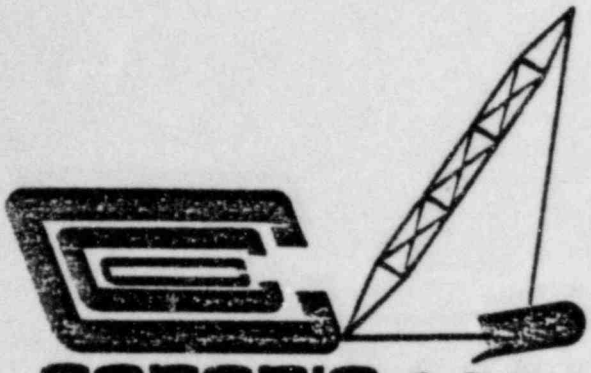

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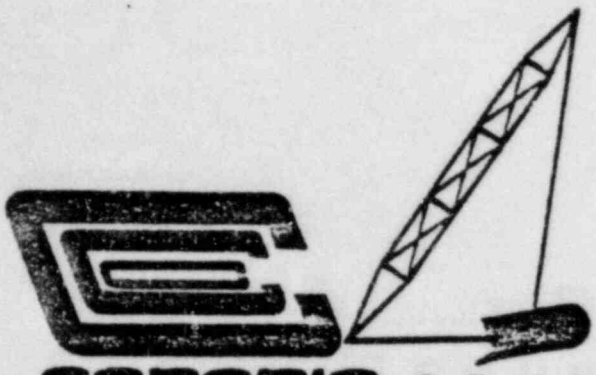

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Quality Assurance Manual

Road Building / Foundation Piling / Earth Moving / Caisson Drilling / Marine Construction

CANONIE CONSTRUCTION COMPANY / P.O. BOX 509 / U.S. 31 & M-43 / SOUTH HAVEN, MICHIGAN 49090 / (616) 637-1171

THIS MANUAL HAS BEEN REVIEWED AND APPROVED

FOR USE

QUALITY ASSURANCE MANUAL

AUGUST 16, 1976

PREPARED BY David E. Troxell — August 16, 1976
David E. Troxell, E. D'Appolonia Consulting Engineers — Date

APPROVED BY MANAGER OF QUALITY ASSURANCE Jack McKane — August 16, 1976
Jack McKane — Date

APPROVED BY PRESIDENT Ray L. Holden — August 16, 1976
Ray L. Holden — Date

CANONIE CONSTRUCTION COMPANY

TABLE OF CONTENTS

CANBERRA CONSTRUCTION COMPANY

TABLE OF CONTENTS
(Continued)

QUALITY ASSURANCE MANUAL

1.0 INTRODUCTION

This manual has been prepared for the purpose of presenting the Quality Assurance Program which has been adopted by the Canonie Construction Company and shall be applied to all quality related activities.* Thus, the Canonie Quality Assurance Program shall be applicable to all work for which it is required either by regulatory or contractual commitments. This manual is intended both to provide regulatory agencies or clients with a description of the Canonie Program and how it is implemented, and also to provide Canonie personnel guidelines on how the program is to be implemented during the course of work. This manual has been developed to fulfill the requirements of 10 CFR 50 Appendix B where it applies to the scope of work performed by Canonie.

The Canonie Quality Assurance Manual is intended to provide a general statement concerning the implementation of this Quality Assurance Program. Specifics concerning the actual performance of the Quality Assurance work are contained herein; however, the specifics of Quality Control work are contained in Manuals of Practice developed by Canonie. In general, these Manuals of Practices are to provide guidance for Canonie personnel relating to daily quality related tasks for our activities.

The Quality Assurance Program described in this manual is fully endorsed by the management of Canonie Construction Company. Objective evidence

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* In general, quality related activities shall be work which is defined as Class I as defined by the USNRC. This program will be extended to Class II or other work as contractually required by the client or owner.

of this is shown on the manual approval sheet by the acceptance of this manual as company policy by the President of Canonie.

2.0 ADMINISTRATION OF THE QUALITY ASSURANCE, QUALITY CONTROL PROGRAM

2.1 Organization

Figure 1 presents the organizational structure within Canonie for the operation of the Quality Assurance Program. This organization chart is only intended to show the relationship of the Quality Assurance Staff to the Project Staff for a specific project. Independence of the Quality Assurance Staff is assured because the On Site Project Manager has no control over the members of the Quality Assurance Staff, nor can the On Site Project Manager or Construction Manager invalidate the findings of the Quality Assurance Staff.

Within this organizational structure the responsibilities for Quality Assurance and Quality Control shall be as defined by ANSI Standard N45.2:

- Quality Assurance

  "All those planned or systematic actions necessary to provide adequate confidence that an item or a facility will perform satisfactorily in service."

- Quality Control

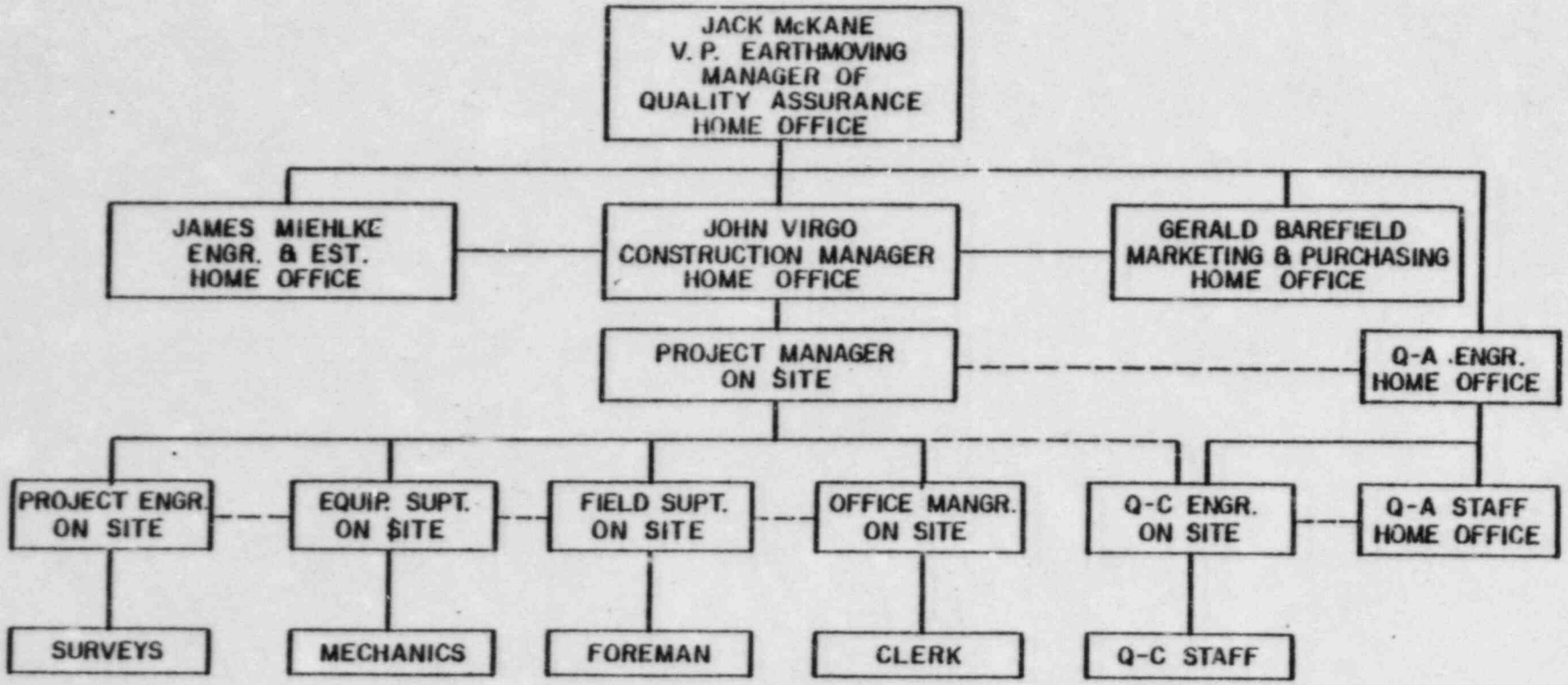
  "Those Quality Assurance actions which provide a means to control and measure the characteristics of an item, process or facility to established requirements."

Thus, Quality Control is intended to be the execution of daily activities, such as inspection, to established procedures to assure compliance of the work to the pertinent specifications and/or regulatory requirements.

Quality Assurance shall be an organization as defined in Figure 1 which is not responsible for any project related activities such as scheduling or cost. Rather, the Quality Assurance Staff shall be independent to

CANONIE CONSTRUCTION COMPANY

ORGANIZATION CHART



——————— INDICATES LINES OF RESPONSIBILITY

– – – – – – – – INDICATES LINES OF COMMUNICATION

determine, through scheduled or unscheduled audits, if the Quality Control Staff is fulfilling its obligations for the proper conduct of quality related activities. Auditing shall be performed by members of the Quality Assurance Staff who are totally independent of the activity being audited.

2.2 Manager of Quality Assurance

As shown on Figure 1, the Canonie Vice President - Manager of Quality Assurance is assigned the overall responsibility for all activities affecting quality within the scope of project work assigned to Canonie--both Quality Assurance and Quality Control. As such, the Quality Assurance Staff will be directly responsible to this individual for the reporting of all quality related problems. The implementation of the Quality Control Program shall be the responsibility of the Quality Control Engineer. Further, the Manager of Quality Assurance is responsible for the preparation and approval of procedures or standards used by the Quality Assurance and Quality Control Staffs. This includes their implementation as well as the implementation of procedures and standards contractually imposed on Canonie.

Basically, the Vice President - Manager of Quality Assurance is responible for all phases of the project: quality, administration and production. However, the direct responsibility for production on all Canonie projects is assigned to the Construction Manager. Likewise, the direct responsibility for all quality related matters on a specific project is assigned to the Quality Assurance Engineer.

2.3 Quality Assurance Engineer

As stated, the Quality Assurance Engineer and Staff are directly responsible to the Vice President - Manager of Quality Assurance. Each project requiring Quality Assurance activities will be assigned to a Quality Assurance Engineer who will be responsible for the implementation of the Quality Assurance Program as described in this manual.

These responsibilities shall include the scheduling and conducting of audits, preparation of audit reports for the project and the authority to stop quality related work on a project pending review and resolution basis by the Vice President - Manager of Quality Assurance.

2.4 Quality Control Engineer

The Quality Control Engineer shall be directly responsible for the on site execution of the Quality Control Program. Quality related items shall include the daily inspection and testing work which must be performed as prescribed for the project and the resultant preparation and maintenance of Quality Control records.

In general, the duties of the Quality Control Engineer and Staff shall not involve a responsibility for production. The actual supervision of work shall be the responsibility of the On Site Project Manager and the personnel assigned thereto.

Exceptions to total separation of production and quality related activities shall be for work such as surveying or supervision of backfill. In these cases the activity shall be responsible to both the Quality Assurance Engineer and the On Site Project Manager as shown in Figure 1.

However, for these events the On Site Project Manager cannot instruct the personnel performing the work to not comply with quality requirements.

2.5 Project Communication

Referring to Figure 1, lines of communication are shown between the On Site Project Manager and Quality Control Engineer and the Quality Assurance Engineer and Staff. For the Quality Assurance/Quality Control Program to be truly functional these lines of communication must exist. The Quality Assurance Engineer and Staff must be available to the Quality Control Staff to aid in the interpretation of the Quality Assurance Program and procedures, standards or regulatory requirements should the need arise. Conversely, the Quality Control Staff shall inform the Quality Assurance Engineer and Staff, or the Vice President - Manager of Quality Assurance, if problems arise in the daily execution of the Quality Control Program. Such occurrences could be the determination of an error in project specifications or drawings, an inadequacy in the Quality Assurance/Quality Control Program such as an inadequate calibration requirement, or the repeated deficiency of material or equipment.

3.0 QUALITY ASSURANCE PROGRAM

The purpose of this section of the manual is to describe the implementation of the Quality Assurance Program and the activities of the Quality Assurance personnel in executing the program.

3.1 Quality Assurance Standards

All activities within Canonie that are quality related shall be governed by written procedures. These procedures shall take the form of this Quality Assurance Manual or, as previously mentioned, Manuals of Practice for specific work items.

The Vice President - Manager of Quality Assurance shall be responsible for the approval of all standards--whether they be Quality Assurance or Quality Control related. Further, approval of the Quality Assurance Program, as stated by the Quality Assurance Manual, shall also be by the President. The approval of standards, such as the Quality Assurance Manual, shall make them binding upon all personnel whose work is affected by them.

Quality Assurance standards shall be initiated by the Manager of Quality Assurance with responsibility appointed to Quality Assurance personnel or an organization external to Canonie if so desired by the Manager. Quality Control standards, which will generally be working or testing procedures or specifications pertinent to a generic activity or project, may be prepared by either Quality Control or Quality Assurance personnel or external organization. However, Quality Control standards shall be subject to review and approval by the Manager of Quality Assurance, or designated Quality Assurance personnel, prior to implementation.

Activities which may be routinely performed by Canonie as part of inspection services on a project, such as concrete testing, structural earthwork control or reinforcement testing, shall whenever possible be conducted to recognized standards. Such standards shall include those prepared by the American National Standards Institute (ANSI), the American Society for Testing and Materials (ASTM) and the American Concrete Institute (ACI).

Standards that are contractually imposed upon Canonie as part of a specific project shall take precedence over the equivalent Canonie standards. However, prior to the acceptance of such standards as a contractual item, the standards will be reviewed and accepted by the Manager of Quality Assurance as discussed in Section 3.5 of this manual.

3.2 Maintenance of Quality Assurance Manual and Standards

3.2.1 Control of Copies

The Quality Assurance Manual and Manuals of Practice shall be numbered with a distribution list of copyholders maintained by the Manager of Quality Assurance or member of the Quality Assurance Staff. Control of copies shall be so that in the event of revision all copyholders may be presented the revision and also to withdraw copies if necessary. Canonie considers the Quality Assurance Manual and Manuals of Practice to be proprietary documents of Canonie and as such reserves the right to withdraw copies from internal copyholders if a change in their function no longer requires the use of such manuals or if copies have been issued externally to a client for review and such work is completed.

Uncontrolled copies of manuals may be issued as part of bid documents if required for submittal by the prospective client or owner. If Canonie

is awarded the work, the copies will be issued control numbers and the client notified of this number. The copyholder within the client organization will then be added to the distribution list. If Canonie is not awarded the work, the return of the uncontrolled copies will be requested.

3.2.2 Distribution of Documents

The Quality Assurance Manual and the Manuals of Practice shall be available to all Canonie personnel if required by their work function. This will include all members of the Quality Assurance Staff and pertinent company management. As a minimum, at least one copy of the Quality Assurance Manual and the appropriate Manuals of Practice shall be maintained at the project site. The copyholder of these documents shall be the Quality Control Engineer; however, they shall be available to all on site personnel for use.

3.2.3 Revision of Documents

As necessary, the Quality Assurance Manual and the Manuals of Practice shall be revised. Revision shall be on an aperiodic basis dependent upon changes within the Canonie Quality Assurance Program or in regulatory requirements or in accepted standards for the performance of inspection functions. As a minimum, the Quality Assurance Manual and the Manuals of Practice shall be reviewed by the Manager of Quality Assurance, or a designated member of the Quality Assurance Staff or external organization, on a yearly basis. Such reviews will be documented as Quality Assurance Records.

When documents are revised, all current copyholders shall be presented a copy of the revision. Attached to the revision shall be instructions

for the filing of the revision within the appropriate manual and a revision receipt. The revision receipt shall indicate the copy number and shall state that a copyholder has filed the revision as instructed and has destroyed or removed from use and marked "Void - Outdated Information." The revision shall be signed and dated by the copyholder and promptly returned to the Manager of Quality Assurance. The receipts shall be maintained by the individual responsible for the copyholder list to indicate the revisions have been issued and properly included in the manuals.

Revisions may take the form of either the complete adoption of new procedures, the deletion of old procedures, or the correction of ongoing procedures. Revision pages will be noted by a line down the right hand side of the page where the revision has been made and either a number indicating the revision number or the date of revision. This is particularly relevant to revisions which affect only a portion of a page. Finally, to complete the revision, a new approval sheet shall be issued which indicates the revision number and/or date and its acceptance by the appropriate members of Canonie Management.

3.3 Quality Assurance Audits

In general, Canonie shall conduct or participate in three types of Quality Assurance audits:

- internal audits to verify compliance with the Quality Assurance/Quality Control Programs by members of the Quality Control Staff;
- prequalification audits of prospective subcontractors to verify their ability to fulfill the Quality Assurance/Quality Control functions of their intended work and the surveillance of subconstractors performing work; and

- cooperation with clients, owners or regulatory agencies who are auditing the work performed by Canonie.

Auditing shall be performed by members of the Quality Assurance Staff who are totally independent of the activity being audited. Each of these types of audits are discussed below.

3.3.1 Quality Assurance Internal Audits

At the beginning of work on a project, the Manager of Quality Assurance shall appoint a Quality Assurance Engineer, or an external organization to perform the function of the Quality Assurance Engineer, who shall be responsible for the implementation of the Canonie Quality Assurance Program on that project. The primary evidence of the performance of the Quality Assurance Engineer and Staff shall be by conducting audits and issuing the resulting audit reports.

The Quality Assurance Engineer shall establish a projected schedule of Quality Assurance audits to be conducted during the course of the project work. The audits shall be scheduled at least every three months or more frequently as required by the project activities. The quarterly audits may be postponed only if the project schedule has been interrupted by events such as work stoppage, for any reason, or delays due to weather. In the event that a quarterly audit is postponed or cancelled, the reason shall be documented as a project Quality Assurance record.

Because quarterly audits are scheduled, the Quality Control and Project Staffs will be notified of their occurrence. However, if in the opinion of the Manager of Quality Assurance and the Quality Assurance Engineer,

the quarterly audits are either not sufficiently verifying the conduct of quality related activities or are not resolving quality related problems then unscheduled and unannounced audits may be conducted.

Further, additional audits may be required if activities related to the Quality Control Program are initiated or completed between quarterly audits. It is the intention of the internal audits to not only provide periodic evidence of compliance with the Quality Assurance Program, but to audit activities when they begin to establish that all procedures have had provision for compliance at the onset and at completion to assure that all required documents are complete and properly maintained. If the aperiodic audits just discussed occur within one month after the date for an upcoming quarterly audit, the quarterly audit can be rescheduled to coincide with this activity.

The content of all internal audits shall be prepared in advance by the Quality Assurance Engineer in the form of a checklist. The checklist shall include all on site quality related activities such as:

- completion of Quality Control forms for all work,
- completion of daily activity records,
- completion of all required equipment calibrations, and
- the proper storage and maintenance of these documents.

At the conclusion of the Quality Assurance audit, the individual conducting the audit shall conduct an exit interview with the Quality Control Engineer and present on a preliminary basis the findings of the audit.

3.3.2 Prequalification Audits of Subcontractors and Subcontractor Surveillance

Subcontractors employed by Canonie shall be contractually required to provide Quality Assurance/Quality Control activities as required for their scope of work. The Quality Assurance activities for which it is intended that a subcontractor perform shall be included as part of their procurement document. To assure that the subcontractor can fulfill these activities, a prequalification audit shall be conducted prior to issuance of a contract at the direction of the Manager of Quality Assurance by a member of the Quality Assurance Staff. The prequalification audit shall determine if the intended subcontractor can provide a Quality Assurance/Quality Control Program that will satisfy their scope of work. In general, this shall include testing program, equipment calibration, document completion, and subcontractor internal auditing. However, in general, auditing of the subcontractors Quality Assurance/Quality Control Program will be performed by Canonie rather than the subcontractor by the performance of Canonie conducted subcontractor surveillance audits. The surveillance audits will be conducted similarly to internal audits both as to schedule and conduct of the audit.

All audits of subcontractors will be conducted using prepared checklists in the same manner as internal audits.

3.3.3 Audits by Others

For audits that are conducted of Canonie by clients, owners or regulatory agencies, it is the stated policy of Canonie to provide the personnel necessary to assist in the auditing and if required exit interview. All

quality related documents maintained by Canonie will be available for inspection by external auditors.

3.4 Quality Assurance Records

In this section is discussed only those records which are originated by the Quality Assurance personnel. Records such as daily activity logs or field inspection logs which are prepared by members of the Quality Control Staff are considered to be Quality Control records and are discussed as part of Section 4.0.

3.4.1 Audit Reports and Corrective Action

At the conclusion of an audit conducted by Canonie Quality Assurance personnel, an audit report shall be prepared which includes the following:

- summary of the activities audited,
- personnel of both the Quality Control and Quality Assurance Staffs who were involved in the audit,
- findings of the audit which shall consider both positive and negative aspects,
- recommendations for corrective action,
- means for completing the recommendations for corrective action if possible,
- a date when the corrective action is to be completed, and
- the means by which the corrective action will be verified.

Issuance of the audit report, as discussed in the following paragraph, shall be in a timely manner and unless prevented by scheduling difficulties, should be within ten days of the completion of the audit. Also, the time period stated in the audit report for completion of the corrective action shall be such that further deterioration of the quality related to the corrective action item does not occur.

The audit report shall be submitted to the Manager of Quality Assurance. The Manager of Quality Assurance shall review the audit report and indicate review and approval by signing and dating the audit report which will then be maintained as a project Quality Assurance reocrd. If the Manager disagrees with any of the corrective action items, it shall be so indicated on this copy of the audit report and those items will be considered closed. After approval of the audit report by the Manager, copies of it shall be submitted to the Construction Manager, the On Site Manager and the Quality Control Engineer.

Upon receipt of the audit report by the On Site Project Manager and the Quality Control Engineer, action for complying with the corrective action items shall be initiated. This work shall be completed by the corrective action date set in the audit report and shall comply with the means stated in the audit report for verification of the audit report. It is noted that once approved by the Manager of Quality Assurance, the corrective action items must be completed. Failure to do so by the date stated in the audit report, without proper justification as approved by the Manager of Quality Assurance or the Quality Assurance Engineer, shall constitute sufficient grounds for stopping the work activities related to those corrective action items.

Verification of the completion of corrective action items shall be performed by the Quality Assurance Staff. This may be accomplished by either reauditing the items or by reviewing the documentation submitted by the personnel identified for correction in the audit report to support completion of the corrective action if so permitted in the audit report.

Reauditing shall be by returning to the location of the audit for verification. If the corrective action requested in the audit report can be resolved by the submission to the Quality Assurance Engineer of documents to show completion, reauditing is not required. Such an event would be, for example, if the Quality Assurance Engineer has requested the completion of portions of inspection records. Then, submission of copies of the completed records would be verification.

Upon verification of the completion of corrective action items, the Quality Assurance Engineer shall issue to the Manager of Quality Assurance a closure statement indicating that the audit has been satisfactorily completed. Copies of the closure statement shall also be issued to the Construction Manager, the On Site Project Manager and Quality Control Engineer.

For audits, either prequalification or in-progress surveillance, conducted by Canonie on subcontractors the auditing process will be similar. After the audit report has been approved by the Manager of Quality Assurance, copies will be issued to the responsible personnel of the subcontractor. The verification of corrective action completion and a closure statement will be as stated in the preceding paragraphs.

3.4.2 Maintenance of Records

For each project where the Quality Assurance Program is implemented, a file of project Quality Assurance records shall be initiated and maintained by the Quality Assurance Engineer. This file shall be separate from the project records during the course of the project and not available to the Project Staff. The project Quality Assurance records shall

include the audit schedule, audit reports, audit checklists, verifications of corrective action, audit closure statements and objective evidence that other Quality Assurance activities such as the training of personnel and review of procurement documents have been performed.

At the completion of the project, the Quality Assurance records may be included in the general project file as a separate category. These records will be retained by Canonie in accordance with the contractual or regulatory requirements of the project or submitted to the client or owner as required.

3.4.3 Providing of Records to Others

All project Quality Assurance records maintained by Canonie are available to client, owner, or regulatory agencies concerned with that project as part of their Quality Assurance activities. Further, if requested by the client or owner, records for completed audits shall be provided as the audits are closed.

3.5 Procurement Document Review

To assure that procurement documents issued by Canonie to subcontractors include the proper provisions for quality related aspects of the work, the procurement document shall be reviewed by the Manager of Quality Assurance, or representative if so designated, prior to issuance. It is the intention of this review to assure that the proper aspects of the Quality Assurance activities imposed on Canonie by the client or owner are required of the subcontractor. Only those items which directly bear upon the subcontractor need be imposed.

Procurement requirements may take many forms dependent upon the intended scope of work to be performed by the subcontractor. For example, Canonie could require the full implementation of 10 CFR 50 Appendix B upon a subcontractor or merely the daily submission of records. In general, the procurement document will require the calibration of measuring equipment, the completion of test records, the completion of field activity records and the maintenance of these records. In addition, Canonie shall require that the subcontractor provide Canonie or the client, owner or regulatory agency access to the subcontractor's facilities and quality related records for the purpose of auditing.

Conversely to the review of procurement documents issued by Canonie, the Manager of Quality Assurance or his representative shall review all procurement documents issued to Canonie for quality related items prior to their acceptance by Canonie. This review is to assure that all quality related items are understood and are properly within the scope of work to be performed by Canonie. It is hoped that during the contractural negotiations and when the review by the Manager of Quality Assurance of the proposed procurement document is completed that all quality items are resolved prior to the start of work.

Evidence of the review of procurement documents by the Manager of Quality Assurance or his representative shall be signing and dating the copy that is reviewed. If possible, this document shall be maintained as a Quality Assurance record. An alternate will be the maintenance of the signed copy in the project files.

3.6 Training of Personnel in Quality Assurance/Quality Control Activities

Prior to the initiation of a project, a meeting will be conducted by the project Quality Assurance Engineer with the On Site Project Manager and all personnel performing or affected by Quality Control activities. The purpose of this meeting shall be for the Quality Assurance Engineer to discuss with the Project and Quality Assurance Staffs all quality related aspects of the work. This will include:

- a review of the pertinent portions of the Quality Assurance Program as contained in the Canonie Quality Assurance Manual,
- a review of the Quality Control aspects which would include both administrative and technical aspects of the Quality Assurance Manual and the pertinent Manuals of Practice, and
- the project contractural requirements and specifications.

The review will include testing requirements, testing and inspection frequency, equipment calibration and frequency and the preparation and maintenance of project documents. A project Quality Assurance record shall be prepared after this meeting listing the attendees, their function and the subjects discussed.

Personnel assigned to perform either Quality Assurance or Quality Control tasks shall be experienced to properly perform their function. The overall responsibility for the training of personnel shall be vested with the Manager of Quality Assurance. The Manager shall be responsible for appointing personnel to functions within the Quality Assurance organization who have demonstrated a capability to perform this work. Further, the Manager of Quality Assurance has the right to approve or prevent the assignment of personnel to Quality Control functions.

Selection of personnel to the Quality Assurance Engineer position shall be by either formal training in Quality Assurance work or by a minimum of two years experience in Quality Assurance. The Quality Assurance Engineer shall be experienced in the performance of auditing. Training to qualify an individual for this position shall include the preparation of audit outlines, checklists, audit reports and Quality Assurance procedures. Experience to qualify as a Quality Assurance Engineer shall be shown in personnel resumes which will include, as deemed necessary by the Manager of Quality Assurance, on the job training, formal education, and in-house seminars. Members of the Quality Assurance Staff may be qualified as Quality Assurance Engineers only if they can demonstrate sufficient background in all aspects of the auditing process. On the job experience for promotion to Quality Assurance Engineer shall demonstrate experience as an audit team member under the direct supervision of a Quality Assurance Engineer who is responsible for their training. If Canonie cannot provide personnel to fulfill this position on a particular project then an external organization shall be contracted to provide this service.

Quality Control personnel shall be capable of performing their functions within the stipulations of the contractual requirements of the project. For example, if the contract stipulates that inspectors shall meet a certain level requirement (such as stated in ANSI N45.2.6) then individuals capable of meeting these requirements will be assigned to the Quality Control Staff. In general, the minimum requirements for a Quality Control Engineer shall be that of a Level II inspector as stated

in ANSI N45.2.6. A Level III inspector will not in general be required on site. Again, if Canonie cannot furnish properly qualified personnel for a specific project, an external organization capable of performing the task will be contracted.

Ability to meet these requirements or other requirements which are contractually stipulated shall be demonstrated through personnel resumes which will be maintained as company documents. Backup information such as certificates or licenses will be kept with the resumes. Copies of the resumes or supporting documents will be provided to a client, owner or regulatory agency if requested.

3.7 Management Review of Program

Management review of the Quality Assurance/Quality Control Program shall be an ongoing effort. For review of the entire quality program, the Manager of Quality Assurance shall conduct an annual review of the program to assure that it is up to date and applicable to the functions being performed by Canonie. To document this review, the Manager of Quality Assurance shall issue a report to the President of Canonie stating the activities and documents reviewed and the results of the review.

Further review shall be evidenced by the signed approval of the Quality Assurance Manual and the Manuals of Practice by the Manager of Quality Assurance. As stated previously, formal acceptance of the Quality Assurance Program as a company policy shall be shown by approval of the Quality Assurance Manual by the President.

In addition to these activities to review the overall program, the Manager of Quality Assurance shall conduct a review of the Quality Assurance work being performed for each project at least annually. This activity may also be performed by an external organization if so designated by the Manager of Quality Assurance. The purpose of this annual review shall be to assure that all Quality Assurance records are complete and properly maintained. Evidence of the review and approval of individual audit reports shall be shown by the signed and dated copies of the audit reports which the Manager has approved prior to issuance. These will be maintained as Quality Assurance records.

4.0 QUALITY CONTROL PROGRAM

4.1 Introduction

The Quality Control Engineer shall be responsible for the overall operation of the Quality Control Program. This includes the scheduling of inspections, the execution of these inspections and their documentation subject to the approval of the Quality Assurance Engineer. Although the Quality Control Engineer is responsible to the Project Manager for the completion of administrative matters, such as the filing of drawings and specifications as subsequently discussed, in matters affecting quality the Quality Control Engineer shall be responsible only to the Quality Assurance Engineer. This would include the repeated failure of inspections or the repeated arrival of non-confirming materials or equipment. From this point it is the responsibility of the Quality Assurance Engineer to intercede until the issue is satisfactorily resolved.

As previously stated, it is not intended that Quality Control personnel have direct responsibility for production. However, it should be recognized that certain quality related functions are part of production. This could include the supervision of the spreading of backfill prior to compaction and the actual compaction of backfill. Also, surveying that is conducted on site is both a production and quality related function as the chief of the survey crew is responsible for both functions.

4.2 Governing Project Documents

The documents which will govern the on site work by Canonie shall be the project specifications and drawings as prepared by the client or owner, and the Canonie Quality Assurance Manual and pertinent Manuals

of Practice. It is expected that the client or owner prepared specifications and drawings will provide full information to Canonie concerning the scope of work to be performed and the tolerances for such work. As an alternative, standards may be cited as part of these documents such as those published by ASTM or ACI or by regulatory agencies. If such information is not provided to Canonie, the practices in the Canonie Manuals of Practice shall apply.

For other items which will not normally be stipulated by the client or owner, such as calibration frequencies or tolerances, the Canonie Manuals of Practice shall apply. The establishment of such items will be by the adoption of recognized standards whenever possible.

4.3 Control of Project Documents

All drawings and specifications shall be stamped received and dated at the project site. A log shall be maintained for specifications which shows the name and number of the specification, the revision number, revision date, date received on site, number of copies received and the personnel to whom the specifications were given for use. This log shall be updated as required to show the addition of new specifications or the revision of old specifications. Specifications that are revised, or cancelled from use, have marked across their entry in the log "void - revised" or "void - cancelled" as appropriate. A similar system shall be instituted for drawings.

To purge obsolete drawings and specifications from use, they will be collected from the copyholders, as shown in the log, when replaced with

new revisions, or merely collected if the documents are cancelled. The purged documents will be clearly marked "VOID" across either the title block or title page.

If return receipts and disposition instructions accompany the specifications or drawings they will be completed and returned as instructed. If no instructions are provided to Canonie for either returning voided copies or destroying them, it will be the practice of Canonie to maintain one copy for reference in a separate file entitled "Void - Do Not Use." Copies beyond the first copy will be destroyed.

The foregoing discussion is intended to apply to documents that have been presented to Canonie by the owner or client or those prepared by Canonie. However, in general, Canonie will not issue specifications but shall use when possible the Manuals of Practice.

The individual responsible for the maintenance of these documents shall be the Quality Control Engineer.

4.4 Establishment and Implementation of the Inspection and Testing Program

At the beginning of the project, the Quality Assurance and Quality Control Engineers shall review the quality related portions of the scope of work. For all of the various activities, a testing or inspection schedule shall be established. Included in this schedule shall be hold points where the work must be inspected prior to continuation. All equipment which requires calibration shall be reviewed to assure it will be in current calibration when needed. Requirements for recalibration shall

also be reviewed so that equipment which must be recalibrated can be serviced in a timely manner and on schedule so that the inspection and testing functions may continue uninterrupted. Finally, the inspection and testing documentation requirements will be reviewed so that all documentation forms are available and approved by Quality Assurance at the onset.

With this work completed the Project and Quality Control files will begin with the preparation of the specification and drawing logs. To this file will then be added an Organizational Chart similar to that shown on Figure 1, but including the names of the individuals called out.

4.5 Ongoing Inspection and Testing Program

After the on site Quality Control program has been established and implemented as discussed in Section 4.4 it shall be supervised by the Quality Control Engineer. It will be this individual's responsibility to see that all inspections are conducted by the Quality Control Staff as scheduled, all hold points are observed and that all resultant documentation is completed and properly maintained.

To assure ongoing compliance with the Quality Control portions of the project, the Quality Control Engineer shall prepare a weekly report of Quality Control activities stating what inspections, etc., were conducted and the results of this work. For inspections that resulted in deficiencies, a complete description of the deficiency shall be made, the remedial action shall be described. It shall be particularly noted

if this is a continuing deficiency, what the cause is and the action taken or recommended to prevent reoccurrence. Copies of all deviation reports shall be attached to the weekly report.

Copies of the weekly report shall be submitted on the Monday following the report week to the On Site Project Manager and the Quality Assurance Engineer. Both individuals shall review the report, and indicate their review and acceptance by signing and dating the copy. The On Site Project Manager's copy will be filed in the Quality Control files and the Quality Assurance Engineer's copy shall become a Quality Assurance record.

If deficiencies have not been corrected or are ongoing, it then becomes the responsibility of the Quality Assurance Engineer to become actively involved in the problem until it is corrected.

4.6 Calibration of Measuring Equipment

All production and inspection or testing equipment that involves a quality related measurement shall be subject to scheduled recalibration. The only exception to this will be items such as engineer's scales or levels that are appropriately in use. This type of instrument is of sufficient accuracy if used properly and only for the correct function.

Equipment that is subject to recalibration shall be uniquely identifiable either by manufacturers serial number or a Quality Control number assigned by Canonie. Numbers assigned by Canonie shall be non-repetitive and not reused if an instrument is permanently removed from service. To indicate identification, a permanent sticker shall be affixed to the

instrument which gives the Quality Control number. If the manufacturers serial number is readily apparent this may be used in lieu of the sticker. For the identification of calibration dates, a sticker shall be attached to the instrument which provides two dates--last date calibrated and date due recalibration.

For each instrument that requires recalibration, a file shall be maintained. The cover sheet for the file shall be a general log sheet suitable for use on all instruments which will indicate:

- the equipment number and name,
- calibration frequency,
- dates of recalibration, and
- individual performing recalibration.

Behind the log sheet for each piece of equipment will be a calibration record prepared for that type of equipment which shall include:

- the number and name of the equipment,
- the acceptable calibration tolerances,
- a record of the data collected as part of the calibration, and
- a statement that the equipment passes or fails the recalibration followed by the date and the signature of the person performing the recalibration.

For equipment that is purchased, calibration and the subsequent files must be completed prior to use. For initial calibration, manufacturers calibration or statement of calibration may be accepted provided the work is traceable to the National Bureau of Standards or as appropriate for the equipment.

The required frequencies for recalibration shall be determined based upon the criticality of the instrument in measuring, its sensitivity and the probability of the instrument drifting from calibration tolerances. Tolerances for recalibration will be established based on codes applicable for the specific project, or accepted standards such as ASTM. If codes or standards do not exist, the tolerances will be established by Canonie based upon the effect of the instrument on the quantity it is measuring. Frequencies for recalibration shall be at a minimum of three months and a maximum of biannually.

Recalibration shall be performed using standards and equipment that is traceable to the U. S. National Bureau of Standards. Such equipment, such as weights to recalibrate balances, shall be used only for recalibration and not used in service. This equipment shall be recalibrated every three years with identification and records maintained for it as for service equipment. In general, this equipment shall be accurate to within one-quarter of the tolerance level it is measuring to determine adequacy of service equipment.

As an alternative to recalibration within the Canonie organization, equipment may be recalibrated by external agencies who have the equipment which can perform the work. If performed by an external agency, it shall be required to have standards and equipment traceable to the National Bureau of Standards or other agency as approved by Canonie. Records of recalibration shall be required and included in the equipment files.

Equipment that fails either recalibration or becomes inoperable during use shall be isolated to prevent possible continued use and clearly

tagged "Equipment Failure - Do Not Use." This equipment must be repaired and satisfactorily recalibrated prior to reuse.

Records of the failure and repair shall be included in the equipment file. If repair is not feasible to within the specified tolerance limits the equipment shall be destroyed.

For equipment that malfunctions during service between the recalibration dates, it is the responsibility of all persons using the equipment to notify the Quality Control Engineer that the equipment is either inoperable or suspect. It will then be tagged as stated above and recalibrated immediately.

To provide for proper maintenance of equipment calibration, equipment items shall be assigned to individuals who shall be responsible for the protection of the equipment while in use. When controlled equipment is not in the possession of the assigned individual, proper storage facilities shall be provided for the equipment commensurate with the equipment item. Storage facilities shall be controlled by the Quality Control Engineer.

4.7 Control of Purchased Materials and Equipment

The purchase of materials or equipment shall be controlled prior to purchase as stated in Section 3.3.2 for subcontractor's services if appropriate. If the material or equipment is a quality related item it shall be subject to a prequalification audit of the supplier, procurement document control to assure insertion of proper specifications and codes, and ongoing surveillance.

Upon receipt of purchased materials and equipment by Canonie that is quality related, it shall be inspected for conformance to the pertinent specification, code or drawing by a member of the Quality Control Staff. This inspection shall be documented, dated and signed with the results of the inspection including the governing document clearly stated. The documentation shall be maintained as a Quality Control document.

The material and equipment that has been approved by inspection and that will be stored prior to use shall be handled in such a way to prevent damage and stored in accordance with the requirements of the materials or equipment. Storage facilities shall be either isolated or restricted from general site activity to prevent damage. Storage requirements shall be determined by the necessity of preventing environmental or man-made deterioration. For example, if the condition of the materials or equipment will be affected by rain it must be sheltered. Or if the item is susceptible to freezing, it shall be stored in a heated structure.

Purchased materials and equipment that do not pass inspection shall be isolated to prevent inadvertent use. If possible, such items shall be immediately returned to their source and as a minimum the supplier shall be notified immediately of the failure. Isolation of failed equipment or materials shall be in an area which is restricted solely for this purpose. The area will be posted with signs stating "Failed Inspection - Do Not Use" to prevent accidental use.

The disposition of non-conforming materials shall be determined in a meeting of the Quality Control Engineer and the On Site Project Manager.

If repair is possible, a reinspection shall be scheduled during this meeting, if possible. The Quality Control Engineer shall prepare a report of the meeting stating what actions were taken. This report will be maintained as a Quality Control Document.

4.8 Special Process Work

All special process work whether for production or inspection (welding versus welding inspection) shall be performed to applicable codes or standards for that work. For example, the qualification of welders, inspectors and inspection techniques shall be in accordance with the American Welding Society Code. Records as required in such codes shall be prepared and maintained as Quality Control documents.

4.9 Quality Control Documents

All project documents which are quality related shall be maintained as Quality Control documents by Canonie. Storage and maintenance of such documents shall be continuous during the on site work and shall be in a fire-proof and water resistant container to provide protection for them. Maintenance of the Quality Control documents shall be by the Quality Control Engineer. Also the Quality Control Engineer or member of the Quality Control Staff shall be responsible for controlling the usage and distribution of these documents.

The document file shall contain, as a minimum, separate categories for:

- drawing and specification logs,
- drawings and specifications,
- void specifications and drawings if pertinent,

- procedural manuals for the conduction of the Quality Control Program,
- necessary references (such as ASTM standards),
- equipment calibration records,
- inspection records,
- material testing reports,
- daily activity logs,
- originals and Project Manager signed copies of the weekly Quality Control reports, and
- copies of the resumes of personnel involved with quality related work.

At the beginning of the file shall be an index listing all files by category and by number if there is more than one file per category. The file index shall be continuously updated as necessary. With the file shall be a sign out sheet stating what file has been removed, the date, and to whom it was given. The date of return shall be noted next to the borrow entry.

Access to the Quality Control files shall be limited to the individual responsible for controlling their usage. Thus, if a file is needed, this individual, or the Quality Control Engineer in an emergency if different, must be contacted for access. The files shall be kept locked except when in use and only the Quality Control Engineer and controlling individual shall have keys. It is intended that the usage of documents, except in some cases for specifications and drawings be limited to the immediate area of the record storage. If it becomes necessary to remove a document from this area it shall be copied with the original being returned to the file.

In the event of auditing or review by personnel of the client, owner or regulatory agencies, a member of the Canonie Quality Control Staff will be present to assist them. Copies of records that are requested shall be provided.

At the completion of project work by Canonie, it is anticipated that the Quality Control files will be turned over for storage in the plant vault as directed by the client or owner. With the submission of these records, Canonie will present a receipt itemizing the files. It is the request of Canonie that this receipt be signed and dated by the individual receiving them to show proper transfer of the records.

4.10 Quality Control Work Performed by Others

In the event that Quality Control inspection is performed directly by agents or representatives of the client or owner and not by Canonie or an agency contracted by Canonie, full cooperation will be granted by Canonie personnel to these personnel. This will include providing access when required, accompanying personnel if needed, and notification of such personnel when a hold point has been reached if such personnel are not present at that time.

5.0 EXAMPLES OF QUALITY ASSURANCE/QUALITY CONTROL DOCUMENTS AND PROCEDURES

Attached as appendices to this manual are examples of Quality Assurance/ Quality Control Documents and Procedures. These are provided to serve as guidelines for Canonie personnel who will be preparing such documents and to provide clients and owners with examples of these documents for review.

Briefly, the appendices contain:

- Appendix A - An example of a checklist used for internal Quality Assurance audits. The particular portion presented deals with on site document control.
- Appendix B - An example of the checklist used for the prequalification audit of a subcontractor. The checklist presented is based on the eighteen points of 10 CFR 50 Appendix B and is used to evaluate a subcontractor's Quality Assurance Program.
- Appendix C - An example of a Quality Control procedure. This particular procedure and the attached data forms would be applicable for the control of structural fill.
- Appendix D - An example of the written procedure for the calibration of equipment used on site for inspection measurements. The example provided is for equipment used in the control of structural fill.
- Appendix E - Example of a deviation form used by the Quality Control Staff to record deviations, or deficiences from the Project Documents.

It is noted that these appendices are presented only as examples.

APPENDIX A

EXAMPLE OF INTERNAL AUDIT CHECKLIST

canonie CONSTRUCTION COMPANY QUALITY ASSURANCE

AUDIT TITLE:

PROJECT:	PROJ. NO:	DATE:		PG OF

AUDIT PARTICIPANTS:

QUESTIONS:

1. Who is responsible for maintenance of the Quality Control records?

2. Are all records stored in an environmentally acceptable container?

3. Does the record index list all files?

4. Are the following items present and up to date?

   a. Specification and drawing logs

   b. Manuals

   c. Necessary reference material

   d. Daily activity logs

   e. Inspection records

   f. Testing records

   g. Deviation forms

   h. Weekly Quality Control reports

REMARKS/COMMENTS:

canonie CONSTRUCTION COMPANY QUALITY ASSURANCE

AUDIT TITLE:

PROJECT:	PROJ. NO:	DATE:		PG OF

AUDIT PARTICIPANTS:

QUESTIONS:

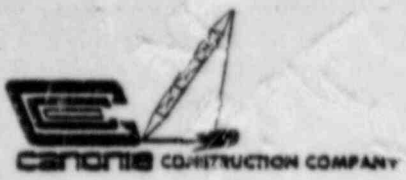
i. Void documents

j. Resumes

5. Is the sign out record present?

6. If any files are not present are they properly signed out and readily retrievable?

REMARKS/COMMENTS:



APPENDIX B

EXAMPLE OF SUBCONTRACTOR PREQUALIFICATION AUDIT CHECKLIST

canonie CONSTRUCTION COMPANY QUALITY ASSURANCE

AUDIT TITLE: SUBCONTRACTOR QUALITY ASSURANCE PROGRAM PREQUALIFICATION AUDIT

PROJECT:	PROJ NO:	DATE:		PG 1 OF 13

AUDIT PARTICIPANTS:

QUESTIONS:

SUBCONTRACTOR _____

_____

SUBCONTRACTOR ACTIVITY _____

_____

_____

_____

REMARKS/COMMENTS:

Instructions: All questions are to be completed. Answers shall indicate acceptance or deficiency. If the question does not apply it may be marked NA. If additional sheets are required for answers they shall be attached to the checklist and referenced to the question.

canonie CONSTRUCTION COMPANY QUALITY ASSURANCE

AUDIT TITLE: SUBCONTRACTOR QUALITY ASSURANCE PROGRAM PREQUALIFICATION AUDIT

PROJECT:	PROJ. NO:	DATE:		PG 2 OF 13

AUDIT PARTICIPANTS:

QUESTIONS:	REMARKS/COMMENTS:
I. Organization 1. Is the Quality Assurance program maintained internally or by an external organization? If external, indicate the organization. 2. Do Quality Assurance personnel have an organizational independence to perform their function? 3. Are these functions properly defined? 4. How is independence shown? Organization Chart? 5. To whom do Quality Assurance personnel report? 6. Is this individual independent of project functions? 7. Do the Quality Assurance personnel have the authority to stop work?	

B12.

Canonie CONSTRUCTION COMPANY QUALITY ASSURANCE

AUDIT TITLE: SUBCONTRACTOR QUALITY ASSURANCE PROGRAM PREQUALIFICATION AUDIT

PROJECT:	PROJ. NO:	DATE:		PG 3 OF 13

AUDIT PARTICIPANTS:

QUESTIONS:	REMARKS/COMMENTS:
II. Quality Assurance Program	
1. Is the program documented in a Quality Assurance Manual?	
2. Are procedures for Quality Assurance/ Quality Control documented?	
3. Is provision made for the verification of Quality by test or inspection?	
4. How is the Quality Assurance Manual revised?	
5. How is the Manual controlled?	
6. How are copy holders notified of revision of the Manual?	
7. How is Management acceptance of the Quality Assurance Program indicated?	

canonie CONSTRUCTION COMPANY QUALITY ASSURANCE

AUDIT TITLE: SUBCONTRACTOR QUALITY ASSURANCE PROGRAM PREQUALIFICATION AUDIT

PROJECT:	PROJ. NO:	DATE:		PG 4 OF 13

AUDIT PARTICIPANTS:

QUESTIONS:	REMARKS/COMMENTS:
III. Design Control 1. How is it assured that the correct regulatory requirements are translated into specifications, drawings, procedures and calculations? 2. Who establishes design bases? 3. How are design documents, including calculations and drawings, reviewed? 4. Is this review independent of the originator? 5. How are design changes affected? 6. Do they receive the same review as original work? IV. Procurement Document Control 1. Are procurement documents reviewed by Quality Assurance personnel prior to issuance?	

B14

canonie CONSTRUCTION COMPANY QUALITY ASSURANCE

AUDIT TITLE: SUBCONTRACTOR QUALITY ASSURANCE PROGRAM PREQUALIFICATION AUDIT

PROJECT:	PROJ. NO:	DATE:		PG 5 OF 13

AUDIT PARTICIPANTS:

QUESTIONS:	REMARKS/COMMENTS:
2. What individual is responsible for the inclusion of the appropriate Quality Assurance requirements in the procurement document?	
V. Instructions, Procedures and Drawings	
1. Are all work activities which are quality related covered by instructions, procedures or drawings?	
2. Are acceptance criteria stated in these documents where appropriate?	
VI. Document Control	
1. Are provisions made in the Manual for the issuance of all quality related documents?	
2. Are all quality related documents reviewed prior to issuance?	
3. How is the review accomplished?	

canonie CONSTRUCTION COMPANY QUALITY ASSURANCE

AUDIT TITLE: SUBCONTRACTOR QUALITY ASSURANCE PROGRAM PREQUALIFICATION AUDIT

PROJECT:	PROJ. NO:	DATE:		PG 6 OF 13

AUDIT PARTICIPANTS:

QUESTIONS:	REMARKS/COMMENTS:
4. How are obsolete documents purged from use?	
VII. Control of Purchased Material, Equipment, and Services	
1. Are sources evaluated for ability to supply as required by specifications, codes, etc.?	
2. Upon receipt at the plant site are the items inspected for applicable manufacturers inspection records and conformance to the contract documents?	
3. How are these records maintained?	
VIII. Identification and Control of Materials, Parts, and Components	
1. How are materials, parts and components identified?	

canonie CONSTRUCTION COMPANY QUALITY ASSURANCE

AUDIT TITLE: SUBCONTRACTOR QUALITY ASSURANCE - PROGRAM PREQUALIFICATION AUDIT

PROJECT:	PROJ. NO:	DATE:		PG 7 OF 13

AUDIT PARTICIPANTS:

QUESTIONS:	REMARKS/COMMENTS:
2. Does this identification system provide unique traceability? 3. How are items controlled to prevent inadvertent use? IX. Control of Special Processes 1. Are special processes controlled by written and approved procedures? 2. Do these procedures cite applicable codes, standards, etc., as appropriate? 3. Are provisions made to perform such work with qualified personnel and equipment? 4. How is this qualification shown? X. Inspection 1. Are provisions made for inspection of quality related items to assure compliance?	

canonie CONSTRUCTION COMPANY QUALITY ASSURANCE

AUDIT TITLE: SUBCONTRACTOR QUALITY ASSURANCE PROGRAM PREQUALIFICATION AUDIT

PROJECT:	PROJ. NO:	DATE:		PG 8 OF 13

AUDIT PARTICIPANTS:

QUESTIONS:	REMARKS/COMMENTS:
2. Is the inspection work independent of the personnel performing the original work? 3. How are the qualification of inspectors shown? 4. Are inspections conducted as a scheduled event? 5. Are hold points stipulated where applicable? XI. Test Control 1. Are test procedures documented? 2. Do test procedures allow for proof tests prior to installation, pre-operational tests, and operational test as required? 3. Are applicable codes, standards, etc., stated in the test procedures?	

8108

Canonie Construction Company QUALITY ASSURANCE	AUDIT TITLE: SUBCONTRACTOR QUALITY ASSURANCE PROGRAM PREQUALIFICATION AUDIT			
PROJECT:	PROJ. NO:	DATE:		PG 9 OF 13

AUDIT PARTICIPANTS:

QUESTIONS:	REMARKS/COMMENTS:
4. Are calibration records maintained? XIII. Handling, Storage and Shipping 1. Are storage facilities required to provide adequate protection for items? 2. If special environmental conditions are required, are these stipulated in written procedures? 3. Is shipping required to provide adequate protection? 4. Is a system established for the proper marking of items during handling, storage and shipping? XIV. Inspection, Test and Operating Status 1. Are procedures available to provide means for identifying inspection, test or operating status?	

canonie CONSTRUCTION COMPANY QUALITY ASSURANCE

AUDIT TITLE: SUBCONTRACTOR QUALITY ASSURANCE PROGRAM PREQUALIFICATION AUDIT

PROJECT:	PROJ. NO:	DATE:		PG 10 OF 13

AUDIT PARTICIPANTS:

QUESTIONS:

2. What personnel are authorized to determine and identify status?

XV. Nonconforming Materials, Parts or Components

1. Are procedures available to properly tag and isolate from use nonconforming items?

2. How is the disposition of nonconforming items determined?

3. If items are repaired, are they reinspected?

4. If items are totally rejected how are they disposed of?

XVI. Corrective Action

1. Are procedures available to identify items which require correction?

REMARKS/COMMENTS:

canonie CONSTRUCTION COMPANY QUALITY ASSURANCE	AUDIT TITLE: SUBCONTRACTOR QUALITY ASSURANCE PROGRAM PREQUALIFICATION AUDIT			
PROJECT:	PROJ NO:	DATE:		PG 11 OF 13

AUDIT PARTICIPANTS:

QUESTIONS:	REMARKS/COMMENTS:
2. Is a procedure available that allows for the appropriate review of corrective action items to prevent reoccurrence? 3. Are corrective action items reported to management? 4. Who is this individual? XVII. Quality Assurance Records 1. Are provisions made for the retention of the following records? a. Operating logs b. Results of Reviews c. Inspections d. Tests e. Audits f. Maintaining of work performance g. Material analysis	

canonie CONSTRUCTION COMPANY QUALITY ASSURANCE	AUDIT TITLE: SUBCONTRACTOR QUALITY ASSURANCE. PROGRAM PREQUALIFICATION AUDIT			
PROJECT:	PROJ. NO:	DATE:		PG 12 OF 13

AUDIT PARTICIPANT:

QUESTIONS:	REMARKS/COMMENTS:
h. Personnel qualifications i. Procedures, drawings, etc. 2. Do the record forms contain all pertinent information? 3. Are the records properly protected and controlled? 4. Are provisions made for record retention? XVIII. Audits 1. Are audits conducted by the subcontractor or an external agency? 2. If an external agency, provide information. 3. Are personnel performing the audits properly qualified?	

canonie CONSTRUCTION COMPANY QUALITY ASSURANCE

AUDIT TITLE: SUBCONTRACTOR QUALITY ASSURANCE PROGRAM PREQUALIFICATION AUDIT

PROJECT:	PROJ. NO:	DATE:		PG 13 OF 13

AUDIT PARTICIPANTS:

QUESTIONS:	REMARKS/COMMENTS:
4. Are audits scheduled?	
5. Are written procedures available for the performance of an audit?	
6. Are the audits conducted using checklists?	
7. Are audit results reported to management?	
8. Who is this individual?	
9. Are provisions made for corrective action and reauditing if necessary?	

B-13.

APPENDIX C

EXAMPLE OF A QUALITY CONTROL PROCEDURE

Note: This procedure is an example only, it is not to be used for soil control and is presented only to show general items which should be present in a Quality Control procedure.

QUALITY CONTROL PROGRAM FOR STRUCTURAL FILL (SOILS)

1.0 QUALITY CONTROL STAFF AND RESPONSIBILITIES

The Earthwork Inspection Team is responsible for the complete Quality Control and documentation of all earthwork. The Inspection Team shall consist of experienced personnel properly qualified in the field of soil mechanics and earthwork construction.

Materials testing will be performed by Quality Control personnel designated by the Quality Control Engineer. A field laboratory including equipment necessary for performance of all tests subsequently described in this section, will be established at the site where all laboratory tests will be conducted. In addition, a field office will be established at the site where report preparation and documentation will be performed.

2.0 GENERAL INSPECTION REQUIREMENTS

Should excavation be required as part of the plant construction, the excavated soil will be selectively stockpiled for later use as structural fill or spoiled, under the direction of the field inspectors. Soils stockpiled for later use as structural fill will be visually examined and classified as to suitability for use as structural fill.

During placement and compaction of the soil, the soil type, gradation, water content, compaction procedure, compaction equipment, and the layer thickness will be continually monitored. All backfilling and compaction operations will be performed under the strict inspection of the field earthwork inspectors in order to assure that the minimum required in-place densities are achieved.

3.0 QUALITY OF MATERIAL

The material to be used as structural fill shall be approved prior to its use by the earthwork inspector. The soil shall be clean of all trash, organic matter and debris and shall contain no more minus No. 200 sieve material than stipulated in the Project Specifications. The water content of the soil used shall be within a range which will result in the required in-place density being achieved when compaction procedures are used in accordance with the Project Specifications. (Use Forms E15, E16, E17, E18.)

4.0 DENSITY REQUIREMENTS

1. The required minimum relative densities and/or Modified Proctor densities shall be established by the requirements shown on the Construction Drawings and called out in the Project Specifications.

2. A relative density control criteria will be used for field control of soils possessing less than 12 percent minus No. 200 sieve material where relative density is defined as follows:

$$D_d = \frac{e_{max} - e}{e_{max} - e_{min}} \times 100 = \frac{\gamma_{max}(\gamma - \gamma_{min})}{\gamma(\gamma_{max} - \gamma_{min})} \times 100$$

Where:

D_d = relative density in percent

e_{max} = void ratio of the granular soil in its loosest state (minimum dry density = γ_{min})

e_{min} = void ratio of the granular soil in its densest state (maximum dry density = γ_{max})

e = void ratio of the soil in its natural state (natural dry density = γ)

3. The relative density is a measure of the soil density with respect to a minimum and maximum density as obtained in standardized tests. The minimum density will be measured by the method described in ASTM Designation D2049. The maximum density will be established either by (1) compacting the soil in molds of a known volume such as a Modified Proctor Mold or Standard Proctor Mold with the use of a compaction rammer in such a manner that the highest maximum density achievable is obtained without causing breakdown of the soil particles, or by (2) the method described in ASTM Designation D2049,* whichever yields the highest maximum density. (Use Forms E12, E13.)

4. A Modified Proctor compaction criterion will be used for field control of the backfill operations for soils containing more than 12 percent fines. The Modified Proctor compaction testing and control work will be performed as described in ASTM Designation D1557 Method A. (Use Form E14.)

5. Any testing methods stipulated in the Project Specifications shall supercede the above.

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* All ASTM Designations shall refer to latest issue.

5.0 MATERIALS TESTING EQUIPMENT

5.1 In Situ Dry Unit Weight

The in situ dry unit weight of the structural fill will be determined by the following methods:

a. Water balloon

b. Sand cone

c. Nuclear density gauge

The Washington Densometer will be used as stated in ASTM Designation D2167 (E3,E4).

The apparatus and procedure used in the sand cone method will conform to ASTM Designation D1556 (E8, E9).

The apparatus and procedure for a nuclear density gauge will conform to ASTM Designation D2922 (E7).

5.2 Plate Load Test

Plate Load Tests may be used at the discretion of the Earthwork Inspector to supplement data obtained from the direct dry density measurements. The Plate Load Test will be performed in accordance with ASTM Designation D1196.

5.3 Standard Penetration Test

The Standard Penetration Test may be used at the discretion of the Earthwork Inspector to supplement relative density data from the direct dry density measurements. The tests will be performed in accordance with ASTM Designation D1586.

5.4 Grain-Size Analysis

Grain-Size determination for the structural fill will be made by sieving and/or hydrometer analyses. Sieving will establish the grain-size distribution for the greater than No. 200 sieve size friction; a hydrometer analysis will be required for the fraction passing the No. 200 sieve. (Use E15, E16, E17, E18.)

5.5 Water Content Determination

Water content determination will be made by oven drying soil at approximately 110 degrees centigrade in accordance with ASTM Designation D2216. However, for rapid moisture determination, drying by alcohol burning techniques may be used at the discretion of the Earthwork Inspector. (Use E11.)

5.0 FREQUENCY OF SOIL TESTS

6.1 Maximum and Minimum Density Tests

Maximum and minimum density tests will be conducted with every in situ density test unless the backfill materials are uniform. A soil sample will be taken during the density testing and used in the laboratory for maximum-minimum density testing.

6.2 Modified Proctor Tests

Modified Proctor Tests will be conducted with every in situ dry density test and as often as necessary to assure that the water content of the cohesive soil is not affecting the degree of compaction.

6.3 In Situ Dry Density

During the initial stages of the construction, the structural fill dry density determinations will be made for every 1,000 cubic yards of fill. After the contractor and the earthwork inspector have acquired familiarity with the soil and the procedures, less frequent testing will be necessary. However, the maximum amount of fill to be placed without a dry density determination will be 5,000 cubic yards. At least one in situ dry density test will be made each day backfill is placed.

6.4 Grain-Size Analysis

Grain-size analyses will be conducted with every in situ dry density test and/or with every change in material. One grain-size analysis will be conducted for every 5,000 cubic yards of fill placed or each day backfill is placed.

6.5 Water Content Determination

Water contents will be determined for every dry density test, and as required in the field to maintain proper control.

7.0 COMPACTION EQUIPMENT REQUIREMENTS

All compaction equipment shall be thoroughly checked daily to assure that it is operating properly. Vibratory compaction rollers should have a roller drum vibration frequency of at least 26 cycles per second and vibratory hand compactors should possess a plate vibration frequency of at least 35 cycles per second. In order to assure that adequate in-place densities are achieved with the compaction equipment chosen for use by the Contractor, a test fill area shall be set aside to evaluate the effectiveness of the equipment when it is used to compact the on site soils in accordance with procedures

outlined in the project specifications. Should this testing indicate that a compaction procedure differing from that called for in the Project Specifications should be used to effectively densify the fill material, the client shall be immediately notified.

8.0 QUALITY CONTROL DOCUMENTATION FOR STRUCTURAL FILL

1. Inspection and testing records will be kept on a daily basis in the form of daily reports, sketches and photographs as required. These reports will be submitted to the Quality Control Engineer or his agent immediately as they are completed. At the completion of the structural fill, a final report will be submitted which will contain a complete history of the backfill construction including complete descriptions of testing methods and test results.

2. Calibration records will be continuously maintained for all field and laboratory equipment used for soils testing. All equipment shall be recalibrated according to the schedule of the appropriate calibration procedure.

3. Any deviations in the structural fill requirements as established by the Project Specifications shall be thoroughly documented (Form D1) to include a thorough description of the deficiency and the corrective action taken.

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SIEVE ANALYSIS

PROJECT _____
PROJECT NO. _____
LOCATION _____
_____
SAMPLE _____

TESTED BY _____ DATE _____
CALC. BY _____ DATE _____
CHD. BY _____ DATE _____

Wt. of TOTAL SAMPLE (WET) = _____ gm
Wt of TOTAL SAMPLE (DRY) = A _____ gm
Wt. of TOTAL (+#10) SAMPLE = B _____ gm
Wt. of TOTAL (-#10) SAMPLE = C = A-B _____ gm

SPECIFIC GRAVITY _____ MEASURED / ASSUMED

SIEVE NO.	SIEVE OPENING, mm	WT. SIEVE, gm	WT. SIEVE + SOIL, gm	WT. SOIL RETAINED, gm	PERCENT RETAINED	ACCUMULATIVE PERCENT RETAINED	PERCENT FINER

E15

CANONIE CONSTRUCTION COMPANY

C-7.

HYDROMETER ANALYSIS

PROJECT _____
PROJECT NO. _____
LOCATION _____
SAMPLE _____

TESTED BY _____ DATE _____
CALC. BY _____ DATE _____
CHD. BY _____ DATE _____

SOIL SAMPLE WEIGHT

CONTAINER NO. _____

Wt. CONTAINER + DRY SOIL, _____ gm

Wt. CONTAINER, _____ gm

Wt. DRY SOIL, W_s, _____ gm

HYDROMETER NO. _____

MENISCUS CORRECTION _____

SPECIFIC GRAVITY, G, _____ MEASURED / ASSUMED

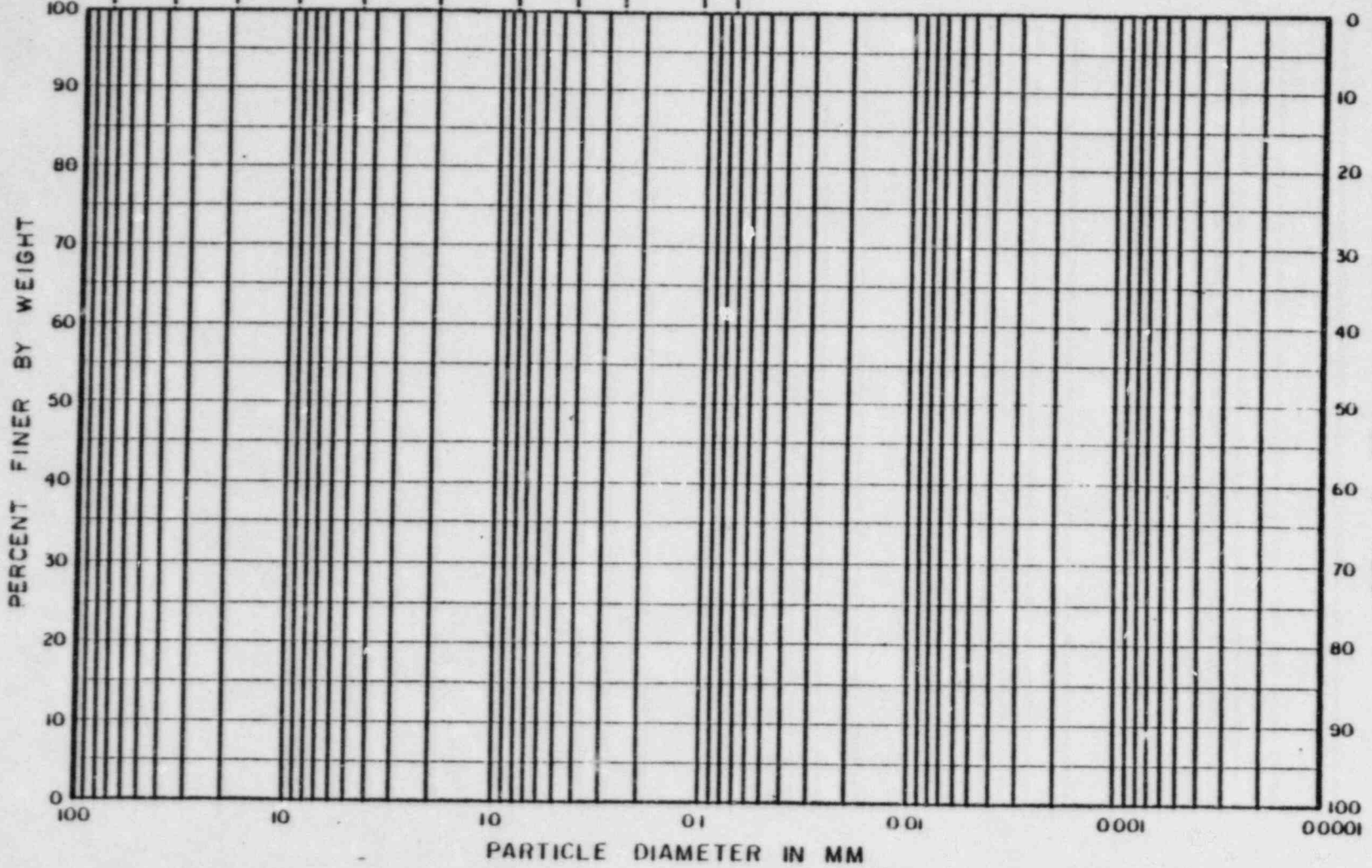
$$N, \% = \frac{G}{G-1}\,\frac{V}{W_s}\,\gamma_c(r-r_w)\times 100 = \_\_\_\_(R-R_w)\ ;\quad N' = \%\ \text{FINER NO. 200} \times N = \_\_\_\_ N \left(\begin{array}{c}\text{FOR COMBINED}\\ \text{ANALYSIS ONLY}\end{array}\right)$$

$$D = \sqrt{\frac{18\mu}{\gamma_s - \gamma_w}}\sqrt{\frac{z_r}{t}}\ ;\quad D, \text{mm} = \_\_\_\_\_\ \sqrt{\frac{z_r, \text{cm.}}{t, \text{min.}}}$$

DATE	TIME	ELAPSED TIME, min.	$R = 1000(r-1)$	$R_w = 1000(r_w-1)$	TEMPERATURE, °C	$R-R_w$	N, %	z_r, cm	$\sqrt{\frac{z_r, \text{cm}}{t, \text{min}}}$	D, mm	N'
		0									
		1/4									
		1/2									
		1									
		2									
		2									
		5									
		15									
		30									
		60									
		250									
		1440									

CARLTON CONSTRUCTION COMPANY

GRAIN SIZE ANALYSIS
COHESIVE MATERIAL



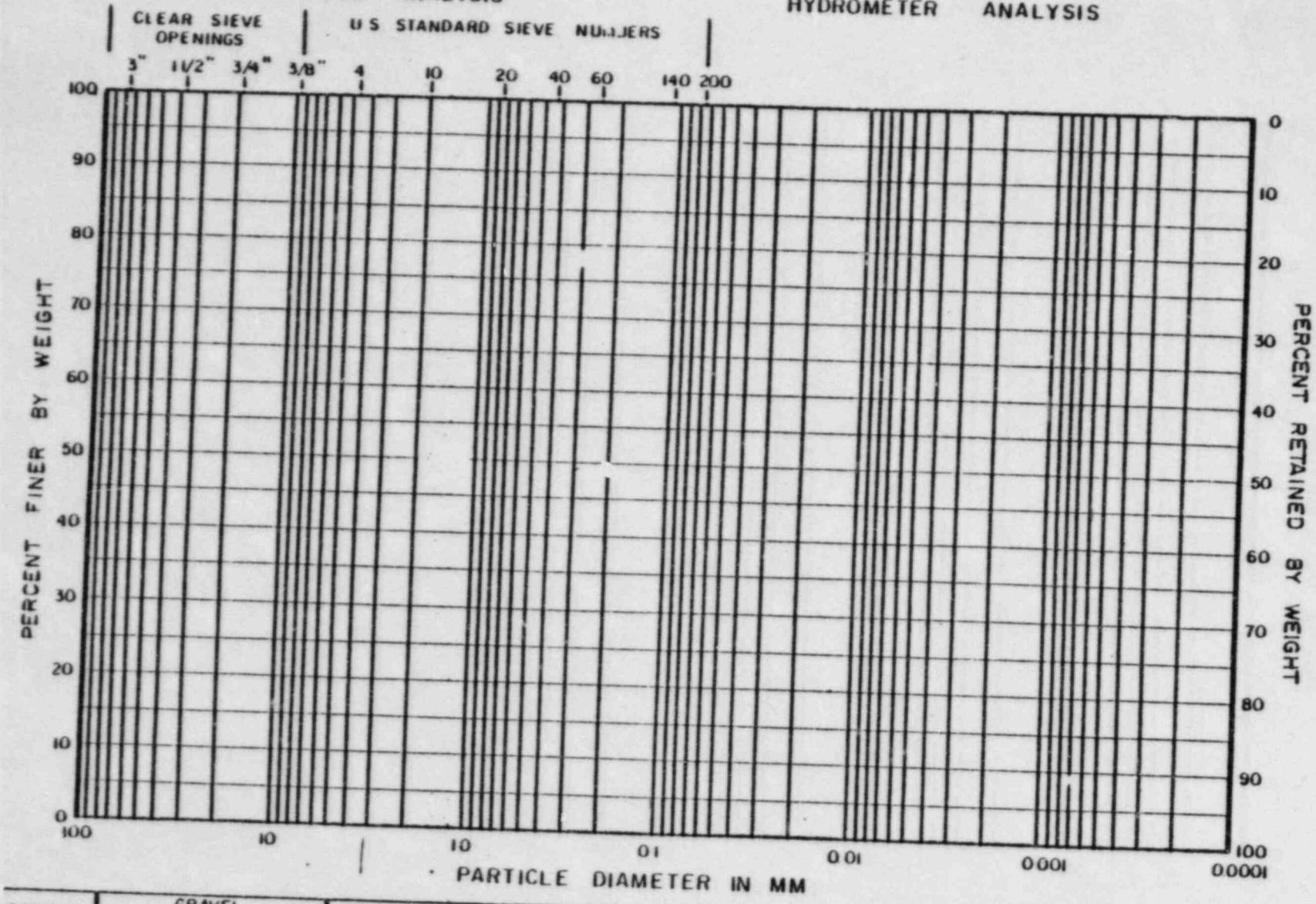
COBBLES	GRAVEL		SAND			SILT AND CLAY	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT FRACTION	CLAY FRACTION

LOCATION	SOIL DESCRIPTION	USCS	D_{10}	C_u	WC. %

E17

CANONIE CONSTRUCTION COMPANY

GRAIN SIZE ANALYSIS
COHESIVE MATERIAL



COBBLES	GRAVEL		SAND			SILT AND CLAY	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT FRACTION	CLAY FRACTION

LOCATION	SOIL DESCRIPTION	USCS	LL	PL	WC. %

E

CANNON CONSTRUCTION COMPANY

C-10.

RELATIVE DENSITY TESTS

PROJECT _____ TESTED BY _____ DATE _____

PROJECT NO. _____ CALCULATED BY _____ DATE _____

LOCATION _____ CHECKED BY _____ DATE _____

SOIL DESCRIPTION _____

MINIMUM DENSITY

METHOD					
Wt. MOLD + DS,	lb.				
Wt. MOLD,	lb.				
Wt. DS, W_s,	lb.				
VOLUME MOLD, V_c,	ft.3				
MIN. DRY DENSITY, γ_{min},	pcf				

MAXIMUM DENSITY (ASTM VIBRATORY TABLE)

BEFORE TEST	METHOD					
	LEFT GAGE READING (3AV)	in.				
	RIGHT GAGE READING (3AV.)	in.				
	AVG. GAGE READING, R,	in.				
	SURCHARGE BASE PL. THKS., t_{sp},	in.				
	STRAIGHTEDGE THKS, t_{se},	in.				
	INITIAL GAGE READING, R_i,	in.				
	X-SECTIONAL SAMPLE AREA, A	ft^2				
	VOLUME MOLD, V_c,	$ft.^3$				
AFTER TEST	LEFT GAGE READING (3AV.)	in.				
	RIGHT GAGE READING (3AV.)	in.				
	AVG. FINAL GAGE READING, R_f,	in.				
	VOLUME SOIL, V,	$ft.^3$				
	Wt. MOLD + DS,	lb.				
	Wt. MOLD,	lb.				
	Wt. DS, W_s,	lb.				
	MAX. DRY DENSITY, γ_{max},	pcf				

RELATIVE DENSITY

NATURAL DRY DENSITY, γ_d,	pcf				
MAX. LAB DRY DENSITY, γ_{max},	pcf				
MIN. LAB DRY DENSITY, γ_{min},	pcf				
RELATIVE DENSITY, D_r,	%				

$$\gamma_{min} = W_s / V_c$$

$$\gamma_{max} = W_s / V$$

$$V = V_c - \frac{(R_i - R_f)A}{12}$$

$$D_r = \frac{\gamma_{max}(\gamma_d - \gamma_{min})}{\gamma_d(\gamma_{max} - \gamma_{min})} \times 100$$

$$R_i = R + t_{bp} - t_{se}$$

RELATIVE DENSITY TESTS

PROJECT _____
PROJECT NO. _____
LOCATION _____
_____
SOIL DESCRIPTION _____

TESTED BY _____ DATE _____
CALCULATED BY _____ DATE _____
CHECKED BY _____ DATE _____

SG = ASSUMED _____
MEASURED _____

NATURAL DENSITY

LENGTH RECOVERY,	cm					
TUBE DIAMETER,	cm					
AREA TUBE,	cm^2					
VOLUME TUBE,	cm^3					
WT. TUBE + WS,	gm					
WT. TUBE,	gm					
WT. WS,	gm					

WT. TARE + WS,	gm					
WT. TARE + DS,	gm					
WT. WATER,	gm					
WT. TARE,	gm					
WT. DS,	gm					
WC,	%					

γ,	gm/cm^3 OR PCF					
γ_d,	gm/cm^3 OR PCF					
NATURAL VOID RATIO	$= \frac{\gamma_w (SG)}{\gamma_d} - 1$					

MINIMUM DENSITY

METHOD						
WT. MOLD + DS,	lb.					
WT. MOLD,	lb.					
WT. DS,	lb.					
VOLUME MOLD,	ft^3					
MIN. UNIT WEIGHT,	PCF					
MAXIMUM VOID RATIO	$= \frac{\gamma_w (SG)}{\gamma_{min}} - 1$					

MAXIMUM DENSITY (MODIFIED PROCTOR / IMPACT)

METHOD						
WT. MOLD + DS,	lb.					
WT. MOLD,	lb.					
WT. DS,	lb.					
VOLUME MOLD,	ft^3					
MAX. UNIT WEIGHT,	PCF					
MINIMUM VOID RATIO	$= \frac{\gamma_w (SG)}{\gamma_{max}} - 1$					

RELATIVE DENSITY

$D_R = \frac{e_{max} - e}{e_{max} - e_{min}} \times 100\%$					

C-12.

MOISTURE - DENSITY RELATIONSHIP

PROJECT _____ TESTED BY _____ DATE _____

PROJECT NO _____ CALCULATED BY _____ DATE _____

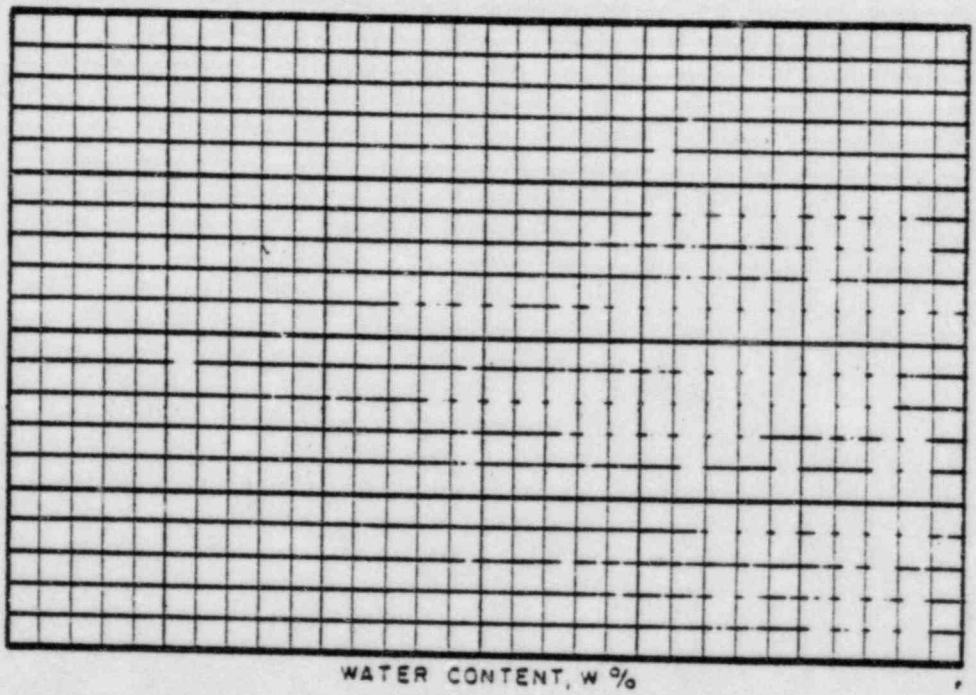
SOIL DESCRIPTION _____ CHECKED BY _____ DATE _____

Project No.	Location	Depth, Ft.
Test Type (b)	Method Used (c)	
Wt. of Mold, gm.	Vol. of Mold, cc	

(b) STANDARD or MODIFIED

(c) A, B, C or D

Wt. Mold + WS gm					
Wt. Mold gm					
Wt. WS gm					
Vol. Mold cc					
γ, gm/cm³					
γ, PCF					
Tare No.					
Wt. Tare + WS gm					
Wt. Tare + DS gm					
Wt. Tare gm					
Wt. DS gm					
Wt. Water gm					
W, %					
$\gamma_d = \gamma/(1+w)$ PCF					



Method	Material Size	Mold Size	Blows**
A	All Passing #4	4" dia.	25
B	All Passing #4	6" dia.	56
C	All Passing 3/4"	4" dia.	25
D	All Passing 3/4"	6" dia.	56

**Blows/Layer

Designation Used: _____

Method Used: _____

Designation	Ham/Drop	Layers
Standard	5.5 #/12"	3
Modified	10 #/18"	5

CAMINO CONSTRUCTION COMPANY

SAND CONE FIELD DENSITY TEST

PROJECT NAME _____

PROJECT NO. _____

SAMPLE NO. _____

COORDINATES N= _____

E= _____

ELEVATION (MSL) _____

SOIL DESCRIPTION _____

REMARKS _____

IN SITU DENSITY DETERMINATION:

CAN NO.		
INITIAL WT. OF APPARATUS	"A" (GR)	
FINAL WT. OF APPARATUS	"B" (GR)	
WT. OF SAND USED	"A" - "B" (GR)	
WT. OF SAND IN FUNNEL	"C" (GR)	
WT. OF SAND IN HOLE	(GR)	
BULK DENSITY OF SAND	(PCF)	
VOLUME OF HOLE	(CF)	
WT. WET SOIL	(LBS)	
WET DENSITY	(γ_w) (PCF)	

MOISTURE CONTENT DETERMINATION:

TARE NO.			
WT. OF WET SOIL + TARE	(GR)		
WT. OF DRY SOIL + TARE	(GR)		
WT. OF TARE	(GR)		
WT. OF DRY SOIL	(GR)		
WT. OF WATER	(GR)		
WATER CONTENT (WC)	(%)		
AVERAGE WATER CONTENT	(%)		

DRY DENSITY DETERMINATION:

FIELD DRY DENSITY (γ_D) = γ_w / (1+WC) (PCF)	

RELATIVE DENSITY DETERMINATION

MAXIMIM DRY DENSITY *(γ_D MAX.)	(PCF)	
MINIMUM DRY DENSITY *(γ_D MIN.)	(PCF)	
FIELD DRY DENSITY (γ_D)	(PCF)	
RELATIVE DENSITY $\left[\frac{\gamma_D \text{ MAX}(\gamma_D - \gamma_D \text{ MIN})}{\gamma_D(\gamma_D \text{ MAX} - \gamma_D \text{ MIN})}\right]$	(%)	

* SEE RESULTS OF MAXIMUM / MINIMUM DENSITY TESTING FOR THE SAME MATERIAL.

CANONIE CONSTRUCTION COMPANY

SAND CONE FIELD DENSITY TEST

PROJECT NAME _____

PROJECT NO. _____

SAMPLE NO. _____

COORDINATES N= _____

E= _____

ELEVATION (MSL) _____

SOIL DESCRIPTION _____

REMARKS _____

IN SITU DENSITY DETERMINATION:

CAN NO.		
INITIAL WT. OF APPARATUS	"A" (GR)	
FINAL WT. OF APPARATUS	"B" (GR)	
WT. OF SAND USED	"A" - "B" (GR)	
WT. OF SAND IN FUNNEL	"C" (GR)	
WT. OF SAND IN HOLE	(GR)	
BULK DENSITY OF SAND	(PCF)	
VOLUME OF HOLE	(CF)	
WT. WET SOIL	(LBS)	
WET DENSITY	(γ_w) (PCF)	

MOISTURE CONTENT DETERMINATION:

TARE NO.			
WT. OF WET SOIL + TARE	(GR)		
WT. OF DRY SOIL + TARE	(GR)		
WT. OF TARE	(GR)		
WT. OF DRY SOIL	(GR)		
WT. OF WATER	(GR)		
WATER CONTENT (WC)	(%)		
AVERAGE WATER CONTENT	(%)		

DRY DENSITY DETERMINATION:

FIELD DRY DENSITY (γ_D) = γ_w / (1+WC) (PCF)	

PERCENT MAXIMUM DRY DENSITY

MAXIMUM DRY DENSITY * (γ_D MAX.) (PCF)	
FIELD DRY DENSITY (γ_D) (PCF)	
PERCENT MAXIMUM DRY DENSITY (PCF)	

* SEE RESULTS OF MOISTURE-DENSITY RELATIONSHIP FOR THIS SAME SOIL.

canonie CONSTRUCTION COMPANY

NUCLEAR RELATIVE COMPACTION TEST DATA

PROJECT NAME _____ TESTED BY _____
PROJECT NO. _____ CALCULATED BY _____
DATE _____ CHECKED BY _____

TEST NUMBER										
STATION										
OFFSET										
ELEVATION										
MODE & DEPTH										
COMPACTION METHOD										
NUMBER OF PASSES										
LIFT THICKNESS										
DENSITY COUNT										
DENSITY COUNT RATIO										
WET DENSITY (PCF)										
MOISTURE COUNT										
MOISTURE COUNT RATIO										
MOISTURE (PCF)										
DRY DENSITY (PCF)										
% MOISTURE										
MAX. OBTAINABLE DENSITY										
OPTIMUM MOISTURE										
% RELATIVE COMPACTION										
MATERIAL DISCRIPTION										

STANDARD COUNT	
DENSITY	MOISTURE

REMARKS:

C-15.

E7

CANONIE CONSTRUCTION COMPANY

FIELD DENSITY TEST
(WASHINGTON DENSOMETER)

PROJECT NAME _____

PROJECT NO. _____

SAMPLE NO. _____

COORDINATES N= _____
E= _____

ELEVATION (MSL) _____

SOIL DESCRIPTION _____

_____

REMARKS _____

_____

IN SITU DENSITY DETERMINATION:

FINAL READING	(A)	
RING CONSTANT	(C)	
	(A)+(C)	
INITIAL READING	(B)	
VOLUME OF HOLE (A+C)−B	(CU. FT.)	
CAN NO.		
WT. OF WET SOIL FROM HOLE + CAN	(LBS)	
WT. OF CAN	(LBS)	
WT. OF WET SOIL FROM HOLE	(LBS)	
WET DENSITY (γ_w)	(PCF)	

MOISTURE CONTENT DETERMINATION:

TARE NO.			
WT. OF WET SOIL + TARE	(GR)		
WT. OF DRY SOIL + TARE	(GR)		
WT. OF TARE	(GR)		
WT. OF DRY SOIL	(GR)		
WT. OF WATER	(GR)		
WATER CONTENT (WC)	%		
AVERAGE WATER CONTENT	%		

DRY DENSITY DETERMINATION

FIELD DRY DENSITY (γ_D) = γ_w / (1+WC) (PCF)	

PERCENT MAXIMUM DRY DENSITY

MAXIMUM DRY DENSITY * (γ_D MAX.)	(PCF)	
FIELD DRY DENSITY (γ_D)	(PCF)	
PERCENT MAXIMUM DRY DENSITY	(PCF)	

* SEE RESULTS OF MOISTURE-DENSITY RELATIONSHIP FOR THIS SAME SOIL.

CANONIE CONSTRUCTION COMPANY

FIELD DENSITY TEST
(WASHINGTON DENSOMETER)

PROJECT NAME _____

PROJECT NO. _____

SAMPLE NO. _____

COORDINATES N= _____

E= _____

ELEVATION (MSL) _____

SOIL DESCRIPTION _____

_____

REMARKS _____

_____

IN SITU DENSITY DETERMINATION:

FINAL READING	(A)	
RING CONSTANT	(C)	
	(A)+(C)	
INITIAL READING	(B)	
VOLUME OF HOLE (A+C)−B	(CU FT)	
CAN NO.		
WT. OF WET SOIL FROM HOLE + CAN	(LBS)	
WT. OF CAN	(LBS)	
WT. OF WET SOIL FROM HOLE	(LBS)	
WET DENSITY (γ_w)	(PCF)	

MOISTURE CONTENT DETERMINATION:

TARE NO.			
WT. OF WET SOIL + TARE	(GR)		
WT. OF DRY SOIL + TARE	(GR)		
WT. OF TARE	(GR)		
WT. OF DRY SOIL	(GR)		
WT. OF WATER	(GR)		
WATER CONTENT (WC)	(%)		
AVERAGE WATER CONTENT	(%)		

DRY DENSITY DETERMINATION:

FIELD DRY DENSITY (γ_D) = γ_w / (1+WC) (PCF)	

RELATIVE DENSITY DETERMINATION

MAXIMIM DRY DENSITY *(γ_D MAX.)	(PCF)	
MINIMUM DRY DENSITY *(γ_D MIN.)	(PCF)	
FIELD DRY DENSITY (γ_D)	(PCF)	
RELATIVE DENSITY $\left[\frac{\gamma_D \text{ MAX}(\gamma_D - \gamma_D \text{ MIN})}{\gamma_D (\gamma_D \text{ MAX} - \gamma_D \text{ MIN})}\right]$	(%)	

* SEE RESULTS OF MAXIMUM / MINIMUM DENSITY TESTING FOR THE SAME MATERIAL.

C-18.

CANONIE CONSTRUCTION COMPANY

WATER CONTENT TESTS

PROJECT _____ TESTED BY _____ DATE _____

PROJECT NO. _____ CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SAMPLE NUMBER								
DEPTH, ft.								
TARE NUMBER								
WT. TARE + WS, gm								
WT. TARE + DS, gm								
WT. WATER, gm								
WT. TARE, gm								
WT. DS, gm								
W, %								
COMMENTS								

SAMPLE NUMBER								
DEPTH, ft.								
TARE NUMBER								
WT. TARE+ WS, gm								
WT. TARE+ DS, gm								
WT. WATER, gm								
WT. TARE, gm								
WT. DS, gm								
W, %								
COMMENTS								

APPENDIX D

EXAMPLE OF CALIBRATION PROCEDURE

CALIBRATION OF WASHINGTON DENSOMETER

A Washington densometer shall be calibrated for use in determining the in-place density of soils. Specifics regarding the test may be found in ASTM Designation D2167.

Initial calibration may be performed by the manufacturer. Subsequent recalibration by Canonie shall be every six months to assure proper operation and accuracy. The volume of each of the three densometer rings and the accuracy of the piston rod scale shall be checked as subsequently discussed.

If direct measurement of the rings is employed to determine their volume, the rings shall be calibrated using a caliper which has been calibrated. Four diameters, 45 degrees apart, shall be measured and averaged, and the depth of the ring shall be measured at four points 90 degrees apart and averaged.

As an alternate method, the rings may be calibrated by precise water methods. With a rubber surface as a base and a lightly greased glass plate as a cover, fill one of the small rings with water of known weight and temperature until the water contacts the cover over the entire area of the ring. A calibrated balance and thermometer must be used. Knowing the temperature and weight of the water, calculate the volume of the ring. Repeat this procedure for each ring until three volumes are secured having a maximum range of variation of 0.0005 ft^3.*

---

* ASTM requirement is 0.0001 ft^3; however, this tolerance is more stringent than required. Therefore, Canonie has changed the acceptable tolerance.

Note that the first volume calculated is not the true volume of the ring as it includes the added volume of the lap joint used to nest the rings. The true volume of the other two rings can now be determined with the above procedure using the ring discussed above as a base. To determine the true volume of the first ring, use one of the rings with a known volume as a base and follow the same procedure.

If the ring volumes agree within $\pm$ 0.0002 ft^3 of the rated volume of 0.0500 ft^3 and 0.1000 ft^3, respectively, the rated volume may be used as the ring constant. Otherwise, the ring shall be marked with its true volume.

The scale on the piston rod shall be checked by comparing it to the rings of known volume. (Calibrated Proctor molds may also be used.) The procedure is as follows:

> Clamp the filled densometer on the assembly rings and template seated on a flat smooth surface. Fill the balloon within the rings and read the rod scale. Remove one of the rings and repeat the procedure. The difference in the two readings should equal the known volume of the removed ring.

If the difference between the two readings on the rod do not equal the known volume of the ring ($\pm$ 0.0002 ft^3) after two trails, refer to "Suggested Method of Test for Density of Soil In Place Using the Washington Densometer," which is found in ASTM STP479 and correct the scale on the rod.

Attached are the calibration record forms to be completed for each Washington densometer.

Canonie CONSTRUCTION COMPANY

WASHINGTON DENSOMETER CALIBRATION

EQUIPMENT NUMBER ______________________

EQUIPMENT NAME ______________________

DATE ______________ DATE OF LAST CALIBRATION ______________

CALIBRATION PERIOD ______________________

I. VOLUME OF THE RINGS (DIRECT MEASUREMENT)

ALL MEASURMENTS TO BE TAKEN IN INCHES

RING NUMBER ______ RATED VOLUME ________ ft^3

D_1 =	H_1 =	Vol. = $\frac{\pi D^2_{Avg.}}{6912} H_{Avg.}$
D_2 =	H_2 =	
D_3 =	H_3 =	
D_4 =	H_4 =	Vol. = ________ ft^3
$D_{Avg.}$ =	$H_{Avg.}$ =	

RING NUMBER ______ RATED VOLUME ________ ft^3

D_1 =	H_1 =	Vol. = $\frac{\pi D^2_{Avg.}}{6912} H_{Avg.}$
D_2 =	H_2 =	
D_3 =	H_3 =	
D_4 =	H_4 =	Vol. = ________ ft^3
$D_{Avg.}$ =	$H_{Avg.}$ =	

RING NUMBER ______ RATED VOLUME ________ ft^3

D_1 =	H_1 =	Vol. = $\frac{\pi D^2_{Avg.}}{6912} H_{Avg.}$
D_2 =	H_2 =	
D_3 =	H_3 =	
D_4 =	H_4 =	Vol. = ________ ft^3
$D_{Avg.}$ =	$H_{Avg.}$ =	

FOR ACCEPTANCE, Vol. = RATED VOLUME $\pm$ 0.0005 ft^3

II. SCALE ON THE PISTON ROD

KNOWN VOLUME OF RING TO BE REMOVED (ft^3)	A	
READING OF ROD WITH RINGS IN PLACE (ft^3)	B	
READING AFTER REMOVAL OF RING (ft^3)	C	
CALCULATED VOLUME OF RING (ft^3)	D	
DIFFERENCE BETWEEN TWO VOLUMES (ft^3), E = A−D	E	

FOR ACCEPTANCE, $E < 0.0002\ ft^3$

SIGNED ______________________

WASHINGTON DENSOMETER CALIBRATION

(ALTERNATE METHOD)

EQUIPMENT OWNER CONSTRUCTION COMPANY

EQUIPMENT NAME _____

DATE _____ DATE LAST CALIBRATED _____

CALIBRATION PERIOD _____ CALIBRATED BY _____

I. VOLUME OF THE RINGS (WATER METOD)

RING NO.	WEIGHT OF CONTAINER		WT. OF WATER TO FILL RING (grams)	TEMP. OF WATER IN RING (°C)
	BEFORE FILLING RING (grams)	AFTER FILLING RING (grams)		

CALCULATE THE VOLUME OF EACH RING UNTIL THREE VOLUMES ARE OBTAINED HAVING A MAXIMUM VARIATION OF 0.0005 FT^3.

THE FIRST VOLUME CALCULATED IS NOT THE TRUE VOLUME OF THE RING AS IT INCLUDES THE ADDED VOLUME OF THE LAP JOINT USED TO NEST THE RINGS.

$$\text{VOLUME OF RING } (ft.^3) = \frac{\text{WEIGHT OF WATER IN RING (grams)} \times \text{UNIT VOLUME } (ml/g)}{28317 (ml/ft^3)}$$

RING NO.	VOLUME ($ft.^3$)

TEMP.(C)	UNIT VOLUME($^{ml}/_{g}$)
16.0	1.00103
17.0	1.00120
18.0	1.00138
19.0	1.00157
20.0	1.00177
21.0	1.00198
22.0	1.00220
23.0	1.00245
24.0	1.00269
25.0	1.00294
26.0	1.00320
27.0	1.00347

II. SCALE ON THE PISTON ROD

KNOWN VOLUME OF RING TO BE REMOVED ($ft.^3$)	A	
READING OF ROD WITH RINGS IN PLACE ($ft.^3$)	B	
READING AFTER REMOVAL OF RING ($ft.^3$)	C	
CALCULATED VOLUME OF RING ($ft.^3$)	D	
DIFFERENCE BETWEEN TWO VOLUMES ($ft.^3$) E = A − D	E	

FOR ACCEPTANCE, $E < 0.0002\ ft.^3$

CANONIE CONSTRUCTION COMPANY

APPENDIX E

EXAMPLE OF DEVIATION FORM

Comments re Canonie
3-30-77

SECTION 1.0 INTRODUCTION

Second paragraph states in part, "The specifics of Quality Control for work are contained in manuals of practice developed by Canonie. In general, these manuals of practice are to provide guidance for Canonie personnel relating to daily Quality-related tasks for our activities." Where are these manuals of practice?

Are they
The will cover

SECTION 2.1 ORGANIZATION

States in part, "Figure 1 presents the organizational structure within Canonie for the operation of the Quality Assurance program. This organization chart is only intended to show the relationship of the Quality Assurance staff to the Project staff for a specific project." Where is the specific organization chart for the Midland Project?

CANONIE ORGANIZATION CHART

On Page 2-2 - Where is the President on this Organization Chart? What does the dash line to the left of QC Engineer on Site mean? Who fills the job of Project Manager, QC Engineer, QC staff on site? Also, who fills the position of QA Engineer Home Office and QA Staff Home Office?

Are they

SECTION 1.0 INTRODUCTION and 2.1 ORGANIZATION

State the "Quality Assurance Program" What actually is the Quality Assurance Program? QA = QA + QC

SECTION 2.2 MANAGER OF QUALITY ASSURANCE

First paragraph states in part, "The implementation of the Quality Control Program..." What actually is the Quality Control Program?

QA = QA + QC

SECTION 2.2 MANAGER OF QUALITY ASSURANCE

Also states in part, "The Quality Assurance staff will be directly responsible to this individual for the reporting of all Quality-related problems." How is this reporting documented? ✓ NCR to Mgr. of QA for copy of NCR

SECTION 2.4 QUALITY CONTROL ENGINEER

Last paragraph states, "Exceptions to total separation of production and quality-related activity shall be for work such as surveying or supervision of backfill. In these cases the activity shall be responsible to both the Quality Assurance Engineer and the on-site Project Manager as shown in Figure 1. However, for these events the on-site Project Manager cannot instruct the personnel performing the work to not comply with quality requirements." Why is this exception taken? ✓ See Item 1

SECTION 2.5 PROJECT COMMUNICATION

States in part, "The Quality Assurance Engineer and staff must be available to the Quality Control staff to aid in the interpretation of the Quality Assurance Program and procedures, standards or Regulatory requirements should the need arise." Why does the Quality Control staff have anything to do with the Quality Assurance Program? They should only be working with the Quality Control Program. ✓

SECTION 2.5 PROJECT COMMUNICATION

States in part, "Conversely the Quality Control staff shall inform the Quality Assurance Engineer and staff or the Vice-President - Manager of Quality Assurance of problems arising in the daily execution of Quality Control Program." This conflicts with Section 2.2, Manager of Quality Assurance, which states in part, "As such, the Quality Assurance staff will be directly responsible to this individual for the reporting of all Quality-related problems." ✓

SECTION 3.1 QUALITY ASSURANCE STANDARDS

States, "All activities within Canonie that are Quality-related shall be governed by written procedures. These procedures shall take the form of this Quality Assurance Manual or, as previously mentioned, manuals of practice for specific work items." This "or" should be "and".

SECTION 1.0 INTRODUCTION

Last sentence on Page 1-1 states, "The Quality Assurance Program described in this manual is fully endorsed by the management of Canonie Construction Company." Define "management".

SECTION 3.1 QUALITY ASSURANCE STANDARDS

Last sentence on Page 3-1 states,"However, Quality Control Standards shall be subject to review and approval by the Manager of Quality Assurance or his designated Quality Assurance personnel prior to implementation." This contradicts Section 2.2, Manager of Quality Assurance,which states in part "Further, the Manager of Quality Assurance is responsible for the preparation and approval of procedures or standards used by the Quality Assurance and Quality Control staffs."

SECTION 3.1 QUALITY ASSURANCE STANDARDS

First paragraph on Page 3-2 states in part, "Activities which may be routinely performed by Canonie as part of its inspection services on the Project; such as concrete testing, structural earthwork control or reinforcement testing, shall whenever possible be conducted to recognized standards." This statement has to be more specific. Item 1

SECTION 3.2.1 CONTROL OF COPIES

States in part, "The Quality Assurance Manual and Manuals of Practice shall be numbered, with a distribution list of copy holders maintained by the Manager of Quality Assurance or a member of the Quality Assurance staff." The wording of this statement should be clearer. Also, I feel that the Manager of Quality Assurance should keep the distribution list.

SECTION 3.2.1 - goes on to state, "Control of copies shall be so that in the event of revision, all copy holders may be presented the revision and also to withdraw copies if necessary." This statement has to be more specific.

SECTION 3.2.3 REVISION OF DOCUMENTS

First paragraph states in part, "As a minimum, the Quality Assurance Manual and the Manuals of Practice shall be reviewed by the Manager of Quality Assurance or designated member of the Quality Assurance staff or external organization on a yearly basis. Such reviews will be documented as Quality Assurance records." What will be included in this review?

SECTION 3.2.3 - First paragraph on Page 3-4 states in part, "The revision shall be signed and dated by the copy holder and promptly returned to the Manager of Quality Assurance." This should read, "The revision receipt shall be signed and dated." Also it seems that the Mangger of Quality Assurance should be the one that retains the distribution list.

SECTION 3.2.3 - Last sentence of this section on Page 3-4 states, "Finally, to complete the revision a new approval receipt shall be issued which indicates the revision number and/or date and its acceptance by the appropriate members of Canonie management." State who the appropriate members of Canonie Management are.

SECTION 3.3 QUALITY ASSURANCE AUDITS

States in part, "Internal audits to verify compliance with the Quality Assurance/Quality Control Programs by members of the Quality Control staff..." I thought the Quality Control staff was in charge of implementing Quality Control Program, not the Quality Assurance Program.

SECTION 3.3 - Goes on to state, "Cooperation with clients, owners or regulatory agents who are auditing the work performed by Canonie..." Why does Canonie conduct or participate in this type of audit?

SECTION 3.1 QUALITY ASSURANCE STANDARDS

Third paragraph states in part, "Quality Control Standards which will generally be working or testing procedures with specifications pertinent to a generic activity or project may be prepared by either Quality Control or Quality Assurance personnel or external organization. However, Quality Control standards shall be subject to review and approval by the Manager of Quality Assurance or designated Quality Assurance personnel prior to implementation." Quality Control standards that are prepared by Quality Assurance personnel should not be approved by Quality Assurance personnel. Also in Section 3.1.1, Quality Assurance Internal Audits, states in part, "The Manger of Quality Assurance shall appoint a Quality Assurance Engineer or an external organization to perform the function of the Quality Assurance Engineer." If a Quality Control standard is prepared by an external organization, the review and approval should not be by the Quality Assurance Engineer who in fact is the external organization.

SECTION 3.3.1 QUALITY ASSURANCE INTERNAL AUDITS

Paragraph 4 states in part, "Further, additional audits may be required if activities related to the Quality Control Program are initiated or completed between quarterly audits. It is the intention of the internal audits to not only provide periodic evidence of compliance with the Quality Assurance Program..." This section states, "Quality Control Program and Quality Assurance Program" — What is the difference between these programs?

SECTION 3.4.1 AUDIT REPORTS AND CORRECTIVE ACTION

States in part, "Issuance of the Audit Report as described in the following paragraph shall be in a timely manner and, unless prevented by scheduling difficulty, should be within ten days of issuance of the audit." What scheduling difficulties are foreseen?

SECTION 3.3.1 QUALITY ASSURANCE INTERNAL AUDITS

Third paragraph states in part, "Because quarterly audits are scheduled, the Quality Control and Project staff will be notified of their occurrence." Who are the Project staffs? First paragraph on Page 3-9 states in part, "A project Quality Assurance record" "Record" is spelled "Reocrd" -- This paragraph goes on to state in part, "After approval of the Audit Report by the Manager, copies of it shall be submitted to the Construction Manager, the On-site Manager and the Quality Control Engineer." Why aren't copies submitted to Bechtel? Page 3-10, second paragraph states in part, "Copies of the closure statement shall also be issued to the Construction Manager, the On-site Project Manager and Quality Control Engineer." Why isn't a copy submitted to Bechtel?

SECTION 3.4.2 MAINTENANCE OF RECORDS

States in part, "The Project Quality Assurance records shall include the Audit Schedule, Audit Reports, Audit Checklist, verifications of corrective action, Audit Closure Statements and objective evidence that other Quality Assurance activities such as the training of personnel and review of procurement documents have been performed." Contrary to this statement, there are other Project Quality Assurance records such as is found on Page 3-5, second-to-last paragraph; Page 3-9, first paragraph; and Section 3.2.3 last sentence of the first paragraph; Pg 3-12, last para.; Pg 3-13, 2ND to last para.; Pg 3-15, 2ND to last para.; Pg. 3-16, last para.; Pg 4-5, 2ND to last para. of sec. 4.5.

SECTION 3.4.2 - Will the maincenance of records be in accordance with ANSI N45.2.9? Item 1

SECTION 3.6 TRAINING OF PERSONNEL IN QUALITY ASSURANCE/QUALITY CONTROL ACTIVITIES

States in part, "This will include the review of the pertinent portions of the Quality Assurance Program as contained in the Canonie Quality Assurance Manual, a review of the Quality Control aspects which would include both administrative and technical aspects of the Quality Assurance Manual and the pertinent Manuals of Practice..." Define "pertinent"

SECTION 3.6 - Last paragraph on Page 3-13 states in part, "The Manager of Quality Assurance has the right to approve or prevent the assignment of personnel to Quality Control functions." What about the assignment of personnel to Quality Assurance functions? QA is appointed by Mgt. O.K.

SECTION 3.6 - First paragraph on Page 3-14 states, "The requirements for the Quality Assurance Engineer." What are the requirements for the Quality Assurance staff? The second paragraph on this page goes on to state, "Quality Control personnel shall be capable of performing their functions within the stipulations and contractual requirements of the Project. For example, if the contract stipulates that inspectors shall meet a certain level requirement (such as stated in

SECTION 3.6 (Contd)

ANSI N45.2.6) then individuals capable of meeting these requirements will be assigned to the Quality Control staff." Is ANSI N45.2.6 contractually the requirement?

SECTION 3.7 MANAGEMENT REVIEW OF PROGRAM

States in part, "To document this review, the Manager of Quality Assurance shall issue a report to the President of Canonie stating the activities and documents reviewed and the results of the review." Is this report a Quality Assurance record? And, if so, is this maintained as a Quality Assurance record?

SECTION 3.7 - On Page 3-16 states in part, "The purpose of this annual review shall be to assure that all Quality Assurance records are complete and properly maintained. Evidence of the review and approval of individual audit reports shall be shown by the signed and dated copies of the audit reports which the Manager has approved prior to issuance. These will be maintained as Quality Assurance records." I don't understand what this is saying. Also, this review should be more formally documented.

SECTION 4.1 INTRODUCTION

First paragraph states in part, "This includes the scheduling of inspections, the execution of these inspections and their documentation subject to the approval of the Quality Assurance Engineer." How is this approval made by the Quality Assurance Engineer? This paragraph goes on to state, "In matters affecting Quality, the Quality Control Engineer shall be responsible only to the Quality Assurance Engineer." What does this responsibility curtail?

SECTION 4.1 INTRODUCTION

Second paragraph states in part, "As previously stated, it is not intended that Quality Control personnel have direct responsibility for production. However, it should be recognized that certain Quality-related functions are part of production. This could include the supervision of spreading of backfill prior to compaction and the actual compaction of backfill." I disagree with this statement.

SECTION 4.2 GOVERNING PROJECT DOCUMENTS

Define pertinent Manuals of Practice.

SECTION 4.3 CONTROL OF PROJECT DOCUMENTS

Second paragraph states, "To purge obsolete drawings and specifications from use, they will be collected from copy holders as shown in the log and replaced with new revisions." How is this indicated on the log?

SECTION 4.3 - Second-to-last paragraph states in part, "However in general Canonie will not issue specifications but shall use when possible the Manuals of Practice." The words, "when possible" should be deleted.

SECTION 4.4 ESTABLISHMENT AND IMPLEMENTATION OF THE INSPECTION & TESTING PROGRAM

States in part, "Requirements for calibration shall also be reviewed so that equipment which must be calibrated shall be serviced in a timely manner and on schedule so that inspection and testing functions may continue uninterrupted."

SECTION 4.5 ONGOING INSPECTION AND TESTING PROGRAM

Second paragraph states in part, "What the cause is and the action taken or recommended to prevent reoccurrence..." This should state to prevent recurrence.

SECTION 4.5 (Contd)

Also the handling of deficiencies will have to be in accordance with 10CFR50 Appendix B and ANSI N45.2.

Audit 18.6 3 months

SECTION 4.7 CONTROL OF PURCHASED MATERIALS & EQUIPMENT

Third paragraph states in part, "Material and equipment that has been approved by inspection and that will be stored prior to use shall be handled in such a way to prevent damage and stored in accordance with the requirements of the materials and equipment." What are the requirements of the materials or equipment?

SECTION 4.9 QUALITY CONTROL DOCUMENTS

Last sentence on Page 4-11 states, "If it becomes necessary to remove a document from this area, it should be copied with the original being returned to the file." Is the copy marked "Uncontrolled"?

No need to copy items - Steve Hagen and 7-14-77

SECTION 4.10 QUALITY CONTROL WORK PERFORMED BY OTHERS

Has Canonie been given the responsibility for Quality Control inspections? YES

APPENDIX B - EXAMPLE OF SUBCONTRACTOR PREQUALIFICATION AUDIT CHECKLIST

"Subcontractor" is spelled "Subonctractor" Corrected App. B.

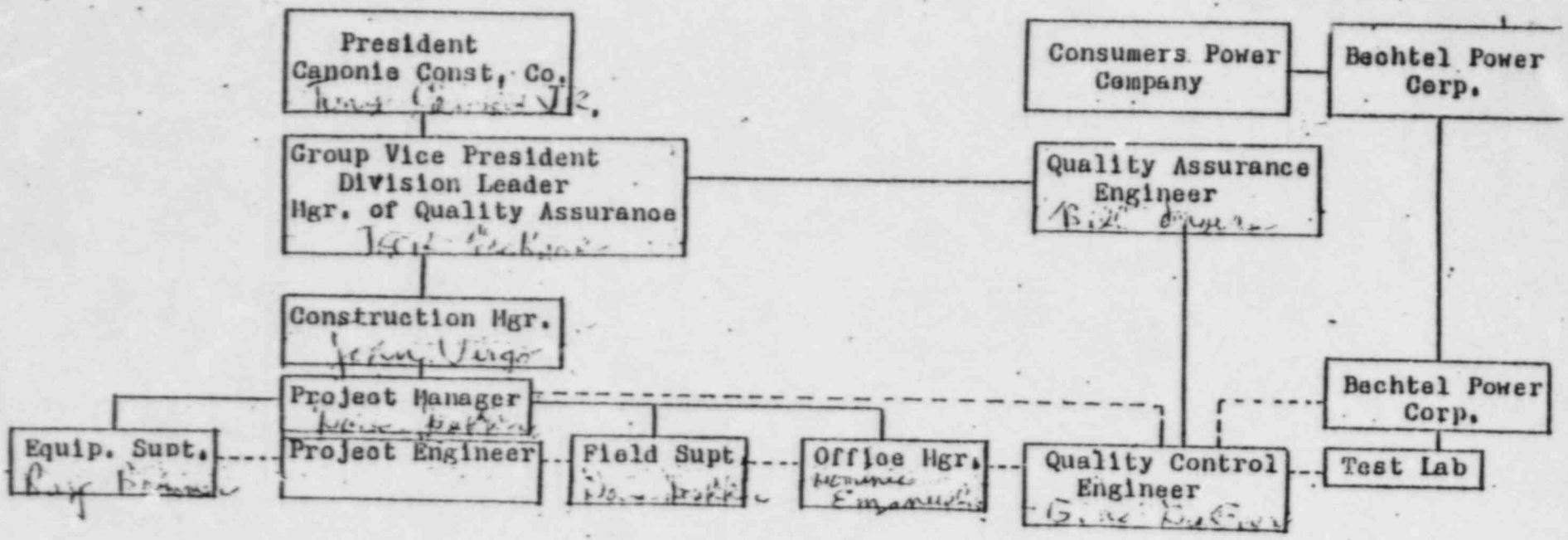
APPENDIX C - EXAMPLE OF A QUALITY CONTROL PROCEDURE

Page C-1, Section 2.0, General Inspection Requirements, second paragraph states, "All backfill and conpaction operations will be performed under the strict inspection of the Field Earthwork Inspectors in order to assure that the minimum required in-place densities are achieved." Are the Field Earthwork Inspectors QC Engineers? YES

CANONIE CONSTRUCTION CO.

Midland Station Units 1&2

Plant Foundation Excavation & Cooling Pond Dikes



_____ Direct Responsibility

--------- Communication

TO Midland File: B3.0.3

FROM GSKeeley/TCCooke, P-14-408B

DATE December 4, 1978

SUBJECT MIDLAND PROJECT -
DIESEL GENERATOR BUILDING
SETTLEMENT MEETING -
FILE: B3.0.3 SERIAL: 6175

CC DBMiller/TCCooke, Midland
CAHunt, P-14-209B
DEHorn, Midland

Consumers Power Company
INTERNAL CORRESPONDENCE

On Thursday, November 2, 1978, a meeting was held in Ann Arbor between Bechtel and Consumers Power Company technical people to review the situation on the settlement of the diesel generator foundation. An agenda and names of personnel in attendance are attached (Attachments A and B).

During this meeting the following discussion took place:

I. A. See Attachment C for Listing of Inconsistencies

1. Tuveson of Bechtel stated the following:

C-501 is an AA design guide. Bechtel feels that Geo Tech, although not there full time, performed technical supervision. They did not have a man full time for either dike work or power block backfill.

Geo Tech only reviewed data if field requested them to review and only if field had problems. Bechtel feels that field engineers' personnel involved in compaction were qualified soils engineers and could interpret tests and correlation of tests. CP Co does not feel that they were qualified soils engineers on site (most were right out of school). Bechtel (PAMartinez) had said in July 1974 they would have a man full time on the job, but not the site.

2. Bechtel feels that relaxation of Dames & Moore recommendations is supported by field testing on compaction and the D&M Report does not specify the type of equipment to be used. 1973 testing showed that it varied depending on equipment and material. Would have used different compaction if lifts were 6" - 8". CP Co talked to Rexford about difficulty of monitoring spreading and compaction especially in small areas. Bechtel says they feel as comfortable with 12" lifts as 6" - 8". See J L Corley letter to Connolly, 7/23/74. Don Horn says there were areas around containment where they went above mark. During July 1974 PAM committed to CAH that JWanzek would be on job full time - affected by slowdown.

3. Bechtel does not feel there is any conflict. If backfill froze and then thawed, it should be removed. It was all scraped off (usually 2") and then tested with a pickax.

4. C-501 - On-site sand.

   C-211 - Structural backfill so does not have to be too high a percentage (bought off-site sand). CP Co feels that the Bechtel C-210 specification did not require sand soil to be compacted to 85%. Bechtel feels that whether it is 80% or 85% it has no structural effect assuming the sand meets the gradation for structural sand (imported off-site).

5. Bechtel says that they requested that more borings be done before diesel generator problem and they have now demonstrated that we do have adequate compaction of material in sand lens area questioned.

6. Bechtel says that, in some cases, the wrong standards could be followed and that this was the problem with grade beam. There have been times when inexperienced man could have selected the wrong coorelation. Since the diesel building problem, Bechtel has gone to running proctors as soil is being placed although they had taken some borings after grade beam, but did not see any problems. How many proctors were run as material was removed from borrow pit - none. This would have shown whether technicians were utilizing the correct proctors. Present practices require higher density which is more difficult to obtain watching wheel action in small areas was assumed to be impractical.

7. Should Bechtel modify proctor vs ASTM (see NRC Exit #6 below)?

B. <u>NRC Exit (See Attachment D for Listing of Findings)</u>

1. During construction, we are doing every week on diesel and every 60 days on others. We see no need to change from FSAR commitment.

2. Use of random fill was identified as okay in Dames & Moore and PSAR and as long as adequately compacted is okay. Will change FSAR to indicate random fill will be used. In addressing judgment on area and non-uniformity of soil, we should also cover conservatism of structure design to settlements. The building is a stiff structure and can span settlements.

3. Due to various types of equipment, acceptance was performance rather than procedure. Copied from dike work, but not applicable to backfill. The table should be modified.

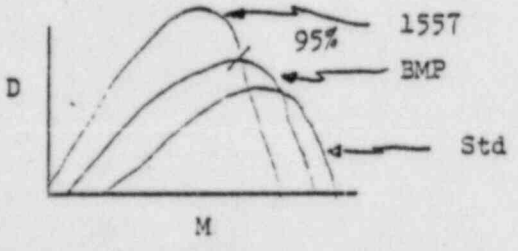
4. Cover this in compaction explanation. Review and change the FSAR. The PSAR said 1/2" is a ballpark figure.

5. Typo; grade instead of actual.

6. C-10 specification in 1969 used four-pass performance specification and test to 20,000 foot pounds Bechtel Modified Proctor (BMP). On restart in 1973, C-10 became C-210 for dike (methods) and performance for rest of fill (testing to BMP with modified - 95% of 1557D). Was added to Section 13 - testing is still based on BMP per Section 12.

   In 1977, Revision 5 was rewritten to 1557 for placement (was re-written for type of materials - sand). On clays said 95% of 1557. Q-List dike was tested to 95%. but rest was accepted on 4-pass. Test in these areas shown less than 95%. There were 3,000 tests taken.

1557	BMP
95%	100%



(Varies from 8 to 16%.)

BMP was originally implied to be used for dikes. 20,000 ft lb vs 56,000 ft lb of effort on BMP vs 1557. On other jobs Bechtel uses 95% of 1557. Dames & Moore recommended 95% of 1557 or 100% of BMP. Bechtel does not know why 95% BMP was used - possibly 56,000 ft lb was accidently copied out of the D&M Report. As it ended up, Bechtel used 95% of BMP for everything.

	Referenced 1557 (1968)	BMP (1969)
Under & Support Of	95	100
Adjacent to Structure	90	95
Nonsupportive & Adjacent	90	90

7. Working on. Continue monitoring. The elastic foundation question has not yet been analyzed for the worst case.

8. Will discuss utilities and random fill calculations which are major concerns.

9. Feels no problem and could close up later. It is under observation. 0.02" maximum allowable under ACI architectural.

10. Okay.

11. Will be monitoring. Initial calculations did consider variations on water level.

12. Okay. Check consultant on preload.

13. Okay.

14. Mat foundations not used normally over random fill or in diesel building; Bechtel disagrees.

    Bechtel disagrees on blow count question and noted that tests may have been taken at planes.

    OK

15. Does not believe material was placed as indicated (low blow counts).

II. A. Planned Future Actions

1. Start monitoring underground utilities prior to other activities.

   a. Condensate lines - measure gaps and survey (elevation).

   b. Other pipes - measure sleeve gaps - do additional excavation as required.

   c. Get initial readings on adjacent underground pipes.

2. Release the duct banks.

3. Grout gaps between building footings and soil for more uniformity in soil pressure and avoidance of building stress.

4. Check the relative displacement between duct bank and footings - include the off-set duct bank.

5. Run a profile along the bore of pipe beneath the building before and after preloading. Include horizontal and vertical measurements on center line.

6. Monitor condensate pipes and duct banks and check continuity on one duct per bank.

7. Install soils instrumentation.

   a. Building settlement markers.

   b. Piezometer for pore water pressure (in and out).

c. Settlement monitoring of existing fill at varying elevations.

d. Inclinometers.

8. Preparation for surcharge.

a. Three feet of sand will be placed approximately 20' around the outside of the Diesel Generator Building and inside the Diesel Generator Building for frost protection.

b. Manholes may be utilized in the approximately 2,000 cubic feet of sand.

c. Excavate both sides of duct banks.

d. Protect the turbine generator basement wall, if a surcharge is required in that area.

9. Resolve what will be done in the transformer areas.

B. Scheduling

The duct bank should be cut loose on November 6, 1978. This operation will take approximately 2½ weeks. On November 24, 1978 start grouting operation (1½ weeks maximum time estimate). The pond should be filled by January 1, 1979 if at all possible. Instrument preparation should start immediately to complete in 2-2½ weeks. The meeting with consultants will be held on November 7, 1978 in Champaign, Ill. Decisions on surcharge will be made November 14, 1978.

It is anticipated that cribbing for the surcharge will be complete by mid-December. NRC confirmation of the planned course of action may be required. Once fill has been started, it will take approximately 2 weeks to complete. The surcharge will then remain until approximately June 1, 1979 (assumption). Removal would take about 2 weeks. It is assumed that work would continue where possible in mechanical and electrical areas. Civil work on Diesel Generator Building would probably continue from March 1, 1979 through May 1979 and complete June 1, 1979. One machine must be turned over on March 1, 1980 for hot functional.

Monitoring operations should start as soon as possible prior to cutting the building loose (initial work has been completed).

The NRC, Darl Hood, will be contacted on November 7, 1978 and a meeting will be set up with Messrs Hood and Lyman Heller.

GSK/cg

Attachment A

Bechtel Power Corporation

MEETING AGENDA

Midland Units 1 and 2
Consumers Power Company
Bechtel Job 7220

DATE: Thursday, November 2, 1978, 10 a.m.

PLACE: Ann Arbor Office, 4 D 5

SUBJECT: DIESEL GENERATOR REVIEW MEETING

ATTENDEES: Consumers Power Company / Bechtel

DISCUSSION ITEMS:

(I) CPCo/NRC Questions & Concerns

- (A) "Inconsistencies Discovered to Date"
- (B) NRC Exit Meeting October 27, 1978

(II) Future Activities

- (A) Releasing Duct Banks
- (B) Grouting Gaps Under Footing
- (C) Utilities Monitoring During Release of Duct Banks
- (D) Soil Settlement Instrumentation and Monitoring of Utilities During Surcharging
- (E) Preparation for Surcharge
  - (1) Protective Measures
  - (2) Frost Protection
- (F) Schedule

PP

Attachment B 11/2/77

Diesel Generator Review Meeting

Attendees:

P. Martinez	Bechtel
N. Swanberg	"
Karl Niedner	"
M O Rothwell	✓
B.C. McConnel	—
A.P Betts	"
M. R Williams	" QA
J. O Wanzeck	Bechtel
Stan Blue	Bechtel
R M Wheeler	CPCO
D E Siddall	CPCO
D.E. Horn	CPCO
G.S. Hawley	CPCo.
T.C. Cooke	CPCo.
C. A. Hood	CPCo
G A Tuveson	Bechtel

ATTACHMENT C

INCONSISTENCIES DISCOVERED TO DATE

1) References:

a. Dames & Moore Report (Page 15)

b. Standard No 7220-C-501, "Civil & Structural Design Criteria" (Page 8)

"Filling operations shall be performed under the technical supervision of a qualified Soils Engineer who will perform in-place density tests in compacted fill to verify that all materials are placed and compacted in accordance with recommended criteria."

Bechtel Field did not have a Soils Engineer on site.

2) References:

a. Dames & Moore Report (Page 14)

b. Bechtel Specifications C-210 and C-211

Dames & Moore - "All fill and backfill materials should be placed at or near the optimum moisture content in nearly horizontal lifts approximately six to eight inches in loose thickness."

Bechtel Specs - C-211, Section 5.2.2 - "However, in no case shall the uncompacted lift thickness exceed 12 inches."

Obviously, these two requirements conflict.

3) References:

a. Dames & Moore Report (Page 15)

b. Bechtel Specification C-211

Dames & Moore - "In addition, no compacted soils should be allowed to freeze. If fill or backfilling operations are discontinued during periods of cold weather, it is recommended that all frozen soils be removed or recompacted prior to resumption of operations."

Bechtel Spec - "No backfill shall be placed upon frozen surface nor shall any frozen material be incorporated in backfill."

This does not address the question of removal or recompaction upon resumption of work.

4) References:

a. Bechtel Design Standard C-501

b. Bechtel Specification C-211

Bechtel Design Standard - Table of Minimum Compaction Criteria

Purpose of Fill	-	On Site
Support of Structure		Sand Soil
		Percent Relative Density
		85% (D2049-69)

Spec C-211, Section 5.5.1 - "Cohesionless (sand) material shall be compacted to not less than 80% relative density...by ASTM D. 2049."

Specification and Design Standard conflict.

5) References:

a. Dames & Moore Report (Page 14)

b. FSAR Pages 2-7

c. Drawing C-44

Dames & Moore - "It is recommended that all areas in which the final grade will be raised by placement of fill be stripped of all topsoil and other unsuitable soil if any and be thoroughly proof rolled."

FSAR - "All loose in-site sands, soft or compressible clay soils and organic soils will be excavated in the Turbine Building area."

Bechtel Drawing C-44, Note #4 - "Within the excavation area shown, all loose surficial sands with relative density less than 75% shall be removed."

Added to this drawing 8/23/75.

Boring logs show us that the soil was not removed; however, it may be greater than 75%.

Discussion

The question of whether the loose sands as described in the PSAR were ever removed is a good example of why there should be mechanisms to insure that commitments are properly conveyed to the Construction Group and that the outlined work is successfully concluded. When the note to Drawing C-44 was added, it was too late to economically excavate the loose sand since they had for the most part been covered by backfill.

The attached boring logs and locations confirm existance of the sands, although the blow counts look very good.

6) We question the method used to select the proctors. Errors in reported compaction probably resulted in selection of lower maximum density proctors. See Bechtel letter to US Testing dated February 1, 1978.

Attachment D

TO — MWMarguglio, JSC-220A

FROM DEHorn, Midland DEH

DATE October 31, 1978

SUBJECT MIDLAND PROJECT - NRC EXIT INTERVIEW OF OCTOBER 27, 1978
File: 0.4.2 Serial: 280FQA78

Consumers Power Company

INTERNAL CORRESPONDENCE

CC SAfifi, Bechtel - Ann Arbor
WRBird, JSC-216B
RLCastleberry, Bechtel - Ann Arbor
TCCooke, Midland
JLCorley, Midland
GSKeeley, P14-408B
DBMiller, Midland
JFNewgen, Bechtel

The following people were in attendance at the subject exit interview which was conducted at the end of G. J. Gallagher's inspection of October 24-27, 1978:

CPCo	Bechtel	NRC
RCBauman	WLBarclay	RJCook
TCCooke	ABoos	GJGallagher
JLCorley	RLCastleberry	
DEHorn	LADreisbach	
GSKeeley	PAMartinez	
DBMiller		
BHPeck		
RMWheeler		

Mr. Gallagher stated that the visit was a follow-up on 50.55(e) report of the diesel generator settlement and that it was also a fact finding visit. The inspection consisted of a review of past data, activities in progress and planned activities for future work. Inspection was performed by review of the FSAR commitments; Specification C-210; Specification C-211; PQCI/IR C-1.02; Dames and Moore Report of Foundation Investigation and Preliminary Explorations for Borrowed Materials dated June 28, 1968 and supplement to this report dated March 15, 1969; preliminary data on diesel generator settlement problem including boring plan, cross sections of fill, blow count versus the elevation graphs, lab data, settlement data, boring logs, dutch cone logs, weather data and penetrameter readings in test pits; design drawings C-45, C-109, C-117 and C-1001; soil tests taken in the diesel generator building area during construction compiled by B. T. Cheek, Bechtel QC; observation of soil testing at the test lab and in the field; and discussions with Bechtel Geo-Tech, Project Engineering, Field Engineering, Quality Control Engineering, U.S. Testing, Consumers Power Company, PMO and QA personnel. Mr. Gallagher stated that he would not handle the findings as noncompliances, however, they could become items of noncompliance when they are reviewed by his management.

His findings/observations were as follows:

1. The FSAR states that during operation, settlement readings will be taken every 90 days. Because of the diesel generator settlement problem, this frequency should be re-evaluated for adequacy.

2. FSAR Table 2.5-14 "Summary of Foundation Supporting Seismic Category I Structures" identifies the supporting soil materials under the diesel generator building as being controlled, compacted cohesive soils. However, construction drawing C-109, Rev. 9 and C-117, Rev. 6 identifies the material in this area as Zone 2 material. Zone 2 material is identified as random fill described as any material free of organic or other deleterious materials. In the field a variety of materials have been used for the diesel generator foundation material, in particular, sands, clay, and lean concrete, silty sands and clayey sands. The apparent conflict is that Table 2.5-14 identifies cohesive soils where, in actuality, cohesionless sands have been utilized. A review of the records indicate that sands have been used between elevation 594'-608', areas of elevation 611'-613' and areas between 616'-623'. This indicates the extent of the variability of the material placed under the diesel generator building foundation. Mr. Gallagher did not feel it was good judgement to use random material under the support of a structure.

3. FSAR Table 2.5-21 "Summary of Compaction Requirements" identify random fill to require a compaction effort of a minimum of 4 passes with the specified equipment in this table. This requirement has not been an imposed requirement of Bechtel Specification C-210 nor an inspection requirement of Bechtel Quality Control Instruction C-1.02 for backfill.

4. FSAR section 3.8.5.5 states that settlements of shallow spread footings founded on compacted fill are estimated to be on the order of ½" or less. Site Survey Program has identified settlements in the diesel generator building foundation on spread footings to range from 0.55 inches to 2.30 inches and in excess of 3.0 inches for the diesel generator pedestal.

5. FSAR figure 2.5-47 indicates the foundation of the diesel generator building to be at elevation 634', according to design drawings C-1001, Rev. 5 it is indicated for the diesel generator spread footings and pedestal foundation to be at 623'.

6. A. Specification C-210, section 13.7.1 requires all cohesive backfill in the plant area to be compacted to not less than 95% maximum density as determined by ASTM D1557 method D which requires an effective compactive effort of 56,000 foot-pounds of energy per cubic foot of soil. However, section 13.4 Testing requires testing of the materials placed in the plant area to be performed in accordance with tests listed in section 12.4. This section, in particular section 12.4.5.1, "Cohesive Soils," requires maximum lab densities to be determined using ASTM D1557 Method D provided a compactive energy equal to 20,000 foot-pounds per cubmic foot is applied (Bechtel Modified Proctor Density). To date, the Bechtel Modified Proctor Density for determining maximum proctor density versus optimum moisture content has been utilized. This conflict results in an unconservative method of determining the maximum proctor density and method of assuring that the required percent compaction is achieved. In particular, the actual in-place compaction would be less using the Bechtel Modified Proctor Density as a reference than using the standard ASTM D1557 method D. This is due to the fact that the compactive energy exerted using the Bechtel Modified Method is less than the effort exerted by the standard method D - example: 20,000 foot-pounds versus 56,000 foot-pounds.

6. B. Bechtel Quality Control Instruction C-1.02 section 2.4 testing identifies the applicable inspection criteria and includes Specification C-210, section 13.7 and 12.4 which includes the apparent conflict as described in detail in Part A above.

   C. A further review of the original subsurface investigation performed by Dames and Moore and documented in report supplement dated March 15, 1969 page 16 indicates that the recommended minimum compaction criteria for support of structures be 100% of maximum density using a compactive effort of 20,000 foot-pounds (resulting from Bechtel Modified Proctor determination). However, this 100% of Bechtel Modified Proctor corresponds to 95% compaction according to the standard ASTM D1557 method D and not 95% compaction according to Bechtel Modified Proctor method which has been utilized for the entire plant fill area to date. Furthermore, Dames and Moore Report, page 15 states that all fill and backfill material should be placed at or near the optimum moisture content in near horizontal lifts approximately 6-8" in loose thickness. Bechtel specification permits a maximum of 12 inches which affects the compactability of the material.

7. Piping, condensate lines, duct banks, and other utilities under the diesel generator building may also be affected and must be evaluated.

8. Mr. Gallagher stated he was leaving not having seen settlement calculations and will be discussing design calculations, assumptions made, and conflicts with the FSAR with Licensing.

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10. The following tests were observed to be performed in accordance with the applicable tests standards by U.S. Testing:

    A. Lab Test ASTM D1557-70

    B. Field Test ASTM D/1556-64

11. Calculations should be evaluated on the increase and the rate of increase of the pond fill and the effects of the water in other areas.

12. Mr. Gallagher stated that the NRC does not view preloading of the structure to be a fix or resolution of the problem at this time.

13. Seismic loading calculations should be determined for the type of material existing in its present condition.

194

Consumers Power Company

Midland Project: P.O. Box 1963, Midland, Michigan 48640 • Area Code 517 631-0951

May 16, 1980

Mr. L. H. Curtis
Bechtel Power Corporation
P.O. Box 1000
Ann Arbor, MI 48106

MIDLAND PROJECT GWO 7020 - OPEN ITEMS - SOILS
File: 0485.16 UFI: 00234(S), 71*01 Serial: CSC-5043

Representatives of CPCo Project and Quality Assurance and Bechtel Project and Quality Assurance met in Ann Arbor on May 15, 1980 to discuss the follow-up of the May 1, 1980 meeting action items above subject. Attendees were as follows:

Shing Lo	Bob Wheeler
Bob Rixford	Don Horn
Walt Bird	Tom Cooke

With relation to the earlier meeting the following was noted:

1. Questions 24 thru 35 are now included on the Status Report.

2. Bechtel Quality Assurance has identified commitment dates made to the NRC.

3. Question 23 missed commitment dates; will have new dates on May 19 instead of May 15, 1980.

4. The target of June 1, 1980 for getting new commitment dates to the NRC appears to be logistically unobtainable at this point in time.

5. Don Horn has reviewed all action items and Question 2 thru 22. A list was presented at this meeting. In addition, Mr. Horn also reviewed action items for Question #1 and Question #24 thru #35.

Messrs. Rixford and Lo have done a significant amount of work in listing the action items for the 50.54(f) Soils Questions and status of same. It should be noted that since these questions and the responses covered a lengthy period of time, with many interruptions, several of the action item responses may be outdated or in some cases the completion date may have been missed. Various interruptions have not assisted the situation in any way. Some items have probably been completed but the present status may indicate "status unknown".

194

Two main objectives were discussed at the meeting:

1. It is imperative that we have cleared or set new dates for response to all of the action items and commitments so that we can complete our work in thorough, timely efficient manner. It is more sensitive in this particular activity, since missed dates, if pointed out by others, could have adverse publicity reaction on the project that could affect the upcoming public hearings.

2. It is our intent that all action items be cleaned up prior to the public hearings (possibly late summer of 1980) so that we may go through the hearings with a minimum of non-productive time consuming delays arguing why we have or have not completed some particular activity. In this regard, several action items came about from this meeting. Confirming our telecon of May 16, 1980, your assistance is required where an asterisk is shown next to the action item number.

Action Items:

*1. Bob Rixford to compare Don Horn's review of action items on Questions 1 thru 35, excluding Question 23, with the list represented in BLC-9271. Shing Lo will assist Bob Rixford on questions other than 1 and 23. R. M. Wheeler will assist Shing Lo on revisions 1 thru 6 to Questions 1 thru 35. A master punch list will be updated. This master punch list will include the items listed in the G. S. Keeley/J. A. Rutgers letter Serial 8548. The master list will have to be developed by June 5, 1980. The updated list of NRC commitments, which will be a portion of the master list, will also be developed and sent to Licensing at that time.

2. Bob Sevo and Don Horn will verify for Quality Assurance the completion status of all action items listed as Code 2 by June 13, 1980.

3. Question 1, Action Items 21 and 22 - Surveillance and Documentation - Quality Assurance will pull their approval on SC105, unless an acceptable Bechtel response to Consumers Power Co. comments is received by noon on May 23, 1980. If SC105 is disapproved, work on soils, block wall, grout, rebar, cadwelds, etc. would have to come to a halt.

*4. L. Curtis' aid is requested to determine the correct code and new or forecast completion dates for action items presently listed as Code 4 (indeterminate status). S. Lo has sent the action items to the various people involved, however, management attention is required to get up-to-date answer(s) back to Shing Lo in a timely fashion.

*5. L. Curtis is requested to divert mechanical resources to Question 19, action item 3; Question 20, action item 1 and action item 2, to get a response back to Shing in a timely fashion.

*6. Realistic forecast dates for Questions 1 thru 22 from various parties in Bechtel Ann Arbor should be returned to Shing Lo by May 27, instead of May 30, 1980 in order to meet the June 5, 1980 target for getting this information to Licensing.

194

7. Procedures governing the placement and completion of soils and implementing the requirements of the Nuclear Quality Assurance Manual are required immediately. Bob Rixford will see that words are revised to properly state the question and the response. Bob Wollney is issuing an NRC which places holds on the usage of compaction equipment where qualifications are in question. Hold tags were to be placed in "Q" areas where work is anticipated. Additionally, the usage of the pogo stick on "Q" fill will be prohibited until it can be qualified to an agreed upon qualification procedure. Don Horn will assure that Walt Bird's comments are incorporated into the field procedure for equipment qualifications and Bob Rixford will see that the NQAM is updated before June 1, 1980.

FC 1.100

*8. Quality Assurance has created a list of examples for action item 31 of Question 23. Project Engineering has to complete the activity. Walt Bird feels that this item should possibly be escalated to John Rutgers.

T. C. Cooke
Project Superintendent

TCC/sd

CC: JWCook
ABoos, Bechtel
RCBauman
GSKeeley
Attendees

To BWMarguglio, JSC-220A

From DEHorn, Midland DEH

Date October 31, 1978

Subject MIDLAND PROJECT - NRC EXIT INTERVIEW OF OCTOBER 27, 1978
File: 0.4.2 Serial: 280FQA78

Consumers Power Company

Internal Correspondence

cc SAfifi, Bechtel - Ann Arbor
WRBird, JSC-216B
RLCastleberry, Bechtel - Ann Arbor
TCCooke, Midland
JLCorley, Midland
GSKeeley, P14-408B
DBMiller, Midland
JFNewgen, Bechtel

The following people were in attendance at the subject exit interview which was conducted at the end of G. J. Gallagher's inspection of October 24-27, 1978:

CPCo	Bechtel	NRC
RCBauman	WLBarclay	RJCook
TCCooke	ABoos	GJGallagher
JLCorley	RLCastleberry	
DEHorn	LADreisbach	
GSKeeley	PAMartinez	
DBMiller		
BHPeck		
RMWheeler		

Mr. Gallagher stated that the visit was a follow-up on 50.55(e) report of the diesel generator settlement and that it was also a fact finding visit. The inspection consisted of a review of past data, activities in progress and planned activities for future work. Inspection was performed by review of the FSAR commitments; Specification C-210; Specification C-211; FQCI/IR C-1.02; Dames and Moore Report of Foundation Investigation and Preliminary Explorations for Borrowed Materials dated June 28, 1968 and supplement to this report dated March 15, 1969; preliminary data on diesel generator settlement problem including boring plan, cross sections of fill, blow count versus the elevation graphs, lab data, settlement data, boring logs, dutch cone logs, weather data and penetrameter readings in test pits; design drawings C-45, C-109, C-117 and C-1001; soil tests taken in the diesel generator building area during construction compiled by B. T. Cheek, Bechtel QC; observation of soil testing at the test lab and in the field; and discussions with Bechtel Geo-Tech, Project Engineering, Field Engineering, Quality Control Engineering, U.S. Testing, Consumers Power Company, PMO and QA personnel. Mr. Gallagher stated that he would not handle the findings as noncompliances, however, they could become items of noncompliance when they are reviewed by his management.

His findings/observations were as follows:

1. The FSAR states that during operation, settlement readings will be taken every 90 days. Because of the diesel generator settlement problem, this frequency should be re-evaluated for adequacy.

2. FSAR Table 2.5-14 "Summary of Foundation Supporting Seismic Category I Structures" identifies the supporting soil materials under the diesel generator building as being controlled, compacted cohesive soils. However, construction drawing C-109, Rev. 9 and C-117, Rev. 6 identifies the material in this area as Zone 2 material. Zone 2 material is identified as random fill described as any material free of organic or other deleterious materials. In the field a variety of materials have been used for the diesel generator foundation material, in particular, sands, clay, and lean concrete, silty sands and clayey sands. The apparent conflict is that Table 2.5-14 identifies cohesive soils where, in actuality, cohesionless sands have been utilized. A review of the records indicate that sands have been used between elevation 594'-608', areas of elevation 611'-613' and areas between 616'-268'. This indicates the extent of the variability of the material placed under the diesel generator building foundation. Mr. Gallagher did not feel it was good judgement to use random material under the support of a structure.

3. FSAR Table 2.5-21 "Summary of Compaction Requirements" identify random fill to require a compaction effort of a minimum of 4 passes with the specified equipment in this table. This requirement has not been an imposed requirement of Bechtel Specification C-210 nor an inspection requirement of Bechtel Quality Control Instruction C-1.02 for backfill.

4. FSAR section 3.8.5.5 states that settlements of shallow spread footings founded on compacted fill are estimated to be on the order of ½" or less. Site Survey Program has identified settlements in the diesel generator building foundation on spread footings to range from 0.55 inches to 2.30 inches and in excess of 3.0 inches for the diesel generator pedestal.

5. FSAR figure 2.5-47 indicates the foundation of the diesel generator building to be at elevation 634', according to design drawings C-1001, Rev. 5 it is indicated for the diesel generator spread footings and pedestal foundation to be at 628'.

6. A. Specification C-210, section 13.7.1 requires all cohesive backfill in the plant area to be compacted to not less than 95% maximum density as determined by ASTM D1557 method D which requires an effective compactive effort of 56,000 foot-pounds of energy per cubic foot of soil. However, section 13.4 Testing requires testing of the materials placed in the plant area to be performed in accordance with tests listed in section 12.4. This section, in particular section 12.4.5.1, "Cohesive Soils," requires maximum lab densities to be determined using ASTM D1557 Method D provided a compactive energy equal to 20,000 foot-pounds per cubmic foot is applied (Bechtel Modified Proctor Density). To date, the Bechtel Modified Proctor Density for determining maximum proctor density versus optimum moisture content has been utilized. This conflict results in an unconservative method of determining the maximum proctor density and method of assuring that the required percent compaction is achieved. In particular, the actual in-place compaction would be less using the Bechtel Modified Proctor Density as a reference than using the standard ASTM D1557 method D. This is due to the fact that the compactive energy exerted using the Bechtel Modified Method is less than the effort exerted by the standard method D - example: 20,000 foot-pounds versus 56,000 foot-pounds.

6. B. Bechtel Quality Control Instruction C-1.02 section 2.4 testing identifies the applicable inspection criteria and includes Specification C-210, section 13.7 and 12.4 which includes the apparent conflict as described in detail in Part A above.

   C. A further review of the original subsurface investigation performed by Dames and Moore and documented in report supplement dated March 15, 1969 page 16 indicates that the recommended minimum compaction criteria for support of structures be 100% of maximum density using a compactive effort of 20,000 foot-pounds (resulting from Bechtel Modified Proctor determination). However, this 100% of Bechtel Modified Proctor corresponds to 95% compaction according to the standard ASTM D1557 method D and not 95% compaction according to Bechtel Modified Proctor method which has been utilized for the entire plant fill area to date. Furthermore, Dames and Moore Report, page 15 states that all fill and backfill material should be placed at or near the optimum moisture content in near horizontal lifts approximately 6-8" in loose thickness. Bechtel specification permits a maximum of 12 inches which affects the compactability of the material.

7. Piping, condensate lines, duct banks, and other utilities under the diesel generator building may also be affected and must be evaluated.

8. Mr. Gallagher stated he was leaving not having seen design calculations and will be discussing design calculations, assumptions made, and conflicts with the FSAR with Licensing.

9. The inspector observed the structural concrete crack that has developed in the east exterior wall. The crack was observed with members from Bechtel Geo-Tech and Consumers Power Company. The crack extended full height of the wall and continued down through the spread footing as seen from the inside of the building. The crack is expected to have been induced flexurally caused by differential settlement. Discussion with Bechtel design staff has indicated that this crack is under study and is currently being evaluated. ACI-318-71 in the commentary section 10.6.4 limits flexural crack exposed to the outside to 0.013". Corrective action may be required if this limit is exceeded.

10. The following tests were observed to be performed in accordance with the applicable tests standards by U.S. Testing:

    A. Lab Test ASTM D1557-70

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11. Calculations should be evaluated on the increase and the rate of increase of the pond fill and the effects of the water in other areas.

12. Mr. Gallagher stated that the NRC does not view preloading of the structure to be a fix or resolution of the problem at this time.

13. Seismic loading calculations should be determined for the type of material existing in its present condition.

Bechtel Power Corporation

Post Office Box 2167
Midland, Michigan 48640

June 26, 1979

U.S. Testing
1415 Park Ave.
Hoboken, New Jersey 07030

Attention: Mike Anselno

Job 7220 Midland Project
Subcontract No. 7220-C-208
Soils Testing
C-208-2-(0)

Dear Mr. Anselno;

To confirm earlier conversations with your on-site laboratory chief, you are hereby directed to check all field density tests against a zero-air-voids curve, using an assumed specific gravity of 2.65. A suggested method is:

Plot a zero-air-voids curve on the same graph as used for ASTM D1557 reporting.
Plot the field density test result on the graph.
Any field test result which plots on, or to the right of the zero-air-voids curve shall be regarded as suspect and cause for retest. Report all such field tests immediately to Quality Control.

Please implement the above immediately.

If there are any questions concerning this direction contact W. L. Barclay at the Midland jobsite.

Very truly yours,

J. F. Newgen
Project Superintendent
Bechtel Power Corporation
Agents for Consumers Power Co.

JFN/WLB/vmm

Bechtel Power Corporation

Post Office Box 2167
Midland, Michigan 48640

December 20, 1977

Consumers Power Company
P. O. Box 1963
Midland, MI 48640

Attention: T. C. Cooke

Job 7220 Midland Project
Disposition of Failing
Non-Q Tests
BCCC-2990 R

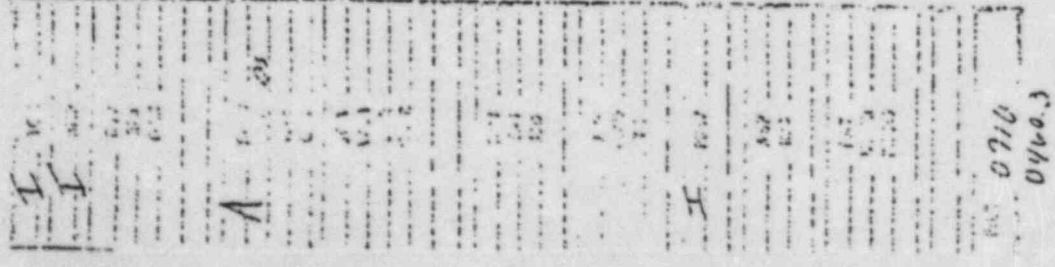
Dear Mr. Cooke:

Reference: T. C. Cooke's letter to J. F. Newgen, dated December 2, 1977, CCBC 1201 (Serial #2638)

In response to your referenced letter, we must point out that a quality verification and documentation program has not been established for the Non-"Q listed" sections of this project. At the beginning of the construction effort it was determined that such a program would not be cost effective and, since not required for licensing, was not to be implemented. We, therefore, have proceeded with construction allowing traditional decisions made by field engineers to continue and not requiring that relatively minor deviations and interferences be "cleared" by Project Engineering. For items which are considered significant or important for permanent record purposes, field engineers use FCR's, TMX's, letters, telecons, etc... with Project Engineering.

The Field Engineer effectively "dispositions" problems without Project Engineering input when he can extend a Project Engineering response to a similar case, when he can make a determination based upon codes or practice or when common sense or general interpretation yields an answer. Consumers Power position, as stated in the referenced letter, which deals primarily with "failing" soil reports on Non-Q dirtwork, is that only Project Engineering, as opposed to Field Engineering, has the authority to evaluate and accept or reject failing Non-Q soil tests. The letter further states that all failing Non-Q soil tests for the dike turnover package must be reviewed and acceptance of the turnover package by Consumers Power.

Discussions with representatives of Consumers Power subsequent to receipt of your letter have identified that Consumers Position on dispositioning failing Non-Q tests is not restricted to just soil and concrete tests, but rather to all tests on Non-Q items and that a formal or documented approval by Project Engineering is required. While these formal requirements may be part of the QC program for "Q-listed" work, they are not part of the program for Non-Q items.



The first point which we would like to make is that field engineers have never been given specific approval to accept failing Non-Q soil tests without closure. In the past, the U.S. Testing technician notified the grade foreman (or Canonie, the earthwork Subcontractor) of ailing Non-Q tests on the day the tests was taken. The grade foreman (or Canonie) then reworked the failing soil and called for a retest. Since several days may have been required to rework the soil, the testing technician was not always aware he was performing a "retest" and, hence, did not always indicate so on his test report. This would obviously indicate that some failing tests were never resolved when, in fact, the soil was reworked until passing tests were obtained. The situation is somewhat complicated by the fact that we had noted a few cases where the testing technician had incorrectly identified the location of tests. The upshot of all this is that while the failing tests were being resolved by reworking and retesting the soil, some apparent documentation discrepancies resulted. To put an end to future documentation problems, the following actions were taken in October of this year:

1) The U.S. Testing technician was directed to notify both the grade foreman (or Canonie) and the cognizant field engineer of all failing Non-Q tests on the day of the failure.

2) The cognizant field engineer was directed to monitor the testing technician's test location information and to make sure the technician noted all retests and test closures on the record sheets.

3) U.S. Testing was directed to assure that accurate and complete test location information is given and to back check as necessary to determine and indicate when a failing test is closed.

While there are some documentation anomalies which exist in records prior to October 1977 concerning resolution of Non-Q soil tests, the program required that the areas represented by failing tests be reworked prior to acceptance or placement of additional material. Adequate compaction was thus the objective rather than extensive documentation.

A second area of Non-Q tests over which Consumers has expressed concern and which should, therefore, be discussed is concrete tests. Field Engineering acceptance of Non-Q concrete tests which fail to meet specification requirements falls into the following categories to date:

1) Occasional low or high air content in the 2% to 7% range.

2) Low air content for concrete not exposed to freeze thaw cycles.

3) Occasional portions of loads with an air content in excess of 7% or below 2%, and occasional slumps out of the inadvertency margin. Because record tests are taken at the end of the pump line, instances have occurred where several yards of a load have been placed before test results are available. The remainder of the truck load is, of course, rejected.

The key point to note here is that the field engineer's acceptance of these conditions is based on the dispositions which Project Engineering has provided to similar nonconformances on Q-listed placements and upon the reality of the situation, i.e., a few yards of non-specification material in a large placement is a more acceptable situation than removal or cold jointing. This certainly seems logical from a quality as well as commercial point of view. It should also be pointed out that Field Engineering conducts a complete test by test review of concrete cylinder strengths for all Non-Q placements for compliance to specification requirements. No conditions of non-compliance have been noted in these reviews to date.

In conclusion, it has not been our program to require full traceability, documentation, or design engineering disposition of minor or routine items on Non "Q listed" construction. Field Engineering disposition of failing test in concrete is one of these routine cases. In the future, we could institute a full program of documentated resolution if desired by Consumers Power Company. In our opinion, such a program would have significant cost and schedule impact on the project without accompanying benefits. If Consumers Power Company wishes to investigate such a program, please contact us immediately. In the meantime, we cannot do otherwise than continue with the current program which does not conform with your referenced letter. Therefore, we request that the letter be reexamined and a suitable acceptance criteria for Non "Q listed" work be developed.

Very truly yours,

J. F. Newgen

JFN/AJB/jae

C-230.2.049

BECHTEL MIDL

BECHTEL ARB
810-223-6032 CLG 810-266-9497

TWX #3370 2/25/74
ATTN.: E. E. FELTON

BEBC - 213

SUBJECT: CONSUMERS POWER COMPANY
MIDLAND PLANT - JOB 7220
CONCRETE
FILE: 0274, 1122, [illegible]

RE FIELD'S QUESTION DURING FEBRUARY 21, 1974 MEETING WITH P. A. MARTINEZ PURSUANT TO MUDMAT MATERIAL UNDER CLASS I STRUCTURES AND DUCT BANKS. THIS MATERIAL IS NOT CONSIDERED TO BE Q-LISTED.

P. A. MARTINEZ
ANN ARBOR/7PE211B/7220-001/KTM

14 27 EDT

BECHTEL MIDL

Meeting in Champaign Nov. 7, 1978 8:35

16

Chris Law
Austin Marshall
Jim Batta
Stan Blue
Phil Martinez

Don Horn
Bob Wheeler
Don Sibbald
Chuck Hunt

Tom Cooke
Neal Swanberg
Chuck McConnell
S. Afifi

Dr. Ralph Peck
Dr. Skip Handron
Walt Ferris
John Dunnicliff

Call @ 10:30 our time to NRC

What the NRC knows.

NRC - contact Daryle Hood & later Heller before Thanksgivin

McConnell

Settle of last Fri - no surprises / trend is the same

Test Pit pad N.W. 1" settle N.E. 3/4" settle

1/10" S.W. & S.E.

during the last month ~~since pt was dug~~

Austin presented boring data.

McConnell Options considered.

(1) Use as is with some grouting
(2) Cont. Mat
(3) Pre load
(4) Contin. Mat + Preload
(5) Underpinning
(6) Remove & replace fill

S. Afifi said since consult. in the field consult. feel preload is the most attractive.

Dr. Peck

Fill is loose, settle. is due to its own weight

only 2 options remove or preload

Get on with instrumentation & preload !
~~Get the data~~ & go from ~~there~~
We do not have adequate data

Hendron? None — homogeneous Engineered fill — random anything.
McConnell

(1) No excavation option
(2) Mat. will not stop the dif. sett. & still have sett. of duct banks
How long will it take
Once preload ~~starts~~ we will know how long preload ~~will take~~ settlement will occur ~~fast~~ after preload.

Preload & then put pond upto 627'

Continue const. of the D.G. - Hendron said no problem.

Hendron was disappointed - Heller & ~~staff~~ had not seen the test pits.

Underpinning may be required after (only ~~after~~) preload

Peck - Preload should do the job
Hendron - No bearing problem
Static or dynamic loading.
← Bearing justification to NRC

If piling is used - Explanation 50% chance justification to NRC

Hendron - ~~Cutting~~ duct banks has to be done.

Peck/Hendron Settlement @ various depths / even away from structures

High priority - instruments in / piezometers can go in later

Height of preload - 23'
Rate of loading any rate, but evenly distributed
quit after 10' for about a week — 20' ... 20
approx 6" more of settlement

Grout gap between footing & soil before, but also after (defin. after) !!
Monitoring

Grout footing before cutting duct banks
Break up mudmat before preload

Hendron
Peck

Cause

Bad fill (Compacted & Uncompacted)
Too much variation in lift thickness (Erratic composition)

(1) Dry of optimum & later moisture added
(2) Excavation after fill placement & refill
large vs small areas

— — — — — — — — — —

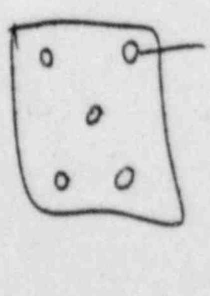
Test Pits possible in other areas

Drilling holes in dike may cause hydro fraction

Cooke, Phil M. Peck & Hendron — conference call to NRC — Ferris?

Chris Hen stated he had plot of low counts in sand materials under D.G.
50% of the plot was questionable on liq. acceptance.

Deformation optical survey
Structures
Fill
Pipes



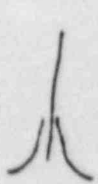
5 riser pipes

Pore Pressure

50 — 3 ... — 3 ...

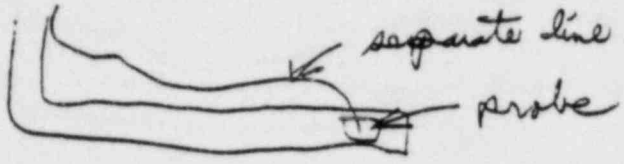
Borros Anchors

settlement platform



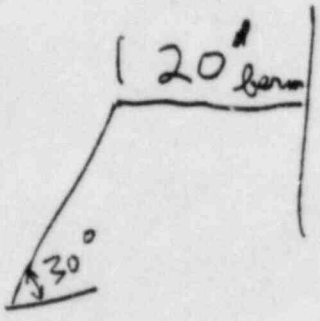
settlement platform also @ Borros anchors

Drag-Thru settlement gages ≈ ± 1/4 ~~tolerance~~ elev.
Average of 4 readings



8- Install inclinometers
Rock suggested not using lateral monitoring

4 Electrical device to monitor cracks
Tape the cracks in the walls



Pore Pressure

piezometer
20 Stand pipe 3 diff. elev.
elevations same as Bores points 1 anchor

Early Dec. 3rd or 4 meeting with NRC

Eng. to look @ not putting sand under the slab 5' over with Max. of 20'

Daily readings of anchors!

about Jan. 16 another meeting with Consultants.

Also other areas in a discussion (Other areas to be discussed on Dec. 4 after NRC meeting @ site).

AGENDA

UPDATE ON DIESEL GENERATOR BUILDING	
Settlement Date	Project
Soils - Borings	Geotech
- Lab Data	Geotech
OPTIONS CONSIDERED BY BECHTEL	Project
RECENT DISCUSSIONS WITH CONSULTANTS	Geotech
DISCUSSION OF PREFERRED OPTION	Drs. Peck & Hendron
QUESTIONS	All Participants

Soils and Effects on Underground Utilities
- Bearing Capacity
- Settlement
- Liquefaction

Structural

Licensing

INTERFACE WITH NRC	Project/Geotech
SUMMARY AND PLAN FOR ACTION	Project

~~10:30 NRC left~~ ~~12-20-78~~

Call to G. Gallagher
from B. Wheeler &
D. Horn

NRC 10:35 - 11:15 12-22-78

1. Occurred End of Aug 1977
Bechtel FE noticed it
8-23-77 survey.

How long is the distance
160 - 170

126
40
166

8 pads
size of footing 6 middle 7'-6" x 7'-6" } depth 1'-9"
southern 7'-6" x 9'-6"
northern 6' x 6' } bottom of footing 622'-6"

column goes up to the grade beam
629'-6" bottom of grade beam
1' wide grade beam
Steam tunnel was excavated to
613' clay placed up to bottom of footing
up from footings is sand backfill.

Took whole grade beam & footing out.

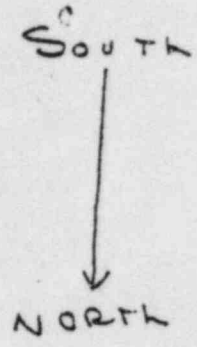
Took backfill material
Change design of footing / to continuous mat

7'-6"

Sim Ad. Bldg
2nd Ad. Bldg - Evap & S of D.G.

1) When did occur? Near End of Aug. 1977 - Making Adjacent Stair. Pour Noted gap between form & Top of grade Beam. Asked for survey of Column Anchor Bolts.

P_a = 1.32"
N_K = 2.04"
M_p = 2.4"
L_N = 1.92"
K_B = 3.36"
J_C = 3.36"
H_T = 3.48



2) Borings A TOTAL of 7 borings were taken as a result of Problem:
5 in the Adm. Bldg.
2 out side

1 evap.
1 South of D/G Bldg. } Noted Good M+L.

3) Original Footings - 8 Mat ftgs.
6 - 7'6" x 7'6"

After Removal Continous ftg - 7'6" wide.

4) Material : Sequence:

a) Excavate for steam tunnel below Adm. Ftgs. - 613±
b) Poured steam tunnel
c) Placed clay to B.O.F. 622'6"
d) Placed sand Above ftgs to T.O. Grade firm

4. c) Removed Material : Ftg. down to good Material

d) Back fill Concrete to B.O.F.

5) Cause: percent compaction was less than Required by U.S. Testing - erroneous selection of compaction standards

(a) Hand held for compaction.

DRAFT

The following information was given Gene Gallagher pertaining to questions he had on the administration building settlement problem from my ~~in the~~ 12/21/78 log.

1. Question - When did problem occur?

   Answer - Near end of August 1977. An adjacent slab pour was being made and a Field Engineer noticed a gap between the form and top of grade beam on 8-23-77. Field Engineering asked for survey of the column anchor bolts and the settlements at the columns were following ~~was~~ found:

   P_a = 1.32" South
   N_k = 2.04"
   M_p = 2.4"
   L_n = 1.92" to
   K_b = 3.36"
   J_f = 3.36"
   H_t = 3.48 North

2. Question - How many borings were taken and what were their location?

   Answer - A total of seven borings were taken as a result of the problem. Five in the administration building area and two outside. Of the two outside, one was in the evaporator building area and one was south of the diesel generator building. Both the evaporator building boring and diesel generator building boring noted good material.

3. Question - Corrective Action - How many footings involved, how much fill material removed?

   Answer - Removed grade beam, footings and material down to good material. Backfilled with concrete to bottom of footing, forming a continuous mat.

4. Question - Cause if it had been determined.

   Answer - Cause - Percent compaction was less than reported by U.S. Testing. Erroneous selection of compaction standards.

5. Question - Was fill placed any different than in the diesel generator building area?

   Answer - Canonie placed the dike and plant fill. Later, excavation for steam tunnel was made below administration footings to approximately 613' elevation. Poured steam tunnel, and later hand compacted clay to bottom of footing, ~~to approximate~~ elevation 622'-6". Placed sand above footings to top of grade beam. The re-excavation and backfilling would have been done by Bechtel and this work was non-Q. Do not know what lift thickness was used. & probable ~~C-211~~ Specification C-211 was used.

6. Question - Foundation details.

   Answer - Total length of the administration building is approximately 160'-170'. Original footings were 8 mat footings. The middle 6 footings were 7'-6" x 7'-6" x 1'-9" ~~deep~~. Southern footing was 7'-6" x 9'-6" x ~~depth~~ 1'-9", northern footing 6' x 6' x 1'-9" deep. Bottom of the footin was 622'-6". Columns go up to the grade beam. Bottom of the grade beam is 629'-6". ~~Grade beam~~ and 1' wide, as stated above in 3, ~~changed~~ design of ~~was changed~~ footing to continuous mat 7'-6" wide.

FIELD CHANGE REQUEST

PROJECT NO. 7220

1. PAGE 1 OF 1

Q No. Non-Q

2. No. C-5

3. DATE 11-2

4. REF. DWG. OR SPEC. 7220-C-210 REV. 2

5. TITLE Plant Foundation Excavation & Cooling Pond Dikes

6. DESIGN ORIGIN: ENGRG ☒ VENDOR ☐ (IDENTIFY) NAME

7. EXISTING CONDITION:

Paragraph 12.6.1 allows the water content of Zone 1, 1A, and 2 to be 2 percentage points below optimum moisture content and shall not be more than 2 percentage points above optimum moisture content.

8. CHANGE REQUEST / SKETCH

Field requests that the moisture content for Zone 2 be relaxed to allow a water content of 2 percentage points below optimum moisture content, and 5 percentage points above optimum moisture content.

Field requests this change for the following reasons:

1) Excavated material from cooling pond is excessively wet.

2) If moisture relaxation can not be authorized, work will have to be stopped.

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NOV 12 1973
BECHTEL POWER CORP.
JOB 7220
PER

10. REVIEWED BY:

		Date
CIVIL	Richard Woods	11/5/73
ELECT.	N/A	
MECH.	N/A	
WELDING	N/A	

9. PREPARED BY: Richard Woods

11. APPROVAL OF FIELD DISPOSITION:

[signature] 11/5/73

12. PROJECT ENG'R'G APPROVAL: YES ☒ NO ☐ PROJ. ENGR. [signature] Date: 11/7/73

REMARKS: Approved per ASME 194 Letter Nov 2 1973 - Quantities to be agreed at [illegible] [illegible]

WHITE – PRINT COORDINATOR

CC – 3 PGS

NONCONFORMANCE REPORT

PROJECT NO. 7220

PAGE 1 OF 2 | SKETCH ATTACHED Yes ☐ | 2. NO. NC-26 Rev. 1 | 3. DATE MO 12 DAY 5 YR 73

4. ITEM LOCATION AREA/BLDG.	5. DWG/PART No.	REV.	6. ITEM NAME	Q.A. No.
Cooling Pond	7220-C-109	6	Dike Density	1.5.1 & 1.8

7. INSPECTION CRITERIA: DWG ☐ SPEC ☒ OTHER ☐ (EXPLAIN) DOCUMENT NUMBER & TITLE: 7220-C-208 Material Testing Services

8. SOURCE: ENGRG. ☐ CONSTR. ☒ OTHER ☐ (EXPLAIN) ADDRESS

9. P.O. No. 7220-C-210

10. No.	11. NONCONFORMANCE (DISCREPANCY) DESCRIPTION: (LIST SERIAL NUMBERS WHERE APPLICABLE)	ASME: YES ☐ NO ☒
1	Testing intervals for earthwork field densities taken during the interim material testing services subcontract (Specification 7220-C-208A) were established in Pittsburg Testing Laboratory's Quality assurance Manual. This interval was one (1) test per 500 cubic yards placed.	
	Testing intervals for earthwork field densities taken under the permanent material testing service subcontract is established in table 9-1, page 14a of specification 7220-C-208. This interval is one (1) test per 500 cubic yards placed. (Continued on Sheet 2.)	

12. NCR PREPARED BY: Responsible Engr. D. C. Chenel Date 12/7-73 | CONCURRENCE: Responsible Lead Engr. Richard Wade Date 12/11/73

13. FIELD DISPOSITION. REWORK ☐ REJECT ☐ ROUTE TO PROJECT ENGRG ☒ NOTIFY AUTHORIZED INSP. ☐ ROUTE TO MAT'L SUPV. ☐

1	Field recommends that borings be taken to evaluate the in-place density of affected areas.
	Additional training and instruction will be given the inspectors to thoroughly educate them in the specification governing work they are involved in. Closer contro will be maintained on the testing laboratory to insure their compliance with governing criteria.

14. FIELD DISPOSITION BY: Richard Wade Date 12/13/73

APPROVAL OF FIELD DISPOSITION: PE CONCURRENCE AUTH. INSP. Jerry C. Townsend Date 12/14/73

15. ENGRG DISPOSITION: REPAIR ☐ REJECT ☐ USE AS IS ☐ SEE BELOW ☒ OCN REQD: YES ☐ NO ☒ OCN No.

1	Engineering has requested that the GeoTech group evaluate the testing frequency required and the frequency achieved and recommend a program of corrective action. (IOM to J. E. Allen dated Jan. 17, 1974). Pending re-evaluation of required frequency all testing done shall be in accordance with existing specifications.
	RER 2/22/74 QAE 2-3-74 (see continuation sheet)
	DFC 4-22-74
	PE 4-19-74

16. APPROVAL OF DISPOSITION: ENGRG. PE [illegible] Date 3/15/74 | PE [illegible] Date | CONCURRENCE AUTH. INSP. Date

17. REINSPECTION: ACCEPT ☒ Responsible Engr. [illegible] Date 5/15/74 | REJECT ☐ Responsible Lead Engr. E. R. Albert Date 5/15/74 | CONCURRENCE: Auth. Insp. Date

WHITE – Q.C. ENGR. PINK – Q.A. ENGR. SHADED AREAS APPLICABLE QC – ENGR

NONCONFORMANCE REPORT

CONTINUATION SHEET

PROJECT NO. 7220

1. PAGE 2 OF 2

SKETCH ATTACHED Yes ☐

2. No. C-26

3. DATE MO 12 DAY 5 YR 73

10. No. CONT'D

11. NONCONFORMANCE (DISCREPANCY) CONT'D. or ☒
13. FIELD DISPOSITION CONT'D or ☐
15. ENGRG. DISPOSITION CONT'D and ☒

1.) Field densities taken on the west plant dike, north plant dike, and the 100.ft. berm in the northeast dike average one (1) test per 2300 cubic yards placed.

15. Engrg. Disposition Cont'd.

1.) Based upon Geotech's evaluation, Engineering recommends that the testing frequency remain as specified and the boring program recommended in BEBC-238, be implemented. RLR 3/15/74 JJ for JCH 3/15/74

Based upon IOM dated March 21, 1974 J. P. Connolly to P. A. Martinez (QCFM - 088), Engineering has reviewed the response in block 15 above and adds the following comments:

1. A further memo (BEBC 249) containing additional information as to the type of tests, etc. has been forwarded to E. E. Felton on March 22, 1974. This resolves QC's question as to testing procedures and other test information to resolve this NCR.

2. The Geotech group was consulted on the engineering disposition of this NCR. Nothing in our response to this NCR or in BEBC 238 is meant to abrogate Field Quality Control responsibilities.

3. The above comments close NCR C-26, Revision 1.

J. L. Hinds 4/17/74

4/17/74

WHITE – Q.C. ENGR. PINK – Q.A. ENGR.
CANARY – FIELD ENGR. GOLDENROD – RESP. ENGR.

QC – 3NCR REV. 7-1-72

Bechtel Associates Professional Corporation

Inter-office Memorandum

BEBC - 238

To E. E. Felton

Date March 15, 1974

Subject Midland Plant Units 1 & 2
Job No. 7220
Soil Testing Frequency
File: C-208, C-210

From P. A. Martinez

Of Engineering

At Ann Arbor

Copies to Ref: 1) NCR C-26
Enc: a) Summary of Test Boring Program - 5 sheets

RECEIVED
MAR 19 1974
BECHTEL POWER CORP.
JOB 7220
PER

J. H. Allen
S. S. Afifi
M. Dragicevic

In response to Ref. 1), the Geotechnical Services Group has reviewed the testing done to date and recommends the program of corrective action described in the following paragraphs.

A total of 63 borings, located in the West, North, and Northeast Plant Dikes, are proposed. The boring locations, depths, and the required tests from each boring are shown in Enc. a).

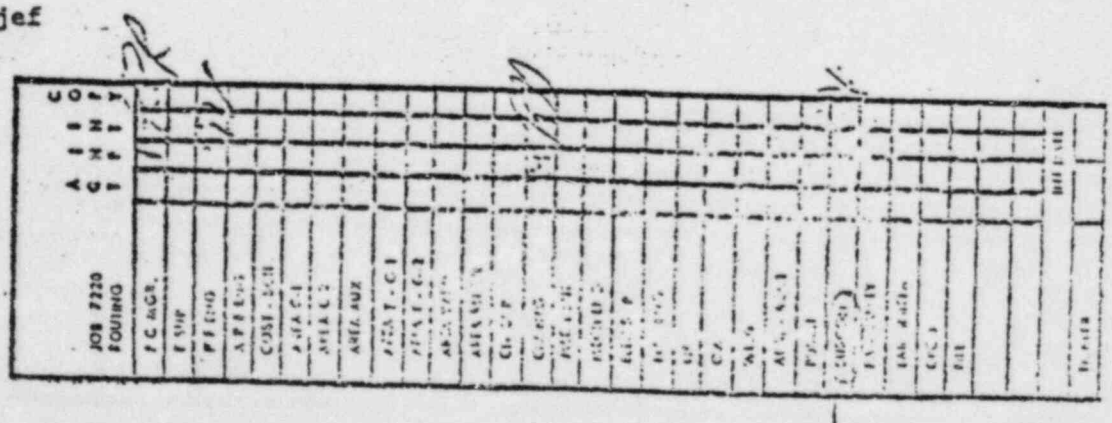
The estimated cost of the program is $30,000. The drilling is estimated to take approximately four weeks with the testing to proceed concurrently but requiring an additional six weeks to complete.

Due to the limited time available before full-scale earthwork operations resume, Engineering recommends that Raymond be requested to perform the drilling and U.S. Testing do the laboratory testing.

It is also recommended that the drilling and testing work be done under Geotech's supervision, and that any questions relative to the proposed boring program be directed to them.

P. A. Martinez

RLR/jef



032

SUBCON HAS A COPY OF THIS MEMO & ATTACHMENTS

DATE

DESIGN BY [illegible] DATE 11/[illegible]/73 CHECKED BY SHEET NO 1

PROJECT MIDLAND MUNICIPAL [illegible] JOB NO [illegible]

SUBJECT SUMMARY TEST BORING [illegible] FILE NO.

DIKE	Number Test borings zone (T)	Number Test borings zone (F)	Total Number Test borings	Number Hydraulic zone (T)	Number Hydraulic zone (F)	Total Hydraulic	Total Number S.T. [illegible]
WEST PLANT DIKE	4	2	6	78	16	94	24
NORTH PLANT DIKE	20	16	36	254	266	520	298
NORTHEAST DIKE (PLANT AREA FILL)	11	10	21	51	75	126	31
TOTAL	35	28	63	333	357	690	353

NOTE: TEST-PIT SUBSTITUTION FOR T.B.s AT NORTHEAST DIKE (PLANT AREA FILL) IS ANTICIPATED, EITHER FOR ZONE (T) OR ZONE (F) MATERIAL

DATE

DESIGN BY [illegible] DATE [illegible] CHECKED BY [illegible] SHEET NO. 2

PROJECT [illegible] JOB NO. [illegible]

SUBJECT COST ESTIMATION – [illegible] – [illegible] AREA FILL FILE NO.

DIKE	ZONE [illegible] MATERIAL: Number Borings	Number feet per boring	Total footage	ZONE [illegible] MATERIAL: Number borings	Number feet per boring	Total footage	GRAND TOTAL FOOTAGE
West Plant Dike	4	14	56	2	14	28	84
North Plant Dike	20	15	300	16	19	304	604
Northeast Dike (plant area)	11	5	55	10	12	120	175
TOTAL	35	—	411	28	—	452	863

NOTE: These listed total footage is based on assumption that drilling will start from elevations as follows:

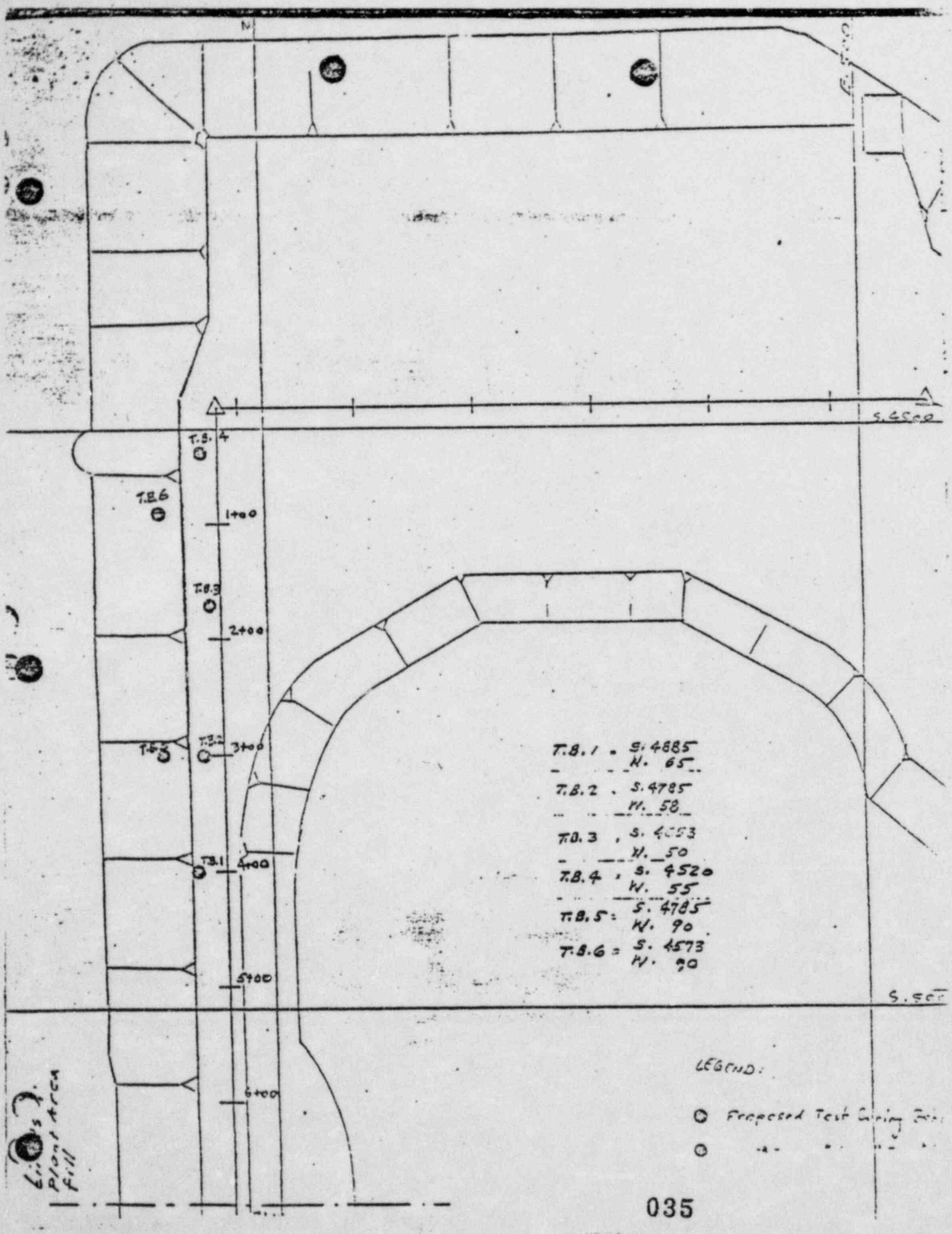
DIKE	ELEVATION
West Plant Dike	624±
North Plant Dike	624±
N.E. Dike (plant area only)	617±

Assumed: a) Cost per linear foot = $25.00 (Includes moving the rig from boring to boring, drilling, sampling, Shelby tubes & handling, labor cost, moist & dens. tests)

b) Time of performance = 40 feet/day/rig

TOTAL COST = 863 × 25 = $21,575

ENDING TIME = 21.6, say 22 working days/rig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S.4500
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3+00
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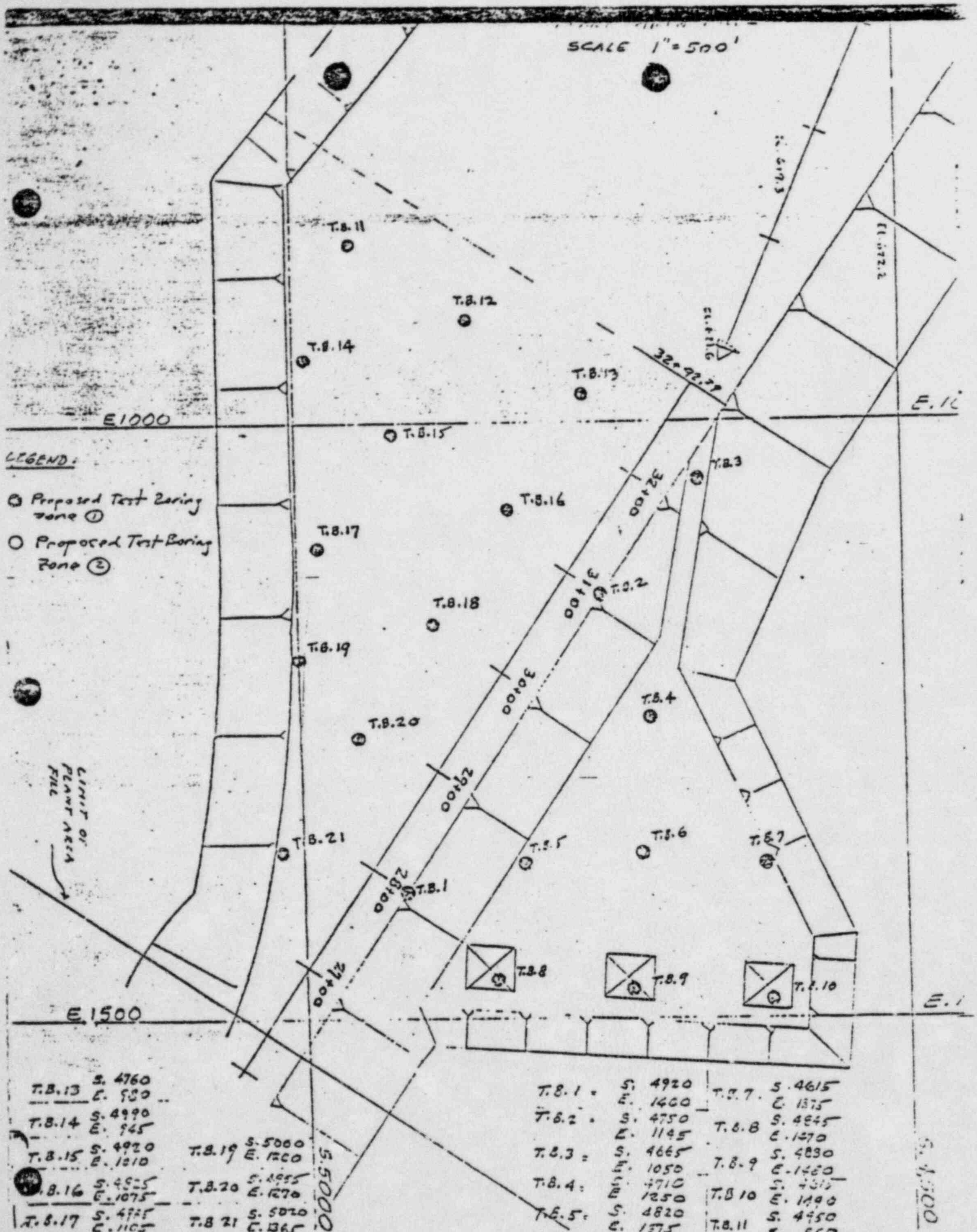
S.4000
6+00
T.B.1 . S. 4685 W. 65
T.B.2 . S. 4785 W. 58
T.B.3 . S. 4653 W. 50
T.B.4 . S. 4520 W. 55
T.B.5 = S. 4785 W. 90
T.B.6 = S. 4573 W. 90
LEGEND:
Proposed Test Curing
Plant Area Fill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T.B. 20
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T.B. 2
T.B. 3
T.B. 4
T.B. 6
T.B. 8
T.B. 9
E1000
E1500
32+92.79
32+00
31+00
30+00
29+00
28+00
27+00
S.5000
LEGEND:
Proposed Test Boring Zone ①
Proposed Test Boring Zone ②
LIMIT OF PLANT AREA FILL
T.B.13 S. 4760 E. 980
T.B.14 S. 4990 E. 945
T.B.15 S. 4920 E. 1010
T.B.16 S. 4925 E. 1075
T.B.17 S. 4925 E. 1105
T.B.18 S. 4885
T.B.19 S. 5000 E. 1260
T.B.20 S. 4955 E. 1270
T.B 21 S. 5020 E. 1365
T.B. 1 = S. 4920 E. 1460
T.B. 2 = S. 4750 E. 1145
T.B. 3 = S. 4665 E. 1050
T.B. 4 = S. 4710 E. 1250
T.B. 5 = S. 4820 E. 1375
T.B. 6 S. 4770
T.B. 7 S. 4615 E. 1375
T.B. 8 S. 4845 E. 1470
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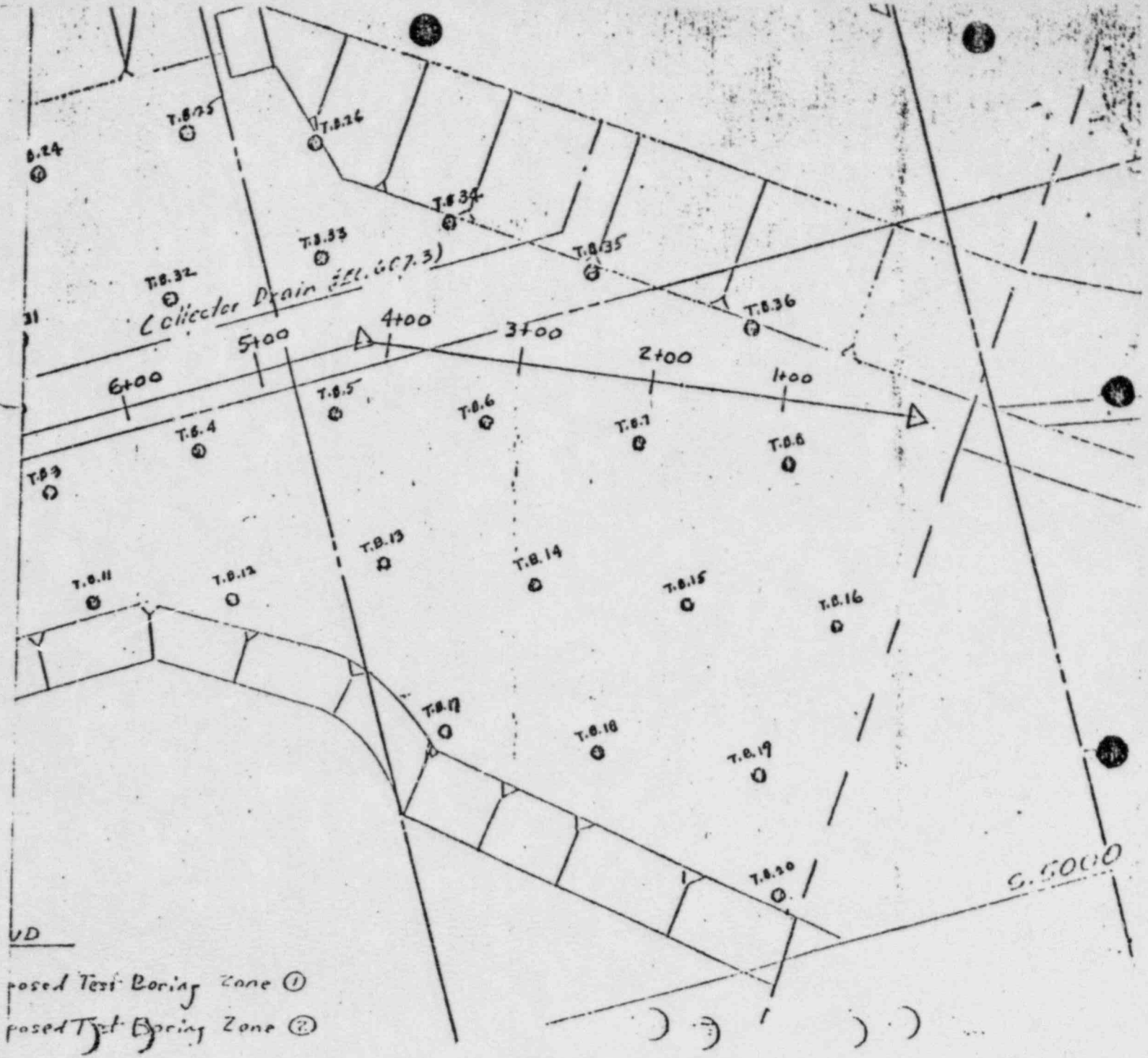
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1+00
T.B.5
T.B.6
T.B.4
T.B.7
T.B.8
T.B.3
T.B.13
T.B.14
T.B.11
T.B.12
T.B.15
T.B.16
T.B.17
T.B.18
T.B.19
T.B.20
5.6000
UD
posed Test Boring Zone ①
posed Test Boring Zone ②

Teletype

TYPE DOUBLE SPACE • BE BRIEF

CHECK APPROPRIATE BOX:				CONFIRM AGST. CITE
Night Ltr:	Full Rate:	Report Delivery: YES NO		NUMBER TO BE CALLED

MESSAGE ADDRESSED TO	ADDRESSEE	ADDRESS	LOCATION (CITY, STATE OR COU
	Bechtel Power corporation	3500 E. Miller Road	Midland, Michigan
	Attn: E. E. Felton		

MESSAGE SECTION - If additional addresses are required continue to list below:

March 22, 1974

REDC-249

Subject: Midland Plant Units 1 & 2, Job No. 7220
Soil Boring Program
File: C-210, C-208, 0274
Reference: 1) REDC-239 attach. Sht. 1

In response to telecon request from R. Grote on 3/20/74, this is to clarify that the "M-tests" referred to in ref. 1) consist of moisture content determination (ASTM D 2216) and dry density.

The dry density is to be determined by the following procedure:
Samples will be extracted in Shelby tubes. A representative four to six inch sample shall be cut from the Shelby tube. The cuts must be uniform and perpendicular to the axis of the tube. The sample should then be carefully extruded from the cut portion of the Shelby tube, using a jack with a diameter equal to the inside diameter of the Shelby tube. The extrusion should be

COPIES TO: R. Grote, J. H. Allen, S. S. Afifi

RLB/pjf

038

DATE | LOCATION & EXT: | ORIGINATORS COPY:

Telecype Message

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CHECK APPROPRIATE BOX: | CHARGE ACCT. CODE:

Night Ltr. | Full Rate: | Report Delivery: YES NO | INQUIRER TO BE CALLED

MESSAGE ADDRESSED TO	ADDRESSEE	ADDRESS	LOCATION (CITY, STATE OR COUNTRY)

MESSAGE SECTION - If additional addressees are required continue to list below:

made vertically with care taken to assure an undeformed sample.

The inside diameter of the Shelby Tube will be used to express the sample diameter and the volume of the sample computed from the cross-sectional area and the average of four height measurements.

The wet density is the ratio between the weight of the extruded sample and the calculated volume of the sample.

The dry density is the ratio between the weight after oven drying at 105°C for 24 hours and the calculated volume of the sample.

Extreme care is required in handling these samples between the boring location and the laboratory to assure obtaining an undeformed sample. The extrusion and weight and height measurements should be made by a qualified technician under the supervision of the engineer.

COPIES TO:

DATE	SIGNATURE	LOCATION & EXT:	ORIGINATOR'S COPY:
		039	

AAO-17A

GAR05

Teletype Message

TYPE DOUBLE SPACE • BE BRIEF

MESSAGE NUMBER	CPR UNL	
DDG	TELTEX	TWX	TELEX	OTH

CHECK APPROPRIATE BOX:

Night Ltr.	Full Rate:	Report Delivery:	YES / NO

CHARGE ACCT. CODE:

NUMBER TO BE CALLED

MESSAGE ADDRESSED TO	ADDRESSEE	ADDRESS	LOCATION (CITY, STATE OR COUNTRY)

MESSAGE SECTION - If additional addressees are required continue to list below:

Weight measurements are to be to the nearest 0.1gm and dimensions to the nearest 0.01 inch.

Bechtel Power Corporation

Interoffice Memorandum

To P. A. Martinez

Date March 21, 1974

Subject NCR C-26
QCFM-088

From J. P. Connolly

Of Quality Control

Copies to E.E. Felton w/a
Z.G. Tucker w/a

At Midland, Michigan
Job 7220

Field Quality Control does not concur with the Engineering Disposition stated in block 15 of NCR C-26. The reasons for this non-concurrence are as follows:

1. Sufficient information concerning the type of tests and testing procedures are not contained in the Engineering Disposition or the referenced memo (BEBC-238).

2. Inspection and testing of "Q" listed work is the responsibility of Field Quality Control. Quality Control will cooperate fully with the personnel assigned by the Project Superintendent for the completion of the work. The NCR will be closed out after reinspection of the work by Quality Control Personnel.

The original copy of the NCR is attached for your action.

J. P. Connolly

JPC/jmw

041

NONCONFORMANCE REPORT

PROJECT NO. 7220

PAGE 1 OF 2 | NCR No. 1.C-26 | SKETCH ATTACHED Yes ☐ | DATE 12/5/73

4. ITEM LOCATION AREA/BLDG.	5. DWG/PART No.	REV.	6. ITEM NAME	C No.
Cooling Pond	7220-C-109	6	Dike Density	1.3.1.3.2.3

7. INSPECTION CRITERIA: DWG ☐ SPEC ☒ OTHER ☐ (EXPLAIN) — DOCUMENT NUMBER & TITLE: 7220-C-208 Material Testing Services

8. SOURCE: ENGRG. ☐ CONSTR ☒ OTHER ☐ (EXPLAIN) — ADDRESS — 9. P.O. No. 7220-C-210

10. No.	11. NONCONFORMANCE (DISCREPANCY) DESCRIPTION: (LIST SERIAL NUMBERS WHERE APPLICABLE) — ASME YES ☐ NO ☒
1	Testing intervals for earthwork field densities taken during the interim material testing services subcontract (Specification 7220-C-208A) were established in Pittsburg Testing Laboratory's Quality assurance Manual. This interval was one (1) test per 500 cubic yards placed.
	Testing intervals for earthwork field densities taken under the permanent material testing service subcontract is established in table 9-1, page 14a of specification 7220-C-208. This interval is one (1) test per 500 cubic yards placed. (Continued on Sheet 2.)

12. NCR PREPARED BY: Responsible Engr. L. C. Vincent — Date 12/7/73 — CONCURRENCE Responsible Lead Engr. Richard Slate — Date 12/10/73

13. FIELD DISPOSITION: REWORK ☐ REJECT ☐ ROUTE TO PROJECT ENGRG ☒ NOTIFY AUTHORIZED INSP ☐ ROUTE TO MATL SUPV. ☐

1	Field recommends that borings be taken to evalute the in-place density of affected areas.
	Additional training and instruction will be given the inspectors to thoroughly educate them in the specification governing work they are involved in. Closer control will be maintained on the testing laboratory to insure their compliance with governing criteria.

14. FIELD DISPOSITION BY: Richard Slate — Date 12/10/73 — APPROVAL OF FIELD DISPOSITION: PFE CONCURRENCE / AUTH. INSP. Harry C. Clifford — Date 12/10/73

15. ENGRG DISPOSITION: REPAIR ☐ USE AS IS ☐ REJECT ☐ SEE BELOW ☒ — DCN REQD: YES ☐ NO ☒ — DCN No.

1	Engineering has requested that the GeoTech group evaluate the testing frequency required and the frequency achieved and recommend a program of corrective action. (IOM to J. H. Allen dated Jan. 17, 1974). Pending re-evaluation of required frequency all testing done shall be in accordance with existing specifications.
	RFC 2/23/74 Cyclic 2/4/74. (see continuation sheet)

012

16. APPROVAL OF DISPOSITION: ENGRG. PE R. E. Richardson 3/15/74 Date — PFE / CONCURRENCE / AUTH. INSP. N. Bucci Date

17. REINSPECTION: ACCEPT ☐ Responsible Engr. Date — REJECT ☐ Responsible Lead Engr. Date — CONCURRENCE: Auth. Insp. Date

WHITE – Q.C. ENGR. CANARY – FIELD ENGR. PINK – Q.A. ENGR. GOLDENROD – RESP. ENGR. SHADED AREAS APPLICABLE TO ASME COMPONENTS QC – ENGR REV. 7-1-72

NONCONFORMANCE REPORT

CONTINUATION SHEET

PROJECT NO. 7220

PAGE 2 OF 2

SKETCH ATTACHED Yes ☐

No. C-26

DATE 12 5 73

10. No. CONT'D

11. NONCONFORMANCE (DISCREPANCY) CONT'D or
13. FIELD DISPOSITION CONT'D or
15. ENGRG. DISPOSITION CONT'D and

1.) Field densities taken on the west plant dike, north plant dike, and the 100 ft. berm in the northeast dike average one (1) test per 2300 cubic yards placed.

15. Engrg. Disposition Cont'd.

1.) Based upon Geotech's evaluation, Engineering recommends that the testing frequency remain as specified and the boring program recommended in BEBC 238, be implemented. RLP 3/15/74 JCH 3/15/74

043

WHITE – G.C. ENGR. PINK – O.A. ENGR. GC – ENCR

INCONSISTENCIES DISCOVERED TO DATE

QUESTION #6

It is my feeling that this is the most significant item out of the seven listed. This is confirmed by several observations to date and may be born out by the lab tests.

Observations to date:

1. As noted in an attachment, this problem (selection of incorrect proctors) has occurred in the grade beam failure. Bechtel at that point did not elect to modify the method of testing in light of the situation.

2. The methods being employed on site at this point in time are designed to verify the selection of the correct proctor. Currently, for each test a proctor curve is developed to assure the percent compaction. Construction may proceed with a one point verification. (see attached for procedure)

3. When all tests are completed at the lab in Boston, it will be easy to compare the B.M.P. which were developed from the material which can readily be compared with the U. S. Testing results.

4. At this point, the proctors look suspect because the average is approximately 125#/ft^3, which could be significantly less than the ones developed from the borings.

In conclusion, it appears that the field tests are, at best, suspect and at worst, of no value at all. Corrections should have been made during the process of supervising the work to account for the gaps provided in the specification. I'm not sure if much thought went into the types of materials to be used for foundation support.

RMWheeler/pp
11-1-78

Attachment

TOTAL TESTS IN D/G AREA

279 - Tests

Less than 120#/ft^3 = 39 tests, or 14%

Between 120#/ft^3 and 125#/ft^3 = 109 tests, or 39%

Greater than 125#/ft^3 = 131 tests, Or 47%

Average dry lab densite for all tests = 124.92#/ft^3

INCONSISTANCIES DISCOVERED TO DATE

Question #1

Discussion

Work performed during Diesel Generator area fill era was not done under the direct supervision of a qualified soils engineer. In fact, Geotech (soils consultants to Bechtel) did not have anyone on site between late 1974 and June/July of 1976 (the grade beam failure). Attachment 1 is an I.O.M. describes the responsibilities of Geotech during the early phases of the job. The item of the letter indicates that the need for Geotech personnel is based solely on the availability of Field Engineers and Q.C. personnel. The letter concludes by stating that the acceptance authority for earthwork was delegated to Q.C. and Field Engineers.

It would have seemed prudent at the remobilization after the 1975 slowdown to reaffirm under the supervision of Geotech that work was being performed properly. Failure to do this has resulted in specification and work operation misunderstandings.

RMW/11-1-78

JLC	
REW	
DRK	
DFH	
FILE	
RETURN	

Q#1

Bechtel Power Corporation

Interoffice Memorandum

To J. P. Connolly

Subject Job 7220 Midland Project
Geotechs Responsibility on
Earthwork Subcontract
0-817

Copies to

Date October 1, 1974

From T. C. Valenzano

Of Construction

At Midland, Michigan

This is in response to your request for clarification of Geotech's responsibilities during summer 1973: Geotech's responsibilities were that of providing design assistance to project engineering and assistance to field engineering and QC. Furthermore, Geotech has the responsibility for being cognizant of all phases of the soils work in both engineering and construction. It is their responsibility to be assured that the design is properly interpreted, construction properly performed, and the specified testing requirements properly implemented, and if they are not satisfied, to advise appropriate management personnel. It was within this context that Geotech was allowed to perform acceptance validation for both field engineering and quality control.

This was done because sufficient numbers of experienced Bechtel field engineering and quality control personnel were not available on the site. Geotech's assistance was requested for this reason.

Sufficient numbers were later made available and Geotechs services as an acceptance authority was delegated to QC and field engineers for Q and non-Q work respectively.

T. C. Valenzano

TCV/sw

INCONSISTANCIES DISCOVERED TO DATE

Question #2

Discussion

Although lift thickness may not be solely responsible for the poorly compacted soil, we believe that it is a factor particularily if the following is considered:

1. Dames and Moore recommended 6" - 8" lifts and the report as written today and supposedly used as a design document, still states that the recommended lift thickness be 6-8 inches. (See attachment #1)

2. It has been documented by letter and log entries that on several occasions the 12" left thickness which is unconservative to begin with were exceeded. (See attachment #2)

In conclusion, it is evident that the unconservative approach to lift thickness has aggrevated and contributed to the poor soil conditions.

RMW/11-1-78

Power Company

P.O. Box 1963
Midland, Michigan 48640
July 23, 1974

Midland Project CWO 7020
Canonie QA/QC Daily Report
File: 16.0 Serial: 81FQAE74

Mr. J. P. Connolly
Bechtel Power Corporation
P.O. Box 2167
Midland, Michigan 48640

Dear Mr. Connolly:

There is a discrepancy in the Canonie Fill Placement QA/QC Daily Report and Lift Thickness Check for June 4, 1974, in the QC File. This report gives length 1075' ±, width 150' ±, load count 428, and average lift thickness of 1' uncompacted. Using 18 uncompacted cubic yards per load and the data above, we obtain an average lift thickness of 15.5" uncompacted. According to Specification C-210 Rev 2, Section 12.5.2, "the uncompacted lift thickness shall be not more than 12"."

We request an explanation for this discrepancy by July 31, 1974.

Yours very truly,

J. L. Corley
Field Quality Assurance Engineer

JLC/DEH/dm

CC: HWSlager
RCBauman
TCCooke

CONSUMERS POWER COMPANY

RECEIVED

JUL 30 1974

MIDLAND PLANT PROJECT
MIDLAND, MICHIGAN

Bechtel Power Corporation

Post Office Box 2167
Midland, Michigan 48640

July 29, 1974

✓	JLC	
	REW	
	ORK	
	OEH	
	FILE	
	RETURN	

Consumer Power Company
P. O. Box 1963
Midland, Michigan 48640

Attention: J. L. Corley

Reference: 81 FQAE 74
Date: July 23, 1974
FQCL-019

Dear Mr. Corley:

Verification of lift thickness is performed, in the field, by Quality Control personnel of both the subcontractor and Bechtel. Lift thickness verification is documented on the subcontractor's lift thickness report and the Bechtel Quality Control inspection plan for that area. The approximate location of the placement and amount of fill placed (truck count) are also recorded on the subcontractor's report. Further investigation of reports for the day in question, (June 4, 1974) indicate that some of the fill reported to have been placed in a "Q" area was actually placed in a non "Q" area. This situation has now been corrected by having the truck count made at the point of placement rather than at the borrow area, as was previously done.

It should again be stressed that the inspection of the earthwork lift thickness is performed at the point of placement by Quality Control personnel. The load count discrepancy for the day in question, or any other day, has no effect on the quality of the completed work.

Sincerely,

J. P. Connolly

JPC/jmw

Bechtel Corporation

Interoffice Memorandum

To J. P. Connolly

Subject Discrepancies in Report

Copies to

Date August 5, 1974

From L. V. Hendry

Of Quality Control

At Midland, Michigan
Job No. 7220

This letter will confirm the fact that there are a few minor differences between my daily field inspection report, subcontracts daily report and Canonies QA-QC daily report for the day of June 4, 1974. All reports agree that it was Zone 1 material that was placed upstream from the sand drain, but the actual area covered is a little cloudy, as is the actual load count for this area. Corrective action has since been taken to more closely keep track of placement bays and all loads are counted on the fill by the dump man.

L. V. Hendry

LVH/jmw

All of the materials mentioned above should be considered suitable for use in the construction of the plant fills. However, it is recommended that preference be given to placement of granular materials in the plant area, if possible, due to the relative ease of compacting these materials. Granular materials can generally be placed and compacted properly under a range of moisture conditions using a variety of compaction equipment. Cohesive clay soils can generally not be placed during periods of wet or freezing weather. In addition, clay soils would be difficult to place in restricted backfill areas because heavy compaction equipment would be required to break-up and compact hard chunk-size pieces that would be removed from on-site excavations.

Filling and Backfilling - It is recommended that fill and backfill materials be placed at or near the optimum moisture content in lifts approximately six to eight inches in loose thickness and that each lift be compacted in accordance with the following criteria:

	RECOMMENDED MINIMUM COMPACTION CRITERIA PERCENT OF MAXIMUM DENSITY*	
PURPOSE OF FILL	ON-SITE COHESIVE SOILS	ON-SITE GRANULAR SOILS
Support of Critical Structures	95	100
Support of Non-Critical Structures	90	95
Adjacent to Structures	90	95

* Maximum density and optimum moisture content should be determined by the ASTM Test Designation D 1557-66T.

Slopes of excavations cut into compacted fill materials should be the same as the recommended slopes provided for excavations into natural soils.

INCONSISTENCIES DISCOVERED TO DATE

Item #4 - References: a) Bechtel Design Standard, C-501
b) Bechtel Spec., C-210, C-211

Conflict: C-210, C-211 both specify 80% relative density.

C-501 specifies 85% relative density for structure support.

Question: Has Bechtel's specifications, C-210 and C-211, always used 80% relative density as a compaction standard?

Answer:

1) Specification C-211 for structural backfill has always specified 80% relative density.

2) Specification C-210 did not originally address the requirements for compaction of cohesionless materials to be utilized as plant area fill. Revision 5 of the specification is where the requirements for Sands first appeared. When the specification was revised to add a paragraph about sands, it was added at 80% relative density.

In conclusion, the specifications have always been inconsistant with the Project Design Standard.

RMW/10-24-78

INCONSISTANCIES DISCOVERED TO DATE

7. The Bechtel specs do not reflect the compaction requirements as found in the Engineering Design Documents and the Dames and Moore Soils Investigation Report.

References: Confirming ASTM-D1557-Method D.

1. Page A-76 of "Soils and Foundation Investigation Report", December 1975.

   Support of Structures - 100% B.M.P.

2. Page A-18 as in #1 -

   Support of Critical Structures - 95% D1557

3. Table 10 of as in 1 -

   Support of Structures - 95% D1557

4. Standard #C-501 - Under Design Documents - 2.4.4 - "Soil and Foundation Investigation Report."

5. Specification C-210 - Section 13.7 -

   95% ASTM D1557

References to BMP (95%)

1. Spec. C-208 - Section 9.1 - 95% B.M.P.

2. Spec 210 - 12.4 Refers to - 95% B.M.P.

3. Spec C-211 - 95% B.M.P.

From the point in which Bechtel anticipated (field) doing the plant fill work the question of which proctor was correct was an area of confusion. In fact, the field wrote Engineering a letter asking for a clarification which was not addressed by letter (the question of proctors). FCR C-302 was finally the vehicle for answering the question, in that Engineering approved the use of the B.M.P.

Apparently, the specification (C-210) was still not clear since a telecon was recorded (attached) in which Engineering stated that their method for the plant fill area is acceptable. However, in 1974 Geotech stated in a memo (attached) that the plant fill compaction requirements are as that stated in section 13.7 (ASTM D1557). Obviously, the intent of which proctor to use has always been unclear. It is my opinion that 95% of D1557 is what was intended to be used under the plant structures.

This conclusion is based on the following:

1. All design related supportive documents indicate 95% of

D1557. A telecon with Geotech also confirmed that the intent was to use the more conservative method.

2. Justification for clarifications were within the specs themselves, which were not clear to begin with.

MEMORANDUM

TO J. C. CHILDS LOCATION MIDLAND NUCLEAR PL

FROM J. O. WANZECK GEOTECH DATE SEPT 18 19 74

SUBJECT COMPACTION REQUIREMENTS JOB NO. 7220

PLANT ZONE II FILL FILE

SPECIFICATION 7220-G-210 REV 2

SECTION 13.0 PLANT AREA BACKFILL & BERM BACKFILL.

HEREIN WE ADDRESS 13.7 COMPACTION REQUIREMENTS ONLY

IT IS OUR OPINION THAT ALL THE COMPACTION REQUIREMENTS THAT ARE NEEDED FOR ZONE II MATERIAL IN THE PLANT FILL IS AS STATED IN 13.7 WITH THE EXCEPTION THAT ZONE 4, 4A, 5, 5A AND 6 MATERIALS NEED NO SPECIAL COMPACTIVE EFFORT OTHER THAN DISCUSSED IN SECTION 12.4.1

J. O. Wanzeck

CC: J. ALLEN

SS AFFI

FILE AND ACKER

All of the materials mentioned above should be considered suitable for use in the construction of the plant fills. However, it is recommended that preference be given to placement of granular materials in the plant area, if possible, due to the relative ease of compacting these materials. Granular materials can generally be placed and compacted properly under a range of moisture conditions using a variety of compaction equipment. Cohesive clay soils can generally not be placed during periods of wet or freezing weather. In addition, clay soils would be difficult to place in restricted backfill areas because heavy compaction equipment would be required to break-up and compact hard chunk-size pieces that would be removed from on-site excavations.

Filling and Backfilling - It is recommended that fill and backfill materials be placed at or near the optimum moisture content in lifts approximately six to eight inches in loose thickness and that each lift be compacted in accordance with the following criteria:

PURPOSE OF FILL	RECOMMENDED MINIMUM COMPACTION CRITERIA PERCENT OF MAXIMUM DENSITY*	
	ON-SITE COHESIVE SOILS	ON-SITE GRANULAR SOILS
Support of Critical Structures	95	100
Support of Non-Critical Structures	90	95
Adjacent to Structures	90	95

* Maximum density and optimum moisture content should be determined by the ASTM Test Designation D 1557-66T.

Slopes of excavations cut into compacted fill materials should be the same as the recommended slopes provided for excavations into natural soils.

Filling operations should be performed under the continuous technical supervision of a qualified soils engineer who would perform in-place density tests in the compacted fill to verify that all materials are placed and compacted in accordance with the recommended criteria.

	RECOMMENDED MINIMUM COMPACTION CRITERIA	
	ON-SITE SAND SOILS	ON-SITE CLAY SOILS
PURPOSE OF FILL	PERCENT RELATIVE DENSITY*	PERCENT OF MAXIMUM DENSITY**
Support of Structures	85	100
Adjacent to Structures	75	95
Areal Fill (Not supporting or adjacent to structures)	70	90

* Maximum and Minimum density of sand soils should be determined in accordance with A.S.T.M. Test Designation D-2049-64T.

** Maximum dry density and optimum moisture content should be determined in accordance with A.S.T.M. Test Designation D-698, modified to require 20,000 foot-pounds of compactive energy per cubic foot of soil.

FOUNDATION DESIGN DATA

General - Foundation design data presented in this section assumes that individual building areas will be prepared in the manner previously recommended. It is our opinion that the major plant structures may be satisfactorily supported on mat foundations established at the presently planned elevations. Similarly, shallow spread foundations founded on controlled compacted fill soils will provide satisfactory support for the appurtenant structures.

12.0 COMPACTION CRITERIA

Fills up to 35 feet thick will be required to obtain the final plant grade elevation of 634. Fill will also be required to achieve the foundation elevation portions of the auxiliary building and the turbine building. Backfills will also be required around all structures.

On-site excavated soils, both sands and clays, are considered suitable for general fill material. Soils containing organic matter are not suitable for use as fill material.

All fill and backfill material should be placed at or near the optimum moisture content in six to eight inch lifts. Each lift should be compacted in accordance with the recommendations shown in Table 10.

No compacted soil should be allowed to freeze. It is recommended that all frozen soils be removed and the affected zone be recompacted prior to resumption of operations each season. Fill compaction and decisions regarding remedial measures for frozen soils at the surface should be performed with the supervision of a soils engineer. In-place density tests in compacted fill will be

TABLE 10

MINIMUM COMPACTION CRITERIA
PLANT AREA FILL AND BERM

Function of Fill	Minimum Compaction Criteria In Situ Sand[1]	In Situ Clay[2]
Support of Structures[3]	85%	95%
Adjacent to Structures[4]	80%	-
Category I Slopes	-	95%
Berm	-	95%
Area Fill (not supporting or adjacent to structures)	-	95%

Notes

[1] All sand compaction is in terms of relative density as determined from ASTM D 2049 test.

[2] All clay compaction is in terms of maximum density as determined by ASTM D 1557, Method D except for area fill not supporting or adjacent to structures. In these areas, ASTM D 1557 may be altered such that only 20,000 ft-lb/ft^3 of energy would be required.

[3] Strength and compressibility testing may be required.

[4] Gradation Specification

The materials used for structural backfill within three feet of the exterior wall of any plant area structure shall be cohesionless and free-draining. The grain-size gradation, as determined by ASTM C-136 (and C-117 when required by the Field Engineer), shall be within the range shown below:

Sieve Size	Percent retained Fine	Coarse
1 inch	-	0
#4	-	25
#10	0	50
#40	40	95
#200	95	-

BECHTEL CORPORATION
POWER DIVISION

TUCSON - AZ

Telephone call

J. HOOK
Route G. RICHARDS
B. CHEEK
B. WARD
J. DEAN

By F. G. TEAGUE Of SITE

To S. RAO Of AZ

Date 10/7 19 77 Time 8:00 AM

Subject: SPEC C-210 BACKFILL TESTING Job No. 7770

TEAGUE Q.A. HAS ASKED FOR CLARIFICATION OF SUBJECT SPECIFICATION, SECTION 13, FOR PLANT AREA + BERM BACKFILL. SECTION 13.4 FOR TESTING OF MATERIALS REFERS TO SECTION 12.4 AND THEREFORE REQUIRES THE BECHTEL MODIFIED PROCTOR DENSITY TEST FOR COMPACTION OF COHESIVE BACKFILL, SECTION 13.7 FOR COMPACTION OF THE SAME MATERIALS REFERS TO TESTING IN ACCORDANCE WITH THE ASTM D-1557, METHOD D PROCTOR, WITHOUT SPECIFIC REFERENCE TO THE BECHTEL MODIFICATION.

RAO THIS APPARENT CONFLICT IS CLARIFIED BY SPEC. C-208 SECTION 9.1.9, DIRECTIONS TO THE TESTING SUBCONTRACTOR, WHICH CALLS FOR THE ASTM-D1557 TEST FOR THESE MATERIALS AND ALSO ALLOWS BECHTEL FIELD (THE CONTRACTOR) TO CALL FOR THE BECHTEL MODIFICATION OF THAT TEST. EITHE METHOD IS THEREFORE ACCEPTABLE TO PROJECT ENGINEERING.

Fred G Teague

Bechtel Power Corporation

MEETING AGENDA

Midland Units 1 and 2
Consumers Power Company
Bechtel Job 722o

DATE: Thursday, November 2, 1978, 10 a.m.

PLACE: Ann Arbor Office, 4 D 5

SUBJECT: DIESEL GENERATOR REVIEW MEETING

ATTENDEES: Consumers Power Company / Bechtel

DISCUSSION ITEMS:

(I) CPCo/NRC Questions & Concerns

- (A) "Inconsistencies Discovered to Date"
- (B) NRC Exit Meeting October 27, 1978

(II) Future Activities

- (A) Releasing Duct Banks
- (B) Grouting Gaps Under Footing
- (C) Utilities Monitoring During Release of Duct Banks
- (D) Soil Settlement Instrumentation and Monitoring of Utilities During Surcharging
- (E) Preparation for Surcharge
  - (1) Protective Measures
  - (2) Frost Protection
- (F) Schedule

PP

Meeting with Consultant on Nov. 7
- Consultant will at that time give a firm recommendation

I. CPCo questions

① Geotech - periodic trip not full time
More coverage on like then plant felt
Bechtel feels they have meet the
intent of Dames & Moore report &
Design Criteria
CPCo doesn't feel Bechtel had
qualified soils engineers at the
site. (after 1974)

② 12" lift thickness exceeds Dame & Moore
recommendation -
- Dames & Moore didn't identify
the compaction equipment &
Bechtel did test on the 12" lift
using various different equipment
& could obtain density therefore
it was felt that the 12" lift
is acceptable.

③④ Same thing is said in both
85% addresses on site mat that
is recompact
80% addresses off site structural mat work
a certain gradation

Even if 80% was used for on site it would have been OK, NRC only requires 75% RD of on site ~~D~~ sand

5. Loose sand ck - Have met commitment of FSAR
6. Is a problem on all jobs Impractical

~~H~~

NRC Exit Interview

1. Don't feel need to increase 90 day interval at this time during operation
2. Will change FSAR to show random
3. True will change FSAR
4. " " " "
5. Will correct
6. Can answer - will investigate more

II Future Activities

A. Releasing Duct Bank

1. Condensate line
   Excavate N & S end of casing
   check gaps between sleeve & pipes
2. Diesel fuel line } same as above
3. Service lines }
4. Take elevation of Top of casing for Condensate line
5. Relative displace between duct bank & Bldg - measure
6. CO_2 & Oily waste, service air needs monitoring
7. [7]

START Fill - Mid Dec

Struct complete 5/1/78

Spare pipes

(1) 151-755-7

Meeting Thurs. is @ 10:00

Tues 10/31/78 D.G. Bldg. Meeting

Purpose: To resolve questions raised by CPCO & address observations made by NRC (Gallagher) relative to the descrepancies between the FSAR and Project specs.

Action Boos OK — Provide 7 day settlement readings for eastern most pedestal in D.G.

NRC Observations

Action Boos OK — Get a copy of CPCO version of NRC observation from exit

1. Q = Will settlement program (90 day, reading frequency) be altered during plant operation?

A. No, we recommend staying w/ (FSAR section) 2.5.4.13.2 for plant operation.

2. Q. FSAR & spec. do not agree on nature of matl to be found under bldg.? (Spec. allows random fill; ~~spec~~. FSAR says bldg will be founded on a cohesive matl.

A. FSAR will be revised to refine nature of in place matl.

3. Q There is a descrepancy between testing methods in ~~the~~ specifications C-210 sections 13.7.1 and 13.4 & 12.4.5.1

A. The BMP was originally specified and ~~was~~ is what is req'd. The statement in C-210 section 13.7.1 is in error.

Check rev. 4 of Spec. C-210 sect. 13.7.1

4. Q Current settlements shown in FSAR are in conflict, aren't they?

A. Yes, they are; the FSAR will be revised.

5. Q Dames + Moore report basically calls for ASTM 1557 Method D yet Bechtel in the spec C-210 section 12.4.5.1 calls for BMP. What is basis for Bechtel's decision to waive D+M reqt.

A This will require considerable evaluation by P.E. + Geo-Tech. Main thrust must be even if ASTM 1557 D should have been used, use of BMP did not cause problem

only comment available @ this time

6. Q Dames + Moore report calls for ~~use~~ lift thickness of 6"-8". Bechtel spec. allows a 12" max. lift thickness. What is basis for Bechtel position?

A We must review test program on the equip. used which we feel also qualified the use of the 12" max lift thickness.

Action Book/J. Hook OK

7. Q. How will Bechtel predict settlement given current in place matl's.? NRC will want to review calcs

A. Too early to present calcs, however, Bechtel will present calcs

8. Q. Will Bechtel monitor cracks in D.G. bldg. and note those in excess of ACI reqts (i.e. those that are struc. cracks)?

Copy of crack readings

A. Yes

CPCO/Bob Wheeler comments/questions

1. Q. Why didn't Bechtel follow spec. C-501 and provide a Geo-Tech rep to

verify ~~[illegible]~~ soils placement ~~[illegible]~~ and take soils samples

A. Provide written response why our program meets this reqt.

2. Q + A = Little NRC observation 6. on lift thickness

3. Q. Bechtel spec. C-211 does not address removal or recompaction of soil that has been frozen upon resumption of work. Dames + Moore report does

A. The Bechtel spec. has the same reqt + says the same thing in less words

4. Q. Dames + Moore report calls for 85% relative density; Bechtel spec C-211 calls for 80%! Resolve conflict

A. Geo-Tech will provide response

5. Q. Why weren't boat wands removed? Do we have a problem?

A. Geo Tech will present their response to the FSAR question

6. Q. CPCO questions the method used to select proctors. Did selection of improper proctors present a problem.

A. Geo tech to provide response

Action
Geos. furnish UST letter

CPCO Concerns On Preloading

1. Q. What is basis for suggesting pre loading ~~consolidating~~ the soil under the D.G. bldg to ~~[redacted]~~ arrest settlement problem

A. [redacted]

a) [redacted] No, consultants prelim basis
b) [redacted] Yes as regards diff. settlement
c) [redacted] premature to tell
d) premature to tell

G. Tech may give opinion at

2. e) Will not know until the soil test data is deciphered & we review with the consultant
f) Yes, they are being addressed
g) Can't be answered @ present
h) Will be determined by testing of removed samp
i) This will be reviewed with consultant
j) We, Bechtel, will review the underground facil with the consultant
k) At this time don't feel we need an outside consultant
l) Will be addressed in overall acceptance of the structure. If repair is rqd we will do it

2. Q Could construction on the Bldg

A a) Yes
b) Save all that time that would follow pre-loading

3. Q. Will filling the pond acc. settlement

A Yes

Q. If preloading doesn't work will filling the pond cause other problems

A. Nothing we couldn't handle, besides the pond must be filled to test the dike

Q. What effect will filling the pond on other structures

A. Little effect we think, however, this is another reason for filling the pond.