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PRE-FEASIBILITY STUDY ON GELATINE MADE FROM BONE*

Prepared by a consultant for the Office of the
Board of Investment, Government of Thailand

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I. INTRODUCTION

This is a study of a possible investment opportunity. It is one of a series of studies undertaken by the Board of Investment to help promote investment in Thailand. This report must not be construed as a feasibility study. It does not attempt to state that the investment opportunity is a viable project now or in the future. Instead, it provides the potential investor sufficient preliminary information about a project in an effort to encourage him to undertaken his own feasibility study.

The study relates to production of gelatin from bone. Gelatin is an organic, nitrogenous, colloidal and protein substance. It is obtained by hydrolysis from white fiber of the connective tissues of the animal skin, bones and tendons. Gelatin may be classified into four types as follows:

1. Photographic gelatin - Gelatin products are widely used by the motion-picture and photographic industries. Coated on the film box, it sensitizes the light - sensitive silver salts of the films.

2. Pharmaceutical gelatin - Gelatin is used by the pharmaceutical industry for making capsules and as an emulsifier.

3. Edible gelatin - Gelatin is a widely consumed food. It is very popularly prepared as a dessert.

4. Technical gelatin - Gelatin has been used for sizing paper, textiles and strawhats.

II. SUMMARY AND CONCLUSIONS

Animal bone is a main raw material for producing gelatin. As a country which has an abundance of cattle and buffalo bones, Thailand amazingly spends about Baht 45 million to import gelatin and gelatin capsules each year. Most of the unworked bone and the processed ossein (the intermediate product derived from bone for making gelatin) are exported at a value of Baht 60 million and Baht 30 million, respectively. There is, therefore, a potential investment opportunity for establishing a project that will manufacture the exported bones or the intermediate substance, ossein, into gelatin. The gelatin can be further processed to produce pharmaceutical capsules or used outright by other end-user industries.

Pharmaceutical grade gelatin is presently imported at about Baht 100 per kilogram. It normally requires about 3.03 kilograms of bone to make a kilogram of gelatin. The price of unworked bones per kilogram is about Baht 2.30. The other main raw materials such as hydrochloric acid and lime are likewise available in Thailand. A large margin therefore exists for a local producer to absorb labor and overhead costs and set a competitive price that would enable him to have a reasonable market share.

It is roughly estimated that a gelatin plant with a capacity of about 300 tons of gelatin would require an initial capital outlay of Baht 80 million. If selling prices are set at a competitive level of say Baht 90 per kilogram, the project will have a net profit as a percentage of total investment of about 13.6 % before tax and about 8.8% after tax.

III. MARKET CONSIDERATIONS

A. DOMESTIC MARKET

Gelatin is presently all imported by Thailand in finished forms: gelatin capsules, edible gelatin and gelatin derivatives. The import statistics, thus, approximates the total domestic demand for gelatin.

1. Import Statistics

The imported volume and value of gelatin products from 1972 to 1976 are presented in Table 1.

Table 1

Volume and Value of Imported Gelatin Products
1972 - 1976

Quantity in Tons and Value in Million Baht

Year	Total		Gelatin Capsules		Gelatin Edible		Gelatin and Gelatin Derivatives	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1972	152.0	24.0	47.4	21.6	-	-	104.6	2.4
1973	131.2	26.4	56.1	24.1	33.0	1.1	39.5	1.2
1974	206.8	45.6	139.8	40.3	67.7	4.2	30.3	1.1
1975	193.2	37.2	111.6	31.8	79.5	5.2	3.1	0.2
1976	224.3	47.4	121.6	42.4	93.7	5.1	9.6	0.3

Source: Department of Customs

Among the three groups of products shown in Table 1, gelatin capsules have consistently had the highest tonnage, except in 1972. The import values of capsules have likewise been significantly higher than other gelatin products.

2. Origins

Gelatin capsules are imported mainly from Canada, Japan, United States, Australia, Taiwan and West Germany. The proportion of importation from different countries during the last 3 years is shown in Table 2.

Table 2
Proportion of Gelatin Capsules Imported
from Major Supplying Countries - By Value
1974 - 1976

Supplying Countries	1974	1975	1976
Canada	28.1%	40.7%	48.7%
Japan	18.4	36.1	23.3
United States	30.7	11.0	17.9
Australia	17.7	9.9	6.4
Taiwan	1.3	1.3	1.6
West Germany	3.0	*	0.8
Others	0.8	1.0	1.3
	100.0%	100.0%	100.0%

* Very small

From Table 2, Canada, Japan and United States supplied 90% of the total gelatin capsules imported in 1975 and 1976.

Edible gelatin are imported mainly from the United Kingdom, West Germany, France, Japan and Australia. Imports from other countries are very small.

Gelatin and gelatin derivatives are imported mainly from United Kingdom, United States and Japan. Recently, there has almost been no importation from other countries.

3. Prices

The average CIF prices of different qualities of gelatin capsules imported from the three major suppliers: Canada, Japan and United States, were Baht 416, Baht 367 and Baht 423 per kilogram in 1974, 1975 and 1976 respectively. Among these three countries, the CIF prices of gelatin capsules imported from Canada have been the lowest.

Pharmaceutical grade gelatin can be imported at Baht 100 per kilogram. Gelatin and gelatin derivatives, and edible gelatin have lower imported prices. Last year CIF prices averaged about Baht 34 and Baht 75 per kilograms respectively.

B. DOMESTIC PRODUCTION

There is no registered manufacturer of gelatin made from bone in Thailand. At present, there is only one major manufacturer of products made from bones, Thai Bone Industrial Co., Ltd. This manufacturer is registered with the Board of Investment. It produces basically three bone products with the following annual capacities.

1.	Ossein (raw material for producing gelatin and glue)	1,500 tons
2.	Di-calcium phosphate	1,800 tons
3.	Bone by-products	varied quantities

The ossein produced by the manufacturer are all exported to Japan. Hence, there is no production of gelatin in Thailand.

The FOB price of ossein exported by Thai Bone are as follows:

Ossein - Grade A	Baht 24/kg.
Ossein - Grade B	Baht 19/kg.
Ossein - Grade C	Baht 15/kg.

In addition to the normal taxes, quarantine fee has to be paid on the exports at Baht 0.20/kg.

Very recently another company applied for Board of Investment promotion to produce hard gelatin capsules. This company, however, envisions to import all its gelatin requirements needed to manufacture the capsules. The company plans to import about 100 tons of gelatin per year to produce about 600 million capsules annually. If the project is implemented, it would represent an immediate linkage opportunity to an investment project engaged in gelatin manufacture.

C. EXPORT MARKET

The other four ASEAN countries also import raw bone, bone articles, ossein, gelatin and gelatin capsules. Some of these countries would represent potential markets of a Thailand manufacturer of gelatin if the price is competitive. Importation of gelatin and gelatin capsules by the other four ASEAN countries are shown in Table 3.

Table 3
Gelatin and Gelatin Capsules Imported
by Other Four ASEAN Countries
1974-1976

	1974		1975		1976	
	Quantity (Tons)	Value ($'000)	Quantity (Tons)	Value ($'000)	Quantity (Tons)	Value ($'000)
PHILIPPINES:						
Gelatin, edible, medical grade	21	1,526	12	877	20	587
Gelatin capsules for pharmaceutical uses	45	14,787	27	9,068	566	23,193
INDONESIA:						
Unflavored gelatin	509	11,530	246	5,286	321	7,085
Other gelatin	168	1,218	206	1,396	309	2,008
Capsules for pharmaceutical products	1	61	1	570	3	435
MALAYSIA:						
Gelatin and gelatin derivatives	53	5,029	NA	NA	NA	NA
SINGAPORE:						
Gelatin and gelatin derivatives	51	2,672	23	1,690	35	2,010

Note:

NA - Not Available

Source: Foreign Trade Statistics of the Philippines, Indonesia, Malaysia and Singapore

IV. TECHNICAL CONSIDERATIONS

A. MANUFACTURING PROCESS

The main raw materials for producing gelatin from bone are bone, hydrochloric acid and lime. Besides these raw materials, steam is a significant requirement during the process. The process starts from degreasing to crushing and acidulating to derive an intermediate substance called ossein. The ossein is further processed through soaking, washing, extracting, molding and cooking, cutting, drying and grinding. The finished gelatin is in powder form and is ready to be used to make gelatin capsules or other products.

In making gelatin capsules, the pharmaceutical grade gelatin is prepared in distilled water before it is transferred to an automatic machines, which performs the following production process: dipping of pinbars, drying, stripping, cutting and joining the body and cap portions of the capsules. During the process, strict control of the temperature and humidity is required. The finished capsules have to be inspected before they are packed in moisture proof packages which are ready to be delivered to the customers.

B. RAW MATERIALS

1. Supply of Bones and Ossein

As mentioned earlier, the only company producing ossein in Thailand is Thai Bone Industrial Co., Ltd. which is located in Bangkok. Thai Bone produces about 1,400-1,500 tons of ossein per year. The total production is presently exported to Japan. Instead of exporting the ossein to Japan, a plant can be established to process ossein to gelatin and to gelatin capsules respectively.

Besides the ossein production, another source of raw material is the raw bone itself which are exported in high quantities every year. Table 4 shows statistics on the volume and value of unworked bones and horncores exported.

Table 4
Volume and Value of Unworked Bones and Horncores Exported
1972 to 1976

Year	Tons	฿ '000
1972	19,537	38,247
1973	18,681	54,276
1974	13,735	63,063
1975	11,343	47,655
1976	23,086	92,024

Source: Department of Customs

In Table 4, due to the Department of Customs' classification, the unworked bones and unworked horncores are combined together. It is estimated that more than halfs of these are unworked bones.

The major sources of bones in Thailand are buffaloes and cattle. For the past six years the number of buffaloes and cattle in Thailand have been ranging annually from 5.4 to 5.9 million and 4.3 to 4.5 million heads, respectively. For the same period, the number of heads slaughtered ranged from 59,000 to 89,000 heads annually for buffaloes, and from 224,000 to 269,000 heads for cattle.

Tables 5 and 6 summarize the number of buffaloes and cattle in Thailand from 1971 to 1976 and the number of buffaloes and cattle slaughtered during 1971 to 1975.

Table 5
Number of Buffaloes and Cattle in Thailand
1971 to 1976
(In Thousand Heads)

Year	Buffaloes	Cattle	Total
1971	5,574	4,460	10,034
1972	5,361	4,485	9,846
1973	5,941	4,335	10,276
1974	5,946	4,432	10,378
1975	5,442	4,310	9,752
1976	5,679	4,546	10,225

Source: Ministry of Interior

Table 6
Number of Buffaloes and Cattle Slaughtered in Thailand
1971 to 1975

Year	Buffaloes	Cattle	Total
1971	88,826	253,110	341,936
1972	85,243	268,593	353,836
1973	58,656	249,216	307,872
1974	59,722	239,935	299,657
1975	71,646	223,877	295,523

Source: Ministry of Interior

It must be pointed out however, that the above statistics of slaughtered buffaloes and cattle represent only those slaughtered legally in established abattoirs which keep a record of their activities. A cattle expert has made a rough estimate that legally and illegally slaughtered buffaloes and cattle might be around 1.2 million heads a year.

There is no actual data on the volume of bones derived from the buffaloes and cattle slaughtered in Thailand during 1971 to 1975. The volume, however, can be reasonably estimated using the findings of the Department of Livestock Development from an experiment conducted at the Preserved Food Organization slaughterhouse in 1973. In that experiment, it was concluded that:

1. The average weight of one hot cattle carrion (before chilling) is about 156.72 kgs.
2. The carrion, when deboned after being chilled overnight (about 18 hours), produces on the average 26.15 kgs. of bones. This is about 16.68% of the weight of carrion before chilling.
3. For buffaloes, the average weight of one hot carrion is about 263.93 kgs.
4. After being chilled overnight, the carrion when deboned produces on the average 43.73 kgs. This is about 16.5% of the weight of the whole carrion before chilling.

Based on the conclusion derived above and on Table 6, the volume of bones derived from the slaughtered buffaloes and cattle can be reasonably determined as shown in Table 7.

Table 7
Volume of Bones Derived from the
Buffaloes and Cattle Slaughtered in Thailand
1971 to 1975
(In Tons)

Year	Buffaloes	Cattle	Total
1971	3,868	6,617	10,485
1972	3,712	7,021	10,733
1973	2,554	6,515	9,069
1974	2,601	6,272	8,873
1975	3,120	5,852	8,972

Computation:

1. Buffaloes: No. slaughtered x 263.93kgs per carrion x 16.5%
2. Cattle: No. slaughtered x 156.72kgs per carrion x 16.68%

However, if one considers the number of illegally slaughtered cattle estimated at 90,000 heads, this would represent an additional 2,460 tons of bones available. This would roughly place the tonnage of total bones available each year at about 12,000 tons. Out of this tonnage, the local manufacturer of ossein uses only about 2,000 tons a year.

2. Collection of Bones

Bones are collected by middlemen in various parts of Thailand and delivered to manufacturers or exporters in Bangkok or nearby provinces. A manufacturer/exporter assigns several collection agents in different cities. The agents send the bones in separate truckloads to the manufacturer/exporter, if there is enough quantity or send them with other products on regular delivery trips. Some manufacturers/exporters do not employ regular agents but do have suppliers who with established long-time business relationships. Once

in a while, they also get some irregular suppliers. The price and other selling terms are then concluded at the manufacturers' premises.

The biggest suppliers of bone are the Union Livestock Trading Company (ULTC) and Preserved Food Organization (PFO). These government slaughterhouses produce an average of 2,000 tons of bones a year.

Bones exported are mostly in the form of crushed bone or bone powder which are derived through the simple process of drying, boiling and crushing or grinding.

The export price of bone powder was ₱4.91/kg. in 1976 decreasing to ₱ 3.78 in 1977.

Dried unworked bone is purchased at Baht 1.70 to Baht 2.30 in Bangkok. If the bone is not dried, normally there is a deduction of about Baht 0.20 per kilogram.

Because of the substantial export of bones and the unsystematic collection system proliferated by middlemen for bones available outside Bangkok, the local manufacturer of ossein has found it cheaper and more convenient to import bones during certain periods. On the average, they import about 200-300 tons of bones a year from India.

3. Other Raw Materials

Other raw materials for producing gelatin and gelatin capsules from bone such as hydrochloric acid and lime are adequately available in Thailand.

C. LABOR

Manpower Required

Since this is not a feasibility study, only a rough idea about manpower requirement will be given here.

Production of gelatin capsule from bones can be divided into 3 stages:

Stage 1 - Bone to ossein
Stage 2 - Ossein to gelatin
Stage 3 - Gelatin to gelatin capsules

Thai Bone Co. which is engaged in the Stage 1 process employs about 240 employees. The operation is to some extent relatively labor intensive because it deals with the movement of heavy tonnage of raw bones. Stages 2 and 3 are relatively less labor intensive. The company which applied for promotional privileges for a Stage 3 project estimates the employment of about 63 employees. It is envisioned that a slightly higher number, about 155 employees would be needed for Stage 2. Most of the factory employees required will be relatively unskilled.

The present employment rates in Thailand follows:

	Monthly Salary (฿/Month)
Minimum wage rate	฿ 28 per day (8 hours)
Semi-skilled labor	฿ 1,500 - ฿ 2,500
Skilled labor	฿ 2,500 - ฿ 3,500
Engineer (BS degree with 2 years experience)	฿ 4,500
Engineer (BS degree with 5 years experience)	฿ 7,500

Source: Field survey

). CAPITAL

1. Land

The ideal location for the gelatin plant should be either near the center of bone collection or near the gelatin end-users. Since the largest abattoir and gelatin end-users are in Bangkok, it would be ideal to locate the plant within the suburbs. Land size for the project will be around 20 rai (8 acre). The price of land varies from one location to the other. The Industrial Estate Authority provides land within the radius of 40 kilometers from central Bangkok with sufficient facilities such as access roads, electricity, water, telephone, etc. Costs and locations of these land areas are shown below.

Location	Land Available (Rai)	Selling or Rental Rates (Baht/Rai)
Bangchan	700	Rent - ฿ 600/month
Minburi	1,000	Sale - ฿ 200,000
Bangpoo	3,733	Sale - ฿ 170,000-฿ 200,000
Nava Nakorn	4,345	Sale - ฿ 200,000

Note: 1. One Acre = $2\frac{1}{2}$ rai
2. It is estimated that land filling cost will have to be paid at about ฿ 100,000 per rai on top of the purchasing cost.

If the land is in one of these areas, the investment for 20 rai of land will cost about Baht 6 million

2. Buildings

The size and style of the building will depend on the specific requirement of each investor. In general, the cost for the factory building is about ฿ 1,500/ square meter; the cost of an office building is about ฿ 2,000 - ฿ 3,000/square meter depending on the quality of the construction material used.

E. UTILITIES

1. Fuel and Oil

Fuel and oil prices at present are listed below.

	Baht/Litre
Fuel	฿ 1.66
Benzine (super)	4.22
Benzine (regular)	3.93
Diesel (high speed)	2.64

2. Power

Power is supplied by the Metropolitan Electricity Authority for Bangkok Metropolis area and by Provincial Electricity Authority for the provinces. Both of them are government enterprises. Power supply is relatively sufficient in Bangkok and nearby provinces. Main power supply is from the Bhumiphol Dam which is located in the Northern part of Thailand. Power rates can be divided into two types:

1. Power requirement charge measured at peak requirement within the month - Maximum of ฿ 60/kilowatt.

2. Power consumption charge - Maximum of ฿ 0.68/kilowatt-hour

Power can also be generated and used within the factory provided that it is not sold, it must not exceed 50 kilowatt per generating source and a licence must be obtained from the Electricity Generating Authority.

3. Water

Water supply can be obtained from the government water supply; otherwise the manufacturer can dig his own deepwell. Water is readily available everywhere in Bangkok and nearby provinces. Government water supply rates for this size of plant is estimated as follows:

1.	Deposit for installation	฿ 3,500
2.	Water consumption charge	฿ 2.50/cubic meter

4. Telephone

Telephone facilities are reasonably sufficient in Bangkok and nearby provinces. Immediate telephone installation can be achieve by purchasing the ฿ 30,000 government bond which will be paid back within a period of 10 years with 8% interest per annum. Installation and deposit is about ฿ 4,500 per number.

The Board of Investment and The Industrial Estate Authority can provide assistance to the manufacturers registered with them to obtain telephone lines.

V. INVESTMENT OUTLOOK

A. MARKET OUTLOOK

From the import statistics, there has been a consistent demand for 120 tons of gelatin capsules worth about ฿ 40 million annually. In addition to this, demand for other gelatin products is about another 100 tons worth about ฿5.5 million annually. This is a market which is presently satisfied solely through imports. An investment opportunity to replace the imports with local production therefore exists. A proposed gelatin capsule plant with a capacity of 600 million capsules which will require 100 tons of pharmaceutical grade gelatin is currently being envisioned by a group of investors. If this plant is implemented, it will be able to satisfy a substantial volume of the present demand for capsules. Hence, there may be no room for another gelatin capsule plant. On the other hand, there is enough ossein produced in Thailand to produce the gelatin required by the proposed gelatin capsule plant, but there is presently no gelatin plant. It is also interesting to note that Thailand still exports about 10 to 20 thousand tons of unworked bones and horncores every year. An investment opportunity apparently exists either in the production of gelatin from ossein or from raw bone. The more attractive project is producing gelatin from bone, because the project while have strong linkage possibilities will not have to depend on the other two companies for raw material (ossein) or for a market (capsule). Gelatin can be both domestically used and exported. Moreover, bone supply is still plenty in Thailand provided that the bone collection system can be improved.

B. RETURN ON INVESTMENT

Experts in the gelatin field estimate that it would take an investment of about Baht 80 million to establish a plant which can produce 300 tons a year of gelatin from raw bone. This includes an ossein plant which would probably require an investment of Baht 20 million. Based on this production capacity, the ratio of net profit to total investment is estimated at about 13.6% before tax and 8.8% after tax. Detailed calculations and assumptions are shown in Table 8.

In order to cope with the bone collection problem in the upcountry areas it might be worth considering setting up additional ossein plants in certain areas other than Bangkok. Some suggested locations are:

Saraburi	-	where the Chokchai cattle ranch is located. This ranch is furnished with a modern abattoir with a substantial capacity.
Songkla	-	To serve as the collection point for bones in the southern area.
Sukothai/ Uttaradit	-	There are livestock breeding centers in the North.

Each ossein plant in the upcountry area may require an additional investment of Baht 10 - Baht 15 million. However, this would ensure the adequate supply of ossein for the gelatin plant in Bangkok and may result into savings in terms of bone procurement cost. Moreover, the establishment of an ossein plant in upcountry areas would be in line with the government's plan to promote agro-related industries in the rural areas. As such, additional investment incentives may probably be granted to the interested investor.

Table 8

Illustrative Statement of Income

Items		₪'000	Assumptions
Sales		₪ 27,000	300 tons of gelatin, ₪90,000/ton
Cost of Goods Sold			
Bone	₪ 2,093		910 tons, ₪ 2.30/kg.
Hydrochloric acid	410		342 tons, ₪ 1,200/ton
Lime	684		228 tons, ₪ 3,000/ton
Direct Labor	2,790		155 labor, average salary ₪1,500/month
Depreciation	5,750		Rates: machinery 10 years, building 20 years
Other overhead	800	12,527	Estimated
Gross Profit		14,473	
Selling and Admin. Expenses		3,600	Estimated
Net Profit Before Tax		10,873	
Estimated Income Tax		3,[illegible]	35% of net profit
Net Profit		[illegible]	
Total Investment		₪ 80,000	

Profit before tax as a percentage of total investment = 13.6%

Profit after tax as a percentage of total investment = 8.8%

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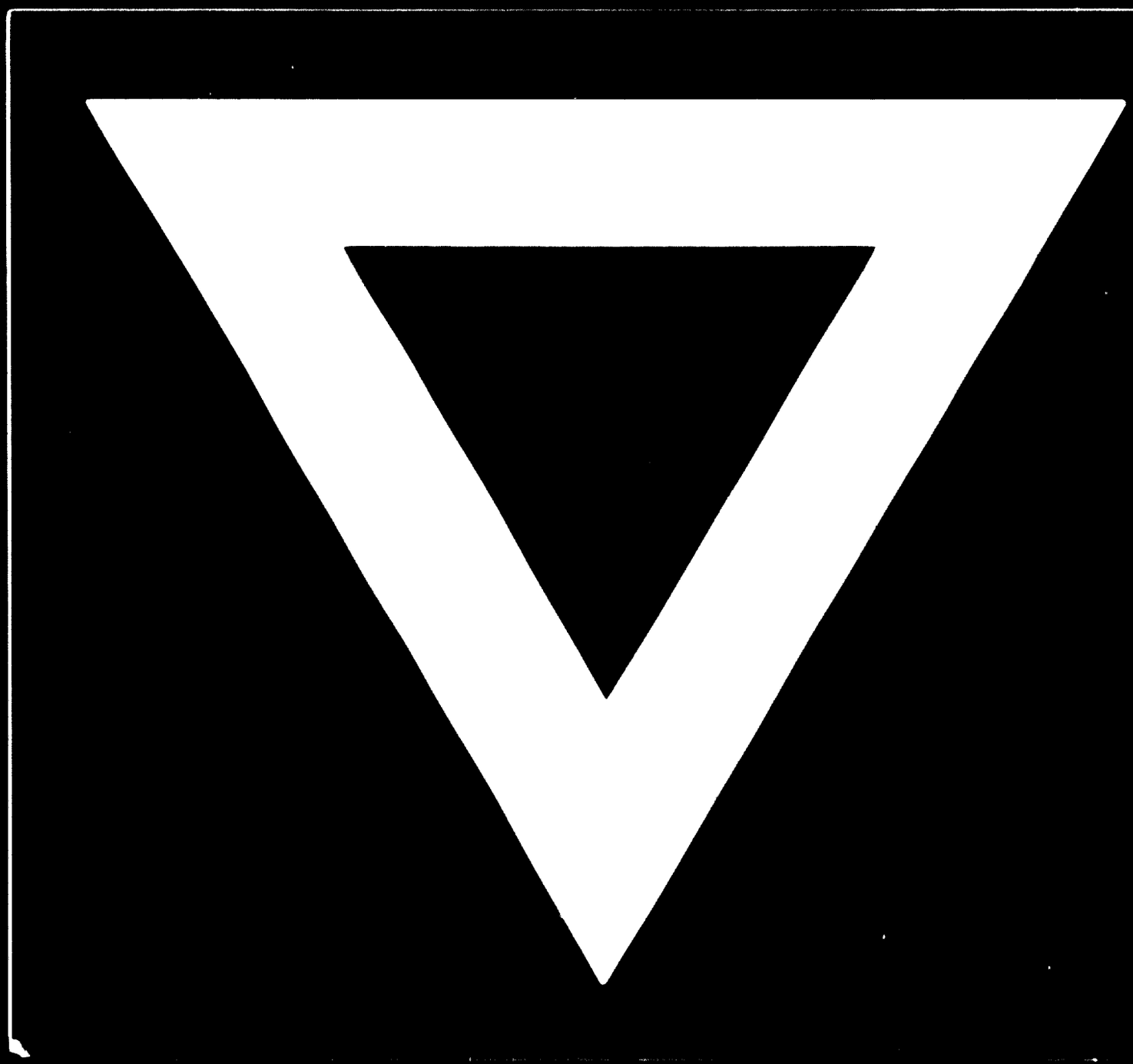

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