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Prepared [illegible]

of the Libyan Arab R[illegible]

United Nations Industrial D[illegible]

Based on the work of S. M. C[illegible]x, expert [illegible]

id. 75-9225

Explanatory notes

Reference to "tons" (t) indicates metric tons, unless otherwise stated.

Reference to "dollars" ($) indicates United States dollars, unless otherwise stated.

The monetary unit of the Libyan Arab Republic is the dinar (LD). During the period of the project its value in relation to the United States dollar was $US 1 = LD 0.296.

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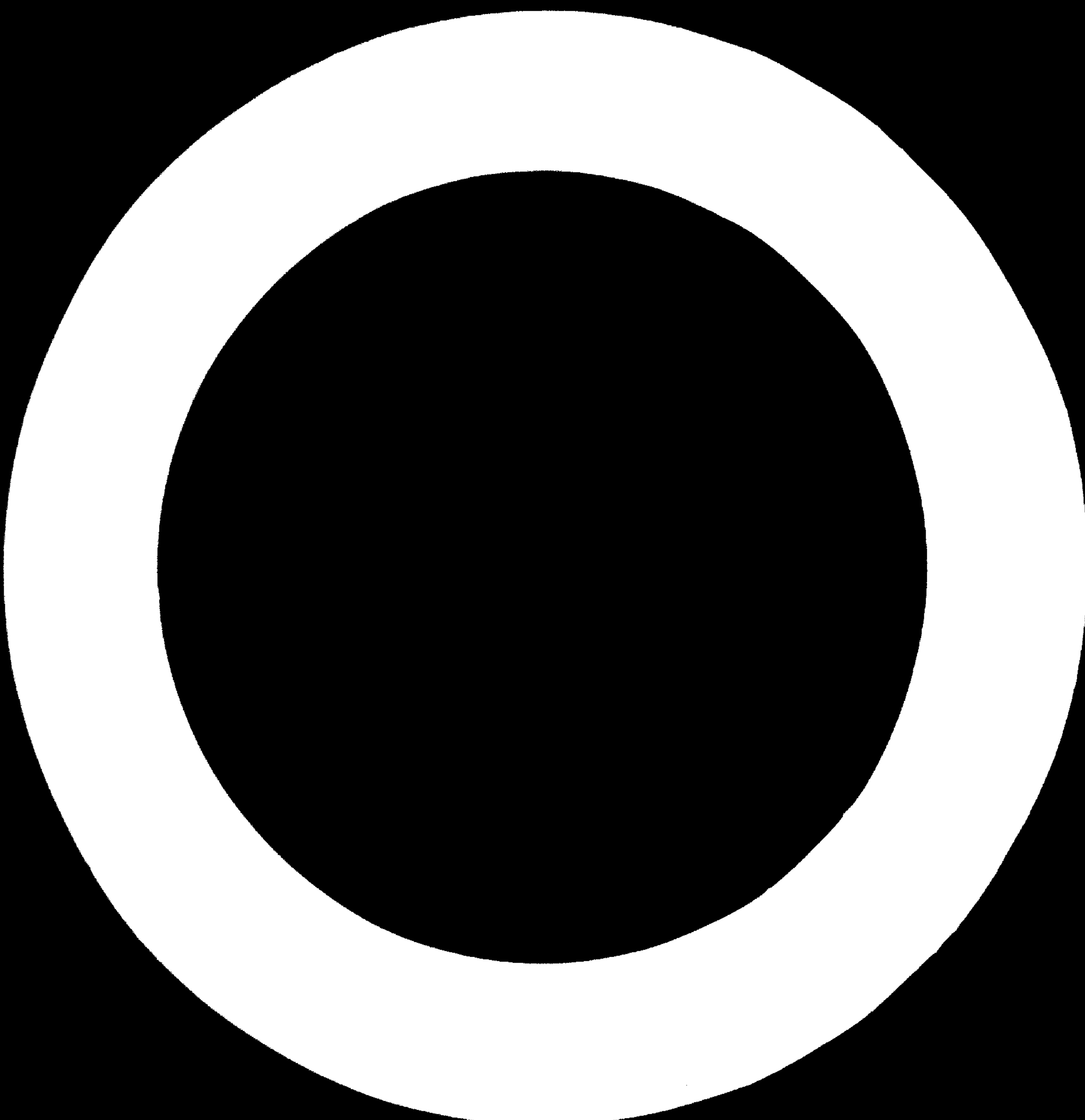


SUMMARY

This is the report of the project "Selection of Technology and Equipment for Production of Flat Glass" (TF/LIB/[illegible]). It presents the findings and recommendations of a two-man mission ([illegible] and [illegible]) to the Libyan Arab Republic in connexion with a proposal to manufacture flat glass there. This proposal was based on a feasibility study prepared by consultants in [illegible].

The study is reviewed and commented on in this report; the conclusion is that with some minor but important modifications it provides a satisfactory basis for drafting Tender Documents. The draft Tender Document given in annex II was prepared accordingly, and after being modified to fit the format used by the General National Organization for Industrialization, it was issued as an invitation to Bidders.

For the most part the proposed alterations turn on the more effective operation of two different technologies at the same site; they also relate to the potential growth of a glass industry in a developing country. The consultant's recommendations reflect these suggestions for modifications.

In annex II a comparison is made of the offers received, and comparative estimates are given indicating the relative operating costs in order to enable the Organization to make its choice. Although some minor technical points will have to be resolved during negotiation, the main parameters are sufficiently determined to make a valid choice of a contractor. It is suggested that a second choice be held in reserve until negotiations have been satisfactorily concluded.

1. INTRODUCTION

This is the report of the project "Selection of Technology and Equipment for Production of Flat Glass" (TF/LIB/[illegible]). The project consisted of a two-phase mission. The purpose of the first phase (January 1974) was to assist the Libyan Arab Republic (LAR) in the selection of the most suitable technology for flat glass manufacture and to assist in preparing Tender documents for the supply of machinery and equipment. The purpose of the second phase (June 1974) was to assist in the analysis and evaluation of bids and to advise on the further execution of the project.

In fact it was found on arrival that firm decisions had already been taken on the main features of the project, based on the recommendations contained in a feasibility study by German Consult. This document is, therefore, the principal document in the case and the first task was clearly to make a critical review of this document.

The document "Feasibility study for the Establishment of Flat Glass Industry in the Libyan Arab Republic" (Referred to as the "Consult Document") was prepared by a team consisting of three economists, a civil engineer, a mining engineer, an electrical engineer, a geologist, a chemist and an expert for the glass industry. It is a very comprehensive study, running to about 300 pages, written almost wholly from the view-point of the economist - as one might expect from the composition of the team.

It is also well to bear in mind that an economist looking at the glass industry almost always tends to over-rationalize, ignoring the fact that glass-making is still largely an "art" rather than a "science".

This error is easily made in Germany where, generally speaking, the chief executive is himself a glass technologist of high standing and can infuse the necessary lore from the top to a management team recruited from the non-specialised professions. This is not obvious to an outsider because this all-important function is hidden by the chief executive's title.

Elsewhere the chief executive is usually chosen purely for his administrative abilities but he then has a chief glass technologist to advise him and to ensure that the best practices are followed throughout the plant.

There is reason to believe that this criticism is valid in the present case since there is no provision at all for a glass technologist in the proposed organization.

The main recommendations of the Consult Document are summarized in and commented upon in the next section. An important factor is that a glass container factory (bottles and tumblers) is at present under construction in the Libyan Arab Republic and expected to come on-stream later this year. This has been given due consideration and Consult proposes the integration of flat-glass production with this activity.

2. FINDINGS

The principal recommendations have been extracted from the Consult document and are set out in the eight sub-sections below (2.1). Comments on them are made in section 2.2 following the same sub-section numbering.

2.1. Consult Recommendations

2.1.1. Market. The anticipated domestic market for drawn sheet is as follows:

1975	9,800 tons
1980	14,800 "
1985	18,800 "

Export possibilities are not very favourable.
It is recommended that a flat glass industry should be established in LAR.

2.1.2 Choice of Technology. Only glass that can be drawn by the Pittsburgh or Fourcault process should be made, although 22% of the product can be after-worked by surface grinding and polishing or coating. The Fourcault process is recommended.

2.1.3 Raw Materials. Local sand can be used after beneficiation. Local dolomite and limestone will produce glass of poor colours and imported dolomite may be necessary for a quality product. Fuel can be supplied by local refinery. Azizia water must be treated but Tripoli water needs no treatment. Nevertheless in the interests of integration the Azizia site is recommended.

2.1.4 Integration. It is recommended that the flat-glass plant should be integrated with the glass-container factory under construction at Azizia.

2.1.5 Investment. Total estimated investments for the proposal amount to 2,191,000 L.D. An additional 145,000 L.D. will become necessary in 1981.

2.1.6 Costs. Total estimated costs amount to 88.8 LD/ton for drawn glass, 136.6 LD/ton for ground and polished glass, and 133.6 LD/ton for coated glass, based on Libyan dolomite. Use of imported (German) dolomite would add 4 LD/ton.

2.1.7 Tenders. It is recommended that tenders be invited on a "turn-key" basis.

2.1.8 Organization and Layout. Proposals are made for the organisation and lay-out of the integrated factories.

2.2. Comments on Consult Recommendations.

2.2.1. Market. The estimates of the future demand for unworked drawn glass appear to be soundly based although it must be realized that some of the statistics are probably distorted by the development of the float-glass process which, one might say, is potentially capable of making plate-glass quality at sheet-glass prices. Apart from largely superseded [illegible] plate glass it has already made considerable inroads into the drawn sheet market. Often its inclusion in statistics is arbitrary in classification.

It is tacitly assumed that the proposed glass works can achieve 100% of the market. In a free market this would seem to be unrealistic. In the case of unworked drawn sheet glass an achievement of 80% might be regarded as a good performance. This is within the range of the various forecasts and, therefore, not particularly significant, but in respect of ground and polished glass it seems unlikely that the proposed discontinuous process could compete with imported float glass. However, being a batch process, failure to realize this business is chiefly detrimental only in that the volume of the primary product is reduced. In this connexion it should be pointed out that in table 81 the breakdown into fixed and variable costs in respect of ground glass and coated glass is not realistic. For example the largest item of cost (31,100) is the primary product which is variable and not a fixed cost, being a "raw material" so far as those processes are concerned.

2.2.2 Choice of Technology. The recommendation to adopt the Fourcault process is probably the correct one on the general grounds that one must learn to walk before running, but the supporting evidence given by Consult seems biased and because of the importance of understanding the implications of the decision. the attempt is made to qualify their statements here. In round numbers the relative rate of production for the three processes is:

Fourcault	1
Pittsburgh	2
Float	6

Thus it is obvious that only factories in a very large scale of business can contemplate installation of a float line. These large-scale operators have used the Pittsburgh process. The reason why Pittsburgh plants rather than Fourcault plants (page 118 have been replaced by float plants is no reflection on this particular technology but due entirely to the scale of manufacture. It is true (on the same page) that a Fourcault machine is often retained in a Pittsburgh factory, but this is because, with its smaller output, it is more suited to smooth out variations in demand. The list of new plants based on Fourcault (page 121) could be matched by listing plants which have replaced Fourcault by Pittsburgh machines.

Not listed amongst the advantages of the Pittsburgh process is its ability to work glass of lower soda content(by far the most costly ingredient), i.e. a saving in raw material cost and a more chemically resistant product.

The advantages of the Fourcault process listed on page 249 are valid but the disadvantages - lower drawing speed, occasional drawing waves, complicated manufacture of debiteuse - are dismissed as of minor importance despite the statement on page 242, repeated on page 251, that it is vital to realize a high drawing speed. The drawing wave is a characteristic defect of Fourcault glass-cords in the direction of drawing which mar the optical performance and can be quite persistent so that much glass of poor quality may be made before the trouble is mastered. With regard to the use of a debiteuse, although the manufacturing cost of about 8,500 DL p.a. is not high, the loss of production time for changing and melting out devitrification is not insignificant in view of the high fixed costs in operating the factory, and involves a cost in the region of 60,000 LD p.a.

It would seem that the choice between Fourcault and Pittsburgh is much more marginal than the Consult document implies. Purely on technical point there is no doubt in the present writer's mind that Pittsburgh is the superior process. The weight that is attached to non-technical aspects tilts the balance the other way.

If the decision is firm that the project should be undertaken on a turn-key basis, there is probably no alternative to the Fourcault process, for turn-key contractors are unlikely to be able to offer the training and higher-level expertise needed for the Pittsburgh process. It would be necessary to enter into an agreement with (say) Pilkington to licence their variant of the process and to supply expertise and training. Training by this means is usually much more effective than that given under turn-key contracts.

Until the bottle works have been in operation for some time it will not be known how receptive local personnel are to the skills of glass manufacture. The Fourcault being the easier process, there is less risk involved on this account.

If the market develops more slowly than anticipated, a Fourcault process would be the more viable. If on the other hand the market greatly exceeds expectation, it may be possible on review to provide expansion in terms of Pittsburgh machines for then many of the skills will have been developed.

2.2.3. <u>Raw Materials</u>. There appears to be a lack of understanding of the respective roles of MgO and CaO in the glass composition and also on the influence of iron content. As in many places in the report the recommendations are put forward without giving the reasons for them.

At one time common glass, both bottle and window glass, was based on limestone for the source of alkaline earth oxide, but in those countries where dolomite or dolomitic limestones of low iron content were more readily available it was found that substitution could be made and indeed there were marginal advantages apart from the cheaper raw material.

The partial substitution of MgO for CaO tends to "shorten" the glass, that is to say, to reduce the working range. This means that, for example, bottle machines are more difficult to operate but when the skill is there they can be made to run faster. Magnesia also lowers the thermal expansion of the glass slightly so that losses in the process may be smaller. The weather resistance of the glass may also be improved, but all these factors are marginal and it is a question of purity and cost of raw material which dictates the practice. In the UK dolomite is seldom used in bottle making; in Germany on the other hand, where there is a very pure dolomite available, it is used in quite high proportions.[1]

In Libya the dolomites so far found have about 30% higher iron contents than the limestones so that the emphasis should be to use a composition low in magnesia. In making colourless bottles or tableware it is usual to "decolorize" the glass by adding traces of chemicals to mask or compensate the green tint of iron contamination. If the iron content of the glass exceeds about 0.1% Fe_2O_3, this becomes virtually impossible. In window glass, however, it is unusual to decolorize because the green tint only shows strongly when the glass is viewed through its edge. The Consult market survey does not give any indication as to the proportion of the demand which requires truly colourless glass, but it seems unlikely that it is significant in Libya.

Apart from the sales appeal, the iron content of the glass has an important influence during melting.

If the content is too low the radiant heat in the furnace penetrates to the bottom and can make the operation of the Fourcault process difficult. From this point of view a content of 0.2% Fe_2O_3 is considered desirable.

In considering calculated iron contents it must be remembered that the glass product usually has a higher content, particularly if high cullet ratios are used, due to pickup of dirt in the factory. Good housekeeping must be maintained and it is worth installing a magnetic separator in the cullet lime to remove tramp iron.

The estimated iron content for various raw materials mixtures to achieve the recommended composition (except No. 3 which has only CaO) are as follows:

1/ MgO is necessary in sheet glass to control devitrification but may be added as magnesite.

	From Dolomite	From Lime	From Sand	Total
1. Libyan Sand, Dolomite and Lime as mined	0.162	.0035	.116	0.2815%
2. Beneficiated Sand and mined Lime + Dolomite	0.162	.0035	.036	0.2015%
3. Limestone replacing Dolomite and beneficiated sand	-	.12	.036	0.156%
4. Imported Dolomite with Libyan Lime + beneficiated sand	.003	.0274	.037	0.064%

It should be noted that there is a decimal error in the glass analysis for Federal Republic of Germany dolomite given on page 117; this should read Fe_2O_3 = 0.034%.

If it is felt desirable to preserve the recommended MgO content at 3.2% yet minimize the iron content, the most economical way of doing this is to use imported dolomite only to provide this and balance with Libyan limestone. This would have an iron content of 0.06490 (example 4 above) and correspond to the range which, for bottle glass, can be decolorised.

The batch composition would be as follows:

	kg	Unit Cost (LD)	Cost of Batch (LD)
Beneficiated Sand	726.0	3.94	2,860
Imported Dolomite	149.0	22.00	3,278
Libyan Limestone	84.5	1.60	0,135
Soda Ash	217.0	45.00	9,765
Sodium Sulphate	57.5	37.00	2,127
Coke	4.0	49.00	0,200
Other			1.000
			19.365

This would represent a saving of about 1.2 LD/t over the batch proposed on page 208, i.e. about 6% on the raw material cost.

It should be noted that recent tests (Polservice) on sand in the Malga locality of the Tarhuna Region show

SiO_2	99.0 - 99.2 %	
Fe_2O_3	0.038 - 0.05%	
TiO_2	.063 - 0.118%	

This raw sand compares favourably with the beneficiated sand, although the batch might require a small addition of alumina - perhaps in the form of feldspar.

Limestone in quality and quantity suitable for glass making is also reported.

It is, therefore, probable that by the time the proposed plant is ready to operate the material situation will have changed sufficiently to invalidate any recommendation made now as to the best formulation. However, this possibility is unlikely to seriously affect the general conclusions and estimates of the feasibility study.

2.2.4 Integration. The Consult document advocates integrating the proposed flat glass production with the existing containers factory without indicating the disadvantages of so doing. The sharing of factory and general overheads has obvious economic advantages, but the disadvantages are much less tangible yet so important that seldom does one find these two different technologies integrated and where they are integrated the first opportunity to separate them is taken. The point can perhaps best be made by saying that the same purely economic argument could be used to justify integrating bottle-making with (say) brick and tile manufacture.

A glass-making operation depends so much on unspecifiable factors - glass composition variation, machine malfunction etc. - that for success it is essential that managers at all levels have clear sight of their particular province and be in a position to control it immediately. Just as one man cannot serve two masters, no manager can efficiently share one man or department, and almost certainly any attempt at budgetary control or equivalent becomes a hollow mockery. An element of bad management in one manufacture infects the whole and is difficult to detect because allocation of costs on an arbitrary basis confuses the issues.

By way of illustration, Consult proposes that the existing container works with 160 workers should share 120 of them (discounting 32 management) to complement the additional 132, giving the distribution:

Flint Factory	Common	Flat Glass
40	120	132

This distribution is of course patently unrealistic, but the illustration shows the type of muddle one can get into when one proposes to grow apples and pears on the same tree.

With the limited Libyan market where both container and flat glass production are only marginally viable, it is probably correct to locate the factories close enough to be served by common general administration and non-specialist services, but the term "integration" is going too far. On the contrary, every step should be taken to overcome the disadvantages by segregating the two technologies as far as possible on the same site and giving very careful thought to the organization. For these reasons it is felt that the proposed layout and organisation require radical changes (see 2.2.8 below).

2.2.5 __Investment__. The estimated cost of the investment (2,191.00 LD plus 145,000 in 1981) seems high even when inflation is taken into account, having regard to the extent to which the new plant depends on the existing facilities of the container works. In fact, if the operation is a turn-key one, the investment may not be an over-estimate because that is usually a very expensive installation. However, with regard to the influence which the first cost has on the running cost (20% of which is depreciation alone), it is worth looking at the estimates against some frame of reference. In spite of the different technologies the container factory provides a rough basis for comparison and the comparable costs are set out in the following table.

Breakdown of fixed Investments	Flat Glass Estimate 1977 10,300 tons p.a.	Container Factory Contract, March 1971 12,000 tons p.a.
Equipment c.i.f. Tripoli (f.o.b. xl. 1)	LD	
Beneficiation Plant	(add.Equip.only 11,000)	119,000
Batch House	(add.Equip.only 27,500)	127,000
Melting Furnace	462,000	169,000
Feeders (3)	-	38,000
Forming Machines (3 Fourcault)	154,000	-
(2 Bottle, 1 press)		126,000
Annealing LEHRS (3)	-	75,000
Decoration (bottles)	-	64,000
After and auxiliary process (sheet)	177,500	-
Debiteuse equip.	27,500	-
Services equipment	(add.Equip.only343,000)	279,900
Preliminary costs	190,000	-
Start-up costs	40,000	13,000
Spare parts	-	39,000
Engineering and installation	187,000	162,000
Total cif. Tripoli	1,619,500	1,211,900
Civil Works	557,000	
Freight Tripoli - Asisia	14,500	
	2,191,000	

The two items that stand out are (a) the melting furnace which is almost three times the cost of the furnace for the container factory and (b) the additional services equipment which is greater than the original investment.

Derivation of the daily melting capacity of the furnace does not appear to be given. It can be arrived at by taking the annual production, allowing for 3[illegible]% process loss and dividing by the estimated number of working days.

	Required tons good	Working days	Daily Melting Capacity
1977	1[illegible],300	280	47.5 ton/day
198[illegible]	13,14[illegible]	320	53.3
1985	16.600	320(additional machines)	67.6

The technical data (page 146) calls for a melting area of 90 m^2 and a minimum melting capacity of 54 t/day at approximately 1500°. This is a rather poor performance - corresponding to 600 kg/m^2/day.

European producers are able to melt 700 kg/m^2/day at 1400°C. At 1500°C the efficiency should reach 1,300 - 1,500 kg/m^2/day.

This compares with 1,540 - 2,700 kg/m^2/day achieved in the less exacting melting of glass for bottles.
It seems, therefore, that the high cost of this item is largely due to the liberal provision of melting capacity.

This may be regarded as an insurance for success but it must also be remembered that it also increases operating costs because 80% of the fuel input goes to maintaining the furnace hot and only 20% is actually utilised in melting the glass.

In view of the savings to be made in capital cost, depreciation and fuel a much cheaper insurance could be provided by engaging expertise on a continuing basis by retaining a glass-technology consultant.

b) There is no detail given of the make-up of the investment cost for services. Except in the matter of water supply one would anticipate that the services would be less intricate for flat-glass manufacture than for bottles but, allowing for the equipment shared in the present case the estimate for flat-glass is twice as big. If in fact this difference is due to the provision of water treatment plant it should have been given due weight in the argument for locating the factory at Azizia rather than Tripoli where no treatment is necessary.

2.2.6 Costs. The Consult estimate of cost of production gives an average, according to the anticipated product mix, of 99 LD ton. It is of interest to compare a breakdown of these costs with the actual costs of a glass factory operating in the East Mediterranean. To make the comparison the Consult figures are presented in a different way. The comparison factory is not integrated and in the year quoted (1973) was in the process of converting from Fourcault to Pittsburgh Technology. Its output was about 70,000 tons per year i.e. about twice the size of the proposed integrated factory, taking container making also into consideration. This size difference and the fact that allocation of costs to the different centres is probably somewhat different, means that the comparison can be no more than a rough guide.

Consult Estimate of Operating Costs (1977) compaired with Actual Costs (1973) in East Mediterranean:

	Estimate LD/t	Actual LD/t
Raw material	16.4	13.0
Other materials	11.2	2.6
Fuel	7.2	6.0
Direct labours	12.2	9.7
Factory O.H.	18.9	5.6
Depreciation	19.6	6.3
Selling and gen. admin.	11.1	11.0
Total cost per ton	96.6	54.2

The estimated other materials cost included 8 LD per ton for packing. Presumably steps will be taken to recover the packing cases. The other outstanding items are factory overheads and depreciation, both of which (as estimated) are closely related to investment value which, as already seen, is very high. The biggest contribution is the expensive furnace which has been depreciated over 8 years - surely too short a period in view of the fact that replacement of refractories every 4 years is already allowed for.

It should be emphasized that the depreciation cost of [illegible] will prove to be a very heavy burden for future management to carry. For once the money is spent there is nothing they can do about it other than by increasing volume of sales. But the comparison above confirms Consult's view that the prospects of exporting are slight so that they will be restricted to the natural growth of the Libyan market.

2.2.7 Tenders. The Consult recommendation to deal with the proposal on a turn-key basis has the obvious advantage of minimizing the client's involvement in the early stages but has considerable disadvantages which usually means that a very high price is paid for the required facility with a lasting detriment to the operation of the plant because of high depreciation costs. Seldom is the turn-key operator experienced in glass manufacture but only in the mounting of turn-key operations and depends on the advice of self-interested sub-contractors. The client, unless he employs a consultant to act in his interest, is therefore quite removed from the intricacies of the technology in which he is about to embark and although he is dealing only with one man, that man is acting primarily in his own self-interest.

The contractor must cover himself for all eventualities although some of them may not occur. His choice of subcontractors is often governed more by their preparedness to do the engineering paper work and provide training facilities than the excellence of the equipment to be supplied. The Tender Document usually contains a phrase such as "the equipment and processes must be of the most modern and up-to-date practice" which invites him to put forward highly sophisticated ancillary equipment only marginally justifiable in countries with a very high level of technical advancement and unsuited to developing countries.

Where instead a consulting firm is employed to execute the proposal his charges [illegible] because they are out in the open. The greater part played by the client personnel is an excellent training and helps to build confidence in the future management particularly if they are party to the various decisions made.

The inflexibility of a turn-key contract once signed means that it is essential that, for example, the best layout is decided in advance. The view is expressed in Section 2.2.8 that the layout proposed by Consult is not acceptable as it stands. Rectification would present no problem if the Organization were to execute the civil works outside a semi-turn-key contract.

Otherwise a hurried modification must be made if time is not to be lost in putting the project out to tender.

It should be noted also that debiteuse manufacture should start well in advance of factory start-up. It is usual to "age" a debiteuse for at least two years before use.

If the decision is firm to use a turn-key operator it is suggested that a glass technologist be retained on an intermittent basis, during the implementation of the project and for some time afterwards, to safeguard the Organization's interests; and that the Tenderers be required to show as optional extras those items where degree of sophistication is a matter of choice.

2.2.8. Organisation and Layout.

The importance of an organization which segregates the functions in a plant operating two technologies has already been mentioned in 2.2.4. It is not felt that the Consult recommended organization is satisfactory in this respect and it is suggested that the first opportunity should be taken to shape the organization of the Hollow Glass Factory, soon to start, so that the integrated organisation will follow somewhat on the lines set out below. Apart from ensuring ultimate success for the project the immediate importance is that the training by the Tender should be compatible with the organization.

GENERAL MANAGER

- CHIEF GLASS TECHNOLOGIST — Raw Materials Testing, Batch Formulation, Melting Supervision, Quality Control, Trouble-Shooting Tech. Advisor
- CHIEF ENGINEER — Machine and Mould Shops, Electric, Air, Water, Oil Services. All trade Maintenance
- Production Mgr. Flat Glass
  - Shift Masters — All Production Workers Including sorters
- Production Mgr. Hollow Glass
  - Shift Masters — All production workers including sorters
- Commercial Mgr. — Finance, Purchasing, Sales, Warehouse, Despatch
- Admin. Officer — Personnel, Social Welfare, Security
- Quarries and Ore Dressing — Quarries, Beneficiation Plants, Cullet Handling, Yard Crew

With regard to layout, a general arr[illegible] [illegible] the two technologies is given in 2.2.4.

More specifically it is to be noted that the bottle factory is an inflexible one depending, as it does, on two high-speed bottle machines and one furnace only, although clear and coloured bottles are contemplated. This means that only large volume orders can be entertained and that production must stop, although costs are maintained, for about 14 days every time a colour change is made and for about four months for rebuild of the furnace. To be viable it will be necessary to minimize colour changes and, therefore, offer extremely poor delivery dates for colour not currently in production. Inevitably there will be pressure to build a second furnace close enough for forming machines to be easily transferred and so that [illegible] ar within reach.

In addition to the poor delivery the Libyans will feel poorly served by their new glass industry if they are unable to obtain small order deliveries of special lines so frequently needed in a developing economy to promote new products and very difficult to obtain from abroad. There will, therefore, be pressure to install a small furnace to serve semi-automatic machines to give versatility to the plant.

Demands for technical glasses for tubing borosilicate or opal ware are likely to grow - none of which are likely to be viable on a green-field site, but may well be so if developed as an adjunct to the bottle factory.

All these considerations make it essential that the area immediately adjacent to the bottle factory should be reserved for future manufacture of compatible products and should not be pre-empted by siting a sheet factory there which could only be removed at a cost of more than 80% of its investment value.

This situation can easily be met by displacing the proposed new factory northwards possibly as far as the present parking area and changing the function of the present spare parts and maintenance buildings to grinding/polishing and debiteuse making respectively. The displaced functions can be housed elsewhere.

Two other interchanges are necessary. The wood-working department now proposed should change places with the present general store.

A [illegible] by Consult is that a [illegible] part of [illegible] 'finished' flat glass is in fact 'work in [illegible]ess' since it has yet to be cut to order. This stock should, therefore, be [illegible] to the cutting shop - say in the area marked [illegible] - and the packing carried out in the finished product store building.

Displacement of the flat glass factory will involve some additional pipe and services work and a modified method of transferring the batch. In the later respect some change is in any case necessary as the method proposed by Consult is not compatible with the existing equipment, ignores the risk of contamination when coloured bottles are being made and the risk of batch segregation after mixing.

3. RECOMMENDATIONS

1. The broad features of the Consult document should be taken as a basis for drafting the Tender document. Exceptions are made below.
   Thus the scale of the operation, the choice of technology and the Azizia site should be accepted.

2. As a basis for planning the plant it may be assumed that local limestone with the minimum of imported dolomite will be used - the actual composition being reviewed nearer the start - up date when local resources are better known.

3. The plant should be located at Azizia to enable it to share top management and services with the container factory. However the aim should be to segregate the two activities as far as possible consistent with this.

4. The Tender document should be framed to avoid any unnecessary sophistication and so avoid loading the overhead charges having regard to the marginal viability of the project.

5. Distribution should be designed to recover the cost of cases which amount to 10% of manufacturing cost.

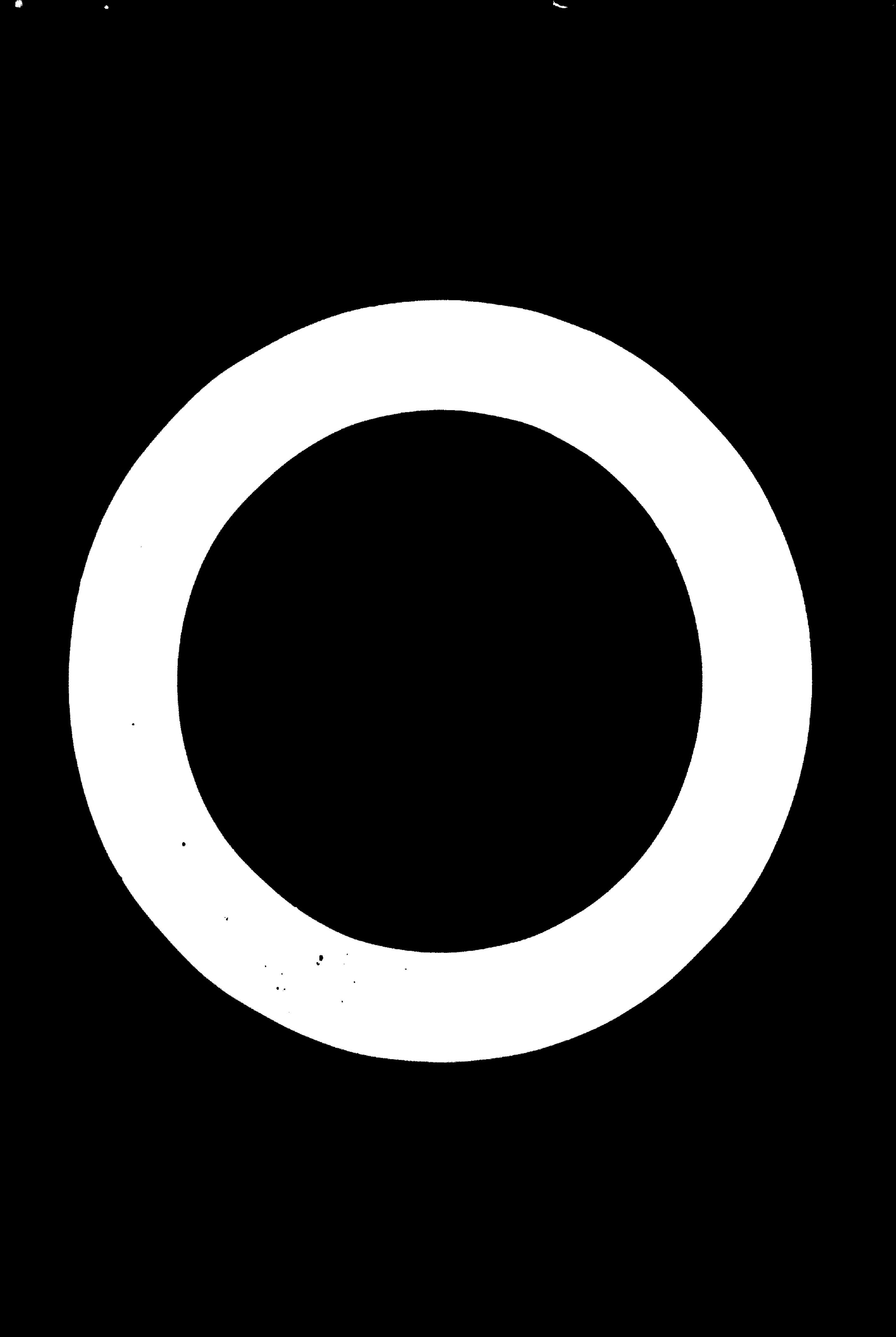
6. Debiteuse manufacture should start well in advance to start-up to allow necessary ageing.

7. The organization proposed by Consult should be revised to secure better management for the two technologies located on the same site.

8. The situation of the new production should be displaced northwards with respect to the Consult proposal to enable development of the glass industry in Libya without incurring heavy penalties.

   Minor redeployment of auxilary functions should also be made.

9. The basis of tender, i.e. whether turn-key or otherwise, should be reviewed. If turn-key is preferred it is recommended that a glass technology consultant should be retained on an intermittant basis to safeguard the interests of the organization.



Annex I

DRAFT TENDER DOCUMENT

GENERAL CONDITIONS OF CONTRACT

AND

SPECIFICATIONS FOR

FLAT-GLASS FACTORY IN AZIZIA

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Section 1. INTRODUCTION

1.1. Background Information. This proposal represents a plan to extend the Libyan glass industry established at Azizia into the field of flat-glass manufacture. The present factory at Azizia, situated 35 km south of Tripoli, produces containers and tumblers from a regenerative furnace supplying two IS bottle machines and an automatic press. The plant is designed to make the best use of the facilities there, the raw materials preparation plant, the batch plant, services and the technical and managerial expertise.

Tenders are invited to the plant to produce 15,000 to 20,000 tons/year of drawn flat glass based on the Fourcault process.

1.2 The Scope of the Contract.

1.2.1. The main contractor will be wholly responsible for the supply of the complete production plant, its installation and satisfactory operation and the training of personnel. The work will be carried out without disrupting the current production of the container factory.

1.2.2. The term "Complete Production Plant" is to be understood as including:

(a) Batch transport and charging from existing batch-house;

(b) Factory cullet processing handling and charging;

(c) Glass-melting unit complete with all accessories, measuring and control devices, firing system etc;

(d) Sheet-glass forming machines complete with cut-off devices;

(e) Cutting, sorting, packing and storage equipment;

(f) Debiteuse fabrication and firing equipment;

•(g) The additional services, maintenance and auxiliary facilities necessary to permit both container plant and flat-glass plant to operate concurrently;

•(h) Grinding, polishing and coating equipment;

•(i) Civil engineering work.

The equipment must be new and of modern design best suited to ensure the highest quality of sheet glass in a country of developing technology.

- A distinction is made with respect to ancillary finishing processes, to any elaboration or sophistication proposed by the bidder, to the additional services, maintenance and auxiliary facilities and to civil engineering which may be treated separately by negotiation when the contract is awarded to ensure the most effective integration of flat-glass production with the existing container factory. The Bidder is requested to give separate itemized prices to enable the Organisation to consider the possibility of contracting for all or part of the works object of the Tender, and the Organisation reserves this right.

Section 2.

Form of Tender.

Tender will be subject to the general conditions and terms set out in Section 3. They should be submitted in the form set out below in .... copies addressed to:

....

....

and should be marked "Tender - Flat-glass".

The closing date for tenders will be ....
Tenders shall be valid for a period of at least .... months from this closing date.

2.1. The Offer.

2.1.1. (a) Price.

The total price of the complete plant for "turn-key" delivery including civil engineering work, start-up operations and training of personnel. This price will be firm;

(b) Price. main production plant, excluding additional services, grinding/polishing equipment and civil works;

(c) Price: Additional services;

(d) Price: Grinding/polishing equipment ;

(e) Price: Civil works.
(see footnote to 1.2.2.)

2.1.2. Delivery:

The over-all period of time necessary to reach the date of starting up from the day the contract is notified. The shortest possible delivery time is essential.

2.2. Terms and Conditions.

Statement of compliance with the terms and conditions set out in Section 3.

Compliance with the guarantees and performance rating set out in Schedule B. Terms and schedule of payment upon which the offer is based shall be indicated and will be negotiated when the contract is awarded.

2.3. Technical Description.

A technical description in accordance with Schedule C attached hereto.

2.4. References.

The Bidder shall enclose a list of references showing installations already erected by him for similar types of production. He should lay stress on such installations which compare in output capacities.

Schedule A

2.5 Detailed Price List.

The total price of every equipment unit including piping, electrical connexions etc. and of spare parts for two-year operations should be given.

The Bidder shall follow accurately the disposition of the following price breakdown table.

A. Engineering.

Studies, patent rights or licence fees, purchasing charges, basic data and drawings for the civil engineering work.

B. Equipment C + F.

(including lubricants for the first fill-up and spares)

B.1. Batch transfer from existing batch-house to furnace charger, including surge hoppers, access to batch mixer discharge

[illegible]

ne[illegible] [illegible] separation of tramp iron at final delivery.

B.2. Cullet processing and handling including collection, crushing, de[illegible] [illegible] storage.

B.3. Melting furnace comprising batch charger, tank furnace, control and measurement, heating and cooling systems with piping and ducting.

B.4. Drawing machines complete including automatic cutting and lifting devices, control and measurement and water cooling system.

B.5. After treatment equipment including lifting devices, automatic cutting tables, manual cutting tables, testing equipment.

B.6. Glass [illegible] and polishing.

B.7. Metal [illegible] equipment.

B.8. Debiteuse fabrication equipment including firing furnace for debiteuses and floaters.

B.9. Additional workshop equipment including lathe and press for fixing asbestos disc or rollers.

B.10. Additional installation for energy and water supply including additional transformers and switchgear, DC generators and batteries, [illegible] valves and piping, air compressors, water pumps and treatment.

B.11. Additional devices for internal transport etc.

B.12. Civil engineering work including construction of flat-glass production building, and auxiliary buildings. Drilling of additional well.

C. Delivery costs (C+F).

D. Erection supervision.

E. Start-up operation.

F. Training.

Schedule B

2.6 **Guarantees.**

2.6.1. Guarantees applying to materials and equipment parts.
During a period of at least one year starting from the date of the final acceptance certificate, the furnace, machines and equipment units supplied by the contractor shall be guaranteed against any defects in design, construction, material or workmanship. During this period, and under the condition that the directions given by the contractor will have been carried out, every part found defective will be replaced at the contractor's cost, including all related expenses. The duration of guarantee in respect of the replaced part shall run again, entirely, from the date of replacement.

2.6.2. Performance ratings for the installation.
The contractor will give an over-all guarantee of satisfactory operation, and in addition a guaranteed performance rating in respect of each of the following installations.

(A) Output capacity.

1. The batch-conveying equipment will be capable of handling in 8 hours, and storing 100 tons per day.
2. The cullet plant will be capable of handling and processing at least 35 tons per day with provision for dealing with emergencies.
3. The furnace will be capable of supplying to the drawing machine molten glass of a quality and temperature uniformity necessary for accordance with international standards, to the extent of 54 tons (metric) per day initially and ultimately (1985) 75 tons per day the increased output being achieved by higher melting temperature.
   The specific rate of melting shall not be less than 600 kg/m^2 a day based on the area of the melting end covered by the flames.
   The specific oil consumption shall not be greater than 0.60 kg oil per kg glass melted.
   The tank shall be designed to have a lifetime of six to eight years.

4. The [illegible] forming machines shall operate [illegible] the [illegible] principle. Based on the expected tonnages with [illegible] glass thickness, viz.

5%	2 mm
4[illegible]	3 mm
25%	4 mm
15%	6 mm
10%	8 mm

The installation shall be capable of producing 54 gross tons per day initially and 75 tons per day ultimately (1985), the increased output being achieved in part by the higher drawing speeds made possible by acquired skill and in part by the addition of a drawing unit.
The quality of the product shall be to international standards (ASTM, DIN, BSS etc) and rejection on inspection shall not exceed 15%.

5. The cutting, sorting, packing and storage equipment shall have a handling capacity to cope with the machines, and the total loss of gross production due to edge losses, breakage in the machine, cutting and internal transport losses shall not exceed 30%.

6. The debiteuse fabrication and firing installation shall have adequate capacity to serve the plant with correctly matured and fired debiteuses and floaters and provision will be made, either by pre-start-up production or by importation, to meet the initial requirements of the plant.

7. The additional services, maintenance and auxiliary facilities shall permit both existing container plant and proposed flat-glass plant to be operated efficiently at the same time. The schedule of relevant existing equipment and possible additional equipment given in Section 5, as a guide to the Bidder, will not in any sense relieve him of his responsibilities in this respect.

8. The grinding/polishing equipment and also the coating equipment will each have a net output of 1,140 tons per year initially and 2,000 tons ultimately. The Bidder will state whether his proposals are based on an 8-hour day or a 24-hour day.

(B) Efficiency rating.

The Bidder will specify and guarantee the ratio of net production (to the warehouse) to gross production.

(C) Consumption figures - utilities.

In his proposal the Bidder shall guarantee the consumption figures in respect of:

Electric power
Cooling water
Fuels
Compressed air
Every utility required

Each consumption figure will be given per ton of net production.

Schedule C

2.7 Technical Information to be supplied.

A technical description shall be submitted to cover every unit proposed according to the plan detailed hereafter in Technical Specifications, Section 4.

2.7.1. Production Units

2.7.2. Utilities

2.7.3. Storage Facilities

2.7.4. Drawings and Diagrams. The following documents and drawings are mandatory and should accompany the Tenders

Layout drawing of the production plant

Plan and elevation drawings of each equipment unit

Flow diagrams, leaflets and brochures, showing and describing principle equipment and processes

2.7.5. Schedule of Operations. A detailed programme will show:

The time required to prepare drawings and specifications to be sent for approval;

The overall time requirements for procurement of equipment, workshop inspection, test and for shipping this equipment;
The time required for execution of civil engineering;
The time estimated in detail to carry out erection;
The time required for start-up for each production unit.

2.7.6 Man-power Requirement.
The Bidder shall list the required labour force in each installation for production, maintenance, administration, management etc., specifying the qualification and number of men required.

2.7.7. Maintenance Costs.
The Bidder shall give estimates of maintenance and up-keep costs of the installation showing cost of materials and number of men required. This information may be given as a percentage of investment costs.

Section 3.

General Conditions of Contract.

3.1. **Division of Responsibilities.**

3.1.1. **Obligations of Contractor:**

....

....

3.1.2. **Obligations of the Organization:**

....

....

3.2. **General Rules of Contract.**

3.2.1. **Language of Contract** ....

3.2.2. **Patents and Licences** ....

3.2.3. **Penalties** ....

3.2.4. **Bond, Insurance and Arbitration** ....

3.3. Additional Rules of Contract.

Section 4.

Technical Data to be Supplied.

To simplify the comparison and evaluation of tenders the Bidders are required to submit technical data in the form here prescribed.
The metric system should be used for all numerical values. Buildings should be identified using the legends in the drawings. Where alterations are called for, the Bidder is invited to offer his recommendations supported by comparisons of operating and maintenance costs etc. The Bidder should bear in mind that the site at Azizia must also allow for potential growth of container and similar production.
The decision to locate the factory at Azizia was taken to exploit the existing facilities to minimize investment costs and overhead expenses. His proposals and recommendations will, therefore, be to this end. To guide him in this there is given equipment and manning information relating to the container factory with some tentative estimates of the additions needed for the flat-glass production. He will recommend how best to draw batch from the existing batch-house bearing in mind that from time to time this facility will be mixing batch for coloured bottles. He may wish to propose a change of function for some of the auxiliary buildings in the interest of good over-all layout and future expansion of both manufacturers.

4.1. Production units.

- 4.1.1. Glass-melting furnace
- 4.1.2. Drawing machines
- 4.1.3. Cutting and inspection
- 4.1.4. Grinding and polishing
- 4.1.5. Coating
- 4.1.6. Palletizing of products

4.2. Technical service units.

- 4.2.1. Raw materials storage
- 4.2.2. Batch plant
- 4.2.3. Making, maturing and firing of debiteuses and floaters
- 4.2.4. Laboratory

4.3. Auxiliary Services

- 4.3.1. Electricity, fuel, water and air
- 4.3.2. Maintenance of machines and equipment
- 4.3.3. Maintenance and repairs of furnaces

4.4. Warehousing and Packing

4.5. Civil Engineering Work

4.6. General Requirements

- 4.6.1. Organization of Production
- 4.6.2. Power sources
- 4.6.3. Manpower
- 4.6.4. Training of personnel
- 4.6.5. Erection schedule
- 4.6.6. Start-up
- 4.6.7. Production costs

Section 5.

Technical Description of Existing Operations.

For the guidance of the Bidder there is set out here technical information relating to existing facilities, which should be used in conjunction with the drawings provided in Section 6. The layout of existing buildings is shown in 6.1.

5.1. Building.

It is anticipated that to house the flat-glass production with its auxiliaries, whilst utilizing existing facilities to the full, buildings of the following approximate floor areas and heights and civil work will be required.

5.1.1.	Roofed storerooms for additional dressed and imported raw material	1,000 m^2	4.0 m high
5.1.2.	Furnace hall	1,100 m^2	16.0 m to roof truss
5.1.3.	Drawing hall	750 m^2	20.0 m to roof truss
5.1.4.	Cutting shop	1,200 m^2	5.0 m to roof truss
5.1.5.	Joinery and case-making	670 m^2	5.0 m to roof truss
5.1.6.	Warehouse	1,350 m^2	5.0 m to roof truss
5.1.7.	Foundation for the furnace, drawing, grinding/polishing machines, flues chimneys		
5.1.8.	Welfare building extension	400 m^2	
5.1.9.	Miscellaneous foundations, ducting etc.		

The Bidder's attention is particularly drawn to the existing buildings "spare parts" and "maintenance shop". He may wish to recommend that the functions of these buildings be changed, for example, to house the grinding/polishing shop and debiteuse fabrication respectively and so allow the main production building to be sited adjacent and yet leave adequate space for future expansion of the container factory. In such a case these functions would have to be housed elsewhere. Likewise the existing "general store" might be more appropriately occupied by joinery and case-making and replaced in the interests of better layout.

5.2. Process.

The existing hollow-glass factory has been recently completed and comprises ore-dressing, batch mixing and all services for maintenance and administration of a manufacturing facility producing 9,000 tons/year of bottles and 3,000 tons/year of pressed glass. The layout provides for a future extension of at least the same capacity. The productive units are two 4-Section IS. machines (single gob but drilled and aligned for double gobbing) and an automatic press.

The following project engineering schedule for the combined factory is given as a guide to the Bidder as to the extent to which the proposed flat-glass manufacture is expected to share existing equipment and where additional equipment is necessary.

5.2.1. Beneficiation Equipment

(a) Sand Dressing (Insert Consult pages 141 + 142)

(b) Dolomite and Limestone Dressing (Insert Consult page 143)

5.2.2. Batch Plant. (Insert Consult pages 144 + 145)

5.2.3. Melting furnace.

A complete new regenerative furnace for flat glass, including refractories for emergency, hot-repair and specification of refractories required for overhaul.

5.2.4. Drawing Machines.

2 Machines net drawing width 2.4 m

2 " " " " 1.2 m

Complete with supporting frames, automatic cutting, breaking and lifting devices and cooling boxes for water cooling.

5.2.5. After-Treatment Equipment *(Insert)

5.2.6. Glass Grinding and Polishing units *(Insert)

5.2.7. Metal-Coating Equipment *(Insert)

5.2.8. Debi' use Fabrication Equipment *(Insert)

5.2.9. Workshops and Laboratory *(Insert)

5.2.10. Installations for Energy and Water Supply *(Insert)

5.2.11. Others *(Insert)

* Take insertions under appropriate headings from Consult's pages 148 to 160.

5.3. Raw Materials.

Sand, limestone and dolomite are native to Libya but, although further exploration is in progress, the accessible quarries so far explored show rather high iron contents. It is probable that superior sources will be found before this project is implemented but meanwhile it is assumed that the following analyses are valid.

	SiO_2	Al_2O_3	R_2O	CaO	MgO	Fe_2O_3
Raw sand	96.2	1.35	0.03	0.38	0.07	0.16
Beneficiated sand	98.1	1.15	0.13	0.14	0.03	0.04
Limestone	2.85	0.93	-	52.97	0.70	0.32
Dolomite	4.85	1.02	-	36.56	13.51	0.45

Although a dolomite/limestone crushing plant is installed at the site it is possible that the glass composition will be based on local beneficated sand, local limestone with imported dolomite to minimise the total iron content. Other materials must also be imported through Tripoli and conveyed by road to Asisia.

Prices, delivered at the factory are as follows:

Beneficiated sand	3.94	LD/ton
Uncrushed dolomite and limestone	1.6	LD/ton
Timber for packing cases	45	LD/m^3

5.4. Fuel, Power and Water.

5.4.1. Fuel. A number of oil refineries have been planned for Libya, one of which is already operating. The specifications of the oils to be used and stored at Azisia according to section .... are given below

Specifications of Fuel Oils

(Insert)

Prices:	Gas Oil	0.0286	LD/litre
	Fuel Oil	0.010	LD/litre

5.4.2. Electricity.

Electricity is supplied to the factory at 11 kV by two underground feeders rated at .....kVA
The existing main high tension switchboard is metal-clad and composed of six cells as follows.

(1) Two isolating switches and a third common isolating switch for the main in-coming feeder and stand-by one.

(2) For measurements containing three current transformers, three ammeters, three potential transformers with fuses, three voltmeters with change-over switches, one frequency meter, one power-factor meter, one kWh meter, one kVA meter.

(3) One load-isolating switch and three ammeters.

(4) Oil circuit breaker with time delay signal lamps, ammeter, voltmeter, isolating for outgoing feeder to the first transformer.

(5) Similar for the second transformer.

(6) For the outgoing feeder to the stand-by transformer.

There are three transformers each of 1000 kV one being stand-by. The transformation ratio is 10.5 kV to 380/220 volt, three phase 50 cycles/sec.
For the guidance of the Bidder the additional maximum motor capacity required for the present project is estimated to be 810 kW The actual required capacity after elimination of the reserve aggregates and the assumption of a simultaneous factor of 0.7 is estimated as 481.5 kW. Allowing for power-factor losses the connecting load for the flat-glass factory is estimated to be 752 kVA On this basis an additional transformer of 1000 kVA seems to be called for.

For the drawing machines DC generators calculated for 110 volts have to be provided. They have to be connected additionally with a battery emergency current unit in such a way that, in the case of a power cut, an automatic switch-over is ensured.
For the flat-glass factory an additional emergency current aggregate is required with capacity calculated on the basis of the installations which must not be interrupted. Estimates suggest a capacity of 600 kVA

Price (special tariff) 0.12 LD/kWh

5.4.3. **Water.**

There are two operating bore holes on the Azizia site; a further well is contemplated. Although the reserves of water are considered adequate the hardness is such that water treatment and a re-circulating system is necessary.

Azizia water has the following approximate analysis.

Degree of German hardness	56.5
pH value	7.3
Cl-content	300 mg/litre
SO_4--content	625 mg/litre

5.5. **Transportation.**

There is a good road system connecting the site at Azizia with Tripoli (45 km). There is no rail service.
Current costs of transport between Tripoli and Azizia are approximately 30 LD per truck load (12 tons)

i.e. 0.055 LD per ton and km

5.6. **Manpower.**

The township of Azizia is a rural community of about ...... inhabitants. The glass factory is the only industry in the area.
The wages and salaries currently paid in Libya are as follows:

	LD year	Including social charges
Unskilled workers	840	950
Skilled workers	1,200	1,350
Highly skilled workers	1,440	1,600
Engineers	1,800	2,000
Managers	2,400	2,650

154 of the staff and workers currently employed in the existing factory have functions which will be common to both manufactures when the flat-glass factory is installed, viz.

Management	General Manager	1
	Commercial Manager	1
	Technical Manager	1
Administration	Office Manager	1
	Payroll Master	2
	Clerks	4
	Secretaries	5
	Health Officer	4
	Canteen Personnel	6
	Yard Crew	10
	Guards and Gate-keepers	18
Commercial Dept	Financial Manager	1
	Purchase Officers	2
	Sales Officer	2
	Clerks	2
	Secretaries	2
Storage	Foreman (Raw Mats)	1
	Foreman (Finished ware)	1
	Helpers	3
Technical Dept	Chief Engineer	1
	Measure + Control Engineer	1
	Assistant Engineer	1
	Draughtsman	2

Laboratory	Chemist	1					
	Assistant	4					
	Helpers	3					
Quarry Personnel	Engineer	1					
	Operators	4					
	Truck Drivers	2					
	Shift		I	II	III	IV	Reserve
Benefication Plant	Foreman		1	-	-	-	-
	Operators		1	1	-	-	-
	Helpers		2	2	-	-	-
Batch Plant	Operators		1	1	-	-	-
	Helpers		1	1	-	-	-
Materials Handling	Lift-Truck		1	1	1	-	-
	Helpers		3	2	2	-	1
Service Personnel	Electricians		1	1	1	1	1
	Fitters		1	1	1	1	1
	Helpers		1	1	1	1	1
Workshop Personnel	Fitters		2	2	2	2	1
	Welders		1	-	-	-	1
	Electricians		1	-	-	-	1
	Carpenters		2	-	-	-	1
	Helpers		3	1	1	1	1

Some reorganization of the management is anticipated to operate the joint manufacture efficiently. It is possible that the organization of top management will accord with the following.

General Manager
- Chief Glass Technologist
- Chief Engineer
  - Production Manager, Hollow Ware
  - Production Manager, Flat Glass
- Commercial Manager
  - Administration Officer
    - Quarries + Ore Dressing Superintendent

5.7. [illegible]

([illegible] from flint factory contract document)

6. [illegible]

Drawings

6.1. Schematic layout. The shaded areas are indicative only of the additional building foreseen in Section 5.1. The actual siting of such additional buildings will be recommended by the Bidder.

6.2. Plan of existing factory. Scale 50[illegible]:1 with Arabic-English translation of legends.

6.3. Detail of existing batch-mixing discharge pit. (N.B. the additional pit for belt conveyor marked on the drawing has no relevance to the present project but refers to hollow-glass cullet handling.)

6.4. General store. Plan and elevation Scale 1[illegible]:1. The utility buildings on this site are built to a modular construction illustrated by this example. (Translation of Arabic not necessary.)

5.2.1. Beneficiation Equipment

(a) Sand dressing. Existing capacity 120t/day

Required for flint glass 30t/day

		kW
2	loaders in sand store	
1	hopper 7 m^3	
1	extracting belt	0.5
1	roller mill	35.0
1	Belt conveyor	2.0
1	static sieve	
1	spiral classifier	3.0
1	hopper 30 m^3	

			kW
1	Conveying pump		1.0
2	Hydrocyclones		
1	Set of pipings		
1	Travelling crane		1.0
1	Static sand drier		
1	Bucket elevator		5.0
1	Belt conveyor		3.0
	Steel structure		
1	Reversing belt		2.0
1	Soda-ash hopper 2 m^3		
1	Soda-ash pump		
1	Air compressor for Soda-ash pump		33.0
1	Metallic hopper 10 m^3		
1	Bucket elevator		5.0
			90.5
Estimated current consumption for flat glass (40 t/day)			30.0
Additional equipment for flat glass			
1	Dust-removing and collecting equipment	500	1.0

b) Dolomite and limestone dressing. Existing capacity 60t/day.
Required for flint glass 10t/day.

1	Hopper 3 m^3	
1	Extracting belt	0.5
1	Jaw crusher	5.5
1	Belt conveyor	2.2
1	Hopper 7 m^3	
1	Extracting belt	0.4
1	Rod mill	56.5
1	Belt conveyor	2.2
1	Vibrating screen	4.0
2	Belt conveyors	4.4
1	Bucket elevator	5.0
2	Steel silos 13 m^3 each	
2	Pumps, piping and steel structure	
1	Loader 1 m^3	
2	Air compressors	66.0
		146.7

		kg	kW
	Flat [illegible] t/day		37.0
	Addition[illegible] equipment for flat glass		
1	Du[illegible]	50[illegible]	1.0
5.2.[illegible]	[illegible] plant. [illegible] capacity 1[illegible] t/day		
	[illegible] flat [illegible] 60 t/day		
2	San[illegible] [illegible] m^3 each		
2	Soda-ash [illegible] each		
1	Dolom[illegible] [illegible]		
1	Limestone [illegible]		
	Steel [illegible]		
17	Level indicators		
3	Dust removing plants		4.5
1	Cyclone		
	Dosing and vibrating conveyor lines		3.0
2	Container balances 1,00[illegible] kg and 400 kg		
1	Belt conveyor		3.0
1	Chute on mixer		
2	Mixers		80.0
	Steel structure		
	Electric control system		
1	Passenger-freight lift		5.0
2	Fork-lift trucks lifting 2 t		
			95.0
	Estimated current for flat glass		43.0
Additional equipment for flat glass			
1	Horizontal and reversible distributing belt to day silo	1,500	5.0
1	Day silo with slide valve 50 m^3	1,000	
1	Batch feeder with auto control, glass level air cooled or S.S. chute	3,000	15.0
1	Cullet silo with elevator (60 m^3)	2,500	2.0
1	Cullet-breaking device	1,000	3.0
1	Dosing equipment	50	1.0
1	Magnetic separator	100	1.0
1	Dust exhausting device	500	1.0
		9,650	71.0

5.2.3. Melting Furnace

Melting area 90 m^2

Total length 32 m

Total width 20 m

Capacity at least 54 t/day

Tank contents 500 t

Melting rate min. 600 kg/m^2 day

Melting temperature approx. (1,500°C)

Oil consumption 25,000 litres/24 h

Number of machines 3 (4)

		kg	kW
a)	Refractory materials including mortar all types	1,300,000	
b)	Anchorage of steel sections	100,000	
c)	20 automatic oil burners and accessories	10,000	
	2 oil pumps (1 reserve) 750 l/min. with day container and heating-up equipment	1,000	15.0
	3 heating installations for the drawing machine	750	
d)	Tank-cooling plant, 6 medium pressure tank-cooling ventilators (2 reserve) 1,000 m^3/min. 0.018 atmos. with air ducting etc.	4,000	150.0
e)	Reversing equipment 2 waste exhausters (1 reserve) 10,000 m^3/min. 0.006 atmos.	1,000	20.0
	1 fully automatic reversing equipment 3 valves 1 chimney, 30 m high	45,000	20.0
f)	Furnace-measuring and control equipment		
	40 T/C with compensating line	100	
	6 six-colour recorders	100	
	1 furnace pressure control with accessories and recorder	100	
	4 control boards for the fully automatic system	300	
	1 recorder for oil and air consumption	20	
	1 complete board for fully automatic temperature regulation of furnace and for reversals	50	
	2 oil quantity registration units for furnace and drawing machines	10	
	1 switchboard control	500	
		1,462,030	205,0

		kg	kW
5.2.4.	Drawing Machines		
	3 Complete Fourcault machines	75,000	15.0
	23 Roller pairs, length 9 m		
	net drawing width 2 x 2.4 m		
	1 x 1.2 m		
	drawing speed (3 mm) 50 mph		
	3 supporting frames with platforms etc.	12,000	
	3 fully automatic glass-cutting devices	300	3.0
	3 fully automatic breaking and lifting dev.	300	3.0
	3 cooling boxes (water cooling)	2,000	
		39,600	21.0
5.2.5.	After-treatment equipment		
	3 vac. lifting devices for sheets	300	3.0
	2 fully automatic cutting tables, cutting traverse + longitudinal (3 x 2.5 m)	5,000	8.0
	1 fully automatic cutting table for transversal directions (3.0 x 1.5 m)	1,000	2.0
	6 manual cutting tables	600	
	40 movable frames, max. width 2.4 m	6,000	
	10 sets tools for manual cutting		
	1 testing equipment		
		12,900	13.0
5.2.6.	2 grinding machines complete (max. 3x2 m)	4,000	40.0
	2 polishing machines (3x2 m)	4,000	60.0
	1 ball mill } 1 spiral polishing machine }	2,000	4.0
	1 emery washing unit	100	1.0
		10,100	105.0
5.2.7.	1 complete vacuum metal-coating equipment for max. 3.5 x 2 m	1,200	5.0

		kg	kW
5.2.8.	Debiteuse fabrication equipment		
	1 arch for tempering debiteuses and floaters dimensions approx. external 4 x 2.5 x 2 m internal 3 x 1.5 x 1 m		
	Forming temperature up to 1300°C gas oil		
	quantity of refractories	30,000	
	Steel work	1,000	
	1 furnace heating unit, complete	200	5.0
	1 temperature controller/recorder		
	Ready mixed, dry raw clay for approx. 2 years debiteuse and floater	15,000	
	1 mixer, 150 litres	1,000	5.0
	1 vacuum press		
	tools for manufacture of D + F		
	1 thermo-hygrograph		
	1 stone-cutting saw with 1000 blades (500 mm)	1,200	2.0
	1 car for the transport of D + F, with tools	500	
		49,500	15.0

		kg	kW
5.2.9.	Workshop and Laboratory		
a)	Maintenance workshop, existing		
	1 sheet sheer		
	1 sheet bender		
	1 portable welding set		15.0
	1 autogeneous welding set		
	1 milling machine		2.0
	1 lathe 1500		6.5
	1 shaping machine		1.0
	1 drilling machine		1.0
	1 power hack-saw		1.0
	1 grinding machine		0.5
			26.0
	Estimated current for flat glass		13.0
Add for flat glass:			
	1 lathe approx. 3000 mm	2,000	5.0
	1 press for fixing asbestos disk on roller	800	3.0
		2,800	8.0

		kW
b)	Electric workshop, existing	
	testing devices	0.5
	drilling bench	2.0
	winding machine	0.5
	battery charging unit	2.0
	grinding machine	0.5
	electric test furnace	2.5
		6.0
	Estimated current for flat glass	3.0

No addition

c)	Joinery workshop, existing	
	1 band saw	5.0
	1 planer	3.0
	1 thicknessing machine	3.0
		11.0
	Estimated current for flat glass	6.0

No addition

d) Laboratory, existing - one each

Precision balance, analytical balance, vibrating testing screen, drying oven, muffle furnace, test furnace, refrigerator, water bath, heating plate, water still, Orsat gas analyser, viscometer, calorimetric bomb, pH meter, jaw crusher, ball mill, grinding/polishing machine, instrument for density measurement, centrifuge and vacuum pump, polariscope, vernier, micrometer, measuring calipers, flame photometer, dilatometer, microscope, seed-scope, optical pyrometer, potentiometer, photometer, cutting saw, polarising microscope, 2 platinum disks, 5 platinum crucibles 30 ml, 2 platinum crucibles 100 ml, 1 platinum crucible 500 ml, 1 platinum rod, 2 platinum-lipped forceps and various small tools — 10.0 kW

No addition

	KD	KW
5.2.10. Installation for energy and water supply		
a) Electricity, existing		
1 supply feeder (11 kV)		
1 main HT switchboard		
1 transformer 1000 kVA (reserve)		
Additional for flat glass		
1 transformer 1000 kVA	3,000	
1 emergency current air-cooled aggregate, capacity 750 kVA with motor, approx. 100 hp	7,500	
complete with network from HT switchboard to all installations	10,000	90.0
complete switchboards, contactors, fuses etc.	2,000	
2 DC dynamos for the drawing machines (reserve)	50	2.0
2 sets of batteries (1 reserve) for drawing machines (approx. 80 Ah)	500	
	23,050	92.0

b) Oil, existing

(Mazout oil)

2 storage tanks including pumps 350 m^3 each storage time 2 months. Consumption in flint factory 9 t/day, consumption in flat-glass factory 25 t/day. Storage time will be reduced to c. 20 days.

(light oil)

2 storage tanks including pumps of 120 m^3 each storage time 2 months. Consumption flint glass factory 4 t/day, consumption flat-glass factory 0.5 t/day. Storage time will be reduced to ca. 50 days.

Additional equipment		
Valves, fittings, piping to the melting furnaces	1,000	
c) Compressed air, existing		
1 compressor with air tank (reserve) capacity 30 m^3/min., 4 atmos.		(150.0)
Additional equipment		
1 compressor 15 m^3/min., 4 atmos.	2,000	75.0
1 unit to produce oil-free air	200	1.0
Valve piping, etc.	1,000	
	3,200	76.0

		kg	kW
d)	Water, existing equipment from flint factory		
	1 water reservoir 200 m^3		
	1 hot water boiler		
	2 sewage pumps		4.0
	2 drainage pumps		1.0
			5.0
	Estimated consumption of flat glass		2.5
Additional equipment			
	1 deep well pump	200	25.0
	valves piping, etc.	1,000	
	2 cold water pumps (1 reserve) for water circuit 3.5 m^3/min.	400	
	1 water cooling unit (with reserve blower) 180 m^3 h		16.0
	1 water softening and desalting plant	2,000	2.0
	valves, fittings and piping for industrial and drinking water	2,000	
		6,000	75.0

5.2.11. Others

		kg	kW
a)	Internal transport, existing, 2 fork-lift trucks (2 tons)		
Additional			
	2 lifts (3 x 3 x 2 m cabin)	6,000	10.0
	2 trolleys for the ramp	500	3.0
	40 movable shelves	4,000	
	2 vacuum lifting devices with trolley	500	2.0
b)	Safety system, existing	11,000	15.0
	4 fire extinguishers on wheels with hoses and piping to water tower		
	2 foam production units		
No additional			
c)	Weighing equipment, existing		
	1 weigh bridge, 30 t		
Additional			
	2 dial weighing balances, 1 t each	2,500	
	1 dial weighing balances, 50 kg	150	
		2,650	

Annex II

STUDY OF TENDERS FOR THE PRODUCTION OF FLAT GLASS

SUMMARY

This report aims to give an early appreciation of tenders for the flat-glass project in the Libyan Arab Republic. The salient features of comparison presented suggest that only two of the tenders can be considered.

It is recommended:

(a) That negotiations be opened on the premise that civil construction work is to be by separate contract;

(b) That grinding, polishing and coating equipment be eliminated from the main contract as being irrelevant;

(c) That negotiation of technical points be conducted on the bidder's premises.

CONTENTS

INTRODUCTION

The principal purpose of this report is to review and compare the tenders offered in connexion with the flat-glass project.

The project was based on the "Feasibility study for the establishment of flat-glass industry in the Libyan Arab Republic", prepared for the Industrial Research Centre, Tripoli, by German Consult in May 1974. This document was reviewed on behalf of UNIDO by the present writer who recommended that integration of flat glass manufacture with the existing plant for bottle manufacture - a principal feature of the Consult proposals - should be confined to sharing the same site, common services and higher management but should otherwise be organized as a separate entity having regard to the different technologies involved.

Particularly it was argued that the layout must allow for proper expansion of the bottle factory to make two colours simultaneously and probable semi-automatic production for small orders. It was also pointed out that tendering on a turn-key basis was likely to prove expensive. In drafting the tentative tender documents, which were accepted and issued after modification to conform with the organization's practices, the writer sought to contain these points by inviting the Bidder to propose layouts allowing for bottle works expansion; Bidders were also required to break their offers down into sections, leaving the organization the option of accepting a turn-key operation or accepting the offer in part only.

Limited success was achieved in these respects. None of the four Bidders have given proper consideration to expansion room for container manufacture. This is not a serious matter at this stage because the situation can be easily corrected by a cross-the-table negotiations and should involve only the additional costs of meeting the greater length of service lines.

Three of the Bidders have quoted on a turn-key basis and their prices are very high: the fourth is not turn key, but proposes to design only for all floors and foundations, leaving this work to the organisation to arrange. As was anticipated, their quotation appears much more favourable, by a factor of more than two; nevertheless, even this price is considerably higher than that envisaged by Consult. And since Consult's investment estimate already attributed about 30% to operating costs through depreciation and maintenance it is necessary to look again at the viability of the project.

As a matter [illegible], [illegible] are abbr[illegible] [illegible]:

S	[illegible] (I[illegible]) [illegible] Tripoli, [illegible]
K	KHD I[illegible] [illegible], [illegible], [illegible]
P	P[illegible] [illegible]
H	[illegible], M[illegible] [illegible], Belgium
C-Estimate	German C[illegible] [illegible]

In table 1 a first comparison of the offers is [illegible] Libyan dinars. The figures are [illegible] individually comparable [illegible] differences in equipment offered and of make-up; however the [illegible] the need for reappraisal since the C-Estimate on which the [illegible] project was judged allowed only LD 1,[illegible] for the investments.

[illegible]

		K		
[illegible] factor	[illegible]	DM ([illegible])	[illegible]	[illegible]
[illegible] design supply	[illegible]	[illegible]	[illegible] freight insurance [illegible] customs [illegible]	[illegible]
[illegible] and [illegible]	[illegible]	4 [illegible]		[illegible] 068
Erection, [illegible] up, and [illegible]	[illegible]	[illegible]	[illegible]	[illegible] 407
				5 113
[illegible]	[illegible]			
Construction	[illegible]	[illegible]	[illegible]	[illegible] Bldg. only)
Know-how, Documentation	[illegible]	[illegible]	[illegible]	[illegible]
Tuition	[illegible]	[illegible]	Fr[illegible]	Free
Inland transport	140 5[illegible]	2 540	Incl. [illegible]	51 326
Total price	7 156 8[illegible]	[illegible] 92[illegible]	[illegible]	[illegible]
Qualification	Firm excluding civil work and tax in Libya	Firm; subject to tax etc. var.	Excluding grinding, polishing, coating. Not firm	Excluding foundations; firm. Excluding tax in Libya

4. [illegible]

[illegible] of the [illegible].

[illegible] of the [illegible] a [illegible] silvering [illegible] case [illegible] or have [illegible] equipment. [illegible] no attempt [illegible] their [illegible]. Thus, [illegible] raw [illegible] electricity and water [illegible] cost [illegible], are taken [illegible].

The H-tender [illegible] civil works is [illegible]. It is therefore [illegible] to show maintenance [illegible] separately; it is appended in table [illegible] and [illegible] given.

The Bidders' quoted performance figures need adjustment [illegible]. Thus, some Bidders base their figures on operation at the [illegible] performance of 54 ton/day. Others give the final more favourable figures totalling to 75 tons/day. It was thought best to amend these figures before entering them in the comparison tables, even if it has meant drawing from personal experience rather than information specifically given by the tenders.

The generally high values of the tenders compared with C-Estimate reflect in part the world-wide inflation. It is likely that the C-Estimate for imported raw materials and possibly for labour is no longer valid. However, purely for the purposes of comparison of tenders, it is more convenient to use the C-Estimate unit costs and to refer to inflationary aspects later.

The following unit prices have been extended from C-Estimate :

Batch materials	16.39 LD/ton finished glass
Fuel oil	8.33 LD/ton
Gas oil	26.00 LD/ton
Propane-butane is assumed at its same price at	equal calorific value
Electricity	0.012 LD/kWh
Water	0.03 LD/ton
Packing materials	8 LD/ton glass

[illegible] :

	[illegible]
[illegible]	1,350
[illegible]	1,600
[illegible]	2,000
[illegible]	2,650

[illegible] investment [illegible] [illegible] the [illegible] and the P-tender are [illegible] favourable. [illegible] construction and the P-tender [illegible] offer would have to be rejected. If [illegible] in this section of the work [illegible] (say) LD 1,[illegible] would [illegible] for P-tender LD [illegible] per [illegible] and [illegible] corresponding to a 10% and [illegible]% increase resp[illegible] estimate. In these figures about [illegible] per cent is att[illegible] estimating the manpower required, thus illustrating the point [illegible] earlier report that Consult was over-optimistic in b[illegible] two plants would [illegible] highly economical.

Th[illegible] given in table [illegible] is based on the first year output of 10,300 [illegible] saleable glass irrespective of the designed capacity of the various [illegible] offered. It therefore puts the smaller plant (H-tender) at a relati[illegible] compared with the larger plant (P-tender). To evaluate the bids it [illegible] necessary to calculate the total cost when the plants are running [illegible] respective maximum capacities. In making the calculations, it is ass[illegible] investment cost of civil works is LD 1,500,000 in all cases and not tha[illegible] each tender.

In all cases it is assumed that with experience gained the number of production days will increase from 280 in the first year to 340.[a]

---

a/ Since writing the report the detailed specifications of H-tender have come to hand. The most significant feature of this tender is that, unlike the other offers, it contains a proposal for a recuperative furnace and not a regenerative furnace as is usual in a factory of this size. This would make for a substantial savings in investment (perhaps LD 200,000) and a firing system much easier to control. On the other hand, the attainable fuel economy is not so great, i.e. about 10% more fuel is required. They argue that in Libya where oil is available but not glass-melting skills, this is the more practical proposal. The writer's calculations tend to confirm this view; however, in comparing tenders it should be recognised that the H-tender has less physical content than the others. Assuming this differential amounts to LD 200,000, the H-tender still remains the most attractive offer.

Table [illegible]

	Tender [illegible]				
	C-Estimate	J	K	P	[illegible]
Net production	10 [illegible] a/	[illegible]	[illegible]	[illegible]	[illegible]
	(first year, in [illegible])				
Raw materials	[illegible]	[illegible] 300	[illegible]	[illegible]	[illegible]
Gas oil	4 000	26 [illegible]	34 [illegible]	[illegible]	[illegible]
Fuel oil	70 000	100 700	[illegible]	[illegible]	[illegible]
Water	3 300	3 300	3 [illegible]	[illegible]	[illegible]
Electricity	[illegible]	[illegible] 560	59 [illegible]	[illegible]	[illegible]
Maintenance	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sub-total	[illegible] 100	[illegible] 179	494 [illegible]	[illegible]	[illegible]
Personnel cost	[illegible] 500	199 150 d/	200 [illegible]	[illegible]	[illegible]
Depreciation	[illegible] c/	[illegible]	[illegible]	[illegible]	[illegible]
Sub-total	631 550	1 319 093	1 390 541	[illegible]	[illegible]
Debit to bottle works	107 300	107 300	107 300	[illegible]	[illegible]
Packing materials	32 400	32 400	32 400	32 400	[illegible]
Administration and marketing	55 000	55 000	55 000	55 000	55 000
Transport	38 100	38 100	[illegible] 100	[illegible]	[illegible]
Total cost	914 650	1 602 393	1 613 341	1 404 [illegible]	1 07[illegible] 789
Cost per ton	38.?2	155.57	162.52	136.37	-
Depreciation and maintenance civil work	24 200	79 155	49 693	173 333	-
Cost per ton, excluding depreciation and maintenance civil work	86.47	147.89	157.68	119.54	104.54

a/ Although this tonnage was proposed to cover also ground/polished and coated demands which are here excluded, current trends suggest that it will be needed for unworked glass alone.

b/ Not including the extension of the furnace proposed for 1981. However, the Bidders have included provision for this expansion.

c/ Not including maintenance and depreciation in respect of civil works.

d/ The S-tender quotes excessive labour (399) owing to an arithmetical error and also the inclusion of labour to be supplied from the bottle works. The total should read 239, of which about 63 are bottle works part-timers. The figure entered here is amended in both respects.

e/ No staffing requirements were submitted so that the mean value of the other three tenders has been taken.

S						Machine speed	
S	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		46 [illegible]
K	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Machine speed	161 [illegible]
K	[illegible]	[illegible]	[illegible] 300	[illegible]	[illegible]		130 [illegible]
P	[illegible]	[illegible]	[illegible] 000	4	7 [illegible]	By sheet	[illegible]
P	[illegible]4	340	[illegible]0 000	1	8 2	Width	73 4[illegible]
H	[illegible]4	340	[illegible]	3	6 0	By adding	9[illegible] 4[illegible]
H	75	340	[illegible]	4	7 [illegible]	One machine	53 79

It sh[illegible] that [illegible] only [illegible] the S and K installations give poor cost performance [illegible] the total width of sheet provision is low and probably greater sk[illegible] w[illegible] needed to obtain the maximum output.

In comparing the P-tender and H-tender it must be remembered that the P-Tender [illegible] firm. Price inflation of say 30% for equipment would have the effect of increasing the cost per ton for this tender by about 10%.

It is clear that the organization's economists will want to review the viability of the project in face of (say) a [illegible]% increase in operating cost owing to investment value and labour requirements alone.

The cost of labour, fuel and electricity may also have increased. With regard to raw materials, the cost of soda ash is most significant; because of world shortage this increased sharply last year. A c.i.f. price of 111 LD/ton was quoted compared with 45 LD/ton of C-Estimate. This would have added LD 14.85 per ton to the cost of manufacture of glass. Fortunately, there appears to have been a recovery and German soda ash (at 0.24 DM/kg) could probably be delivered at Azizia at LD 49.8 per ton adding only LD 1 per ton to the cost of glass.

On the [illegible] side it seems certain that the [illegible] produ[illegible] inflation. The [illegible] statistics [illegible] of the inherent variability of the [illegible]. [illegible] Consult [illegible] imports of low quality [illegible] another [illegible] the [illegible] classification [illegible] another. The [illegible] ing gr[illegible] classifications were formulated. For drawn sheet [illegible] figures have been extracted:

Year	Unit pri[illegible]
Mean [illegible]	[illegible]
1972	[illegible]
1973	47.[illegible]
1974	[illegible]

It will be seen that although 197[illegible] shows a [illegible]% [illegible] year available to Consult), little reliance can be placed [illegible] a marked decrease.

Of almost as great importance as sales val[illegible], inflat[illegible] capital-intensive project is increased with the volume of sales.

Consult based their projections on the average of four different assessments viz. trend analysis, end users, <u>per capita</u> comparison and growth rate.

Their trend analysis gave much lower estimates than the others. Now that values for 1973 and 1974 are available it is obvious that the trend analysis was invalid (through trying to fit a linear line to curvilinear results) and they under-estimated consumption by 20% in 1972, 7.6% in 1973 and [illegible]% in 1974.

If the "low" and "high" values for the other three projections are taken for drawn, unworked sheet glass for pertinent years, the following tonnages are obtained.

Year	Low	High	Actual
	(tons)		
1974	6 700	7 500	7 392
1977	8 000	10 500	-
1978	8 500	11 000	-
1980	9 500	13 300	-
1985	10 500	16 900	-

On [illegible] basis of [illegible] there seems good prospect of finding a [illegible] [illegible], [illegible] the time [illegible], [illegible] for [illegible] most [illegible] without the need to after-work a [illegible] by grinding and polishing.

In view of what is said in the next section, it is recommended that the [illegible] should [illegible] consider the installation of after-working equipment at the present time.

[illegible]. AFTER-WORKED PRODUCTS

None [illegible] the T[illegible] [illegible] plate [illegible] with [illegible] envisaged by German C[illegible]. This is [illegible] [illegible] [illegible] w[illegible] fact that Con[illegible] recommendation [illegible].

Consult[illegible] [illegible] Libya by also making products that are [illegible] factory. This [illegible] primary [illegible] this part of their pr[illegible] in putting [illegible] products at [illegible]. In fact, however, [illegible] validity. Almost the whole of the [illegible] and [illegible] has [illegible] taken over by float glass, a product in some ways of [illegible] quality and [illegible] price than plate glass. Likewise, most of the [illegible] float glass (for mirrors) or tinted float glass made [illegible] modification of the primary float process.

It is clear that home-produced sheet glass [illegible] cannot hope to make significant in-roads in [illegible] viability study that relied on winning this market w[illegible] poorly based. Fortunately, as pointed out in the last section, the indications are that the projected production of un-worked sheet glass can be absorbed by the market without recourse to these conjectural sales.

The recommendation is therefore made that this project should be judged, and the contract negotiated, on the basis of production of un-worked sheet glass alone.

If it is thought necessary to instal these additional facilities, it can be a jobbing activity that has little relationship to the continuous production of sheet glass; it may well be that it could be done (for example) in a workshop in Tripoli. In any case, the optimum scale of equipment cannot possibly be foreseen in advance, and it is almost certain that more appropriate equipment for these shops could be bought directly at a fraction of the cost necessary to cover the present ill-defined need.

The following remarks refer to the individual tenders.

[illegible]

[illegible] (ID 11?, [illegible]).

[illegible]

[illegible]

[illegible]. RECOMMENDATIONS

It seems [illegible] that two tenders [illegible] short-listed, viz. the P-tender and the H-tender, and that detailed technical study can be confined to these two. Likewise, the study of the terms by the organization's legal experts can be confined to these two. N.B. The writer has not concerned himself with the legal and [illegible] of the tenders except where they have technical implications. It may be argued that the P-tender is inadmissable because the prices are not firm, but since in any case they are not the most favoured, they are more suitable to retain for the time being to strengthen the negotiating position with the most favoured. It is suggested that the technical points could most effectively be dealt with by a cross-the-table negotiation.

1. It is recommended therefore that (say) a three-day visit to Warsaw and a three-day visit to Auvelais (Belgium) should be authorized. It would be best if the visits took place in that order, and if the writer would be prepared to assist a representative of the organization.

2. That the main tender be negotiated on the basis that civil construction work will be by separate contract.

3. That the main tender shall be exclusive of ancillary grinding, polishing and coating.

4. [illegible]

4.1 Civil works

Although very different prices are quoted, the ground and areas of buildings offered do not differ greatly as can be seen from the following table.

Type of building	C-Estimate	S	K	P	H
			Tender		
			Areas m²		
Furnace, Draw and Purpose Buildings	1 850	3 900	1 800	2 743	1 536
Standard buildings	4 720	2 160	4 155	4 577	1 674
Roofed stores	1 000	1 161	400	1 577	372
Welfare building	400	-	375	480	418
Total	7 950	9 445	6 370	9 377	7 500
Type of work			Price (LD)		
Civil work	557 00	2 309 982	1 490 796	5 200 000	
Walls and roofs only					552 576
C.W. Design					35 113
Design and supervision		64 796			

The S-tender includes an expensive multi-floor cutting buildings. The P-tender includes a 60 m high chimney and also an LPG plant. The furnace hall is an unusual trapezium shape probably not best suited to Libyan climate. Assuming that the concrete work for the H-tender is no greater cost than the walls and roofs, this tender seems much the most favourable.

[illegible]

Th[illegible] of the time taken [illegible] significant points in the [illegible].

Stage	Tenders S	K	P	H
	(months)			
Complete take-over tests	(32)	[illegible]	35	30
Production started	29	26	32	24
Building complete	22	28	26	18
Auxillary foundations complete	-	28	-	18
Main foundations complete	-	24	-	11
Approval of design and specifications	3	13	12	..

It will be noticed that the most favoured H-tender depends on the main foundations being completed within 11 months. This may be difficult to achieve if the civil work is given to an independent contractor. There is therefore much to be gained if a favourable price can be negotiated with HMJ themselves for this civil work. They have offered to quote and thus to make their tender a turn-key one. In any case early negotiation with them is essential to procure the necessary drawings to enable Bidders to offer tenders for the civil works.

The preliminary time schedule for the H-tender is as follows:

Stage of work	Month number Start	Finish
Design civil works	0	3
Documentation	-	15
Foundation civil works	6	11
Auxillary civil works	11	18
Building supply f.o.b.	9	12
Building erection	12	16
Deliveries f.o.b.	9	15
Erection of deliveries	14	23
Furnace heat-up	23	24
Take-over tests	23	30
Training Libyans abroad	16	22
Training in Libya	22	30

They [illegible] that [illegible] in [illegible] than [illegible]

4.3. Training [illegible]

The [illegible] by the various [illegible] are [illegible]

	S-tender	[illegible]	[illegible]	[illegible]
Number of persons	37	11	[illegible]	12
Number of man months	444	30	[illegible]	[illegible]
Country	India	Germany	[illegible]	[illegible]

It should be possible to negotiate that the [illegible] be in the medium of English in the case of the [illegible] seem less likely in the case of Germany or Poland.

4.4. Provision of [illegible] and [illegible]

	S-tender	K-tender	[illegible]	[illegible]
Debiteuses	–	50	[illegible]	[illegible]
Clay (tons)	20	–	50	[illegible]

4.5. General scope and performance of the plant [illegible]

It is not possible to make a detailed comparison of the [illegible] offered until the H-tender specifications are available; particularly since this seems to be the most favourable offer. However, from the information that is [illegible] it is clear that the broad requirements are met and that any [illegible] desirable can be arranged during negotiation. To give some guidance in this the following table provides a breakdown in plant costs so far as they have been provided.

[illegible]

	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]		-
Ba[illegible]		1 [illegible] 33[illegible]		41 [illegible]
M[illegible]		[illegible]		[illegible]
W[illegible]		4[illegible]		514 [illegible]
Gri[illegible] and [illegible]		[illegible]14 [illegible]	Ex [illegible]	([illegible]41[illegible])a/
D[illegible]		[illegible]		[illegible]
Add. S[illegible]		91 [illegible]		515 40[illegible]
Sub-total	[illegible]66 3[illegible]	3 [illegible]	[illegible]	2 160 043
Start-u[illegible]	[illegible]09 2[illegible]	[illegible]	4[illegible] 700[illegible]	
Spare parts	Inclusive	[illegible]	Inclusive	[illegible]
Engineer and installation	2 309 95[illegible] k/	[illegible] l/		407 [illegible] m/
Civil works	2 [illegible]4 67[illegible] k/	1 490 [illegible]	[illegible] 20[illegible] n/	(5[illegible]4 [illegible])o/
Tripoli-[illegible]	[illegible]46 561	45[illegible] 240[illegible]		
Fill-up lubricants				1 499

a/ Including a new mixer and cullet processing, LD [illegible]

b/ Made up of Cutting-shop equipment 139 961
Grinding and polishing 206 150
Minor marketing 113 271
Packing plant 55 14[illegible]
LD 514 52[illegible]

c/ Including:
Cutting room equipment 173 109
Edging, grinding and polishing (Not face grinding) 97 215
Silvering equipment with one year mats 191 601

d/ Including:

Electrical equipment	706 436
Oil supply system	2 980
Water supply system	26 974
Compressed air	14 927
Workshops	31 748
Laboratory	3 062
Safety equipment	5 046
Structural steel and internal equipment	124 617

e/ Including:

Workshop	20 824
Services	281 999
Additional devices	251 579

f/ Including design and spare parts.

g/ Including:

Deliveries, machinery, equipment and spares	2 318 900
Freight, insurance and inland transport	244 500
Custom duties (equipment)	323 600

h/ Covering transfer of know-how, technical assistance and documents

i/ Including:

Commissioning	242 502
Training Libyans	37 510
Transfer of know-how and documents	335 174
	615 186

j/ Including:

Erection, start-up and take-over tests	286 900
Transfer, know-how and documents	177 300

k/ Civil Design/Drawings/Supervision = LD 64,796

l/ Including:

Erection machinery	1 906 576
Electrical	458 727
	2 365 303

m/ Including: erection of deliveries, start-up and take-over tests of plant; also design of main foundations and auxiliary works, 35,113

n/ Including: customs duties and fees, labour and materials for civil work

o/ Including c.i.f. deliveries of structures, roofs and walls and erection, but excluding execution of foundations and auxiliary civil works. Including estimate of delivery to Azizia, 31,826

p/ Including:

f.o.b. to C and F	316,560
C and F to c.i.f.	68,839
c.i.f. to Azizia	72,846

4.6. Raw materials

All the Bidders question the quality of the Libyan raw materials. The E-tender goes so far as to say "In order to make glass under acceptable conditions it is not possible to use raw materials native of Libya in the first

76. 05. 20