Section No. 1-00
E. A. No. 761.10-4-488
Date: March 20, 1964
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Approved by: RPS

Revised July 9, 1965

1-00 General Design Basis

The conception of this project stems from:

1) Forecasted sales of aroclors in excess of our present capacity.

2) The desirability of up to 30% more capacity than indicated in sales forecasts.

3) Anticipated need for facilities for higher chlorinated aroclors than now produced.

4) The desire to upgrade existing operations so that production can be expanded without additional labor.

5) The need for more HCl recovery capacity at Anniston to match higher aroclor production.

Evaluation studies by engineering have indicated the desirability of expanding capacity at both Krummrich and Anniston. Evaluation grade estimates by Engineering for the Anniston aroclor phase of the expansion, together with rough estimates based on TSD work at both plants, were used to scope out the desired project with the Product Director, the Director of Engineering and the Technical Production Manager. The estimated cost is $750,000; this amount is the limit which will be committed rather than a specific estimate based on a well defined scope. In effect, the scope will be defined so as not to exceed this amount.

The original design basis has been upgraded to include a second appropriation of $350,000 (Project 1772A) and a third appropriation of $214,000 (Project 1931).

1.1 Project Objectives

a) To increase our total aroclor capacity to 80-90 M lbs./yr.

b) To install a separate solid aroclor unit at Anniston designed to minimize present operating difficulties and to increase capacity to approximately 10 M lbs./yr.

c) To increase liquid aroclor capacity at both WGK and Anniston by modifications to the existing chlorinators.

d) To increase muriatic acid capacity at Anniston to match the new chlorinator capacity.

e) Accomplish the above, if possible, without increasing operating labor.

1.2 The Process

1.21 Aroclors are the reaction products formed by the chlorination of biphenyl or terphenyls in the presence of iron and iron chloride catalysts.

Biphenyl or terphenyl is chlorinated to a specified specific gravity or "hold point" which is a measure of chlorine content. The off gas hydrogen chloride is piped to recovery systems.

The crude aroclors are air blown to remove residual hydrogen chloride, then transferred to stills or tanks. The material is distilled under vacuum, semi-continuously, or batchwise, in a direct takeover still with an external gas fired heater.

The distillate from the liquid aroclor distillation is agitated with dry attapulgus earth, filtered and stored for shipment. Distillate from the solid aroclor distillation is drummed, flaked or ground and packaged for shipment. Distillation residues are generally discarded as waste or sold as Montars.

Process documents to be used for detailed design:

"Standard Operating Instructions", July 1964 - J. W. Molloy.

"Process Description for the Manufacture of Aroclor in Dept. 246" December 17, 1962 - E. E. Martin

"W. G. Krummrich Operating Instructions - Dept. 246" September 7, 1961 - E. E. Martin

"Standard Manufacturing Process for Aroclor - Anniston" October 22, 1957 - M. J. Williams & R. L. Hedworth

"Dept. 27 - Operating Instructions" February 20, 1961

"Standard Manufacturing Process for Muriatic Acid" October 22, 1957 - M. J. Williams & R. L. Hedworth

"Final Report on the Continuous Chlorination of Biphenyl" June 4, 1957 - R. A. Simone

"Tentative Process for Continuous Chlorination of Biphenyl" March 23, 1956 - R. A. Simone

"Final Report on the Continuous Chlorination of Aroclors - Plant Demonstration" May 7, 1958 - H. L. Merten

"Process for the Production of Aroclors, Pyranols, Etc. at the Anniston and Krummrich Plants" April, 1955 - E. Mather

1.22 Raw Materials Specifications

Supply

Chlorine is in sufficient supply at the Krummrich Plant. At the Anniston Plant, it is supplied from outside sources when shortages develop.

Biphenyl is in sufficient supply for both plants.

Santowax "R" is in sufficient supply for the solid aroclor production requirement.

Quality

Quality of biphenyl and Santowax "R" is satisfactory. However, the quality of the chlorine is quite variable at both plants. Sulfuric acid carryover in the Krummrich system has resulted in low quality aroclors being produced. Variable air to chlorine ratios will result in chlorine, biphenyl and/or aroclor carryover into the muriatic acid off gas system.

1.23 Products and By-Products

Minor changes to the present chlorinator tank design for solids chlorinations may result in some product differences as measured by isomer ratio of components. Research agrees with this approach however, and the changes envisioned should not affect the finished product specifications for these aroclors.

1.24 Packaging

No changes are contemplated in the existing packaging methods in use at this time. A separate project will be submitted to cover material handling and warehousing.

1.25 Waste Streams

No additions to the waste streams are contemplated.

1.26 Toxicity and Safety

Fire Hazard

Biphenyl has a flash point of 255°F CC and terphenyls a flash point of 340°F. to 410°F. OC. The aroclors do not have any flash points and are considered non-flammable.

Toxicity - Chlorine

Chlorine is an extremely toxic gas. The allowable concentration for an eight hour day is reported to be from 0.35 to 2 parts per million. An exposure of 1000 ppm is rapidly fatal. It is readily detectable by odor at a concentration of 3.5 ppm and 15.1 ppm gives throat irritation.

Toxicity - Biphenyl

Large concentrations of biphenyl vapors cause intoxication. Respiratory equipment should be worn when working in contact with its vapors.

Toxicity - Aroclors

Aroclors can give rise to dermatitis when contacted with the skin. Inhalation of vapors is usally followed by systemic poisoning. Proper protective clothing should be worn when handling aroclors. Respiratory equipment should be used when vapor contact is anticipated.

1.3 The Facilities

1.31 The following facilities will be added to the aroclor department at Anniston:

One 2400 gallon chlorination tank and accessory equipment to be used for solids chlorinations.

One 2500 gallon still pot, external heater, vapor condenser, receiver and ejector system for solids distillations.

One 2000 gallon Monel tank to debottleneck the existing 1242 distillation system.

External coolers on the existing chlorinators.

A chlorine feed control system for each chlorinator.

A therminol heater to provide a heating medium for jacketed process and transfer lines at the solid still and chlorinator.

A new control room at the second or operating level containing instruments for both stills and chlorinators.

Installation of three heavy duty pumps on the chlorinators.

Minor relocations and alterations to equipment in the chlorination area.

New biphenyl feed pump for the continuous chlorinators, and a new transfer pump for the crude material from the continuous chlorinators.

A new tar withdrawal system for the four still units.

A new supervisor's office.

Demisters (Brink type) on all of the chlorinator units with one heat exchanger on the solid system and one on the liquid system to remove any entrainment from the gas stream.

A muriatic acid plant which will include a new absorber and tails tower, carbon towers for continuous processing of muriatic acid solution, relocation of the existing filter and installation of four 18,600 gallon storage tanks for acid.

A vent system for tank truck and tank car loading to remove muriatic acid fumes during loading.

A new motor control center and power transformer and conversion of all existing power circuits from 220 volts to 440 volts.

The following facilities will be added to the aroclor department at Krummrich:

External coolers on 4 of the existing chlorinators (#5 already has one).

New circulating pumps on 4 of the 5 chlorinators (#5 already has been modified).

A chlorine feed control system for each chlorinator.

A gravity indication on one chlorinator system to permit monitoring the course and end point of the reaction without manual sampling.

1.32 Design Capacity

Operating Stream Time

Operating stream time is 7900 hours per year. This assumes 3 shifts per day 7 days per week operation with 10% downtime for necessary repairs.

Rated Annual Capacity

Rated annual capacity will be:

At Anniston	On liquid aroclors	48.6 M lbs./yr.
	On solids aroclors	10.0 M lbs./yr.
	On muriatic acid	32.8 M lbs./yr.
At Krummrich	On liquid aroclors	28.6 M lbs./yr.
	Total Aroclors	87.2 M lbs./yr.

Present capacity of the two plants, based on cost standard rates and on the production shown in the sales forecast is:

At Anniston	On liquids & solids	27.6 M lbs./yr.
At Krummrich	On liquids	20.4 M lbs./yr.
	Total	48.0 M lbs./yr.

Design Capacity

At Anniston

On liquid aroclor products other than Aroclor 1242	3160 lbs./hr.
On Aroclor 1242 thru the continuous unit	2980 lbs./hr.
On solid aroclors thru the new chlorinator	1266 lbs./hr.
On muriatic acid (as 100% gas)	4120 lbs./hr.

At Krummrich

On liquid products 3620 lbs./hr.

Design capacities of the various aroclors are as follows:

At Anniston

Chlorination-Liquid Aroclors	Batch	Continuous
Chlorinator Size	940 gals.	940 gals.
Chlorinator Loading	58%	51%
Number of Chlorinators	Four (4)	Four (4)
Cycle	Variable	Continuous
Productivity/hr. of aroclor	790 lbs.	2980 lbs.

Distillation-Liquid Aroclors

Type of operation	Semi-continuous
Number of stills	Three (3)
Size of still pots	1285 gallons
Productivity per still per hour	
No. 1	1550 lbs.
No. 2	2300 lbs.
No. 3	2300 lbs.

Chlorination-Solid Aroclors

Type of operation	Batch
Chlorinator size	2400 gallons
Number of chlorinators	One (1)
Cycle	Variable
Productivity per hour of aroclor	1480 lbs.

Distillation-Solid Aroclors

Type of operation	Batch
Number of stills	One (1)
Size of still pot	2500 gallons
Productivity per hour	1266 lbs.

At Krummrich

Chlorination - Liquid Aroclors

Type of operation	Batch
Chlorinator Size	1090 gallons
Chlorinator Loading	60%
Number of Chlorinators	Five (5)
Cycle	Variable

Distillation - Liquid Aroclors

Type of operation	Semi-continuous
Number of stills	Two (2)
Size of still pots	
No. 1	1280 gallons
No. 2	2500 gallons
Productivity/hr. of Aroclor	3620 lbs.

1.33 Flexibility of Operation

Chlorination

Addition of external air cooling to the chlorinators will allow the chlorinators to operate at increased capacity. We expect from this change a capacity increase of 40% at Krummrich and 25% at Anniston.

External air cooling eliminates the need for water cooling to jackets and coils and will result in less operating downtime and lower maintenance costs.

Distillation

A commercially designed heater of correct design should result in some fuel savings and some maintenance savings. A unit of this type will be installed on the new solids still at Anniston and will provide comparative data for replacement heaters for the future.

A separate Therminol heater to provide hot Therminol for line heating at the new solids still at Anniston will result in greater throughput due to decreased blockages from frozen lines. Aroclor 1268 has a hold point of 150 to 170°C and the other solid aroclors have high viscosities at relatively high temperatures.

Installation of a new 2000 gallon receiver for Still No. 3 in place of the existing 1000 gallon receiver will result in a 4-1/2 hr. blend and filtering cycle instead of the existing 9 hr. cycle.

Time cycle for the new solid distillation will be:

Charge	1.0 hr.
Heat Up	2.0 hrs.
Distill	10.2 hrs.
Empty	2.0 hrs.
Xtra	1.8 hrs.
Total	17.0 hrs.

1.34 Future Expansion

If the large chlorinator proves feasible, the present batch type chlorinators can be replaced with a saving in space and attendant production increase.

Additional still capacity can be added at Anniston in the existing Bldg. 27 by replacing existing systems with larger units. Additional still capacity at Krummrich may have to go on a new structure north of the existing control room and office.

1.35 Physical Appearance

At Anniston

Consolidation of chlorination and distillation controls in a new control room will allow us to dismantle the existing control rooms. The west section of Bldg. 27 will be dismantled to provide space for the new solids still.

Existing No. 2 Blowing Tank in the chlorinator area will be dismantled. The Motor Control Center will be installed in a new structure immediately under the control room.

At Krummrich

No extensive changes are contemplated except those changes which will be a part of the debottlenecking work.

1.36 Raw Material and Product Storage and Shipping Requirements

No additional storage tanks are provided for in this project. Storage capacity at the completion of this project and TSD projects underway is listed below:

Intermediate Storage	Anniston	Krummrich
Blowing Tanks	1 - 750 gal. (cont.) 4 - 2,500 gal.	2 - 2,200 gal.
Still Feed Tanks	1 -10,000 gal. 1 -12,000 gal.	None
Still Receivers	2 - 1,000 gal. 2 - 2,000 gal.	2 - 1,000 gal.
Blend Tanks Filter Receivers Flaker Hold Tank	6 - 2,000 gal.	4 - 2,000 gal.
Finished Storage	60,000 gal.	116,000 gal.

1.4 Service Requirements

1.41 Utilities

Utilities are now available in both plant areas. The use of highly efficient still heaters should partly offset any additional gas consumption required for increased production.

The use of external air cooled heat exchangers will actually decrease the amount of cooling water now required.

Electric power consumption will increase, and a new power transformer will be installed to satisfy the new loading.

1.42 Services

At Anniston

A new supervisor's office will be added. No other additions to service facilities are planned at this time.

At Krummrich

No additions are planned at this time.

1.43 Personnel

At Anniston

For Entire Dept.	One chief operator
For Chlorinators	One ~~head~~ operator. One operator who assists the ~~head~~ operator and operates the muriatic system.
For Stills and Filter	One operator.
For Flaker	One operator utilized on an overtime basis.
Drumming and Biphenyl Flaking	Two laborers who drum aroclors, bag flaked material, flake and bag biphenyl and clean cars.

At Krummrich

For Chlorinators Stills, Blending and Filtering	One chlorinator-still operator. One operator who charges the chlorinators, earth treats the distilled product and filters and makes the Pyranol Blends
Drumming	

No change in labor requirements, either additions or deletions, are contemplated by this project.

1.5 Costs

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1.51 Capital Cost Estimate

An equipment list, instrument list, process piping diagram, definitive scope and preliminary layouts were used in establishing the cost estimate for the aroclor additions at the Krummrich and Anniston Plants.

1.52 Manufacturing Cost Estimate

Manufacturing cost estimates were made by scaling up both the Krummrich and Anniston aroclor plant variable costs from the standards of January 1, 1964 and leaving the cost of labor unchanged. Repair costs and depreciation were scaled upward based on the new capital that is being added to the two plants. The cost estimate as submitted is based on Production Dept. estimates.

1.53 Scope of Work

Scope of work for the aroclor and muriatic acid plants is based on definitive definition of the additions proposed at Anniston and Krummrich.

1.6 Plans and Schedules

Engineering design is complete. The Krummrich phase of the work will be carried out first, followed by the Anniston phases. Target dates are:

June 15, 1964 complete design package for Krummrich Plant.

July 1, 1964 start construction at Krummrich Plant.

September 1, 1964 complete construction at Krummrich Plant
start construction at Anniston Plant.

May 15, 1965 complete construction of aroclor facilities at Anniston Plant.

July 15, 1965 complete construction of muriatic acid facilities at Anniston Plant.

Oct. 1, 1965 complete construction of miscellaneous additions.