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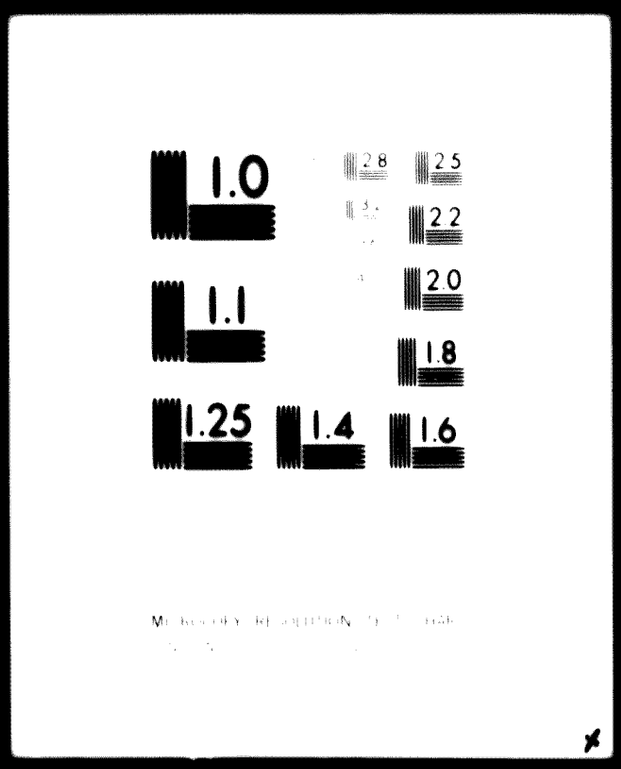

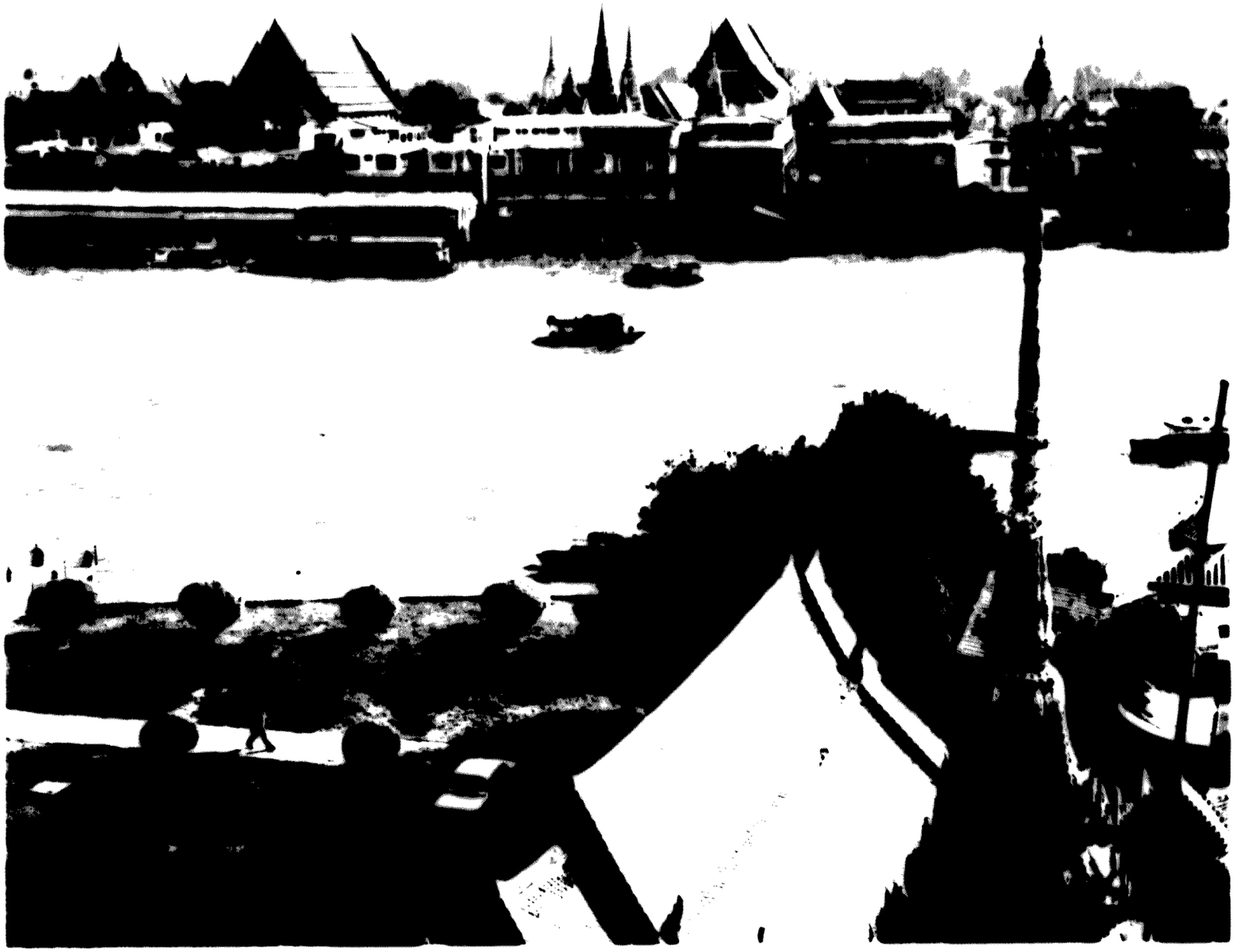

Bangkok, Thailand

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United Nations Industrial Development Organisation

Survey report on maintenance and repair needs in Thailand

From W. D. Scott & Company, Pty. Ltd. Australia.

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From W. D. Scott & Company, Pty. Ltd.
Management Consultants,
Australia.

December 1970

CONTENTS

CONTENTS (Contd.)

APPENDICES

1. INTRODUCTION

This report presents the findings and recommendations of an exploratory mission on maintenance and repair facilities, services and needs in Thailand.

The study was undertaken at the request of the United Nations Industrial Development Organisation which was approached by the Department of Industrial Works, Thailand.

The study was made in September-October, 1979, by Mr. Hugh D. Munro, specialist in maintenance management, W.D. Scott & Company.

The main findings are:

* While existing maintenance and repair schemes are generally adequate in both government and private industry, they could be much more effective in government in particular.

* Much of the industrial equipment and spare parts used in Thai industry is bought off the shelf from foreign suppliers. The items are frequently unsuitable for Thai conditions. Major maintenance problems result.

* The encouragement of private maintenance contracting firms, and increased emphasis on standardisation of plant and machinery, would cut maintenance costs and minimise maintenance problems.

* In the face of the very great range of equipment now used (most of it imported) there is little opportunity for local manufacture of spare parts. In the absence of standardisation, the local market is much too small to offer profitable production runs.

Special Attention for Government Industries

While the study was broadly based, to cover representative Thai private industry, the Department of Industrial Works asked for special attention to Government owned industries.

The reasons for the Government request, and the subsequent altered emphasis in the UNIDO brief, were explained in our letter of September 25, 1970, a copy of which appears as Appendix 1-A.

But, as many of the problems facing Government industry also confront private Thai firms, the findings in this report are - we believe - valid for both groups.

It should be stated, however, that before detailed maintenance planning is undertaken for Government plants a prime need is to decide which of the plants are inherently viable.

While some Government plants appear both profitable and efficient, others are less obviously successful. Marginal capital investments might alter that situation, which is explored in more detail later in this report.

2. REVIEW OF REPORT

In this section we summarise the report's main findings and recommendations.

Findings

1. Greater expertise is needed in initial plant design and equipment specification. There is a tendency to assume that equipment which is suitable for Europe or Japan will be an automatic success in Thailand. But in fact this often leads to wrong purchases being made in the first place. Maintenance problems multiply.

2. It is difficult for Thai plant and equipment buyers to get adequate service on their purchases. Few supplier companies have effective local representation. Instead they rely on local agents who mainly place and receive orders, and can give little help on maintenance needs.

3. It is also a problem for Thai industry to modify existing plant and equipment. Though modifications are frequently necessary, under the demands of local operating conditions, relatively few Thai firms are confident in undertaking such modifications.

4. Because there is very little standardisation of plant and equipment firms often have unduly large inventories. As well, the many spare parts tend to mean numerous suppliers, higher prices for the parts and delays in delivery from the original foreign supplier. All these lead to increased maintenance costs.

5. Private industry makes some, if limited, use of maintenance contractors. It thereby encourages the development of specialised maintenance skills. But little use of private groups is made by Government plants, which could help stimulate the development of valuable contracting maintenance firms.

6. There is low awareness of the economic nature of maintenance. This applies to both Government and private plants. Plant, rather than investments, is protected. The result is that maintenance and repair schemes lack the sophistication warranted by the investment.

7. Many plants cannot point to where maintenance costs actually occur. Naturally they find it difficult to control their maintenance costs.

8. There is a marked shortage of technically qualified maintenance people. This applies at both the management and artisan levels, but it is acute in the area of back-up skills for chief engineers. Plant modification opportunities are therefore neglected; costs are given inadequate attention; and technical control suffers.

9. There are not great needs for new machinery for efficient maintenance and repair activities. There are, however, opportunities in the automotive equipment and possibly in the electrical industries for a more extensive network of service and spare parts depots. Private contractors might be encouraged to take advantage of such opportunities.

10. Because Government statistics do not distinguish between parts which have been imported for local assembly and those which are used for repair and maintenance, it is difficult to evaluate the opportunities for increased local manufacture of spare parts.

But failing standardisation of spare parts, leading to a larger local market for the small number of standardised items, there appears little reason to think that a local spare parts manufacturing operation would be attractive to investors.

Overall, in respect of Government plants, steps should be taken to establish their viability, before major changes are introduced to their systems of maintenance.

Special Note on Electronics, Electrical Equipment, Mechanical Machine Shop Practices

Though it had been hoped, in the study, to give priority to electronics, electrical equipment and mechanical machine shop practices, this was not feasible for two reasons.

a. The increased emphasis on Department of Industrial Works plants meant major attention for those plants and the fields in which they operate (sugar, paper, textiles, distilling).

b. Private industry in Thailand is only sketchily represented in electronics and electrical equipment. The great bulk of this is imported. Maintenance of such equipment consists largely of replacing defective parts with imported spare parts.

Moreover, it should be noted that Government import statistics lacked the detail to enable confident analysis of future opportunities for increased manufacture of electronics and electrical equipment spare parts. Manufacturing prospects subsequently referred to in this report, therefore, must be regarded as very tentative.

3. RECOMMENDATIONS

The recommendations are in two sections - short and long-term programmes. The short-term programme is concerned primarily with Government plants. The long-term programme covers Thai industry as a whole.

Short-Term Recommendations

This has four main features:

1. A plant capacity, plant modification study of Department of Industrial Works plants. This would provide the basis for setting sound maintenance policies. It would also lead to an assessment of what plant modifications were justified to lower plant maintenance costs.

2. Development of maintenance/plant modification policy. This would result in specifications for the most effective systems of maintenance reporting and control within individual Departmental plants. As well, maintenance objectives would be defined. Particular attention would be given to equipment selection policy in individual plants.

3. Organisation and conduct of an annual maintenance forum. This would be a showcase for advanced maintenance management. The forum would bring together maintenance engineers from both Government and private plants.

   Each year the forum would be addressed by specialists in such fields as plant selection, equipment selection, corrosion engineering, cooling problems, new materials and other aspects of interest to maintenance management and control in Thailand's special conditions.

   Selected suppliers would demonstrate new products and processes; group discussions would encourage personal participation by engineers; plant visits would be made.

4. Preparation of a revised maintenance course. This would be a practical course for maintenance management and maintenance engineers. It would replace the current programme offered by the Thailand Management Development and Productivity Centre.

   Where technical people are concerned, the present course, which was designed for a general management level, is at a disadvantage.

   The course is not specific on maintenance needs and problems. Nor does it give guidance on such questions as plant specification and selection, which are of key importance in Thailand.

An integral part of the recommended short-term programme would be an analysis of the viability of individual Departmental plants. Until that is established detailed maintenance planning seems premature.

Though past studies have been made of Departmental plants, especially on marketing and supply questions, the plants have not been analysed in detail as to what improvements are needed to ensure their viability. This is a most important question in establishing plant and equipment selection needs, and in maintenance management planning.

The viability analysis would show:

* The potential for improved plant operations.

* What marginal capital is required, to realise that potential.

It would also reveal the present production capacity of each major item of plant; the cost profile for increasing the capacity of each item by improved maintenance, modification, duplication or replacement; the opportunities which exist for cost reduction at constant capacity; and the optimum combination of increasing plant item capacity and cost reduction.

Long-Term Recommendations

1. Plant and Equipment Selection

Development of local standards for equipment. This will ensure that equipment is in keeping with local requirements and minimise the present high risks in ordering equipment from foreign suppliers whose main markets lie outside Thailand.

More effective Government regulations. Standardisation should also extend to the development of more effective Government regulations, for example electrical protection and wiring. This would further guard against the selection of unsuitable equipment.

Government departments' influence. Departments should also take account of standardisation, in purchasing, to further encourage the spread of standardisation. To encourage service oriented suppliers, Government departments should make allowance, when purchasing equipment, for quality and servicing. At present, they make decisions purely on price.

We understand UNIDO is aware of these standards needs.

2. Contractors

Building up maintenance specialists. Government departments should encourage the development of a pool of contractors equipped with particular maintenance skills and facilities. They could do so by calling on those firms for tenders for selected maintenance work.

3. Spare Parts

Improved Government statistics. Statistics need to be refined to show what equipment is imported as spare parts, and what is used for local manufacturing. This will enable business enterprises to assess the scope for local spare parts manufacture.

The Government should also encourage suppliers to hold larger inventories of spare parts within Thailand. For example, the Government can provide free bonded spare parts storage in or near Bangkok. This will help cut down the waiting time and high costs which industrialists now face on many spare parts.

4. Maintenance Training

Systematic teaching of maintenance management. In tertiary, technical and vocational school curricula, maintenance management policies should be taught. This will help overcome the present shortage of skilled maintenance people, and increase the understanding of maintenance requirements. As well the trained artisan output needs to be increased.

Training courses need to be developed for artisans currently in industry, but who have not had formal vocational training. This will result in improved maintenance practices.

The establishment of Government centres to accomplish this artisan retraining should be considered.

The plant maintenance training course at the Thailand Management Development and Productivity Centre needs to be adapted to the level of foremen. This course should be in addition to that for maintenance management and engineers recommended earlier.

The foremen's course should include training in supervision, as well as technical maintenance skills.

The Small Industry Services Institute should be further developed to offer advice and training in maintenance problems. It would serve the special needs of small industry.

5. Research and Development

A special attack on corrosion. The Government should consider development of research facilities in corrosion engineering. Corrosion is a very prevalent problem for Thai industry.

Particular corrosion problems could be passed to bodies such as the Technological Research Institute for evaluation.

Consideration should also be given to the establishment of a Chair of Corrosion Engineering at one of the Bangkok universities.

6. Other Recommendations

Board of Investment interest in maintenance. Companies which seek Board assistance in establishing enterprises should be required to nominate their maintenance policies, and control systems.

Thai Industries Association help. This could be enlisted in publicising the availability of training courses and in creating an awareness of maintenance problems.

Management education programmes. The Government could also encourage an awareness of maintenance needs, by management education campaigns in technical journals, educational forums, and special addresses through the Thailand Management Development and Productivity Centre.

Throughout all such educational programmes, stress should be laid on the necessity to specify the correct plant and equipment in the first place.

Priorities in Implementation of Recommendations

The distinction between the "short-term" and "long-term" recommendations involves the time period over which the recommendations might be implemented. However, the relative urgency and establishment of priorities among these recommendations should also be examined.

In fact, some of the highest priorities involve commencing implementation of a number of the long-term recommendations. These are mostly associated with the rapidly growing private manufacturing sector, while the short-term recommendations centre around the relatively static Government industries.

We believe a suitable order of priorities to be:

a. Urgent - The following require the earliest possible start and the practical maximum in resources -

* Development of local standards for equipment
* Development of more effective Government regulations
* Improvement of Government statistics to reveal the true usage of spare parts
* Training and retraining of artisans for maintenance work.

b. Less urgent - An early start is desirable on -

* Studies of the viability of Government plants and development of improved maintenance policies
* Development of maintenance education programmes, for all levels of maintenance management and particularly for maintenance engineers
* Development of corrosion research efforts and facilities.

c. Not urgent - When resources permit, the following would provide major benefits -

* Development of Maintenance Forum
* Development of Government purchasing policies to encourage standardisation
* Encouragement of private contractors
* Development of maintenance teaching in tertiary, technical and vocational schools
* Expansion of the Small Industry Services Institute services to cover maintenance programmes for small industries
* Involvement of the Board of Investment and the Thai Industries Association in encouraging better maintenance policies and practices.

Assistance Required to Implement the Recommendations

Mr. Munro's letter to the Director General of the Department of Industrial Works (a copy of which is contained in this report) suggests an external consulting programme to assist the Department in implementing our recommendations relating to the Government plants.

We also believe that the Government will require external assistance in implementing the "Urgent" matters referred to above. We understand that UNIDO has considered the question of improvement in Government statistics. As well, the training and retraining of maintenance artisans would appear to be a natural extension of the work being done by ILO at the National Service for Technical Skill Promotion and Job Entry Training for Industry.

The development of standards and regulations will, on the other hand, require regular contributions from -

* existing Government authorities
* private industry users
* Government users
* manufacturers and suppliers

* testing authorities
* technical experts in specific fields
* academic institutions
* legal authorities.

The organisation and development of effective structures and procedures for an accelerated attack on this vital problem is a very big challenge. Although administrative work might be carried out through existing Government departments, it is preferable that an independent body be created to develop the standards (and possibly the regulations) for submission to, and approval by, the Government. In any case, a thorough study of the operation of similar bodies in the industrially advanced countries would be wise.

We see this as a programme occupying at least two years. The programme could be carried out under the direction of UNIDO, in conjunction with the Ministry of Industry. Specialist consultant assistance of perhaps three to six months' duration could be desirable at the stage of formulating the objectives, the organisational structure and the procedures associated with the establishment of the various co-ordinating bodies.

4. METHODOLOGY, SOURCES OF DATA, USE OF TERMS

The programme as undertaken consisted of:

1. Personal inspections of Government and private plants in Thailand.
2. Distribution of a Technical Questionnaire on maintenance.
3. Personal interviews with representative interests.
4. A review of published and unpublished statistics and documentary data.

1. Personal Inspections of Plants

In company with Mr. Pragit, counterpart from the Department of Industrial Works, Mr. Munro inspected each of the industrial plants shown in Appendix 3.

Each inspection consisted of:

* A preliminary discussion with the Plant Manager, with the objective of identify the major factors governing plant operation.
* A plant tour, including services, workshops and stores. This tour was done with the Plant Chief Engineer.
* A discussion of the plant's maintenance function with the Chief Engineer, and usually the Plant Manager. The discussion covered maintenance needs and problems related to:

  Organisation
  Staffing
  Equipment
  Methods
  Materials
  Inventory
  Purchasing
  Records
  Controls

In some cases the effectiveness of this discussion was limited by language difficulties.

2. Distribution of Technical Questionnaire on Maintenance

A brief questionnaire on the maintenance function and its activities was prepared and a copy forwarded to each of the Government plants visited, and to three of the private companies visited.

The form of this questionnaire and the answers received up to the date of Mr. Munro's departure from Thailand are set out in Apperdix 4. A number of details of the replies, some of which were not translated for our consultant, have been omitted.

3. Personal Interviews with Representative Interests

In addition to interviews with factory management, our consultant conducted other personal interviews. These were with people with either a direct or indirect interest in the factors which influence the effectiveness of the country's repair and maintenance activity, or who were in a position to supply useful background industrial or economic data.

A list of these people is attached as Appendix 2.

4. A Review of Published and Unpublished Statistics and Documentary Data

A number of publications were used to provide background data or specific data relating to industries, machinery or spare parts.

A list of the publications consulted is attached as Appendix 5.

Every effort was made to come in contact with all sources of information which were considered relevant to the mission. There are, no doubt, informed areas of opinion or fact which have not been brought to our attention in the limited time available for the project.

Use of Terms

We met some confusion in the use of terminology related to the field of maintenance and repair among various groups of people in Thailand.

The sense in which we use certain words in this report is:

Maintenance - Those activities which keep plant and equipment in a serviceable condition, such as:

- Inspection
- Cleaning
- Polishing
- Lubrication
- Painting
- Replacement of parts prior to functional failure.

Repair - Those activities which restore plant and equipment to a serviceable condition after deterioration, or failure, such as:

- Filling
- Resurfacing
- Joinery or welding mechanical failures
- Replacement of parts after functional failure.

Modification - Changes in the function, form, size or material of plant or equipment or parts thereof.

Installations - Installation of new plant or equipment which is not a modification of existing plant or equipment.

Breakdown Maintenance - The practice of attending to functional breakdowns of plant as the chief means of "maintenance". Maintenance activities are usually at the minimum level to keep the plant running, and repair is the major activity of the "maintenance" work force.

Planned Maintenance - The practice of deciding on a regular (normally weekly or monthly) basis, in advance, a programme of maintenance, repair, modification or installation jobs to be accomplished by the "maintenance" force during the next planning period. When such a practice is used, some proportion of the available time of the "maintenance" force is set aside as an allowance to cover unscheduled breakdowns.

Preventive Maintenance - The practice of carrying out routine inspection, maintenance or overhaul on plant or equipment on the basis of a pre-determined schedule. The objective of Preventive Maintenance is to prevent costly breakdowns by taking anticipatory action. Preventive Maintenance jobs usually form part of a Planned Maintenance work load, the remainder being made up of repairs, modifications and installations.

"Maintenance" - We use the word in quotation marks to signify the overall function as normally delegated to the head of the Maintenance Department of an organisation. This function is taken to include the planning, direction and control of maintenance and repair activities, and such modification and installation activities as are delegated by management.

5. REVIEW OF STATUS OF MAINTENANCE AND REPAIR ACTIVITIES

Overview

As indicated, a significant part of the study was given to a review of industrial plants owned by the Department of Industrial Works.

The Department owns seven plants, the majority outside of Bangkok, at distances of up to 400 miles from the capital.

The plants, concerned with sugar, textiles and paper are medium sized, employing between 250 and 600 people. There is one much larger plant, of 2,000 people. This is a distillery, in Bangkok.

Very much larger than Government enterprise is private industry. It has grown rapidly over the past ten years, to account for about 15 per cent of national product. Though industry is concentrated in Bangkok and neighbouring Thon Buri, the aim of the current (1967-71) development plan is to encourage decentralisation.

The success of this decentralisation programme can be gauged from the fact that new industrial projects - which approached 200 a month in 1969 - were fairly evenly divided between Bangkok and the provinces.

There is increasing sophistication in industry - for example the World Bank recently invested $22,000,000 (U. S.) in an expansion programme by the Siam Cement Group to include a cement factory, an asbestos sheet plant, a concrete pipe factory and a steel rolling mill.

On the other hand, the most prominent form of private industry is still the rice mill. Some 12,000 of these are found throughout the country, some being very small indeed.

Maintenance skills in private industry naturally vary considerably with the size and sophistication of plant. However, there appears to be a significant difference, in favour of private industry, in comparing maintenance effectiveness in medium sized Government and private industry. Private industry's better showing stems largely from greater attention to planning, recording and cost control.

Like the Government plants, however, private industry appears to suffer problems - often severe - in specifying its initial plant and equipment needs. Maintenance training is inadequate, too, at both executive and artisan levels in both groups; maintenance records are inadequate; and maintenance concepts are often narrowly based.

Those and associated aspects are expanded under

Maintenance Objectives and Policies
Specification and Design of Plant
Maintenance Management and Training Needs
Maintenance Staff
The Role of Machinery and Equipment Suppliers
Capacity for Spare Parts Manufacture.

Maintenance Objectives and Policies

We observed four policies of "maintenance":

a. In seasonal process plants (notably sugar mills), there was breakdown maintenance during the running season, and complete overhaul of all plant during the shut-down period.

b. In certain plants which operate throughout the year, there was inspection and, if necessary, overhaul, of most plant to a preventive maintenance schedule.

c. In some cases, the preventive maintenance schedule was based on daily attention to plant during non-operating hours.

d. In the remaining cases, breakdown maintenance was the essential policy, with some lubrication and cleaning.

Lack of Clear Maintenance Policies

We found a general lack of clear formulation of these policies or the underlying objectives in terms of the most economic protection of the investment, both in Government and private industry.

In no case did our inspections reveal a medium- to long-term plan or programme of modification or replacement of plant in parallel with the maintenance and repair activities. However, in certain cases (such as the installation of stainless steel distillation towers at Bangyikhan or extension of the clarifier at Uttaradit) obvious shortcomings in plant were being rectified by ad hoc modifications.

When viewed again the scarcity of capital and the problems associated with the great dependence of Thailand on imported plant and equipment (see below), this lack of balanced objectives and economic policies for "maintenance" must be regarded as a serious deficiency in management education.

The Objectives of the Maintenance Function

The objectives of the "maintenance" function and the factors which influence the choice of the most economic protection policy are given in Appendix 6.

We believe the primary objective to be protection of the investment in buildings, plant, services and equipment.

Where the product life is long, the plant expensive or the rate of technology change within the industry low, concentration on maintenance of the plant to prevent functional deterioration may be the best means of protecting the investment.

The case may be different where product life is expected to be short, where machine speeds within the industry are increasing rapidly year by year, or where plant is relatively cheap.

Then the best means of protecting the investment (rather than the plant) may be to reduce maintenance to a minimum, repair breakdowns only, and adopt a sound plant replacement policy as the best means of protecting the investment.

In the absence of such a broad view of the "maintenance" function

* The Government plants tend to suffer from lack of modifications and replacement which are necessary to protect the investment.

* The Government sugar mills are probably being over-maintained during the shut-down period.

* Some preventive maintenance programmes are too expensive for the results achieved.

Different Approaches in Private Enterprise

There appears to be a significant difference between the policies adopted in Government and private enterprise. These differences include:

* Private industry provides more qualified support for the Maintenance Engineer (or Chief Engineer). This difference is reflected both in the organisation structure and the salary ranges.

  Very few purely "staff" engineering functions appear to exist in the Government plants, except at the Railway Workshops, whereas each private organisation of more than 100 people had at least one staff engineer.

  In conducting preventive maintenance and effective plant modification programmes, this type of support is invaluable, if not essential.

* Private industry exercises much more control over the "maintenance" process. For example, preventive maintenance is a more firmly established practice.

* Private industry aims to attract better staff by paying higher wages and salaries, particularly at the maintenance management level.

* Private industry tends to use contractors for maintenance to limit its fixed labour force wherever possible.

Specification and Design of Plant

The great majority of plant, machinery and equipment is imported into Thailand from countries situated in the temperate zone, notably U.S.A., Japan, West Germany, and Britain.

Many of the characteristics of such plant are sensitive to climatic and environmental influences. For example, electrical insulation in such items as electric motors, generators, switchgear, transformers, etc., which will perform satisfactorily in the temperate zone, is unsuitable in Thailand's climates owing to higher average ambient temperatures and relative humidity.

Another example illustrates the practical difficulties

> Automotive assembly companies found excessive rates of consumption of spot-welding tips due to over-heating.
>
> The cooling water temperature available in Thailand is about 78°F, compared with the spot-welding equipment design temperature of 60-65°F.
>
> Booster pumps have been necessary to increase the cooling water flow. Cooling towers have also been installed.

We observed other examples of such difficulties, where designs and materials were not appropriate to the local environment.

The Relation of Maintenance to Suitability of Plant

The amount of maintenance and repair work associated with a particular installation depends partly on the effectiveness with which the plant and equipment has been

* specified to meet the demands placed upon it
* designed or selected to meet the specification
* installed and tested.

The specification of plant and equipment in Thailand is complicated by the relative lack of a well organised, documented, respected and enforced set of Government regulations and standards.

It is possible, for example, for a client to specify a certain sized electric motor to drive a pump, without adequate protective equipment to safeguard the motor against overload or power surge. The initial saving in capital may be more than offset by the cost of rewinding a burnt-out motor.

Historically, the responsibility for both writing plant specifications and meeting them appears to have been largely vested in the suppliers of plant and equipment, including consulting engineers who have designed complete operating plants.

Where the suppliers have been experts in their field, and in addition motivated by professional ethics, some excellent installations, such as the paper mill at Kanchanaburi or the gunny bag factories, have been developed.

On the other hand, plants such as the soda ash recovery plant at Kanchanaburi, the Suphanburi sugar mill, or the Bang Pa - In paper mill suffer from poor design and material selection.

In many cases it is uneconomical to modify or replace a poorly conceived plant, and the penalty must be borne in terms of excessive maintenance and repair for the life of the plant.

Much more attention needs to be directed towards ensuring that plant and equipment imported into Thailand meets mimimum specified performance requirements when subjected to local environmental factors such as heat flow, humidity, ground water composition, etc.

As well, steps must be taken to ensure this equipment is in keeping with the most advanced technological practice available in the country of origin. It is not in Thailand's interests to import obsolete practices or equipment.

We understand that a programme is in hand to develop a comprehensive set of industrial standards. This programme should be hastened, as foreign equipment is being imported at an accelerating rate.

Management and Training Needs

As in most countries, the "maintenance" policies and practices adopted in each Thai enterprise reflect to a great extent the interest and understanding of the enterprise's management.

For example, the sugar mills at Uttaradit and Lampang, despite their age, are in an excellent repair so far as the plant itself is concerned. This reflects both managements' keen interest in plant maintenance, possibly stemming from the engineering backgroun of the Mill Manager at each location.

The predominant practice, however, of primarily keeping the plant in good repair rather than maximising the return on investment, lessens the impact of such interest on the overall economics of operation. For instance, a high polish on the brass work does not necessarily indicate effective "maintenance", whatever its effect on morale may be.

As pointed out above, there is a need to further educate management in analysing the problems and opportunities of technological change. Education is needed too in the establishment of optimum maintenance policies which take account of plant upgrading and replacement.

Drawbacks to Present Maintenance Training

The Thailand Management Development and Productivity Centre, of the Department of Industrial Works, has a current training course on Plant Maintenance which seeks to provide this education. We do not regard this course as being fully effective. Our reasons include:

* The course is too general in its objectives to be of maximum use to maintenance management.

* It adopts a particular approach to preventive maintenance without discussing the range of policies which are possible and the method o establishing the best policy for the particular situation.

* It is conducted by people who are not skilled and experienced in maintenance management.

We have made recommendations for improving this course and for subsequently adapting it for presentation to junior management and foremen.

There is a further means of bringing more sophistication into management's attitude to maintenance. This would be to move for inclusion of an appreciation of the alternative policies and their discriminants in engineering courses at degree, diploma and certificate levels. A suitable presentation could also be included in a brief form in management courses at educational institutions.

The influence of management on maintenance practice could also be improved by a free exchange of views among maintenance engineers, and between maintenance engineers and other groups, such as machinery suppliers, experts in materials, corrosion engineering and so on. We have made recommendations relating to the conduct of regular Maintenance Forums as a means of achieving this.

Need for Top Management Education

The fact remains, however, that the degree of intelligent control which management exercises over the setting and achievement of objectives is very largely determined by the attitude of the chief executive of the enterprise. We repeat that with significant exceptions, this attitude to maintenance appears to be limited to plant upkeep in most cases.

It may be that the Thailand Industries Association can be encouraged to undertake a programme of top management education on what controls are necessary and how they should be exercised. That programme could be done in association with the Thailand Management Development and Productivity Centre.

We also believe that awareness of maintenance requirements at top management level could be reinforced by:

1. Requiring companies seeking assistance through the Board of Investment or other Government agency to nominate their maintenance policies and controls. The Board's influence could be considerable. For example, nearly 400 enterprises had set up, under its auspices, by the end of 1969.

2. Including advice on maintenance policies in the range of advice offered by the Small Industries Service Institute.

3. Encouraging the publication of knowledgeable articles on maintenance policies in prestige magazines, such as The Investor.

"Maintenance" Staff

Four levels of personnel need to be distinguished:

1. Maintenance management

2. Technical supporting staff

3. Trade supervisors

4. Artisans.

The areas of weakness we observed were:

* Only half of the chief maintenance executives in Government plants were university graduates. In contrast, all private companies, except the small rice mills, employed a university graduate.

* With few exceptions, the Government plants provided little technical support for the chief engineer. Again, in contrast, most private companies had several people with a degree or diploma to assist the chief engineer.

* Trade supervision appears, generally, to be the weakest area of management. Very few foremen had any formal training in supervision. In most plants, the foreman is regarded as being part of the work force rather than part of management.

* Most artisans lack adequate general training, and acquire their knowledge "on the job". Very few graduates from vocational schools appear to enter the maintenance field. The maintenance impact of the Vocational Training Project being undertaken by ILO in association with the Ministry of Labour has not yet been felt.

* We were favourably impressed by the intelligence and aptitude of Thai labour. But there is a need to provide more formal training in both general and particular fields. In a number of cases the amount of detailed supervision on job procedures appeared to be excessive.

* Private industry again fares better than Government industry in the proportion of qualified artisans, and pays higher wages accordingly.

The Shortage of Graduate Engineers

The problems of maintaining sophisticated industrial plant are of the same order of complexity as the technology of the plant itself.

The increasing importation and importance of manufacturing plants, and the increasing complexity of these plants, together with the pressures exerted on maintenance costs by increasing wages and spare parts costs, make it essential that a higher proportion of "maintenance" personnel must be educated and trained in the technologies concerned.

At this stage in Thailand's development, "maintenance" does not appear to have great attraction for graduates.

The output of university and vocational school graduates is still at a level where demand exceeds supply. Graduates are able to choose positions with more stature and higher income than those in maintenance.

Even when free housing is available, plants in rural areas, such as the sugar and paper mills, also appear to be at a disadvantage in attracting qualified personnel.

6. SPECIAL NEEDS: DEPARTMENT OF INDUSTRIAL WORKS

Our findings and recommendations on the Department of Industrial Works' plants were set out in a letter to the Director General of the Department.

This letter is summarised below, and followed by brief comments.

Mr. Udomsakdi Bhasavanich,
Director General,
Department of Industrial Works,
Ministry of Industry,
Rama VI Road,
Bangkok, Thailand.

Dear Mr. Udomsakdi,

This letter is to confirm the findings and recommendations arising from my tour of the Government owned plants, which I set before you verbally on Wednesday 23 September.

The plants which I visited were

Sugar mills at Suphanburi
Uttaradit
Lampang

Paper mills at Kanchanaburi
Bang Pa-In

Distillery at Thonburi

Gunny Bag Factory at Nonthaburi.

The purpose of the visits was to survey the problems and needs of the Government plants in the field of repair and maintenance.

A. Findings

1. Organisation

In general, the organisation of the maintenance work force as it has been described to me is appropriate to the needs in each plant, except that little or no technical and clerical support functions are provided for the Chief Engineers.

2. Staffing

The quality of Chief Engineers in the plant varies considerably, from practical men with little academic training to fully qualified engineers. The quality of maintenance artisans appears to be acceptable in most cases, though few of these have vocational training. In those plants where turnover of artisans is a problem, the lack of vocationally trained men causes a major training work load, particularly at Uttaradit and Bang Pa-In. The lack of such training also results in a number of faulty maintenance practices.

3. Condition of Plants

The Government plants are in a generally acceptable condition with the following exceptions:

a. Housekeeping of work areas is poor at Suphanburi, Bangyikhan, Bang Pa-In and in the stores area at Lampang.

b. Surplus and obsolescent material or equipment is left in working areas at Suphanburi, Bangyikhan, Bang Pa-In, Uttaradit and Lampang. In all cases, a special storage area and accounting for surplus materials is required.

c. Treatment of feed water for boilers needs to be given more attention at most plants.

d. Building maintenance requires more attention.

e. Corrosion is a problem at all plants.

Government plants are, in my judgement, becoming obsolete by default, through failure to make modifications which can be justified by return on investment, and which would keep these plants abreast of productivity improvements within the industry. The installation of boiler economisers and individual condensers for vacuum pans, for example, could almost certainly be justified for sugar mills by the reduction in fuel costs.

In certain cases, notably Suphanburi and Bang Pa-In, the condition of the plant is affected by unsuitable selection of plant and materials at the design stage.

Lost time is excessive in the paper mills and at Suphanburi.

4. Equipment

The equipment available for maintenance is generally satisfactory at Suphanburi, Bang Pa-In and Khanchanaburi. The workshops at Uttaradit, Lampang, Bangyikhan and Nonthaburi are equipped with old and worn machine tools, many of which are unsuitable even for maintenance purposes.

5. Work carried out by the Maintenance Departments.

a. Excessive maintenance work is being carried out on boilers, pumps and electric motors at the process plants. While this may be due to unsuitable choice of equipment and material, and to some extent to the age of the equipment, the dismantling of pumps and motors could probably be reduced by implementing maintenance histories.

b. The maintenance workshops at Suphanburi, Uttaradit, Lampang, and, to a lesser extent, at Bang Pa-In and Nonthaburi, are acting as spare parts manufacturing shops. The economic wisdom of this is questionable.

c. The activity of most plants is restricted to breakdown repair during the operating seasons (all the year for plants other than sugar mills).

d. Only Bangyikhan uses contractors for maintenance work to any extent. In any case, there is a lack of capable and available contractors even in the Bangkok area.

e. Maintenance of trucks and tractors is carried out by maintenance staff at each sugar mill. In addition, Uttaradit and Lampang maintain steam locomotives, rolling stock and track. There appears to be a good case for contracting this maintenance out.

6. Methods and Quality of Work

The following exceptions to good practice were observed:

a. Dismantling of electric motors in plant areas, in wet, dirty and corrosive surroundings.

b. Welding of electric motor shafts after failure.

c. Butt-welding of pipes where bolted flanges were required.

d. Use of two different metals in corrosive conditions without an electrically insulating separator.

e. Incorrect mounting of ball and roller bearings.

f. Damaging of surfaces by hammering to cut gaskets.

These are a few examples to demonstrate the need for better training of maintenance labour in good maintenance methods.

It is difficult to comment on the quality of work done in the machine shops and foundries, since this is to a large extent influenced by the quality of machine tools and equipment available. Improved quality is almost certainly possible with an upgrading of machinery and shop methods.

Choice of better materials for parts which have failed through corrosion or wear should also provide significant gains in the quality of work done.

7. Inventories

Stock records for spare parts are kept at all plants, but insufficient attention is given to the setting and revision of Re-order Points and Re-order Quantities, and to the quitting of redundant and obsolete materials. In consequence, I believe that scope exists for reduction of stock levels without loss of adequate cover against breakdown, following a detailed study of spare part usage.

In particular, the sugar mills should be able to substantially reduce stock levels by detailed planning of the annual overhaul. Relatively few items need to be carried in stock to cover breakdowns during the crushing season, while the bulk of spares may be ordered once a year, with deliveries timed to coincide with the planned overhaul.

8. Maintenance Records and Control

Maintenance Job Orders are in use at the Lampang, Uttaradit, Bang Pa-In, and Nonthaburi plants. Plant history cards are in use at the Uttaradit plant (for new plant only) and the Bang Pa-In plant. Little analysis of these cards has been undertaken at these plants, however. Plant Log Sheets are kept at Khanchanaburi, but these are not analysed on a formal, routine basis. Maintenance Schedules are not in use at any plant. Maintenance Backlogs (of work requested or planned, but not completed) are not in use at any plant. Performance of the maintenance workers on jobs is recorded at the Lampang mill. A common system of yearly and monthly budgets and of planned Maintenance Committees is used in all plants except Bangyikhan.

In summary, it can be said that control is loose and that virtually no preventive maintenance apart from lubrication is undertaken while the plants are in operation.

The shutdown maintenance carried out in the sugar mills between crushing seasons is a form of preventive maintenance. The absence of Plant History Cards and Maintenance Schedules for shutdown works makes it probable that the sugar mills are being over-maintained during this period.

It can be said that none of the Government plants has put into practice the principles of maintenance recording and control which are put forward in the Management Development and Productivity Centre's training Course on Plant Maintenance

9. Other Comments

a. The service given to the Government plants by machinery and equipment suppliers is poor. Engineers do not appear to be kept up to date on the available improvements in such things as materials, designs, water treatment, etc.

b. Plant performance and maintenance characteristics have depended very much on the skill and integrity of foreign designers and suppliers of plant and equipment, who have matched the plant to the demands of operating under conditions in Thailand with varying degrees of success. In the absence

of plant histories and qualified technical support for the plant Engineers, soundly based programmes of plant modification to overcome design shortcomings have not been achieved.

c. In general, the Government plants are kept in good repair on a breakdown basis. The above findings do not therefore necessarily reflect on the maintenance management at the plants. In fact, within the limits imposed by the practice of "breakdown maintenance", the plants at Uttaradit and Lampang are kept in outstanding condition.

B. Recommendations

It is recommended that

1. Steps are taken to implement full job recording and plant histories at all plants. Details of maintenance work carried out during shutdown in the sugar mills, with the man hours used, should be recorded. The necessary clerical effort to achieve this should be provided.

   The implementation should commence with in-plant training of management and supervisors, and system development for the particular plant.

2. A study is made of the actual production capacity of each segment of each plant, to identify the critical and sub-critical items of the equipment. The action to be taken to remove the successive actual bottlenecks (whether by improved maintenance or by plant modification), the cost of this action and the benefits to be gained from it, should be listed and submitted to the Department for policy decision. These decisions should be incorporated in a capital budget for each plant.

In the case of the paper mills and distillery, installed stand-by equipment should be considered as a means of overcoming breakdowns, where this can be justified by saving in lost time.

This step is viewed as an effort to protect the investment of public money in Government plants from depreciation by mis-matching and obsolescence.

3. All redundant plant and equipment is removed from plant working areas into a special compound at each plant. Obsolete stock should be segregated for decision on its disposition by the Department.

4. Consideration is given to divestment of all factory-owned transport and farming equipment to contractors. Alternatively, consideration may be given to the use of contractors for maintenance on vehicles.

5. A study of the cost and benefits of individualising the drives on machine tools, and replacing machine tools by more modern machines is made at the Nonthaburi, Uttaradit and Lampang plants.

6. An annual Maintenance Forum of one week is organised by the Productivity Centre. This should be addressed by representatives of suppliers of equipment, on matter of interest submitted by plant engineers. Invitation should be extended to engineers and foremen of Government plants, and to private industry through the Thai Industries Association.

7. The Productivity Centre's Maintenance Course should be adapted to the level of foremen and junior executives, by being made -

   * more practical
   * more directed towards "Selling" preventive maintenance.

8. The Department undertake a phased programme of contract development by -

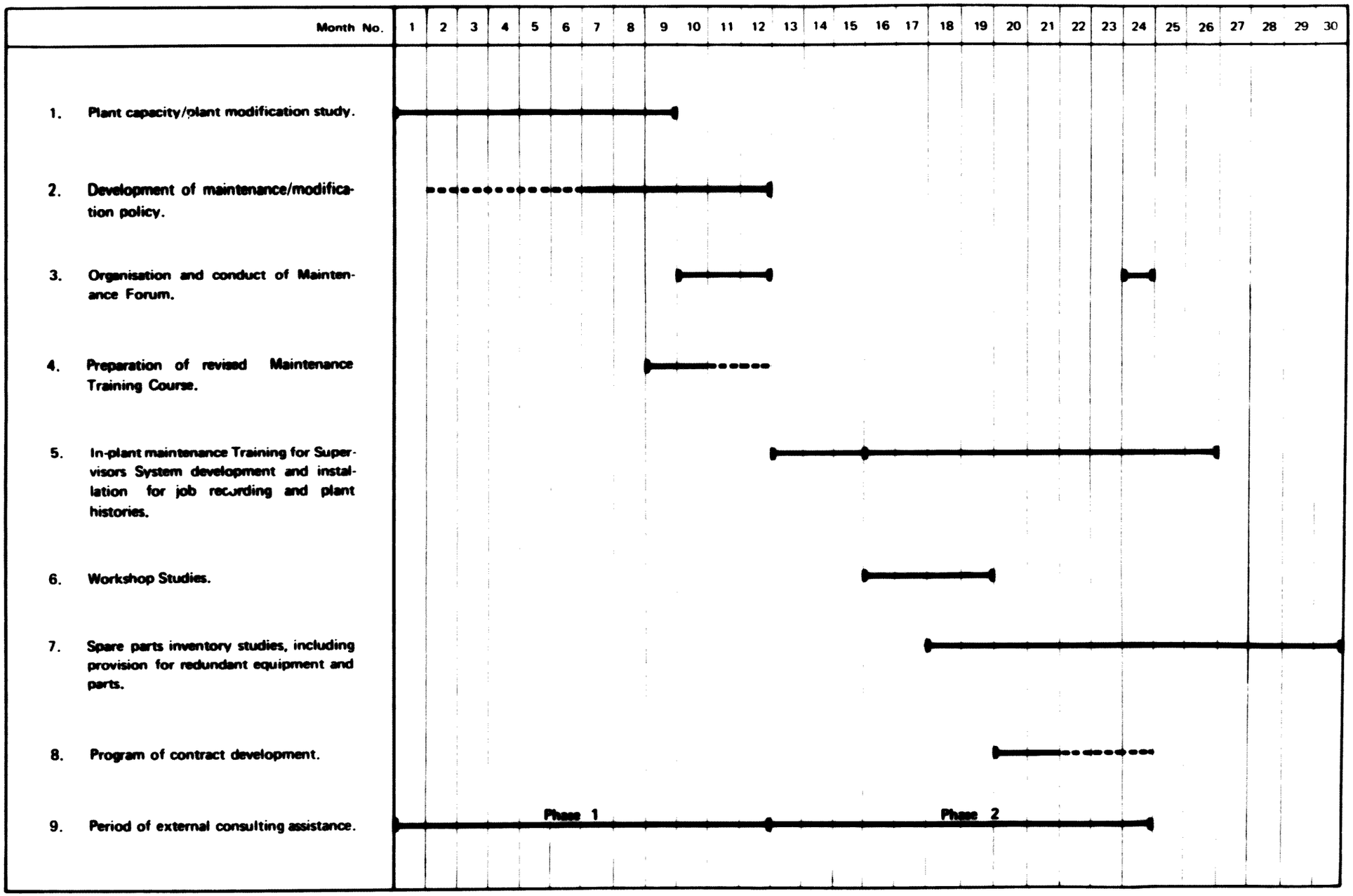
   * setting up a list of "approved" contractors
   * encouraging the use of contractors by Government plants.

9. An examination of the stock levels of spare parts at each plant is made, with the objective of setting maximum/minimum levels, and of segregating obsolete stock.

C. Suggested Programme

In order to implement these recommendations, a programme of activity by the Department's staff, with assistance from outside organisations where necessary, could be:

Suggested Consulting Programme



This programme calls for an initial detailed study of the economically justifiable modifications called for at each Government operated plant in order to optimise the plant's effectiveness, without undertaking major investment programmes. The study could be effectively carried out on the six plants in nine months (or, if Bangyikhan were included, 11 months) by an appropriately qualified engineering consultant with the assistance of one engineer and one economist/commercial type from the Department.

At the conclusion of this study, information would be available for the Department, in consultation with the study team, to formulate a forward policy relating to the way in which each plant is to be either -

* developed and protected
* protected only
* allowed to degenerate.

This formulation will require, of course, not only the results of the above study, but an examination of future markets and market trends, and competition in the market. The appropriate maintenance practices will be developed from the policies thus formulated. This stage should take a further three months, with the assistance of the consultant who undertakes the initial study.

The next stage would be the organisation and conduct of a Maintenance Forum, and the development of a revised Maintenance Training Course, for the supervisor level.

In-plant maintenance training and system development and installation for job recording and plant histories could then commence. Each plant would require about two months of initial full-time effort by a consultant from the Productivity Centre, adequately qualified and trained for the job. The consultant would then follow up each plant on the basis of one day per fortnight for a period of six months.

A study of the requirements of the older workshops could be initiated at about the same time by the external consultant, and should take about four months.

It would then be appropriate to initiate studies of spare parts inventory, in co-operation with stores staff at the plants. This would be carried out in a similar fashion to the stage of maintenance training and system development - that is, by Productivity Centre consultants. The initial full-time period would be somewhat longer, being at least three months at each plant.

Finally, the initiation of a Departmental section to encourage and control the use of contractors and assist in the specification of equipment would take one to two months, with a continuing effort of communication with plant engineers.

This programme calls for resources as follows:

1. Two consultants from the Management Development and Productivity Centre for a period of approximately two and one half years. One of these consultants would have an economic/commercial bias, the other an engineering bias.

2. An experienced consultant, primarily an engineer, with experience in maintenance activities in the process industries, investment studies, inventory control, contract control and staff training, for a period of twenty four months.

   This consultant should be engaged firstly for a period of twelve months (Phase 1) for the plant evaluation study, and any further commitment, and indeed the programme itself, should be reviewed at the completion of this phase.

   The second phase, as seen at the moment, would comprise twelve months of developing and implementing maintenance policies and controls at the plants.

In view of the wide range of skills demanded of the experienced consultant, it might be desirable to use a different consultant for each phase, depending on the skills available.

It is unfair to expect that a consultant with the necessary skills and experience will be found within the staff of the Department. Assistance from the United Nations Industrial Development Organisation is recommended to provide a consultant qualified to oversee the programme.

Permanent Controls

The controls which the Department needs to exercise over the plants in order to ensure that the gains made during the consulting programme are not dissipated will need to be established during the programme.

Certainly, these controls will need to be closer than the present method of budgetary control. Regular performance reports and work backlogs would be the minimum additional requirement. The method of analysing and acting on reports from the plants will need to be examined.

D. Conclusion

It is my intention to incorporate the above findings, recommendations and suggested programme in my report to UNIDO, Vienna.

If you have any comments or suggestions, I would appreciate receiving these by Friday 9th October so that I may take account of them in my report.

Finally, I would like to take this opportunity of thanking you most sincerely for the co-operation and warm hospitality which you and your staff have extended to me. In particular, Mr. Chongcharoen has made very satisfactory arrangements for all of my plant visits and given the courtesy of his office and his staff at all times, and Mr. Pragit has been a most helpful and effective counterpart. The assistance and hospitality which I found at each of your plants was outstanding. It has been both a pleasant and rewarding experience to work with the Department on my first visit to Thailand.

Yours sincerely

(Signature)

(H. D. MUNRO)
W. D. SCOTT & CO.

Comments on Letter

It appeared to us that there was a question of viability on some - though not all - Departmental plants. That question cannot be resolved without an objective analysis of the plants' potential for improvement.

Only when it is clear as to what is the most advisable future for the plants can the appropriate maintenance policies be established. At that time it will be practicable to formulate a programme of "maintenance" improvement.

The possibility must be faced, however, that the programme of "maintenance" improvement could result in diminished activity for some plants. For example, it might be demonstrated that the extent of overhaul of sugar mill equipment in the non-crushing season could be reduced without significantly increasing the cost of operation during the crushing season.

On the other hand there is the prospect that, by making marginal capital investments, one or more of the plants could realise significantly more of its potential than is now the case. Additionally, opportunities for rationalisation will occur from analysis of the viability of plants.

In brief, major maintenance programmes would appear premature in the absence of answers on the plants' future. As indicated in the letter to the Director General of the Department of Industrial Works, the logical course seems to meet both needs - viability questions and maintenance planning - as part of the one, integrated programme.

7. CONCLUSION

This report has given the main findings and recommendations of an exploratory study on maintenance and repair facilities, services and needs in Thailand.

The report has concentrated, in part, on Government plants run by the Department of Industrial Works. The physical preservation of these plants is in some cases outstanding, but in the setting of policies directed towards protection of the investment, and in controlling the cost effectiveness of maintenance work, maintenance management in Government plants is seen as being less effective than in private plants.

Specific recommendations have been made as to how maintenance management can be improved in the Government plants. But it has been stressed, too, that such improvements cannot be made in isolation: the future viability of the plants must also be established, and opportunities for rationalisation established.

In particular - and this applies to private plants as well as departmental factories - a concerted programme is needed at many levels to overcome the greatest single problem facing Thailand maintenance management: the fact that the initial plant and equipment investments are too often poorly made. From that fact flows a major proportion of the country's maintenance problems and costs.

W.D. Scott & Co. Pty. Ltd.

December 23, 1970.

COPY OF A LETTER TO UNIDO ON CHANGE IN STUDY EMPHASIS

September 25, 1970

Mr. D. C. Newton
Chief, TEPCO
United Nations Industrial Development
Organisation
Felderhaus
Rathausplatz 2
A-1010 VIENNA AUSTRIA

Dear Mr. Newton

Subject: Exploratory Mission on Maintenance and Repair Facilities, Services and Needs - Thailand
Job Description THA-013-A (SIS)

I have received a progress report from our Mr. Hugh Munro who is currently in Bangkok undertaking the above assignment.

Mr. Munro has provided details of his initial discussions and activities in Thailand, and it seems appropriate to pass the essential points on to you.

There was a good deal of confusion at the outset, because:-

(1) A major difference has existed between the views of the Thai Department of Industry and UNIDO.

(2) Your UNIDO representative had to leave on the first day of the assignment for three weeks in Tokyo and the Far East.

(3) The UNDP Resident Representative was unavailable for the first three days.

Eventually, however, a programme was agreed with the UNDP Resident Representative, taking into account both the objectives which the UNIDO has had in mind for this exploratory mission, while endeavouring to meet some of the Department's demands in terms of visiting specific factories.

The UNDP Resident Representative indicated to Mr. Munro that he would write to you in Vienna confirming the arrangements he authorised, so that you would be fully informed of the situation.

During the first week of the project, Mr. Munro collected as much data as possible on Thai industry in general, and on the sugar and paper industries in particular. He visited several factories, and at the end of the week visited a sugar mill and a paper mill, both more than 100 miles from Bangkok.

The future plan agreed in outline for the subsequent three weeks of the programme included the following:

1. Plant Visits

   Mr. Munro would visit a Government distillery and a private caustic chlorine plant, and then follow this with an additional week of Government plant visits and about two days of visits to private plants.

2. Training

   Mr. Munro would have detailed discussions relating to the training of maintenance personnel with such people as:-

   - ILO personnel working in this area of activity;
   - Department staff;
   - Educational officials.

3. General Interviews

A series of interviews on all aspects of maintenance management, including future priorities, and financial and manpower needs, with

- The Association of Manufacturers;
- Ministry of Industry officials;
- Department of Industry officials.

Following these activities, the data will be analysed and assessed, a report drafted, and debriefing sessions held with UNIDO and UNDP Resident Representatives.

Although the administrative difficulties have been frustrating, Mr. Munro believes that the programme agreed with the UNDP Resident Representative will enable him to achieve the broad objectives of the study. He has had good cooperation from Department of Industry officials, and reports that he finds them "easy to work with".

I trust that this informal background report is of assistance to you.

Yours sincerely

Sgd. B. W. Scott
Director

EXPLORATORY MISSION

ON MAINTENANCE AND REPAIR IN THAILAND

EXTRACT FROM CONTRACT BETWEEN UNIDO AND W D SCOTT

" **1.02** Aims of the Project

The industrial sector in Thailand needs to organise and upgrade its maintenance and repair facilities. The Contractor's expert shall work with the local authorities and industry to help initiate action in this field by studying the existing situation and future requirements.

1.03 Having this in mind, the Contractor shall, in close co-operation with the Thailand Government authorities and institutions:

(a) collect all available information and statistical data concerning the import of industrial equipment and spare parts by category;

(b) evaluate the adequacy of the existing maintenance and repair schemes in different industrial sectors and enterprises;

(c) examine the possibilities of upgrading and improving the existing maintenance and repair facilities and services;

(d) determine the needs for new machinery to be used for efficient maintenance and repair activities;

(e) identify the industrial and economic opportunities for profitable manufacture of certain spare parts;

(f) formulate both a short and long-term programme in this field.

In carrying out the work as set forth under (a) to (f) hereabove

the Contractor shall give priority but not necessarily be limited to electronics, electrical equipment and mechanical machine shop practices."

APPENDIX 2-1

LIST OF PERSONS MET AND INSTITUTIONS VISITED

(In addition to industrial plants, Appendix 2.)

Ministry of Industry

Professor Yos Bunnag, Under-Secretary of State for Industry

Department of Industrial Works

Mr Udomsakdi Bhasavanich, Director-General

Mr Vira Susangkomkara, Deputy Director-General

Thailand Management Development and Productivity Centre

Mr Udomsakdi Bhasavanich, Director

Mr Chongcharoen Tansukasem, Administrative Officer

Mr A D Granger (ILO), Chief of Project, Management Consultancy Training Project

Mr P P Colborne (ILO), Industrial Engineering Consultant

Mr J J Healy (ILO), Marketing Consultant

Industrial Economics and Planning Division

Dr Vichit vong Na Pombhejara, Acting Director

Mr Samnao Chulkaratana, Chief, Industrial Project and Planning Section

Applied Scientific Research Corporation of Thailand (ASRCT)

Dr C L Wrenshall, Chemical Technologist

Mr N L Wake, Research Director, Economic Evaluation Group

Small Industry Service Institute (SISI)

Mr T W Lomnicky (ILO), Chief of Project

Mr J D Lloyd, (ILO), Marketing Consultant

Machinery Suppliers

Workshop Manager, B Grimm & Co.

Manager Technical Division, Lindeteves (Thailand) Ltd

General Sales Manager, Jardine Waugh Ltd

Maintenance Manager, International Engineering Co

Service Manager, Yip In Tsoi Co.

INDUSTRIAL PLANTS VISITED BY W.D. SCOTT CONSULTANT

Owner ship	Company or Plant	Location	Product	Age of Plant in years	Approx. no. of people employed	Pattern of Operation	General Maintenance Policy
Government	Sugar Mill	Suphanburi	Sugar	12	400	Continuous through 3-5 month crushing season	Breakdown Mtce. during crushing season. Plant completely inspected & overhauled in off-season.
		Uttaradit	(Plantation white)	29	300		
		Lampang		32	250		
	Paper Mill	Kanchanaburi	Writing & Printing papers	32	400	continuous	breakdown
		Bang Pa-in		13	400		
	Gunny Bag	Nonthaburi	Kenaf bags & Twine	20	500	2 shifts	preventive schedules
		Pathum Thani		3	400		
	Bangyikhan Distillery	Thonburi	Mekhong Whisky	more than 50	2000	continuous	breakdown
	State railway repair workshop	Makkasan	Coach construction, rolling stock + loco repair	24 +	3600	1 shift, 6 days for 50 weeks	preventive schedules
	Thai T.V. Co.	Bangkok	T.V. Broadcasts	16	40 (technicians only)	6 hours per day, every day	breakdown (stand-bys available)
Private	Thai-Asahi Caustic Soda Co. Ltd.	Amphur Muang Samut Prakarn	Caustic Soda, Chlorine and by-products	4	200	continuous	preventive schedules
	Bangkok paper Factory Co. Ltd.	Bangkok	Writing, Printing & Wrapping paper	20	200	continuous	breakdown
	Rice Mill	Bangkok	Rice	13	10	1 shift, 6 days for up to 50 weeks	breakdown
	Kanasuta General Assembly Co. Ltd.	Bangkok	Motor vehicles	7	150	1 shift, 5 days for 52 weeks	preventive schedules
	Siam Motor & Nissan Assembly Co. Ltd.	Bangkok	Motor vehicles	7	300	1 shift, 5½ days for 52 weeks	regular lunch time inspections

Notes: * Purchased second-hand
+ Age from post-war reconstruction.

MAINTENANCE QUESTIONNAIRE AND ANSWERS RECEIVED

W. D. Scott & Company developed a maintenance questionnaire. This was passed to the Department of Industrial Works for transmission to the Government and representative private plants visited.

Four of the Government plants replied to the questionnaire, as did one private firm. These were :

Suphanburi	Sugar Mill
Uttaradit	" "
Lampang	" "
Nonthaburi	Kenaf Mill
Thai - Asahi caustic soda plant	

No reply was received from the following government plants.

Kanchanaburi Paper Mill

Bang Pa - In Paper Mill

Bangyikhan Distillery

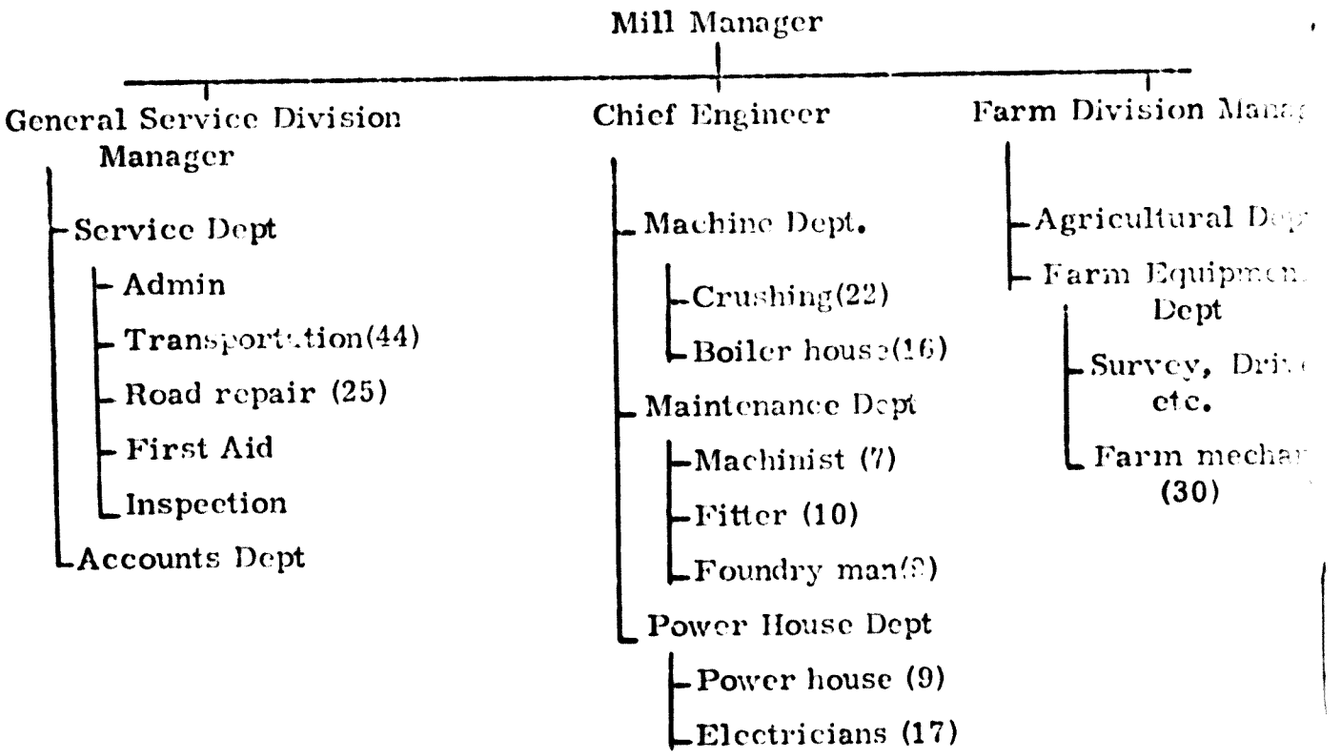
Eleven questions were asked in the questionnaire. The questions and the responses received are as follows:

QUESTION 1. Will you please supply an organisation chart of the plant, identifying all sections responsible for maintenance or repair activities, whether these be for productive plant, buildings, services or vehicles of any kind.

(The answers to Question One follow on the next three pages)

Answers from:

SUPHANBURI



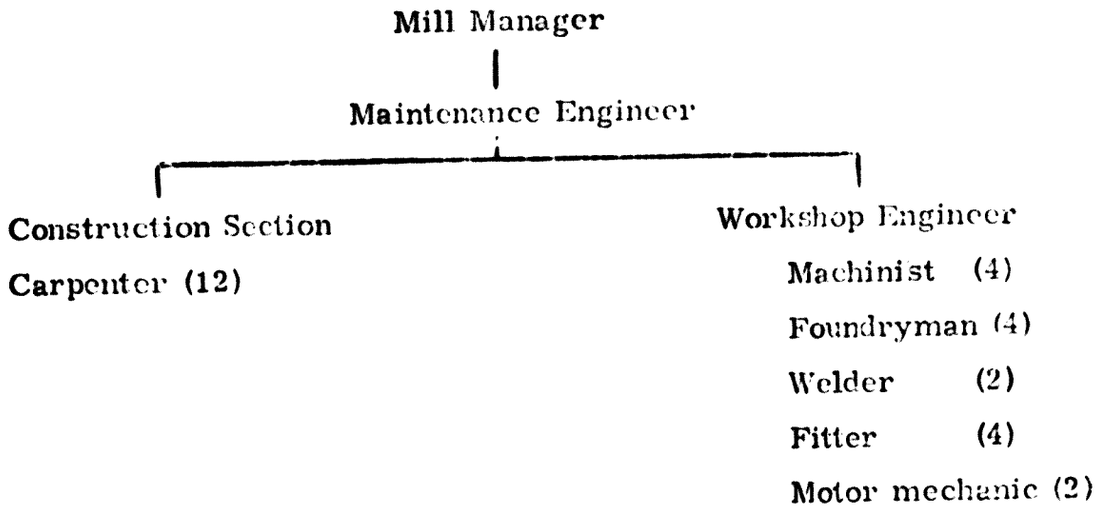
The number of people engaged in maintenance and repair activities are indicated beside the position.

In the case of Suphanburi, such people report not only to the Chief Engineer, but also to the other Divisional heads. Those engaged in truck and road repairs work within the Service Department, while those engaged in tractor maintenance work within the Farm Equipment Department.

The people in the Machine Department carry out minor maintenance and repairs to their own equipment during the crushing season, and assist in the overhaul during the non-crushing season.

Answers from:

UTTARADIT

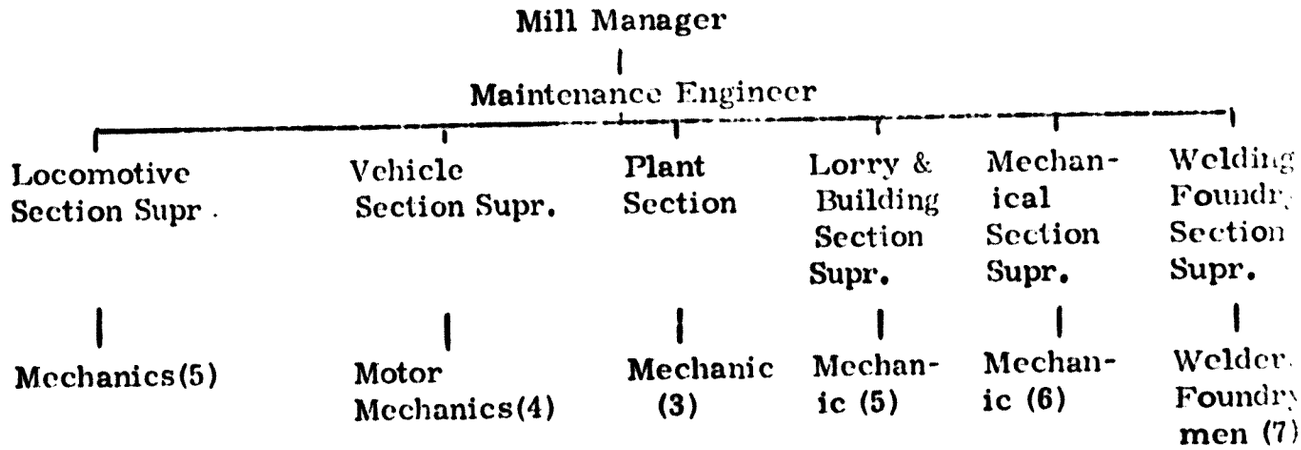


We understand that the people in the Machine Department work in a similar fashion to that described above for Suphanburi, i.e. minor maintenance during the crushing season, assisting overhaul in the non-crushing season.

Other functions reporting to the Mill Manager were not shown.

Answers from:

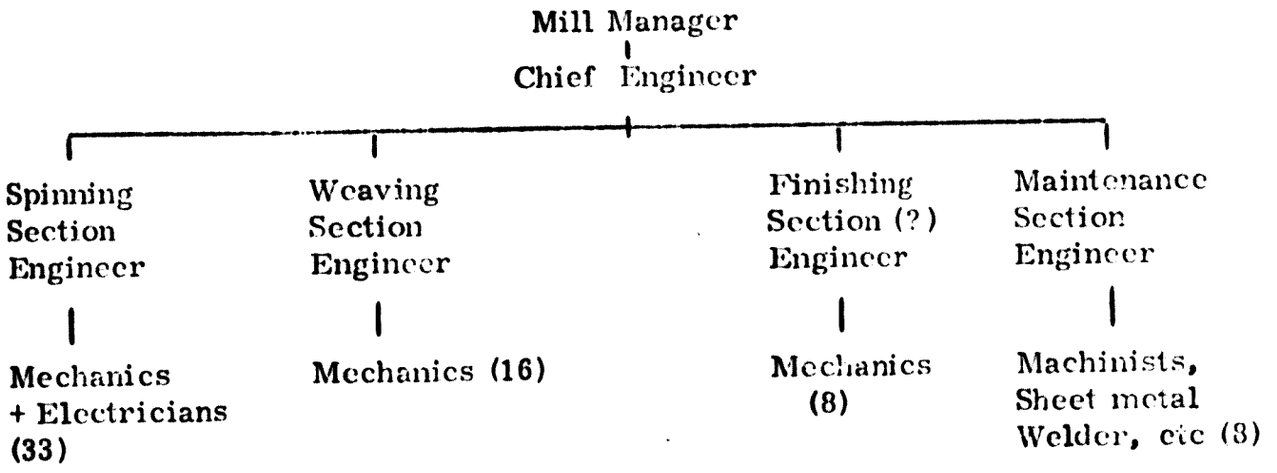
LAMPANG



Similar remarks apply as for Uttaradit.

Answers from:

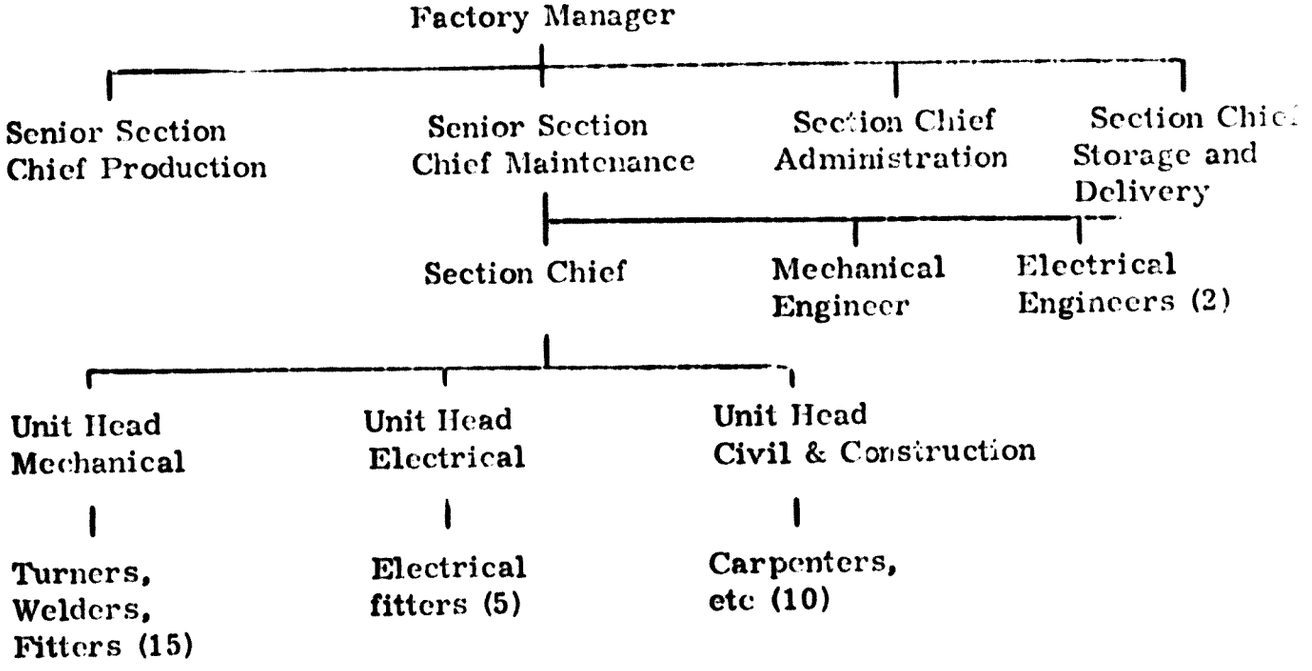
NONTHABURI



Other functions reporting to the Mill Manager were not shown

Answers from:

THAI-ASAHI



Q. 2. A full list of all people who undertake, supervise or manage maintenance, repair or modifications to buildings, plant, equipment or vehicles, showing for each person

Department or Section

Shift

Classification (e. g. Chief Engineer, fitter, etc)

Qualifications or training

Salary or wages paid per year

Number of years worked at the plant

Answers from :	Suphan-buri	Uttaradit	Lampang	Nontha-buri	Thai-Asahi
Qualifications of Chief Engineer	Degree	Diploma	Certificate	Diploma	Degree
No. of people with Diploma or Degree	2	3	-	5	4
No. of people with Certificate	18	-	2	9	12
No. of unqualified people	169	27	35	57	17
Salary range for supervisors Baht/annum	N. A.	19,000 - 38,000	7,200 - 20,400	8,400 - 22,800	21,000 60,000
Wage range for workers Baht/annum	N. A.	4,300 - 18,000	4,300 - 13,700	5,400 - 7,800	6,000 18,000
Average wage for workers Baht p. a.	N. A.	7,750	7,020	6,210	10,500
Years worked at plant -					
0 - 1	23	1	-	7	21
1 - 5	38	4	3	2	12
More than 5	108	25	34	62	-
Average age, years	N. A.	42. 5	44. 6	35. 2	28. 2

N. A. = Not available.

Q. 3. A description of the types of repair or modification work which is sent to outside contractors through lack of equipment or ability to handle the work at the plant.

No answer was given to this question by the Suphanburi and Nonthaburi plants. The Department did not translate the replies from Uttaradit and Lampang. The reply from Thai - Asahi was :

" a. General maintenance of electric substation (once or twice a year)

b. Big reconstruction or modification of building, etc.

c. Repairing of vehicles (trucks etc)

d. Big repairing of rubber lining of tanks."

Verbal replies to this question indicate that very little work is contracted out by government plants, except at Bangyikhan, where most repair work is done by contract.

Q. 3. A description of the types of repair or modification work which is sent to outside contractors through lack of equipment or ability to handle the work at the plant.

No answer was given to this question by the Suphanburi and Nonthaburi plants. The Department did not translate the replies from Uttaradit and Lampang. The reply from Thai - Asahi was :

" a. General maintenance of electric substation (once or twice a year)

b. Big reconstruction or modification of building, etc.

c. Repairing of vehicles (trucks etc)

d. Big repairing of rubber lining of tanks."

Verbal replies to this question indicate that very little work is contracted out by government plants, except at Bangyikhan, where most repair work is done by contract.

Q. 4. A summary of lost time in hours, classified by cause, for each of the past three years. For this purpose, lost time is defined as the time during which production is unable to continue due to breakdown, maintenance, etc.

Answers from:

		1967	1968	1969
Suphanburi	Actual crushing hrs.	2746	2805	3830
	% Stoppage due to machine breakdowns	6.7	3.6	6.9
	% Stoppage due to lack of cane	9.0	5.7	1.9
	% Stoppage due to cleaning	5.9	4.8	3.5
Uttaradit	Actual crushing hrs.	1226	1615	1560
	% Stoppage due to machine breakdowns	2.9	1.7	2.8
	% Stoppage due to lack of cane	0.4	3.4	8.2
	% Stoppage due to cleaning	9.3	13.5	4.4
Lampang	Actual crushing hrs.	1350	1380	2100
	% Stoppage due to machine breakdowns	2.6	2.6	2.0
	% Stoppage due to lack of cane	-	1.3	5.3
	% Stoppage due to cleaning	3.6	4.3	2.7
Nonthaburi	No lost time recorded.			

Thai Asahi

a). General maintenance 2 days p. a.

b). Stoppages caused by electrical supply (fluctuation, voltage drop, etc.) average 2 times per month, for a total of 144 hours p. a.

Most of the machines, such as motors, are installed in pairs for periodically alternated use or as a spare, if either of them is out of order. This saves lost time. Otherwise operation is continuous.

Q. 5. An analysis of the maintenance and repair expenses for the last financial year, classified under the following headings:

Land and buildings

Plant - modifications or additions

- repair and maintenance

Services, except vehicles

Vehicles

If possible, each of these classifications should be further divided into

Wages

Material - Spare Parts

- Consumable Stores

Other expenses.

Answers from :	Suphanburi	Uttaradit	Lampang	Nonthaburi	Thai-Asahi
Land & Buildings					
Wages		59,000	9,500		
Spares		35,000	28,000		
Consumables		16,700	16,700		
Other		11,200	3,200		
Total	-	122,000	57,000	11,700	9,200
Plant R & M					
Wages		118,000	131,000	51,100	
Spares		512,000	332,000	931,000	
Consumables		27,500	60,000	371,000	
Other		176,000	109,000	225,000	
Modifications		-	-	84,000	70
Total	1,936,000	834,000	680,800	1,662,000	1,534,000
Services					
Wages		35,400	11,900		
Spares		63,500	34,800		
Consumables		8,300	29,100		
Other		6,700	-		
Total	-	114,000	75,800	-	31,500
Vehicles					
Wages		23,600	195,000		
Spares		33,900	560,000		
Consumables		5,000	25,400		
Other		4,400	33,800		
Total	1,050,000	66,900	814,200	137,000	90,800
Miscellaneous					
	1,992,000	198,000			
TOTAL	4,977,000	1,335,000	1,628,400	1,761,900	1,664,000

Q. 6. The number of vehicles in use at the plant

a. Motor trucks

b. Tractors

c. Other

Answers from :	Suphanburi (Approx.)	Uttaradit	Lampang	Nonthaburi	Thai-Asaki
Motor trucks	50	6	7	2	1c
Tractors	50	-	14	-	-
Other	(Details not given)	4 Jeeps 11 Locos 391 Wagons	7 Car & Bus 9 Locos 300 Wagons	8 Car & Bus 6 Fork Lift	3 Car 2 Fork Lift

Q. 7. The method of maintenance of vehicles - that is whether they are repaired by the factory or are sent out to private repair facilities.

Answers from:		
	Suphanburi	All vehicles repaired at factory
	Uttaradit	All vehicles repaired at factory
	Lampang	All vehicles repaired at factory
	Nonthaburi	Vehicles repaired by outside contractor
	Thai-Asaki	Mostly vehicles repaired by outside contractors, with minor work at factory

Q. 8. The approximate value of inventory held for maintenance purposes, classified by

Buildings

Plant - Spare Parts

- Other Items

Vehicles - Spare Parts

- Other Items

Answers from :	Suphanburi	Uttaradit	Lampang	Nonthaburi	Thai-Asia
Buildings	-	72,000	32,000	-	10,000
Plant - Spares	3,377,000	905,000	594,000	3,000,000	4,795,000
- Other	67,000	123,000	46,000	-	-
Vehicles - Spares	2,234,000	128,000	260,000	-	10,000
- Other		53,000	64,000	-	-
Fuel oil & Lubricants	185,000				
TOTAL	5,863,000	1,281,000	996,000	3,000,000	4,815,000

Q. 9. Which of the following documents is in regular use at the plant·

Maintenance Job Order

Register of Current Maintenance Job Orders

Weekly or Monthly Program of Planned Maintenance Work

Preventive Maintenance Schedule

Plant Register

Plant History Cards

Plant Log Book

Other Documents (List)

Answers from :	Suphanburi	Uttaradit	Lampang	Nonthaburi	Thai-Asah
Maintenance Job Order	No	Yes	Yes	Yes	Yes
Register of Current MJO	No	No	Yes	No	Yes
Program of Planned Mtce.	No	No	No	No	Yearly Monthly
Preventive Mtce. Schedule	No	No	No	No	Yes
Plant Register	Yes	Yes	Yes	No	Yes
Plant History Cards	No	New machines only	Nc	No	Yes
Plant Log Book	No	No	No	No	Yes
Others			Work perform-ance on each MJO		

(The following are verbal replies from other plants on this important question).

	Kanchana -buri Paper	Bang Pa-In Paper	Pathum Thani Kenaf	Bangyi-Khan Distillery	Railwey Work-shop
Mtce. Job Order	No	Yes	Yes	No	Yes
Register MJO	No	Yes	No	No	Yes
Program	No	Yes	Yes	No	Yes
Preventive Mtce. Schedule	No	No	Yes	No	Yes
Plant Register	Yes	Yes	Yes	Yes	Yes
History Cards	No	Yes	No	No	Yes
Log Book	Yes	No	No	No	No
Others					

	Thai TV	Bangkok Paper	Rice Mill	Kanasuta Assembly	Siam Motor Assembly
Mtce. Job Order	No	No	No	Yes	Yes
Register MJO	No	No	No	Yes	Yes
Program	No	No	No	Yes	Yes
Preventive Mtce. Sched.	Yes	No	No	Yes	Yes
Plant Register	No	No	No	Yes	Yes
History Cards	No	No	No	Yes	No
Log Book	Yes	Yes	No	No	No
Others					

Q. 10. Which of the following reporting and control media are used in the plant:

Annual Maintenance budget

Monthly Maintenance budget

Backlog Report

Max/Min control of stores

Regular meeting between maintenance manager and supervisors

Other controls (List)

Answers from :	Suphanburi	Uttaradit	Lampang	Nonthaburi	Thai-Asia
Annual budget	✓	✓	✓	-	✓
Monthly budget	-	✓	✓	-	✓
Backlog report	-	-	-	-	-
Max/min stores control	✓	-	-	✓	✓
Regular meetings	-	✓	✓	-	Weekly
Other				Monthly report unfinished work	Special budget Control on materia price

Q. 11. The levels of authority for expenditure on

a. Maintenance

b. Plant modifications

Answers from :	Suphanburi	Uttaradit	Lampang	Nonthaburi	Thai-Asahi
a. Maintenance	Mill Manager authorises all expenditure	Mill Manager authorises all expenditure	Mill Manager authorises all expenditure	Managing Director authorises all expenditure	Factory Manager below 10,000 Baht Above this, Managing Director
b. Plant Modifications	Referred to Department of Industrial Works				Referred to Board of Directors

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SCOPE OF THE MAINTENANCE FUNCTION

A. Objectives of the "Maintenance" Function

1. Maintenance
   a. To maintain plant, equipment, services, land and buildings in a state which permits production to proceed at the required quality and quantity level.
   b. To protect the investment in these facilities from deterioration resulting from environmental or operating conditions.

2. Repair — To restore plant, equipment and services which have ceased to function to an operable condition.

It is also common for the function to have the following additional objectives:

3. Plant Modification
   a. To overcome deficiencies in the original design of the plant, as discovered during operation, by making suitable modifications.
   b. To adjust plant capabilities to changed circumstances, such as changes in raw material or end product.
   c. To protect the investment in plant, equipment and services from depreciation due to obsolescence, by modifications which keep the investment abreast of current technology.

This objective involves an element of capital expenditure. It is the practice of a number of large enterprises to assign its achievement to an Engineering Design function which is separate from the

"Maintenance" function, but in the small to medium size enterprise both functions are often fulfilled by the Chief Engineer and his staff.

B. Factors which Influence the "Maintenance" Requirements

The maintenance and repair work load which arises over a given period depends on

1. The type and size of plant
2. The environment to which the plant is subjected, made up of elements such as

   climate
   chemicals
   water
   loads

   This environment is to a considerable degree affected by the care and attention of the people operating the plant.
3. The design of the plant
   a. How well it is adapted to its environment and demands.
   b. How much attention has been paid to "maintenance" requirements.
4. The pattern of demand on the plant - whether continuous, batch or intermittent (e.g. seasonal).
5. The past history of the plant. Maintenance work loads carry a cumulative element, in that neglect of a maintenance requirement increases the probability of breakdown.

The work load which is actually required to be handled by the 'maintenance' work force depends in addition on

i. The machinery, equipment and skills available to carry out the work.

ii. Management policies regarding the standards of plant performance and appearance which must be maintained, which should take account of

- Expected product life
- Expected plant life
- Expected salvage value of plant at the end of its working life

iii. Management policies regarding plant modification, which should take account of

- Rate of technological change within the industry
- Competition within the industry
- Economics of modification

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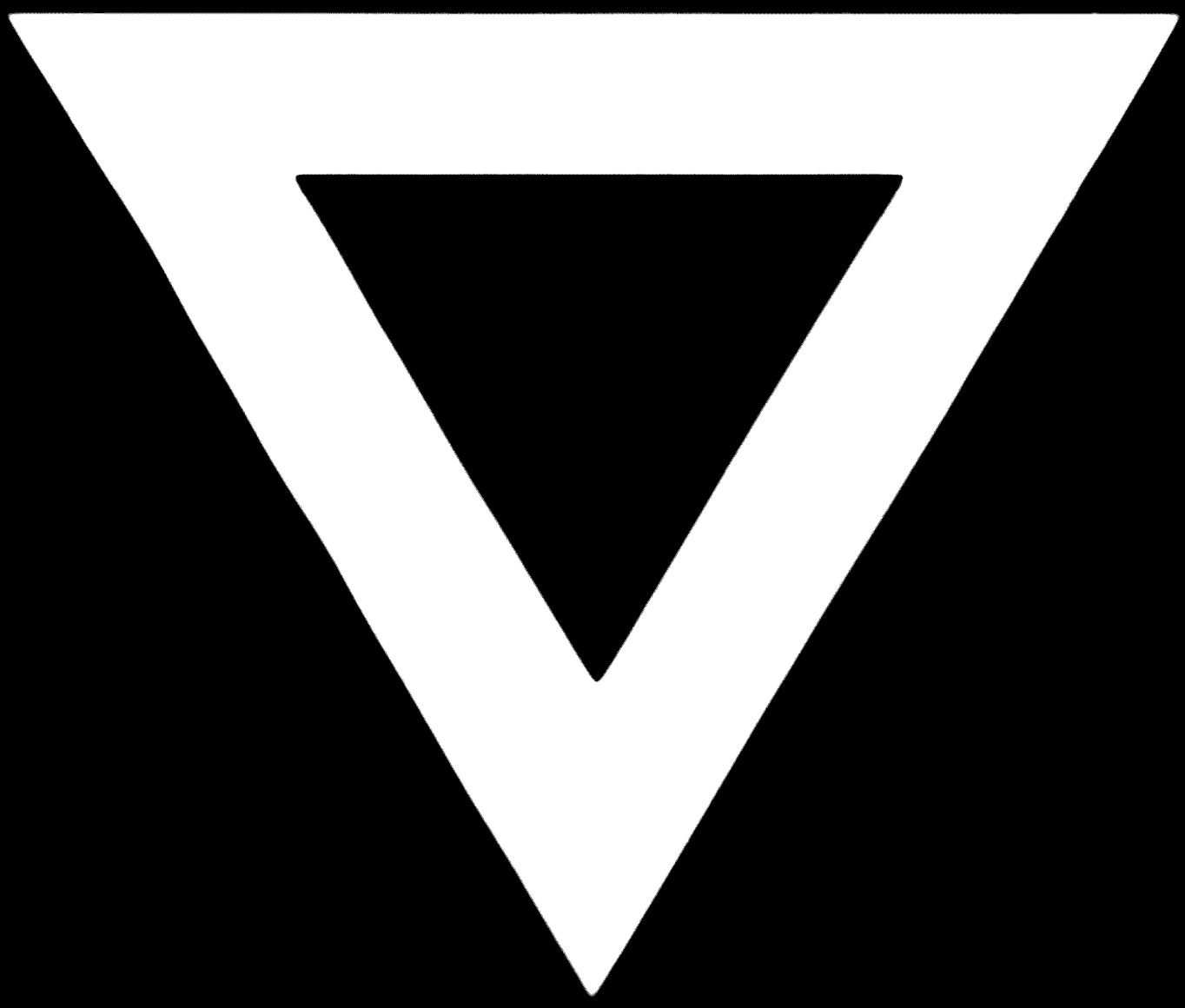

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