DOE/PC/92205--T1

BENCH-SCALE TESTING OF THE MULTI-GRAVITY SEPARATOR IN COMBINATION WITH MICROCEL

Contract No: DE-AC22-92PC92205
First Quarterly Report

DOE/PC/92205--T1

DE93 009703

Reporting Period:
September 29, 1992 to December 31, 1992

Prime Contractor:

Virginia Center for Coal and Minerals Processing
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061-0258

Subcontractors:

Carpco, Inc.
Roberts & Schaefer Company
Consolidation Coal Company
Kerr-McGee Coal Corporation

Prepared for:

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U.S./DOE Patent Clearance is not required prior to the publication of this document.

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1.0 Abstract

Work during the past quarter was primarily directed towards development of the various project plans and modification of the ET Test Area. The requested modifications included extending the existing floor drain system and flight conveyor. In addition, a two-story mezzanine was added in the northeast corner of the ET Test Area. All modifications were completed according to schedule.

The preliminary drafts of the project plans were completed and submitted to DOE/PETC on October 19, 1992. Reviewers' comments were returned to the VCCMP on November 24, 1992. The plans were amended according to the reviewers' comments and the final versions resubmitted on December 7, 1992.

Work was also initiated on the preliminary circuit design. Flowsheets showing the solid and liquid material balances were developed for each proposed circuit layout. A preliminary list of required process equipment was prepared; thus allowing for development of plan drawings showing initial equipment placement within the CPPRF.

2.0 Project Objectives

The primary objective of the proposed work is to design, install and operate an advanced fine coal processing circuit combining Microcel and MGS technologies. Both of these processes have specific advantages as stand-alone units. For example, the Microcel column is effective in removing ash-bearing mineral matter, while the MGS is capable of efficiently removing coal-pyrite composites. Therefore, by combining both of these unit operations into a single processing circuit, synergistic advantages can be gained. As a result, this circuit arrangement has the potential of improving coal quality beyond that which could be achieved using either one of the technologies individually.

In addition to the primary objective, secondary objectives of the proposed test program will include:

- *Circuit Optimization:* The performance of each unit operation, individually and combined, will be optimized by conducting parametric studies as a function of key operating variables. The goal of this work will be to maximize the rejections of pyritic sulfur and ash while maintaining a high energy recovery.

- *Process Variability:* The steady-state performance of the optimized processing circuit will be studied (i) by conducting several long-duration test runs over a period of several days and (ii) by testing coal samples from other sources specified by the participating coal companies.

- *Process Evaluation:* Detailed technical and economic evaluations will be conducted to examine the feasibility of the proposed concept for fine coal cleaning on an industrial scale. This evaluation will include a projected cost-benefit analysis and a review of all test data, engineering analyses, scale-up procedures, and process deficiencies.

The test work will be conducted at the Pittsburgh Energy Technology Center's Coal Preparation Pilot Research Facility (CPPRF) located in Pittsburgh, Pennsylvania. The CPPRF is a state-of-the-art pilot-scale facility for coal preparation research and testing. The Emerging Technology (ET) section of the pilot plant will be used for testing the combined Microcel and Multi-Gravity-Separator (MGS) circuit. The ET area, and subsequently installed mezzanine, is adjacent to the pilot plant and was established for testing of new and emerging technologies in coal preparation. This facility is ideally suited for pilot-scale test work due to the availability of all necessary ancillary facilities i.e., bulk solids handling, preparation and waste disposal. In addition, the necessary environmental, safety and health aspects related to handling and disposal of coal waste are already in place.

3.0 Project Task Updates

3.1 Task 1.0 - Project Planning

3.1.1 *Development of Project Plans*

An initial project kick-off meeting was held at the Virginia Center for Coal and Minerals Processing (VCCMP) on October 9, 1992. Representatives from each of the major subcontracting organizations were present. The organizations and respective personnel attending were as follows:

- *VCCMP*; Jerry Luttrell - Associate Professor
  Mike Mankosa - Research Scientist
  Keith Kutz - Project Manager
- *Roberts & Schaefer*; Bob Jackson - Project Manager
- *Carpco, Inc*; Steve Hearn - Project Manager

A project summary was presented to the subcontractors and the proposed work plan was discussed. Based on the results of this discussion, work responsibilities, schedules, deadlines and reporting requirements were presented to each subcontractor. The lines of communication between each subcontractor, VCCMP and DOE were also established.

Outlines were developed for the initial drafts of the required project plans immediately after the subcontractor organizational meeting. These included the following:

- ES&H Plan
- Test, Sampling and Analytical Plan

- Project Work Plan
- Coal Procurement, Handling and Logistics Plan
- Decommissioning Plan
- Management Plan
- ET Area Modification Plan
- Hazardous Substance Plan
- Installation and Shakedown Plan
- Procurement and Fabrication Plan
- Labor Plan
- Project Schedule/Milestone Plan

These plans were completed and draft copies submitted to the Contracting Officer's Representative on October 19, 1992. The official DOE project kick-off meeting was also held on October 19, 1992. Representatives from DOE/PETC, VCCMP, Roberts and Schaefer and Gilbert Commonwealth were present. The list of participants and their respective organizations is shown below.

Attendance List - DOE/PETC Kick-Off Meeting (10-19-92)

Organization	Company
US DOE/PETC	Carl Maronde
US DOE/PETC	Bruce Utz
US DOE/PETC	Rick Killmeyer
US DOE/PETC	W.P Barnett
VCCMP	Jerry Luttrell
VCCMP	Mike Mankosa
Roberts & Schaefer	Bob Jackson
Roberts & Schaefer	Bob Sheaffer
Gilbert Commonwealth	Vince Balsone
Gilbert Commonwealth	Paul Zandhuis
Gilbert Commonwealth	Fred Gromicko

At the meeting, the project subcontractors and their responsible parties were presented to DOE/PETC. Organizational charts showing the hierarchy of each organization and among participating subcontractors, VCCMP and DOE were also presented. A technical overview of the proposed project was presented and preliminary equipment descriptions and locations were discussed. A detailed breakdown of the project tasks and subtasks, as outlined in the preliminary statement of work, was also presented. The individual tasks outlined in the project work plan are shown on the detailed project schedule (Figure 1). Roberts and Schaefer concluded the kick-off meeting with a brief description of the proposed CPPRF modifications.

The preliminary project work plans were reviewed and returned to the VCCMP on November 24, 1992. The appropriate corrections were made to each plan, based on the reviewers comments, and the final versions resubmitted to DOE on December 7, 1992.

3.1.2 *Project Reporting*

The required monthly project reports have also been submitted as outlined in the final Project Work Plan. These reports were submitted on the twenty-fifth of each month, starting in November, 1992, and included the following:

- Project Status Report
- Summary Report
- Milestone Schedule Status
- Cost Management report

All reports have been submitted and the overall project is up-to-date according to the detailed project schedule shown in Figure 1.

3.2 Task 2.0 - CPPRF Modification

During final negotiations for the award of this contract, DOE/PETC requested additional cost proposals for seven (7) permanent modifications to the existing CPPRF. Three (3) of these modifications (numbers 1, 2 and 4) were accepted and included as Task 2 in the Scope of Work of this Contract. DOE/PETC's schedule called for the CPPRF modifications to be completed by December 31, 1992.

Roberts & Schaefer Company was given full responsibility by VCCMP for all modifications. The work to be performed in Task 2 consisted of the following:

- *Modification #1* - Addition of two structural steel platforms to be installed in the north-east corner of the building (ET Area) and to be contiguous with the existing floors at elevations 1096'-6 and 1106'-6.

- *Modification #2* - Extension of the existing floor drainage trench system into the shipping area to confine potential spills and washdown water within the building.

- *Modification #4* - Extension of the existing flight conveyor into the shipping area so that material can be discharged directly into a dump truck.

At this point, modifications 1 and 2 have been completed. The design effort for Modification 4 was delayed at the request of DOE/PETC.

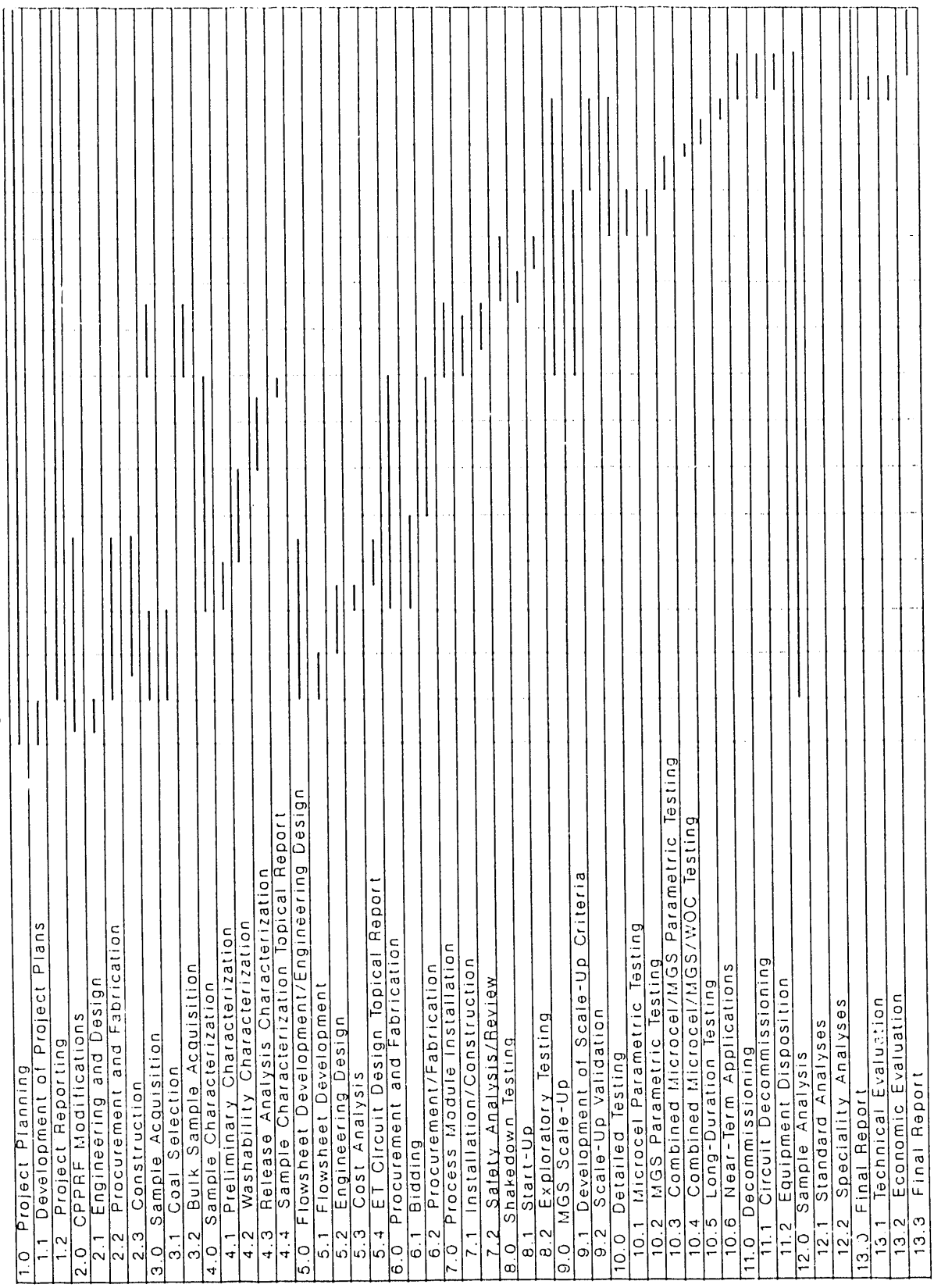

Figure 1. Detailed Project Schedule

3.2.1 *Engineering and Design*

3.2.1.1 Design Drawings

Based on direct site evaluation and construction blueprints for the existing CPPRF, a series of design drawings were generated for bid, procurement and construction of the facility modifications. Several series of field measurements were completed by Roberts and Schaefer, since "as-built" drawing were not available from DOE/PETC. The complete design consists of the following drawings:

D1400 - General Structural Steel and Foundation Notes
D1401 - Plan of New Floor Trench Extension and Pier Details
D1402 - Plans and Elevations of New Floor Extension Platforms
D1403 - Elevations and Misc. Sections of New Floor Extension Platforms
D1404 - Electrical Lighting for New Floor Extension Platforms
D1405 - Piping for Washdown Water and Floor Drains

The construction drawings are available upon request.

3.2.1.2 Design Description for Modification #1

The new platforms at elevations 1096'-6" and 1106'-6" were designed to match the existing CPPRF structure where practical. In addition, the following design specifications were also included.

- Platforms were designed for 150 PSF floor loading plus 2000 lb. point loading.
- Floor surfaces were constructed from 3/8" checkered plate and were to include floor drains.
- Floor and toe plates were to be sealed with silicone to facilitate washed down.
- The existing knee-brace support for the overhead air handler platform was to be replaced with a structural post support located on the 1106'-6" elevation.
- The handrail and caged ladder from the existing sludge storage tank were to be relocated and used for the new platforms.
- The structure for the new platforms was to be connected only to the existing CPPRF structure and not supported or stabilized in any way by the building columns or walls.
- Each platform was to be fitted with a 9'-0 x 4'-6 removable hatch.

In addition, the following items were to be completed by PETC using existing contractors.

- The existing fire protection sprinkler system would be extended into the new platform areas under an existing contract with All Systems, Inc.
- Fire extinguishers would be furnished and installed under an existing contract with a fire extinguisher sales and service organization.
- Washdown stations would be furnished and installed by Gilbert/Commonwealth.

3.2.1.3 Design Description for Modification #2

The new floor trench extension was designed to match the existing CPPRF floor trench system where practical. The design is such that neither washdown water nor accidental spills can by-pass the trench system. The new trench extension was designed to slope 1/8" per linear foot and drain into the existing system; thus negating the need for an additional sump/pump. Floor grating for the new trench extension was designed for H-20 loading (capable of supporting trucks) and the concrete was designed with a 5000 psi compressive strength.

3.2.2 *Procurement/Fabrication/Construction*

The subcontract for the fabrication, construction and installation of Modifications #1 and #2 was competitively bid. Installation of the Microcel column was also included in the scope of work. Beitzel Corporation of Grantsville, MD (the low bidder) was awarded a firm lump-sum contract on November 24, 1992. Beitzel moved onto the work site on December 7, 1992. Work was initiated after completing the Pre-Construction Conference conducted by PETC.

The initial task involved removal of existing concrete for the floor trench and piers. This task took somewhat longer than anticipated. In addition, weather delays were encountered which precluded work from noon on December 10 to 7:00 a.m. on December 14, 1992. To compensate for the delays an accelerator was added to the concrete mix for the column piers to speed-up the curing process. As a result, the original 5000 psi compressive strength was derated by 20% to 4000 psi. Minor interferences with conduit on the north building wall were also encountered. The conduit was relocated as an approved extra by DOE/PETC. In total, Beitzel worked 103 premium time hours to meet the project deadline. All contract modifications were approved prior to execution by DOE/PETC.

A final inspection of the work was made by Roberts & Schaefer, DOE/PETC, and Beitzel on December 23, 1992. Verbal approval was given by all parties. The total of extra work performed by Beitzel was $4,931.00. It is anticipated at this time, that the cost of the extra work will be offset by potential savings in Tasks 6 and 7. Work was completed and the

contractor moved off-site on Wednesday, December 23, 1992.

3.3 Task 3.0 - Sample Acquisition

3.3.1 *Coal Selection*

The Pittsburgh No. 8 and Illinois No. 6 seam coals were selected for evaluation in this project, since these coals are well-known for their large reserve base and relatively high pyritic sulfur content. Other coal samples will be tested if time permits. Preliminary samples (approximately 400 lbs) of each of the base coals have been collected. These samples have been crushed to a 1/4-inch top size using a laboratory jaw crusher followed by a roll crusher. The subsequent sample was split into four 100 pound lots. A single 100 lb lot from each coal sample was then further reduced to 32 individual increments. The remaining 300 pound bulk sample for each coal seam was sealed in a 55-gallon drum and inerted. The individual increments have been stored in a laboratory freezer to minimize oxidation. A preliminary analysis of the Pittsburgh No. 8 seam coal indicated feed ash and total sulfur contents of 18.58% and 3.08%, respectively. The Illinois No. 6 seam coal has not been analyzed.

3.4 Task 4.0 - Sample Characterization

3.4.1 *Preliminary Characterization*

A variety of laboratory characterization studies are planned to evaluate the potential cleanability of the base coal samples. These will include, at a minimum, centrifugal washability and release analysis. Preliminary plans are to evaluate each coal at three different grind sizes (-28 mesh, -65 mesh and -200 mesh). In each case, a 90% passing size will be used as the defining criteria.

3.5 Task 5.0 - Flowsheet Development/Engineering Design

3.5.1 *Flowsheet Development*

A schematic diagram of the proposed test circuit is shown in Figure 2. The primary separators in the test circuit are the Microcel column flotation cell, water-only cyclone (WOC) and multi-gravity separator (MGS). The circuit has been designed so that each unit can be tested independently or in series with other units. Three independent feed sumps have been also been included in the circuit. The sumps will be designed with a built-in overflow system to maintain a constant level and each unit will have a separate circulation pump and agitator for maintaining the solids in suspension. In addition to the process feed sumps, a waste sump/sump will be installed on the bottom floor (elev. 1086'-6) to collect all circuit products and for transfer to the CPPRF thickener.

The preliminary instrumentation is also shown in Figure 2. The anticipated instrumentation for the proposed circuit includes the following:

- Nuclear density gauges
- Magnetic flow meters
- Paddle-wheel flow meters
- Differential/Absolute pressure gauges
- Electronic metering pumps
- Automatic control valves
- PID controllers
- High/Lo level controllers

The proposed instrumentation will be used to stabilize and control the circuit to ensure steady-state operation.

Estimates of liquid and solid flow rates have been determined for the proposed circuit based on previous work conducted with the Microcel flotation column and preliminary data collected with the MGS. The four proposed test circuits are as follows:

- Column Flotation
- Multi-Gravity-Separator
- Column Flotation/MGS Combined
- Column Flotation/WOC/MGS Combined

Figure 3 shows the flow balance for the proposed column flotation circuit. In this case the column will be operated independently to determine the range of operating parameters for each of the two test coals. In addition, performance data for a surface-based separation process will be established. Figure 4 shows a similar flow balance for the MGS. This circuit will also be used to determine the range of operating parameters and establish separation characteristics for the MGS.

Figure 5 shows the combined circuit flowsheet for series testing of both the Microcel and MGS. In this case, the column product reports directly to the MGS feed sump via a rotary foam-breaker. The intention of this circuit design is to illustrate the advantages in metallurgical performance of the combined circuit. The final flowsheet, shown in Figure 6, includes a water-only cyclone in series between the flotation column and MGS. Preliminary data indicate that a substantial portion of clean coal can be extracted from the column product stream prior to entering the MGS. This approach greatly reduces the feed rate to the MGS, thus reducing the number and/or size of MGS units. In all cases, the circuit product and reject streams report to the process waste sump and are conveyed to the CPPRF thickener.

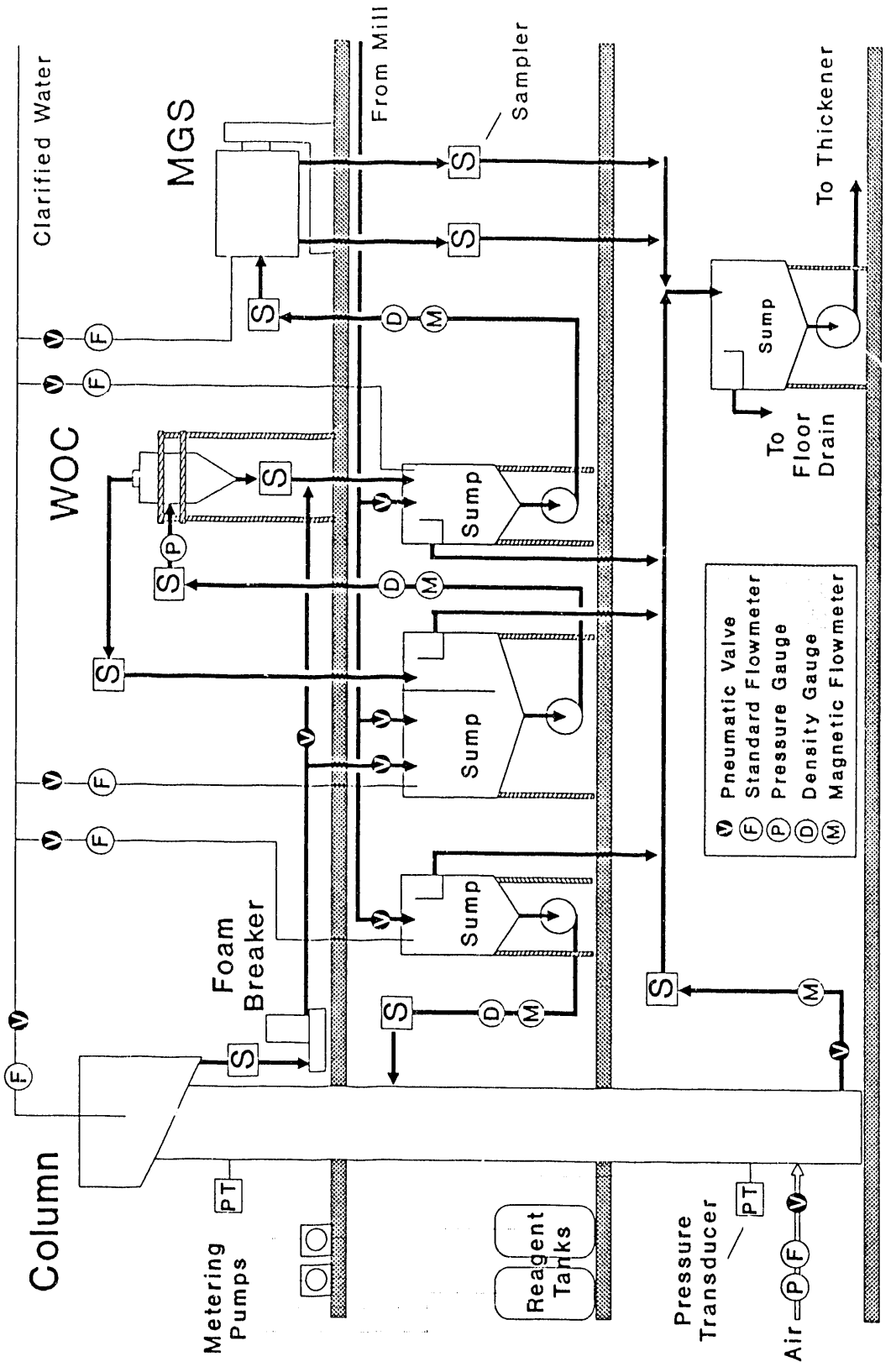

Figure 2. Proposed Project Test Circuit.

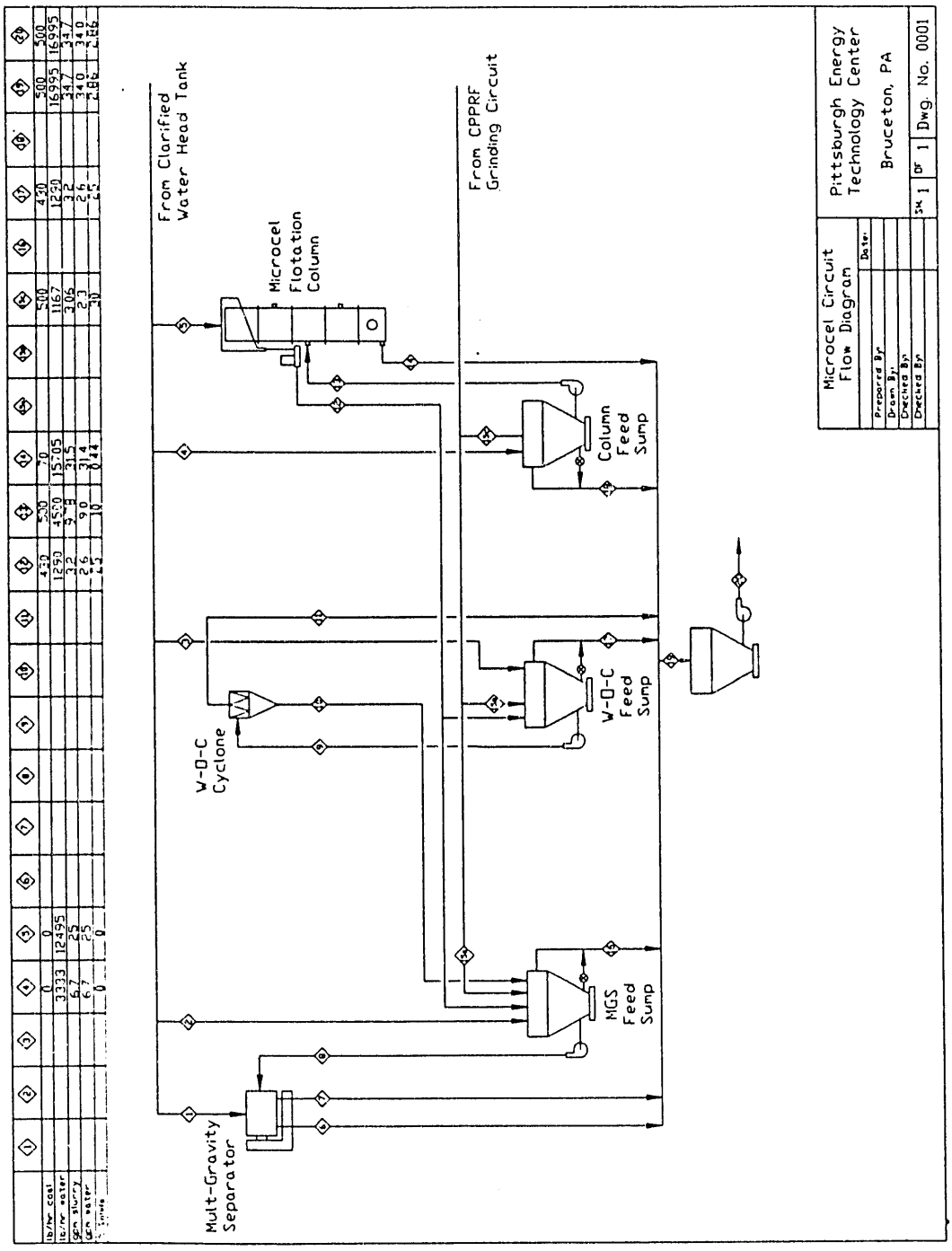

Figure 3. Column Flotation Preliminary Circuit Flowsheet.

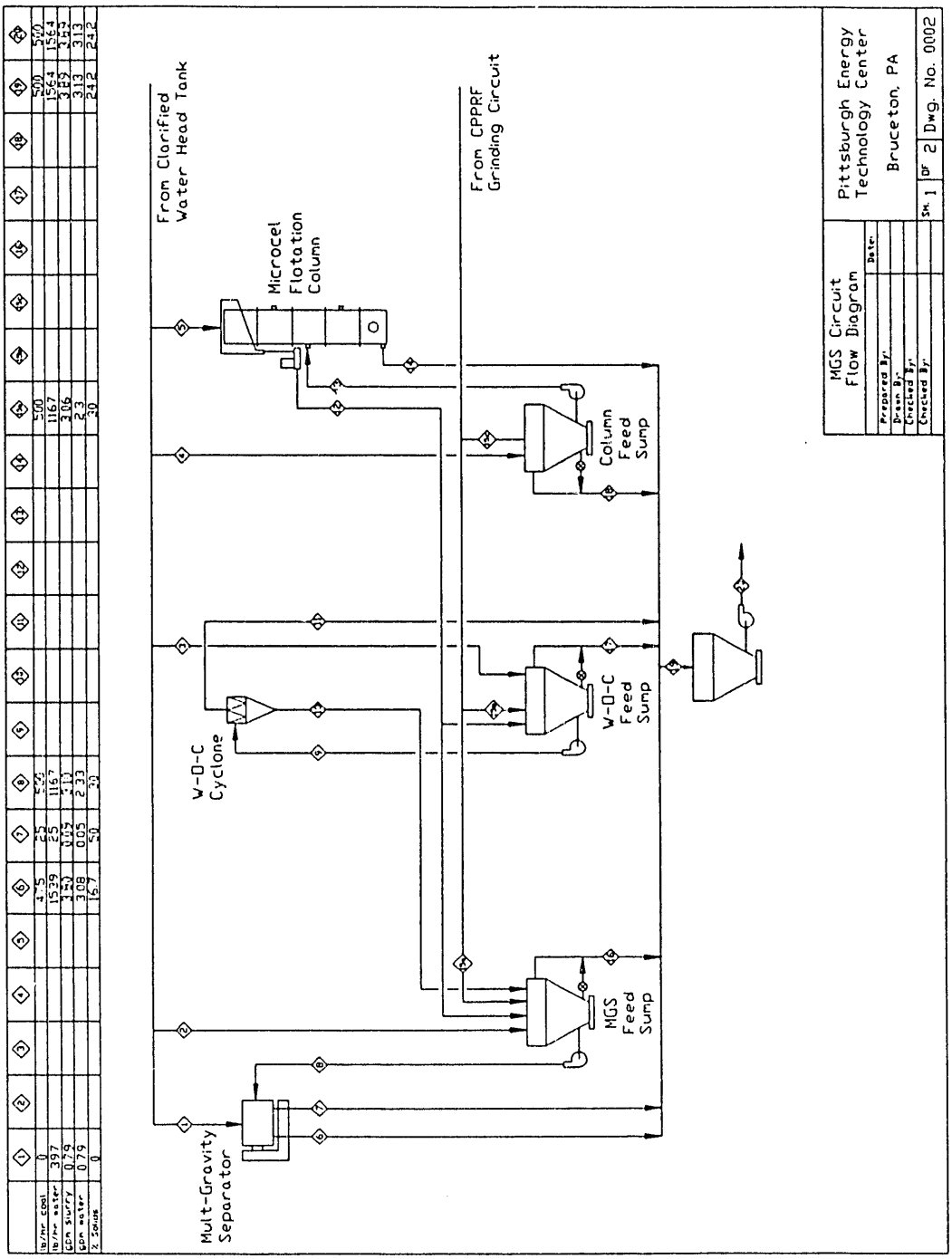

Figure 4. MGS Preliminary Circuit Flowsheet.

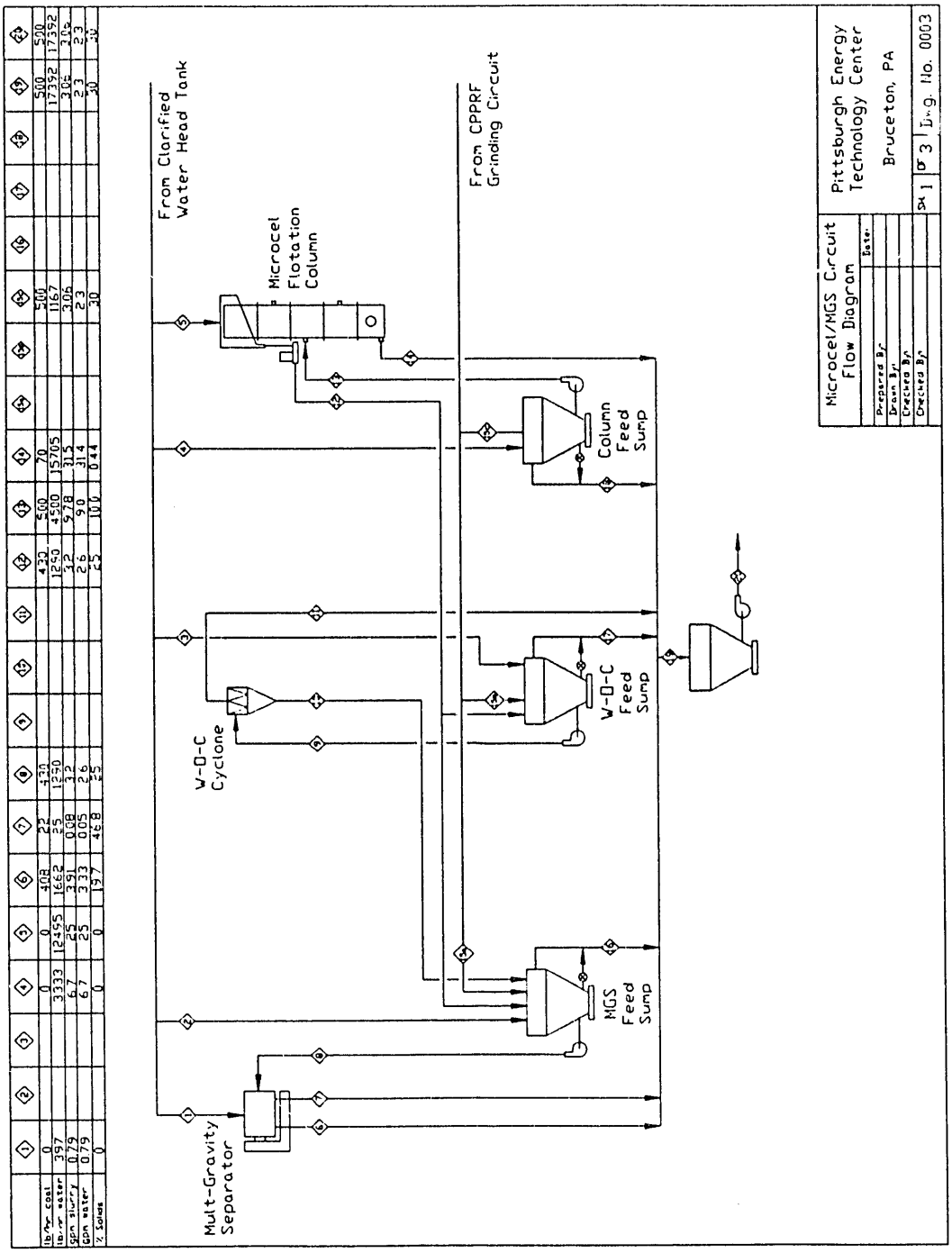

Figure 5. Column/MGS Preliminary Circuit Flowsheet.

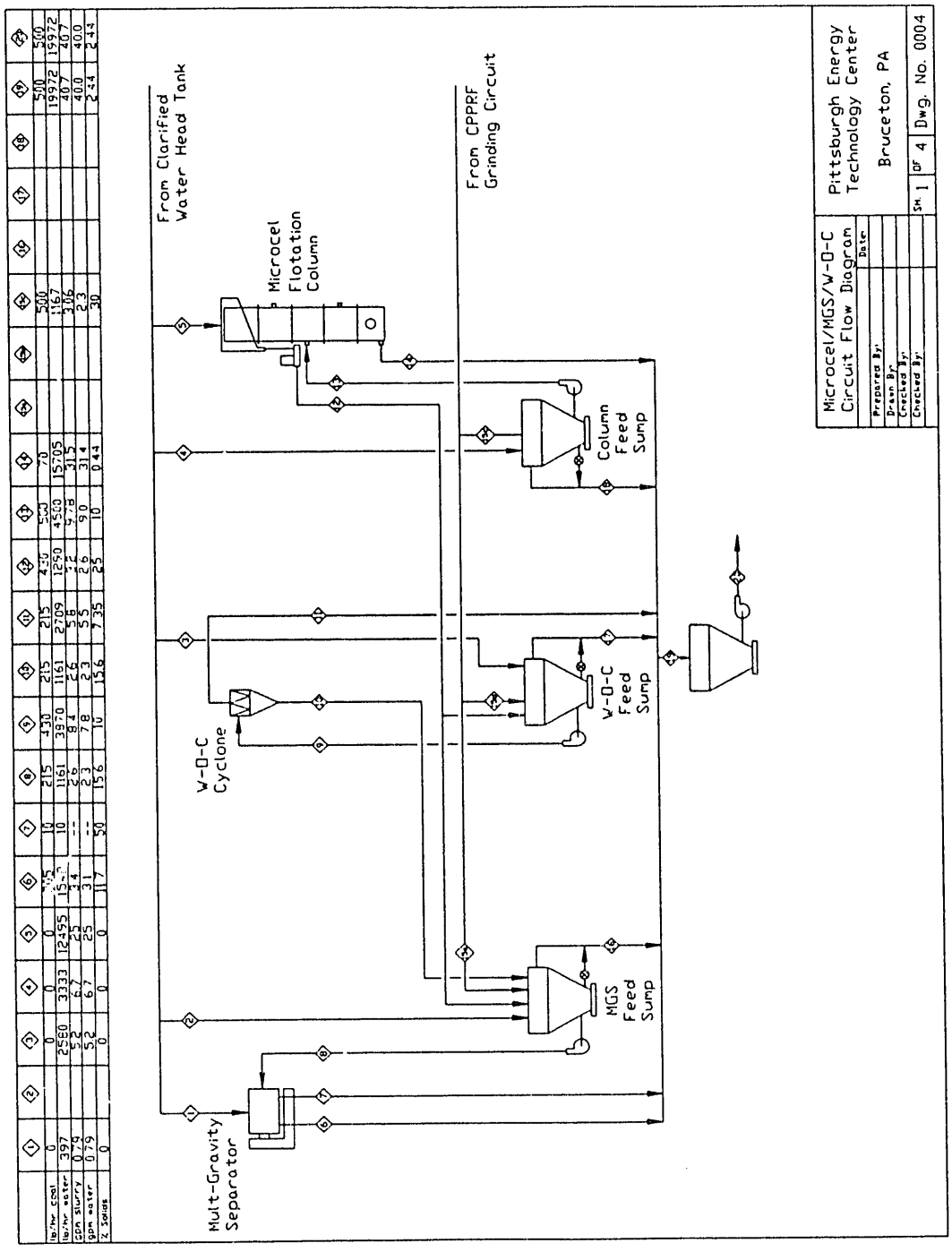

Figure 6. Column/WOC/MGS Preliminary Circuit Flowsheet.

3.5.2 *Engineering Design*

Engineering design for the proposed test circuit is currently underway. Proposed equipment and locations within the newly installed mezzanine have been finalized. It is planned at this time to utilize PTI's existing structure for location of several pieces of process equipment. Plan views showing equipment locations and clearances are shown in Figures 7-9. Figure 7 (elev. 1106'-6) shows the location of the MGS, flotation column, reagent sumps/pumps and water-only cyclone. Figure 8 (elev. 1096'-6) shows the location of the process feed sumps/pumps and the column bubble generation pump. The bottom floor (elev. 1086'-6), shown in Figure 9, will house the process waste sump/pump. Elevation drawings are shown in Figures 10-13. The final engineering design will also consist of the following items:

- Detailed equipment listing including unit size, capacity, power requirements, air/water requirements and operating limitations.

- A final process flowsheet summarizing piping layout, valves, pumps, sampling points, process control instrumentation, etc. Complete material balances will be projected for the entire circuit.

- Engineering drawings detailing the construction, fabrication and installation of all components. The drawings will specify spatial layout, electrical requirements, piping arrangements and associated mechanical/electrical specifications.

- CPPRF Integration Plan/Schedule which outlines the specific requirements for integrating the proposed test circuit into the existing facility.

All of the engineering design information will be included in an ET Circuit Design Topical Report. This report will be prepared by the VCCMP and R&S and submitted to the DOE COR for approval. Final approval will be obtained prior to initiation of any additional work elements.

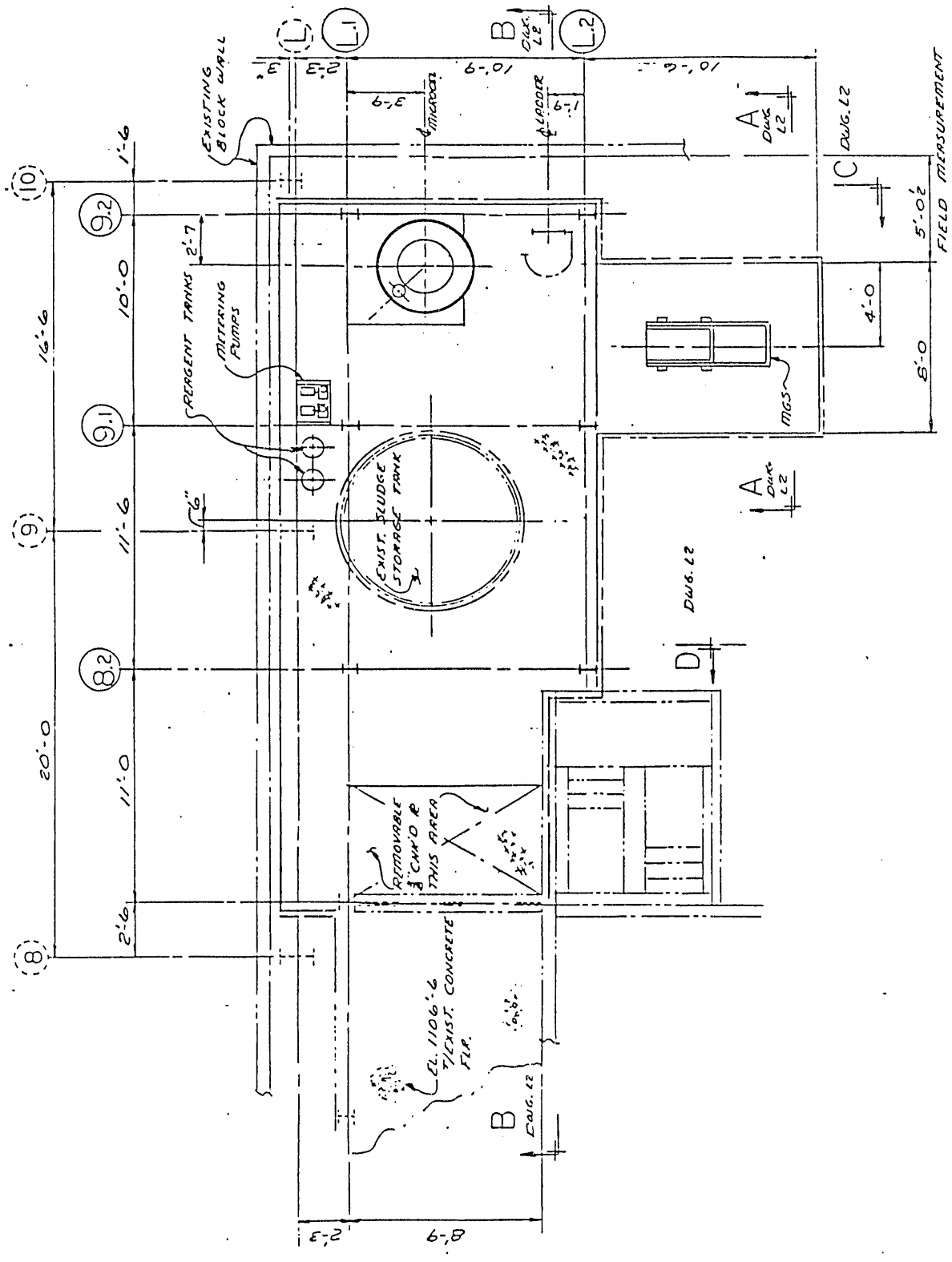

Figure 7. Plan View Elevation 1106'-6.

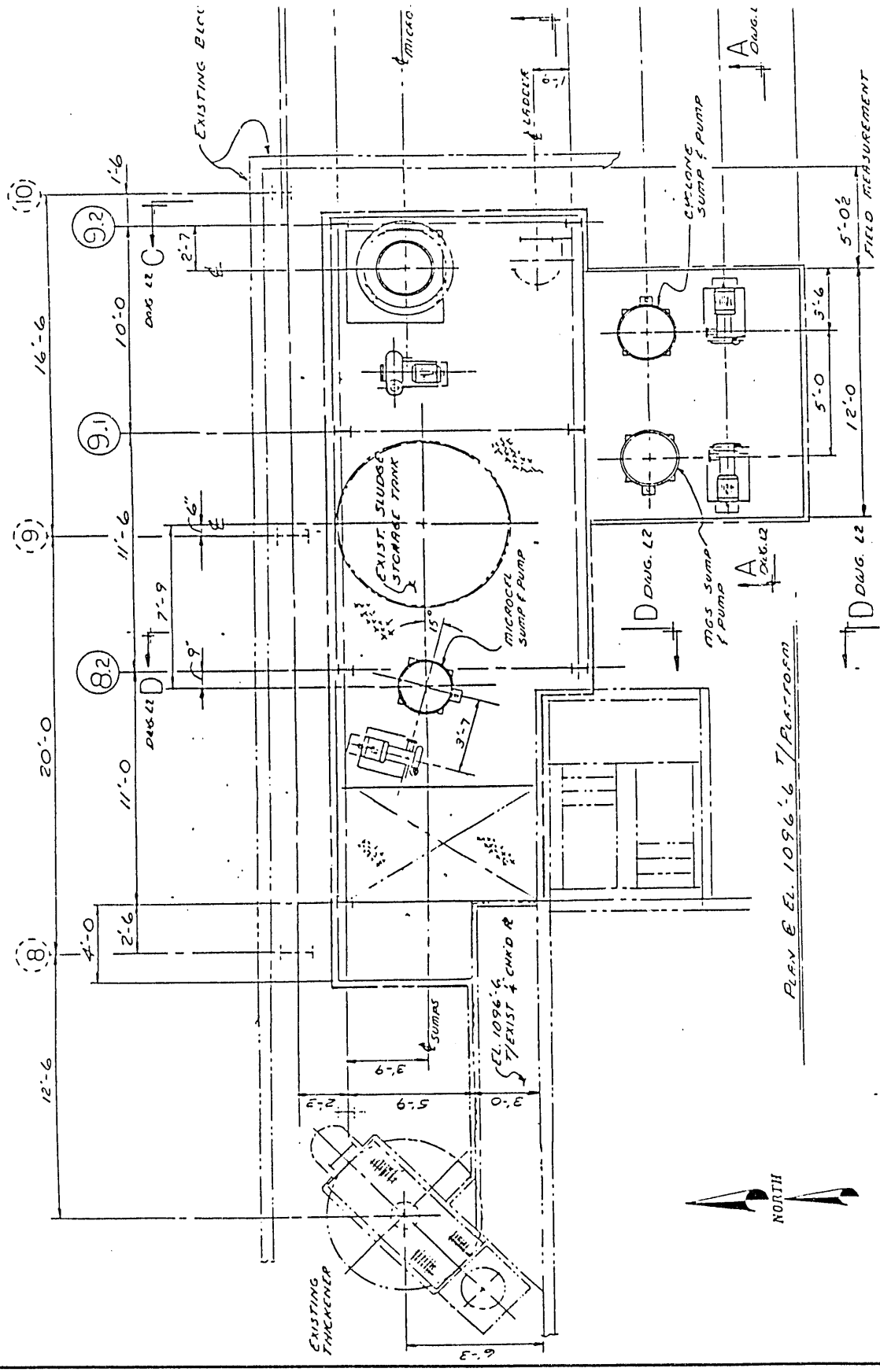

Figure 8. Plan View Elevation 1096'-6.

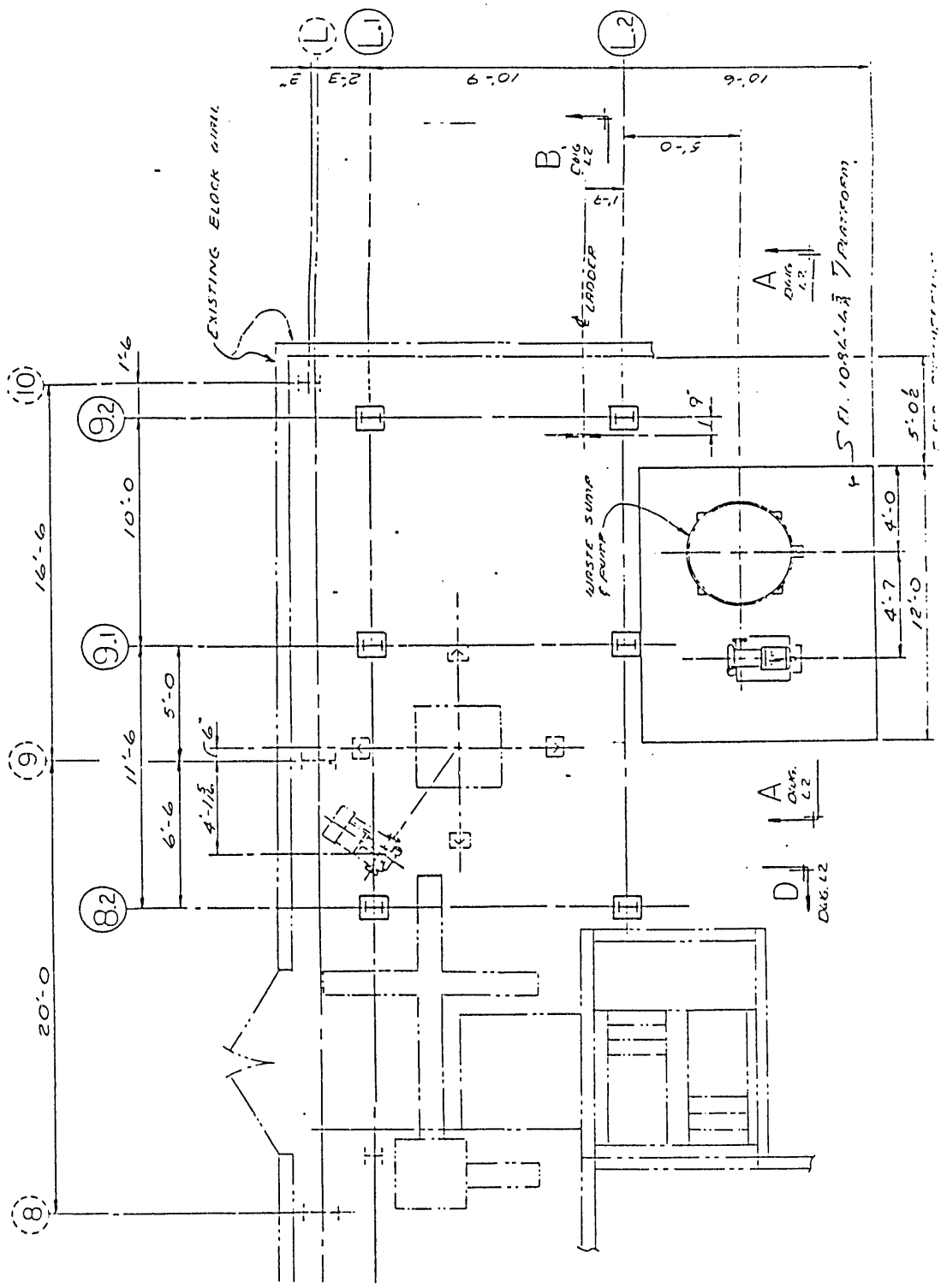

Figure 9. Plan View Elevation 1086'-6.

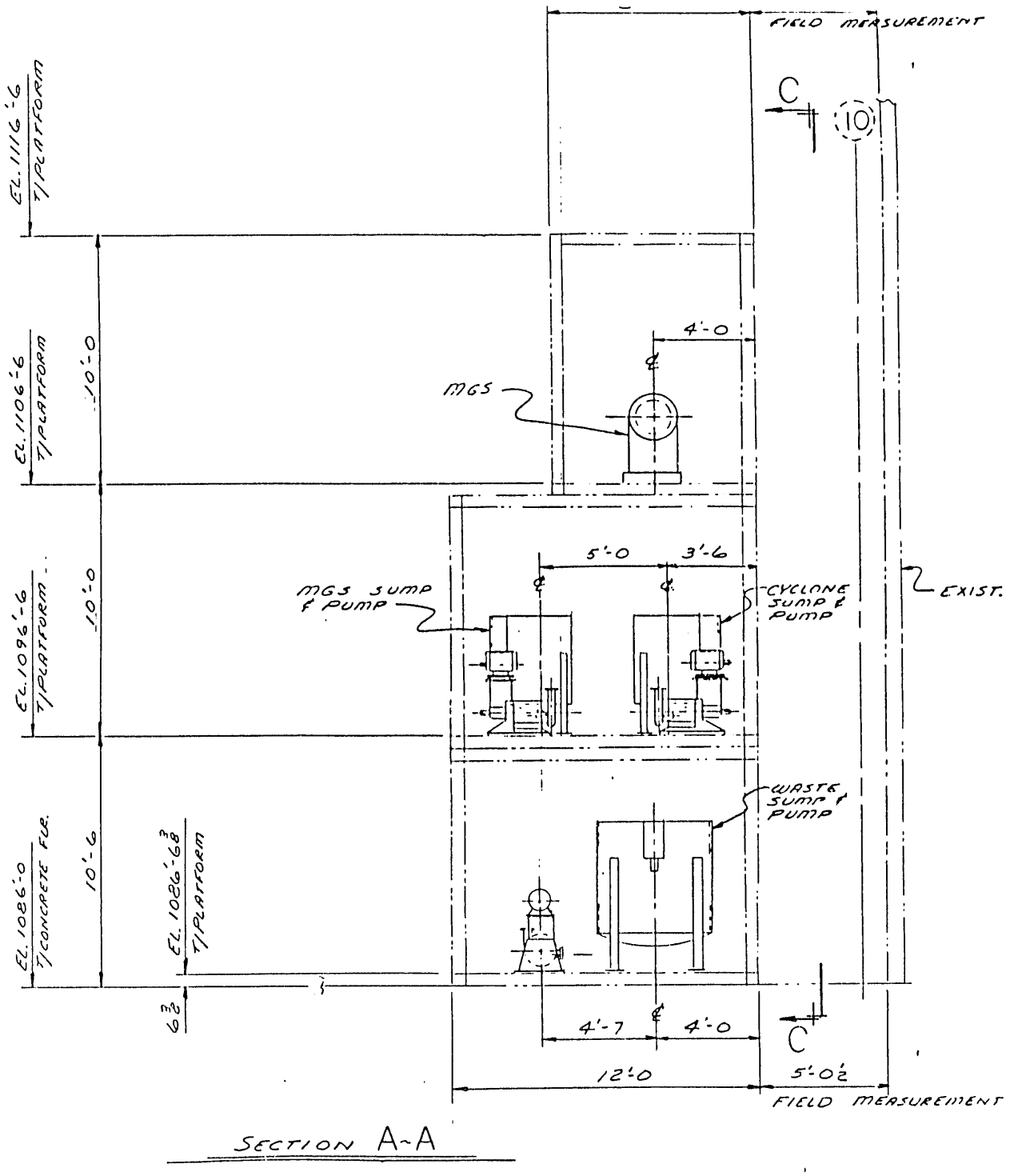

Figure 10. ET Circuit Elevation - Section A-A.

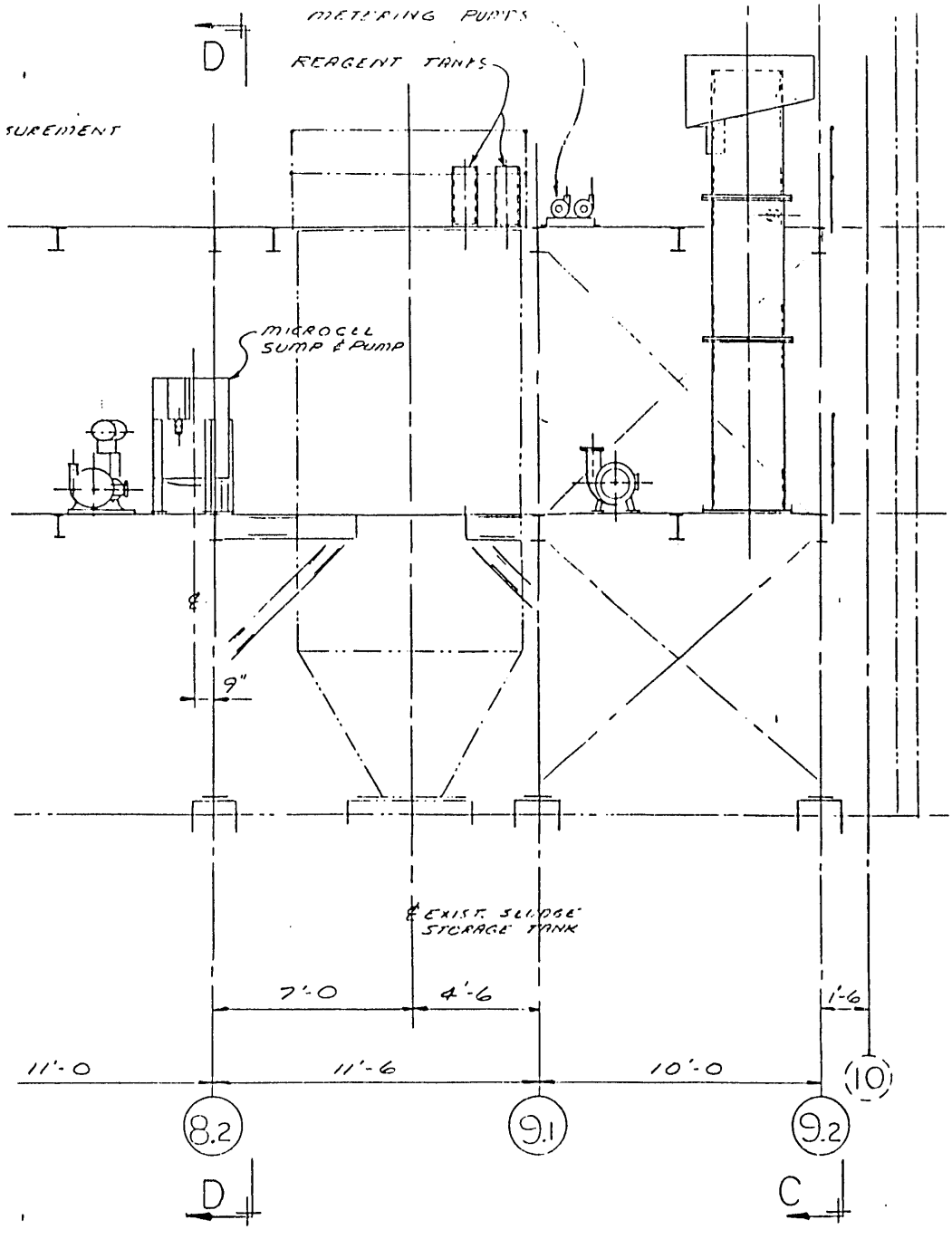

Figure 11. ET Circuit Elevation - Section B-B.

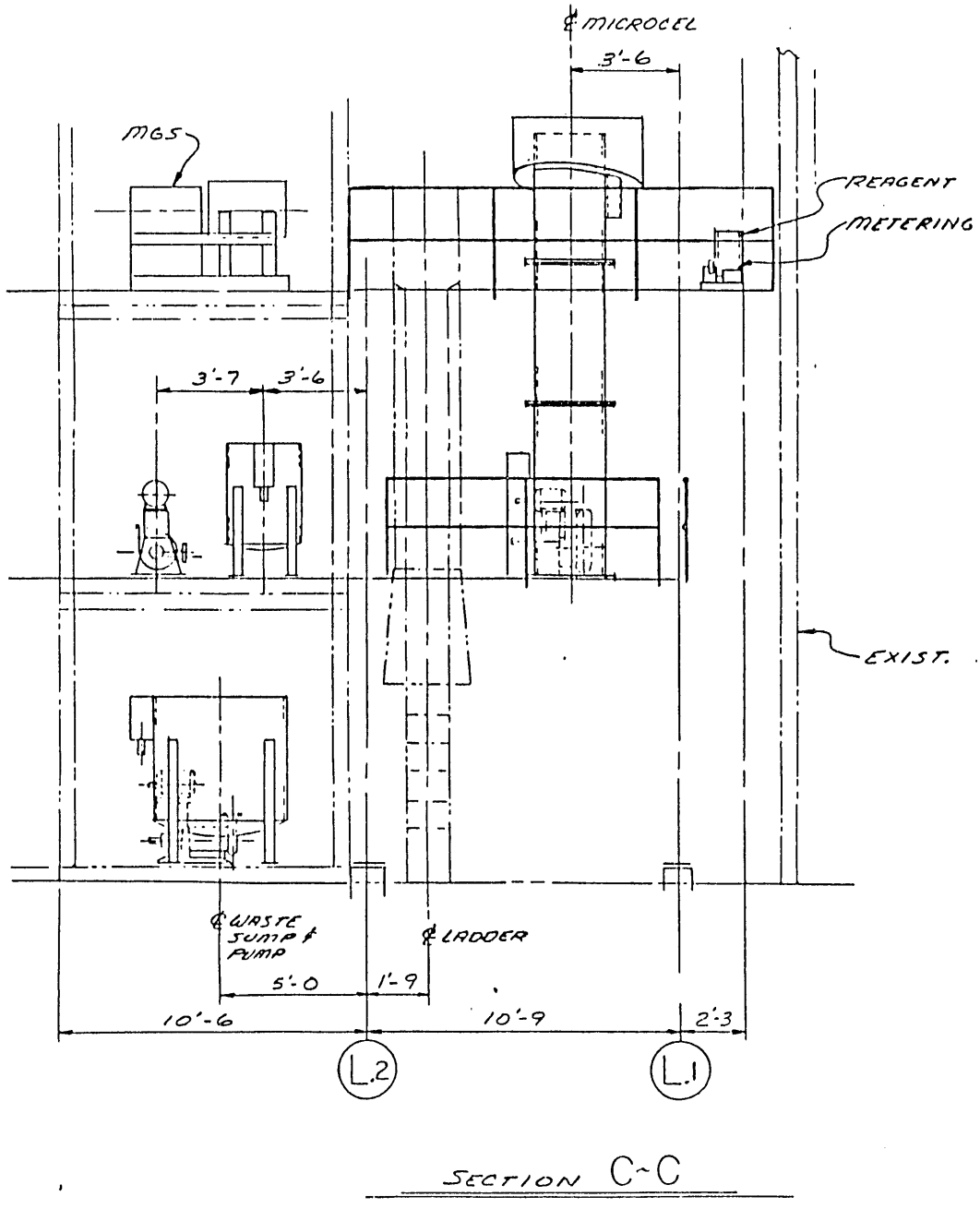

Figure 12. ET Circuit Elevation - Section C-C.

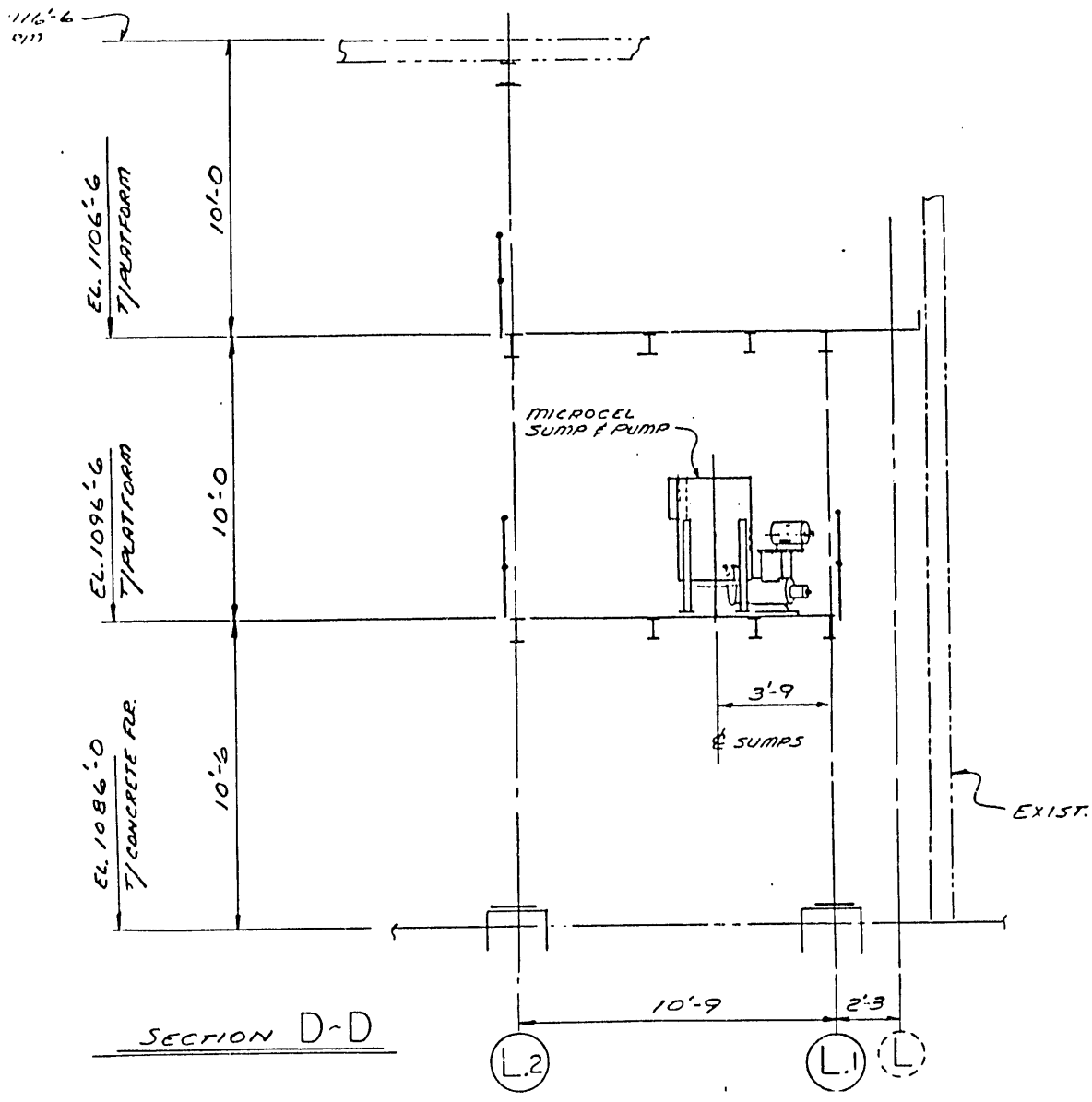

Figure 13. ET Circuit Elevation - Section D-D.

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