg. Bales of oriental leaf measure approximately 60 cm x 30-40 cm and weigh 20-25 kg. Virginia, Kentucky, Maryland, Burley and other kinds of tobacco are also packed in wooden hogsheads or casks 90-100 cm high and 85-100 cm in diameter.

C. Tobacco classes

The disproportionate share of lower leaf classes (leaf particles without stems and strong ribs are currently unavailable in the Lao People's Democratic Republic) should be remedied. The planned share of each class is shown in table 2.

Table 2. Class distribution in tobacco crops

Class	Share of dry leaf crop in 1981[a] (percentage)	Expected share of dry leaf crop in 1983 (percentage)
Virginia[b]		
I	8	12-13
II	9	15-16
III	16	19-23
IV	29	25-26
V	38	22-29
Burley[c]		
I	13	17-18
II	16	22-25
III	22	25-26
IV	24	15-17
V	25	16-19

a/ Total Virginia dry leaf, 130-135 t; total Burley dry leaf, 100-110 t.

b/ Planned increase up to 160 t/a by 1984/85.

c/ Planned increase up to 150-160 t/a by 1984/85.

During the 1980/81 season a small quantity of Thailand oriental seed was imported for experimental planting without acclimatizing the seed. The results have been disappointing (150-160 kg in 1981). Without attempting a detailed explanation of these results, the expert considers it better to start oriental leaf growing not in the tropical valley, but in the highland areas 800-1,000 m above sea-level, using real oriental tobacco seed imported from Albania, Bulgaria, Greece, Turkey or Yugoslavia.

D. Combating pests and parasites

The expert received reports of serious pest damage to tobacco crops near the village BAN HOME 2 during the 1980/81 growing season. At least 25 t of fresh leaf tobacco are estimated to have been lost. Having arrived in the country after the growing season, the expert was unable to observe first-hand the type of pests involved. However, crop protection measures can still be recommended despite the

lack of specific information concerning pest types. A plant protection project (LAO/78/013) is being carried out in the country under the auspices of the United Nations Food and Agriculture Organization and the Ministry of Agriculture. The necessary spraying equipment, pesticides and insecticides are available. In order to prevent further serious crop damage in future, arrangements should be made through the appropriate channels, with the co-operation of the international bodies concerned, to make the most effective and timely use of the available crop protection methods.

E. Transport

The unsatisfactory state of existing roads, the lack of railways and motor vehicles, and the insufficiently developed transport infrastructure help to explain why tobacco from all cultivation areas is not regularly delivered to the two established cigarette factories near Vientiane. With the construction of the proposed new laboratory within the confines of Factory I, there will be an urgent need to provide the following vehicles for travelling between the laboratory, Factory II and the different tobacco stations around Vientiane to pick up the necessary samples of already-manufactured cigarettes and of leaf tobacco (green and dried): two Land-rovers, one heavy-duty motor car (for passenger transport) and two or three high-powered motor cycles.

III. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

1. Both Factories I and II suffer from severe shortages of spare parts and equipment of all kinds.

2. The methods and quality of cigarette and tobacco production in the Lao People's Democratic Republic need considerable improvement.

3. Cigarettes manufactured by BYL show very high levels of carbon monoxide and condensates as compared with average international values.

4. There is an urgent need for the establishment of a testing and quality control laboratory for cigarettes and other tobacco products manufactured by BYL.

B. Recommendations

1. More productive tobacco plants should be cultivated in the Lao People's Democratic Republic, imported tobacco seeds should be acclimatized, and the tobacco fields should be suitably prepared and fertilized before seedlings are distributed. Target levels for leaf production per hectare of cropland should be as follows: 1,700-1,800 kg of fresh leaf per ha (minimum output); 2,200-2,800 kg of big leaf per ha (average output); over 3,000 kg of fresh big leaf per ha (very good output).

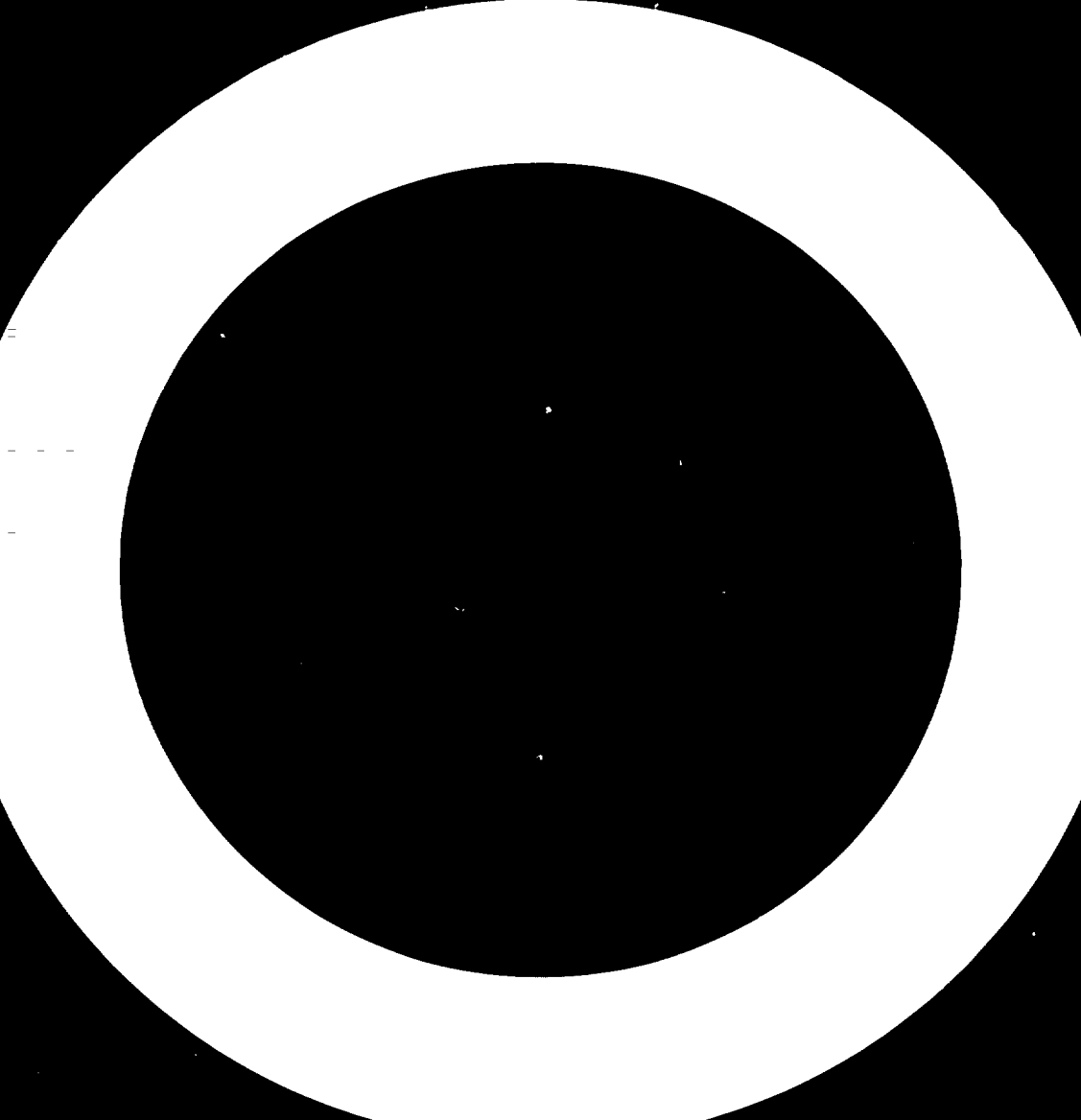
2. To help improve tobacco output and quality, the relevant international bodies should assist BYL in securing the services of a tobacco plantation expert for two or three years.

3. A training camp for tobacco specialists, farmers and plantation workers should be established under the supervision of an experienced Lao agricultural expert, with the initial assistance of an expert made available through international co-operation.

4. The import of essential agricultural machinery designed for use in tobacco cultivation should be given equal priority with the establishment of a testing and quality control laboratory.

5. Planning should begin immediately for the construction of a testing and quality control laboratory on the site of Factory I. Consideration should be given to the possible subsequent extension of the laboratory building to form a complete tobacco institute with all the necessary facilities for both agricultural research and the scientific control of the two existing BYL factories.

6. An expert with extensive knowledge of tobacco laboratory equipment and installation requirements should be made available for at least one year to supervise the establishment and initial operation of the new laboratory. The expert should also be able to help train the laboratory workers on equipment operation and standard laboratory practices.



Annex

PARTIAL LIST OF TOBACCO LABORATORIES OFFERING SPECIALIST TRAINING PROGRAMMES

Austria Tobacco Works AG, A-1091 Vienna, Austria

Bulgartabac, Plovdiv, Markovo, Bulgaria

Centralne Laboratorium Przemyslu Tytoniowego
PL-31 982 Kraków, Al.Planu 6-latniego 148a, Poland

C.S.T.P., Cs-89701 Bratislava, Mileticova 21, Czechoslovakia

Dohanypari and Dohanykutato Intezet, H-4002 Debrecen, P.O. Box 66, Hungary

Glawtabac, Moscow, Union of Soviet Socialist Republics

Station Centrale des Recherches pour la culture et l'industrialisation du tabac
1, Rue Girlei, Bukaresti - Sec.I, Romania

Tabakindustrie VEB, 1020 Berlin, Rungestrasse 22/24, German Democratic Republic