SUPPLEMENT NO. 2

0094

8003240 726

Docket Nos. 50-302 and -303
Supplement No. 2
March 1, 1968

SUPPLEMENT NO. 2

The information contained herein is submitted voluntarily in response to an oral inquiry by the AEC regulatory staff. Supplement No. 2 is divided int two areas:

a. Answers to seven "informal" questions from the DRL on the following subjects:

   1. Construction Quality Control

   2. Criterion 39

   3. Electrical equipment that must survive DBA

   4. Index references to proposed 70 criteria

   5. Responses to ACRS concerns in TMI and Oconee "letters"

   6. Testing of Reactor internal vent valves

   7. Leak characteristics of relief and turbine stop valves

b. "Package" on Engineering Geology and Foundation Design which includes the following:

   1. Foundation Investigation Report by Woodward, Clyde & Associates. |7

   2. Excerpts from Unit 2 Foundation Grouting Report by Gilbert Associates, Inc.

   3. Test Grouting Report, Units 3 and 4 by Gilbert Associates, Inc.

   4. Technical Specifications for Foundation Grouting, Unit 3.

   5. Specification for Excavation and Construction of Structural Fill. |7

   6. Proposed General Procedure for Excavation, Grouting, and Placement, of Structural Fill.

0095

INFORMAL QUESTION 1

Describe in more detail the program for construction inspection by identifying the organization, responsibilities, authority and independence of the quality control group.

ANSWER

The Preliminary Safety Analysis Report in a number of references contains details of the construction organization of Florida Power Corporation. Figure 1-12 indicates quite clearly the line of responsibility from the Nuclear Project Manager directly to the Construction Superintendent in the Mechanical Engineering Department. Shown under this Construction Superintendent is a Quality Control Supervisor.

This Quality Control Supervisor will be responsible to the Construction Superintendent for quality assurance and for the quality control program described in revised Appendix 5D. Under Section 1.3 of Appendix 5D an independent testing agency/agencies will be retained by FPC. Use of such agencies is a policy of FPC construction procedures that will be retained on this project.

It shall be the responsibility of any such agency/agencies to perform such tests and/or surveillance programs required by the design of the plant to assure that materials and/or methods used in construction conform to the applicable codes or specifications listed in the PSAR. All reports or evaluations from such agency/agencies will be submitted to the FPC Quality Control Supervisor who will consult as required with appropriate FPC supervisors, Gilbert Associates engineering personnel and/or other qualified consultants in preparing final evaluation recommendations which will be used by the FPC Project Management to decide as to acceptance or rejection of the materials or work. The FPC Construction Superintendent is authorized to issue any required work stoppage or rejection orders to any contractor.

As has always been our practice any such agency/agencies will be under contract to Florida Power Corporation and no other contractor. Such an agency is hired by FPC contract requirements as an independent contractor and by law he will so remain. We are at this time evaluating U. S. Testing Co., Pittsburgh Testing Laboratories and Florida Testing Co. prior to entering into a formal agreement. There are other equally qualified agencies which also might be considered. Our concern here is to obtain the most qualified organization for each specialized requirement and have each remain independent from the others in carrying out our quality assurance program.

The Babcock & Wilcox Company's separate and distinct "Quality Control Organization" is responsible for the quality of workmanship for both the B&W manufacturing and field assembly functions. Quality control during field assembly will be administered by competent personnel trained and versed in the approved quality standards of B&W's central quality control organization. 4

0096

All welding processes which are utilized during field assembly will be performed in accordance with B&W's established procedural specifications; B&W's compliance with applicable codes and metallurgical requirements have been established through numerous procedure qualification tests to prove their competence for welding in accordance with specific B&W procedures.

Competent technicians trained in B&W's quality control procedures will provide continuous inspection during the performance of all welding processes to verify compliance to applicable codes and B&W procedures. Documentation will be provided of all quality inspections which are performed for a particular weld along with such other pertinent data as operator identification, preheat and post heat times and temperatures as well as the results of the performance of any required non-destructive tests. B&W will maintain such records and will provide such verification of performance including specific welding procedures and backup procedural qualification test results. (Non-destructive testing will be utilized to give maximum assurance of weld integrity and as required by applicable codes and B&W procedures.) Such testing will be performed by competent specialists trained in established testing techniques and versed in B&W quality procedures. Upon completion of assembly reactor coolant and auxiliary system required cleanliness will be achieved in accordance with procedures established by B&W's quality control organization. Competent personnel will perform systems inspection to assure adequacy of cleaning techniques and thereby ascertain systems readiness for operational testing.

Florida Power Corporation through the above lines of internal responsibility and its agreements of contract will be the final authority for rejection of materials and/or stopping of work required by the quality assurance program. All records and documentations required by the program will be received and held at all times by FPC personnel.

0097

INFORMAL QUESTION 2

How do you meet Criterion 39 with respect to off-site power sources?

ANSWER

Our present design incorporates one normal feed to the emergency busses from the startup transformer. Upon loss of this feed, the emergency busses will be automatically switched to the engineered safeguards diesel generators. In addition, we are making provisions by incorporating quick disconnecting links on the generator isolated phase bus to enable feeding the emergency busses from the unit auxiliary transformers. It is anticipated that it will take approximately one hour to isolate the generator so that the unit auxiliary transformer could be back fed from the 500 kv system.

0093

INFORMAL QUESTION 3

Provide a list of all electrical equipment in the containment which must survive the design basis accident.

ANSWER

Electrical components within the containment (reactor building) required for proper functioning of the engineered safety features are as follows:

a. Reactor coolant pressure transmitters.
b. Electric motor isolation valves.
c. Reactor building cooling fan drives.
d. Instrument cables for pressure instruments.
e. Power cables and limit switch cables for the valves.
f. Power cables for the fan motors.

Survival demonstration testing will generally be performed using the complete assembly. For example, under a. the complete transmitter rather than just the outer housing or case will be tested.

0099

[redacted]

INFORMAL QUESTION 4 Provide assurance that your design conforms to the Commission's 70 General Design Criteria. Reference the PSAR sections where applicable.

ANSWER Assurance that the design of Crystal River Plant Units 3 & 4 meets the 27 General Design Criteria for Nuclear Power Plant Construction Permits is given in Section 1.4 of the PSAR.

Florida Power Corporation has reviewed extensively the proposed 70 General Design Criteria, and it is the intention of FPC that the design of Crystal River Units 3 & 4 meet these proposed 70 criteria. Our PSAR as amended and supplemented reflects this intent in the design presented, limited by our ability to interpret the specific intent. The following is a listing of references in the FSAR for the Proposed 70 General Design Criteria.

REFERENCES IN PSAR
FOR PROPOSED
70 GENERAL DESIGN CRITERIA

I. OVERALL PLANT REQUIREMENTS

Criterion 1 - Quality Standards (Category A)

Reference PSAR, Appendix 5D; Sections 4.1, 4.1.5, and 4.4, Section 5.1.2.4

Criterion 2 - Performance Standards (Category A)

Reference PSAR Sections as follows:

(a) Earthquake----------Sec. 5.1.2.3.5
(b) Flooding (hurricane)----------Sec. 5.1.2.3.4
(c) Tornadoes (external pressure)----------Sec. 5.1.2.3.3
(d) Missiles (i) external----------Sec. 5.1.2.3.2
(ii) internal----------Sec. 5.1.2.7
(e) Tsunami----------Sec. 2I, pages 4 & 5
(f) Ice----------None
(g) Other local site effects----------None

PSAR Section 5.1.2.3.6

Criterion 3 - Fire Protection (Category A)

Reference PSAR Section 7.4.5, Section 8.2.2.10, Section 9 and Figure 9-6

0100

Criterion 4 - Sharing of Systems (Category A)

Reference PSAR Sections 8, 9 and 11.

Criterion 5 - Records Requirements (Category A)

Reference PSAR Section 12.4, Section 13, Section 1.4.1, Appendix 5D.

II. PROTECTION BY MULTIPLE FISSION PRODUCT BARRIERS

Criterion 6 - Reactor Core Design (Category A)

Reference PSAR Sections 3.2.4.2 and 3.2.3.1.1, Section 9, Figure 9-10, Section 10, Sections 14.1.2.6 and 14.1.2.2.3.

Criterion 7 - Suppression of Power Oscillations (Category B)

Reference PSAR Section 3.2.2.2.3

Criterion 8 - Overall Power Coefficient (Category B)

Reference PSAR Sections 3.1.3 and 3.2, Table 3-9

Criterion 9 - Reactor Coolant Pressure Boundary (Category A)

Reference PSAR Section 4.1

Criterion 10 - Containment (Category A)

Reference PSAR Section 5.1, Section 6.2.1, Section 14.2.2.3c, Appendix 5.

III. NUCLEAR AND RADIATION CONTROLS

Criterion 11 - Control Room (Category B)

Reference PSAR Section 7.4.5, Supplement No. 1, Question 1.3

Criterion 12 - Instrumentation and Control Systems (Category B)

Reference PSAR Sections 7.2 and 7.3.2

Criterion 13 - Fission Process Monitors and Controls (Category B)

Reference PSAR Section 7.2.2, Section 1.4.14

Criterion 14 - Core Protection Systems (Category B)

Reference PSAR Section 6.1, Section 7.1

010

Criterion 15 - Engineered Safety Features Protection Systems (Category B)

Reference PSAR Section 6, Section 7

Criterion 16 - Monitoring Reactor Coolant Pressure Boundary (Category B)

Reference PSAR Section 4.2.7

Criterion 17 - Monitoring Radioactivity Releases (Category B)

Reference PSAR Section 1.4.27, Section 2, Section 11, and Supplement No. 1, Question 5.8

Criterion 18 - Monitoring Fuel and Waste Storage (Category B)

Reference PSAR Section 1.4.24, Section 11.2.2, Supplement No. 1, Question 5.8

IV. RELIABILITY AND TESTABILITY OF PROTECTION SYSTEMS

Criterion 19 - Protection Systems Reliability (Category B)

Reference PSAR Section 7.1

Criterion 20 - Protection Systems Redundancy and Independence (Category B)

Reference PSAR Section 7.1

Criterion 21 - Single Failure Definition (Category B)

Reference PSAR Section 7.1.3

Criterion 22 - Separation of Protection and Control Instrumentation Systems (Category B)

Reference PSAR Section 7.1.3

Criterion 23 - Protection Against Multiple Disability for Protection Systems (Category B)

Reference PSAR Section 7.1.1

Criterion 24 - Emergency Power for Protection Systems (Category B)

Reference PSAR Sections 8.2.2.6, 8.2.2.7, 8.2.3.2, and 8.2.3.3

Criterion 25 - Demonstration of Functional Operability of Protection Systems (Category B)

Reference PSAR Section 7.1.3, Supplement No. 1, Question 5.3

Criterion 26 - Protection Systems Fail-Safe Design (Category B)

Reference PSAR Section 7.1.3

0102

V. REACTIVITY CONTROL

Criterion 27 - Redundancy of Reactivity Control (Category A)

Reference PSAR Section 7.2.2.1.2

Criterion 28 - Reactivity Hot Shutdown Capability (Category A)

Reference PSAR Section 7.2.1.2

Criterion 29 - Reactivity Shutdown Capability (Category A)

Reference PSAR Section 3.2.2.1

Criterion 30 - Reactivity Holddown Capability (Category B)

Reference PSAR Sections 3.2.2.1 and 3.3.3.1

Criterion 31 - Reactivity Control Systems Malfunction (Category B)

Reference PSAR Section 3.2.2.1

Criterion 32 - Maximum Reactivity Worth of Control Rods (Category A)

Reference PSAR Sections 3.2.2 and 3.2.4.3, Sections 14.1.2.4 and 14.2.2.2

VI. REACTOR COOLANT PRESSURE BOUNDARY

Criterion 33 - Reactor Coolant Pressure Boundary Capability (Category A)

Reference PSAR Section 14.2.2.2, Supplement No. 1, Question 9.11

Criterion 34 - Reactor Coolant Pressure Boundary Rapid Propagation Failure Prevention (Category A)

Reference PSAR Section 4.1.4

Criterion 35 - Reactor Coolant Pressure Boundary Brittle Fracture Prevention (Category A)

Reference PSAR Section 4.1.4, Supplement No. 1, Question 8.11

Criterion 36 - Reactor Coolant Pressure Boundary Surveillance (Category A)

Reference PSAR Section 4.4.3

0103

VII. ENGINEERED SAFETY FEATURES

A. General Requirements for Engineered Safety Features

Criterion 37 - Engineered Safety Features Basis for Design (Category A)

Reference PSAR Section 14.2.2.3, Supplement No. 1, Question 8.9

Criterion 38 - Reliability and Testability of Engineered Safety Features (Category A)

Reference PSAR Sections 6.1.3, 6.1.4, 6.2.3, 6.2.4, and Table 6-3

Criterion 39 - Emergency Power for Engineered Safety Features (Category A)

Reference PSAR Sections 8.2.3 and 8.3, Supplement No. 2 Informal Question 2

Criterion 40 - Missile Protection (Category A)

Reference PSAR Section 5.1.2.7

Criterion 41 - Engineered Safety Features Performance Capability (Category A)

Reference PSAR Sections 6.1.3.1 and 6.2.3.1, Section 14

Criterion 42 - Engineered Safety Features Components Capability (Category A)

Reference PSAR Section 6.1.3

Criterion 43 - Accident Aggravation Prevention (Category A)

Reference PSAR Section 14.2

B. Emergency Core Cooling Systems

Criterion 44 - Emergency Core Cooling Systems Capability (Category A)

Reference PSAR Section 6, Section 9, Section 14

Criterion 45 - Inspection of Emergency Core Cooling Systems (Category A)

Reference PSAR Section 4.4

Criterion 46 - Testing of Emergency Core Cooling Systems Components (Category A)

Reference PSAR Section 6.1.4 and Table 6-3

Criterion 47 - Testing of Emergency Core Cooling Systems (Category A)

Reference PSAR Section 6.1.4 and Table 6-3

Criterion 48 - Testing of Operational Sequence of Emergency Core Cooling Systems (Category A)

Reference PSAR Section 6.1.4, Section 7.1.3

C. Containment

Criterion 49 - Containment Design Basis (Category A)

Reference PSAR Section 5.1, Appendix 5-B, Section 14

Criterion 50 - NDT Requirement for Containment Material (Category A)

Reference PSAR Section 1.4.11, Sections 4.1.4 and 4.2.5

Criterion 51 - Reactor Coolant Pressure Boundary Outside Containment (Category A)

Reference PSAR Section 5, Sections 9.1 and 9.2

Criterion 52 - Containment Heat Removal Systems (Category A)

Reference PSAR Section 6.2 and accompanying tables

Criterion 53 - Containment Isolation Valves (Category A)

Reference PSAR Sections 5.2 and 5.3, Table 5-3, Figure 5-4

Criterion 54 - Containment Leakage Rate Testing (Category A)

Reference PSAR Section 5.6.1.3

Criterion 55 - Containment Periodic Leakage Rate Testing (Category A)

Reference PSAR Sections 5.1.2.2 and 5.6.2.1

Criterion 56 - Provisions for Testing of Penetrations (Category A)

Reference PSAR Sections 5.1.2.6.1 and 5.4

Criterion 57 - Provisions for Testing of Isolation Valves (Category A)

Reference PSAR Section 5.2

D. Containment Pressure-Reducing Systems

Criterion 58 - Inspection of Containment Pressure-Reducing Systems (Category A)

Reference PSAR Figure 5-6

Criterion 59 - Testing of Containment Pressure-Reducing Systems Components (Category A)

Reference PSAR Section 6.2.4, Figure 6-5

Criterion 60 - Testing of Containment Spray Systems (Category A)

Reference PSAR Section 6.2.4, Figure 6-5

Criterion 61 - Testing of Operational Sequence of Containment Pressure-Reducing Systems (Category A)

Reference PSAR Section 6.2.4, Figure 6-5, Figure 9-4

E. Air Cleanup Systems

Criterion 62 - Inspection of Air Cleanup Systems (Category A)

Not Applicable

Criterion 63 - Testing of Air Cleanup Systems Components (Category A)

Not Applicable

Criterion 64 - Testing of Air Cleanup Systems (Category A)

Not Applicable

Criterion 65 - Testing of Operational Sequence of Air Cleanup Systems (Category A)

Not Applicable

VIII. FUEL AND WASTE STORAGE SYSTEMS

Criterion 66 - Prevention of Fuel Storage Criticality (Category B)

Reference PSAR Section 9.6.2.3

Criterion 67 - Fuel Waste Storage Decay Heat (Category B)

Reference PSAR, Section 9.4

Criterion 68 - Fuel and Waste Storage Radiation Shielding (Category B)

Reference PSAR Section 9.6

Criterion 69 - Protection Against Radioactivity Release from Spent Fuel and Waste Storage (Category B)

Reference PSAR Sections 11.1.2.4 and 11.1.2.5.3

IX. PLANT EFFLUENTS

Criterion 70 - Control of Releases of Radioactivity to the Environment (Category B)

0106

Reference PSAR Section 11.1.2

INFORMAL QUESTION 5

Provide your position and index your PSAR with respect to the ACRS concerns expressed in the Three Mile Island letter, dated January 17, 1968 and the Oconee letter, dated July 11, 1967.

5.1 Three Mile Island Letter

5.1.1 "Operation of the ECCS is initiated automatically by redundant low-pressure signals from transducers actuated by pressure in the two primary loops. The Committee recommends that in the interest of diversity another method, different in principle from the one proposed, should be added to initiate this function. The diversity thus achieved would enhance the probability that this vital function would be initiated in the unlikely event it is needed."

ANSWER Actuation of the ECCS is now provided for by both low primary system pressure and high reactor building pressure. See the PSAR, Supplement 1, Question 5.10.

5.1.2 "The output circuit of the proposed reactor protection system consists of a single d-c circuit (bus) fed from two station batteries. Both feeders must be interrupted to de-energize the bus and drop all rods. Failure to interrupt either feeder, or any other event that prevents de-energizing the single bus, will inhibit dropping all the rods. The Committee believes this system can and should be revised to correct the deficiency. The revised design should be provided for review prior to installation of the protection system."

ANSWER The original design included a bus which was disconnected from the battery power supply by redundant series-connected breakers in order to trip all 69 rods. The trip is effective if either the positive or negative half of the bus is disconnected. An additional two-conductor bus (positive and negative) has been added to feed 69 trip relays, one for each mechanism. Tripping the second two-conductor bus trips each of 69 relays, each of which interrupts the power supply to the clutch in one of the control rods thereby causing the rod to trip. This new arrangement provides redundant means to assure that all rods trip. See the PSAR, Supplement 1, Question 5.3.

5.1.3 "The applicant has proposed using certain signals from protection instruments for control purposes. The Committee believes that control and protection instrumentation should be separated to the fullest extent practicable, and recommends that the applicant explore further the possibility of making safety instrumentation more nearly independent of control functions."

0107

ANSWER This plant uses certain instrumentation jointly for protection and control. Equipment is designed and supported by test data on isolation to assure that sufficient separation between protection and control is provided as recommended by the ACRS. See the PSAR, Section 7.1.1.2.3.

5.1.4 "Consideration should be given to the development and utilization of instrumentation for prompt detection of gross failure of a fuel element."

ANSWER The short period of time since this recommendation was made in the Three Mile Island letter has been insufficient to allow a full evaluation of the recommendation to be made. Not discussed in the PSAR.

5.1.5 "The applicant described the research and development work planned to confirm the final design of the plant. The Committee continues to emphasize the importance of work to assure that fuel-rod failures in loss-of-coolant accidents will not affect significantly the ability of the ECCS to prevent clad melting."

ANSWER Studies and tests have been made and are continuing. See the PSAR, Supplement 1, Question 1.4.

5.1.6 "The applicant is continuing studies on the possible use of part-length rods for stabilizing potential xenon oscillations."

ANSWER Analytical evaluations to determine the threshold for xenon oscillations and the stability margin for the reactor are underway. Results of these studies will be presented as soon as they are available. A preliminary analysis was conducted to demonstrate the ability to control xenon oscillations -- if they occur -- by using part-length control rods. Additional analyses to develop more detailed control characteristics under these circumstances will be carried out during the detailed design of the plant. See the PSAR, Section 3.2.2.2.3.

5.1.7 "Solid poison shims will be added to the fuel elements if necessary to make the moderator temperature coefficient more negative at the beginning of core life."

ANSWER If it be necessary that the moderator temperature coefficient be made more negative at the beginning of core life, solid poison shims can be added to the fuel elements. See the PSAR, Section 3.2.2.1.4.

5.1.8 "The Regulatory Staff should review the effects of blowdown forces on core internals and the development of appropriate load combinations and deformation limits."

ANSWER Load combinations for seismic and blowdown forces and deformation limits for various reactor components have been set. Additional information will be presented in the future. See the PSAR, Supplement 1, Question 9.11.

0108

5.1.9 "The Regulatory Staff should also review analyses of the possible effects upon pressure vessel integrity of thermal shock induced by ECCS operation."

ANSWER This problem has been analyzed utilizing two different analytical techniques, the NDT approach and the fracture mechanics approach. At the present time the problem is being analyzed using an approach suggested by ACRS consultants. Results from that analysis are not yet available. See the PSAR, Supplement 1, Question 8.11.

5.1.10 "The applicant has proposed core barrel check valves between the hot leg and the cold leg to insure proper operation of the ECCS under all circumstances. Analytical studies indicate that vibrations will not unseat these valves during normal operation. This point should be verified experimentally."

ANSWER Vibration tests of a prototype vent valve will be conducted to verify the analytical studies which indicate that vibrations will not unseat these valves during normal operation. See the PSAR, Supplement 2, Informal Question 6.

5.2 Oconee Letter

5.2.1 "The Committee recommends that the Regulatory Staff review the detailed design of the ECCS and the analysis of its performance for the entire spectrum of break sizes, as soon as this information is available."

ANSWER Analyses of the performance of the ECCS for a spectrum of leak sizes between 0.06 sq ft and 14.1 sq ft demonstrate the ability of the ECCS to protect the core. See the PSAR, Section 14.2.2.3 and Supplement 1, Question 8.9.

5.2.2 "The Regulatory Staff should review analyses of possible effects, upon pressure-vessel integrity, arising from thermal shock induced by ECCS operation."

ANSWER See the response to 5.1.9 of this Question.

5.2.3 "The effects of blowdown forces on core and other primary system components should be analyzed more fully as detailed design proceeds."

ANSWER See the response to 5.1.8 of this Question.

5.2.4 "Further evidence should be obtained to show that fuel-rod failure in loss-of-coolant accidents will not affect significantly the ability of the ECCS to prevent clad melting."

ANSWER See the response to 5.1.5 of this Question.

5.2.5 "The applicant has proposed adding swing-check valves in the core barrel to ensure obtaining adequate height of cooling water in the core under all circumstances of ECCS operation. This feature should be further reviewed to ensure that no new problems are introduced."

ANSWER See the response to 5.1.10 of this Question.

5.2.6 "The applicant will explore further possibilities for improvement, particularly by diversification, of the instrumentation that initiates ECCS action."

ANSWER See the response to 5.1.1 of this Question.

5.2.7 "The Committee continues to emphasize the importance of quality assurance in fabrication of the primary system as well as inspection during service life, and recommends that the applicant implement those improvements in primary system quality that are practical with current technology."

ANSWER The overall quality assurance program is described in the PSAR, Appendix 5D. The applicable codes to which the reactor coolant system is to be designed are itemized in the PSAR, Section 1.4.1 and Section 4.1. The ability to inspect the various components is set forth in the PSAR, Section 4.4. The degree of compliance with the AEC's Tentative Regulatory Supplementary Criteria for ASME Code-Constructed Nuclear Pressure Vessels is indicated in the response to Mr. Morris' letter of January 19, 1968 which appears in the PSAR, Supplement 1.

5.2.8 "The moderator coefficient of reactivity is calculated to be positive at the beginning of core life for the first core. The applicant is making detailed studies of the effect of this coefficient on the course of postulated accidents; if necessary, the coefficient will be made more negative by the addition of solid poison shims to the core."

ANSWER See the response to 5.1.7 of this Question.

5.2.9 "Further evidence should be obtained concerning the ability of the fuel to withstand expected transients at the end of its anticipated lifetime."

ANSWER A program which will provide the information necessary to demonstrate the ability of the fuel to maintain its integrity at the end-of-life condition is being carried on. This program is described in the PSAR, Supplement 1, Question 1.4 and Section 3.2.4.2.2.

5.2.10 "The applicant is investigating further the stability margin for xenon oscillations."

ANSWER See the response to 5.1.6 of this Question.

0110

INFORMAL QUESTION 6

We understand that vibration experiments will be performed on the internals vent valve. Provide a description of the test plan and objectives.

ANSWER

B&W is presently working with the internals vent valve designer-manufacturer and a vibration testing laboratory on the details of the vibration test of a full scale prototype vent valve. The prototype valve will be mounted in a test fixture which duplicates the method of valve mounting in the core support shield. The test fixture with valve installed will be attached to a vibration test machine and excited sinusoidally through a range of frequencies which will encompass those which may reasonably be anticipated for the core support shield during reactor operation. The relative motion between the valve disc and seat will be monitored and recorded during test. The test results will verify the vibration analysis presented in the Three Mile Island Nuclear Station PSAR, Docket No. 289, Supplement 3, Question 16.4, which indicates that the valve will not open during operation as a result of vibration.

0111

INFORMAL QUESTION 7

How will you test the leak characteristics of the secondary steam side relief valves and turbine stop valves?

ANSWER

Provisions for periodic leak-testing will be included in the design to check that the leak tightness of the steam safety valves and turbine stop valves is maintained.

0112

ENGINEERING GEOLOGY AND FOUNDATION DESIGN

ENGINEERING GEOLOGY AND FOUNDATION DESIGN

We are submitting subsurface information in response to an oral inquiry by the AEC regulatory staff. All of the data transmitted herein shall become a part of Supplement #2 of the Florida Power Corporation Preliminary Safety Analysis Report for Crystal River Unit 3. It is forwarded to substantiate analyses and recommendations of the subsurface studies germane to the foundation - foundation rock system interaction, the remedial grout treatment, the methods and procedures to be used for site preparation (grouting) and for the construction of load bearing fill.

These are assembled, in the package entitled, "Engineering Geology and Foundation Design," in the following order:

Foundation Investigation Proposed Nuclear Power Plant Florida Power Corporation - A geotechnical report submitted by Woodward-Clyde & Associates, Consulting Engineers and Geologists. | 7

The listed excerpts from Foundation Grouting Report Unit 2, prepared by Gilbert Associates, Inc.:

a. Pages 7 thru 24
b. Figures 1 thru 6
c. Appendix C

The Gilbert Associates, Inc. report entitled "Test Grouting Program, Units 3 and 4."

Technical Specifications for Foundation Grouting of Crystal River Unit 3 which includes an attachment that specifies how it will be determined that grouting closure has been attained.

Specification for Excavation and Construction of Structural Fill. | 7

Proposed General Procedure for Excavation, Grouting, and Placement of Structural Fill.

0114

SECTION I

SPECIFICATIONS FOR SUBSURFACE GROUTING

AT

CRYSTAL RIVER UNIT NO. 3

TABLE OF CONTENTS

SECTION I

SPECIFICATIONS FOR SUBSURFACE GROUTING

AT

CRYSTAL RIVER UNIT NO. 3

ARTICLE I - GENERAL PLAN FOR GROUTING

(A) Requirement - The general plan for grouting the foundation of the power plant, referred to as Crystal River Unit No. 3, requires the Contractor to perform drilling and grouting operations as follows:

(1) Drilling and grouting in the rock foundation with shallow grout holes grouted at low pressure and deeper grout holes grouted at higher pressures. The magnitude of pressures will be defined in a later article.

The following areas shall be grouted.

(a) Turbine Room

(b) Reactor Building

(c) Auxiliary Building

(2) Core drilling exploratory holes in the foundation exactly on or within the boundary established by the various curtain walls and/or any area adjacent to and contiguous with the immediate building area.

ARTICLE II - GENERAL PROGRAM

(A) Program Determination - The program for drilling and grouting as shown on Drawing GAI-4 is tentative. The extent of the program will be determined by conditions which develop at the site. The conditions shall be analyzed and interpreted by the Engineer. The Engineer shall establish the number, spacing, depth, location and order of drilling of all grout holes, as well as the grouting pressure, grout mix, and order of grouting to be used on these holes. Any changes in the drilling and grouting technique warranted by conditions shall be established by the Engineer.

(B) Curtain Grouting - The curtain grouting shall be performed from the top of a concrete cutoff wall to be placed in a trench which shall be excavated through the overburden and reaching down to competent rock. The top of the wall shall be at an approximate elevation of 91 feet (based on elevation 88.0 as mean low sea level) and it shall be the responsibility of the Company to install the cutoff wall after excavation to elevation 91 feet.

0117

(C) Consolidation Grouting - Consolidation grouting will begin after:

(1) The curtain wall is completed.

(2) The Company has excavated to competent rock within the confines of the cutoff wall and replaced the removed overburden with an approved backfill material up to approximately elevation 91.

Consolidation grouting shall be performed, therefore, from the surface of the backfill material.

ARTICLE III - DEFINITIONS

(A) Circuit Grouting - Circuit grouting is the process whereby grout pipe is inserted to the bottom of a drilled hole and grout is injected through the pipe and percolated from the bottom to the top of the hole. This technique is used on holes that have caved in or are suspected of having caved in.

(B) Company - Florida Power Corporation

(C) Consolidation Grouting - Consolidation grouting applies to the grouting of all material within the confines of the curtain wall. The purpose is to fill all voids with grout, seal off solution channels, solidify the rock mass, and densify and confine the mobile sands, silts, clays, mud, and shell materials that exist as a part of the foundation rock.

(D) Contractor - The company awarded the contract to perform the work outlined in these specifications.

(E) Curtain Grouting - Curtain grouting is performed on the periphery of the various areas comprising the total plant. The purpose of curtain grouting is to fill all voids with grout, seal off solution channels, solidify the rock mass, densify and confine the mobile sands, silts, clays, mud, and shell materials that exist as a part of the foundation, and form an impermeable barrier to inhibit the outward flow of water or grout during subsequent consolidation grouting to be performed inside the closure of the grout curtain.

(F) Engineer - Gilbert Associates, Inc., Engineers and Consultants.

(G) Split-Spacing Method - The split-spacing method employs the procedure of drilling and grouting a hole that is located approximately midway between two holes that have been previously drilled and grouted to at least the same depth as the splitting hole.

(H) Stage - A stage is any part of a hole in which drilling and grouting is performed.

(I) Stage Grouting - Stage grouting consists of drilling a hole to a limited depth within a zone, grouting at that depth, cleaning the hole by washing or other suitable means before the grout has set sufficiently to require redrilling, letting the grout surrounding the hole take initial set, drilling the hole to another limited depth and grouting, and thus continuing in as many stages of drilling and grouting as may be necessary to secure a satisfactory job of grouting within any predetermined zone.

0118

(J) Waterproofing - Waterproofing is the final operation performed on the curtain wall. The purpose is to seal the remaining pores and small fractures in the rock structure that can carry water. Thus, a nearly impermeable wall is created around the perimeter of the Power Plant.

A neat cement and water mixture is used with the proportions of cement to water being determined by the Engineer.

(K) Zone - A zone is an exact, pre-determined depth in a grout hole. Each zone can contain several stages and each grout hole can contain many zones - all of which are located at discrete depths.

ARTICLE IV - PROCEDURES

(A) Curtain Grouting - The split-spacing and stage-grouting techniques shall be employed. The spacing of primary holes will be approximately 32 feet, but may be changed to accommodate existing conditions. Zone I of at least two consecutive primary holes must be drilled and grouted before the splitting secondary can be drilled. Likewise, the secondary must be completed to the bottom of Zone I before either tertiary (one tertiary is located on each side of the secondary and splits the space between the primary and the secondary) can be drilled. Finally, the quaternary holes may be drilled after the tertiary holes have been drilled and grouted to the bottom of Zone I. The quaternary holes are located on both sides of the tertiary holes and split the space between the tertiary and either adjacent hole.

When at least 32 feet on both sides of a primary hole has been completed to the bottom of Zone I, that primary hole may be deepened to the next succeeding zone unless conditions warrant the creation of a stage.

Regardless, the primary holes shall be continued in stages or zones to completion before any succeeding orders of holes located between two consecutive primary holes may be deepened. When any two consecutive primary holes have been considered completed, the secondary hole between these completed primary holes may be deepened in discrete stages or zones.

At the completion of the secondary order, the tertiary holes on either or both sides of the completed secondary hole may be deepened in discrete stages or zones.

No hole may be grouted within 16 feet of another open grout hole. Therefore, upon completion of the tertiary holes not all quaternary holes may be deepened simultaneously since quaternary spacing is approximately 8 feet. In the standard pattern, the maximum spacing from collar to collar shall be 4 feet.

The preceeding sequence does not apply to the waterproofing process (See Section I, Article IV, Item (C)).

(B) Consolidation Grouting - The split spacing and stage grouting techniques shall be employed. The determination of the order of hole is more difficult than for the curtain wall since the holes are located in a grid pattern with the primary holes spaced approximately 20 feet x 20 feet. The location of holes may be found on Drawing GAI-4, but the spacing may be altered to meet existing conditions.

At least the 4 primary holes defining the corners of an imaginary square configuration must be completed to the bottom of Zone I before the secondary hole (located in the geometric center of the imaginary square of which the 4 primary holes denote the corners) can be drilled.

Since the tertiary holes reduce the grid spacing to 10 feet x 10 feet and since they also must be located between completed holes, the tertiary holes cannot be drilled until this requirement is met. When only one square containing 4 primary holes and 1 secondary hole is drilled and grouted no tertiary may be drilled even though the primary hole on either side is completed. The criterion has not been met since one of the adjacent holes to the proposed tertiary hole is a completed secondary hole which does not have a completed counterpart on the opposite side. Therefore, the tertiary hole would not be surrounded by completed holes unless the adjoining square containing another secondary hole was completed.

When all holes from primary through tertiary have been completed to the bottom of Zone I, for a distance of at least 40 feet from any given primary, that primary may then be deepened in its discrete zone or stages.

When deepening beyond Zone I, only the primary holes located on a grid spacing of 40 feet x 40 feet shall be drilled and grouted. These primary holes shall be taken to completion by observing the zone depth restrictions before any other intermediate hole can be deepened.

The next step is to reduce the spacing to 20 feet x 20 feet by drilling and grouting the remaining primary holes to completion, observing the zone depth restrictions.

Upon completion all primary holes within 15 feet of any secondary, that secondary may then be deepened and grouted and all zone depth restrictions must be observed.

Upon completion all primary holes and all secondary holes within 10 feet of any given tertiary, that tertiary hole may then be drilled and grouted to completion by observing all zone depth restrictions.

(C) Waterproofing - Waterproofing shall be done on the curtain walls only. No waterproofing shall be done on the consolidation areas unless circumstances, as determined by the Engineer, warrant it.

On the curtain wall, all primary and secondary holes shall be drilled to depth in succession and grouted with a neat cement grout.

0120

Afterwards, all tertiary holes shall be drilled and grouted with a neat cement grout.

Finally, alternate quaternary holes, eg; quaternary holes located on approximately 16 foot centers, shall be drilled to depth and grouted with a neat cement grout. After the proper length of time has passed, (See Section I, Article IV, Item (D) Paragraph 2) the remaining quaternary holes shall be drilled to depth and grouted with a neat cement grout. If the tertiary holes are tight, the quaternary holes might not be drilled and grouted. If necessary, holes of higher order may be drilled and grouted.

(D) Universal Details - There are specific details that apply generally to all phases of drilling and grouting. These are:

(1) No hole shall be redrilled until at least 12 hours have elapsed since being grouted.

(2) No hole may be drilled within 16 feet of a freshly grouted hole until at least 12 hours have elapsed since the completion of grouting in that area.

(3) No hole shall be drilled between any other holes unless those holes have been drilled and grouted to the bottom of the applicable zone and allowed to set for at least 12 hours.

(4) If proper "closure" (insignificant grout take) has not occurred by the final order in the standard pattern, eg; tertiary or quaternary, higher order holes may be drilled and grouted as is necessary.

ARTICLE V - ZONE DEPTHS

TABLE I

CURTAIN WALL ZONE DEPTHS

Area	Max. collar to collar spacing	Hole Order	Interval Zone I	Zone 2	Zone 3	Zone 4
Turbine Room	4 feet	Primary	0-20	20-50	50-70	70-90
		Secondary	0-20	20-50	50-85	-
		Tertiary	0-20	20-50	50-80	-
		Quaternary	0-20	20-50	50-75	-
Reactor Building	4 feet	Primary	0-20	20-50	50-70	70-100
		Secondary	0-20	20-50	50-90	-
		Tertiary	0-20	20-50	50-80	-
		Quaternary	0-20	20-50	50-75	-
Auxiliary Building	4 feet	Primary	0-20	20-50	50-70	70-90
		Secondary	0-20	20-50	50-85	-
		Tertiary	0-20	20-50	50-80	-
		Quaternary	0-20	20-50	50-75	-

0121

TABLE II

CONSOLIDATION ZONE DEPTHS

Area	Max. collar to collar spacing	Hole Order	Interval Zone I	Zone 2	Zone 3	Zone 4
Turbine Room	10 feet	Primary	0-20	20-50	50-80	-
		Secondary	0-20	20-75	-	-
		Tertiary	0-20	20-70	-	-
Reactor Building	10 feet	Primary	0-20	20-50	50-90	-
		Secondary	0-20	20-50	50-80	-
		Tertiary	0-20	20-70	-	-
Auxiliary Building	10 feet	Primary	0-20	20-50	50-80	-
		Secondary	0-20	20-75	-	-
		Tertiary	0-20	20-70	-	-

ARTICLE VI - DRILLING HOLES

(A) General - All holes shall be drilled with rotary, non-percussive type drills. The bits used for drilling may be of the coring, plug, or tri-cone roller type. The minimum diameter of hole shall be 3-1/2 inches (core holes excepted).

Each hole shall be drilled with a bit followed by a guide barrel at least 10 feet long and having an outside diameter that is equal to but not more than 1/8 inch smaller than the diameter of the hole (core drilling excepted).

To meet schedule requirements (See Section II) the contractor will be required to maintain an average drilling rate of 1500 lineal feet/day of rock and grout. This rate must be sustained with the use of no more than 4 drilling rigs.

(B) Contractor's Responsibilities

(1) Each drilled hole shall be protected in some manner from becoming obstructed until it is grouted. Any hole that becomes obstructed before it is grouted shall be opened by the contractor to the satisfaction of the Engineer and no payment will be made for this "cleaning" operation.

(2) Any hole that is "lost", destroyed, or made unuseable through negligence, incompetence, defective or malfunctioning equipment, or any reason not considered an act of God shall be replaced in full by the contractor at no cost to the Company.

(3) After drilling, a hole shall be washed with water (air will not be allowed) until it is open and clean or until the Engineer is satisfied that the hole cannot be kept open.

0122

(4) The Contractor shall be responsible for setting the collar casing in a vertical orientation by using a level, bubble protractor, Brunton compass or some equally suitable means. Further, the contractor shall assemble his drill rig over the hole to be drilled in such a manner as to drill the hole vertically downward.

(C) Core Drilling - The Contractor shall perform such core drilling as may be directed to determine the condition of the rock, or the effectiveness of the grouting operations. All such core drilling shall be done during and/or after grouting operations have been completed in an area. It is not anticipated that any core hole will exceed 100 feet in depth nor should more than 1500 lineal feet of exploratory drilling be required. All core drilling shall be performed with "M" series or approved standard swivel type double tube core-drilling equipment, using 3-7/8 inch bits and capable of recovering 2-3/4 inch core samples.

The maximum core run shall be limited to 5 feet (conditions may require less than 5 feet at times).

All core drilling shall be performed in a workman like manner by competent and experienced workmen. Special care shall be exercised to obtain and maintain cores in as good condition as possible. The drill bit shall be pulled and the core removed as often as may be necessary to secure the maximum possible amount of core.

Wooden core boxes shall be furnished by the Contractor. The Contractor shall place the cores in the boxes in correct sequence and segregated accurately by labeled wooden blocks according to the measured distances in the holes. No box shall contain cores from more than one hole. Designating marks, hole numbers, and elevations shall be placed on the boxes and along the line of cores as established by the Engineer. The covers shall be fastened securely to the core boxes, and the boxes shall be delivered to the Engineer at the designated point of delivery at the Plant Site.

At least 100 feet of 4 inch flush joint casing in 5-foot and 10-foot lengths shall be immediately accessable at all times.

(D) Casing - The pipe used as grout nipples shall be 4 inch diameter black pipe cut into lengths long enough to penetrate competent rock about 2 feet. The approximate length per casing (curtain wall excepted) should be 10 feet. The Contractor shall be required to provide the casing, seat the casing in as nearly a vertical attitude as is possible, leave it seated for the duration of grouting in that area and finally retreive the casing from all areas except the curtain wall.

The casing shall be set in such a manner as to reduce leakage of grout from around the casing to an absolute minimum and to leave enough protrusion so that buildup of drill cuttings will not bury the casing. The casing (approximately 3.5 feet in length) in the curtain wall shall be placed in the concrete cutoff wall in the following manner.

A hole larger than the pipe to be seated shall be drilled into the concrete (method of drilling is Contractor's option) approximately 2 feet.

A length of pipe (long enough to give adequate protrusion) shall be placed in the hole and be grouted in with a rich neat cement grout. Dehydrating agents may be used if desired.

Pipe embedded in concrete shall be clean and free from grease or other materials that would reduce cohesion.

Extra holes of a higher order, placed in the curtain wall after operations have begun, shall be seated in the same manner as above.

Consolidation pipe shall be seated through the backfill and driven into the rock.

(E) Stage Grouting - If, while drilling a grout hole, the following should occur, drilling shall be stopped on that hole and a stage shall be declared:

(1) If the drill water circulation should be lost.

(2) If the walls of the hole persist in caving in.

(3) If other problems exist that are creating drilling difficulties.

ARTICLE VII - GROUTING

(A) Four basic grout mixes will be considered for Unit #3. They are:

(1) 1:1 (Cement: flyash by weight)

(2) 1:1:3 (Cement: flyash: sand by weight)

(3) Mixture of limerock flour, cement, and flyash in varying proportions.

(4) Neat cement grout with varying water cement ratios.

The Contractor who is awarded the contract for the grouting of Crystal River Unit #3, shall not be concerned with the mixing or procurement of any grout mixes. These mixes shall be provided by Florida Power Corporation.

The Contractor shall, however be responsible for the addition of water to all mixes as directed by the Engineer. The purpose for the additional water in the mixes is to regulate the viscosity of the mix in order to optimize its injection into the retention by the foundation rock system.

(B) Specific Requirements - The following are particular requirements for the grouting operations on Unit #3.

(1) The general rule for pressures used during grouting shall be 1 PSI per foot of depth up to a maximum pressure of 50 PSIG. Less pressure may be used as required and approved by the Engineer.

(2) The grouting of any hole shall not be considered complete until:

(a) 1:1 flyash mix - a grout take of less than 1 cubic foot in 20 minutes has been reached or grout has been held under pressure for a minimum of 10 minutes duration on any hole that refused to take grout from the very start.

(b) 1:1:3 flyash-sand mix - a take of 1 cubic foot per 10 minutes has been attained.

(c) Neat cement grout-absolute refusal with no take whatsoever for at least 15 minutes. The minimum time spent maintaining pressure on any hole shall be 15 minutes.

(3) The longest length of 1-1/2 inch or larger hose that will be allowed to be connected between the grout pump and the header for the purpose of grouting shall be 200 feet. Likewise, the return line from the header to the grout tub shall be limited to 200 feet.

(4) If, during the grouting of any hole, grout is found to flow from another grout hole or holes, the Contractor shall be prepared to make an immediate connection to these flowing holes for simultaneous injection up to a total of 3 holes. If additional holes continue to flow in sufficient quantity to interfere seriously with the grouting operation or to cause appreciable loss of grout, such connections may be capped temporarily. Before the grout has set, the grout pump shall be connected to these capped holes and grouted at the pressures required for grouting.

(5) In the event of surface leakage or foundation upheaval the grouting pressure shall be prescribed by the Engineer until the leakage or upheaval is halted or until it is obvious that cessation of grouting and continuation at a later time would be the better approach.

(6) The grouting of a hole shall be done as soon as the drilling of that hole as is practicable. Unless it is absolutely necessary, no hole shall be left open (ungrouted) for a period of more than 12 hours after drilling.

(7) In the event that any hole should cave in or is suspected of having caved in, that hole shall be circuit grouted.

Circuit grouting requires that grout pipe be inserted to the bottom of the caved hole, and grout pumped through the pipe and circulated to the collar of the hole. The pump speed shall be reduced to equalize the grout flowing from the hole with the natural rate of the hole.

Periodically, the pipe will be raised and grouting shall continue at that interval until once again the pipe shall be raised. This procedure shall continue until the pipe is raised clear of the caved area at which point the pipe shall be withdrawn completely and the header attached to the collar of the hole for appropriate grouting procedures.

While raising or removing the grout pipe, great speed must be realized so that the hole will not seal off before grouting is resumed with a header assembly.

The grout pipe shall be capable of delivering at least 20 CFM at the required pressure of slurry to the point of ejection.

(8) Injection limitations shall be imposed on holes that will not seal off. The following table shows the maximum amount of grout that may be injected at any one time.

TABLE III

GROUT INJECTION LIMITATIONS

HOLE ORDER	INTERVAL	LOCATION	POUNDS OF MIX ALLOWED PER INJECTION
Primary & Secondary	0-20	Curtain	23,500 lbs
	20-50	Curtain	41,500 lbs
	50-70	Curtain	34,000 lbs
	70-100	Curtain	45,000 lbs
Tertiary	0-20	Curtain	17,000 lbs
	20-50	Curtain	31,000 lbs
	50-80	Curtain	31,000 lbs
Quaternary	0-20	Curtain	10,000 lbs
	20-75	Curtain	Unlimited
Primary & Secondary	0-20	Consolidation	34,000 lbs
	20-50	Consolidation	690,000 lbs
	50-90	Consolidation	3,000 lbs/foot
Tertiary	0-20	Consolidation	23,500 lbs
	20-50	Consolidation	Unlimited
	50-70	Consolidation	3,000 lbs/foot

The major exception to the table above will be in the event that a hole is nearly sealed at the maximum injection point. In this case injection shall continue to completion. Other exceptions shall be noted as conditions warrant a change in the injection quantity.

0125

The maximum pumping rate that will be allowed during injection shall be 20 cubic feet of slurry per minute.

(9) After grouting, holes shall be washed to the depth required by the Engineer. A suitable apparatus shall be used that will allow the Contractor to wash to that depth specified by the Engineer.

Payment for redrill shall commence at the point to where the Engineer specified that the Contractor wash unless:

(a) The grout has subsided to a greater depth at which point payment shall commence.

(b) An act of God prevented the washing of the hole to the desired depth in which case payment shall commence from the deepest point attained during washing.

The Contractor shall be responsible for:

(a) The proper apparatus for washing the holes.

(b) The correct time to wash the holes. The time should include time for the initial set of the grout, but not the final set set so as to prevent the removal of grout by the washing process from the rock structure.

(c) The maintaining of an open hole in the event grout intrusion occurs from the grouting of an adjacent hole.

(10) The arrangement of the grouting equipment shall be such as to provide:

(a) Continuous circulation of grout throughout the system.

(b) Accurate control of the pressure at the point of injection by providing the necessary valves and pressure gauges in the system.

(c) Immediate injection of water into the system at the pump that can provide quick flushing of the system without removing the header from the hole, or without injecting water into the grout supply, either through the intake or return lines (see Figure 1 for recommended set-up)

(d) Immediate injection of water into the hole being grouted.

(e) Little or no surge in the grout lines as a result of the pumping. A surge of more than $\pm$ 5 PSI will not be allowed on the waterproofing operations.

(11) A valve shall be situated between the header and the grout hole so that the header may be removed without the loss of grout from the hole when a backpressure exists.

0127

(12) Grout that has reached the age of 3 hours from time of initial mixing shall be rejected.

ARTICLE VIII - EQUIPMENT AND MATERIALS

(A) General - Prior to shipment of grouting equipment to the site, the Contractor shall submit drawings and general descriptions of equipment he proposes to use for the approval of the Company. All equipment shall be of type and capacities approved by the Company and shall be maintained in first-class operating condition at all times.

(B) Drilling Equipment - Drilling equipment shall be of the type as to conform to the requirements specified in Section I Article VI, items (A) and (C) of these specifications.

(C) Grouting Equipment - The grout injection system shall be capable of filtering, storing, agitating, and pumping the grout to the satisfaction of the Engineer. Also:

(1) The grout injection system shall have a minimum capacity of 20 CFM of grout slurry injected at a pressure of no less than 30 PSIG.

(2) The grout storage tube shall be:

(a) Capable of containing at least 6 cu yds of grout slurry without spilling due to agitation.

(b) Built as to be accessable to the Engineer for the purpose of inspecting the grout and measuring the quantity of material therein.

(c) Capable of agitating the slurry in such a manner as to hold all particles in suspension.

(d) Built and situated in such a manner as to be able to accommodate the dumping of grout from a standard ready mix concrete delivery truck.

(e) Have a filter screen with at least 4 openings per square inch with a total surface area of not less than 6 square feet which shall filter all incoming grout being delivered as well as the grout being circulated from the tub to the header and back again to the tub. The foregoing description refers to the 1:1 flyash mix and the 1:1:3 flyash - sand mix. The neat cement grout shall be setup as for the other mixes except the filter shall be a 30 mesh screen.

(f) Constructed to have an intake sump which will allow all but 5 cu ft or less of the grout slurry to be pumped out.

(g) Level while grouting operations are taking place.

(3) The grout injection system shall conform to requirements as specified in Section I Article VII, item (B) paragraph (10) as related to the general layout and versatility of the equipment in operation.

(4) The header assembly shall have at least:

(a) one input from the pump.

(b) one return line to the grout tub filter screen.

(c) one facility for quickly connecting and disconnecting the header assembly to and from the grout hole.

(d) one accurate pressure gauge in good repair to show injection pressure.

(e) one gauge protecter, snubber, or diaphragm assembly.

(f) enough valves to accurately control injection pressures.

(5) Hole washing apparatus shall conform to the requirements as outlined in Section I Article VII, item (L), paragraph (9) of these specifications.

(6) A water supply system shall be established that shall:

(a) be free of deleterious material (organic material or suspended solids) when used to dilute grout mixes.

(b) be capable of adding water to the grout delivery truck.

(c) supply at least 15 CFM at times when all other activities on the same line involving the use of water are in operation.

The water for drilling and grouting may be pumped from the canals on the site or from wells that may be drilled by the Contractor. The wells must be deep enough (20'-30' below grade) as to provide clean water and located far enough from operations as not to be contaminated by run-off or grout intrusion.

(7) Pressure gauges and pressure gauge protection devices shall be available in a quantity great enough to completely outfit three headers per grouting operation plus enough extra to make all replacements necessary during the grouting operation if required. All gauges and protection devices shall be kept in first-class operating condition. Any device that appears to malfunction shall be rejected.

0129

(8) For the purposes of adding water to the grout mixes. a suitable water meter calibrated in 0.1 cubic feet increments shall be attached to the water line. The water meter shall be capable of maintaining the flow rate established for the water system (minimum of 15 CFM).

(D) Responsibilities of the Contractor - The Contractor has certain responsibilities which are basic to any job. The following is a partial list of some specific responsibilities.

(1) The Contractor shall be responsible for maintaining all equipment in first class operating condition. All necessary maintenance and repairs shall be made in such a manner as not to delay the progress of the job.

(2) Any defective equipment which could prove harmful, dangerous, or detrimental to workers, observers, other equipment, or the foundation in general shall be either repaired, replaced, or discarded immediately. Eg; bent rods, frayed cables and ropes, weak and leaking hoses, disengaged safety devices, etc.

(E) Materials - The following indicates material requirements.

(1) Pipe used for grout hole casings shall be standard weight (schedule 40), black, conforming to ASTM Designation A 120.

(2) Water for grouting must be clean and free from objectionable quantities of silt, organic matter, or other deleterious material.

(3) All grout shall be supplied by Florida Power Corporation.

ARTICLE IX - PRESSURE TESTING

(A) Testing Procedure - During the exploratory phase of the grouting program brief pressure tests shall be performed at discrete intervals within any given hole.

The testing shall be conducted by interupting the drilling at various depths and attaching a header to the hole and pumping water from the grout injection system under pressure into the hole and recording the water loss (CFM) in one minute intervals for approximately 5 minutes. This procedure completes the testing for that interval and drilling may be resumed to the next interval.

ARTICLE X - CLEANUP

(A) Specific Requirements - Upon completing all drilling and grouting in an area, all casings are to be removed (curtain wall excepted) and the holes backfilled with a thick sanded mix, until the settled grout is level with the surface. Further all scrap, trash, waste materials, and debris resulting from work under this Contract shall be removed from the site and disposed of in a manner approved by the Florida Power Corporation.

0130

All Contractor owned facilities, materials, and construction plant shall be removed from the site.

ARTICLE XI - RECORDS

(A) Responsibility - The Engineer will keep records of all grout hole, and exploratory hole drilling and of all grouting operations, rate of pumping, grouting pressures, changes in the grout mix, amounts of various materials and such data as may be necessary.

The Contractor shall furnish all necessary assistance and cooperation toward the development of these records.

ARTICLE XII - MEASUREMENT FOR PAYMENT

(A) Specific Items - The following indicates the bases for measurement for payment.

(1) The drilling of grout holes and exploratory holes will be measured for payment on the basis of linear feet of holes drilled in rock and concrete and redrilled in grout. Measurement for determining the depths will be made from the surface of the rock, concrete, or grout where drilling is actually commenced to the actual depth drilled, if approved, into rock,concrete, grout or any combination of these materials. The exception to this is the redrilled grout. The Contractor shall not be paid for redrilling grout when the original responsibility for the removal of the grout was his. (See Section I Article VII, item (B), paragraph (9)).

(2) Grout injection shall be measured for payment on the basis of the number of pounds of solids injected, exclusive of water and regardless of the proportions of the mix.

Any grout not injected into the ground using conventional means as specified in these specifications and in locations designated by the Engineer will not be paid for.

Any failure on the part of the Contractor or his equipment, which results in the wasting of any grout, will result in the Contractors reimbursement to the Company for the wasted grout.

(3) Pipe used for grout hole casing shall be measured for payment on the basis of linear feet of pipe seated in the foundation or concrete cutoff wall and used for drilling and grouting.

Pipe that has been reclaimed at the conclusion of drilling and grouting operations shall not be paid for except for the cost involved with seating and removing them.

0131

(4) Measurement for payment of connections to grout holes will be made only if those connections to grout holes are directed by the Engineer. Measurement for payment shall be made once each time a new stage is drilled. Connections made for the purpose of washing or pressure testing will not be measured for payment as a connection.

(5) Measurement for payment of circuit grouting operations shall be made on a time basis. Measurement for payment shall commence from the time that all apparatus has been assembled at the hole to be circuit grouted and the operation of inserting the pipe has started. Cessation of measurement for payment shall occur when the last pipe has been removed from the hole to make way for the affixing of a header to the hole.

(6) Measurement for payment of pressure testing shall be made on a time basis. Measurement for payment shall begin from the time that the apparatus has been assembled next to the hole to be tested and the procedure has begun to attach the header to the hole. Cessation of measurement for payment shall occur at the completion of the actual water test.

ARTICLE XIII - PAYMENT

The contract unit prices shall be paid for the following items of work completed and measured as specified in these specifications.

(A) Drilling and redrilling of all grout holes.

(B) Drilling of all exploratory holes.

(C) Injecting of grout solids.

(D) Furnishing, installing, and removing pipe for grouting.

(E) Making connections to grout holes.

(F) Circuit grouting grout holes.

(G) Pressure testing exploratory holes.

(H) No additional allowance will be made above the contract price for interrupting the drilling of a hole:

(1) To permit stage grouting.

(2) To permit washing or cleaning out holes before further drilling or grouting.

0132

(I) No additional allowance will be made above the contract prices for any moving of equipment that may be necessary due to the requirements for grouting operation.

(J) An increase or decrease in the amount of drilling or grouting of any description, as provided in the INSTRUCTIONS TO BIDDERS, Paragraph 16, will not be a cause for changes in Contract unit prices, notwithstanding the provisions of Paragraph 19 in the INSTRUCTIONS TO BIDDERS.

SECTION II

ARTICLE I - QUANTITY ESTIMATES

The following figures are estimated average quantities that may be increased or decreased as conditions require.

Feet of limerock to be drilled	141,000 linear feet
Feet of redrilled grout	76,000 linear feet
Number of Curtain holes	630 holes
Number of Consolidation holes	1,258 holes
Number of pounds of grout solids	49,000,000 lbs
Number of casings to be seated	1,900 casings
Number of casings to be reclaimable	1,258 casings
Number of feet of casing to be seated	16,000 linear feet
Number of feet of casing required to perform job	13,000 linear feet
Number of feet of casing not reclaimable	2,600 linear feet
Number of grout hole connections	7,000 connections
Number of circuit grouting efforts	1,490 efforts
Feet of 3-7/8" x 2-3/4" exploratory drilling	1,500 linear feet
Number of short pressure tests	150 tests
Number of workdays estimated for completions	185 work days

ARTICLE II - UNIT PRICES

For drilling and redrilling grout holes --$_____	per linear foot
For injecting grout solids --$_____	per pound
For grout pipe installed --$_____	per linear foot
For grout hole connections --$_____	per connection
For circuit grouting grout holes --$_____	per hour
For drilling exploratory holes (3-7/8" x 2-3/4") --$_____	per linear foot
For pressure testing exploratory holes --$_____	per hour
Lump Sum price for mobilization and demobilization --$_____	Lump Sum

Total Extended Price --$_____

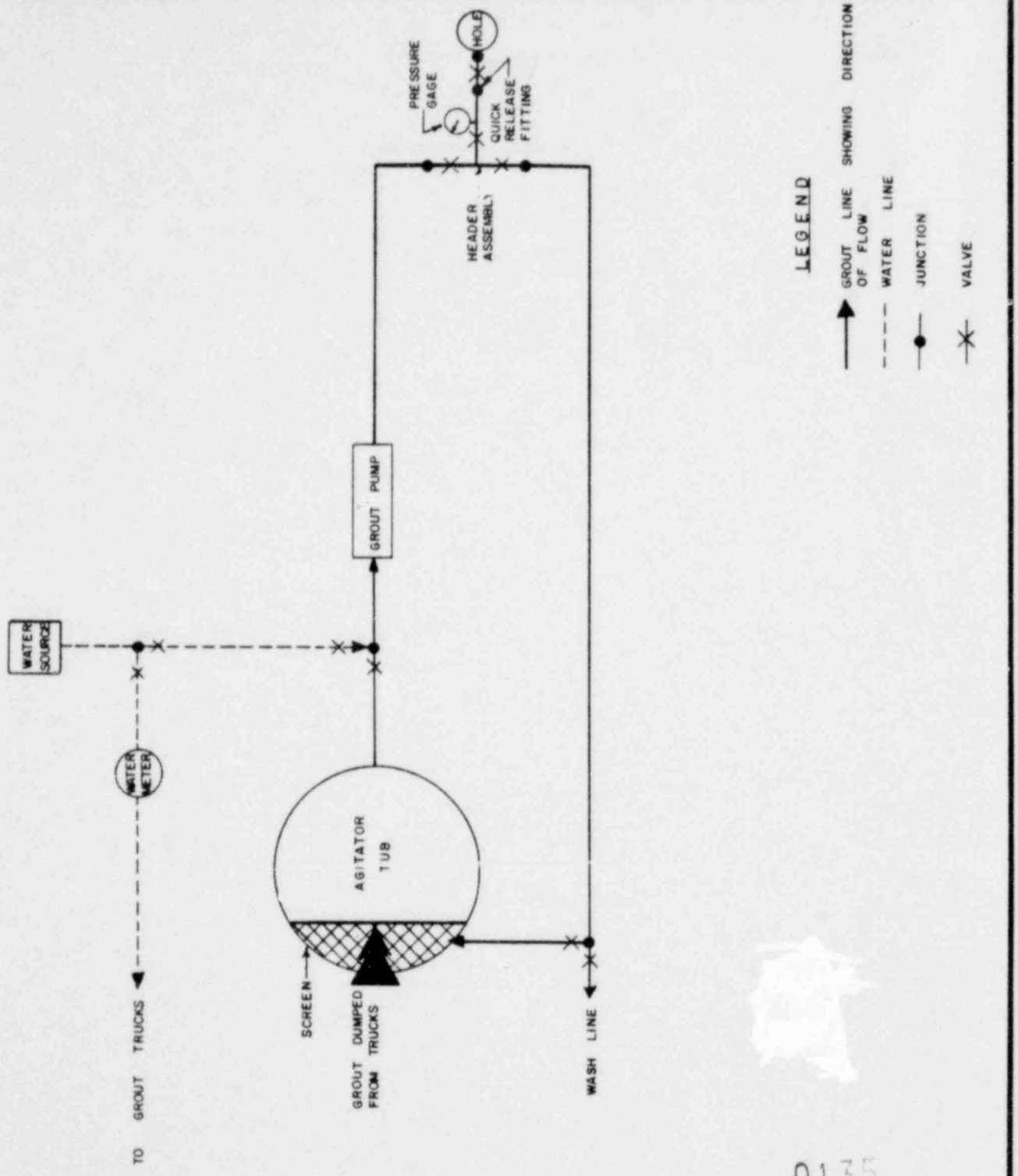
0133

ATTACHMENT

An acceptable closing unit take of grout for curtain holes shall be 1 cu ft/lin ft or less in the Quaternary order injection hole and, for consolidation grouting, shall be 1 cu ft/lin ft or less in the Tertiary order injection hole. This figure is substantiated by both the Unit 2 grouting program and by the Unit 3 and 4 Test Program as being adequate to attain a waterproof curtain wall and to densify loose materials which may occur in solution channels.

The above figure also includes the volume of grout required to merely fill the injection hole as well as the 0.9 bulking factor so that in reality the actual quantity of grout injected into the rock system is significantly less than the permitted 1 cu ft/lin ft.

0134



0135

NO.	DATE	REVISION	BY	CK.	APP.

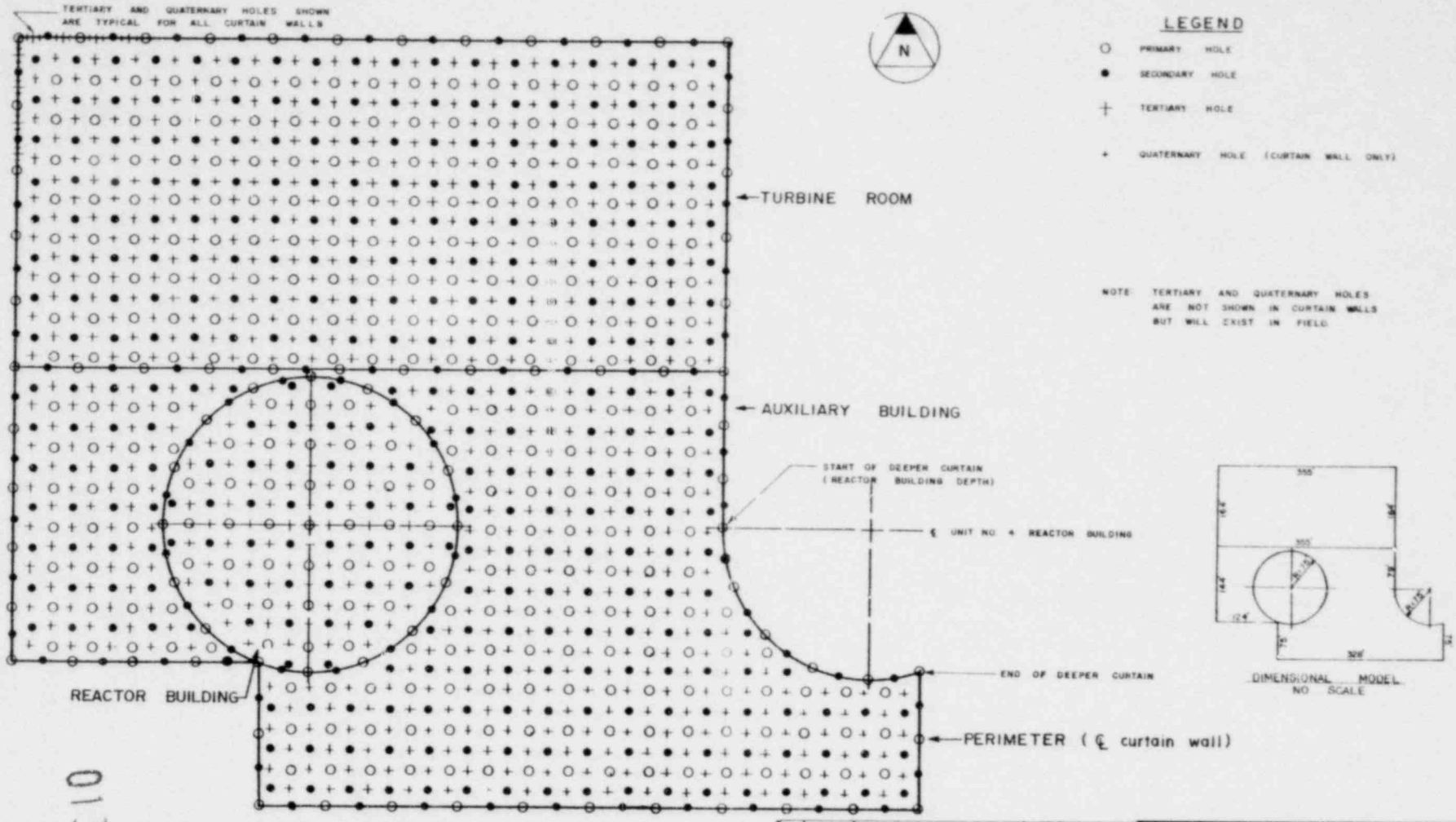
DATE_____ SCALE_____ BY____ CK___ APP___

SUGGESTED GROUT PLANT LINE LAYOUT

PROJECT CRYSTAL RIVER UNIT NO. 3

FLORIDA POWER CORPORATION
ST. PETERSBURG, FLORIDA

DRAWING NO. GAI-5 FIGURE 1



0135

PLAN
SCALE: 1" = 50'

NO	DATE	REVISION	BY	CK.	APP.

DATE 12/29/87 SCALE 1" = 50' BY [illegible]

GENERAL GROUTING PLAN

PROJECT CRYSTAL RIVER UNIT NO. 3

FPC FLORIDA POWER CORPORATION
ST. PETERSBURG, FLORIDA

DRAWING NO. GAI-4

SPECIFICATION FOR EXCAVATION AND CONSTRUCTION OF STRUCTURAL FILL

Pages - 1 - through - 12 -

Revised Amendment No. 7
7-15-69

"SPECIFICATION FOR EXCAVATION AND CONSTRUCTION OF STRUCTURAL FILL"

1:01 Scope of Work

1:01.1 The intent of these Specifications is to outline the overall procedure for excavation and structural fill placement, present the various fill types, delineate acceptable standards for materials and placement, and present testing techniques necessary to ensure that minimum standards exist.

1:01.2 Documents relating to the Scope of Work but not limited to are:

1. Drawings:

   a. GAI E-744-002. Plant Site Excavation - Second Stage.

   b. Other related Drawings as developed.

2. CONTRACTOR'S WORK Procedure and Plan (Including Quality Control Procedure).

3. Specifications for Related Work:

   a. SP-5569, Furnishing and Delivery of Structural Concrete.

   b. SP-5618, Placement of Structural Concrete.

   c. SP-5500, Subsurface Grouting.

   d. SP-5635, Ready-Mixed Grout.

   e. Other related Specifications as may be developed.

1:02 Definitions

It shall be understood that the following terms as used in these Specifications shall have the meaning herein given:

1. "OWNER" shall mean Florida Power Corporation.

2. "ENGINEER" shall mean Gilbert Associates, Inc., Consulting Engineers to Florida Power Corporation.

0139

3. "AUTHORIZED SITE REPRESENTATIVE(S)" shall mean the authorized site engineering representative(s) of Gilbert Associates, Inc. He (they) shall have authority to:

   a. Establish that the anticipated competent bearing material is not damaged or removed during excavation.

   b. Determine competent bearing material.

   c. Accept and/or approve WORK items specifically designated in ENGINEER'S Specifications.

4. "CONTRACTOR" shall mean the party performing the WORK outlined in these Specifications.

5. "WORK" shall mean the labor, services, materials, and equipment necessary to carry out the Scope of Work and intent of these Specifications and various Drawings as developed by Gilbert Associates, Inc.

6. "TESTING LABORATORY" shall mean an independent testing laboratory selected and paid for by Florida Power Corporation except as otherwise noted in these Specifications.

7. "COMPETENT BEARING MATERIAL" shall mean that material which presents a suitable bearing surface upon which the structural building foundation may rest or upon which structural fill concrete or other structural fills as called for in these Specifications may be placed. The AUTHORIZED SITE REPRESENTATIVE(S) shall establish when competent bearing material is reached or established and shall authorize further WORK to continue on top of this competent bearing material.

8. "QUALITY ASSURANCE REPRESENTATIVE(S)" shall mean the authorized site quality assurance representative(s) of Gilbert Associates, Inc. Quality Assurance Department. He (they) shall carry out the quality assurance program over all "WORK" covered in these Specifications.

9. "BLOCKOUT FILL" shall mean that fill which is impervious to the flow of grout and shall be any material meeting this criterion as selected by the OWNER. (Example: Sand or fine graded native limerock.)

0137

10. "STRUCTURAL FILL CONCRETE" shall mean that concrete having a minimum ultimate compressive strength design of 1500 psi in 28 days as specified in Specification SP-5569 "Specifications for Furnishing and Delivering of Structural Concrete" except as amended.

11. "ZONE I FILL" shall mean a groutable crushed Brooksville Limerock (or other as approved by the AUTHORIZED SITE REPRESENTATIVE) as specified herein.

12. "ZONE II FILL" shall mean a compacted crushed Brooksville Limerock (or other as approved by the AUTHORIZED SITE REPRESENTATIVE) as specified herein.

1:03 Excavation and Placement Procedures

1:03.1 The CONTRACTOR shall prepare a detailed WORK procedure which shall establish the plan to be followed to accomplish the WORK covered by these Specifications. This Contractor's Work Procedure and Plan shall be acceptable to the ENGINEER, and the OWNER prior to the start of WORK. It is recognized that unforeseen circumstances may develop in excavation or foundation WORK which may dictate changes in procedures or plans in order for sound engineering and/or construction concepts to be accomplished and for the intent of these Specifications to be fulfilled. At the OWNER'S or CONTRACTOR'S request, the Contractor's Work Procedures and Plan may be revised to meet field conditions and shall be acceptable to the ENGINEER or AUTHORIZED SITE REPRESENTATIVE, and the OWNER prior to the start of WORK involving the revision.

1:03.2 The Contractor's Work Procedure and Plan shall govern and, in general, shall include the following:

At the conclusion of curtain grouting around each discrete area comprising the total plant, the following steps shall be followed:

1. Overburden removed to competent bearing material.

2. Excavation to grade of all building foundations that fall below the elevation of the top of the competent bearing material.

3. Placement of BLOCKOUT FILL material into the excavated areas as specified under subitem 2, above. The BLOCKOUT FILL material shall be impervious to the flow of grout.

4. Placement of STRUCTURAL FILL CONCRETE (or alternate methods per item 1:05.4) to building foundation grades at or lower than elevation 20'-0".

0140

5. Placement of an access fill, up to elevation 92'-0", over the STRUCTURAL FILL CONCRETE (or alternate methods per item 1:05.3).

6. Consolidation grouting of foundation rock.

7. Removal of access fill and BLOCKOUT FILL material.

8. Placement of Zone II material above elevation 90'-0".

9. Placement of Zone III material.

1:04 Excavation

1:04.1 The overburden and all deleterious (non-structural) material shall be removed by suitable means to COMPETENT BEARING MATERIAL. The AUTHORIZED SITE REPRESENTATIVE shall determine when COMPETENT BEARING MATERIAL is reached.

1:04.2 After the excavation has reached the elevation of COMPETENT BEARING MATERIAL, the area shall be proof-rolled with suitable equipment if directed by the AUTHORIZED SITE REPRESENTATIVE. Suspect areas caused by the proof-rolling shall be investigated sufficiently under the direction of the AUTHORIZED SITE REPRESENTATIVE to determine that the suspect area does not exceed 10 feet on its least horizontal dimension. If the suspect area exceeds the 10 feet least dimension criteria, the excavation (cleaning out) of the suspect area shall continue as directed by the AUTHORIZED SITE REPRESENTATIVE until COMPETENT BEARING MATERIAL is reached or a state of excavation is reached so as to produce conditions which are compatible with and will fulfill the requirements of the foundation design.

1:04.3 All parts of the building foundations which penetrate into COMPETENT BEARING MATERIAL shall be excavated to grade prior to consolidation grouting and filled with BLOCKOUT FILL.

1:04.4 In areas where a building foundation penetrates into COMPETENT BEARING MATERIAL, the foundation shall rest immediately upon this material without the need of the grouted Zone I material or structural concrete backfill except for over-excavated areas which will be filled with STRUCTURAL FILL CONCRETE or Zone I material.

1:05 Structural Fill Concrete

1:05.1 The STRUCTURAL FILL CONCRETE shall have a minimum ultimate compressive strength of 1500 psi at 28 days. The concrete shall be furnished and delivered as per Specification SP-5569 "Specification for Furnishing

and Delivering of Structural Concrete" except as modified in this Item below, and shall be placed according to Specification SP-5618, Specification for Placement of Structural Concrete":

Modifications to Structural Fill Concrete

1. Minimum Slump - As determined by the TESTING LABORATORY to be within the limits of a workable mix.

2. Maximum Slump - 5 Inches.

3. Minimum Air Content - No minimum is required except that required for a workable mix and that contained in the natural aggregates and cement.

4. Maximum Air Content - 6%.

5. Cement - Mix designs using Type II Cement, for moderate hydration shall be used when available. Type II Cement (Commercial) may be used at the option of the OWNER until the designs incorporating Type II Cement for moderate hydration are approved.

1:05.2 The ENGINEER shall evaluate the in place STRUCTURAL FILL CONCRETE.

1:05.3 The STRUCTURAL FILL CONCRETE shall be used after excavation in order to backfill the space between the top of COMPETENT BEARING MATERIAL and the bottom of the various building foundations.

1:05.4 In areas where surface sump dewatering is unable to render a dry condition, as directed by the AUTHORIZED SITE REPRESENTATIVE a concrete mix of a higher design strength than 1500 psi may be tremied into the offending area. Choice of mix design shall be made by ENGINEER or by the AUTHORIZED SITE REPRESENTATIVE. Where the use of tremied concrete is not practical, an alternative method shall be to use Zone I fill in a great enough quantity to reach an elevation to allow convenient use of STRUCTURAL FILL CONCRETE.

1:05.5 In areas where the building foundation can rest upon COMPETENT BEARING MATERIAL, no backfill shall be used.

1:05.6 Placement of structural concrete backfill shall be made on "clean" (see item 1:04.1) COMPETENT BEARING MATERIAL.

1:05.7 The ACCESS FILL shall be placed on top of the STRUCTURAL FILL CONCRETE. It need not be of structural quality but should be able to withstand the loads of moving equipment without bogging or liquifying and should contain sufficient fines to prevent the intrusion of grout into the

0142

access fill. The access fill shall be placed to an elevation of 92'-0" until consolidated grouting has been completed at which time it shall be removed down to the structural concrete backfill and/or COMPETENT BEARING MATERIAL.

1:05.8 The BLOCKOUT FILL shall also be removed from the building foundation excavation.

1:05.9 On the periphery of the buildings where the foundations are supported on the structural concrete backfill, the structural concrete backfill shall extend a minimum of ten (10) feet beyond the building line or the thickness of the structural concrete backfill, whichever is greater. However, in areas where the structural concrete backfill threatens to break the grouted curtain wall, this requirement may be relaxed with approval by ENGINEER or the AUTHORIZED SITE REPRESENTATIVE.

1:05.10 In areas where defined on the Drawings and/or in the Contractor's Work Procedures and Plans, special provisions for a filter blanket for the passage and collection of ground water if required shall be made. The filter blanket shall be designed by the ENGINEER and shall be compatible with the design requirements for the foundation WORK.

1:06 Zone I Fill

1:06.1 The Zone I material, to be placed subaqueously under conditions where dewatering is not easily possible, shall consist of a sound durable crushed limestone conforming to ASTM Specification C 33-67 and shall be graded in accordance with sieve size 357 for Coarse Aggregate, except that the Zone I material need not meet the soundness and durability criteria of ASTM C 33-67 Paragraph 6.1.

1:06.2 In the event the excavation extends below groundwater level, special excavation and backfill techniques will be required. A construction procedure shall be adopted which will permit control of groundwater by pumping from surface sumps. This shall enable the greatest portion of the fill to be placed in an essentially dry condition. Complete dewatering may not be readily obtained and provisions shall be made for the construction of limited subaqueous fills by the CONTRACTOR and shall be acceptable to the ENGINEER or AUTHORIZED SITE REPRESENTATIVE prior to commencement of WORK.

1:06.3 Placement of Zone I shall be made on "clean" (see item 1:04.1) COMPETENT BEARING MATERIAL and shall be as uniform as possible to ensure even bottom distribution.

1:06.4 Zone I shall be covered by STRUCTURAL FILL CONCRETE when a problem area requiring the use of Zone I has been contained.

0145

1:06.5 Any placement of Zone I shall be grouted in such a manner as to ensure complete grout intrusion into all of Zone I so as to create a positive water cut-off.

1:06.6 Upon completion of laboratory testing, additional information shall be provided for grouted Zone I material if required by the ENGINEER.

1:07 Zone II Fill

1:07.1 Materials to be placed in Zone II as a controlled compacted fill shall consist of a sound, durable, crushed limestone graded between the following limits and shall have a uniformity Coefficient *(C_u) greater than 4:

TABLE I - ZONE II FILL

U. S. Standard Sieve Size	Per Cent by Weight Passing
2 inches	100
No. 4	25 to 70
No. 40	10 to 30
No. 200	0 to 5**

1:07.2 Zone II shall be placed above elevation 90'-0". In areas where the structural concrete backfill extends at least ten (10) feet outside of the building line and support of a structure is required above elevation 90'-0", Zone II shall be placed on the structural concrete backfill. In areas where support of a structure is required above elevation 90'-0", and the structure protrudes beyond the limits of the structural concrete backfill, Zone II shall be placed in the dry from COMPETENT BEARING MATERIAL.

1:07.3 Zone II shall also be used to backfill excavations for pipe lines when the backfill is to be placed below elevation 92'-0".

*(C_u) = $\frac{D_{10}}{D_{60}}$, where D = the grain size corresponding to the 10 percent and 60 percent distribution frequency.

**May be increased to 5 to 15 percent by weight where placed two feet or more above water level.

0144

1:08 Zone III Fill

1:08.1 Materials to be placed in Zone III as a controlled, compacted fill shall consist of a crushed, friable, limerock, processed so as to limit the maximum particle size before compaction to that passing a four (4) inch U.S. Standard Sieve. The plasticity index and liquid limit of the portion of the fill passing the No. 40 sieve shall be less than six (6) percent and less than twenty-five (25) percent, respectively.

1:08.2 Zone III shall be used as dike material above elevation 92'-0" but shall not be placed beneath any building.

1:09 Placement and Compaction of Zone II and Zone III Fill

1:09.1 The lateral limits of the load bearing fill and the underlying consolidation foundation grouting shall extend beyond the foundation periphery of all plant units to include an exterior peripheral strip, the horizontal dimension at least equal to the thickness of load bearing fill or to ten (10) feet, whichever criteria gives the greatest dimension.

1:09.2 Controlled, compacted load bearing fills shall be placed in approximately horizontal layers. The initial lift thickness shall be determined by the ENGINEER commensurate with groundwater conditions but shall not be more than three (3) feet in loose thickness. Subsequent fill lifts shall not exceed a loose thickness of twelve (12) inches. The fill shall be spread and graded so as to prevent excessive particle segregation.

1:09.3 The water content of the fill during compaction shall be controlled by aerating or moistening as necessary to facilitate compaction. The water content of Zone III fill shall not be greater than two (2) percentage points above or three (3) percentage points below the Optimum Water Content as determined by ASTM D 1557-66 T, Method C, or by prototype field compaction tests.

1:09.4 Unless specifically accepted by the ENGINEER, groundwater infiltration into excavations shall be controlled by sump pumping so as to permit the placement and compaction of load bearing fill in a dry condition. However, under no circumstances shall Zone III fill be placed in water or where the groundwater level is within two (2) feet of the fill or within two (2) feet of the maximum anticipated stable groundwater level. Zone II fill will not be permitted to be placed in more than three (3) feet of water.

0142

1:09.5 Each lift of load bearing fill placed in a controlled, thin-lift construction shall be compacted in accordance with the following criteria:

> Zone II and Zone III fills shall be compacted to an average dry density equivalent to 98 percent of maximum Modified Dry Density with an allowable Relative Compaction variance of two percent. Maximum density shall be determined in accordance with ASTM Test Designation D 1557-66 T, Method C. Alternatively, maximum density shall be determined by prototype field tests as directed by the ENGINEER.

1:09.6 All load bearing fill shall be compacted with an approved, variable frequency, smooth drum, vibratory compactor. The vibratory compactor shall have a minimum weight of 130 pounds per inch of roll and shall impose a total static weight of not less than 9,000 pounds. The frequency of the vibrator shall be adjusted to operate as close to resonance as possible. The speed of compactor travel shall not be greater than 1-1/2 mph. The compactive effort shall include not less than four complete roller coverages per lift.

1:09.7 Equipment shall be mobilized and maintained to facilitate hauling, spreading, grading, disking, watering or any other operation incidental to fill placement and compaction.

1:10 Material and Compaction Control

1:10.1 The following criteria for test documentation of materials and relative compaction are intended to outline minimum standards for quality control. The testing frequency and methods shall be determined by the ENGINEER commensurate with on-site conditions.

1:10.2 Suitable testing facilities subject to the approval of the ENGINEER shall be maintained on-site. Such facilities shall provide a capability for the performance of tests as outlined herein and shall be staffed by qualified testing personnel.

1:10.3 The grain size distribution of samples representative of each 200 cubic yards of Zone I and Zone II Fills shall be determined in accordance with ASTM Test Designation D 422-63. The percent of material by dry weight passing the 3/4 inch and No. 200 sieves shall also be determined for each in-place density sample obtained. Determination of the water content shall be in accordance with ASTM Test Designation D 2216-66. The moisture testing frequency shall be sufficient to enable continuous moisture control during fill construction.

0146

1:10.4 Prior to fill construction, the compaction standard for Zone III Fill shall be determined in accordance with ASTM Test Designation D 1557-66 T, Method C, in sufficient quantity to develop a family of moisture vs. density curves. During construction, single point compaction tests shall be performed to identify the compaction standard applicable to individual in-place density test samples.

1:10.5 Prior to fill construction, the compaction standard of Zone II Fill shall be determined in accordance with ASTM Test Designation D1557-66T, Method C. The test shall be performed with various amounts of +3/4 inch material to determine the relationship between the maximum density and the amount of aggregate retained on the 3/4 inch sieve.

1:10.6 The in-place density tests shall be performed by weight/volume sample measurement or by nuclear density and moisture gauge techniques. The frequency of in-place density testing for Class 1 Structures shall be not less than one test per each 185 cubic yards of fill compacted in-place. The test locations shall be equally dispersed between successive lifts throughout the foundation area. For the remainder of the plant foundation area, the testing frequency should not be less than one test for each 400 cubic yards of fill compacted in-place.

1:10.7 In-place density testing by the weight/volume sample measurement technique shall be performed in accordance with ASTM Test Designation D 1556-64 or by an alternative procedure approved by the ENGINEER. Test hold volume shall not be less than 0.1 cubic feet and the weight of moisture content samples shall not be less than 1,000 grams. At least one-half of the number of tests specified by the minimum testing frequency standard shall be performed by the weight/volume sample measurement technique.

1:10.8 As a rapid density testing technique, the nuclear moisture/density gauge method, employing either direct transmission or backscatter gauge types, may be used as a supplement to the weight/volume measurement method. Prior to fill construction, a laboratory calibration curve shall be developed for the Zone II and Zone III Fills. During the initial fill construction, an additional field calibration curve shall be developed for each material type using the weight/volume measurement in conjunction with the nuclear gauge. Additional calibration curves shall be developed during construction consistent with a change of material type as directed by the ENGINEER.

1:11 Quality Control

1:11.1 The OWNER shall be responsible for the preparation of written procedure(s) to set forth how the WORK to be performed under these Specifications will be carried out. The party performing the WORK shall

0147

also prepare a written Quality Control procedure setting forth what tests will be executed to substantiate compliance with these Specifications. Such written procedures shall be submitted to the ENGINEER for review and comment. All procedures shall be written and approved prior to the start of any WORK. The OWNER shall obtain the services of a TESTING LABORATORY which will perform the testing and inspection of the excavation, structural fill, grouted fill, and the structural concrete backfill.

1:11.2 The excavation shall be performed by methods and equipment that will produce quality WORK. Excavation shall be to the lines, grades, and limits indicated on the Drawings. The excavated area shall be inspected to ensure that all mud, sludge, sediment, or deleterious material has been removed and that a state of general cleanliness exists.

1:11.3 The CONTRACTOR, prior to placing structural fill, shall obtain and submit to the TESTING LABORATORY samples of proposed material to be used as structural fill. The material shall be tested for compliance of these Specifications.

1:11.4 The following ASTM Standards and Specifications herein shall govern the initial material testing and tests required during fill operations:

1. C 33-67 "Concrete Aggregates" (Zones I and II)
2. C 33-67 Table II (357) and item 1:03.8 of these Specifications (Zone I)
3. Table I, page three of these Specifications (Zone II)
4. Page four, item 1:05.1 of these Specifications (Zone III)
5. D 422-63, "Grain-Size Analysis of Soils"
6. D 1556-64, "Density of Soil in Place by the Sand-Cone Method, Test for"
7. D 1557-66 T, Method C, "Moisture-Density Relations of Soils using 10-lb Rammer and 18-in. Drop Tests"
8. D 2216-66, "Laboratory Determination of Moisture Content of Soil"
9. Specification SP-5569, "Specification for Furnishing and Delivering of Structural Concrete" and all references therein.

0148

10. Specification SP-5618, "Specification for Placement of Structural Concrete" and all references therein.

1:11.5 The fill material shall be placed and compacted by means of outlines in these Specifications. Close inspection and periodic testing will be required to assure adequate quality control.

1:11.6 The lift thickness shall be controlled so that the loose thickness will not exceed 12 inches. The initial lift thickness shall be determined by the ENGINEER.

1:11.7 The water content of the fill during compaction shall be controlled by aerating or moistening as necessary to facilitate compaction.

1:11.8 Groundwater shall be controlled so as to permit the placement and compaction of structural fill in a dry condition. However, under no circumstances shall Zone III Fill be placed in water or where the groundwater level is within two (2) feet of the fill or within two (2) feet of the maximum anticipated stable groundwater level. Zone II Fill will not be permitted to be placed in more than three (3) feet of water.

0149

PROPOSED GENERAL PROCEDURE FOR EXCAVATION, GROUTING, AND PLACEMENT OF STRUCTURAL FILL

Revised Amendment No. 7
7-15-69

PROPOSED GENERAL PROCEDURE FOR EXCAVATION, GROUTING, AND PLACEMENT OF STRUCTURAL FILL

7

The concept for excavation, backfill, grouting, and construction of the foundations for Class 1 structures will be:

1. Place peripheral grout curtain.

2. Excavate to competent bearing material. In some localized areas a limited amount of subaqueous excavation will be required.

3. Backfill to underside of foundation with structural fill concrete. In localized areas where complete dewatering is not practical, tremie concrete of a higher strength will be required. Alternatively, blankets of groutable aggregate may be placed subaqueously on top of the competent bearing material and then structural fill concrete can be placed on the groutable aggregate to the underside of foundations.

4. Place access fill on top of concrete fill to give general site access for grouting contractor.

5. Consolidation grout foundation.

6. Remove access fill.

7. Construct foundation.

DELETED AMENDMENT NO. 7

7-15-69

EXHIBIT 1

PROPOSED PROCEDURE OF SITE PREPARATION AND CONSTRUCTION OF LOAD BEARING FILL | 4

Proposed Procedure of Site Preparation and Construction of Load Bearing Fill |4

The following outlines the procedure and sequence of site preparation, foundation grouting, and placement of load bearing fill. All work shall be under the close scrutiny of the ENGINEER and shall meet with the ENGINEER'S approval.

Reference to the attached Exhibit 1 enables one to obtain an understanding of the spatial relationships of the various construction steps.

Step 1. Excavate to sound rock and place the peripheral concrete cutoff trench, through which the grout curtain shall be injected. The top of the cutoff shall be at elevation 91 and the base shall be placed upon sound, unweathered caprock.

Step 2. Inject grout curtain as set forth in Specifications for curtain grouting.

Step 3. Excavate to sound, unweathered caprock within the confines of the cutoff trench and grout curtain. |4

Step 4. Place a minimum of 3 feet of Zone 1 material, or to elevation 84 (whichever is greater), as directed by Specifications for Load Bearing Fill. A well graded filler shall be added to Zone 1 material in areas which are later to be excavated. The purpose of the filler is to prevent intrusion of consolidation grout injections.

Step 5. Place uncontrolled access fill to elevation 91.

Step 6. Set nipples for consolidation grouting and grout from top of Zone 1 material to the depth specified and according to the specifications for foundation grouting.

Step 7. Strip access fill from the top of Zone 1 material.

Step 8. Place Zone 2 and Zone 3 material as directed by Specifications for Construction of Load Bearing fill.

0154