REPORT TO:

USAID/BURMA AND
GOVERNMENT OF BURMA
AID

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SEED EQUIPMENT AND FACILITY RECOMMENDATIONS

FOR

MAIZE AND OIL SEEDS PROJECT

Services Rendered
Under The Cooperative Agreement
Between
AID/W and MSU
AID/DSAN-CA-0148

SEED TECHNOLOGY LABORATORY
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REPORT SUMMARY

TITLE: Seed Equipment and Facility Recommendations for Maize and Oils Seeds Project

CONTRACT: AID/DSAN-CA-0148 with MSU

CONSULTANT: James C. Delouche, with assistance of Edgar Cabrera, G. Burns Welch and Bill Boyd of the Seed Technology Laboratory, MSU

PERIOD OF VISIT: April-May, 1982

SUMMARY

The USAID Affairs Office/Burma requested assistance from Mississippi State University to make recommendations and prepare specifications and layout designs on seed equipment and facilities for the four seed farms to be developed under the AID-grant funded Maize and Oil Seeds Project. James C. Delouche, Seed Technology Laboratory, MSU made a 3-week consultative visit to Burma in April-May, 1982. The equipment and facility recommendations, specifications and designs were prepared after his return to MSU with assistance of Edgar Cabrera, G. Burns Welch and Bill Boyd.

The report and attached drawings comprise the recommendations made for equipment and facilities needed at the four seed farms (three centers) to harvest, dry, process and store the seed produced.

A short supplemental report or addendum to this report will be submitted in mid-August to provide additional information on design details.

JCD

July 28, 1982

I. INTRODUCTION

Background

The USAID grant funded maize and oil seeds production project was approved for FY 82. The purpose of the project is to increase production of oil seed crops and maize in 28 townships of rural Burma so as to improve rural income and employment, national food supply and nutrition.

The project includes assistance to develop a supply of seed that would be needed as part of the improvement package intended for the selected townships. The Project Paper (PP) identified low quality seed and short seed supplies as constraints to improvement of maize and oil seeds production. The seed production and supply component of the project was structured within the existing frame of seed production and supply in Burma, but with stronger emphasis and sharp focus.

The PP envisioned and provided for development of four well equipped seed farms which would be operated by the Agriculture Corporation with cooperation of the research and development departments for breeder seed and assistance in selecting varieties for multiplication and maintaining varietal purity. Equipment lists and cost estimates for the farms were provided.

In the fall of 1981, USAID/Burma requested assistance from Mississippi State University in reviewing the provisions in the PP for the seed farms and in developing detailed recommendations for facilities needed under terms of the centrally funded MSU/AID cooperative agreement. MSU campus based specialists were fully committed during the time

period requested for for the assistance so Dr. Bill R. Gregg of the MSU/Thailand contract (AID loan) staff was asked to undertake the assignment from his Bangkok station. Gregg submitted a long report in early CY 82 in which the potentials of the four seed farms selected by the Agriculture Corporation were assessed, the operations that would be needed were described and discussed, and equipment/supplies were recommended.

In Spring '82, MSU was again requested to provide assistance to USAID/Burma and the GOB to review the equipment and facility recommendations that had been made and to develop appropriate layout designs and equipment specifications for the seed conditioning operations of the farms (harvesting, drying, processing, and storage).

James C. Delouche of the MSU Seed Technology Laboratory staff visited in Burma during April-May, 1982. The present report contains the recommendations on equipment and facilities developed by him and his colleagues at MSU.

Scope of Recommendations

The recommendation made here relate to the "conditioning" phase of the seed production and supply operations which will be based at the seed farms. The "seed conditioning" phase encompasses operations from harvest through storage. Other consultants and the technical assistance group selected are to develop appropriate recommendations on the actual "development" of the farms to include land leveling and forming, irrigation, general facilities, and on the equipment/facilities needed for general crop and seed production operations.

The PP projected quantities of seed that would be needed and could be produced on the four farms, and provided a general list of equipment needed along with estimated costs. During Gregg's visit, the projected seed requirements were elevated considerably, and the concept of using farmer-cooperators to produce additional qualities of seed was introduced. As a result, there was a considerable escalation in the equipment list in Gregg's report, especially in the drying and storage operational components.

In this report the focus is again on the quantities of seed that can be produced on the seed farms. Considering the lack of experience in Burma with mechanized seed operations such as must be established when production is concentrated on specialized seed farms - as it will be - it is not advisable to go beyond this level until the adaptability of the "mechanized" operations to Burma is fully evident and even more importantly, capabilities for management of the operations are developed, and a sufficient number of trained personnel are available for expansion.

The capacities and capabilities of the seed facilities recommended are considerable and represent a first step greater than usually taken. The management capabilities of the Agriculture Corporation and the technical assistance group will be fully strained to just develop and manage the production of the four farms during the first 4 to 5 years without the additional considerable effort required to "take in" farmer cooperators. Depending on the progress made in developing the farms and handling of the seed produced to maintain quality at a satisfactory

level, additional facilities/equipment might need to be considered toward the end of the funding obligation period.

II. FOUNDATION AND CERTIFIED SEED FARMS

Chaungmagyi Farm: Pyawbwe Township

General Description

The "foundation seed" farm is located adjacent to the Chaungmagyi Production Camp, Pyawbwe Township, Mandalay Division. It is fronted by a hard surface road (Rangoon-Mandalay highway) and a power line runs across the farm. The Chaungmagyi river has been dammed to establish an irrigation reservoir and the right and left canals run along the sides of the farm. The left and right canals are said to have capacities for irrigating 6300 and 2900A, respectively, but this is doubtful especially considering the droughts of the past two years. The right canal would service the seed farm if water is available. The seed farm is also distant from the dam and priority would have to be given to it for irrigation. Otherwise it might all be utilized "upstream."

The rainy season begins in May and extends into November (Table 1). Average rainfall is about 33 in./year but has been down to 30 in. or less the last two years. The heaviest rainfall occurs in June (6.4 in., 8 rainy days). Rainfall during May, July, August, September and October ranges from 3.6 to 4.7 in. per month, while the number of rainy days ranges from 7 to 10 (July). Average temperature ranges from about 88F during the March-May period to 75-77 during June and July.

Land Area and Soils: The farm consists of about 350 A. of which 300 could be used for seed production. About half the farm consists of compact vertisols not suitable for groundnuts but suitable for maize, sunflower and sesame. The other half of the farm has alluvial soils

Table 1. Climatic data for seed farms (10 yr. averages).

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Chaungmagyi Farm												
Temp. (F)	77	83	88	87	88	77	75	80	84	82	78	77
Rainfall (in.)		0	0	0.8	3.6	6.4	3.3	4.7	4.6	3.7	2.6	0
No. Rainy Days	0	0	0	3	7	8	10	8	7	8	5	0
Sebin Farm												
Temp. (F)	Not available, similar to Chaungmagyi											
Rainfall (in.)	Tr.	.3	Tr.	1.6	3.9	4.1	6.3	3.4	5.0	2.3	3.1	0
No. Rainy Days	1	1	0	4	10	10	9	8	10	6	5	0
Kyaungsu Farm												
Temp. (F)	Not available											
Rainfall (in.)	0	0	0	1.1	8.1	22.8	29.2	32.9	17.5	7.1	4.3	0
No. Rainy Days	0	0	0	4	13	25	30	30	16	5	8	0
Relative Humidity (%)	61	55	53	59	69	88	92	89	90	85	77	71
Thitcho Farm												
Temp. (F)	81	79	84	88	89	80	82	83	82	84	83	81
Rainfall (in.)	0	0	0	1.7	3.6	13.9	11.2	15.7	4.9	3.1	5.6	-
No. Rainy Days	0	0	0	4	5	24	21	27	10	5	6	0
Relative Humidity (%)	54	42	43	49	62	83	84	85	84	80	70	60

which are suitable for groundnuts and the other crops.

The farm is in quite good condition. Drainage should not be much of a problem. Some land forming will be needed to destroy the existing bunds of the small plots, layout the fields for mechanized and land preparation and cultivation, and grade for irrigation whether from the canal or tubewells.

Water Supply: Rainfall is sufficient for production of seed crops during the monsoon season. Irrigation is absolutely essential, however, for production during the winter season. Supplemental irrigation would also be advantageous during the pre-monsoon period to water the soil for land preparation and planting so that the crops can be started early. This would permit earlier-than-normal harvest and provide time for preparation of the seed for distribution in time for the winter crop, thus obviating the need for a long period of storage.

Water is likely to be the major problem in getting the seed farm operational and on its productivity. The irrigation canal should provide some of the water needed, but it is likely that tubewells will be needed to supplement the canal supply. Information was given that there is or had been a UNDP project on survey of ground water in Pwaybwe Township. This needs to be looked into by the irrigation and drainage consultant.

Facility Site and Services

Since the Chaungmagyi and Sebin farms are only about 10 miles apart, major facilities at one site should be adequate to handle the seed crops from both farms. A single facility at one farm with necessary "support buildings" on the other farm would be most efficient.

The best site for development of the major facilities appears to be near either "end" of the Chaungmagyi farm along the Rangoon-Mandalay highway which runs SE to NW. A temporary "bamboo" type building is already located in the SE corner.

The exact site selected should be located near the highway and as close to the electric power line as feasible. The area required is given in the description of the proposed Chaungmagyi facilities. As mentioned above some support facilities will also be needed at the Sebin farm to reduce the traffic between Chaungmagyi and Sebin.

The site of the seed facilities should be "high and dry". Land fill should be done as necessary to ensure that drainage is away from the facilities.

Projected Seed Production

There is no question about seed production during the monsoon season. Rainfall is sufficient to produce reasonable yields even without supplemental irrigation. Assuming that an adequate supply of water can be established by priority usage of canal water and/or by tubewells, a good winter seed crop can be produced.

A typical and possible cropping pattern and raw seed yields are projected in Table 2.

Sebin Farm: Yamethin Township

General Description

The Sebin "foundation seed" farm is located adjacent to the Shweda Production Camp, Yamethin Township, Mandalay Division. It is served by the Rangoon-Mandalay highway and about 7 miles from Yamethin city. The

Table 2. Projected cropping patterns and yield (baskets/A) of raw seed for the Chaungmagyi and Sebin "foundation" seed farms at full development.

Seed Crop	Acre by Season		Yield Ba./A	Yield by Season	
	Monsoon	Winter*		Monsoon	Winter
	--------- Chaungmagyi Farm (300A)				
Groundnuts	150	100	80	12,000	8,000
Maize	100	50	80	8,000	4,000
Sunflower	50	50	50	2,500	2,500
Sesame			20		
Totals	300	200		22,500	14,500
	---------- Sebin Farm (300A)				
Groundnuts	100	100	80	8,000	8,000
Maize	-		80		
Sunflower	100	50	50	5,000	2,500
Sesame	100	50	20	2,000	1,000
Totals	300	200		15,000	13,500

*It is assumed that even at full development, water supply will be adequate for only about 2/3 of cropping area during the winter season in any given year.

farm is located in an irrigation district based on Thitson dam, which is said to have a capacity for irrigating 18,000 A. The water reservoir, however, is very low as a result of drought the past two years. One of the main irrigation canals runs by the farm - the Wet-Ma-Sut canal. An electric power line also runs across the farm.

The rainy or monsoon season begins in May and extends into November (Table 1). Average annual rainfall is 30 inches. The period of heaviest rainfall is May through September with peaks of 6.3 inches in July and 5 inches in September. The number of rainy days per months are 8-10 from June through September then drop to 6 in October and 5 in November.

Land Area and Soils: The farm has an area of about 370 A., 300 of which can be developed for seed production. About 2/3 of the soils are brown compact vertisols which would not be suitable for groundnuts. About 100A are gray-yellow-brown alluvial soils, which would be suitable for groundnuts. The remaining 30A or so are compact alluvial type soils.

The farm is bissected by a stream channel - dry in the winter - which would have to be adequately bridged for passage. The general layout of the land is uneven, i.e., not very level, and the small plots farmed by the previous tenants have especially high bunds. Considerable land forming will be needed to obliterate the old bunds, form the land for mechanical land preparation and cultivation, and for irrigation.

Water Supply: As mentioned above the Wet-Ma-Sut irrigation canal from the Thitson dam runs near the farm. It should supply some water, especially if the farm is given priority. The canal irrigation system, however, is unlikely to provide an adequate amount of water during the

winter season for more than 80 to 100 A. The most feasible alternative is tubewells. If tubewells are developed they could be used to supplement water available from the canal to provide a reasonable water supply for about 2/3 (200 A) of the farm during the winter season.

The quantity and pattern of rainfall during the monsoon is adequate for crops planted in that season.

Facility Site and Services

As indicated in the review of the Chaungmagyi seed farm, the close proximity of the two seed farms (about 10 miles) provides an opportunity to be efficient in terms of facilities. Major facilities can be located at Chaungmagyi (or alternatively at Sebin if development there can be demonstrated to be easier or more efficient) with only support facilities such as office space, equipment sheds, and open storage units developed at Sebin.

The Sebin farm has some "ridge" type land which is not suitable for land forming and this would be a logical place to develop support facilities as needed. The area (acres) needed for support facilities is given in the section on proposed facilities.

Projected Seed Production

There should be no real problem associated with seed production during the monsoon season. Rainfall is sufficient for good yields. Assuming that an assured water supply can be developed, at least 2/3 of the farm (200A) could be in good production during the winter season. A typical and possible cropping pattern and raw seed yields are projected in Table 2.

Kyaungsu Farm: Kyauktaga Township

General Description

The Kyaungsu "certified seed" farm is situation on the hard surface road to Kwin Khaung Wa, about 1.5 miles from Panwegone, Kyauktaga Township, Pegu Division. The nearest electric power line is about 2 miles in Panwegone.

The farm was mainly a paddy area although some winter crops - groundnuts and sunflower - have been produced. The land is fairly level. A large drainage ditch is situated between the farm and the hard surface road. Several sturdy bridges or large culverts would be needed to provide access to the farm.

A stream - the Tonekan stream - runs along one side of the farm and is apparently perennial, i.e., running water all year. Its irrigation capacity, however, does not appear to be very great especially during the critical months beginning in late January and continuing until the grain filling period is complete for winter crops. It is also claimed that the stream is subject to "meandering" during the monsoon. The farmers in the area have placed a temporary dam to impound water but the quantity impounded does not greatly exceed their requirements, especially if they began to produce more winter crops which is likely as the project gets underway.

The major limitation of the Kyaungsu farm is an over-abundance of water during the monsoon season (Table 1). The average annual rainfall is 123 inches. Heaviest rainfall occurs during June, July, August and September when more than 20 inches of rainfalls each month. May and

October also receive more than 7 inches of rain. The number of rainy days is 30 during July and August, 25 in June, 16 in September, 13 in May, and 8 in November.

Given the heavy rainfall during the peak of the monsoon, drainage will be a major problem and impediment for crops other than rice during the season. Even if drainage can be managed, the nearly continuous rain, high humidity, and warm temperatures establish very favorable conditions for the development of root rots and foliage diseases of crops other than rice. Furthermore, even the slackened rainfall during the harvest period is sufficient to promote field deterioration of the seed and to cause problems in seed drying.

The farm is suitable for rice production during the monsoon. However, if rice is produced, the delays caused by the long harvest period for rice would cause a delay in the availability of the land for preparation and planting of winter crops. This delay is turn would shorten the period between harvest of winter crops and the advent of the monsoon available for threshing, drying, and processing of the winter crops seed. For some of the area it might push harvest of the winter crop almost to the beginning of the monsoon. Gregg in his report advanced the idea of providing for mechanized harvest of the monsoon rice crop to speed up harvest so that the land would be ready early in the winter season for planting. The cost of fully mechanizing rice harvest would be considerable and can hardly be justified, especially considering the inexperience in mechanical harvesting operations in Burma, uncertain capabilities for repair and maintenance of mechanical harvesters, and the associated problems of having to provide drying

facilities for the rice because harvest would be very concentrated and a lot of rice would need drying at the same time.

The alternatives to using the farm for rice production during the monsoon are: no rice production during the monsoon, or only 100 to 150A on relatively well drained land; relocate the farm to a drier area. Events have progressed too far for relocation to be a viable alternative. Thus, rice acreage - if rice is planted - should be restricted to 100-150A on relatively well drained soil. It might also be possible to produce 50 to 100A of maize for seed on the best drained land. Some trials are being made this monsoon season.

Land Area and Soils: The total land area of the farm is about 1100 acres of which about 800A would be suitable for production of seed crops during the winter season. The soils are mostly alluvial clays and clay loams suitable for most crops when well drained. There is a marshy area - even in May before the monsoon - which would essentially be waste or could be developed as a fish pond.

The land is relatively uniform and slopes to the natural drainage. The bunds used for rice production are not large. Some land forming would be required to "break-up" the small plots, form fields suitable for mechanized land preparation and cultivation, and for irrigation.

Water Supply: The existing water resources during the winter season, i.e., the stream, are probably adequate for only 80-100A. Alternative water sources would need to be developed to provide for the 800-900A. of crops in the winter season. The most feasible alternative source of water is ground water via tubewells. Information was not avialable on ground water resources.

As discussed above drainage will be a major problem even if a monsoon crop is not produced. Unless good drainage is established, land preparation for the winter crop will be delayed, possibly into January in some of the lowest, most poorly drained areas.

Facility Site and Services

The most likely site for development of facilities is in the NW corner of the farm along the hard surface road. This is a high area from which essentially all the farm can be observed. Since a deep drainage ditch is between the highway and the farm, a sturdy bridge or culvert would need to be built. Some of the facilties such as equipment sheds and drying floors might be sited in other areas of the farm for convenience. The land area needed for facilities is given in the section on facilities. An approximate 2 mile hook-up would be needed to the nearest power line.

Project Seed Production

The Kyaungsu farm was selected primarily for groundnut seed production and probably should be predominately used for groundnuts. Some maize and sunflower could be produced as needed and handled in the facilities to be provided for groundnuts and minimal facilities for "other" kinds of seed..

A typical and possible seed cropping pattern and projected yields of raw seed are given in Table 3.

Thitcho Farm: Nattalin Township

General Description

The Titcho "certified seed" farm is located about 8 miles from Nattalin City, Nattalin Township, Pegu Division. Thitcho Production

Table 3. Projected cropping patterns and yield (baskets/A) of raw seed for the Kyaungsu "certified" seed farm at full development. Land area is about 1000 acres, but only about 800A can be developed because of drainage and water supply.

Seed Crop	Acres by Season		Yield Ba./A	Yield by Season	
	Monsoon*	Winter		Monsoon	Winter
Groundnuts	-	600	80	-	48,000
Maize	-	100	80	-	8,000
Sunflower	-	100	50	-	5,000
Sesame	-	-	-	-	-
Totals		600			61,000

*Considering the heavy and near continuous rain during the monsoon, seed crops other than rice do not seem to be feasible.

Camp (No. 4) is located on the edge of the farm. The farm is new in the sense it is being taken into cultivation for the first time. Formerly, it was a forest reserve.

It is claimed that about 2000 A. of the 3000 A land area have been cleared and brought under cultivation. The land is still very eneven because of ant or termite mounds which averaged 18-20/A. before clearing. The mounds have been knocked down but the base remains making a small "hill" about 1 ft. higher than the rest of the land in the cultivated areas. Some stumps and projecting roots are also in the cultivated area.

Considerable land forming will be necessary to "even out" the land, remove remaining stumps, prepare the fields for irrigation and ensure adequate drainage.

The farm is not served by an irrigation system or project. There is a small but deeply cut stream running across the farm but it would be aequate for irrigation of only 100 A or so with low lift pumps. Information on ground water reserves was not available.

The major constraints to full and satisfactory development of the seed farm are:

(a) The atrocious condition of the 8 mile road from the highway to the seed farm. The road is old and in a terrible state of disrepair. The bed is elevated about 1 meter and was stone filled. The soil packing has washed out in many places and the exposed stones are impossible to traverse. In the dry season (May) nearly 2 hours was required to make the trip mostly over very dusty cart trails along the "road". In the

monsoon the road and cart trails would be possible only by cart, tractor or 4-wheel drive off-the-road type vehicles.

(b) The nearest electric power line is in Nattalin -- about 8 miles. There is no phone service. The power required for operation of a seed farm the size of Thitcho will be considerable. It will have to be supplied by running a power line 8 miles to the farm, or by electric generators, or a combination of these.

(c) It is claimed that an irrigation project for the area in which Thitcho farm is located is being considered. Even if this is true, the project could not come on-stream within the period of the project - maybe not for 10 years or so if at all. Thus, a winter season production will be dependent on residual moisture, the small stream or tubewells that might be developed.

There is a cropping history for the farm. During the 1981 monsoon season about 1000 A of maize were planted and the yield was about 30 baskets/A. A yield of 21 baskets/A. is claimed for the planting in the past winter season.

The monsoon begins in May and reaches a peak in August with 15.7 in. of rain, then continues - the rainy period - into November (5.61 in.). The average annual rainfall is about 60 inches. The number of rainy days is 20 or more in June, July, and August, then drops to 10 in September, 5 in October and 6 in November.

Land Area and Soils: The farm has a total land area of about 3000 A., 2000-2200 of which have been "cleared" and taken under cultivation.

Since there will be considerable waste in one area - not suitable for cultivation - and roads, facilities, houses will occupy a considerable area, it appears that at full development 2200-2500 A. will be available for cropping.

The soils are mostly yellow-brown forest cambisols which are well suited for production of any of the crops emphasized in the project.

The projected 2200-2500 A can be cropped during the monsoon season, but water supply will probably limit the winter season cropping area to perhaps half of the area for seed purposes.

Water Supply: The water supply situation was discussed in the preceding sections. There should be little or no problem with water supply during the monsoon. For the winter season, however, tubewells appear to be the only available alternative during the next 10 years or so.

Facility Site and Services

Several residences and temporary storage buildings have already been sited. These could be the base for development of the complex of facilities needed. In any event, the site chosen should be "high and dry" even in the monsoon. The most difficult-to-obtain, expensive and yet essential service is electric power, which would have to be brought in about 8 miles. Total reliance on diesel generators would not be a satisfactory solution, especially in view of the recurring fuel shortages. The area required for facility development is given in the proposed facilities section.

Projected Seed Production

The Thitcho farm has excellent soils. If properly formed and provided with adequate water supply during the winter season - even for 60% of the area - the farm could produce considerable quantities of almost any mix of seed kinds.

A typical and feasible cropping pattern and projected seed yields are given in Table 4.

Table 4. Projected cropping patterns and yields (baskets/A) of raw seed for the Thitcho "certified" seed farm. The farm has a total area of about 3000A, but it is anticipated that only about 2200A will be suitable for cultivation after final cleaning and development.

Seed Crop	Acres by Season		Yield Ba./A	Yield by Season	
	Monsoon	Winter*		Monsoon	Winter
Groundnuts	700	800	80	56,000	64,000
Maize	1500	300	80	120,000	24,000
Sunflower	-	50	50		2,500
Sesame	-	100	20	-	2,000
Totals	2200	1250		176,000	92,500

*It is assumed that adequate water supply can be developed for only about 60% of the land during the winter period; the area planted might be larger than projected, but the yields would be reduced because of insufficient water.

Seed Production Targets

There are substantial differences in the seed production targets and their mix among the PP, the Gregg report and information/projections provided during the present and latest consultation.

The PP uses the following seed yields (apparently) clean seed yields) in calculating the acres required to produce the certified seed needed in the intensive townships:

Crop	Baskets/A.	lbs./A
Maize	80	4400
Groundnuts (in shell)	80	2000
Sunflower	50	1600
Sesame	20	1080

These are rather high yield projections even for raw or field run seed. Since about 10 to 20% of field run or raw seed is discarded during cleaning, the field run seed yields needed to obtain 80 baskets (roughly equilivant to bushels) of clean seed of maize or groundnuts per acre would be very high yields indeed. Gregg's report adopted the seed yields in the PP, although some of his calculations were based on lower expected yields. The present report also adopts the projected seed yields in the PP because it seemed most conventient to do so, despite a judgement that they are far too high. Clean seed yields/A are not likely to be higher than 60% of the PP projections.

Seed yields per unit area in the present project are not really critical matter for several reasons: the most important of which are the fact that the seed farms can be expanded as necessary to increase total production, and/or additional seed as needed can be produced by

farmer-cooperators and delivered to the seed farms for drying, processing, storage and distribution.

The differences among the PP, Gregg report, and latest projections referred to above are most substantial in the area of quantities of seed per crop required in 1985/86, when the project is essentially fully operational.

The projections of quantities of seed needed in 1985/86 (excluding foundation seed) in the PP and Gregg report are as follows (in lbs.):

	PP	Gregg Report
Maize	2,100,000	2,888,000
Groundnut	5,000,000	7,500,000
Sunflower	600,000	240,000
Sesame	200,000	270,000

In the discussions during the present consultation emphasis was almost wholly on maize and groundnut - sesame and sunflower were hardly mentioned. This new emphasis is not bad. The greatest opportunities for increased productivity appear to be in maize and groundnuts. Sunflowers are a relatively new crop and their potential is not really known. No varietal development has taken place. Sesame is an old and valued crop, but its potential is limited. Furthermore, since so little sesame seed is required to plant an acre and no new varieties are on the horizon, an extension effort to inform farmers how to select and save (store) sesame seed for planting purposes would be as effective and probably less costly than trying to produce a continuous stream of sesame seed on the seed farms.

Both the PP and the Gregg report mention that the drying and processing facilities should have additional capacity over that required for the seed farms' internal production. The additional capacity could

could be used to handle additional seed produced under agreement with farmer-cooperators.

An attempt has been made to strike a balance between the different projections of seed needs in the proposed facilities described in this report. The facilities and equipment proposed are also sufficiently flexible to accomodate rather wide variation in the quantities of seed per season, and the mix of some kinds within and among seasons. Feasible cropping patterns for the seed farms by season are given in Tables 2, 3, and 4, and were used for planning the facilities proposed.

III. FACILITIES/EQUIPMENT: BASES FOR RECOMMENDATIONS*

General Considerations

The facilities and equipment recommended and specified for the three locations - Chaungmagyi-Sebin, Kyaungsu and Thitcho - were based on the following considerations.

(a) Capability and adequacy to handle the projected quantities of seed and the mix of seed kinds at each of the three centers with some qualifications as noted elsewhere.

(b) Uniformity of equipment and layout - to extent possible - to facilitate development of engineering and construction drawings and specifications, installation of equipment, spare parts inventory, maintenance, and in-service training.

(c) Appropriateness of equipment and layouts in terms of level of technology needed so as to simplify operational management and minimize maintenance problems.

(d) Flexibility in terms of capabilities of equipment and facilities to handle the kinds of seed included in the project and others such as soybeans and chick peas which might be added later.

(e) Replicability in terms of future need for expansion. Expansion or increased capacity can be accomplished by adding drying units, processing plants, and storage units at any one of the centers, or at new centers as might be needed.

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*See Sections IV, V, VI, VII and VIII for facilities and equipment specified for each seed center.

Projected seed production targets in terms of acres planted and potential yields are given for the three seed centers in Tables 2, 3 and 4, and summarized in Table 5. For comparison purposes the basic projections in the PP and Gregg reports are in Tables 6 and 7. These projections were generally used as one of the bases for the equipment and facilities recommended.

It should be noted that the projections are at best "possibilities" since the cropping patterns for the four farms and the overall priorities in terms of seed kinds do not appear to be very firm. Moreover, the production potential for the winter season will depend largely on the extent to which irrigation can be developed at the four seed farms. In any event, the recommendations made are sufficiently flexible to accomodate substantial changes in the projected volumes and mix of the different seed kinds. It has been assumed, however, that maize and groundnuts will continue to be given high priority.

Recommendations in the Gregg report took into account potential off-farm production by cooperating farmers which would need to be dried, processed and stored in project facilities. In our view, provisions for handling quantities of seed beyond the production of the seed farms should not be included in the first phase. The yield projections for the seed farms are very high, i.e., 80 baskets/A for maize and groundnuts, 50 ba/A for sunflower and 20ba/A for sesame, and are not likely to be realized until the farms become fully developed and management becomes quite experienced; in other words, not until 4 to 5 years if ever. Since the facilities for each farm are "sized" to more-or-less handle the maximum yield (except at Thitcho) there will be some capacity

Table 5. Summary of projected seed production on the four seed farms by seed kind and season at full development.

Farm	Crop	Monsoon Acres	Monsoon Baskets	Winter Acres	Winter Baskets
Chaungmaygi	Maize	100	8000	50	4000
Sebin	"	0	0	0	0
Total		100	8000	50	4000
Chaungmaygi	Groundnuts	150	12000	100	8000
Sebin	"	100	8000	100	8000
Total		250	20000	200	16000
Chaungmagyi	Sunflower	50	2500	50	2500
Sebin	"	100	5000	50	2500
Total		150	7500	100	5000
Chaungmaygi	Sesame	0	0	0	0
Sebin	"	100	2000	50	1000
Total		100	2000	50	1000
Kyaungsu	Maize	0	0	100	8000
	Groundnuts	0	0	600	48000
	Sunflower	0	0	100	5000
Thitcho	Maize	1500	120000	300	24000
	Groundnuts	700	56000	800	64000
	Sunflower			50	2500
	Sesame			100	2000
Summary (All Farms)					
Maize		1600	128000	450	36000
Groundnuts		950	76000	1600	128000
Sunflower		150	7500	250	12500
Sesame		100	2000	150	3000

Table 6. Estimates of seed production on each seed farm by season according to Gregg's report.

Farm	Crop	Monsoon Acres	Monsoon Baskets	Winter Acres	Winter Baskets
Chaungmaygi	Maize	50	2500	100	5000
Sebin	"	0	0	0	0
Total		50	2500	100	5000
Chaungmaygi	Groundnuts	100	6000	100	6000
Sebin	"	150	7500	150	9000
Total		250	13500	250	15000
Chaungmagyi	Sunflower	150	6000	100	4000
Sebin	"	0	0	50	2000
Total		150	6000	150	6000
Chaungmaygi	Sesame	150	2000	100	1500
Sebin	"	0	0	0	0
Total		150	2000	100	1500
Kyaungsu	Groundnuts	0	0	800	48000
Thitcho	Maize	2500	125000	100	5000
	Groundnuts	0	0	1000	60000
	Sesame	*		800 (Pre-Monsoon)	5000
	Chickpea			500	5000
Summary (All Farms)					
Maize		2550	127500	200	10000
Groundnuts		250	13500	2050	123000
Sunflower		150	6000	150	6000
Sesame		150	2000	900	7400
Other (Chickpea)				500	5000

Table 7. Seed Production requirements specified in PP (Table 13, p. 55) for 1985/86. (Pounds of seed converted to baskets).

Type	Crop	Acres*	Baskets
Foundation	Maize	3	240
	Groundnuts	125	10000
	Sunflower	7	280
	Sesame	2	30
"Certified"	Maize	469	37500
	Groundnuts	2500	200000
	Sunflower	376	18750
	Sesame	185	3700

* PP did not divide acres among seasons.

at each farm to handle off-farm seed production by farmer cooperators for a 4 to 5 year period. The quantities of off-farm seed production that could be handled would be determined by the shortfall in yields on the seed farms from the maximum projected. If seed production and use expand more rapidly than now seems possible, consideration should be given during the last year(s) of the project to establishing additional seed farms, or at least establishing seed drying, processing and storage facilities in areas where cooperating farmer seed producers have been identified and are active.

Except for the Kyaungsu farm which seems to have only a very limited potential for monsoon season production, the monsoon crop will be the biggest in terms of volume of production. Since the monsoon and winter season harvests are well separated in time, the recommendations made are designed to handle the monsoon crop. This means that substantially larger quantities of winter crop seed could be handled should irrigation be better developed than presently envisaged.

Estimated capacities of the major equipment and facilities are summarized by operation in Tables 8, 9 and 10.

Harvesting

Harvesting is a critical period in seed production operations. Seed allowed to remain in the field too long after it reaches harvest maturity are subject to deterioration from weathering, and losses from birds and rodents. Weathering is likely to be more of a problem for monsoon crops, some of which will reach harvest maturity before the rains stop and humidity decreases. Winter crops that reach harvest

maturity before May will be subject to little if any weathering. As a consequence, winter crops can be field dried to a lower moisture level than monsoon crops, thus reducing the requirement for energy for drying. Also, more drying can be done on drying floors.

In the case of both seasons at least a portion - maybe 60% - of the production will be used for planting in the immediately following season, i.e., 60% plus of the seed produced in the monsoon will be distributed for winter season planting and vice versa. This will require substantial efficienty in harvest, drying and processing operations so that this portion of the seed can be distributed in time for planting in the following season. Considering the needs for fairly rapid harvest to minimize weathering and other damage, the kinds of seed which are to be produced - two of which (maize and groundnuts) are traditionally harvested at relatively high seed moisture contents and require drying - and the operational efficiency required to prepare the seed for planting in the immediately following season, harvest will have to be mechanized to some degree, and drying will also need to be adequately provided for.

A minimum 60% mechanization level for harvest of the two major crops - maize and groundnuts - is recommended and specified. The harvesting equipment recommended are of an intermediate technology type rather than the advanced self-propelled harvests mentioned in the PP and Gregg report.

In the case of groundnuts a good array of modest size, i.e., 1 and 2-row, tractor drawn and powered equipment is avaiable from U.S. manufacturers. Groundnuts along with tobacco are still crops of small farms in

the U.S., so the equipment is still of moderate capacity, sophistication and price. Maize harvest in the U.S. for grain has largely gone in to the direction of direct combining but 1 and 2 row corn picker/huskers are still available.

The harvesters recommended are costly but much less so than the advanced self-propelled combine types. Since the harvesters recommended are tractor drawn, it has been assumed that the project will procure tractors of appropriate horsepower with PTO of appropriate type for the equipment recommended.

The advanced self-propelled combine type harvesters are not recommended because: (1) they are not suitable for groundnuts or maize that is to be used for seed (as compared to grain); (2) the quantities of sunflower and sesame seed are not adequate to justify the large investments in combines; (3) combines are difficult to maintain in a good operable condition without nearby service facilities (i.e., farm machinery mechanic shops) or good in-house service, repair and maintenance capabilites; and (4) the terrain is not too good for self-propelled combines, e.g., remnants of termite mounds and depressions from clearing of trees at Thitcho.

Sunflower and sesame seed harvests are not provided for in terms of mechanization for reasons given above, and because we have been unable to identify moderate capacity suitable equipment in the U.S. It is strongly recommended, therefore, that visits be made to India and perhaps Thailand to survey the locally made threshers which might be suitable for sunflower and sesame. India, especially, manufactures a variety of small stationary type threshers that can be powered by belt

from small tractors or a small diesel motor. Capacities range from 20 to 50 bushels or baskets per hour for wheat, rice, sorghum, millet, etc. Very likely some of these threshers can also be used for sunflower and even sesame. The Indian manufactured threshers are simple, fairly rugged, and not costly.

Groundnuts

Lifting groundnuts from the soil and placing them in windows for "field curing" or drying is part of the harvesting operations. The groundnuts then have to be separated from the vines or threshed. Equipment are recommended specificaly for these operations as follows.

Lifting and Windrowing: Two-row tractor drawn windrowing digger-shakers are recommended for "digging" the groundnuts and windrowing for field drying. The digger-shaker can accomodate row widths of 30 to 36 inches and dig, shake, fluff and windrow groundnuts at a capacity of about 2 to 2.5 A per hour. (Note: An alternative is the so-called "digger-inverter" which does about the same thing as the digger-shaker but also inverts the vines so that the groundnuts are on top; cost would be greater; the choice of digger-shaker or digger-inverter is determined on the basis of climatic conditions, soil type, type and variety of groundnuts grown; project seed specialist should review recommendation before procurement). The digger-shaker specified requires a tractor with minimum 35 - 40 h.p. and PTO at 540 R.P.M. The digger-shaker can also be used to fluff the vines to speed up drying by simply removing the plow on digging shares. Digger-shakers are specified to handle esentially all the groudnuts crop within a 20-25 day digging period.

Threshing: A groundnut combine, tractor drawn and powered by tractor PTO (540 R.P.M.), is recommended and specified for about 60% of the crop. The remainder should be hand threshed. The combine has a capacity up to 2A per hour under reasonable conditions. It requires a tractor of at least 70 h.p. with PTO operating at 540 RPM. The combine is specified with a collecting bin because wagon-type dryers are provided, and the bin can be easily unloaded into the wagon. The combine is also available with a dual head bagging attachment with bagging platform which permits handling of groundnuts in bags or sacks. The combine picks-up the windrow in pull-type operation, or it can be parked and used as a stationary thresher. Much less tractor h.p. is required when operated as a stationary thresher. As mentioned the combine specified is said to have a capacity of about 2A per hour. More likely it will handle about 1.5A per hour.

Maize

Maize will be planted in the largest acreage in the project. With reasonably good management, it also has the greatest yield potential, hence the greatest quantities to harvest. As mentioned previously direct combining or picker-shelling of maize seed has not worked well for seed maize - even in the U.S. Most of the seed ma ze in the U.S. is still picked, husked and dried on the ear. Direct combining and picker-shelling causes too much mechanical damage which reduces quality and shortens the storage life of the seed.

Conventional maize ear pickers are recommended for at least 50% of the projected acreage. The pickers would have husking rolls and an ear

elevator so that the picked, husked ears can be loaded in a trailing grain wagon. The pickers specified are one and two-row depending on the capacity required. Tractor horsepower required would be 70 h.p. plus with PTO at 540 RPM. The capacity of the two row picker is about 2A per hour.

The remainder of the maize that could not be harvested mechanically would be harvested by hand in the traditional manner, thus, providing seasonal employment for villagers. If the pickers work well and hold up well under conditions in Burma, additional pickers can be ordered toward the end of the project as production begans to peak.

Sunflower and Sesame: Mechanization of harvest and threshing of sunflower and sesame is not provided for because of reasons already given. The recommendation to survey by visit what is available in India and might be suitable for Burma is re-emphasized.

Seed Drying

Presently seed and grain crops are field or sun-dried in Burma. The concentration of seed production on seed farms, introduction of mechanical harvesting, and seed quality considerations, however, require the establishment of mechanical or "artificial" drying facilities.

Natural field drying and sun-floor drying should be used to the degree possible consistent with operational efficiency required to get the seed ready for distribution for planting in the immediately following season and maintenance of quality so as to reduce energy costs. This will be most applicable for winter season crops. While natural field and floor drying should be used to the extent possible, mechanical

drying facilties are specified to handle most of the production of maize and groundnuts. (See Note on Thitcho Farm at end of this section). This is necessary because the monsoon crop harvest will not only be the largest, but also the harvest for which reliance on natural or floor drying should be minimal. The rains taper off in September but do continue until November and relative humidity remains high.

The drying facilities specified for maize and groundnuts can also be used for sunflower heads, sesame pods, or threshed seed of same.

Drying floors are recommended and specified at all farms. These should be used to the extent possible to save on drying costs - power and fuel.

Groundnuts: The groundnuts will be dried partially in the windrow after digging. They must dry to below 25% moisture for satisfactory combining or mechanical threshing. For further drying down to about 7 to 8% moisture, wagon bed dryers are specified. The wagon bed dryers are mobile and can be used to collect the seed from the combine or hand threshing operations then pulled by tractor to a drying shed where they are connected to the air distribution tunnel of a diesel fired heater and fan or blower unit. Generally about 24 to 30 hours are required for drying with forced air at 95 to 100F. In the case of winter season groundnuts harvested in April when ambient temperature is in the 90s or even above 100F during the afternoon, the heater will not be needed, i.e., it will not cut on, until the early morning (mid-night to 7 a.m.) if at all. The fan or blower will, of course, be running all the time.

Since some of the groundnuts might be harvested before maize harvest begins, the bin-type dryers specified for ear maize can also be used to dry groundnuts, thus increasing capacity. In like manner the wagon driers can also be used for ear maize although they would be less efficient than the bin dryers. The wagon dryers could also be used to dry sunflower heads or sesame pods.

The drying wagons specified are 4-wheel, 14 ft. long x 8 feet wide x 4 ft. effective drying depth, and with air intake port and unloading door at the rear. The heater-blower drying units specified are capable of drying three wagons at 4 ft. depth at the same time. The capacity of the wagon is about 350 baskets, which at 24 hour drying, means 350 baskets per day. This is maximum.

Maize: For ear maize, drying bin units are recommended and specified. The bins would be of local construction using locally available construction materials except for perforated metal flooring for the bins. This type of bin system is recommended rather than the round metal "silo-type" drying bins mentioned in the PP and Gregg report because it would be more permanent, special expertise would not be required for installation such as would be required to erect metal bins properly with good seals, the dollar cost would be much less, all-weather operation would be possible (under shed), and loading and unloading systems are simpler and more efficient.

The ear maize would be loaded into the top of the bins (bins in multiples of 3 or 4 x 2 or eight bins per system depending on capacity needed) with an inclined flighted belt conveyor (portable for 3 bin

system, permanent for 4 x 2 bin system) to a depth of about 8 ft. The bins are 16 ft. x 12 ft. which at an 8 ft. drying depth would give about 600 baskets shelled maize equivalent capacity per bin. Ear maize drying is rather slow and will range from 1.5 to 3 days (36 to 72 hours) depending on how dry the seed are at harvest for an average of about 2 days (48 hours) drying.

After the seed are dried on the ear to about 12% or less they are unloaded through ports (doors) located at the bottom of the front wall of the bin onto a belt conveyor for transport to a sheller with a capacity of 150-200 baskets per hour. In the case of the 3-bin drying system, the shelled maize are collected in a grain wagon for transport to the processing plant or to ventilated warehouse for bagging for temporary storage until ready for processing. For the 4 x 2 or eight bin system, the maize is handled in the same way except bulk storage hopper bottom "tanks" are provided to hold some of the excess of shelling capacity over processing capacity (and permit double shift operation) with allowances for transport of some of the shelled maize directly to processing, and for load into grain cart to take surplus to warehouse for bagging and temporary storage until "processing" can catch-up.

Sunflower and Sesame: No special provisions have been made for drying sunflower heads or sesame pods. Generally, both sunflower and sesame are field dried. However, depending on availability of space, sunflower heads and sesame pods, or threshed seed of same, could be dried in the wagon bed dryers. The drying floors should, of course, be

used as much as possible. The bin drying system could be used for threshed sunflower and sesame seed, but drying heads of sunflower and pods of sesame would be difficult because of problems in getting the heads or pods out of the bins.

Processing

Processing involves cleaning and grading, treating if desired, and packaging. These operations are important but not critical in terms of time as are harvesting and drying. Time is a factor, however, since at least half of the seed needs to be processed, packaged and in distribution channels as soon as possible to meet the planting dates of the immediately following season.

Only basic cleaning, gravity table separation (density separation) and packaging with optional treating capability is recommended and specified. Basic cleaning removes the trash, seed fragments, immature shrivelled seed, dust, etc. The gravity table is very effective for upgrading germination and seed quality by removing rotten deteriorated seed, unfilled or partially filled seed (sunflowers) or pods (groundnuts), and other light material.

The treating option, i.e., provision of a treater for applying fungicide and insecticide seed treatments, is specified because it was mentioned in the PP and Gregg report. If there is no experience with seed treatment in Burma, the option can probably be eliminated (or postponed). The items that can be (and should be) deleted from the equipment and facility list should the decision be made not to worry about seed treatment in the first phase of the project are identified in

the notes to the "Equipment List", Section VIII.

Quite high capacity handling (elevators), cleaning, gravity grading, and, packing equipment has been specified. In a few cases the processing line has somewhat greater capacity than needed, but in most cases the capacity is not as great as one might like. This cannot be avoided. A little capacity can't be effectively added. The equipment just isn't made in such a variety of capacities. A whole new processing line has to be added which then provides too much capacity. Since the yield estimates are very high (80 ba/A for groundnuts and maize, 50 ba/A for sunflower, and 20 ba/A for sesame) the quantities of seed that will need to be processed (and dried) are likely to be substantially less than projected. Therefore, it seems reasonable to provide - as a first step - a set of facilities that might be used very efficiently, rather than several sets which would be substantially underutilized. Should the yield projections be achieved in the final years of the project, an additional investment in equipment might be warranted before the project terminates.

Separate processing facilities or at least lines of equipment are specified for groundnuts and for maize, sunflower and sesame. Unfortunately, groundnuts, like cottonseed, are just different and require special equipment. This is true whether they are handled in the pod or shelled. This situation does increase the investment in processing facilities and equipment but there is no alternative.

The types of processing facilities recommended and specified are described in detail in Section V, and are clearly evident in the drawings.

Note on Thitcho - Drying and Processing

The summary of estimated capacities by operation for the Thitcho farm (Table 10) indicate considerable short-falls in the capacities of the facilities/equipment specified for maize drying and processing as compared to the capacities required should the rather optimistic acreage and yield projections be realized. Frankly, the Thitcho farm is a problem. Despite an apparent good potential, the farm is so devoid of essential infrastructure, especially electric power and a decent road, that it seems wiser to be slightly pessimistic rather than overly optimistic. Accordingly, only one 4 x 2 bin maize drying system is specified. With good management this system can dry up to about 2000 ba. per day (24 hours). If the harvest season, hence drying, season is as long as 25 days, then 50,000 ba. could be dried in a season. But, 50,000 ba. is less than 50% of the optimistically projected 1500 A for 120,000 ba (80 ba/A) in the monsoon. Even if one takes a more realistic yield, say 40 ba/A then 1500 A would yield 60,000 ba. which is still higher than drying capacity. Yet, by using the drying wagons and drying floors especially for the late harvested maize, all the seed could be more-or-less satisfactorily dried. All of this assumes a good dependable electric power supply to operate the fans or blowers, shellers, and so on, and that drying can be accomplished in 2 days. If the power supply is off a good bit and drying time creeps up to 3 days, then the capacity of the 4 x 2 bin drying system falls to about 1500 ba/day or 37,500 ba. in a 25 day harvest/drying season. Or, to look at another "worst case", if the acreage in maize at Thitcho during the monsoon goes to 2000A, then even at 40 ba/A, 80,000 ba. have to be handled, or 100,000 ba. with a 50

ba./A yield.

One solution to the maize drying capacity shortfall at Thitcho - if production does get up to 80,000 to 120,000 ba./monsoon season - would be to add a second 4 x 2 bin drying system which would bring drying capacity up to 80,000 (3 day drying) to 100,000 ba. in a 25 day harvest/ drying period. A second 4 x 2 bin drying system for Thitcho has not been specified in terms of equipment, but it shown in the general layout drawing (sheet 3) for Thitcho as a possibility for expansion. If it is felt that the equipment for the second 4 x 2 bin maize drying system should be ordered in the first round, we can easily identify the equipment that would be needed, i.e., heater blower units, conveyors, shellers, bulk tanks, and figure out the best ways to position the second 4 x 2 bin dryer in reference to the processing plant.

Maize processing capacity is also a problem. The processing line specified is about as high capacity as can be managed for seed. It will do about 200 ba/hr. with good managment and dependable power supply. This adds to the 1600 ba./day for one shift operation, or 64,000 ba. in 40 days which is not an unrealistic processing period. (Since the seed have been dried, processing can be "stretched" out without detriment to quality; drying on the other hand cannot be delayed). Double shifting during the 40 day processing period would bring capacity up to near 100,000 ba. which should be adequate.

Adherence to a single shift, an abundance of power outages, or a desire to shorten the processing period would require a second processing plant. If a second processing plant is desired, we will be glad to identify the equipment needed. As in the case of a second 4 x 2 bin

drying system, the construction would be the same. It would be important to position the second processing plant and second 4 x 2 bin dryer properly for efficient operation.

Provisions for groundnut drying and processing are adequate even if acreage would go to 1000 or 1200 A.

Storage

It is most difficult to estimate the seed storage needs for the project even simply in terms of space requirements. The difficulties arise out of uncertainities regarding the proportion of the harvest of one season's crop, e.g., monsoon, which can be distributed for planting in the immediately following crop, e.g., the winter season, and the lack of any good data on the longevity of seed under conditions in Burma during the monsoon and winter seasons. These uncertainties combine with other general uncertainties regarding the level of production that can be achieved on the seed farms, and the quantities of seed that might have to be produced off-farm with farmer cooperators, but handled and stored for a time on the seed farms.

Assuming that the same varieties can be planted in either season (as we were informed), then the most efficient system would be to use as much as possible of the seed produced in one season for planting in the immediately following season. This would reduce storage time to a minimum - a few months at the most. Such a system would also require considerable operational efficiency to harvest, dry, process and distribute the seed produced in one season for planting in the next. The harvesting, drying and processing facilities recommended for the three seed

centers (Chaungmagyi/Sebin combined) should make it possible to prepare and distribute at least 60% of the seed for planting in the next season. Thus, only 30-40% of the seed would have to be carried in storage for the 6-8 month period until next annual season (i.e., from monsoon harvest to the next monsoon planting; winter season harvest to the next winter season).

The worst time of the year to store seed in Burma is from the winter season harvest over the monsoon season until planting time for the next winter season. Temperatures are a little lower during this period but the humidity is high. The best season for seed storage in Burma appears to be the winter season from Nov. - May when the humidity drops to 50% or slightly less. Considering this situation, every effort should be made to reduce the need for seed storage over the monsoon period to a minimum.

Looking at seed storage from the standpoint of the kinds of seed involved, groundnut is the "poorest" storer, while maize is the "best" storer. There is little data on the storage potential of sesame and sunflower seed under conditions such as prevail in Burma, but they - sesame and sunflower seed - should be intermediate in longevity between groundnuts and maize.

In considering storage requirements and the storage behavior of seeds, one must recognize and appreciate that the quality of the seed produced, hence, its quality at the time it enters "storage", has a tremendous influence on how well germination is maintained during storage. The most important single step that can be taken - and must be

taken - to maintain seed quality in storage is to produce good quality seed. If seed has already begun to deteriorate at the time they enter storage as a result of untimely harvest, improper drying, poor processing and so on, then they are likely to continue to decline in quality even in very good storage conditions. Put still another way, a good seed storage plan encompasses more than storerooms, it involves a committment to manage the operations that precede the storeroom phase in such a way that good quality seed are produced, and the quality is maintained through the various operations that precede the actual placement of the seed in the storehouse. It has been our experience in both the U.S. and LDCs that storage gets "blamed" for quality losses that have their origin in the production, harvesting, drying and processing operations.

If the seed are harvested at the proper time and dried properly, quality should be stable (i.e., maintained) for the 30-60 day period required to process and distribute them for planting in the immediately succeeding season. Maize seed should maintain their quality satisfactorily during winter season storage under ambient conditions and also hold up reasonably well even during the monsoon season especially if the seed were not harvested until April and were planted in September or early October. Sunflower and sesame seed should also store reasonably well under ambient conditions during the winter season, but not nearly as good during the monsoon season. Groundnuts will probably lose quality even during the winter season under ambient condition storage although germination should still be above 60% for early monsoon planting

provided they were of good quality at the time they entered storage. Severe quality losses of groundnut seed and moderate to severe losses of quality of sunflower and sesame seed can be expected under ambient conditions during the monsoon season. Thus, "air-conditioned" storage will be needed for the quantities of seed of groundnuts, sunflower and sesame that will have to be stored during the monsoon season.

Taking the various factors into account and bearing in mind the many uncertainties as mentioned above, the following "guidelines" have been generally followed in developing the recommendations for storage.

1. About 60% of the seed harvested will be distributed for planting in the immediately following season.

2. Storage capacity should be adequate for the projected production of the three seed centers. If more storage capacity is needed to handle seed from farmer cooperators as the project progresses, additional storage units can be added on the seed centers, or at other more convenient locations, based on experiences gained with the earlier provided units.

3. Ambient storage conditions, i.e., ventilated storehouses, are adequate for maize during both seasons, and for sunflower and sesame during the winter season. Groundnuts will require air-conditioned storage during both seasons (for the portion of the crop <u>not</u> distributed for planting in the immediately following season) and sunflower and sesame seed will require conditioned storage during the monsoon season.

4. A moderate level of air-conditioning should be satisfactory for groundnuts in the shell. (Shelled groundnuts store much more poorly

than those in the shell as a result of mechanical damage sustained during shelling). Conditions specified are 60-65F and 55-60% relative humidity. Good insulation and moisture vapor "proofing" of the conditioned storerooms is economical as energy costs (electric power) will be much reduced.

5. The dehumidification capacity to achieve the level of humidity desired (55-60%) is specified as well as the moisture vapor barrier. One type of construction and insulation is shown in the drawings (sheets 16 and 17) as an example. A local engineering firm should calculate the cooling capacity (BTUs) needed for each conditioned storeroom unit on basis of their experience in Burma, type of air cooling units that will be used, and the type and r-values of the insulation that will be used. The air-cooling equipment should be of a type used in Burma for central air conditioning of hotels, office buildings, etc., so that it can be properly serviced. Likewise, the insulation used should be of a type with which there is some experience in Burma. Thailand has constructed some conditioned storerooms for soybean seed storage. It would be worthwhile for a Burmese engineer to accompany a seed specialist (project staff) to review design and construction of the storerooms in Thailand. It should be appreciated, however, that the conditions in the storeroom only have to be a moderate amount better than those in a well air-conditioned office building (or hotel) which are usually about 72-75F and 60-65% relative humidity (as compared to the 60-65F and 5560% r.h. needed). The conditions of 10C (50F) and 50-55% r.h. mentioned by Gregg are too favorable and too expensive to achieve, and would maintain

quality of groundnuts for about 18-24 months which is much longer than needed.

IV. FACILITIES -- LAYOUT AND CONSTRUCTION

General Layout

The facilities and their layouts (see drawings, sheets 1, 2 and 3) are quite similar for the Kyaungsu and Chaungmagyi-Sebin seed centers except for the greater groundnut drying and storage capacity provided at Kyaungsu. The facilities recommended for the Thitcho seed farm are also generally similar except for size which is larger to accommodate the much greater production potential at Thitcho.

The layouts in sheets 1, 2 and 3 of the drawings show only the facilities directly related to seed drying, handling, processing and storage as well as a small office and quality control laboratory building. The latter is shown as a separate building but could be added on to the main processing building as a lean-to along one side (there is ample height coming off the eaves of the high side walls of the processing buildings for a one story office and laboratory building with bathrooms and perhaps a conference room, with only a little change in roof pitch).

The buildings are grouped rather close together to reduce handling, facilitate management, and provide adequate operational flexibility. An architect will probably not like the layout for aesthetic reasons, and might be able to come up with a better arrangement or layout. This would be fine (and an architect should be consulted) provided efficiency is not sacrificed for aesthetics.

Seed Drying

Three types of drying facilities are shown: drying floor, drying shed for drying wagons, and a conventional type multiple bin dryer with all weather sheds.

Drying Floor (drawings, sheet 4)

The drying floors are all the same size but the number varies among the seed farms in accord with anticipated capacity requirements. The basic floor is 82 ft. (25M) X 40 ft. (12M). This gives an area of 3280 sq. ft. (300 sq.M) which at an average depth of 2½ inches (6 cm) would hold about 500 baskets or bushels of threshed groundnuts, sesame, sunflower and maize seed. Capacity would be considerably less in the case of ear maize (250 baskets equivalent shelled maize), sunflower in heads, and sesame in pods. The drying floor should be of good quality concrete poured on grade with wire net reinforcement at depth of 10 cm (4 inches). This should hold up light tractors and loaded trailers. Expansion joints should be provided in floor according to experience in Burma to prevent expansion buckling.

Drying Sheds for Drying Wagons

Sheds, open ended and sided are provided for all weather operation of the wagon dryers (drawings, sheet 5). The shed is sufficiently wide to provide cover for four 14 ft. (bed) drying wagons and the air tunnel or chamber to distribute the drying air to the drying stations, one per wagon. A drying shed long enough for four drying stations (wagons) is shown in sheet 5 of the drawings. This is the minimum shed; capacity is increased by adding additional minimum sheds (i.e., four station sheds) as needed to provide for adequate capacity. It is assumed that only 3

positions (wagons) will be operational at any one time; the 4th will be vacant or disconnected with the wagon waiting on unloading. The heater-fan drying unit is sized accordingly (i.e., for handling up to 3 wagons at any one time). The heater fan unit provided for the four stations (maximum 3 active) has a capacity of about 16,000 to 17,500 CFM cu. ft. per minute) air volume which is adequate for three of the 8 ft. X 14 ft. wagon bins at 4 ft. depth of groundnuts (or ear maize, sunflower heads, etc.). The temperature rise of the oil fired burner (i.e., the degree to which the burner heats the air above ambient) is specified to be about 12 to 15°F since the average ambient temperature in Burma is in the low 80's during the period September - November and in the high 80's in the period March - May. Groundnuts should not be dried at a temperature above about 95-100°F (unless the natural air temperature is that high or higher) or at a relative humidity of the drying air below 50 to 60%. This means that during the February thru April period of the winter crop drying season, the burner will usually not need to be operated during the day time, and probably only from about 10 p.m. to 6 a.m. if at all, thus, saving fuel. The heater-fan unit is specified with a humidistat rather than thermostat control. It would be set at about 55% relative humidity to control the cycling of the burner to provide for heat as needed to heat the air sufficiently to reduce the relative humidity to about 50-60%. Since some prefer to control drying burners with a thermostat rather than a humidistat even for groundnuts, the project seed specialist should have the final word on the type of control desired for the burner. The specs of the heater-fan unit can be easily changed to thermostat control.

The air from the heater-fan unit will discharge into the air tunnel positioned lenghtwise under the drying shed. Four ports or vents in the "drying side" of the tunnel are provided, each with a close-off gate to shut off the air flow when not in use. The tunnel port to wagon bed port connection is by flexible fabric type connector. (The wagon is specified with air intake at rear).

The construction of the shed for the drying wagons is not critical in terms of materials used. It can be of wood lumber or pole uprights on concrete footings with wooden framing for roof and roofed with galvanized corrugated sheet roofing, or other type of good roofing material. Or, the uprights can be iron or concrete beams on concrete footings with preformed metal trusses to support roof, and good roofing material. The air tunnel should be of masonary construction on a concrete slab (as shown in the drawings, sheet 5) which extends sufficiently to provide a good foundation for the heater-fan unit. If there is difficulty in laying masonary (bricks or blocks) for the the top of the air tunnel, wooden supports can be fitted inside the tunnel to support a poured concrete top, or sheet metal can be fastened to wooden framing with one course of bricks or blocks laid over sides of metal which should extend into brick/block course at least 2 inches. The important thing is to minimize or prevent air leaks which waste energy and decrease drying efficiency.

The air-outlet ports in the drying side of the air tunnel should be framed with wood, well fitted and well caulked. This will provide a seat for gasketing material so that shut-off doors can be tightly fitted, and

also provide a good smooth, gasketed seat for connector from tunnel outlet port to wagon intake port.

The rest of the floor of the drying shed should be of well filled packed gravel to provide a mud free area for the wagons.

Drying Bins

The drying bins recommended and specified are of uniform dimensions 16 ft. long X 12 ft. wide X 13 ft. height (depth) (see drawings, sheets 6, 7, 7a, 8 and 9). The bins are combined in multiples of 3 and 4 X 2 to fit the capacity requirements at the different seed farms and to permit use of heater fan units with not more than 10 h.p. motors. The effective volume of one bin is 16 X 12 X 8 ft. drying depth (for ear maize) or 1536 cu. ft. which translates to about 600 bushels of shelled maize equivalent. The difference between the 13 ft. height of the bins and the 8 ft. drying depth is taken up with an inclined air chamber or plenum beneath the perforated metal floor of the bin. The bins are provided with a shut-off gate on the air intake side so that the drying air only enters actively drying bins. Two unloading ports are provided to unload the ear maize (or groundnuts) onto a horizonal belt conveyor for transport to the sheller or to a wagon for transport to temporary storage before shelling, or to the processing plant. The incoming ear maize for drying is loaded into the bins of the 3-bin dryer (sheet 6) with an inclined belt conveyor (portable) with "hopper" bottom on the floor and discharge end positioned in the notch in the top edge of the bin wall. The conveyor can load about 200-250 bushels of ear corn per hour.

In the case of the 4 X 2 bin dryer for the larger Thitcho operation (sheet 8), loading of the bin is accomplished with an inclined conveyor at the end of the bins under roof. The inclined conveyor would lift the ear maize to horizontal belt conveyor positioned over the central air chambers. This would permit construction of a wooden platform over the rear part of the drying bins and along the conveyor to permit ear sorting before the ears are loaded into the drying bins. This is the normal procedure for high capacity operations. The horizontal belt conveyor (and picking or sorting belt) is specified with side drop chute and scraper bar to unload the belt at predetermined points along both sides so that any one of the eight drying bins can be loaded at a time. If something did happen to the inclined and horizontal loading belts, the bins could be loaded with the portable aluminum flighted belt conveyors that are specified for loading the sheller, and in the open storage warehouse for bagging off seed for temporary stroage before processing.

The heater-fan or drying unit is permanently positioned at one end of the line of drying bins with air tight transition to the air distribution tunnel which is along the back wall of the 3-bin single line systems and between the two lines of 4 bins each in the 4 X 2 bin drying system (the 4 X 2 arrangement has a split central air distribution tunnel). From the distribution tunnel or chamber the air then enters the bottom plenum of any one or combination of bins ready for drying and passes through the seed mass exiting through the open top of the bin (single pass system).

The bins should be constructed on a concrete slab which is shown in the 3-bin unit drawing (sheet 6) as extending in all directions from the

bins to provide a concrete driveway along the loading and unloading side of the bins, a good base for the heater-fan unit at one end, and for maize shelling operations at the other end. Alternatively, the concrete slab could be limited to the area directly under the bin with sufficient extension along the sides to mount the horizontal unloading belt conveyor, and to the ends to provide a good base for the heater-fan unit(s) and the shelling station. The loading and unloading driveways along the sides of the building could be of well parked gravel to reduce the investment in poured concrete slabs. In the case of the 4 X 2 bin dryer, the slab should be as shown in sheet 8 of the drawings.

The entire drying bin facility is under roof with open sides and ends for all weather operation. This is important.

Construction of the drying system should be of a convenient permanent type in the Burmese context. The materials used are not especially important as long as they provide the necessary shelter and are "strong enough" for the loads.

The slab for the drying bin facility should be of 6-inch re-inforced concrete poured on grade. If the alternative of gravel driveways is taken, the gravel should be well parked to eliminate "mudding". The support columns for the shed roofs can be of wood, metal, or re-inforced concrete. Roof framing likewise can be of wood or metal trusses with roofing of corrugated galvanized metal, corrugated asbestos-cement panels, etc.

The drying bins should be of masonary - bricks, concrete blocks - or poured concrete. Since the ear maize exerts lateral pressure on the

bin wall at least two courses of standard size clay bricks would be needed with corners "overlapping" to tie the walls together at the corners. One course of concrete blocks (8in. X 16 in.) would suffice but the blocks should be well mortared, staggered, and "overlapped" at the corners. Formed concrete reinforced would, of course, have the necessary strength. The bins could also be constructed of wood but the wood will shrink leaving cracks. A double wood wall would be needed with heavy asphalt or construction paper between the walls to minimize air leaks. The drawings show details of the framing for the perforated metal floor (preferably wood, sheet 7), the unloading ports with board slides for opening and covering doors (sheet 7a) and the slide type intake port closures (sheet 7a). The important point is that these closures should minimize air leakage.

The heater-fan drying unit(s) are positioned at one end of the drying bin line feeding air into the distribution tunnel. A door(s) is provided at the opposite end of the tunnel to permit a worker to enter for clean-up and to adjust the air intake ports under each bin. The heater-fan units are specified to deliver a minimum of 10 CFM per bushel of ear maize with all bins full at a temperature rise of about 20-25°F with temperature controlled by a thermostat. Maximum drying time is about 3 days with the average about 2 days (48 hrs.).

Drying Capacities

The drying capacities of the different drying systems specified are as follows.

Drying Floor (40 ft. X 82 ft.): It is not possible to estimate the drying capacity of a drying floor because of the variable nature of the materials dried or partially dried on it, e.g., threshed groundnuts, ear maize, sunflower heads, sesame plants or pods, etc., and the lack of control over drying conditions. The drying floors recommended should be viewed as a means of reducing drying costs (electric power and fuel oil are expensive). They should be used to the extent possible consistent with maintenance of good seed quality.

Drying Wagon System: The drying wagons specified are 14 ft. long X 8 ft. wide X 4 ft. high or deep (effective drying depth). The volume of a wagon in bushels (or baskets) is about 350 bu. groundnuts, threshed sunflower and sesame, and 175 bu. shelled maize equivalent in terms of maize in the ear. The usual drying time for groundnuts in the shell (before shelling) is about 24-36 hours. Since the groundnuts will not be shelled in the project, they should be dried to a somewhat lower moisture content so the average time for drying will be about 1½ days (36 hours). This means a daily capacity of about 230 bu. (700 bu. every 3 days). When the wagon dryers are used for drying ear maize, the capacity would be only about 100 bu. per day at the maximum. It is not possible to estimate the capacity for drying such material as sunflower heads or sesame pods. In the case of threshed sunflower, maize and sesame seed, the drying capacity would be about 100 bu. per day (at 2 foot drying depth).

Drying Bin System: The drying bins are 16 ft. long X 12 ft. wide X 8 ft. height (max. drying depth). Only ear maize can be dried at an 8

ft. depth. The maximum depth for groundnuts would be 4 ft., while for shelled maize seed and threshed sunflower and sesame seed, the maximum drying depth would be about 2 ft. Ear maize will take 2 to 3 days for drying (say 2.0 days), while groundnuts, threshed sunflower and sesame will take about 1.5 days. Average daily capacity per bin, therefore, would be: ear maize - 300 bu./day; groundnuts - 340 bu./day; threshed sunflower and sesame - 125 bu./day.

The drying capacities provided at the three seed centers are summarized in Tables 8, 9 and 10 along with processing and storage capacities.

Processing Plants

Three types and/or capacities of processing plants are recommended (see drawings, sheets 10, 11, 12, 13 and 14) to accomodate the processing requirements of groundnuts and the other seed kinds, which differ, and to handle the projected production in a reasonable period of time. The buildings that will house the processing equipment are also of three basic sizes.

Combination Groundnuts and Other Seed Kinds Plant (Type A)

This type of processing plant is recommended for the Kyaungsu and Chaungmagyi-Sebin seed centers. The basic building is 98.6 ft. long (30 M) X 32.8 ft. wide (10 M) X 33.6 ft. high (10.25 M) at the ridge. The substantial height at the ridge (and eave height also) is required because of the vertical belt-bucket elevators needed to elevate and re-elevate the seed during the processing cycle. The considerable length of the building is needed to accommodate groundnuts processing at one

end and processing of other seed kinds at the other end; in other words, two separate processing plants in the same building. An alternative, of course, would be to simply reduce the length by half and construct two separate buildings, or divide the building in the center with a wall.

The two processing lines - groundnuts and other seed kinds - each consist of an intake elevator pit which requires a "hole" or pit in the floor to introduce the seed into the processing line. The seed are dumped from bags or grain carts into the receiving pit, elevated into the surge or holding bin above the main cleaner, pass through the main cleaner where the "clean" seed are discharged into the hopper of another elevator. They are then re-elevated into a holding bin over a gravity table for density separation, or alternatively in the case of seed kinds other than groundnuts to a bagging bin for packaging in bags with the packaging system. If the seed can be benefited by gravity table separation then they are density graded over the gravity table with "good" seed re-elevated to the bagging bin for packaging. An extra bin is provided in the maize-sunflower-sesame processing line to permit treatment of the seed with a fungicide (by means of a seed treater) before packaging. In the case of groundnuts, the seed treatment alternative is not provided for treatment of groundnuts in the shell is not effective. Also, in the case of the groundnut processing line, there is no alternative to running the groundnuts over the gravity table before re-elevating to the bagging bin for bagging. Groundnuts would always be benefited by density grading.

The packaging system provided for maize, sunflower, and sesame is a semi-automatic type consisting of a bagger-weigher, heavy duty sewing

machine (bag closer), and a moving belt for moving the bags quickly after filling through the pedestal mounted bag closer. For groundnuts, a simpler bagging system is specified: a bagger-weigher with portable bag closer (sewing head) and a platform scale for checking bag weights periodically. The bags can also be quickly closed by hand sewing.

Since there will be considerable "dust" during processing, the air system of the basic cleaners are vented outside. Cyclone dust collections are provided for the basic cleaner for the maize, sunflower and sesame seed. The gravity table for groundnuts is specified with a hood and fan for "gathering" the dust and blowing it through a pipe to the outside of the building. Gravity table separation of maize, sunflower and sesame seed will not be as dusty as for groundnuts so a small feeding aspirator is specified to collect the dust as the seed feed onto the deck of the gravity table and blow it to the outside of the building.

Construction: The floor of the combination groundnut and other seed kinds processing plant should be a 6 inch net-wire re-inforced concrete slab. The building itself can be of wood or masonary construction. It should be clear span if possible, i.e., no internal supporting columns. If this is not possible, then internal support columns should be as few as possible and positioned so as to not block the placement of the machines, elevators and bins as shown in the drawings. There should be no ceiling. Support columns can be anything from wood to concrete to metal beams. Ample vents should be provided in the side walls (bottom and top) to maintain good air circulation, and to help in dispersal of dust. The large doors shown in the drawings permit use of grain carts for loose seed or trailers with bagged seed to enter

for dumping into the receiving pit and other vehicular thru-traffic as needed.

Capacities: The capacity of the groundnut processing line in the combination plant is 2 to 3 tons per hour (160 to 240 baskets or bushels per hour), or 1200 to 1900 baskets per 8 hour day. Double shifting during peak periods could increase capacity to 2500 to 3800 baskets. The capacities stated assume an experienced crew. In Burma the capacities are likely to be only about 75% or more. In any event, with reasonable management the groundnut line should be able to do 36,000 to 48,000 baskets in a 30-day processing season which is not very long.

The "other seed kinds" processing line, i.e., shelled maize, sunflower, sesame, has a capacity of about 2 to 2.5 tons per hour without strain, or 75 baskets of maize and sesame and about 60 baskets of sunflower per hour. This should be adequate for the projected production levels at Chaungmagyi-Sebin and Kyaungsu for the two seasons assuming a processing period of 30 to 40 days which is not long.

Groundnut Processing Plant (Type B)

Since it is anticipated that maize will dominate the Thitcho operation and capacity requirements could eventually reach over 100,000 baskets of shelled maize in the maximum production season, the maize and other seed (except groundnuts) processing system has to be of much greater capacity than that for Kyaungsu or Chaungmagyi-Sebin. Accordingly, a larger processing plant with higher capacity equipment is specified (see Type C plant below). This plant would be best entirely separated from groundnuts processing operations which will also be required at Thitcho.

For groundnut processing operations at Thitcho, the groundnut "half" of the combination or type A plant would be adequate. The layout or floor plan and the side and end elevations would be the same as for the groundnut half of the combination Type A plant in sheets 10, 11 and 12. In other words the Type A plant would be "cut" in half with end wall added, and the non-groundnut half eliminated. Construction or capacity is as discussed above for the combination, Type A, plant.

Maize Seed and Other Seed Kinds Plant - Thitcho (Type C)

The processing building is 72.2 ft. long (22 M) X 52.5 ft. wide (16 M) X 35.1 ft. high at roof ridge (10.7 M) with side wall or eave height as shown in the drawings (sheets 13 and 14). Again, the substantial ridge and side wall height is needed to accomodate the elevators and bins which are essential for continuous and efficient operations. The receiving elevator and elevator pit, the basic cleaner, and the gravity table are larger size and capacity. The bagger-weigher and bag closing system and seed treater are the same as in the maize and other seed kinds processing line in the Type A plant. Flexibility is also the same. The seed can be cleaned with the basic air and screen cleaner then elevated directly to the bagging bin for packaging, or alternatively to the gravity table then to treating or bagging, etc. One small size grader is also provided for sizing the maize that will be mechanically planted on the seed farms. This will permit accurate planting. The sizing operation would utilize existing bins and elevators with the sizer (on a frame with casters) rolled under an appropriate bin for the sizing operation. This would be done after the main processing season is over.

The construction features for the Type C plant should be the same as that selected for the Type A plant (see discussion above).

The capacity of the Type C plant for maize seed would be about 4 - 5 tons per hour (at least 200 baskets per hour). With good management it has a capacity of nearly 250 baskets/hour. This means - at the 200 ba./hour level - about 1600 ba. in a normal workday, or 63 days to process 100,000 baskets. A 63-day processing season is rather long but not excessively so. Assuming that the monsoon season will be the biggest production season at Thitcho, harvest and processing could begin with early planted maize in September. The seed that could be harvested, processed and packaged in September thru October (at least) could be distributed for winter crop sowing (with double shift work days this could be 60,000 baskets or more). The rest could be processed more leisurely and stored for planting the following monsoon season.

The capacity of the Type C plant is about as large as practical for a one processing line plant. Gregg mentioned the layout of two identical processing lines in the same plant building. This was considered but the building width becomes excessive for the type of clear span or minimum internal column type of construction needed. In our view, therefore, the single line plant is best. If capacity requirements jump up to well above 100,000 baskets in any one season, a second Type C plant could be constructed and equipped near the one specified. This would not only double capacity, but also permit handling of two varieties of maize seed at the same time with no danger of mixing seeds as could occur in a two line processing plant even with resaonably good

management.

The Type C plant includes a small "shop" and "lab" in the rear.

Storage

Two types of storage are recommended: "normal", ventilated warehouse storage, and "air-conditioned" storage. A third type is mentioned and recommended, but is not specified or shown in the drawings, i.e., a economical "temporary" storehouse but with good roof for short term storage of unthreshed seed, or seed accumulated for processing, such as has been already established at Thitcho. The ventilated and air conditioned storehouses are referred to as permanent and should be of masonary construction, the "temporary" storehouses are referred to as temporary (although they might last for years), and should be of local economical materials.

Permanent Ventilated Storage

A type of basic permanent ventilated storehouse is shown in sheet 15 of the drawings. The storehouse is 140 ft. long X 50 ft. wide X 14 ft. high (sidewall height). Seed would be stacked on pallets (with forklift trucks specified, and/or by hand using bag conveyors also specified, or by combination of these methods) to a height of about 12 feet. At a 12 ft. stacking height, the 140' X 50' X 14' (12' stacking) building would have a capacity of about 33,000 baskets of seed as roughly 50% of the space would be in aisles, spaces between stacks, pallets, etc.

Construction. The permanent type ventilated warehouse should be constructed on a slab of about 6 inches, wire re-inforced concrete with

a 10 mil plastic (polyethylene) sheet in the slab to prevent moisture migration from the soil through the slab. The walls should be masonary and roof either corrugated galvanized metal or asbestos cement roofing panels. In other words, normal good quality "go-down" construction. Wire mesh covered vents are shown in the drawing (sheet 15). This is to provided for good ventilation, yet keep out birds. The roof should be pitched and there should be no ceiling.

The storehouse should be constructed on high ground to ensure good drainage away from the unit. Some fill will be required. In his report, Gregg advocates fill to raise floor of warehouse to truck bed height. This would facilitate loading out of seed and rodent control, but would cause problems in loading of the warehouse with seed from the processing plant which is on a slab on grade. Because of this difficulty, considerable additional cost in elevating a concrete slab floor and potential cracking and settling of the slab if the fill is not compacted properly and footings are inadequate, a concrete slab on slightly elevated grade to ensure drainage is recommended.

Capacity Recommended: The following capacities in terms of permanent ventilated storehouses are recommended for the three seed centers.

Chaungmagyi-Sebin: One (1) ventilated seed storehouse, 40 ft. x 50 ft. x 14 ft (sideall) height.

Kyaungsu: One (1) ventilated seed storehouse, 140 ft. x 50 ft. x 14 ft. (sidewall) height.

Thitcho: Two (2) ventilated seed storehouses, 140 ft. x 50 ft. x 14 ft. (sidewall) height.

Permanent Air-Conditioned Storage

For permanent air-conditioned storage, a basic unit consisting of two (2) 40 ft. x 40 ft. x 14 ft. sidewall height units under one roof with 20 ft. wide loading/unloading hall between the rooms is recommended (drawings, sheets 16 and 17).

Construction: The basic construction should be about the same as for the ventilated storehouses: 6 inch re-inforced slab with moisture vapor barrier of 10 mil sheet plastic film; masonary walls; pitched roof. For air conditioning the storehouse would then have to be provided with a ceiling at 12 feet, moisture vapor barrier, insulation, and a tight fitting insulated door. The moisture vapor barrier is needed to reduce the migration of moisture vapor through the walls and ceiling so that the dehumidifiers can take care of the "moisture" load. The insulation, of course, is to reduce the heat load on the building, thus, reducing the cost of cooling.

One method of installing a moisture vapor barrier and insulation in the walls and ceiling is shown in sheet 17 of the drawings. The moisture vapor barrier, which is usually 10 mil plastic sheeting, is applied to the interior side of the masonary wall with a hot asphalt bed or with mastic. This puts the vapor barrier to the outside of the insulation where it should be. The plastic vapor barrier should be "overlapped" at corners and at juncture of walls and ceiling to insure a good seal. Insulation is then applied to the inside of the moisture vapor barrier. The type of insulation can be blanket rock-wool, rigid polymer foam, cork, or other available type. In the drawing, sheet 17, rigid polystyrene foam or Styrofoam type panels are illustrated. The thickness of

the insulation is shown as four inches of styrofoam or polystrene insulation (2 panels, 2 inches thick) with the two panels set between 4 in. wooden furring strips (vertical and horizonal) and plyboard or other paneling on top nailed to the furring strips to protect the insulation. While 4 inches (two panels thick) of Styrofoam insulation are illustrated, 2 in. (one panel thick) for the walls and 2 x 2 in. for the ceiling would be all right except the compressors would run longer to maintain the desired temperature.

Cooling Load: The services of an air conditioning engineering firm (local) should be secured to calculate the cooling capacity needed to maintain temperature in the rooms at 60-65F under conditions in Burma. Since insulation is one of the main factors in calculating cooling load, the engineering firm should also recommend the type and R-value of the insulation, as well as the type of air cooling equipment that should be used. Window-type air conditioners have been used to cool seed storage rooms but they don't last too long and there is difficulty in maintaining a temperature below 68-70F without freezing of the coils. In any event, the evaporator coils should be of the type that provides for maximum dehumidification so as to reduce the load on the dehumidifiers. The desired temperature in the storeroom units is 60-65F.

Dehumidification Loads: The recommendation on dehumidifiers is based on experiences in other tropical countries. Two heavy duty industrial, condensation type dehumidifiers per room (40 x 40 x 12 ft.) should maintain the desired relative humidity of 55-60% if a good vapor barrier is installed in the wall, all other "cracks" and openings are closed, and the room is fitted with a tight fitting cold room type door.

Capacities Required: The following capacities of conditioned storage are recommended based on considerations discussed in Section III.

Chaungmagyi-Sebin: One (1) 2-unit conditioned storehouse as shown in sheet 16. T' · 40 x 40 x 12 ft. air conditioned unit has a capacity of about 6000 ba. of seed at 8 ft. stacking height and counting aisle space, etc., or 12,000 ba. for two units.

Kyaungsu: One (1) 3-unit conditioned storehouse as shown in sheet 16 but with an extra 40 ft. unit added to either end (total length of building would be 140 ft.). The "extra" 40 x 40 x 12 ft. unit would have only one door leading into the adjacent room. Thus, unloading of the room would have to be accomplished thru the aisle of the adjacent room to the central hall. Capacity would be 3 x 6000 ba. or 18,000 ba.

Thitcho: Two (2) 2-unit conditioned storehouses of the type shown in sheet 16. The four 40 x 40 x 12 ft. rooms would have a capacity of 4 x 6000, or 24,000 baskets of seed.

Temporary Storage

One "temporary" storage godown of about 100 X 40 X 14 ft. would be helpful at each seed center (Thitcho already has godowns of this type).

V. DESCRIPTIONS/SPECIFICATIONS OF EQUIPMENT

Equipment Specified

The equipment, machinery and accessory items recommended for the harvesting, drying, processing, and storage (in part) operations at the three seed centers are described and specified in the following sections. The recommendations/specifications are grouped according to operation, i..e, harvesting, drying and maize shelling, processing, and storage (in part).

For the most part, costs have been estimated. The estimates are current and should be reasonably close, although we're often given are estimate by suppliers and their bid turns out to be quite different. The cost estimates are FOB supplier or manufacturer. On the average, export crating, inland freight to nearest port, and ocean frieght to CIF point (Rangoon) adds about 25% to cost.

In some cases the specifications are quite detailed because experience has shown that substitutes offered can be shoddy and unacceptable. In other cases, e.g. forklift truck, the specs are not so detailed because there is an array of good brands available. Also, some thinking about the exact specs needs to be done by the Burmese and technical assistance group to ensure that the best possible servicing would be available in Burma.

To the best of our knowledge (and review) all the major seed operational and most of the minor items have been specified - with one exception. We will continue to review the lists to search for any major

items omitted as well as any duplications. Very likely a short supplemental list will be developed and sent as an addendum. The exception mentioned refers to equipment for one or more seed testing laboratories. It is my understanding that there is a central seed testing laboratory at Yezin. I did not get a chance to visit it nor was any specific information on the laboratory provided despite my asking for it.

Seed testing services are essential to the good and successful development of the seed component of the project. If an adequate seed testing laboratory is not available, or if it is determined that a laboratory needs to be established within the project, we can layout the size and arrangement of a suitable lab, and specify the equipment and supplies needed. A ball park estimate of the cost of equipment and initial supplies for a testing lab of the size needed for the project would be about $30,000 to $35,000 (excluding building and furniture).

Equipment and Facilities not Specified

The equipment lists in the following sections are long. It should be emphasized, however, that much more additional equipment, which has not been specified, will be needed to develop and operate the four seed farms. We have focussed entirely on seed operational equipment, which is in the area of our expertise and experience. Equipment not specified but which will be needed, should be specified by a farm development and operations persons, the irrigation and drainage specialist, and the MUCIA team include: land leveling and forming equipment; land preparation, cultivating, planting, fertilization, and plant protection equipment; irrigation pumps and piping; cars, trucks, vans; office

furniture and equipment; general shop tools and supplies.

Facilities not specified include offices and conference rooms, equipment sheds, general storage (pesticides, fertilizer, spare parts, etc.). We will prepare a supplemental layout for a small office/conference room/lab building for each center and send later, as well as a layout for a small storehouse for spare parts for seed related equipment which should be carefully inventoried and kept in secure storage.

Note on Equipment not Specified

Some of the equipment not specified includes items essential for some of the seed related equipment specified, e.g., tractors to power PTO operated pull-type harvesters, to pull wagonbed dryers, grain carts, etc. These are indicated below as a "remainder."

Tractors

At least two 50-60 h.p. tractors with hydraulics and PTO are needed to power and pull groundnut diggers and corn pickers at Chaungmagyi-Sebin and Kyaungsu. At least one large 70-90 h.p. tractor is needed to power and pull the groundnut combines at C/S and two at Kyaungsu. Additional small tractors would be needed to pull wagonbed dryers, and grain carts. The Thitcho farm would need at least two small 50-60 h.p. tractors and four 70-90 h.p. tractors just to pull the diggers, groundnut combines, and 2-row corn pickers. Additional small tractors would be needed to pull wagonbed dryers, grain carts, etc. These tractors would of course also be used for the other farm operations such as land preparation, cultivation, planting, etc. It must be kept in mind, however, that a tractor can't be pulling a peanut combine, and breaking

land at the same time. Very likely some of the Agricultural Equipment Corporation for-hire tractors will have to be used during the harvest season.

Trucks and Cars

Every center needs at least one (Thitcho 2) large standard hauling trucks just to haul things around. Distribution of seed from the seed centers would have to be done by commerical or government trucking. Every seed center also needs at least one (Thitcho 2) pick-up type trucks with 4-wheel drive. And, one car or van-type vehicle would also be needed at each center. These are minimum requirements.

Summary of Equipment and Facilities Recommended and Estimated Capacities

The facilities recommended in Section IV, and equipment specified in Sections VI, VII, VIII, and IX are summarized for each seed center along with estimated capacities in Tables 8, 9, and 10.

Table 9. Summary of major facilities and equipment specified for the Chaungmagyi-Sebin seed farms and estimated capacities. (Projected acres and yields are: maize - 100A, 8000 ba; groundnuts - 250A, 20,000 ba; sunflower - 150 A, 7500 ba; Sesame - 100 A, 2000 ba. in the Monsoon season).

Operation	Equipment/Facilities Specified	Estimated Capacities			
		Hour	Day 1/	Season 2/	% 3/
Harvesting					
- Maize	1 - one row picker husker	1 A	7 A	160 A	160
	1 - sheller	150 ba.	1200 ba	24,000 ba	300
- Groundnuts	1 - two row digger shaker	2 A	16 A	320 A	128
	1 - groundnut combine	1.5 A	12 A	240 A	96
- Sunflower	No special provisions				
- Sesame					
Drying					
- Maize	1 - three bin drying system	N/A	700 ba	14,000 ba	175
- Groundnuts	1 - 4 wagon drying bed unit	N/A	800 ba	16,000 ba	80
- Sunflower	Drying floors (4) and wagons when not needed for groundnuts	Cannot be estimated			
- Sesame					
Processing					
- Maize & Sunflower & Sesame	One end (half) of Type A processing plant	75 ba	600	18,000 ba	100 +
- Groundnuts	One end (half) of Type A processing plant	180 ba	1440 ba	43,000 ba	215
Storage					
- Ventilated	Godown	One 140 x 50 x 14 ft. godowns, 33,000 ba.			
- Conditioned	Storeroom	Two 40 x 40 x 12 ft. rooms, 12,000 ba.			

1/ Day is taken as 8 hours for all operations save drying which is round-the-clock or 24 hrs/day. Storage, of course, is also a "24 hour" operation.

2/ A season for harvesting and drying is taken as 20 days; for processing - 30 days; for storage up to 6-8 months.

3/ Capacity as percentage of total capacity required based on acreage and yield projections. The shortfall in groundnut drying capacity can be made up with surplus in maize drying system.

Table 9. Summary of facilities and equipment specified for the Kyaungsu seed farm and estimated capacities. (Projected acres and yields are: maize - 100 A, 8000 ba; groundnuts - 600 A, 48,000 ba; sunflower - 100 A, 5000 ba; in the winter season).

Operation	Equipment/Facilities Specified	Estimated Capacities			
		Hour	Day 1/	Season 2/	% 3/
Harvesting					
- Maize	1 - one row picker husker	1 A	8 A	160 A	160
	1 - sheller	150 ba	1200 ba	24,000 ba	300
- Groundnuts	2 - two row digger shakers	4 A	32 A	640 A	107
	2 - groundnut combines	3A	24 A	480 A	80
- Sunflower	No special provisions				
Drying					
- Maize	1 - three bin drying system	N/A	700 ba	14,000 ba	175
- Groundnuts	2 - four wagon bed drying systems	N/A	2000 ba	40,000 ba	83
- Sunflower	Drying floors (4), and unused wagon bed dryer capacity				
Processing					
- Maize and Sunflower	One end (half) of Type A processing plant	75 ba	600	18,000 ba	138
- Groundnuts	One end (half) of Type A processing plant	180 ba	1440 ba	43,000 ba	89
Storage					
- Ventilated	Godown	One 140 x 50 x 14 ft. godowns, 33,000 ba.			
- Conditioned	Storeroom	Three 40 x 40 x 12 ft. rooms, 18,000 ba.			

1/ Day for all operations save drying = 8 hours; drying (and storage) day = 24 hours.

2/ Season for harvesting and drying = 20 days; for processing, 30 days; for storage, up to 6-8 hours.

3/ Capacity as percentage of total capacity required based on acreage and yield projections. Short fall in groundnut threshing to be taken up by hand threshing; short fall in groundnut drying can be made up with surplus from maize drying; short fall in groundnut processing can be made up by increasing the processing period, or double shifting for a week or so.

Table 10. Summary of major facilities and equipment specified for the Thitcho seed farm and estimated capacities. (Projected acres and yields are: maize - 1500 A, 120,000 ba; groundnuts - 800 A, 64,000 ba; sunflower - 50 A, 2500 ba; sesame - 100 A, 2000 ba; in the Monsoon season.

Operation	Equipment/Facilities Specified	Estimated Capacities			
		Hour	Day 1/	Season 2/	% 3/
Harvesting					
- Maize	2 - two row picker huskers	4 A	32 A	800 A	53
	2 - shellers	400 ba	3,200 ba	80,000 ba	67
- Groundnuts	2 - digger shakers	4 A	32 A	800 A	100
	2 - groundnut combines	3 A	24 A	600 A	75
- Sunflower & Sesame	No special provisions				
Drying					
- Maize	1 - 4 x 2 bin drying system	N/A	2,000 ba	50,000	42
- Groundnuts	3 - 4 wagon bed dryer systems	N/A	3,000	75,000	117
- Sunflower & sesame	Drying floors (8), and unused wagon bed dryer capacity				
Processing					
- Maize	1 - Type C processing plant	200 ba	1,600 ba	64,000 ba	53
- Groundnuts	1 - Type B processing plant	180 ba	1,440 ba	58,000 ba	
Storage					
- Ventilated	Godown	Two 140 x 50 x 14 ft. godowns, 66,000 ba.			
- Conditioned	Storeroom	Four 40 x 40 x 12 ft. rooms, 24,000 ba.			

1/ Day for all operations save drying = 8 hours; drying (and storage) day = 24 hours

2/ Season for harvesting and drying = 25 days (5 days longer than at other centers); for processing, 40 days (10 days longer); for storage, up to 8 months.

3/ Capacity as percentage of total capacity required based on acreage and yield projections. Short fall in maize and groundnut harvesting to be taken up by hand harvesting (maize shelling by double-shifting); shortfalls in maize drying and processing can be made up by adding a second 4 x 2 bin drying system with sheller and a second Type C processing plant as the need becomes clear; short fall in groundnuts processing can be made up by double shifting.

VI.

Description and Specifications for Equipment and Accessories Recommended for Harvesting Maize and Groundnut Seed

Item No.	Description/Specifications	No. Required & Location 1/
	Groundnut Harvesting	
1H	Peanut Windrowing Digger Shaker; two row type adjustable for row width 30 to 36 in.; dug peanuts placed in one row; with quick remove plow to permit fluffing or re-shaking; wide reversible swept back shares with can be inverted to increase share life; adjustable guage wheels for easier draft and accurate depth control; conveyor of dropped bar design with idlers to permit adjustment of conveyor chain for either wet or dry conditions; windrow slides adjustable for gentle transfer of vines from conveyor to the ground and assist in soil removal and proper windrowing; frames and conveyor bars constructed of special high tensile carbon steel. Digger shaker capable of operating at ground speed 4 to 6 km/hr from PTO of 35 h.p. tractor with PTO shaft at 540 RPM. Spare parts selected by manufacturer not to exceed $250 per unit. Brand Name: Hobbs Model 663 Peanut Digger Shaker Supplier: Hobbs-Adams Eng. Co., Mercator Est. Cost Per Unit (FOB): $3200 Est. Total Cost (FOB): $16,000	5 (1-C/S) (2-K) (2-T)
2H	Peanut Combine; for combining peanuts in windrows up to 25% moisture; low profile header for gentle lifting action with rolled header ban edges; automatic picking control which senses and adjusts for variation normally encountered in windrows once the combine has been set for the type and condition of the peanuts to be harvested; overhead picking with large slow speed cyclinders; variable concave for adjusting for "dry" or "wet" harvesting conditions; self-aligning stemmer saws; balanced sectional straw rack; 33 sq. ft. of dirt screens; quality air system; with breast springs and long reach bin of 120 cu. ft. capacity for easy unloading into drying wagons; wheels 24 x 8 steel disc; tires 900 x 24 6 ply rib implement. Combine operable in pick-up mode from PTO of 60 to 80 h.p. tractor at 540 RPM with harvesting capacity 1½ - 2 A per hour; also capable of operation as a stationary thresher with lower tractor power; spare parts to be	5 (1-C/S) (2-K) (2-T)

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	selected by manufacturer but not to exceed $750. Brand Name: Hobbs Model 525 Peanut Combine Supplier: Hobbs Adams Eng. Co., Mercator Est. Cost Per Unit (FOB): $18,000 Est. Total Cost (FOB): $90,000	
	Maize Harvesting	
3H	Corn Picker and Husker; two row pull type for rows 36 to 44 in; 3.73 ft. snapping rolls; 6 gathering chains; standard beaters and trash rolls; picker to be supplied with 12 roll husking unit, 3.77 ft., 6 tire carcass and 6 cast iron; cleaning fan; ear deflector; elevator for lifting husked ears into trailing wagon; slat type "corn saver" with louvered screen, finger grate and husk agitator drum; wheels 24 inch DCR with 7.50 - 24 4-ply ribbed implement tires; units operable on tractor PTO drive at 540 RPM; Complete with: a) beater attachment, hydraulic lift cylinders and brackets, mud scraper, stalk guide bundle and hitch jack on picker unit. b) adapter for husking unit for gathering unit; jacks and stands for husking unit and hitch for trailer c) spare parts to be selected by manufacturer not to exceed $600 Brand Name: Avco New Idea, Model Nos. 324 Picker Model No. 327 Husking Unit Supplier: Avco New Idea, OPICO Est. Cost Per Unit (FOB): $14,500 Est. Total Cost (FOB): $29,000 Note: Picker-husking unit also available for narrow rows (28 to 36 in.); row width to be used in Burma must be considered	2 (2-T)
4H	Corn Picker and Husker: Same general description as item #3H except:	2 (1-C/S) (1-K)

	- picker to be one (1) pull type with matched 6 roll husking bed with wagon elevator; 7.50-20, 4 ply, rib implement tires; beater attachment hydraulic lift cylinder with brackets; weed shield; spare parts to be selected by manufacturer not to exceed $500 Brand Name/Supplier: Same as #3H Est. Cost Per Unit (FOB): $7500 Est. Total Cost (FOB): $15,000	
	General Harvesting/Drying	
5H	Grain Trailer or Cart; for gathering and transporting ear corn, peanuts-in-shell, threshed grain; all metal bodies; 4-wheel type; low profile type; unloading door at rear; capacity of 150-200 bu; bed approximately 10 ft. long x 8 ft. wide x 4 ft. deep. Brand Name and Supplier: Many available Est. Cost Per Unit (FOB): $1800 Est. Total Cost (FOB): $18,000	10 (3-C/S) (3-K) (4-T)
	TOTAL (FOB): $168,000	

1/ Total no. of items needed; number followed by letter indicates seed center for which items are intended, e.g., (2-K) means two of items for Kyaungsu; C/S = Chaungmagyi-Sebin; T = Thitcho.

VII.

Description and Specifications for
Equipment and Supplies Recommended for Seed Drying
and Maize Shelling and Bulk Storage

Item No.	Description/Specifications	No. Required & Location 1/
	Wagon Bed (4) Drying System	
1D	Heater-Fan Drying Unit for Seed; heater to be diesel oil burner modified to deliver 300,000 BTU/hr; blower to be centrifugal type capable of delivering 17,000-18,000 CFM air volume at a static pressure of one (1) inch water guage; unit to be with standard controls and safety devices but with humidistat control to maintain the relative humidity of the drying air above 50% (peanut drying) and high limit thermostat to maintain temperature below 100F; stemmed thermometer; all necessary electric starters and mechanical drive components; electric motor to be sized to meet CFM specs (about 7½ h.p.) and operable on 230V, 50 hz., 3 phase current. Counter clockwise unit. Unit with: a) magnetic starter (for fan) b) transition with entrance collar c) extra nozzle sets of sizes: 0.70, 0.75, 0.80, 0.85, 1.50. d) spare parts to be selected by manufacturer on basis of experience but not to exceed $400 per unit Brand Name: American Drying Systems, Model 1215* Supplier: American Drying Systems, Sukup Mfg. Co., Mercator, Manring** Est. Cost Per Unit (FOB): $10,000 Est. Total Cost (FOB): $60,000	6 (1-C/S) (2-K) (3-T)
2D	Drying Trailer or Wagon for Groundnut (Peanut) Drying: Trailer to be 14 ft. long x 8 ft. wide x 5 ft. depth (4 ft. drying depth); with true towing, 8 ton running gear, double axle, 10 ft. wheel base 9.5 L x 15, 8 ply farm implement tires; ball bearing 5th wheel; drying bed to be of 16 guage heavy metal, all welded	24 (4-C/S) (8-K) (12-T)

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construction with 16 guage floor with cross braced tenances to support the 16 guage perforated floor and the load; rocking bolster for uneven terrain; clean out doors; rear end unloading gate; drying air intake port at rear of wagon; trailer to be complete with tires and tongue hitch to running gear for towing.

Accessories as follows:

a) two (2) standard flexible "connector" to connect drying wagon air intake to heater-blower unit with "frame" to "seat" connector in wagon intake port and an identical frame at opposite end to connect to air outlet port in plenum from a central heater-blower unit. (2 connectors per wagon, one for spare)

b) ball bearing "5th wheel" for easy trailing, and reduced friction turning.

Brand Name: Peerless All Crop Dryer, 14 feet length

Supplier: Peerless Manufacturing Co., Mercator, Manring

Estimated Cost Per Unit (FOB): $2100

Estimated Total Cost (FOB): $50,400

3D Conveyor, Flighted Drag Belt Portable Type; for ear corn, peanuts-in-shell, grain, portable; aluminum construction; 20 ft. length; conveying by belt fitted with neoprene flights (1 in.) at 12 in. spacing; conveying belt 6-inch, 3 ply with replaceable wear strips at edge; belt driven by corded rubber head pulley at 480 FPM; take-up adjustment for belt at foot shaft; driven by two V-belt pulleys; loading hopper at intake. Complete with: 4 (1-C/S) (1-K) (2-T)

a) electric motor, drives and belts operable on 230 volt, 50 hz, 1 phase current; motor to be top mounted.

b) "dolly" carriage with wheels (2) with 4.00 x 8.00 pneumatic tires and adjustable inclination

c) spare parts as recommended by manufacturer (to include replaceable wear strips for conveying belt, and V-belts) not to exceed $75 per unit.

Brand Name: Burrows Series 2500 Portable Aluminum Conveyor

	Supplier: Seedburo Est. Cost Per Unit (FOB): $1,800 Est. Total Cost (FOB): $7,200	
4D	Bagging Scale: semi-automatic; complete with: bag tare device; flow control inlet gate; calibrated weight-beam; graduate over-under indicator; weight range, 25-140 lb.; quick bag release and mounting attachment for mounting unit to bagging bin with 8-inch (20 cm) discharge outlet; capacity of seven 50 lb. bags/minute. Brand Name: Howe Richardson Model G17 Supplier: Howe Richardson, Mercator, Manring Est. Cost Per Unit (FOB): $2,000 Est. Total Cost (FOB): $8,000	4 (1-C/S) (1-K) (2-T)
	3-Bin Drying System	
5D	Heater-Fan Drying Unit for Seed; heater to be diesel oil burner modified to deliver 400,000 BTU/hr; blower to be centrifugal type capable of delivering 17,000-18,000 CFM air volume at a static pressure of one (1) inch water guage; standard controls and safety devices; thermostatic control to maintain drying air temperature below 110F (for ear corn); all necessary electric starters and mechanical drive components; electric motor to be size to meet CFM specs (about 7½ h.p.) and operable on 230 volt, 50 hz, 3 phase current. Counter clockwise unit with: a) magnetic starter (for fan) b) transition with entrance collar c) extra nozzle sets of sizes: 0.70, 0.75, 0.80, 0.85, 1.50 d) spare parts to be selected by manufacturer on basis of experience but not to exceed $400 per unit. Note: This unit is similar to Item #1D except thermostatic rather than humidistatic control and higher BTU/hr. is specified)	2 (1-C/S) (1-K)

	Brand Name: See Item 1D Supplier: See Item 1D Est. Cost Per Unit (FOB): $10,000 Est. Total Cost (FOB): $20,000	
6D	Conveyor, Flighted Drag Belt, Portable Type: identical to Item #3D except conveyor to be: 24 feet in length; and without dolly carriage (letter b option); electric motor to be properly sized for 24 ft. length; brand name and supplier same as Item #3D. Est. Cost Per Unit (FOB): $1,600 Est. Total Cost (FOB): $4,800	3 (1-C/S) (1-K) (1 extra)
7D	Conveyor Flighted Drag Belt, Portable Type: identical to Item #3D; same brand name, supplier and est. unit cost. Est. Total Cost (FOB): $10,800	6 (2-C/S) (2-K) (2-T)
8D	Trough Belt Conveyor (for ear corn); 52 ft. long; 14 inch wide belt of 4 ply nylon rubber coated with friction surface backing; trough pan and side structure of 18 guage steel; 13 guage tubular steel top rails with matching male/female connections between sections for quick installation; belt tension adjustment; depth of conveyor from top of rail to bottom of return belt not to exceed 10 inches except at discharge assembly end; drive with gear reducer; with electric motor of required size operable on 230 volt, 50 hz, 3 phase electric current, motor mount and drives. Capacity of conveyor to be minimum of 1500 BPH Brand Name: Equipment Specialists, Inc. Trough Belt Conveyor Supplier: Equipment Specialists, Inc., Mercator, Manring Est. Cost Per Unit (FOB): $3700 Est. Total Cost (FOB): $7400	2 (1-C/S) (1-K)
9D	Corn Sheller; sheller to be suitable for seed corn; speed of operation to be 520 RPM (modified to this	2 (1-C/S)

	level for seed corn); cob fan activated by main shaft; to be capable of discharging cobs through long sweep elbow and approx. 10 ft. of horizonal pipe; replaceable cylinder lugs; easily removed hopper side plate; full length aspiration; fully accessible screen; low hopper height. Complete with: a) long sweep elbow and 10 ft. of cob blowing pipe b) drive, electric motor, and stop/start control operable on 230 volt, 50 hz, 3 phase current c) replacement parts selected by manufacturer not to exceed $400 Brand Name: Ehrsam Triumph Corn Sheller, Model 3C Supplier: C. E. Raymond Combustion Engineering, Mercator, Manring Est. Cost Per Unit (FOB): $6000 Est. Total Cost (FOB): $12,000	(1-K)
	4 X 2 Bin Drying System	
10D	Heater-Fan Drying Unit for Seed; general description and specifications same as Item #5D except: - diesel oil burner to be modified to deliver 800,000 BTU/hr. - fan or blower to be capable of delivering 24,000 CFM air volume at one (1) inch static pressure (motor about 10 h.p.) One unit clockwise; 2nd counter clockwise - same letter numbered accesories as Item #5D Brand Name: American Drying Systems Model 1220 Supplier: See Item #1D Est. Cost Per Unit (FOB): $12,000 Est. Total Cost (FOB): $24,000	2 (2-T)
11D	Trough Belt Conveyor (for ear corn); same as Item #8D except: - conveyor to be 70 ft. long - motor and drive to be sized for 70 ft. length.	2 2/ (2-T)

	Brand Name/Supplier: See Item #9D Est. Cost Per Unit (FOB): $4500 Est. Total Cost (FOB): $9000	
12D	Trough Belt Conveyor (for ear corn); same as Item # 8D except: - belt 18 inches wide - conveyor to be 56 ft. long - motor sized for width & length and: - conveyor to be provided with six (6) plow-off sections and scraper bars for unloading belt off side; plow off sections to be located as per attached sketch. Brand Name/Supplier: See Item #8D Est. Cost Per Unit (FOB): $6000 (Total Same)	1 (1-T)
13D	Trough Belt Conveyor (for ear corn); same as Item #8D except: - conveyor length to be 38 ft. - motor sized for belt width and length (38 ft.). - 10 feet of weather cover, discharge end of conveyor Brand Name/Supplier: See Item #8D Est. Cost Per Unit (FOB): $3200 (Total Same)	1 (1-T)
14D	Trough Belt Conveyor (for ear corn); same as Item #8D except: - conveyor length to be 68 ft. - weather cover to be provided for entire length of conveyor; motor sized for length Brand Name/Supplier: See Item #8D	1 (1-T)

	Est. Cost Per Unit (FOB): $5000 (Total Same)	
15D	Trough Belt Conveyor (for ear corn); same as Item #8D except: - conveyor to be 20 ft. long - motor to be sized for length - weather cover to be provided for 16 ft. from intake end Brand Name/Supplier: Same as Item #8D Est. Cost Per Unit (FOB): $2000 (Total Same)	1 (1-T)
16D	Trough Belt Conveyor (for ear corn). General description and specifications same as Item #8D except: - conveyor to be 35 ft. long - belt width to be 18 inches and of type for operation of conveyor in an inclined position; notched flight 3-inch on 16-inch centers. - hopper for intake end - electric motor and drive sized for inclined operation and belt width/length Brand Name/Supplier: Same as Item #8D Est. Cost Per Unit (FOB): $3600 (Total Same)	1 (1-T)
17D	Trough Belt Conveyor (for ear corn); general description and specifications same as Item #8D except: - conveyor to be 10 ft. long - belt width to be 18 inches (not flighted) - electric motor to be sized for length and width of belt Brand Name/Supplier: Same as Item #8D Est. Cost Per Unit (FOB): $1800 (Total same)	1 (1-T)
18D	Corn Sheller; specifications identical to Item #9D Brand Name/Supplier: Same as Item #9D	2 (2-T)

	Est. Cost Per Unit (FOB): $6,000 Est. Total Cost (FOB): $12,000	
19D	Bulk Grain Tank, Hopper Bottom, Center Draw; 15 ft. diameter tank with 45° hopper, center draw; overall height 22 ft, 11 in with 1700 bu capacity; heavy guage galvanized roof segments fabricated and punched for tight fit-up and seal with center-fill (21 inch) manhole, roof ladder; sidewalls of corrugated, heavy guage galvanized metal, curved to fit in perfect circle; vertical seams with double row of bolt holes for added strength and tighter laps; hopper section true cone, center draw, 45°; of heavy guage galvanized metal, fabricated and rolled for tight fit-up and smooth load-out; 14 in. bottom opening; heavy angle legs with angle braces position to permit passage of 18 inch horizonal belt conveyor under bin (and other bins in line); complete with: a) standard size hinged manhole in roof section b) side ladder c) rack and pinion slide assembly to control rate of load-out from 14 inch diameter bottom discharge d) all bolts, nuts, steel backed neoprene washers, sealants and caulks, anchor bolts for assembly with instructions for erection Brand Name: Trico Colombian Model No. C-15-3 Supplier: Trico Industries, Inc. Colombian Division, Mercator, Manring Est. Cost Per Unit (FOB): $7,000 Est. Total Cost (FOB): $14,000	2 3/ (2-T)
20D	Elevator, Belt-Bucket Type (out-door type of seed); 42 ft (12.8M) discharge height; 1000 bu./hr. capacity (shelled corn) at 140 FPM belt speed. Head shaft speed to be 60 RPM; buckets to be 9-inch x 5½ inch with 6-inch spacing; standard belt to be 10-inch wide, PVC, woven polyester, 300 lbs. P.I.W. with prepunched holes. Head casing, boot casing and legging to be all metal of 14 guage steel; legging twin-column type; space occupied by boot and standard hopper to be 18-inch x 35-inch; top hopper (up-leg) to	1 (1-T)

be 43 inches above base of elevator. Elevator to have standard features as follows: only industrial quality sealed bearings used; heavy cast iron pulleys with vulcanzied rubber on head pulley; all components machined, welded and fabricated with production line jig features to assure accuracy, uniformity and quality; all fasteners plated to resist corrosion; complete line of stock assemblies available. Elevator complete with required belting, buckets, splicing, assembly hardware and:

a) dump hopper with shut-off slide and hopper cover

b) three-way valve (8 inch) with adapter and transition

c) 3 - C.I. adjustable elbows (8-inch) with six (6) clamp rings

d) 8 - ten foot sections of 8 inch, 12 guage rigid spouting flanged both ends with eight loose 8-inch flanges, and bolts/nuts for asembly of spouting

e) 200 ft. galvanized preformed aircraft cable with 20 5/16-inch clamps

f) service platform with service ladder sized to elevator

g) weather and dust sealing for out-door installation, with 6 cartridges mastic

h) start-stop push button control station

i) drive and motor operable on 230 volt, 50 hz, 1 phase electric power (outdoor use)

j) weather resistant paint for outdoor installation

k) replacement parts to be selected by manufacturer not to exceed $100

Brand Name: Universal Industries Model D-1000 ED

Supplier: Universal Industries, Mercator, Manring

Est. Cost Per Unit (FOB): $6,800
(Total Same)

Drying Accessories

21D	Perforated Metal Panels (corrugated): for installation as "drying" floor in grain drying system; panels 32 in. wide x 8 ft. 6 in. long, 20 guage. Brand Name: Modern Farm Systems Supplier: Modern Farm System, Mercator, Manring Est. Cost Per Unit (Panel) (FOB): $42.00 Est. Total Cost (FOB): $6,636	158 4/ (34-C/S) (34-K) (90-T)
22D	Diesel Fuel Tank; with stand, filter and lines; for holding diesel oil used by drying units. These tanks should be procured locally if at all possible. The following are needed: Chaungmagyi/Sebin -- two (2) 2000 gal. tanks: one for 3-bin drying unit and one for wagon drying unit. Kyaungsu -- three (3) 2000 gal. tanks: one for 3 bin dryer, and one each for two wagon bed drying Thitcho -- five (5) 2000 gal. tanks; two for 4 x 2 bin system, and three for three wagon drying system.	
23D	Dial Thermometer; bimetallic type; stainless steel; recalibrator type; 3 in. dial; 12 inch stem; "straight" type with face of dial at right angle to stem; range 25 to 125F. Brand Name: Seedburo No. 3000R Supplier: Seedburo, Mercator, Manring Est. Cost Per Unit (FOB): $40 Est. Total Cost (FOB): $680	17 (4-C/S) (5-K) (8-T)

TOTAL OF EQUIPMENT COSTED: $275,316

Notes on Drying Equipment Specifications

1/ Total number of items needed; numbers followed by letters indicate seed centers for which items are intended, e.g., (2K) means two of the items for Kyaungsu; C/S = Chaungmagyi/Sebin; T = Thitcho.

2/ A "lot" of trough belt conveyors are used. These are costly but the volume of seed handled into and out of the dryers, into and out of the sheller, etc. preclude hand handling. Bins must be loaded and unloaded fast to ready them for new load of maize; similarly, the seed have to be shelled rapidly and shelled seed sent to large holding bins, processing, or to warehouse for temporary storage before processing. Use of hand labor in these handling operations would reduce capacity of drying system by 50% and of processing plant by nearly 2/3.

3/ We tried to get away from using these bins, but couldn't. They are needed to take up surplus of shelling capacity (400 ha./hr.) over processing capacity (200 ba./hr.), and to provide a good "head" of shelled maize for maximum processing efficiency. The elevator item #20D is the only good way to feed the two bulk storage bins.

4/ These perforated metal panels are needed for the "drying" floors of the 3 and 4 x 2 bin units. The size of the panels of the successful bidder will determine the exact spacing of the floor framing shown in sheet 7 of the drawings. The panels need to be adequately supported.

VIII.

Description and Specifications for
Equipment and Supplies Recommended for Seed Processing

Item No.	Description/Specifications	No. Required & Location 1/
	Groundnut (Peanut) Processing (All Farms)	
1P	Farmer Stock Peanut Cleaner equipped with deck screen to handle Valencia and Virginia Bunch type peanuts-in-shell. Cleaner to be equipped with systems to separate following material from peanuts-in-shell: taproots, stems, hulls, pops, other low density material, dirt, gravel, loose shelled kernels, and other material smaller than peanuts-in-shell. Cleaner equipped with flow feeder, stoner, dual aspirator fans, variable speed top belt kit. Complete with all drives and 3HP electric motor for 230 volt, 50 hz., 1 phase electric power. Spare parts to be selected by supplier but not to exceed $600 per machine. Brand Name: 2/ Model 488 Heavy Duty Peanut Cleaner * Hobbs-Adams Engineering Supplier: 3/ Hobbs-Adams Engineering ** Est. Cost Per Unit: $9,000 Est. Total Cost: $27,000	3 2/ (1-K) (1-C/S) (1-T)
2P	Elevator, Belt-Bucket Type; 31 ft. (9.5 M) discharge height; 1000 bu./hr. capacity (1,250 cu. ft./hr. at 75% bucket filling) at 140 FPM belt speed. Head shaft speed to be 60 RPM. Buckets to be 9-inch X 5½-inch; bucket spacing to be 6-inch. Standard belt to be 10-inch wide, 3 PVC, woven polyester, 300 lbs, P.I.W. with pre-punch holes. Head casing, boot casing and legging to be all metal construction of 14 guage steel. Legging to be twin column. Space occupied by boot and standard hopper to be 18-inch X 35-inch. Top of dump hopper (up-leg) to be 43 inches above base of elevator. Elevator to have standard features as follows: only industrial quality sealed ball bearings used; heavy cast iron pulleys; vulcanized rubber lagging on head pulleys; all components machined, welded and fabricated with production line jig features to assure accuracy, uniformity and quality; all fasteners plated to resist corrosion; complete line of stock assembles available.	3 (1-K) (1-C/S) (1-T)

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	Complete with required belting, buckets, splicing, assembly hardware and: a) dump hopper with shut-off slide b) C.I. adjustable elbow, 8-inch with clamp rings c) one (1) connector, 8 in., with adapter to fit elevator discharge to spouting d) two (2) 10 ft. sections of 8-inch rigid metal spouting (12 guage) e) four (4) 8-inch clamp rings f) four (4) 8-inch loose flanges g) bottom boot cleanout with 4-inch legs h) cup spacers (washer type) i) start-stop push button control station j) drive and motor operable on 230 volt, 50 hz, 1 phase electric power k) replacement parts to be selected by supplier but not to exceed $100 per elevator Brand Name: Model D-1000 ED Universal Industries Supplier: Universal Industries Mercator, Manring Est. Cost Per Unit: $4,200 Est. Total Cost: $12,600	
3P	Elevator, Belt-Bucket Type; Same general specifications as Item #2P but: 24 ft. (7.25 M) discharge height; and following substituted for lettered options and accessories a) dump hopper with shut-off slide b) C.I. adjustable elbow, 8-inch, with clamp rings. c) one (1) connector, 8 in. with adapter to fit elevator discharge to spouting d) four (4) 8-inch clamp rings e) two (2) 10 ft. sections of 8-inch rigid metal spouting (12 guage) f) eight (8) 8-inch loose flanges for 8-inch spouting with bolts	6 (2-K) (2-C/S) (2-T)

	g) start-stop push button control station h) drive and motor operable on 230 volt, 50 hz., 1 phase electric power i) replacement parts to be selected by manufacturer not to exceed $100 Brand Name: Model D-1000 ED Universal Industries Supplier: Universal Industries, Mercator, Manring Est. Cost Per Unit (FOB): $3,800 Est. Total Cost (FOB): $22,800	
4P	Gravity Table Seed Separator, retangular deck 42 inches X 90 inches; multiple fans located under deck separately adjustable for air volume/pressure; equipped with Type A deck (deck covered with large mesh wire cloth for separation of large seed such as groundnuts in shell separation. Dimensions: 102 in. length X 51½ in. width X 54 in. (variable) height. Complete with: a) right hand discharge on separator b) drive and motor of required horsepower for separator operable on 230 volt, 50 hz, 3 phase electric power c) start-stop push button control station d) replacement parts to be selected by supplier but not to exceed $400 e) aspirating feeder with fan and electric motor for dust control Brand Name: Oliver Hi-Cap Model 160 Supplier: Oliver Mfg. Co., Mercator, Manring Est. Cost Per Unit (FOB): $12,000 Est. Total Cost (FOB): $36,000	3 3/ (1-K) (1-C/S) (1-T)
5P	Bagging-Scale, semi-automatic; complete with: bag tare device; flow control inlet gate; calibrated weight-beam; graduated over-under indicator; weight range, 25-140 lb. (or equivalent in kgs.); quick bag release and mounting attachment for mounting unit to	4 (1-K) (1-C/S) (1-T) (1-Spare)

	underside of metal bin equipped with 8-inch (20 cm) discharge outlet; capacity seven 22 kg bags/min. Brand Name: Howe Richardson Model G17 Supplier: Howe Richardson, Mercator, Manring Est. Cost Per Unit (FOB): $2,000 Est. Total Cost (FOB): $8,000	
6P	Bag Closer (sewing-head type); portable heavy duty, 401 stitch type; closer to be operable on 230 volt, 50 hz., 1 phase current; complete with: (for sewing heavy burlap, paper and woven plastic bags a) counter-weight suspension balance for closer b) 10 cases (32 cones/case) of 8 oz. cones 12/4 cotton sewing twine c) 3 gallons of cleaning lubricant d) 3 gallons of thread lubricant e) 8 quarts lubricating oil f) 5 packages of needles (25/package) for bag closer g) spare parts to be selected by supplier not to exceed $50 per unit Brand Name: Union Special 2100 Supplier: Seedbruo, Mercator, Manring Est. Cost Per Unit (FOB): $1,000 Est. Total Cost (FOB): $6,000	6 (2-K) (2-C/S) (2-T)
7P	Conveyor, Flighted Drag-Belt Portable Type; for ear corn, peanuts-in-shell, grain; portable; aluminum construction; 20 ft. length; conveying by belt fitted neoprene flights (1 in.) at 12 in. spacing; conveying belt 6-inch, 3 ply with replacable wear strips at edge; belt driven by corded rubber head pulley at 480 FPM; take-up adjustment for belt at foot shaft; operational at up to 45° inclination; drive by two V-belt pulleys; loading hopper at intake. Complete with: a) electric motor, drives and belts operable on 230 volt, 50 hz., 1 phase current. Motor to be top-mounted.	3 4/ (1-K) (1-C/S) (1-T)

	b) "dolly" carriage with wheels (2) with 4.00 X 8.00 pneumatic tires for adjustable inclination. c) spare parts as recommended by supplier (to include replaceable wear strips for conveying belt, and V-belts) not to include $75 per unit. Brand Name: Burrows Series 2500 Portable Aluminum Belt Conveyor Supplier: Seedburo Est. Cost Per Unit (FOB): $1,800 Est. Total Cost (FOB): $5,400	
8P	Conveyor, Flighted Drag Belt Portable Type; Same specifications as Item #7P but without 2-wheel dolly adjustable carriage. Est. Cost Per Unit (FOB): $1,600 Est. Total Cost (FOB): $4,800	3 (1-K) (1-C/S) (1-T)
	Other Seed Kinds Processing	
9P	Air and Screen Seed Cleaner; three screen type with two independent air separation systems (top and bottom air); two "shoes" with counter-balanced opposed "shake" for vibration free operation; screen frame size to be 42 in. wide X 60 in. long; synchronized brush system; dual brushes on two tracks for positive screen cleaning action; capacity 2 to 2½ T per hour for maize seed. Complete with: a) type A roll feed hopper b) steel sub-frame to raise machine base 39 in. (1 M) above floor level with roll-out platform c) heavy duty vibrating discharge conveyor complete with motor and mountings to discharge on left hand side d) waste product discharge outlets on right side equipped with discharge chutes, bag hangers and complete mounting assemblies e) electric motor, mounting and main drive required for machine operable on 230 volt,	2 5/ (1-K) (1-C/S)

	50 hz., 3 phase electric current f) magnetic starter and push button start/stop control for motor g) screen tappers for all screens h) safety guards for all drives i) fans mounted 45^{0} angle to rear supplied with square to round adaptors j) two (2) cyclone dust collectors matched for machine air system k) replacement parts, i.e., belts, brushes, brush drive coated wire, etc., to be selected by supplier not to exceed $600 per machine l) 24 screens, perforation types and sizes to be determined on basis of samples of maize, sunflower, sesame, soybean, and other seed kinds to be provided by purchaser. Brand Name: Crippen NW-342 Air Screen Cleaner Supplier: Crippen, Mercator, Ferrell-Ross, Manring Est. Cost Per Unit (FOB): $28,000 Est. Total Cost (FOB): $56,000	
10P	Elevator, Belt-Bucket Type; 27 ft. (8.0 M) discharge height; 175 bu. (3.5 T) per hour capacity (220 cu. ft./hr. at 75% bucket filling) at 110-125 FPM belt speed and 4½-inch bucket spacing. Buckets to be 6-X 4-inch X 18 guage steel; belting to be 6½-inch wide X 3 ply cotton FS x FS butyl with pre-punched holes). Elevator head and boot casings to be 18 guage steel and iron frame; legging to be 18 guage steel and twin column type. Space occupied by boot and standard hopper to be 12-inch X 24-inch. Elevator to have standard features as follows: only industrial quality sealed bearings used; heavy duty cast iron pulleys; vulcanized rubber lagging on head pulleys; all components machined, welded, and fabricated with production line jig features to assure accuracy, uniformity and quality; all fasteners plated to resist corrosion; complete line of stock assemblies available. Elevator to be of all metal construction, and supplied with required belting, buckets, splicing and assembling hardware and options as follows: a) dump hopper with shut-off slide b) cup spacers (washer type)	2 (1-K) (1-C/S)

	c) one (1) connector, 6 in., with adapter to fit elevator discharge d) Two (2) 10-ft. sections of 6-inch rigid metal spouting (12 guage) with loose flanges and bolts e) two (2) 6-inch adjustable elbows (metal) with clamp rings f) bottom boot cleanout with 4-inch legs g) start-stop push button control station h) drive and motor sized for elevator operable on 230 volt, 50 hz., phase electric current i) replacement parts to be selected by supplier not to exceed $75 per elevator Brand Name: Universal Industries Model C2-175 Easy Dump Supplier: Universal Industries, Mercator, Manring Est. Cost Per Unit (FOB): $2,500 Est. Total Cost (FOB): $5,000	
11P	Elevator, Belt-Bucket Type; same as Item #10P but: discharge height to be 27 ft. (8.0 M); and following substituted for lettered accessories Item 10. a) dump hopper with shut-off slide b) cup spacers (washer type) c) one (1) three-way valve (metal) 6-inch with adapter to fit elevator discharge. d) four (4) 10-ft sections of 6-inch rigid metal spouting (12 guage), with 12 loose 6-inch flange rings and bolts. e) three (3) adjustable elbows (metal) with clamp (4 clamp rings/elbow), all 6-inch f) bottom boot cleanout feature with 4-inch legs g) start-stop push button control h) drive and motor required, operable on 230 volts, 50 hz., 1 phase electric current. Brand Name: Universal Industries C2-175 Easy Dump	4 (2-K) (2-C/S)

	Suppliers: Universal Industries, Mercator, Manring Est. Cost Per Unit (FOB): $2,700 Est. Total Cost (FOB): $5,400	
12P	Elevator, Belt-Bucket Type; Identical to Item # 11P (22 ft. discharge height) except delete lettered accessory c, one (1) three-way valve, etc. Brand Name and Supplier same as Items 10 & 11. Est. Cost Per Unit (FOB): $2,600 Est. Total Cost (FOB): $10,400	2 (1-K) (1-C/S)
13P	Gravity Table Seed Separator; rectangular deck 36 in. width X 72 in. length; multiple fans located under deck, separately adjustable for air volume/pressure; equipped with Type A deck, 10 mesh with riffles for corn seed, and Type B deck, 30 mesh. Separator dimensions: 79 in. length X 45 in. width X 54 in. (variable) height. Complete with: a) right side discharge on separator b) drive and electric motor of required horsepower operable on 230 volt, 50 hz., 3 phase current c) start-stop push button control station d) aspirating feeder for dust control with fan and required electric motor (230 volt, 50 hz., 1 phase) e) replacement parts to be selected by supplier not to exceed $200 per machine Brand Name: Oliver Hi-Cap Model 80 Supplier: Oliver Mfg. Co., Mercator, Manring Est. Cost Per Unit (FOB): $10,000 Est. Total Cost (FOB): $20,000	2 6/ (1-K) (1-C/S)
14P	Seed Treater, Metered Slurry Type; for application of both liquid and wettable powder seed treatment formulations: treater to be all stainless steel construction with capacity 4-5 T per hour. Complete with: a) film coater with rods;	2 7/ (1-K) (1-C/S)

	b) thirty (30) gallon pre-mix stainless steel tank with pump head, including hose connections, and 100 ft. of hose c) variable speed control on film coater d) push button control stations as needed e) two-way bagger f) four sets chemical cups as follows - 2½ cc, 5 cc, 7½ cc, 10 cc, 15 cc, 20 cc, 30 cc, 40 cc. g) drive and electric motors required operable on 230 volt, 50 hz., 1 phase electric current h) replacement parts selected by supplier not to exceed $150 per unit. Brand Name: Gustafson S-100SS Stainless Steel Seed Treater Supplier: Mercator, Seedburo, Manring Est. Cost Per Unit (FOB): $3,500 Est. Total Cost (FOB): $7,000	
15P	Seed Bagging-Weighing-Sewing System to include: a) Automatic gross bagger with capacity for 25 to 140 lb. in open mouth bags; cam grip bag holder with easy release bar; accuracy ± 60 g; bagging capacity of six (6) 25 to 60 lb. bags/min. of either paper, textile, burlap or woven plastic bagging matieral; bagger scale with height adjustment on pedestal (Howe-Richardson G-17 or equivalent). b) sewing head, heavy duty bag closer for paper, textile, burlap or woven plastic bags; self-lubricating; sealed bearings and moving parts; two (2) to four (4) stitches per inch; Federal type 401, two-thread stitch; 1/2 horsepower sewing head motor with enclosed motor starter and take-up wheel; automatic thread cutter. (Union Special Class 80600 or equivalent) c) sewing head pedestal; height adjustable from 20.5 to 58 in. with horizonal movement to permit centering of needle over variable bag width; initiator for automatic sewing head for automatic sewing head start when impulsed by moving bag.	3 (1-K) (1-C/S) (1-T)

	d) flat belt-bag conveyor, oil resistant 12-inch width and 7 ft. 4 in. length rubber coated carrying service; self-cleaning "cage" type drive and tail pulley; speed reducer; chain drive to drive pully; bag guide adjustable horizonally and vertically back mounted; bag stop limit switch and convey or restart switch activated by foot pedal with synchronized sewing head activator e) entire system unitized, portable (on casters) with all necessary motors operable on 230 volt, 50 hz., 1 phase current. With accessories as follows: 1) Cleaning and lubricating oil for 2 yrs. operation at 100,000 bags/year 2) Thread lubricant as required for 200,000 bags (24 in. width) 3) Thread (standard bag sewing) for 250,000 24 in. wide bags. 4) Spare part kit to include needles for 2 yrs. operation or 250,000 bags. Brand Name: Howe-Richardson, Uni-Pak Bagging System Supplier: Howe-Richardson, Mercator, Manring, Seedburo Est. Cost Per Unit (FOB): $10,000 Est. Total Cost (FOB): $30,000	
	Other Seed Kinds Processing - Thitcho	
16P	Elevator, Belt-Bucket Type; Same specifications as Item 2P except: discharge height to be 34 ft. (10.4M); and add opening & dump hopper for down-leg Brand Name: Universal Industries, Model D-1000 ED Supplier: Universal Industries, Mercator, Manring Est. Cost Per Unit (FOB) $4,200 Est. Total Cost (FOB): $4,200	1 (1-T)
17P	Air and Screen Seed Cleaner; cleaner to consist of four screens in two counterbalanced "shoes" for vibration free operation (bottom or 4th screen position can be two screen lengths long for total of 5 screens); screen size to be 54 in. X 60 in. Independent upper	1 8/ (1-T)

and lower air separation systems (adjustable); synchronized brush system for cleaning screens, dual brushes carried on two tracks; adjustable "shake" to control rate of shake of "shoes"; adjustable screen pitch; selective screen arrangements possible. Capacity of 3-4 T/hour. Separator complete with options and accessories as follows:

a) type A roll feed hopper

b) steel sub-frame to raise machine base 39 in. (1 M) above floor level with roll-out platform

c) heavy duty vibrating discharge conveyor complete with required electric motor (230 volt, 50 hz., 1 phase) and mountings for discharge of clean seed on left side of machine

d) waste product discharge outlets on right side equipped with discharge chutes, bag hangers and complete mounting assemblies

e) all drives and electric motor of required size with mountings for 230 volt, 50 hz., 3 phase current

f) magnetic starter and push button start/stop station

g) screen tappers for all screens

h) safety guards for all drives

i) fans mounted 45^{0} angle to rear supplied with square to round adapters; four 45^{0} angle "round" elbows (14 in diameter)

j) 24 screens complete with tapper strips to be selected on basis of samples of maize, sunflower, sesame, and other seed kinds supplied by purchases

k) two (2) cyclone dust collectors matched for machine fans.

l) replacement parts, e.g., V-belts, brushes, brush drive coated wire, etc., to be selected by supplier not to exceed $750 per machine.

Brand Name: Crippen Model H 5460

Supplier: Crippen, Ferrell-Ross, Mercator, Manring

Est. Cost Per Unit (FOB): $33,000

Est. Total Cost (FOB): $33,000

18P	Elevator, Belt-Bucket Type; same general specification as Item #10P except: discharge height to be 27 ft. (8.0 M); belt speed 270 FPM; 4¼ in. bucket spacing. Substitute lettered options as follows: a) dump hopper with shut-off slide b) cup spacers (washer type) c) one (1) three-way valve with adapter to fit elevator discharge (6-inch) d) three (3) adjustable elbows (metal) with clamp rings; e) four (4) 10 ft. sections of 6-inch metal spouting (12 guage) with 12 loose flanges with bolts. f) complete drive with electric motor of required power operable on 230 volt, 50 hz., 1 phase electric current. g) dust proof, start/stop push button control switch station for motor. h) bottom boot clean-out feature with 4 inch legs i) replacement parts to be selected by supplier not to exceed $200 per unit.	1 (1-T)
	Brand Name: Universal Industries Model C2-500 Supplier: Universal Industries, Mercator, Manring Est. Cost Per Unit (FOB): $2,900 Est. Total Cost (FOB): $2,900	Note: Different model no. from #10P
19P	Gravity Table Seed Separator; same general specifications as Item #4 except for corn and sunflower seed; Type A, 10 mesh deck; and substitute lettered options as: a) left hand discharge on separator b) drive and motor of required horsepower operable on 230 volt, 50 hz., 3 phase electric current. c) start-stop push button control station d) aspirating feeder for dust control with fan and motor of required power (230 volt, 50 hz., 1 phase), and mounting assembly e) replacement parts to be selected by supplier not to exceed $400 per machine	1 9/ (1-T)

	Brand Name: Oliver Hi-Cap Model 160 Gravity Separator Supplier: Oliver Mfg. Co., Mercator, Manring Est. Cost Per Unit (FOB): $12,000 Est. Total Cost (FOB): $12,000	
20P	Elevator, Belt-Bucket Type; same general specification as Item #10P except: discharge height to be 27 ft. (8.0 M); belt speed 270 FPM; 4¼ in. bucket spacing; and options substituted as follows: a) dump hopper with shut-off slide b) cup spacers (washer type) c) one (1) two-way valve (metal) with adapter to fit elevator discharge, 6-inch d) four (4) 10 ft. sections of 6-inch rigid metal spouting (12 guage) with 12 loose flanges and bolts e) bottom boot cleanout feature with 4-inch legs f) three (3) 6-inch adjustable elbows (metal with clamp rings) g) start-stop push button control station h) drive and motor sized for elevator operable on 230 volt, 50 hz., 1 phase electric current i) replacement parts to be selected by supplier not to exceed $100 per elevator Brand Name: Universal Industries Model C2-500 (Note Model No. change from Item #10P) Suppliers: Universal Industries, Mercator, Manring Est. Cost Per Unit (FOB): $2,900 Est. Total Cost (FOB): $2,900	1 (1-T)
21P	Elevator, Belt-Bucket Type; same general specifications as Item 10P except: discharge height to be 24 ft. (7.0 M); belt speed 270 FPM; 4¼ in. bucket spacing; and options substituted as follows: a) two (2) dump hoppers with shut-off slide b) cup spacers (washer type)	1 (1-T)

	c) one (1) connector (metal) with adapter to fit elevator discharge to spouting d) two (2) 6-inch adjustable elbows (metal) with clamp rings e) bottom boot cleanout feature with 4-inch legs f) drive and motor sized for elevator operable on 230 volt, 50 hz., 1 phase electric current g) start/stop push button station h) two (2) 10 ft. sections of 6-inch rigid metal spouting (12 guage) with 6 loose flanges and bolts i) replacement parts to be selected by supplier not to exceed $100 per elevator. Brand Name: Universal Industries Model C2-500 Supplier: Universal Industries, Mercator, Manring Est. Cost Per Unit: $2,600 Est. Total Cost (FOB): $2,600	Note: Model change from Item #10P
22P	Seed Treater, Metered Slurry Type; same specification as Item #14P Brand Name: Gustafson S-100SS Stainless Steel Seed Treater Supplier: Gustafson, Mercator, Manring Est. Cost Per Unit (FOB): $3,500 Est. Total Cost (FOB): $3,500	1 10/ (1-T)
23P	Elevator, Belt-Bucket Type; same specifications as Item #10P except: discharge height to be 24 ft. (7.4 M); and the following substituted for lettered accessories and options under Item #10P. a) dump hopper with shut-off slide b) cub spacers (washer type) c) elevator discharge spout adapted to connect to rigid 6-inch metal spouting with necessary loose flange rings and bolts. d) adjustable 6-inch elbow (metal) with clamp ring	1 (1-T)

	e) bottom boot cleanout feature with 4-inch legs f) drive and motor sized for elevator operable on 230 volt, 50 hz., 1 phase electric current g) start-stop push bottom station h) two (2) 10 ft. sections of 6-inch rigid metal spouting (12 guage) with 8 loose flange rings and bolts i) replacement parts to be selected by supplier not to exceed $75 per elevator Brand Name: Universal Industries Model C2-175-ED Supplier: Universal Industries, Mercator, Manring Est. Cost Per Unit (FOB): $2,600 Est. Total Cost (FOB): $2,600	
24P	Seed Bagging-Weighing-Sewing System; specifications to be same as Item #15P Brand Name: Howe-Richardson Uni-Pak Bagging System Supplier: Howe-Richardson, Mercator, Manring Est. Cost. Per Unit (FOB): $10,000 Est. Total Cost (FOB): $10,000	1 (1-T)
25P	Width and Thickness Seed Separator; for separating seed on the basis of differences in thickness using cyclindrical screens with slotted perforations and in width using cylindrical screens with round perforations; unit to be equipped with quick cylinder change feature for fast, easy changes in types and sizes of perforations; and for thorough cleanout between varieties of seed; vibrating trough to convey the "thrus" to the feed end of the hopper where discharge spout is located; the "overs" to be conveyed in cylinder and discharge through spout in end opposite feed; machine to be approx. 6 ft. 8 in. long X 1 ft. 9 in. wide X 2 ft. 10 in. height. Machine complete with 1/3 horse power electric motor and all drives operable on 230 volt, 50 hz., 1 phase electric current. Replacement parts to be selected by supplier not to exceed $100. Six (6) cylinder screens to be provided with perforation types and sizes to be determined on the basis of maize seed samples to be provided by purchaser.	1 (1-T)

	Brand Name: CEA Carter Day Model No. 1-VT Supplier: CEA Carter-Day, Mercator, Manring Est. Cost. Per Unit (FOB): $4,500 Est. Total Cost (FOB): $4,500	
	General Accessories for Seed Plants	
26P	Fork-Lift Industrial Truck; 3500 lbs. load capacity; minimum elevation (lift) of fork to be 15 ft; side shift capability; diesel motor; cushion tires; other standard features. Spare parts selected by supplier not to exceed $1000/machine. Brand Name: Clarklift 500 Clark Equipment Co. Supplier: Clark Equipment Co., Mercator, Manring Est. Cost Per Unit (FOB): $15,000 Est. Total Cost (FOB): $60,000	4 (1-K) (1-C/S) (2-T)
27P	Vacuum (Cleaner) Pick-Up Power Head; for use with 55 gal. drum; dual power heads - one (1) of 1½ h.p., one (1) of 2½ h.p. for flexible capacity; external filter system; dry and wet pick-up; power units operable on 230 volts, 50 hz., 1 phase electric current; a) jumbo cover to convert 55 gal. drum to trash receptacle b) power heads as specified above c) two (2) large filters d) support rod e) 4-wheel dolly with handle for mounting of 55 gal. drum f) four (4) 10 ft. sections of 2 in. vinyl hose, flexible, with connects g) four (4) hose adapters (and adapters to connect hose to jumbo cover as may be required h) two (2) hand "gulpers" Brand Name: Tornado Jumbo Vac (98800 and 98900 power units; 95000 cover; 90238 large filter; 98049 support rod)	4 (1-K) (1-C/S) (2-T)

	Supplier: Seedburo, Mercator, Manring Est. Cost Per Unit (FOB): $1400 Est. Total Cost (FOB): $5600	
28P	Blower, Hand Held; for cleaning seed processing equipment to prevent contamination of seed varieties; 1½ horse power input; 16,450 RPM; 75 CFM; 24,500 FPM velocity at nozzle, with two (2) rubber blower nozzles and 16 ft. heavy duty power cord, blower operable on 230 volt, 50 hz., 1 phase electric current. Brand Name: Tornado Blower Model 98800 Supplier: Seedburo, Mercator, Manring Est. Cost Per Unit (FOB): $350 Est. Total Cost (FOB): $1,400	4 (1-K) (1-C/S) (2-T)
29P	Platform Scale; portable on casters; double beam graduated in (metric or english system choose one); capacity 1000/lbs (450 kg); standard loose weighs to weigh up to capacity; platform size (minimum) 18 in. X 28 in. Brand Name: Fairbanks-Morse Model 41-3132A21 (avoirdupois or metric) Supplier: Seedburo, Mercator, Manring Est. Cost Per Unit (FOB): $500 Est. Total Cost (FOB): $3500	7 (2-K) (2-C/S) (3-T)
30P	Belt Conveyor, Aluminum Portable; for conveying of seed in bags for stacking; construction of heat treated aluminum alloy; box type frame with slider bed; 19 feet long conveyor with 18-inch wide rough top belt; belt driven by electric motor with V-belt to gear reducer with roller chain final drive at belt speed of approximately 50 FPM; sealed bearings, anti-friction type; forward, reverse and stop controls; 3/4 H.P. electric motor, 230 V, 50 hz., 1 phase; 300 lb. distributed operating load; 150 lb. unit load. Assembled with following options: a) under carriage of caster type; four (4) 5-inch diameter swivel casters and two floor locks	5 (1-C/S) (1-K) (2-T)

	b) mobile stand for lower end of conveyor with 10-inch diameter wheels and wheel locks adjustable for infeed height 24 to 30 inches c) hardware for attaching under carriages to conveyors Note: Conveyor on undercarriages to be adjustable to 45° angle for high stacking of bags. Brand Name: Burrows Aluminum Bag Conveyor, "R" Series Supplier: Seedburo, Mercator, Manring Est. Cost Per Unit (FOB): $2500 Est. Total Cost (FOB): $12,500	
31P	Platform Bag Truck-4 wheel; wheeled platform truck with push handle to transport bagged seed; steel frame with 1-inch hardwood deck; deck or platform 36-inch wide X 72-inch; platform on 2 roller bearing molded-on rubber wheels 12-inch X 2½-inch and 2 double swivel heavy duty ball bearing casters 8-inch X 2-inch; capacity 2,800 lbs.; removable push handle (metal). Brand Name: Burrows Type 4-wheel Platform Bag Truck Supplier: Seedburo, Mercator, Manring Est. Cost Per Unit (FOB): $600 Est. Total Cost (FOB): $6000	10 (3-C/S) (3-K) (4-T)
32P	Bag Truck, 2-wheel; heavy duty all-hardwood construction with steam bent plow handles; heavy beveled wrought iron nose with steel strap extending up the handles: steel plate fastened to nose to prevent load from rubbing when wheeled; capacity 5 to 6 bags, approx. 750 lbs; 52-inch handle; 25-inch wide frame at top, 15-inch wide at nose; nose 10-inch long; 2 molded-on-rubber 10-inch X 2-inch wheels with roller bearings. Brand Name: Minneapolis Bag Truck (Burrows No. 1026) Supplier: Seedburo, Manring, Mercator Est. Cost Per Unit (FOB): $160 Est. Total Cost (FOB): $1920	12 (3-C/S) (3-K) (6-T)

33P	Electronic Moisture Tester for Seed; electronic solid state unit operable on both 230 V, 50 hz, 1 phase current or battery power; standard sample weight; one balance point, built-in thermometer; permanently mounted test cell; moisture range 4 to 36%; with calibration charts for maize, peanut, sunflower, sorghum, soybean and sesame seed; and other charts available and applicable. Brand Name: Steinlite Model 500PT2B Supplier: Seedburo, Mercator, Manring Est. Cost Per Unit (FOB): $1000 Est. Total Cost (FOB): $3000	3 (1-C/S) (1-K) (1-T)
34P	Bag Holder; for holding bags in open position for filling; "Universal" type with malleable iron jaws; adjustable for different heights and widths of bags; quick release spring controlling arm; on platform. Brand Name: Seedburo, Universal Bag Holder #114 Supplier: Seedburo, Mercator, Manring Est. Cost. Per Unit (FOB): $85 Est. Total Cost (FOB): $595	7 (2-C/S) (2-K) (3-T)
35P	Bag Cleaner; for cleaning textile bags by air suction, reversing bag; with 24-inch blower fan driven by 1800 rpm ball-bearing and V-belt drive; 5 h.p. motor, 230 V, 50 hz, 3 phase; flexible joint attaching blower to cleaner drain; mounting bracket; complete and ready for assembly and installation: Note: include electric motor. Brand Name: Burrows Bag Cleaner Supplier: Seedburo, Mercator, Manring Est. Cost Per Unit (FOB): $1200 Est. Total Cost (FOB): $3600	3 (1-C/S) (1-K) (1-T)
36P	Sump Pump; submersible; heavy duty, 1/3 h.p. motor, 230 V, 50 hz, 1 phase; 1¼-inch discharge; designed to pass 3/4-inch solids; liquid level control for automatic operation; for use in elevator (seed) pits.	8 11/ (2-C/S) (2-K) (2-T) (2-extra)

	Brand Name: Burrows Model 1602-474 Supplier: Seedburo, Mercator, Manring Est. Cost Per Unit (FOB): $250 Est. Total Cost (FOB): $2000	
37P	Ladder, Aluminum, Extension Type; 36 feet total height in two sections; minimum 30 feet working height; to meet Type II ANSI A 14.2 standards with spring loaded safety locks, rope and pulley extension set and swivel type self-aligning safety shoes: Brand Name: None Supplier: McMaster-Carr, Mercator, Manring Est. Cost Per Unit (FOB): $200 Est. Total Cost (FOB): $800	4 (1-C/S) (1-K) (2-T)
38P	Seed Divider; heavy duty boerner type; copper and brass construction; bottom section removable; three legs; complete with two sample pans; 31 inches high. Brand Name: Boerner Seed Divider (Seedburo No. 34) Supplier: Seedburo Est. Cost Per Unit (FOB): $500 Est. Total Cost (FOB): $1500	3 (1-C/S) (1-K) (1-T)
39P	Weight-Per-Bushel Tester, Hand Type; single beam, relief etched to give readings in weight per bushel, % loss in cleaning; and direct weight of sample; sliding beveled poise and heavy guage one (1) quart dent proof bucket; for determining weight/bu. of seed; with three (3) strike off sticks. Brand Name: Seedburo No. 26 Hand Bushel Wgt. Tester Supplier: Seedburo Est. Cost Per Unit (FOB): $125 Est. Total Cost (FOB): $375	3 (1-C/S) (1-K) (1-T)

40P	Grain Testing Hopper, Anchor Type; filling hopper of brass with cut-off valve; attached to metal upright; height of hopper adjustable on upright; with hanger device for hand type bushel weight tester; base plate for mounting to table for permanent use. Brand Name: Seedburo No. 42 Grain Testing Hopper Supplier: Seedburo Est. Cost Per Unit (FOB): $60 Est. Total Cost (FOB): $180	3 (1-C/S) (1-K) (1-T)
41P	Seed Trier (Samples); for sampling bagged seed; nickel plated brass; double tube; 30 inch long with 9 openings w/o partitions, 1/2 inch diameter (o.d.) Brand Name: Seedburo No. 236 Bag Trier Supplier: Seedburo Est. Cost Per Unit (FOB): $50 Est. Total Cost (FOB): $350	7 (2-C/S) (2-K) (3-T)
42P	Seed Trier (Samples); same as Item No. 41P but: 18 inch long; 5 openings w/o partitions; Seedburo No. 180. Same Supplier Est. Cost Per Unit (FOB): $40 Est. Total Cost (FOB): $280	7 (2-C/S) (2-K) (3-T)
43P	Seed Trier, Special Purpose; for sampling seed in bags; nickel plated steel, tapered; 9 inch long; 1-inch outside diameter at large end; leatherette shield. Brand Name: Seedburo No. 36 Bag Trier Supplier: Seedburo Est. Cost Per Unit (FOB): $20 Est. Total Cost (FOB): $140	7 (2-C/S) (2-K) (2-T)
44P	Sample Pan, Seed; triangular, heavy tin, enameled dark blue; 10 inch X 10 inch X 2½ inch.	22 (6-C/S) (6-K) (10-T)

	Brand Name: Seedburo No. 64 Sample Pan Supplier: Seedburo Est. Cost Per Unit (FOB): $7 Est. Total Cost (FOB): $154	
45P	Sample Pan, "Official"; aluminum, 1½ quart capacity, 8½ inch X 12 inch X 1½ inch; with pour spout. Brand Name: Seedburo No. 33 Sample Pan Supplier: Seedburo Est. Cost Per Unit (FOB): $12 Est. Total Cost (FOB): $264	22 (6-C/S) (6-K) (10-T)
46P	Grain Scale (Dial-O-Gram Type); 2610 q. capacity w/ weights; direct reading dial 10 g X 0.1 g; front beam 500 x 100 g; rear beam 100 g X 10 g; tare beam with poise; polypropylene scoop; permanent magnets in end post for uniform magnetic damping; attachment weights to bring capacity up to 2610 g. Brand Name: Ohaus Dial-O-Gram 1600 Supplier: Seedburo Est. Cost Per Unit (FOB): $125 Est. Total Cost (FOB): $875	7 (2-C/S) (2-K) (2-T)
47P	Hand Testing Screens (9-inch square); for determining screen sizes to use in seed conditioning, and estimating clean-out; screens of perforation type and size indicated below to be mounted in wooden frame with sizes stencilled on frame; one screen each of sizes indicated: Round hole, perforated metal (64ths inch): 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 24, 26, 28, 30, 32, 34, and fractions of an inch 1/12, 1/13, 1/14, 1/15, 1/16, 1/18, 1/20, (30 screens in all) Oblong holes, perforated metal (width in 64ths inch, length 3/4 inch - only width given):	3 (1-C/S) (1-K) (1-T)

	5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 24; and (in fractions) 1/18 X 1/2, 1/16 X 1/2, 1/20 X 1/2, (21 screens in all). To include three hand testing screen racks of wood with 24 screen capacity each (total - 72 positions) Brand Name: Burrows Hand Testing Screens W/Rack Supplier: Seedburo, Mercator, Manring Est. Cost Per Unit (FOB): $800 Est. Total Cost (FOB): $2400	
48P	Seed Magnifier; 4-inch diameter lens; 3 power with 7-inch focal length; single lens mounted in Universal positioning weighted base (ball joint; with removable glare shield. Brand Name: Burrows No. 1-1790 Magnifier Supplier: Seedburo, Mercator, Manring Est. Cost Per Unit (FOB): $30 Est. Total Cost (FOB): $270	7 (2-C/S) (2-K) (3-T)
49P	Oven, Heated Air; for drying seed samples to determine moisture content and check calibration of electric moisture meters; double wall with stainless steel interior; 3 inches glass wool insulation, and enameled steel exterior; heavily insulated door with push buttom release latch; heaters sheathed; temperature control by sensitive hydraulic thermostat; 3 adjustable shelves adjustable air-vent; 0 to 300C thermometer; capable of maintaining temperature at 110C: for 230 volt, 50 hz. Brand Name: Seedburo Model No. 95076-16 Supplier: Seedburo, Mercator, Manring Est. Cost Per Unit (FOB): $800 Est. Total Cost (FOB): $2400	3 (1-C/S) (1-K) (1-T)
50P	Aluminum Spray Tank for Tornado Blower (Item # 28P); for space spraying seed warehouses with insecticides. Brand name and supplier same as Item #28P.	4 (1-C/S) (1-K) (2-T)

	Est. Cost Per Unit (FOB): $80 Est. Total Cost (FOB): $320	
51P	Mechanics Tool Set; 146 pieces packed in six drawer metal chest. Brand Name: McMaster-Carr No. 7215A31 Supplier: McMaster-Carr Est. Cost Per Unit (FOB): $700 Est. Total Cost (FOB): $2800	4 (1-C/S) (1-K) (2-T)
52P	Filter Masks; 3M type for non-toxic dusts; one piece construction; disposable; 100 in box. Brand Name: Burrows No. 8-0730 Supplier: Burrows, Mercator, Manring Est. Cost Per Unit (FOB): $25 Est. Total Cost (FOB): $1250	50 boxes (15-C/S) (15-K) (20-T)
53P	Metal Bins, Holding and Surge; sheet metal, hopper bottom with discharge spout, floor supported (on angle iron legs). These bins which are shown in the drawings are necessary for efficient operation of processing plant. They should be locally fabricated. Detailed plans for bins with specifications are being prepared and will be submitted as supplement.	To be sent later
	Total for Items Costed: $449,072	

Notes on Processing Equipment Specifications

1/ Total number needed; numbers followed by letter indicate seed centers for which items are intended, e.g., (2-K) means two of the items for Kyanugsu; C/S = Chaungmagyi-Sebin; T = Thitcho.

2/ Metal pipe will be needed to spout aspiration system to the outside of the building. It should be procured from local tin shop. No dust collector is specified. The dust can simply be discharged outside the building, or a simple wooden dust house constructed.

3/ Sheet metal pipe will be needed to carry exhaust of aspirating feeder to outside of building. Local procurement and fabrication.

4/ These conveyors have many uses. This one will be used to lift waste products from gravity table for bagging.

5/ Round sheet metal pipe will be needed to carry air system exhaust to dust collector outside the building. Local procurement and fabrication.

6/ See 3/

7/ Seed traeater is provided. If decision is made not to provide for treating maize and sunflower seed delete Item #14P (treater) and Item #12P (elevator for treater), one bin can also be deleted.

8/ Same as 5/

9/ Same as 3/

10/ See 7/. If treatment option not desired delete Item #22P (treater) and Item #21P (elevator for treater), plus one bin.

11/ These sump pumps will probably be needed to keep elevator pits dry. Pits should be constructed with one corner (1 ft x 1 ft.) about 1 ft. lower for placement of sump pump. Every effort must be made, however, to water proof concrete lining of pit. The sump pump is for emergency.

* Refers to "type" specified; equivalent of other brands are available in many cases.

** Potential supplies; see brand name/supplier index at end of specification section.

IX.

Descriptions and Specifications for Equipment and Supplies Recommended for Seed Storage

Item No.	Description/Specification	No. Required Location
1S	Dehumidifier; heavy duty industrial refrigeration cycle type; 2 h.p. compressor with overload protection; moisture condensing air drying coil (evaporator) and reheating coil (refrigerant condensor) of multi-row design of solid copper tubing with aluminum fins; R-22 refrigerant; double inlet centrifugal blower connected to 1/6 h.p. motor operating at 1050 rpm with 450 CFM capacity; on-off switch; automatic humidity control from 30 to 70% R.H.; temperature compensator for low, medium and high ambient temperature; heavy guage furniture steel cabinet with removeable top panel; on casters; with male hose connector for drain and 5-gallon pail; for 230 V, 50 hz., 1 phase electric power. Brand Name: Remmington Model D-20 Industrial Dehumidifier Supplier: Remmington, Seedburo, Mercator, Manring Est. Cost Per Unit: $1600 Est. Total Cost (FOB): $32,000	20 (4-C/S) (6-K) (8-T) (2-spare)
2S	Hygrothermograph; recording type; records both temperature and relative humidity; weekly recording cycle; temperature range 10 to 110F; relative humidity from 0-100%; with 200 recording charts (weekly); ink supply for same; instructions Brand Name: Bendix Hygrothermograph Supplier: Seedburo, Mercator, Manring Est. Cost Per Unit (FOB): $600 Est. Total Cost (FOB): $3600	6 (2-C/S) (2-K) (2-T)
3S	Hygrometer/Thermometer: 5 inch dial; humidity 0-100%; temperature -10 to 190F; "certified" accuracy; recalibration capability; hang-on wall type. Brand Name: Abbeon (Burrows No. 1-1440)	12 (2-C/S) (3-K) (4-T)

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	Supplier: Seedburo, Mercator, Manring Est. Cost Per Unit (FOB): $70 Est. Total Cost (FOB): $840	
4S	Cooler Door; 5 ft. wide x 7 ft. high; door constructed of 20 guage galvanized steel pans, front and back with cavity filled with 4 in. foamed-in-place polyurethane insulation; casings and jambs of frame metal clad with 26 guage galvanized steel; door to be gasketed with sweep gaskets on sill and soft gaskets on sides and head; hardware to be adjustable galvanized hinges, one safety release fastener, and galvanized door pull on back of door. Brand Name: Jamison Plyfoam Cooler Door Supplier: Jamison, Mercator, Manring Est. Cost Per Unit (FOB): $500 Est. Total Cost (FOB): $4500	9 (2-C/S) (3-K) (4-T)
5S	Weatherstripping; sponge rubber with adhesive back; 1 in. wide x 7/16 in. thick; in 50 ft. rolls. Brand Name: McMaster-Carr #1117A19 Supplier: McMaster-Carr, Mercator, Manring Est. Cost Per Unit (FOB): $15 Est. Total Cost (FOB): $300	20 rolls (50 ft. each) for all sites
6S	Plastic Sheeting; clear, polyethylene, 10 mil; for moisture vapor seals in storehouse floors, and for in walls and ceiling of conditioned storerooms - To be procurred locally (cost not estimated; not expensive)	90,000 sq. ft.
7S	Polystyrene Foam Insulation; rigid panels; 4 ft. x 8 ft. x 2 in. thick (32 sq. ft/panel) - Example only; insulation type and thickness should be specified by refrigeration/air conditioning firm.	1000 of 8' x 4' panels needed for one 2" layer of insulation for 9 rooms of 40' x 40' x 12'.

8S	Air-cooling Units; for maintaining 60-65F temperature in conditioned storeroom; cooling capacity and type to be determined by local air conditioning engineering firm. Total of Items Costed: $41,240	To be determined

X. ELECTRIC POWER REQUIREMENTS

The crucial need for an adequate, dependable electric power supply has been repeatedly emphasized. The Chaungmagyi and Sebin farms are close to a power line; the Kyaungsu center is about 2 miles from a power line, while the Thitcho is 8-10 miles from a power line. The project will have to provide transformers and/or small sub-stations, poles, and line just to get power to the center sites. Then wiring, receptacles, outlets, etc. will be needed to "wire" the drying, handling, and processing systems, and the conditioned storage units.

No attempt has been made to specify or cost transformers, poles, line wire, insulators, etc., because we do not have such expertise, and such items should be specified and costed by the appropriate electrical or power department in Burma.

The electric horsepower requirements for the three seed centers are estimated in Table 11, just for drying, handling, processing and the dehumidification phase of conditioned storage. The air cooling power requirement for the conditioned storerooms would need to be added. Considering the liklihood that there will be periodic and prolonged power outages, diesel generators are usually provided in seed facilities in the LDCs so that critical operations can be continued during these times.

The most critical among the seed operations is drying. To provide diesel generator power to maintain the various operations during power outages would require the following generator capacities.

Chaungmagyi-Sebin: 25 KW just to maintain operation of heater-fan units; 40 KW to maintain operation of dryers, sheller and conveyors; 75

KW to run the dryers and processing plant (assuming that all motors would not be operating at the same time). The conditioned storehouse would require additional power to run the air cooling and dehumidification equipment.

Kyaungsu: Same as for Chaungmagyi/Sebin

Thitcho: Dryer heaters and blowers only - 50 KW; dryers plus shellers and conveying equipment 100 KW: dryers, shellers, conveyors plus processing plants (two) 175 KW. Conditioned storage would be extra.

"Ball park" estimates of the costs of diesel generators for 230/3/50 hz electrics with 50 gal diesel tank, key start, liquid cooled engine, control box, industrial silencer, flexible exhaust and warning gages are (FOB manufacturer):

25 KW ---------- $11,000

50 KW ---------- $14,000

75 KW ---------- $17,000

115 KW ---------- $25,000

125 KW ---------- $26,000

The electrical power requirement estimated here and in Table 11 do not include lighting, office and residence service needs, shops, irrigation pumps, etc., only seed operations excluding the air cooling for conditioned storage.

Table 11. Estimated electrical horsepower (or KW as 1 h.p. = 0.8 KW) required for drying, handling, processing, and storage (partially) at the three seed centers.

Seed Center	Items	Horse Power
Chaungmagyi-Sebin		
1. Drying & Maize Shelling	2 X 7½	15.0
	1 X 10	10.0
	1 X 3	3.0
	2 X 1.5	3.0
	Sub-total	31.0
2. Processing	1 X 3	3.0
	1 X 5	5.0
	3 X 3	9.0
	4 X 1	4.0
	1 X 10	10.0
	1 X 7.5	7.5
	2 X 2	4.0
	2 X 1.5	3.0
	Sub-total	45.5
3. Storage	4 X 2	8.0
	2 X 2	4.0
	+ h.p. required for air cooling **	?
	Sub-total	12.0+ ?
	TOTAL C/S	88.5+ ?
Kyaungsu		
Same as Chaungmagyi-Sebin plus,		84.0+ ?
	1 X 7.5	7.5
	2 X 2	4.0
	plus, air cooling ?**	
	TOTAL	95.5+ ?
Thitcho		
1. Drying & maize shelling	2 X 10	20.0
	3 X 7.5	22.5
	2 X 5	10.0
	1 X 3	3.0
	1 X 3	3.0

Table 11, continued

Seed Center	Items	Horsepower
	1 X 5	5.0
	1 X 2	2.0
	1 X 3	3.0
	1 X 2	2.0
	2 X 10	20.0
	1 X 3	3.0
	2 X 2	4.0
	Sub-total	97.5
2. Processing (Type B and Type C Plants)	4 X 3	12.0
	1 X 10	10.0
	4 X 1.5	6.0
	2 X 10	20.0
	1 X 2	2.0
	2 X 3	6.0
	3 X 1.5	4.5
	2 X 2	4.0
	Sub-total	64.5
3. Storage	8 X 2	16.0
	2 X 2	4.0
	plus, h.p. required for air cooling **	
	TOTAL	182.0+ ?

* Estimate only: manufacturers often size electric motors on the high size; estimate does not include lighting, and other electrical services needed in shops, residences, offices, etc.

** Horse power requirement for air cooling equipment for conditioned storage to be determined by engineering firm.

Note: The larger electric motors operate more efficiently on 3 phase current; thus, both 1 phase and 3 phase power will be needed.

XI.

LIST OF SUGGESTED SUPPLIERS

American Drying Systems, Inc.
1135 N.W. 159th Drive
Miami, FL 33169
CABLE: ADSCO
TELEPHONE: (305) 621-1252

Avco New Idea
Coldwater, OH 45828

CEA Carter-Day
Minneapolis, MN 55432
PHONE: (612) 571-1000
TELEX: 29-0684

C. E. Raymond
Combustion Engineering, Inc.
300 North Cedar
Abilene, KS 67410
PHONE: (913) 263-4300

Clark Equipment Co.
P. O. Box D
Longview, WA 98632
PHONE: (206) 423-2047

Columbian Steel Tank Co.
1509 West 12th Street
Kansas City, MO 64101
PHONE: (816) 221-5020

Crippen Manufacutring Co.
712 West End Street
Alma, MI 48801

Equipment Specialists, Inc.
Box 392, Rt. 48W
Taylorville, IL 62568
PHONE: (217) 287-7227

Gustafson, Inc.
P. O. Box 220065
Dallas, TX 75222
TELEX: 73-0957
PHONE: (214) 661-1334

Hobbs-Adams Engineering Co.
P. O. Box 1833
Suffolk, VA 23434
PHONE: (804) 539-0231

Howe-Richardson Scale Co.
680 Van Houten Ave.
Clifton, NJ 07015

Jamison
Hagerstown, MD 21740

Manring Corporation
13300 Southeast 30th
P. O. Box 1865
Bellevue, WA 98009
PHONE: (206) 746-6152
746-5698
TELEX: 328895

McMaster-Carr
P. O. Box 4355
Chicago, IL 60680
PHONE: (312) 833-0300

Mercator
P. O. Box 142
Reading, PA 19603
PHONE: (215) 376-1578

Modern Farm Systems, Inc.
Main Office: 1811 West Second Street
Webster, IA 50595
PHONE: (515) 832-1811
TELEX: 835420 Mercator Rdg.

Oliver Manufacturing Co., Inc.
Box 512
Rocky Ford, CO 81067
PHONE: (303) 254-6371

OPICO
P. O. Box 849
154 St. Louis Street
Mobile AL 36601
PHONE: (205) 438-9881
TELEX: 505462

Peerless Manufacturing Co.
Shellman, GA 31786-0293

Seedburo Equipment Co.
1022 W. Jackson Blvd.
Chicago, IL 60607
PHONE: (312) 738-3700

Sukup Manufacturing Co.
Contact Manring Corporation to
obtain manufacturer address.

Trico Industries, Inc.
Columbian Sttel Tank Division
5400 Kansas Avenue
Kansas City, KS 66110
PHONE: (816) 621-3700

Universal Industries
1575 Big Rock Road West
Waterloo, IA 50701
PHONE: (319) 291-3800
TELEX: 465-628

Ferrell Ross
1621 Wheeler Street
Saginaw, MI 48602
PHONE: (517) 792-8723
TELEX: 227-421

GENERAL LAYOUT
(SCALE=3/64"=1'0")

0 10 20 30 40 FT

LEGEND

1 - PROCESSING PLANT, TYPE "A"
2 - VENTILATED STORAGE WAREHOUSE
3 - CONDITIONED STORAGE
4 - DRYING WAGON SHED
5 - EAR CORN DRYING, 3-BIN UNIT
6 - OFFICE LOCATION

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SEED TECHNOLOGY LABORATORY
STATE COLLEGE, MISSISSIPPI

GENERAL LAYOUT FOR CHAUUGMAGYI SEHIN
BURMA, M.O.P.

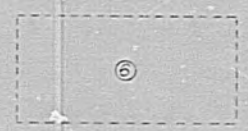
DESIGNED BY: J.C.D. A.H.B. E.R.C.	DATE: JULY, 1982	SHEET 1 OF 23
DRAWN BY: E.R.C.	FILE NO.	
APPROVED BY: J.C.D.		

GENERAL LAYOUT
(SCALE = 3/64" 1'-0")

0 10 20 30 40 FT

LEGEND

1. PROCESSING PLANT TYPE A
2. VENTILATED STORAGE WAREHOUSE
3. CONDITIONED STORAGE (THREE 40' X 40' ROOMS)
4. DRYING WAGON SHED
5. EAR CORN DRYING 3 BIN UNIT
6. OFFICE LOCATION



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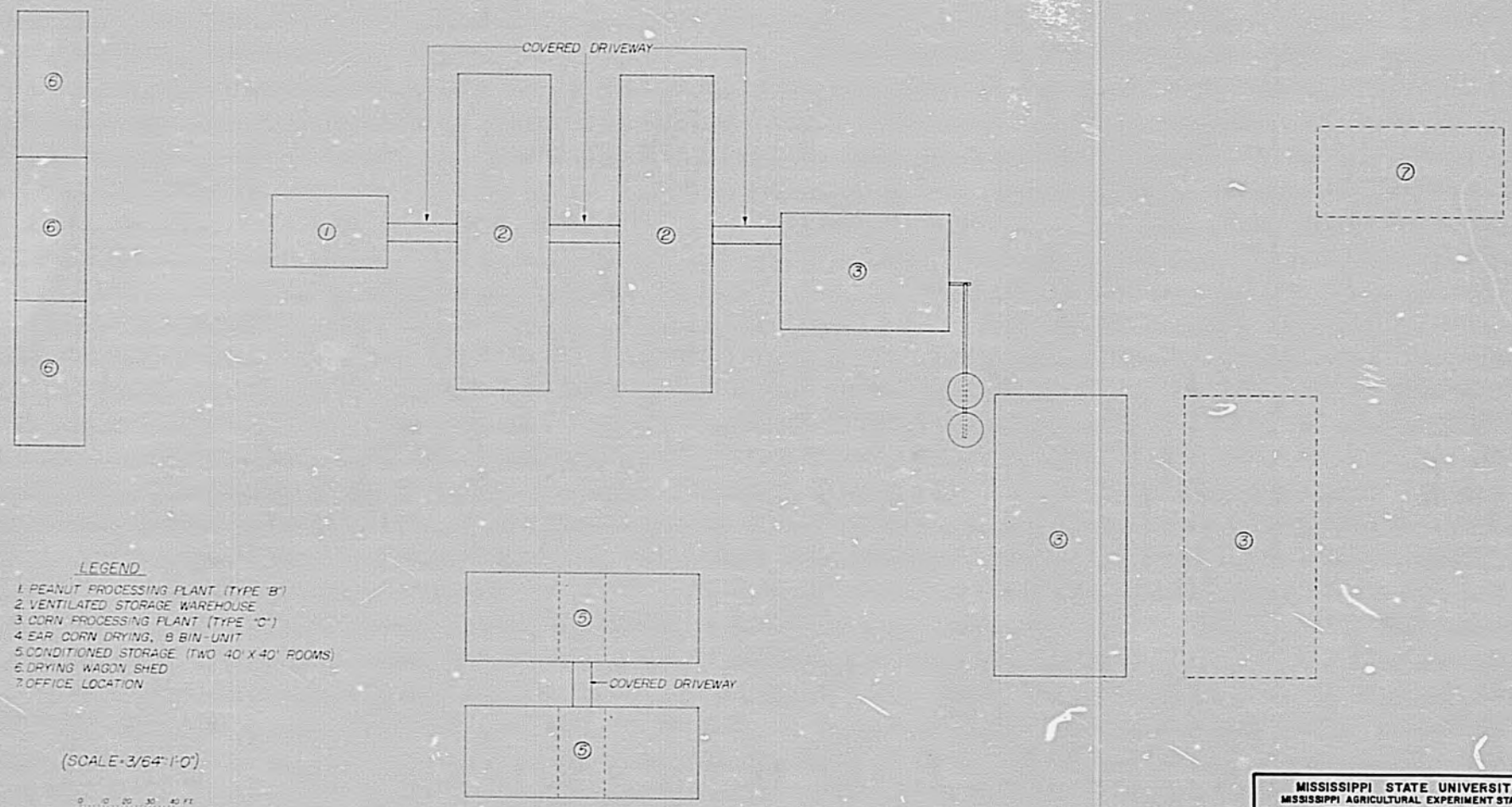
SEED TECHNOLOGY LABORATORY
STATE COLLEGE, MISSISSIPPI

GENERAL LAYOUT FOR KYAUNGSU
BURMA, M.O.P.

DESIGNED BY: JCD AHB ERC	DATE: JULY 1962	SHEET
DRAWN BY: ERC		2 OF 23
APPROVED BY: JCD	FILE NO.	



LEGEND

1. PEANUT PROCESSING PLANT (TYPE "B")
2. VENTILATED STORAGE WAREHOUSE
3. CORN PROCESSING PLANT (TYPE "C")
4. EAR CORN DRYING, 8 BIN-UNIT
5. CONDITIONED STORAGE (TWO 40' X 40' ROOMS)
6. DRYING WAGON SHED
7. OFFICE LOCATION

(SCALE: 3/64" = 1'-0")

0 10 20 30 40 FT

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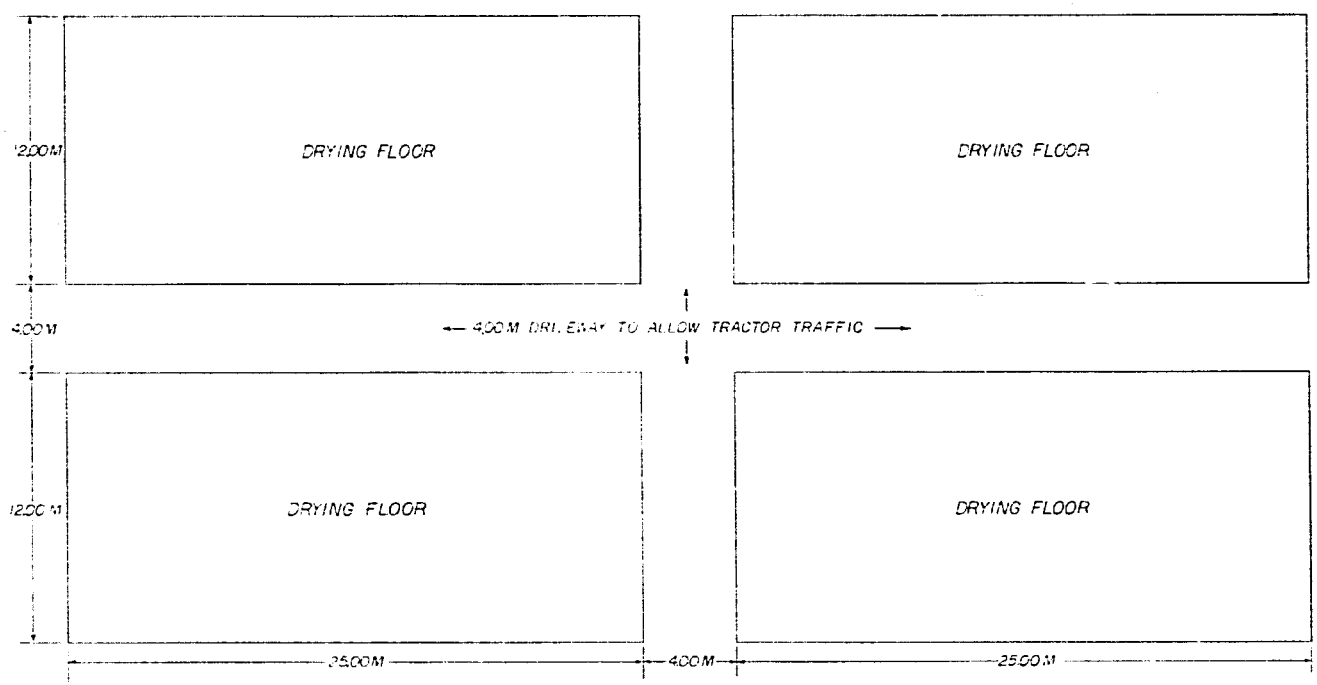
STATE COLLEGE, MISSISSIPPI

GENERAL LAYOUT FOR THITCHO
BURMA, M.O.P.

DESIGNED BY: JCD, AHB, ERC	DATE: JULY, 1982	SHEET 3 OF 23
DRAWN BY: ERC		
APPROVED BY: JCD	FILE NO.	



TOP VIEW

(SCALE-1:10)

0 1 2 3 4 5 M

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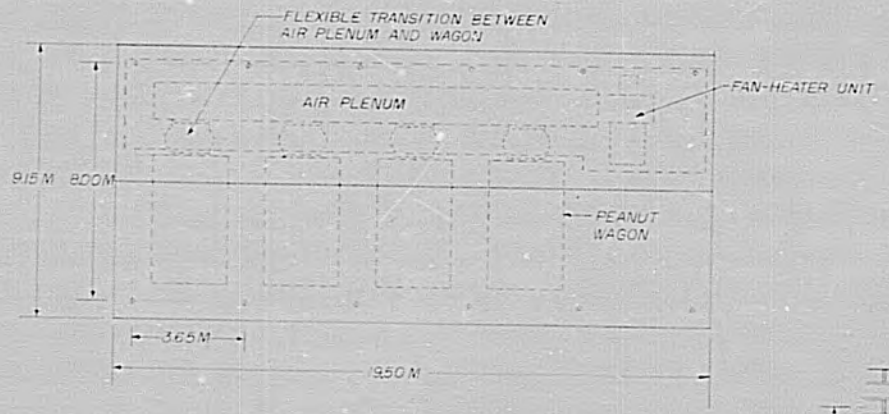
STATE COLLEGE, MISSISSIPPI

DRYING FLOOR GENERAL LAYOUT
BURMA, MSP

DESIGNED BY:	DATE:	SHEET
DRAWN BY:	FILE NO.	OF
APPROVED BY:		



TOP VIEW
(SCALE=1:173)

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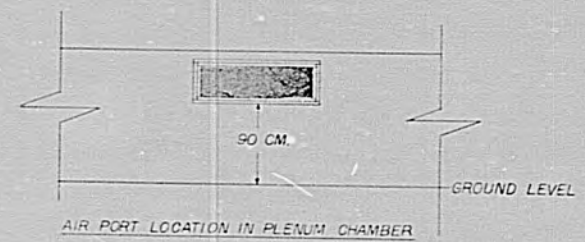
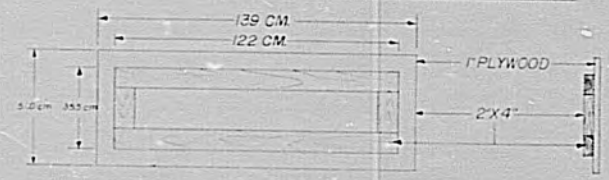
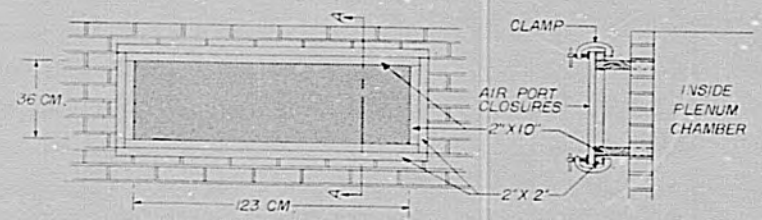
0 3 6 9 12 FT



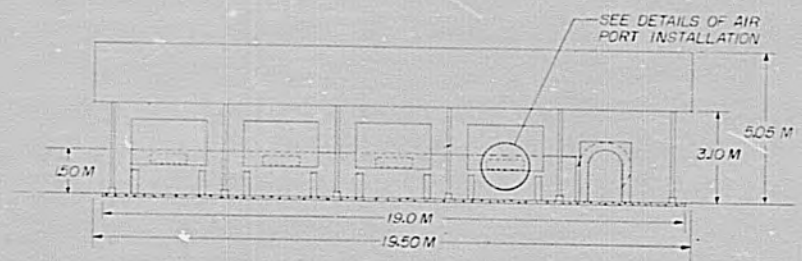
AIR PORT LOCATION IN PLENUM CHAMBER



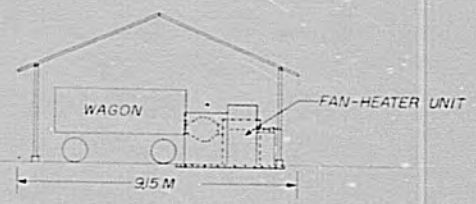
AIR PORT CLOSURE DIMENSIONS



DETAILS OF AIR PORT INSTALLATION
(NO SCALE)



FRONT VIEW ELEVATION



SIDE VIEW ELEVATION

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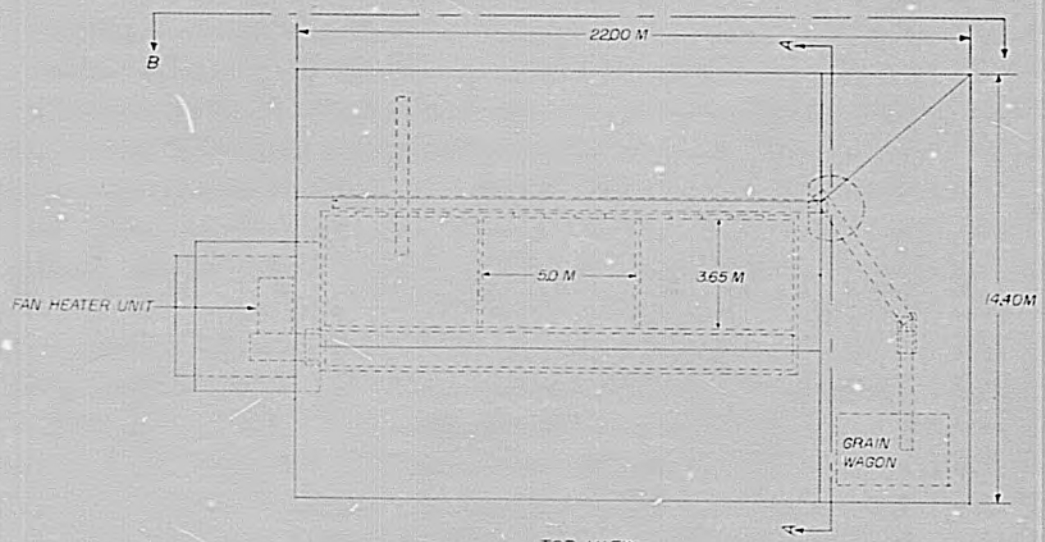
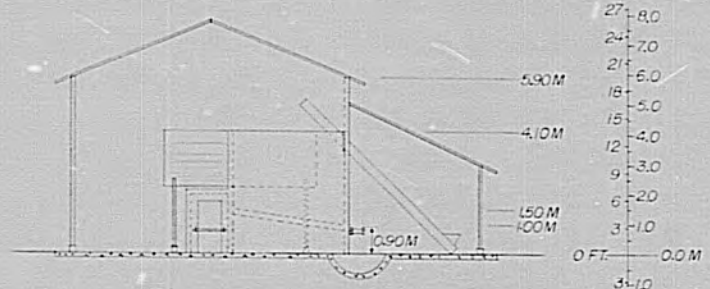
SEED TECHNOLOGY LABORATORY
STATE COLLEGE, MISSISSIPPI

DRYING WAGON SHED
BURMA, MOP

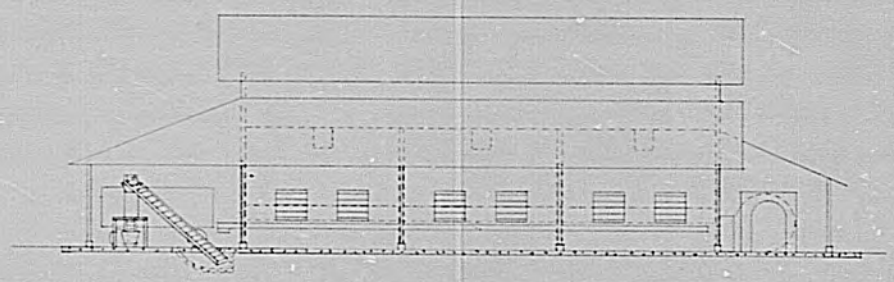
DESIGNED BY: JCD AHB ERC	DATE: JULY, 1982	SHEET 5 OF 23
DRAWN BY: ERC	FILE NO.	
APPROVED BY: JCD		



TOP VIEW



SECTION A-A



SECTION B-B

(SCALE=1:75)

0 1.0 2.0 3.0 4.0 5.0 M

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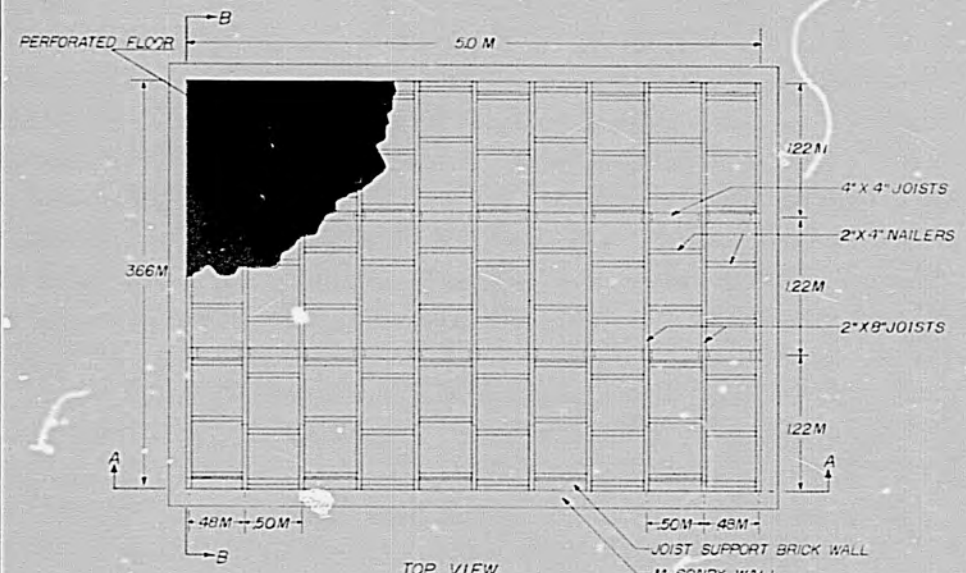
STATE COLLEGE, MISSISSIPPI

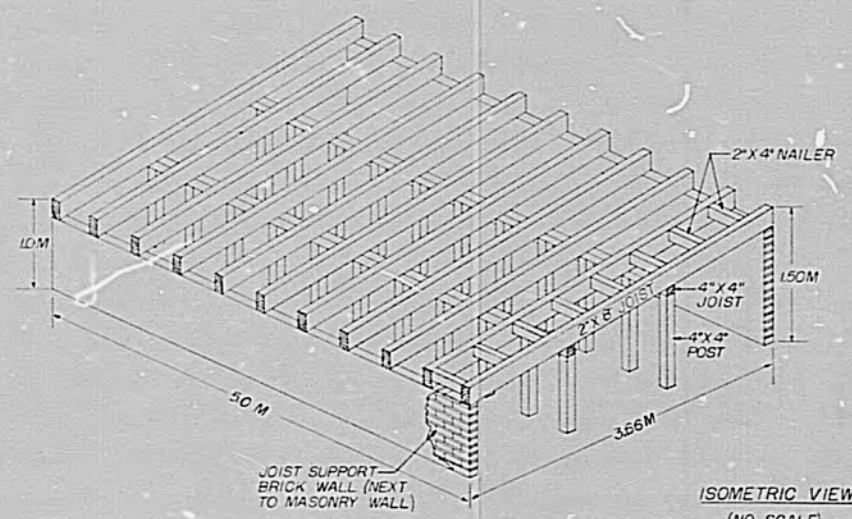
3-UNIT EAR CORN DRIER
BURMA, M.O.P.

DESIGNED BY: JCD, AHB, ERC	DATE: JULY, 1982	SHEET 6 OF 23
DRAWN BY: ERC	FILE NO.	
APPROVED BY: JCD		

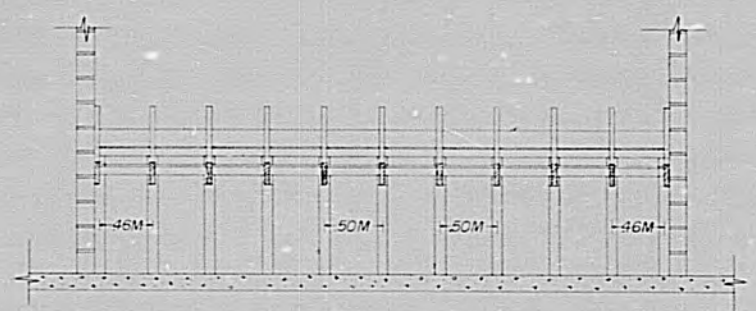
DETAILS OF PERFORATED FLOOR INSTALLATION



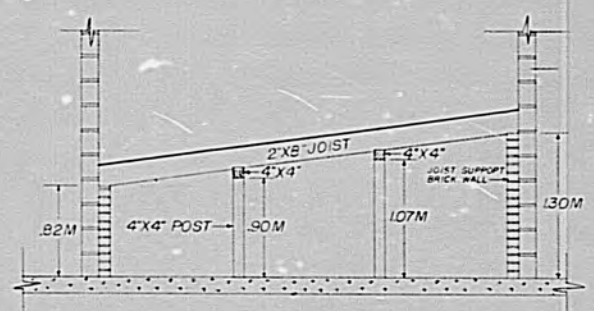
TOP VIEW
(SCALE = 1:20)



ISOMETRIC VIEW
(NO SCALE)



SECTION A-A
(SCALE = 1:20)



SECTION B-B
(SCALE = 1:20)

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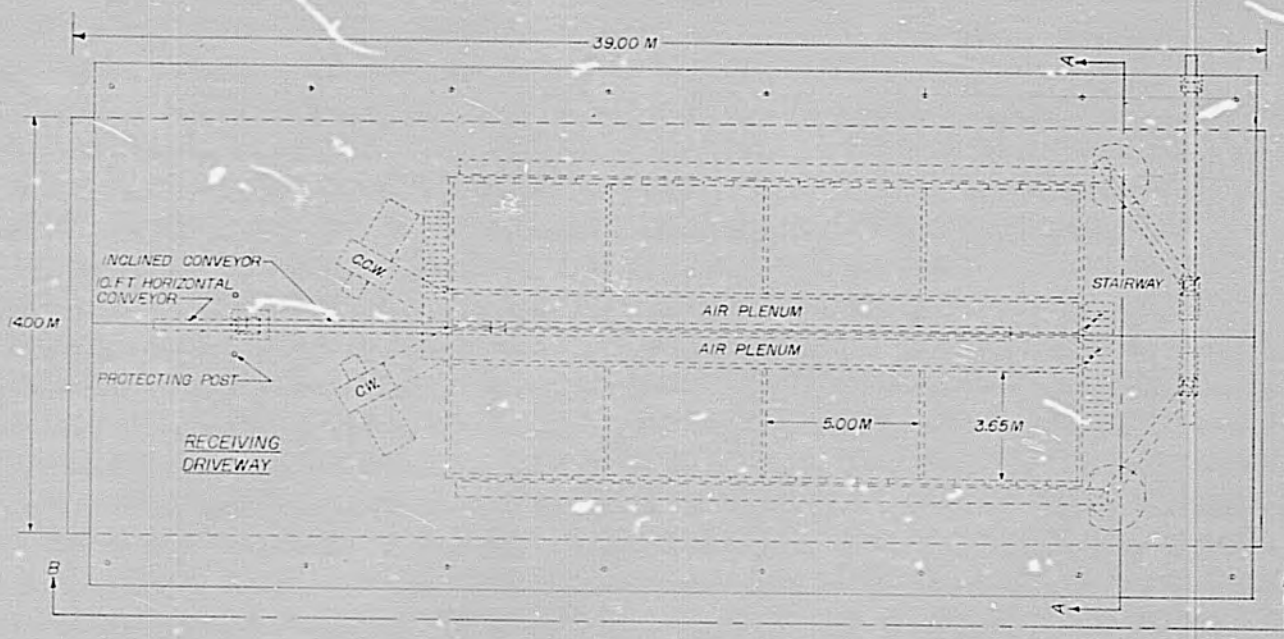
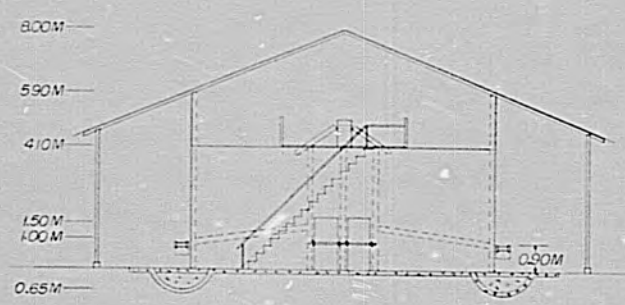
SEED TECHNOLOGY LABORATORY
STATE COLLEGE, MISSISSIPPI

DRYING BIN FLOOR DETAILS
BURMA, M.O.P.

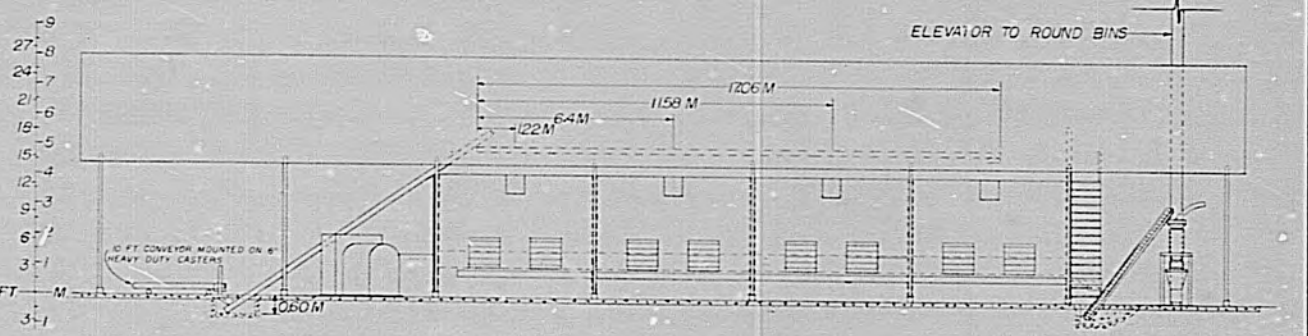
DESIGNED BY: JCD, AHB, ERC	DATE: JULY, 1982	SHEET 7 OF 23
DRAWN BY: ERC	FILE NO.	
APPROVED BY: JCD		



TOP VIEW



SECTION A-A



SECTION B-B

EAR CORN DRIER

(SCALE = 1:75 M)

0 1.0 2.0 3.0 4.0 M

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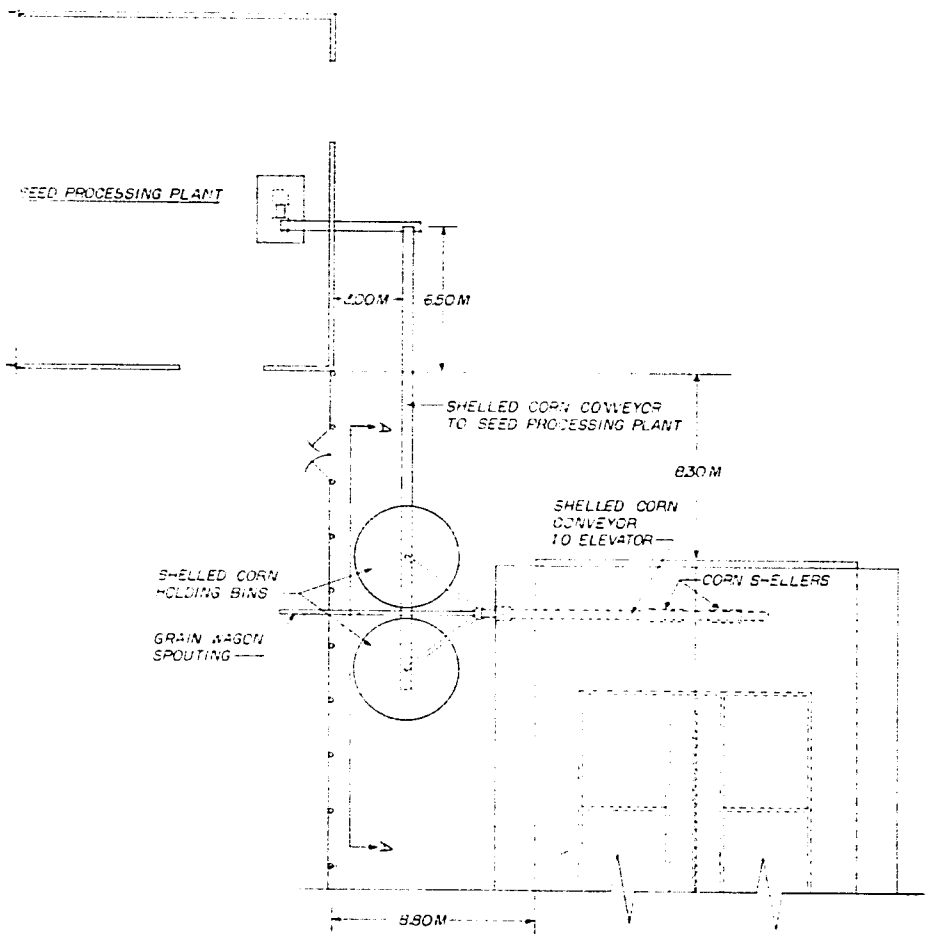
STATE COLLEGE, MISSISSIPPI

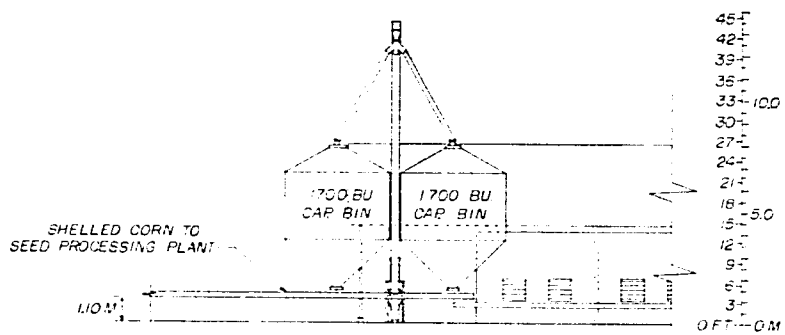
8-UNIT EAR CORN DRIER
BURMA, M.O.P.

DESIGNED BY: JCD, AHB, ERC	DATE: JULY, 1982	SHEET
DRAWN BY: ERC		8 OF 23
APPROVED BY: JCD	FILE NO.	



ARRANGEMENT OF CORN DRIER AND SEED PROCESSING PLANT

TOP VIEW



SECTION A-A

(SCALE = 1:10)

0 1 2 3 4 5 M

3 9 15 FT

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SEED TECHNOLOGY LABORATORY
STATE COLLEGE, MISSISSIPPI

PLANT FOR CORN DRIER
SHELLING DETAILS
PLAN VIEW

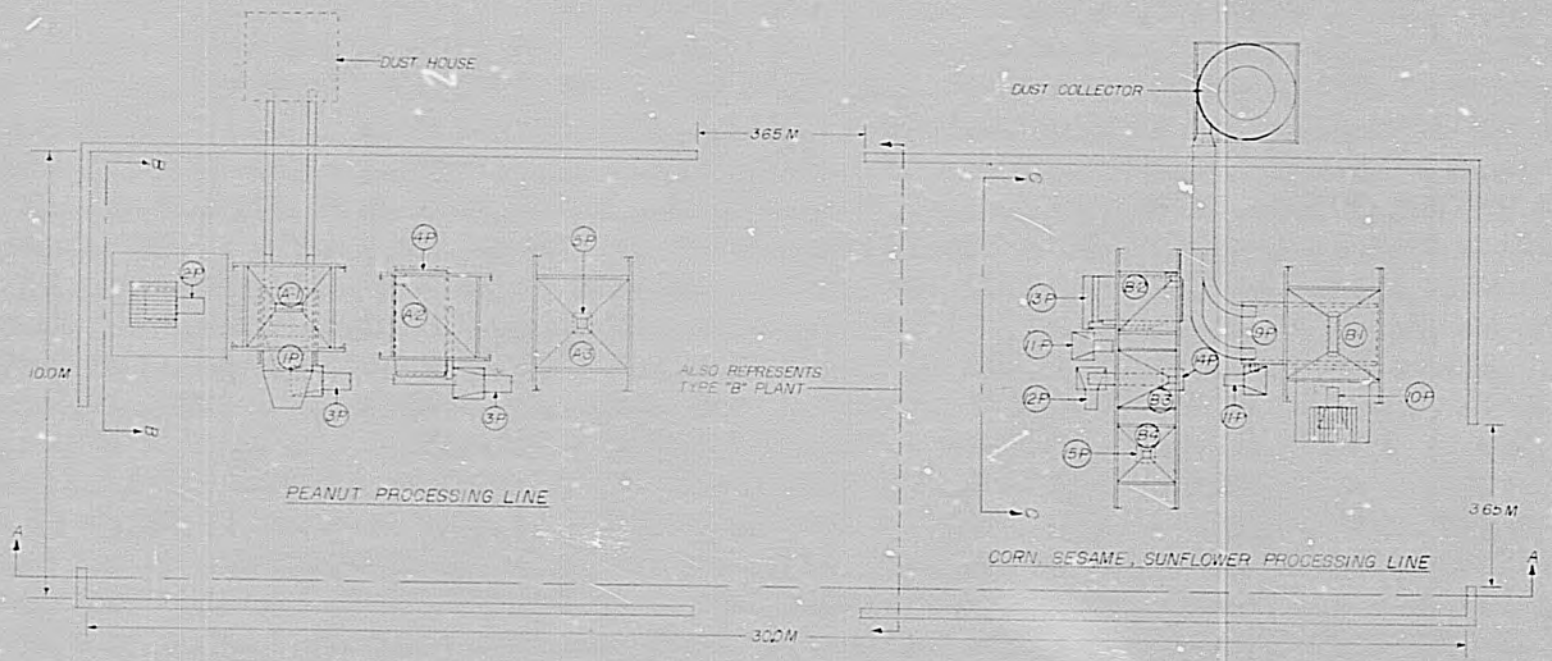
DESIGNED BY: [illegible]
DRAWN BY: [illegible]
APPROVED BY: [illegible]
DATE: [illegible]
FILE NO.
SHEET [illegible] OF [illegible]

LEGEND

ITEM	DESCRIPTION
1-P	FARMER STOCK PEANUT CLEANER
2-P	RECEIVING ELEVATOR
3-P	ELEVATOR
4-P	GRAVITY TABLE
5-P	BAGGING SCALE
A-1–A-3	HOLDING BIN, HOPPER BOTTOM

LEGEND

ITEM	DESCRIPTION
9-P	AIR-SCREEN CLEANER
10-P	RECEIVING ELEVATOR
11-P	ELEVATOR
12-P	ELEVATOR
13-P	GRAVITY TABLE
14-P	SEED TREATER
15-P	BAGGING SYSTEM
B-1–B-4	HOLDING BIN, HOPPER BOTTOM



TOP VIEW
(SCALE=1:50)

0 1.0 2.0 3.0 4.0 M
0 3 6 9 12 FT.

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STATE COLLEGE, MISSISSIPPI

FLOOR PLAN-COMBINATION TYPE "A" PLANT
BURNS, M.O.P.

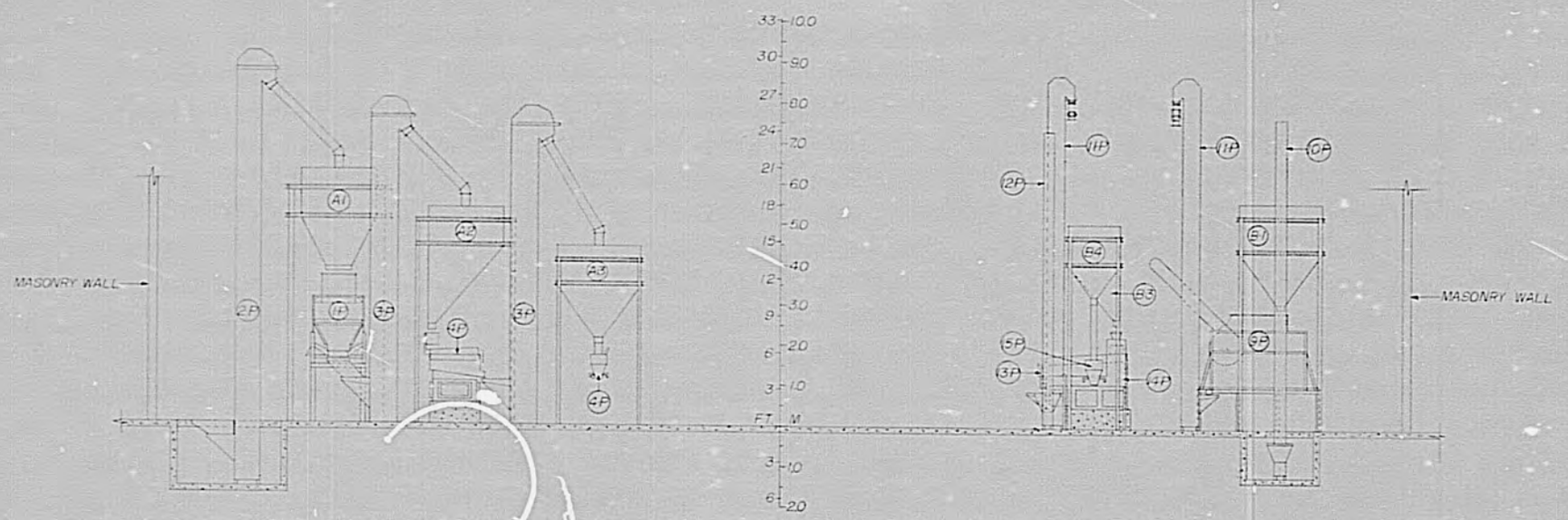
DESIGNED BY: [illegible]	DATE: JULY, 1982	SHEET 10 OF 23
DRAWN BY: F.R.C.	FILE NO.	
APPROVED BY: J.C.D.		

LEGEND

ITEM	DESCRIPTION
1-P	FARMER STOCK PEANUT CLEANER
2-P	RECEIVING ELEVATOR
3-P	ELEVATOR
4-P	GRAVITY TABLE
5-P	BAGGING SCALE
A1-A3	HOLDING BIN, HOPPER BOTTOM

LEGEND

ITEM	DESCRIPTION
9-P	AIR-SCREEN CLEANER
10-P	RECEIVING ELEVATOR
11-P	ELEVATOR
12-P	ELEVATOR
13-P	GRAVITY TABLE
14-P	SEED TREATER
15-P	BAGGING SYSTEM
B1-B4	HOLDING BIN, HOPPER BOTTOM



PEANUT PROCESSING LINE
(REPRESENTS ALSO TYPE 'B' PLANT)

SECTION A-A
(SCALE=1:50)

0 1.0 2.0 3.0 4.0 M
0 3 6 9 12 FT

CORN, SESAME, SUNFLOWER PROCESSING LINE

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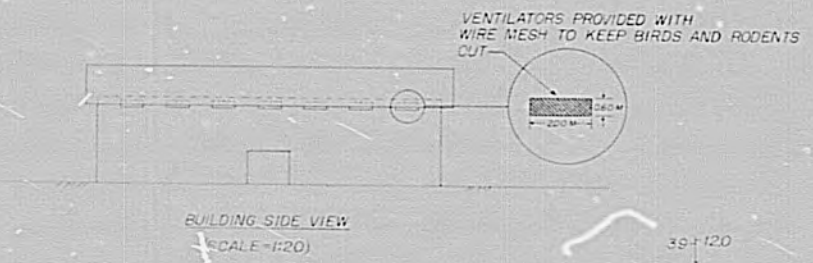
SEED TECHNOLOGY LABORATORY
STATE COLLEGE, MISSISSIPPI

SIDE ELEVATIONS – TYPE "A" PLANT
BURMA, M.O.P.

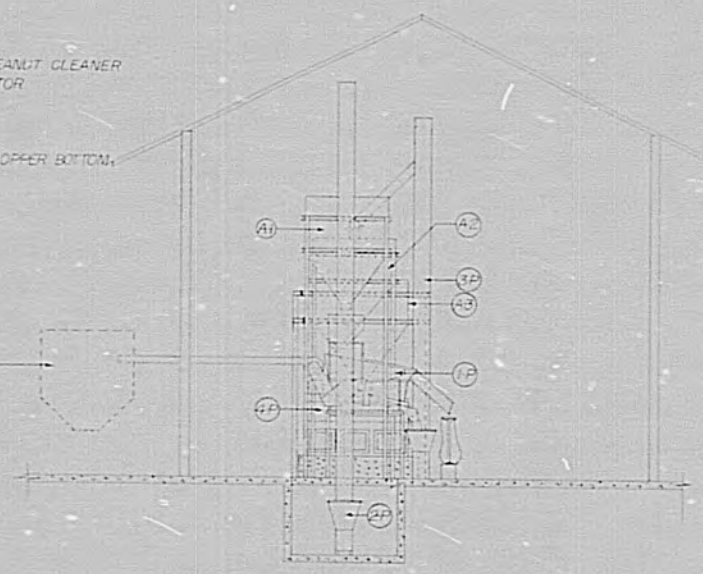
DESIGNED BY: J.C.D. A.H.B. E.R.C.	DATE: JULY, 1982	SHEET 11 OF 23
DRAWN BY: E.R.C.		
APPROVED BY: J.C.D.	FILE NO.	



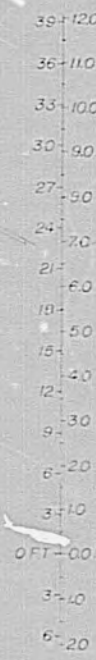
BUILDING SIDE VIEW
(SCALE=1:20)

LEGEND

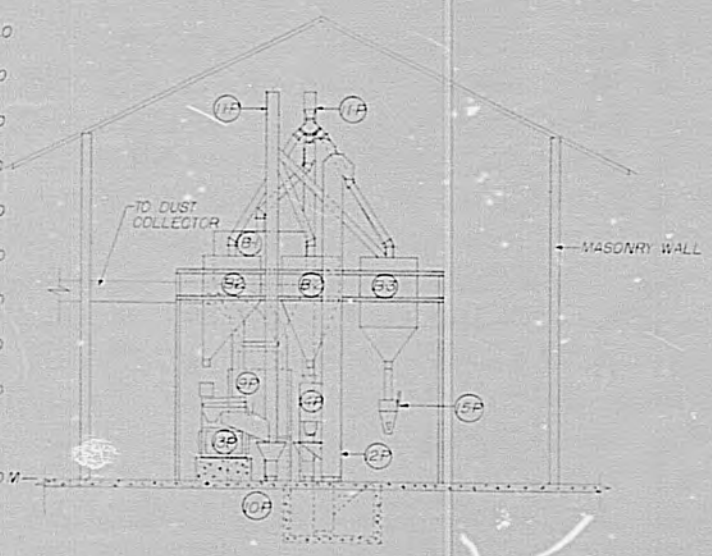
ITEM	DESCRIPTION
1P	FARMER STOCK PEANUT CLEANER
2P	RECEIVING ELEVATOR
3P	ELEVATOR
4P	GRAVITY TABLE
5P	BAGGING SCALE
A1–A3	HOLDING BIN HOPPER BOTTOM



SECTION B–B
(ALSO REPRESENTS TYPE "B" PLANT)



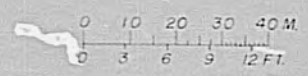
(SCALE=1:50)



SECTION C–C

LEGEND

ITEM	DESCRIPTION
9-P	AIR-SCREEN CLEANER
10-P	RECEIVING ELEVATOR
11-P	ELEVATOR
12-P	ELEVATOR
13-P	GRAVITY TABLE
14-P	SEED TREATER
15-P	BAGGING SYSTEM
B1–B4	HOLDING BIN, HOPPER BOTTOM



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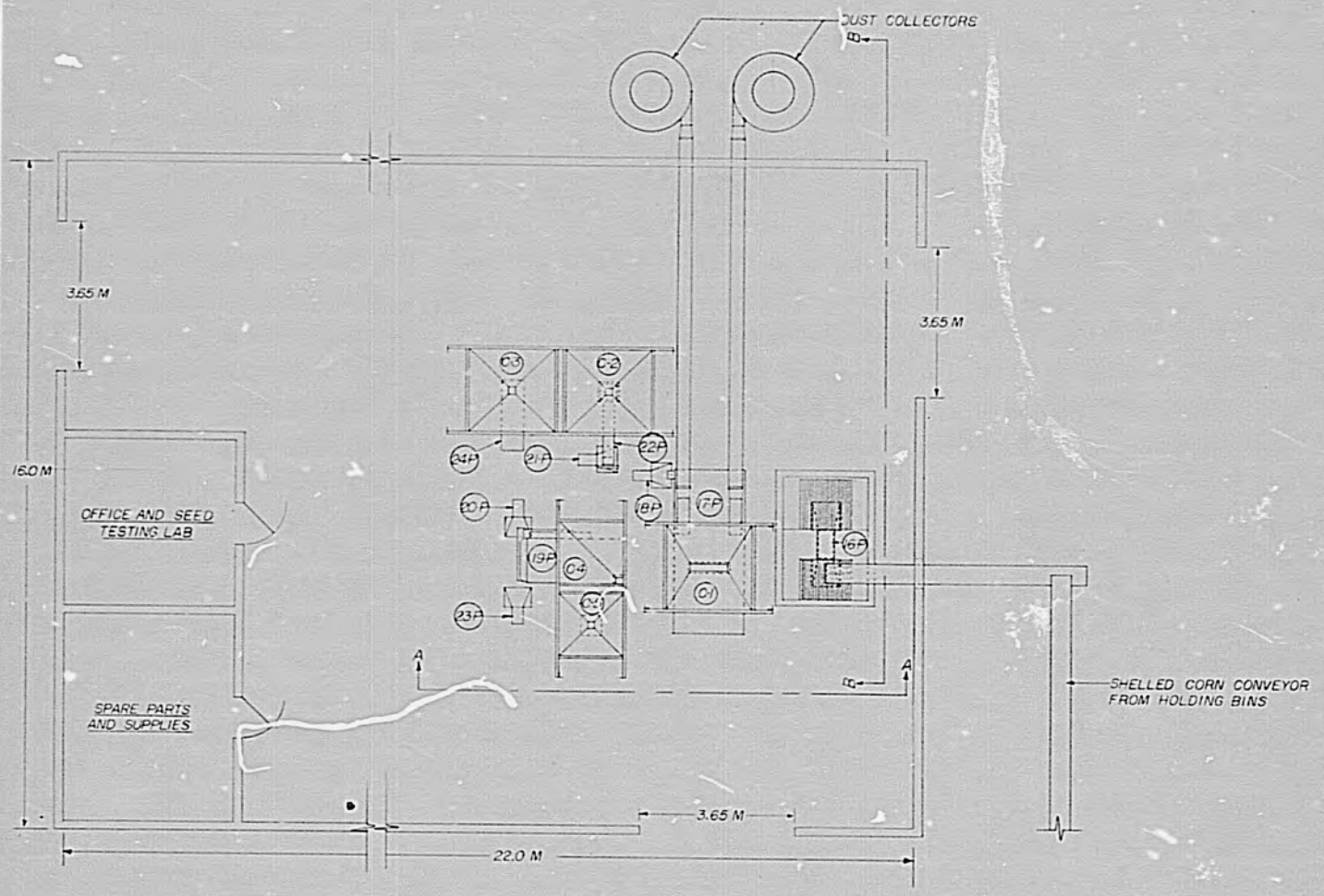
STATE COLLEGE, MISSISSIPPI

END ELEVATIONS–TYPE "A" PLANT
BURMA, M.O.P.

DESIGNED BY: JCD & HG ERC	DATE: JULY, 1982	SHEET 12 OF 23
DRAWN BY: ERC	FILE NO.	
APPROVED BY: JCD		



SEED PROCESSING PLANT

TOP VIEW

(SCALE=1:50)

0 10 20 30 40 M.

0 3 6 9 12 FT.

LEGEND

ITEM	DESCRIPTION
16-P	RECEIVING ELEVATOR
17-P	AIR-SCREEN CLEANER
18-P	ELEVATOR
19-P	GRAVITY TABLE
20-P	ELEVATOR
21-P	ELEVATOR
22-P	SEED TREATER
23-P	ELEVATOR
24-P	BAGGING SYSTEM
25-P	MAIZE SIZER (NOT SHOWN)
C1-C5	HOLDING BIN, HOPPER BOTTOM

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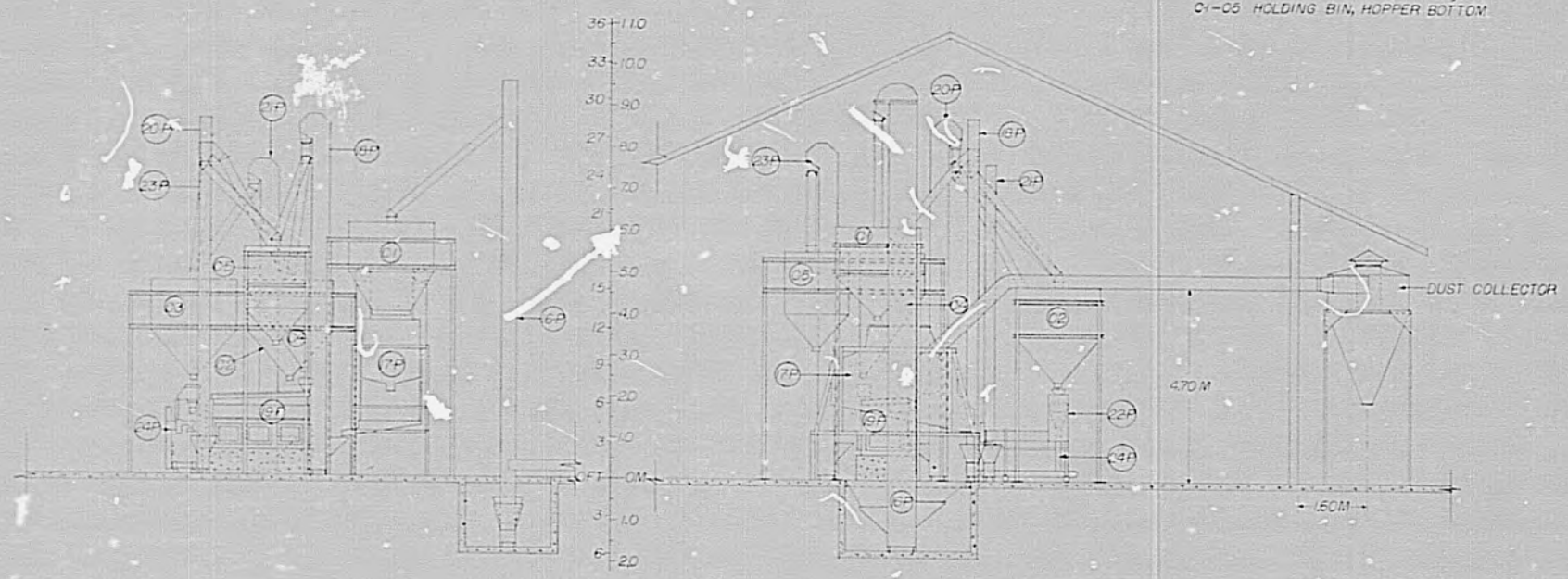
SEED TECHNOLOGY LABORATORY
STATE COLLEGE, MISSISSIPPI

FLOOR PLAN, TYPE "C" PLANT
BURMA, M.O.P.

DESIGNED BY: JCD, AHB, ERC
DRAWN BY: ERC
APPROVED BY: JCD
DATE: JULY, 1982
FILE NO.
SHEET 13 OF 23

LEGEND

ITEM	DESCRIPTION
16-P	RECEIVING ELEVATOR
17-P	AIR-SCREEN CLEANER
18-P	ELEVATOR
19-P	GRAVITY TABLE
20-P	ELEVATOR
21-P	ELEVATOR
22-P	SEED TREATER
23-P	ELEVATOR
24-P	BAGGING SYSTEM
25-P	MAIZE SIZER (NOT SHOWN)
C1-C5	HOLDING BIN, HOPPER BOTTOM



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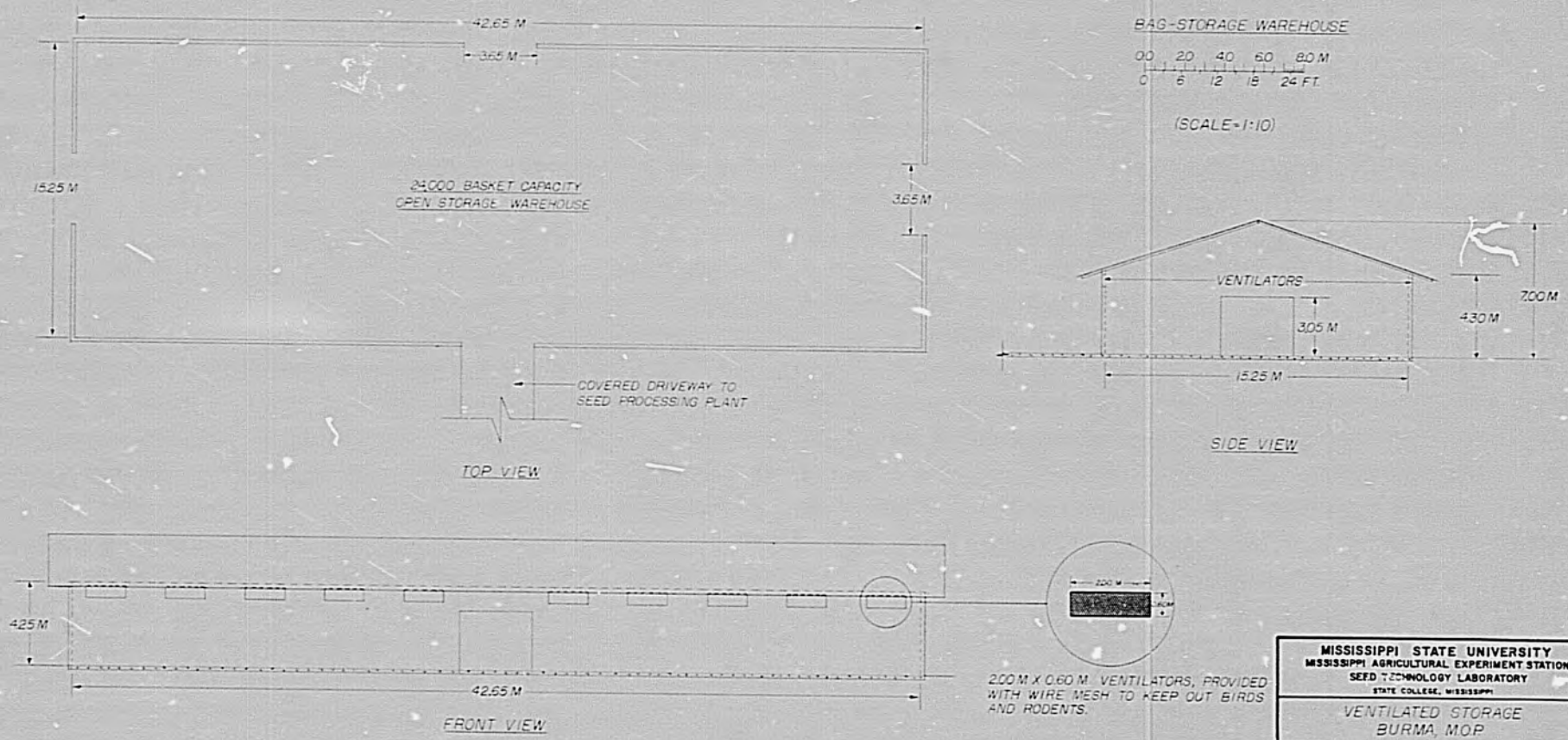
STATE COLLEGE, MISSISSIPPI

ELEVATION VIEWS, TYPE "C" PLANT
BURMA, M.O.P.

DESIGNED BY: JCD, ANB, ERC	DATE: JULY, 1972	SHEET 14 OF 23
DRAWN BY: ERC	FILE NO.	
APPROVED BY: JCD		



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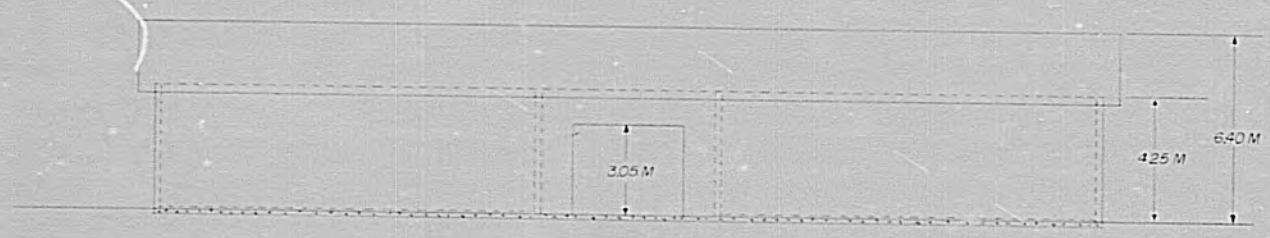
VENTILATED STORAGE
BURMA, MOP

DESIGNED BY: JCD AHB ERC	DATE: JULY, 1982	SHEET 15 OF 23
DRAWN BY: ERC	FILE NO.	
APPROVED BY: JCD		

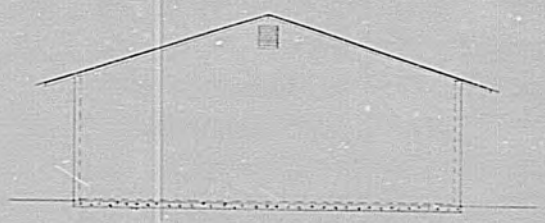
TOP VIEW

CONDITIONED STORAGE ROOMS
GENERAL DIMENSIONS
(SCALE = 1:75)

0 10 20 30 40 50 M
0 3 6 9 12 15 FT.



FRONT VIEW



SIDE VIEW

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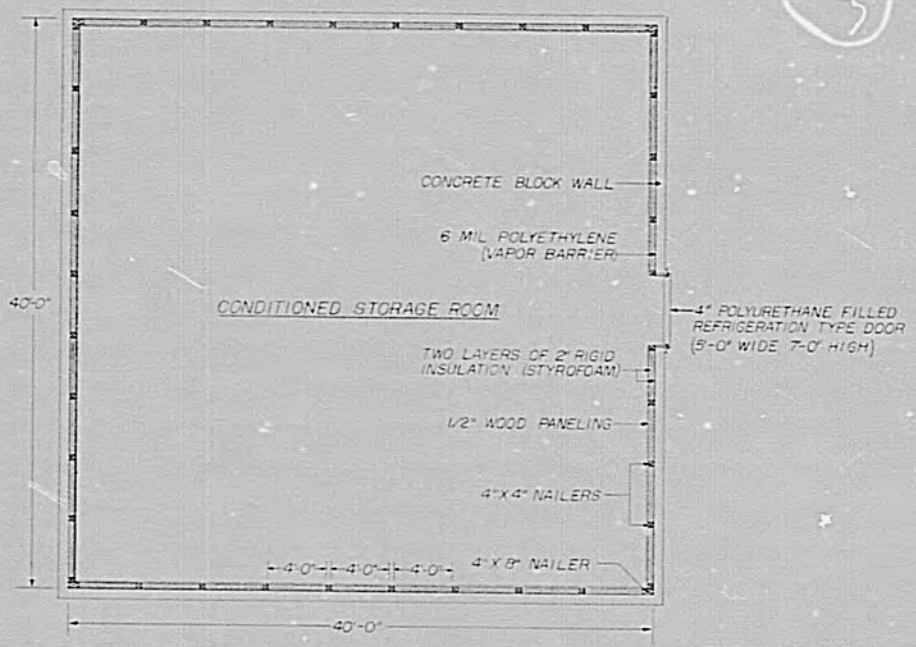
STATE COLLEGE, MISSISSIPPI

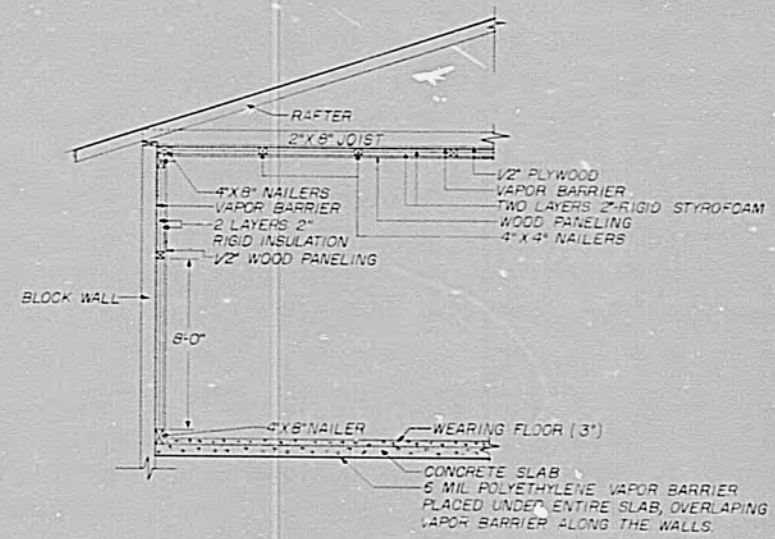
CONDITIONED STORAGE, GENERAL LAYOUT
BURMA, M.O.P.

DESIGNED BY: J.C.D. AHB E.T.C.	DATE: JULY, 1982	SHEET 16 OF 23
DRAWN BY: E.R.C.		
APPROVED BY: J.C.D.	FILE NO.	



TOP VIEW

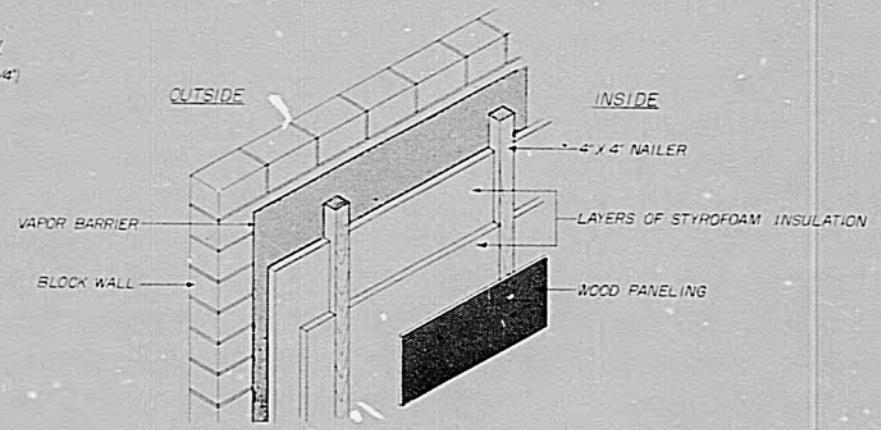
(SCALE=1'-0":1/4")



SIDE VIEW

(SCALE=1'-0":3/8")

NOTE: USE LUMBER OF SHOWN DIMENSIONS



DETAILS OF INSTALLATION OF INSULATION

(NO SCALE)

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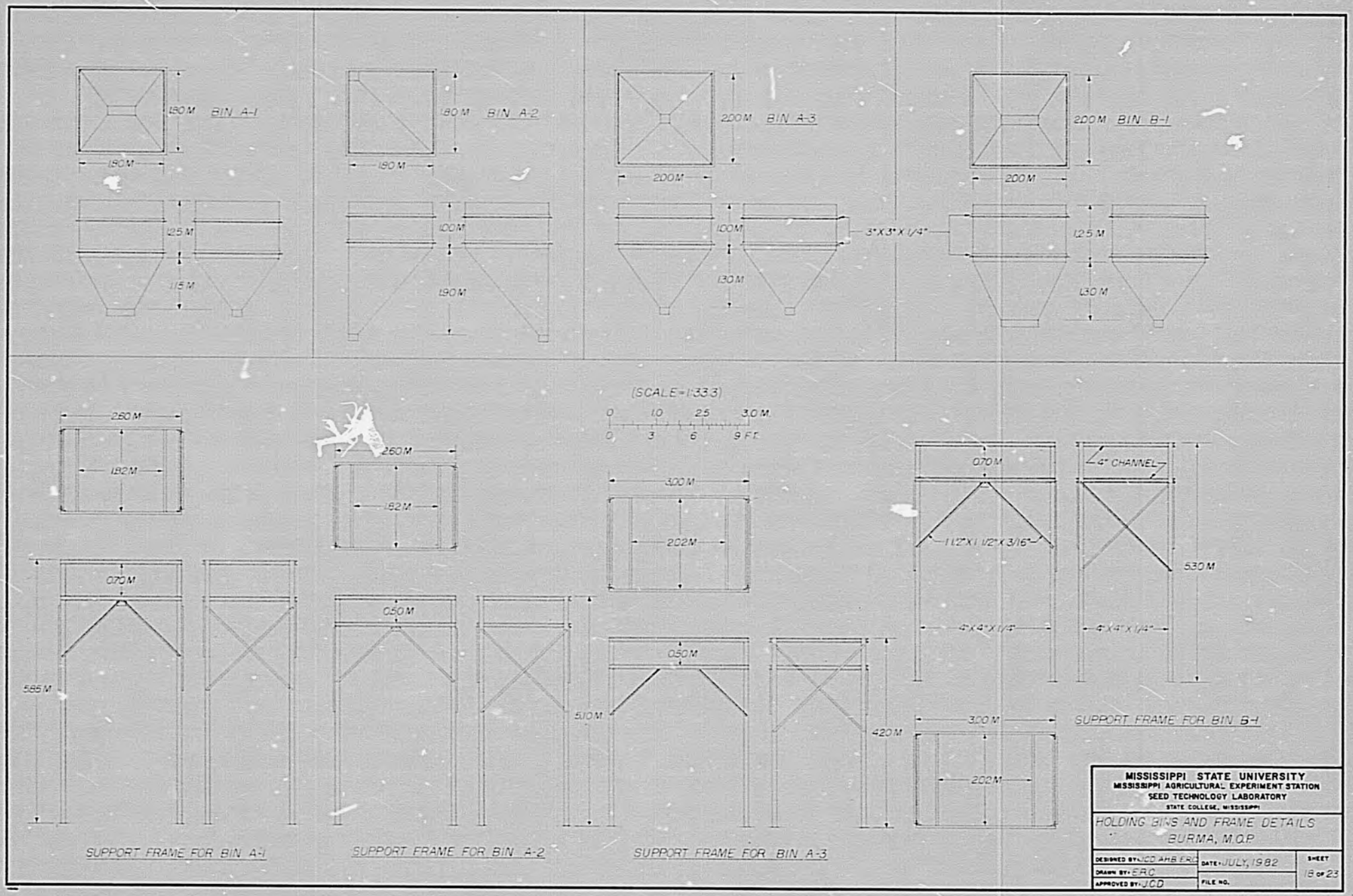
SEED TECHNOLOGY LABORATORY
STATE COLLEGE, MISSISSIPPI

CONDITIONED STORAGE-DETAILS
BURMA, M.O.P.

DESIGNED BY: JCD AHR ERC	DATE: JULY, 1982	SHEET 17 OF 23
DRAWN BY: E.R.C.	FILE NO.	
APPROVED BY: J.C.D.		



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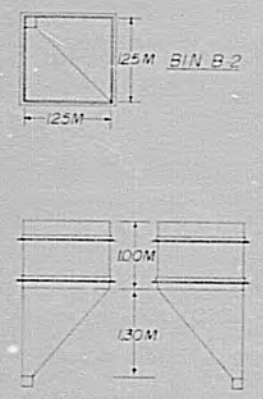
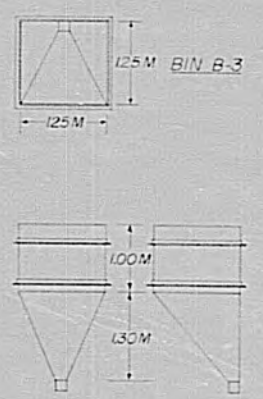
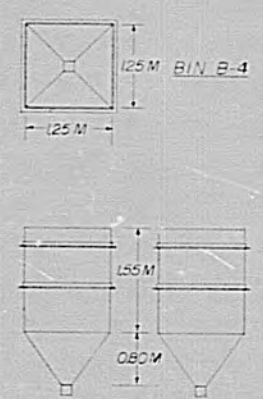
STATE COLLEGE, MISSISSIPPI

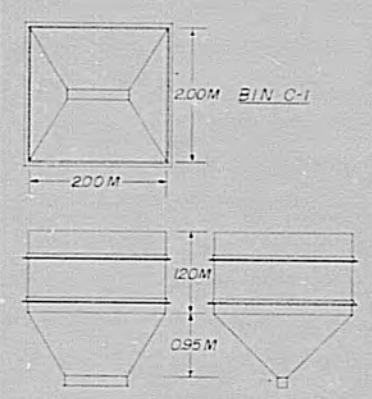
HOLDING BINS AND FRAME DETAILS
BURMA, M.O.P.

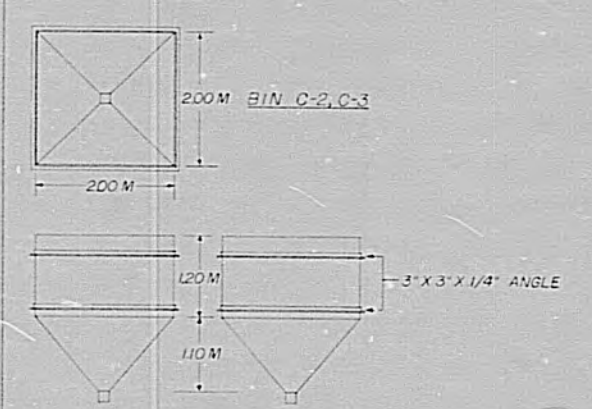
DESIGNED BY: JCD AHB ERC	DATE: JULY, 1982	SHEET 18 OF 23
DRAWN BY: ERC	FILE NO.	
APPROVED BY: JCD		

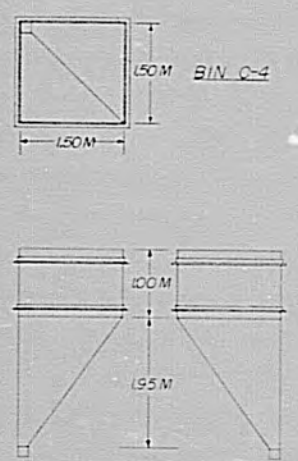


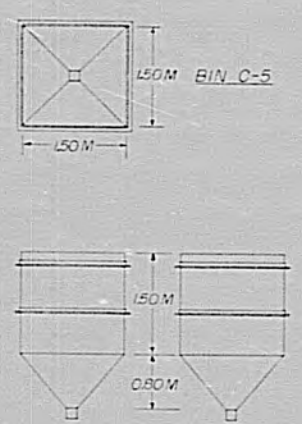


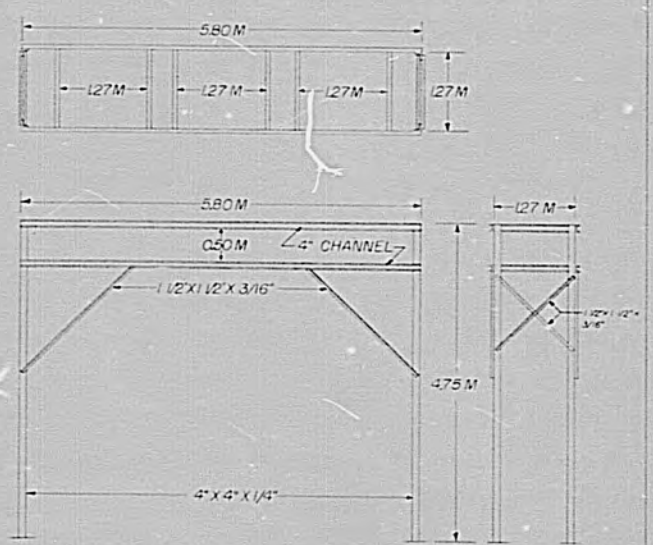




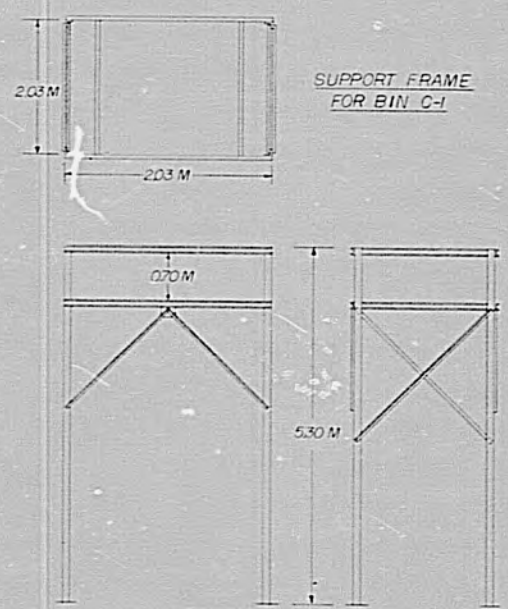








SUPPORT FRAME FOR BINS B2, B-3, B-4



SUPPORT FRAME FOR BIN C-1

(SCALE = 1:33.3)

0 1.0 2.0 3.0 M
0 3 6 9 FT

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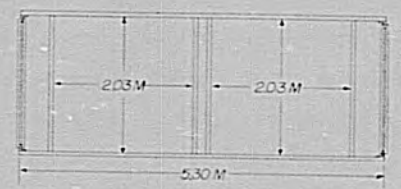
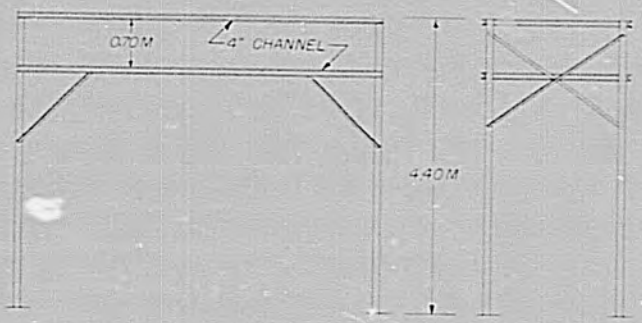
MISSISSIPPI AGRICULTURAL EXPERIMENT STATION
SEED TECHNOLOGY LABORATORY
STATE COLLEGE, MISSISSIPPI

HOLDING BINS AND FRAME DETAILS
BURMA, M.O.P.

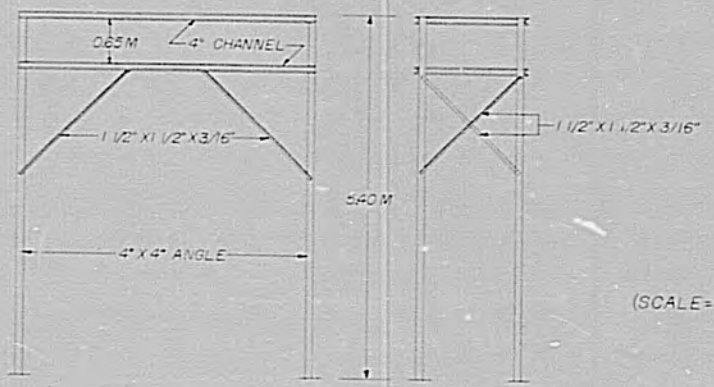
DESIGNED BY: J.C.D. A.H.B. E.R.C.	DATE: JULY, 1982	SHEET 19 OF 23
DRAWN BY: E.R.C.		
APPROVED BY: J.C.D.	FILE NO.	



FRAME SUPPORT FOR BINS C-2 C-3



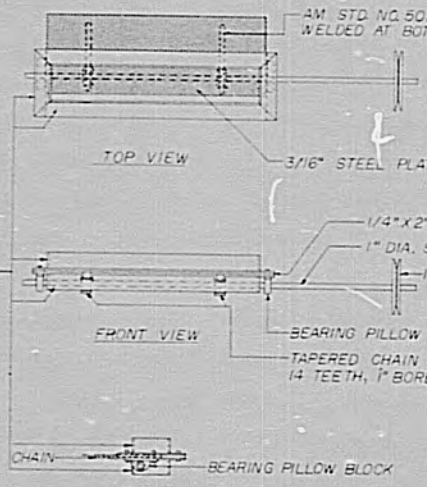
FRAME SUPPORT FOR BINS C-4 C-5

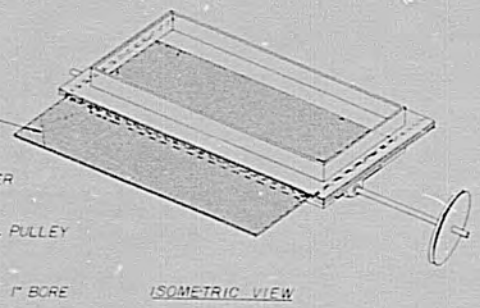


(SCALE = 1:33.3)

NOTE: SHUT-OFF GATE DIMENSIONS TO BE ADJUSTED ACCORDING TO HOLDING BIN DISCHARGE DIMENSIONS

NOTE: SHUT-OFF GATE INSIDE DIMENSIONS FOR BINS A-2 A-3 TO BE 20 CM.

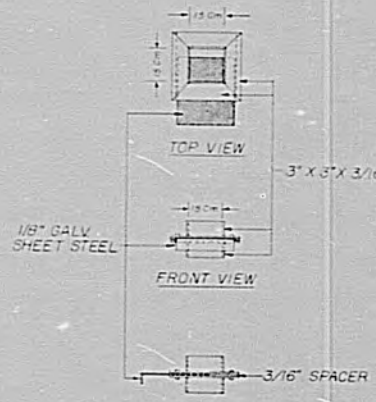


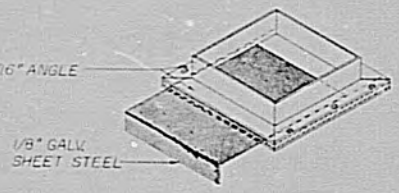


ISOMETRIC VIEW

SHUT-OFF GATE FOR BIN HOPPERS
A-1, B-1, C-1

0 0.5 1.0 M
(SCALE = 1:10)





ISOMETRIC VIEW
(NO SCALE)

SHUT OFF GATE FOR BIN HOPPERS
A-2, A-3, B-2, B-3, B-4, C-2, C-3, C-4, C-5
(SCALE = 1:10)

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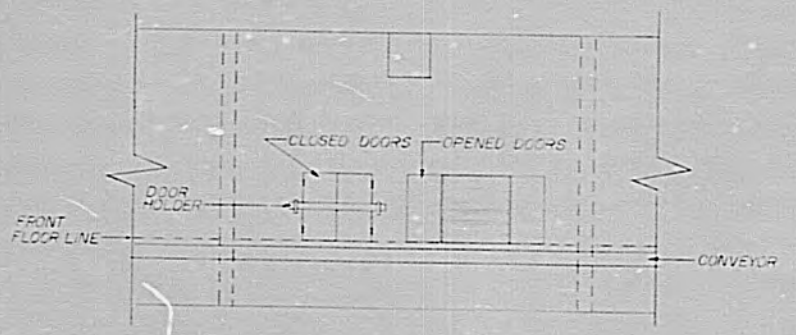
FRAME SUPPORTS AND SHUT-OFF GATES
BURMA, M.O.P.

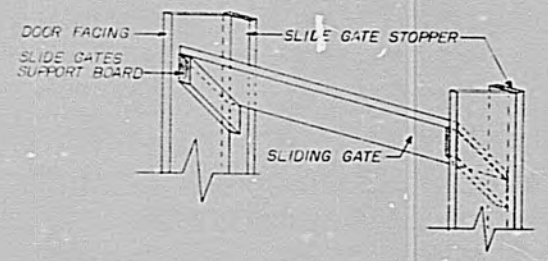
DESIGNED BY: J.C.D. A-H.3. E.R.C.	DATE: JULY, 1982	SHEET 20 of 23
DRAWN BY: E.R.C.	FILE NO.	
APPROVED BY: J.C.D.		



EAR CORN DRYING UNIT

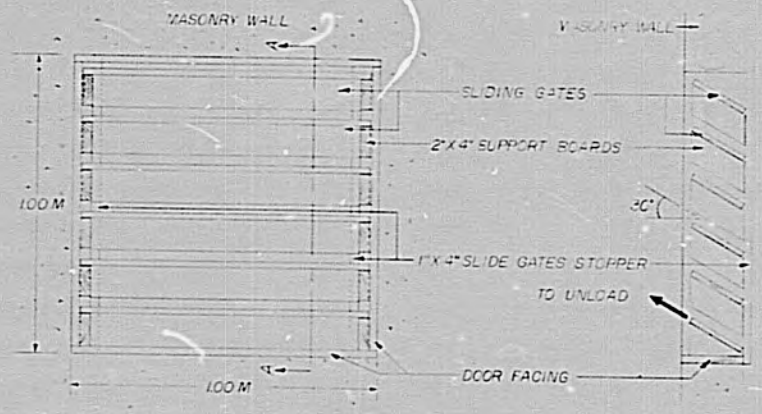
FRONT VIEW

(SCALE = 1:23.3)



ISOMETRIC VIEW

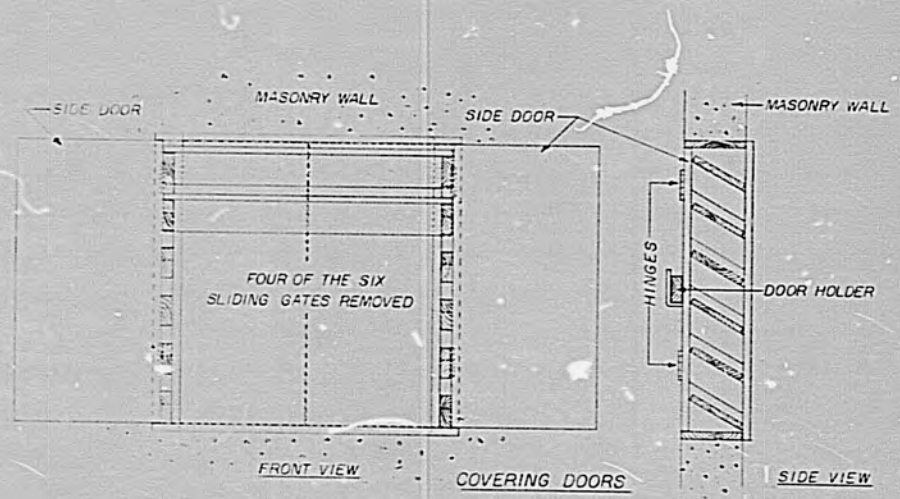
(NO SCALE)



FRONT VIEW

UNLOADING GATE

SECTION A-A



FRONT VIEW

COVERING DOORS

SIDE VIEW

SCALE = 1:7.5

0 0.5 1.0 M

0 6 12 INCHES

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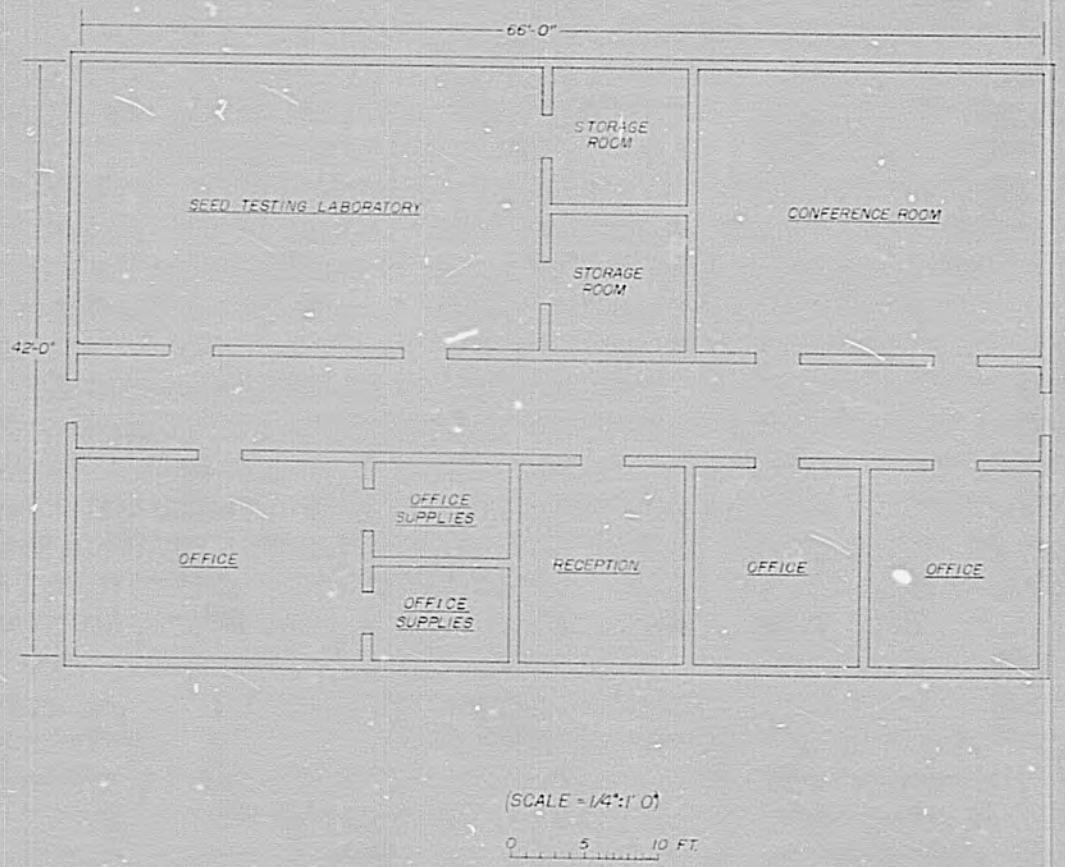
EAR CORN DRIER UNLOADING GATE DETAILS
BURMA, M.O.P.

DESIGNED BY: J.C.D, A.H.B, E.R.C	DATE: JULY, 1982	SHEET 21 OF 23
DRAWN BY: E.R.C.	FILE NO.	
APPROVED BY: J.C.D.		



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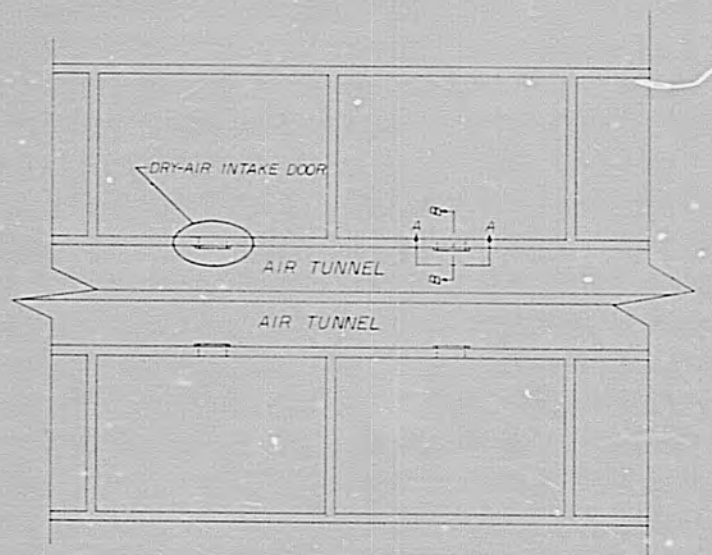
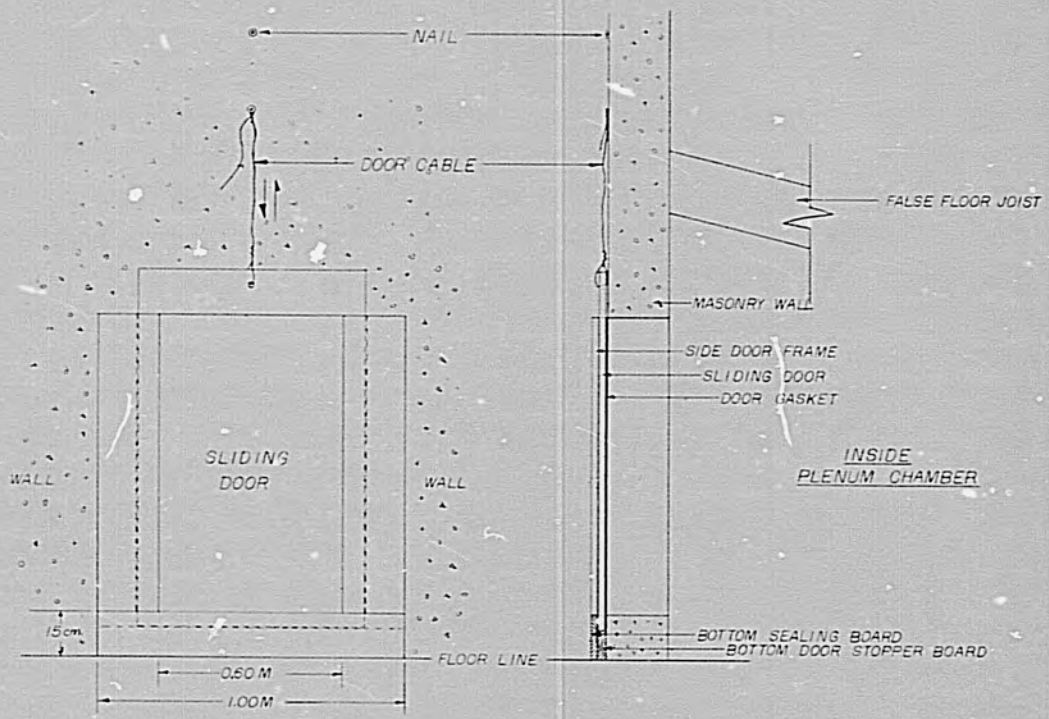
LABORATORY-OFFICE BUILDING
BURMA, M.O.P.

DESIGNED BY: JCD, AHB, ERC	DATE: JULY, 1982	SHEET 22 OF 23
DRAWN BY: ERC	FILE NO.	
APPROVED BY: JCD		



LOCATION OF DRY-AIR INTAKE DOORS

(SCALE = 1:50)

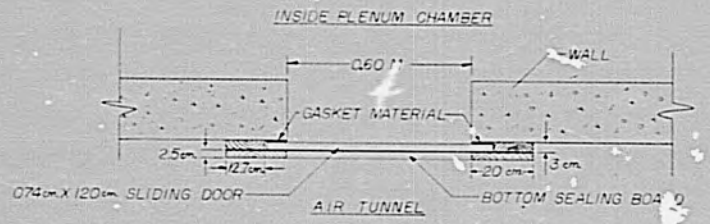


SECTION A-A

SECTION B-B

(SCALE = 1:75)

0 0.5 1.0 M



TOP VIEW

(SCALE = 1:75)

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INSTALLATION OF DRY-AIR INTAKE DOOR
BURMA, M.O.P.

DESIGNED BY: ICD, AHB, ERC	DATE: JULY, 1982	SHEET 23 OF 23
DRAWN BY: E.R.C.	FILE NO.	
APPROVED BY: J.C.D.		