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APPROPRIATE TECHNOLOGY FOR HEAVY INDUSTRIES

APPROPRIATE TECHNOLOGY IN BASIC AND HEAVY INDUSTRIES IN DEVELOPING COUNTRIES.

Discussion Paper

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Appropriate Technology in Basic and Heavy Industries in Developing Countries*

Issues and Considerations

Note prepared by the secretariat of UNIDO

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APPROPRIATE TECHNOLOGY IN BASIC AND HEAVY INDUSTRIES IN DEVELOPING COUNTRIES*

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* This Note has been partly based on the background documentation on the subject, which is attached.

INTRODUCTION

1. Certain industrial processed materials and products are essential requirements for the process of industrialization and constitute the material base for industrial growth at various stages. Apart from infrastructure facilities such as energy and transport, the assured supply of such basic materials and products requires to be assessed and planned for in developing countries, either by domestic production or through imports. The structure of domestic demand for such products changes significantly with successive levels of industrialization, both in quantity and the nature of such materials and products.

2. Since an important objective of industrialization in developing countries is the optimum utilization of domestic natural resources, the planned growth of resource-based industries, producing such basic processed materials, is necessary. Mineral development and production of basic metals, particularly iron and steel, in developing countries having necessary natural resources has to be given high priority, provided other techno-economic considerations can be adequately taken into account. Similarly, the production of certain chemicals, petrochemicals and fertilizers needs to be effectively planned in relation to domestic factor resources and market demand, as such production would provide the material base for a large number of industrial enterprises, both in the organized and dispersed sectors, apart from meeting essential agricultural needs in many developing countries. The metal-transformation sector, particularly capital-goods production, also needs to expand rapidly in developing countries, as it provides the essential base, both for growth of technological skills and for meeting growing needs of machinery and equipment in all production sectors of developing economies. Apart from these production branches, attention has also to be given to other industrial branches producing processed materials for industrial needs. However, an analysis of the technological needs in these branches can illustrate the issues and implications of technological choice in the production of basic industrial materials and products in most developing countries.

3. Industrial undertakings in production sectors such as mineral development, production of chemicals, petrochemicals and fertilizers and manu-

facture of capital goods are often characterized as 'heavy industries' because of the large capital outlays and machinery and equipment requirements involved in most projects in these branches, which are generally undertaken in the large-scale organized industrial sector The term 'heavy industries' can also of course be legitimately applied to other production sectors also having similar characteristics. In this paper, some of the principal technological implications of the production of iron and steel, basic chemicals, petrochemicals and fertilizers, and machine-building, have been discussed, together with the relationship of technological application with the fulfillment of broader socio-economic objectives, particularly industrial and dispersal.

4. The issues of technological choice and application in respect of such basic and 'heavy' industries obviously differ from industry to industry. The principal elements and implications of alternative technologies in these sectors can, however, be identified, together with certain broad parameters for determining appropriate investment and technology strategy. Appropriate technological application and usage in such industrial sectors, however, requires consideration of alternative techniques and processes at various stages of manufacture of final end-products and suitable interlinkages between production enterprises at these stages. The investment pattern has to be determined in such production sectors at various stages of processing and production, together with the range of technological choice. At certain stages of processing, technological choice may be limited to certain techniques and scales of production while, at other stages, greater flexibility can be exercised in determining production scales and application of related technology and know-how. Suitable combinations of investment and technology need to be identified in relation to resource availability, market demand for products at various stages and other techno-economic objectives and considerations.

5. The traditional investment-cum-technology package for such 'heavy' and basic industries envisages large-scale production using increasingly sophisticated and capital-intensive technologies from developed countries. The massive capital outlays involved in most such projects necessitate significant resource allocation which is often not available in developed countries. With growing concentration of production and control by

relatively few transnational corporations, in some of these production sectors, the implications of private foreign investment become particularly significant. Such foreign investments are inevitably related to the global policies and production programmes of transnational corporations. At the same time, it is increasingly recognized in developing countries that effective national sovereignity must be exercised in the utilization of national resources, and in critical industrial sectors. Such sovereignity has increasingly been exercised by several developing countries in respect of scarce resources such as petroleum and certain minerals, where developing countries have achieved a much stronger bargaining position. However, in developing countries, where significant resource advantages do not exist, or cannot be effectively exploited for techno-economic considerations, investment and technological choice can be greatly circumscribed.

6. Apart from natural resource availability, the flow of investible resources in such production sectors is also primarily determined by market conditions, both domestic and external. Global production of steel, copper and certain petrochemicals, for example, has achieved levels where production costs and prices have become increasingly competitive and can significantly affect investment and technological choice in new projects or substantial expansion of existing enterprises in developing countries. In machine-building also, the extent of international competition is increasing significantly. Nevertheless, developing countries have significant resource and factor advantages which should be effectively utilized in the establishment and growth of basic and 'heavy' industries and in the adoption of investment and technological patterns most consistent with socio-economic objectives in each of these production sectors.

OBJECTIVES

7. The principal objectives to be achieved through the establishment of basic and 'heavy' industries in developing countries are to provide essential processed materials and products and ensure better utilization of natural and human resources, within the framework of broader socio-economic goals. The provision of basic industrial materials, such as iron and steel and certain chemicals and fertilizers, are essential for balanced industrial growth and agricultural development, while machine-building capacity is

necessary, both for growth of technological skills and to meet growing demand for machinery and equipment in these countries. Natural resources, particularly minerals, have to be developed in such a manner as to yield maximum advantage to the economy at various stages of growth.

CONSIDERATION OF TECHNOLOGICAL ALTERNATIVES

A. Basic metals - iron and steel:

8. The range of investment and technological alternatives in the metallurgical sector and production of basic metals haveto be considered from the stage of mining and ore extraction to the production of basic metals such as iron and steel and non-ferrous metals. In the mining sector, technological trends in developed countries are towards highly-mechanized operations and handling. The extent of mechanization appropriate in developing countries needs to be related to the employment opportunities that must be provided. While technological improvements which lead to greater safety and efficiency in mining operations should be adapted to local conditions, mechanization resulting in displacement of labour may not be suitable. The use of sophisticated mining equipment, which is generally related to increased mechanization, may also often not be necessary, except in handling operations at mine-heads or at ports. At various stages of mineral processing, however, modern and sophisticated production techniques may need to be acquired to improve product quality and reduce production costs. Appropriate techniques and processes have to be identified at various stages of conversion and processing and while traditional, labour-intensive techniques may be quite suitable at certain operational stages in particular country situations, sophisticated and capital-intensive processing technologies may need to be utilized at other stages.

9. Various alternatives can be considered for the production of basic metals in terms of scales of production and use of related technology and knowhow. In the production of steel, aluminium, copper, zinc and other metals, production scales and choice of technology need to be related to specific country situations in terms of ownership pattern, market demand and availability of resources. Though sophisticated technology and know-how may need to be acquired and absorbed at various stages of processing, several technological alternatives related to production scales can be

considered for most such production sectors. For illustrative purposes, the range of choice in the production of iron and steel is briefly analysed.

10. The choice of alternative technologies in the production of iron and steel has been examined in one of the background papers[1/]. Adequate production or assured availability of iron and steel is essential in developing countries as it constitutes an essential material base for industrial growth and the production of a wide range of engineering-goods, ranging from light-engineering products to various categories of machinery and equipment.

11. Production alternatives range from integrated steel plants producing up to 10 million t/a or more, to the production of steel by electric smelting with capacities from 20,000 t/a onwards. It is estimated that the investment for a steel plant of 1 million t/a would be of the order of US$800 million and would provide employment for about 6000 persons. A plant of such size or higher capacity would obviously necessitate not only major capital outlay but detailed techno-economic analysis in terms of raw material availability, particularly iron ore and coking coal market demand, location, choice of process and technology, choice of end-products and source of financing and supply of machinery and equipment. The establishment of large integrated steel plants with blast furnace and LD oxygen converters, must be based on techno-economic considerations and the use of suitable production technologies at each stage of production.

12. At the other end of the technological spectrum, scrap iron can be melted in electric furnaces to roll steel rods and bar products. Such a production process may be quite appropriate, particularly in smaller countries with limited internal demand, though availability of scrap may constitute a major constraint. In between these two scales of production, various alternative techniques and processes can be considered. High-grade ores can be converted into sponge iron through direct production processes. Such sponge iron can be smelted into steel in electrical arc-furnaces, such an integrated plant of 500,000 t/y requiring an estimated investment of about US$250 million. It is also possible to use charcoal in the pro-

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1/ Choice and Adaptation of Alternate Technology for the Iron and Steel Industry - ID/WG.282-50

duction of high-grade steel up to certain levels of capacity.

13. Technological alternatives in the production of steel can broadly be considered as the following:

(a) The use of blast furnaces based on coking coal, with oxygen converters supplying molten steel to the rolling mill complex. The minimum capacity would be around 500,000 tons/year and capacities could range up to several million tons/year;

(b) Application of a charcoal blast furnace coupled with oxygen converters to supply molten steel;

(c) Use of an electric reduction process and oxygen converters to supply molten steel. The minimum economic capacity would range around 50,000 tons/year;

(d) Application of direct reduction process, coupled with electric arc furnace to supply molten steel. Capacities could range from 200,000 tons/year upwards;

(e) Use of scrap-based electrical furnaces to supply molten steel to bar mills. The capacity would be around 25,000 tons/year;

(f) Use of bar mills (rerolling mills) based on local or imported supplies of steel billets. The minimum economic size would be approximately 10,000 tons/year.

14. The selection of the appropriate technological alternative or alternatives would depend on various techno-economic factors and considerations. In large developing countries, where the demand for steel is increasing rapidly, integrated steel mills may need to be set up using advanced technologies to enable production at competitive costs. In countries having abundant forest resources, charcoal blast furnaces with oxygen converters may be more appropriate. The use of electric reduction process may be more suitable for countries with low-cost electrical power and having limited access to good coking coal. Gas-based direct reduction processes would be more suitable for countries having oil and natural gas resources. Developing countries at earlier stages of industrial growth may utilize electrical furnaces using scrap materials, provided supplies of scrap can be ensured or supplemented by imported sponge iron. Developing countries, having abundant iron-ore resources, may also export ores with possible participation

in steel mills using such ores, till such time as techno-economic considerations can justify domestic production of processed iron and steel.

15. The range of technological alternatives is thus fairly wide, in respect of domestic production of iron and steel. Similar alternatives exist in other metal industries. Choice between such alternatives has to be exercised in the context of particular country situations. Similar choice should also be exercised at various production stages, within the framework of a particular technology.

B. Basic chemicals and petrochemicals:

17. As in the case of basic metals, the availability or domestic production of certain basic chemicals constitutes an essential material base for a wide range of end-products in the chemical industry. While end-products can be manufactured at various scales of production, including small-scale production, technological trends in manufacture of basic chemicals and petrochemicals reflects increasingly large scales of production and use of highly capital-intensive technologies in both developed and developing countries where such production has been undertaken. Petrochemical refineries are being planned for throughputs of up to 10 million t/a of crude oil, while ethylene crackers are being designed for capacities of up to 500,000 t/a and more. Large-scale petrochemical production has increasingly been undertaken in such developing countries having necessary oil or gas resources or in large developing countries with growing internal demand.

18. Technological alternatives in chemicals and petrochemicals can take various forms and can be related to use of particular equipment or to product or operational technology or to process technology[1/]. At the lower end of the production spectrum, a number of end-products can be manufactured from particular types of equipment. Thus, the production of several plastic products can be undertaken through the use of certain machinery. On the other hand, the production of certain basic petrochemicals requires heavy capital outlay and very capital-intensive processes which may be available from only a few sources though, for most products, alternative technologies can be obtained from more than one source.

1/ These have been further elaborated and related to particular products in the background paper "Appropriate Technology for the Chemical Industry" - ID/WG.282-85.

19. The production of chemicals and petrochemicals in developing countries requires to be carefully planned in relation to market demand and availability of feedstock. While, for certain products, the extent of domestic demand would be the determinant factor, the production of certain basic or primary petrochemicals for exports can be undertaken in developing countries rich in oil and gas resources. The objectives of domestic production would be the substitution of imports up to certain stages, and the supply of processed materials, which can be utilized by various domestic enterprises for manufacture of various end-products.

20. It may be necessary to undertake production of certain base chemicals and petrochemicals through large-scale units, using advanced, capital-intensive techniques. Production can, however, be developed in suitable modules related to local factor situations. It is important, however, to ensure close interlinkage between production in large 'Jumbo' plants[1/] and satellite production units, whose location could be dispersed to semi-urban and rural areas. Such dispersed production could also be undertaken in countries where the manufacture of basic chemicals and petrochemicals may not be practicable for techno-economic reasons or resource constraints, and relatively medium-size plants could undertake manufacture of products such as PVC, polyethylene, and polyester fibres. The use of resultant products can be significantly extended both to meet demand for consumption goods of various categories, and to provide alternative materials for agricultural use, such as storage bins, irrigation pipes and various constructions. A number of products can be manufactured in the dispersed sector such as polyethylene sheeting, urea formaldehyde resins and synthetic fibres.

21. A wide range of chemicals can also be produced from alternative raw materials. The scope of production of several chlorine-based chemicals from salt, together with various sodium products and derivates has been discussed in one of the background papers[2/]. Alternative raw materials entail the use of alternative technologies which, in several instances, may be more suitable for use in developing countries.

1/ This concept has been developed and discussed in the background paper "The Petrochemical Industry" - ID/WG.282/16

2/ Basic Materials Industries: Aspects of Technology Choice and Industrial Location - ID/WG.282.20.

22. The production and technology pattern for chemicals and petrochemicals can both be based on alternative raw materials and be related to various scales of production. The raw-material base generally determines the nature and type of technology which needs to be utilized. Appropriate choice of technology has to be related to the availability of raw materials and other techno-economic considerations. In its overall impact on socio-economic aspects, however, the interrelationship between the production of basic chemicals and their effective utilization in the manufacture of a large variety of end-products may be more significant.

C. Fertilizers:

23. In fertilizer production also, it may be more appropriate to decentralize the production of fertilizer end-products to the extent technologically feasible, while ensuring that the basic processed materials and intermediates are produced at optimum scales of production using sophisticated and capital-intensive technologies. The production of ammonia has increasingly been undertaken in larger-sized production units extending to over 1000 t/d not only in industrialized economies but in several developing countries. As pointed out in the background paper[1/] 'Jumbo' ammonia plants of increasingly large capacity and involving heavy capital outlay, could be established either in countries having significant resource advantages, or in large developing countries where internal demand for fertilizers can sustain such production.

24. It should be possible, however, to decentralize production of fertilizer end-products, both in the interest of industrial dispersal and to enable production facilities to be located closer to local markets where fertilizers would be utilized. Intermediate or finished products at particular stages of production can be moved in bulk and blended in decentralized locations to produce appropriate N:P:K mixtures for various agricultural products such as paddy, vegetables, sugar, and plantation products such as tea and coffee. Decentralization of production of liquid fertilizers may require advanced techniques for movement of intermediates and processed products to such satellite and decentralized production units.

1/ The Fertilizer Industry - ID/WG.282/16.

The facilities required in such decentralized plants must include bulk storage facilities, apart from machinery and equipment for blending operations for different fertilizer end-products. An indication of possible investment requirements and technological arrangements necessary for such decentralized production of final products has been given in the background paper. The possibilities in this regard need to be carefully assessed.

D. Machine building and capital-goods production

25. The manufacture of machinery and equipment in developing countries must be considered on a different footing than the production of basic metals or chemicals. The latter usually need to be resource-based to enable large-scale production, using sophisticated technologies, except in countries where internal demand is adequate to justify the heavy capital outlays necessary. The production of capital goods, on the other hand, needs to be undertaken, both in order to meet growing demand for machinery and equipment of various categories and to accelerate the growth of domestic technological skills and capability[1/].

26. Capital goods can be broadly classified as mechanical (non-electrical), electrical and transport equipment, together with the components and inputs thereof, which are utilized as machinery and equipment in various production and manufacturing sectors. Mechanical equipment ranges from common use items such as machine tools, diesel engines, compressors, cranes, pressure vessels, and boilers to a wide range of products utilized in various industrial sectors. Electrical equipment covers the machinery requirements for power generation and distribution, including turbines and generators, transformers, switch-gear, motors, etc. Transport equipment relates to shipbuilding and repairs, the production of railway wagons, locomotives and other railway equipment and the manufacture of commercial vehicles of various types. Besides, a large number of sub-assemblies, parts and components for the various machinery products also need to be considered, together with basic inputs such as castings, forgings and gears of various types, ball and roller bearings and a wide variety of standard parts and components.

1/ Various policy and other aspects of capital-goods production in developing countries have been the background discussed in "Report of the Second Preparator Expert Panel Meeting on the Capital Goods Industry", UNIDO Document Ex, 32.

27. The production of machinery and equipment in developing countries needs to be viewed as essential infrastructure related directly to technological needs at various stages of industrial growth. While machinery imports initially provide training in machine-operation skills, the transmission of such skills to machine-building capability must be effectively bridged within a reasonable period, in order that technological dependence of these countries is not perpetuated and technological progress keeps pace with the level of industrial expansion.

28. Machine-building capability and related design and production engineering skills are an essential element of growth of indigenous technological capability. The relatively higher use of the labour factor, which is typical in capital-goods industries and the series of production linkages involved in machine building, as compared to continuous-process technologies in other sectors, can also provide much greater employment opportunities and be more directly related to the fulfilment of socio-economic needs. Apart from providing a strong and diversified base for a wide range of metal-fabrication industries, considerable impetus is given to the growth of domestic capability in designs, production engineering and production planning for a variety of products.

29. The coverage of capital-goods production extends over a wide area of manufacture and various metal transformation products. Manufacturing operations cover various metal-conversion processes, including fabrication of structurals, castings and forgings, heat treatment, welding and general or specialized machining and final machinery assembly. Most production enterprises are workshops of various sizes and complexity, designed to produce a certain volume of 'batch' products or a mix of several machinery products and components. Since fixed investments, particularly in terms of machinery, can be high and growth of skills is fairly gradual, the gestation period of such enterprises can often spread over several years. It is necessary to ensure that capacity utilization is maximized, consistent with growth of skills. At the same time, since most machinery production is an assembly operation, the production of parts and components can be subcontracted to a number of smaller enterprises.

30. Capital goods production in developing countries will follow different patterns, depending on the stage of industrial growth. It is necessary, however, that sectoral production and technological gaps are identified,

and various criteria of selectivity are applied such as (i) production of items which have a high labour content; (ii) production in branches with technological efficiency at relatively small scales of production; and (iii) manufacture of products whose intermediate components are already produced or can be manufactured on an economic scale.

31. It is not practicable to prescribe any uniform pattern of product selectively or sectoral growth for all developing economies. Conditions are widely divergent, both in terms of factor resources and levels of development, and programmed growth of this sector must be considered in different stages, depending on such factor considerations. Normally, initial efforts are concentrated on repair facilities and production of parts and spares. This level has been reached in most developing countries. It is possible to delineate further stages of capital goods production, even in the less industrially-advanced developing economies, both because market conditions would justify such growth and because it is through such production that greater technological capability and dispersal can take place.

32. In the case of mechanical equipment, for example, relatively small production facilities can be set up for the manufacture of simple equipment and parts such as structurals, simple lathes, small pumps and compressors, fractional motors and the like, often in conjunction with consumer durables of various types. Thereafter, machine-building capacity should be expanded to more difficult items of manufacture and fabrication, together with more sophisticated processes of machining, welding, heat treatment and the like. The production of heavy mechanical equipment for various industrial sectors such as steel, fertilizers and petrochemicals constitutes a third stage of development. The manufacture of electrical equipment can also be similarly delineated in various stages. Initially, production can be undertaken of transformers, insulators, conductors, switches, insulated wires, etc., and small and medium motors and starters. Thereafter, more sophisticated equipment for power generation and distribution, transmission towers and the like can be undertaken for domestic manufacture, together with durable electrical consumer goods. The third stage could cover the manufacture of heavy equipment, such as power boilers, turbines, generators, transformers, circuit breakers, etc. for the increasingly large size of central power stations and the high voltage

transmission systems. At the same time, more sophisticated electrical equipment can be manufactured, such as motors in the range of 1000 to 10,000 HP, with process control equipment for steel, chemical and petroleum industries.

33. The process of import substitution in capital-goods manufacture, though fairly successful in its early stages, cannot be economically pursued beyond a point, unless internal demand growth is high and sustained over a reasonable length of time. Even when domestic markets are sizeable and growing rapidly, other factors such as production efficiency, adequate technological absorption and adaptation, access to technological developments and innovations, and marketing strategies assume increasing significance, particularly when greater exports need to be developed as the logical process of growth in these enterprises.

34. Appropriate technological use in capital-goods production is directly related to the extent to which the manufacture of parts, components and sub-assemblies can be subcontracted to a number of medium and small-scale enterprises. It is through such subcontracting and decentralization of manufacture that greater technological skills can be generated in the economy. Such decentralization would also reduce investments in individual plants and be more cost-efficient over a period of time. Close technological and financial linkage is obviously necessary between enterprises at final stages of assembly and those producing parts and components. Such interlinkage of final machinery products, and the subcontracted parts and components exists in the production of machinery and equipment in developed countries and developing-country enterprises must necessarily develop subcontracting arrangements to the maximum extent, both in the interest of greater dispersal and for greater cost-efficiency over a period of time. Even where large machine-building enterprises have been set up, greater subcontracting should be ensured as expanded production programmes are undertaken, together with technological support.

35. The technological requirements of capital-goods production primarily relate to the acquisition and development of designs and production know-how for various products as most enterprises are multi-product units. Such production know-how can be obtained from several external sources including several enterprises in developing countries which possess re-

quisite production technology for a number of machinery products. Such technology in developed countries is becoming increasingly capital-intensive with the needs of greater automation and numerically-controlled machine tools, 'machine centres' and the like are in much greater demand together with heavy equipment for increasingly larger production capacities. Such technology would often not be suitable for developing countries at various levels of industrial growth. Domestic demand is generally for relatively simple but strong machines and structurals, which can be operated and maintained effectively in conditions prevailing in developing countries. The demand for machinery and equipment in the dispersed sector would also necessitate capital-goods manufacture of types and capacities often not available in advanced industrial economies at present. The need and potential for greater technological co-operation between developing countries is particularly pronounced in the capital-goods sector. A number of countries at intermediate levels of industrialization, who have a growing demand for machinery and equipment of ranges and capacity generally different from those of developed economies, can effectively collaborate in joint production programmes for meeting their respective needs in terms of specific machinery products, and design and production technology for capital goods related to their particular requirements. The flow of technology and know-how to developing countries in this production sector should also be increasingly geared to greater domestic production of parts and components of machinery and equipment, including automotive equipment and products, and necessary technology, particularly suited to smaller-scale enterprises undertaking such manufacture, will need to be acquired on suitable terms and adapted to local circumstances and requirements.

PROGRAMME OF ACTION

36. Developing countries need to identify specific production programmes in the basic and 'heavy' industry sector, in relation to domestic factor resources and potential at various stages of industrial growth. Such programmes should be directed at production of essential industrial materials, including basic metals and chemicals, which can be processed into various end-products by domestic enterprises, particularly in the medium and small-scale manufacturing sector. The production of varying types and ranges of

capital goods also needs to be undertaken in most developing countries, both to meet market needs and to develop technological capability. The extent to which 'heavy' industries can be undertaken will depend on market potential, both internal and external, resource availability and levels of growth. Since domestic markets in developing countries are usually limited, production of such industries should be related, to the extent possible, to regional market potential and joint production programmes in these sectors should be considered.

37. Technological choice in basic and 'heavy' industries should be related to different manufacturing stages and alternatives need to be considered for such stages and for various production functions. While certain stages of processing and manufacture may require large production scales and use of sophisticated and capital-intensive techniques to produce basic processed materials at internationally-competitive costs, other stages of manufacture should use technologies appropriate to the level of domestic enterprises. Broad guidelines should be drawn up, identifying the nature and pattern of production in various manufacturing sectors using basic processed materials and products. Such guidelines should aim at maximum dispersal of industry, particularly through medium and small-scale enterprises and in the rural sector. Appropriate policies supporting such guidelines need to be identified for each country situation. In view of similarity of conditions in several developing countries, technological alternatives available in other developing countries, and greater technological co-operation between such countries, should be given particular consideration.

The following background documents are being circulated on this subject:

The Role of the Engineering Industry	- ID/WG.282/7
The Fertilizer Industry	- ID/WG.282/16
The Petrochemical Industry	- ID/WG.282/19
Basic Materials Industries: Aspects of Technology Choice and Industrial Location	- ID/WG.282/20
The Fertilizer Industry in India	- ID/WG.282/26
Choice and Adaptation of Alternate Technology for the Iron and Steel Industry	- ID/WG.282/50
Large-scale Process Equipment and Appropriate Technology	- ID/WG.282/53
Appropriate Technology for the Chemical Industry	- ID/WG.282/85
Appropriate Technology for the Iron and Steel Industry	- ID/WG.282/70
Report, Conclusions and Recommendations of the Second Preparatory Expert Panel Meeting for Consultations on the Capital Goods Industry, Vienna.	- UNIDO/EX.32

1/ This document will be circulated at the meeting.

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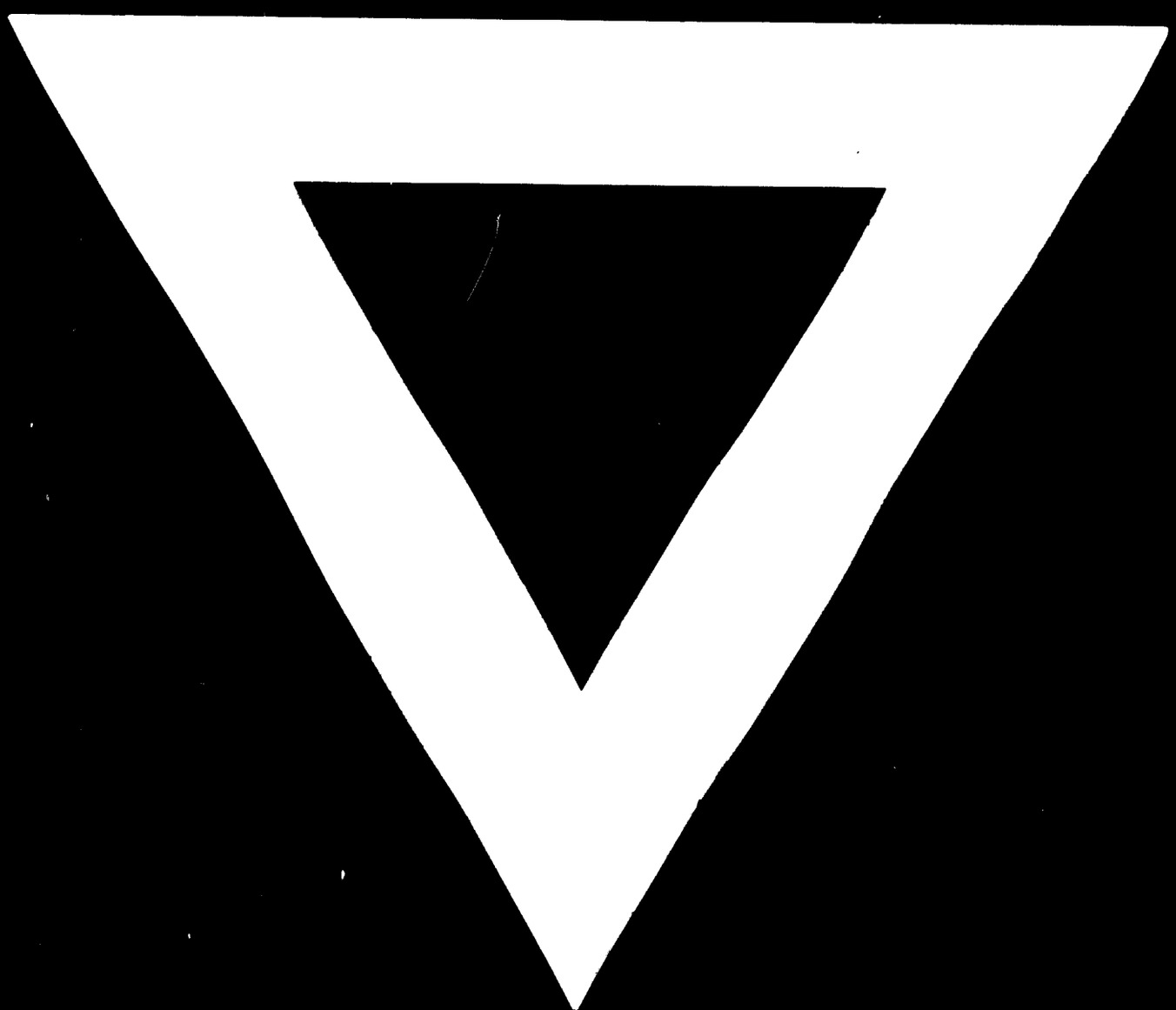

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