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WASHINGTON NUCLEAR PROJECT NO. 3 (WNP-3)

READINESS REVIEW PROGRAM

MODULE NO. C3-01 EARTHWORK

CONTENTS

Topic	Page
Summary and Statement of Module Acceptability (Conclusions)....	i
Purpose and Scope of Review.....	1
NRC Methodology.....	3
NRC Staff Evaluation/Findings.....	4
References.....	22
Tables.....	23
List of Persons Contacted.....	25
Acronyms.....	26

WASHINGTON NUCLEAR PROJECT NO. 3 (WNP-3)

READINESS REVIEW PROGRAM

MODULE NO. C3-01 EARTHWORK

SUMMARY

The Readiness Review Program is being conducted at the initiative of Washington Public Power Supply System (WPPSS) management to assure that design, construction, and operational commitments have been properly identified and implemented at the Washington Nuclear Project No. 3 (WNP-3). Earthwork Module C3-01, which was submitted by Washington Public Power Supply System on September 10, 1986, presents an assessment of the compliance of the Earthwork program with Final Safety Analysis Report (FSAR) commitments and regulatory requirements for the construction phase. This evaluation by the NRC was conducted to determine if the results of the program review of Earthwork represent an effective and accurate assessment of the requirements, and that these requirements have been properly implemented.

This evaluation was performed by NRC reviewers from the Office of Inspection and Enforcement (IE), Office of Nuclear Reactor Regulation (NRR) and from Region V. Also, appropriate reviews were performed by the Office of the General Council (OGC). The evaluation consisted of a detailed examination of each section of the Earthwork Module. Specific NRC staff evaluation of each section of the Earthwork Module C3-01 is provided in this report.

In general, with the exception of the open items (OI) listed below, the NRC evaluation indicates that the licensee's program review was comprehensive and provides adequate assurance that the safety-related soil cement and the safety-related Class A-1 backfill were placed in accordance with the FSAR commitments and regulatory requirements and will adequately perform their intended functions. The NRC review also indicates that the licensee has taken appropriate actions with regard to licensee identified deficiencies and that the Earthwork program effectiveness has been enhanced by active management participation.

STATEMENT OF MODULE ACCEPTABILITY (CONCLUSIONS)

The Construction Assurance Program (CAP) Module C3-01 Earthwork was found to be acceptable for work already completed, except for the following open items (OI):

1. Since EAP Module E3-02 Civil/Structural, which includes engineering/design aspects of Earthwork, has not yet been completed or submitted to the NRC, follow-up is required to determine the impact on construction Module C3-01 Earthwork by the results of the NRC review of EAP Module E3-02. Final acceptance of Module C3-01 is contingent upon acceptance of Module E3-02. This follow-up item is identified as Open Item (OI) 50-508/86-12-01 Interface With Module E3-02.

During discussions with the licensee, it was understood that NRC review of Module C3-01 would be primarily of construction aspects, but that any questions raised during limited review of excerpt material from Module E3-02 included in Module C3-01 would be noted for follow-up. The following items requiring follow-up, when Module E3-02 is submitted, were identified:

- FSAR changes were mentioned in the report but have not been processed through the review and approval cycles. Final review and acceptance of Module C3-01 will be made by the NRC after the FSAR changes are submitted and approved. This follow-up item is identified as OI 50-508/86-12-02 FSAR Changes.

- A question was raised by the NRC inspectors regarding the in-situ rock stresses and the lack of data on measurements of resulting pressures on the Reactor Auxiliary Building (RAB) exterior walls below grade. The licensee indicated that this matter would be addressed in the Engineering Assurance Program (EAP) Module E3-02 Civil/Structural. This follow-up item is identified as OI 50-508/86-12-03 Rock Stress Data.

- A question was also raised by the NRC inspectors regarding the mathematical model used in the dynamic analysis of the RAB and whether the 32 foot excavation for the circulating water pipes along the west wall of the RAB had been considered in selecting mathematical properties of the dynamic analysis model. The licensee indicated that this matter would be addressed in the EAP Module E3-02 Civil/Structural. This follow-up item is identified as OI 50-508/86-12-04 Excavation Consideration In Dynamic Analysis.

2. Physical and chemical requirements for cement and sand used in the production of soil cement fill were not reviewed by the licensee. The licensee stated that the cement and sand qualifications would be reviewed and submitted in the Concrete Module C3-02. This follow-up item is identified as OI 50-508/86-12-05 Cement and Sand Qualification Data.

WASHINGTON NUCLEAR PROJECT NO. 3 (WNP-3)

READINESS REVIEW PROGRAM

MODULE NO. C3-01 EARTHWORK

A. Purpose and Scope of Review

The purpose of this evaluation by the NRC was to determine if the results of the program review of Earthwork presented in Module C3-01 are an effective and accurate assessment of construction requirements, and that these requirements have been properly implemented.

It was noted that the scope of Module C3-01 includes applicable Construction Assurance Program (CAP) information, and also limited design information in the form of an excerpt from Module E3-02 Civil/Structural of the Engineering Assurance Program (EAP). Since Module E3-02 has not yet been completed or submitted to the NRC, it was recognized that the NRC review and inspection of Module C3-01 Earthwork for acceptance is limited to the construction portion of the Module, and that further review and inspection of design information will be required when more complete information is submitted in Module E3-02 Civil/Structural. During discussions with licensee personnel, it was understood that the NRC reviewers would note any questions concerning EAP aspects for follow-up.

The review included an examination of each section of Module C3-01 Earthwork and was performed by reviewers assigned from the NRC Office of Inspection and Enforcement (IE), Office of Nuclear Reactor Regulation (NRR), and from NRC Region V. Also, the material was reviewed as appropriate by the Office of the General Counsel (OGC). The following is a list of the sections of Module C3-01 reviewed:

1.0 Introduction
2.0 Executive Summary
3.0 EAP Summary Report on Earthwork Design
4.0 Review of Program Description
5.0 Program Management
6.0 Methodology
7.0 Program Results
8.0 Conclusions and Recommendations
9.0 Oversight Committee Assessment

The NRC review of Section 3.0 EAP Summary Report on Earthwork Design and Section 6.0 Methodology was limited to information useful in the review of construction aspects of earthwork. It was recognized that Module E3-02 Civil/Structural covers design aspects, including design information for earthwork, and has not yet been completed or submitted to the NRC. Also, it was recognized that Methodology, particularly Sampling Rationale, requires special consideration and judgement for application to each module for WNP-3.

The NRC review of Module C3-01 Earthwork included an in-depth review of Section 7.0 Program Results, a review of critical elements of earthwork,

and an inspection of a selected sample of critical elements, which, in the judgement of the NRC inspectors, required independent review as a part of the NRC evaluation of Module C3-01 (see Table 1 Earthwork Critical Elements).

The NRC methodology and evaluation of each section is provided in the discussion which follows.

B. NRC Methodology

The primary review of Module C3-01 Earthwork was performed by the NRC Office of Inspection and Enforcement (IE) with the cooperation and participation of the Office of Nuclear Reactor Regulation (NRR), the Office of the General Counsel (OGC) and Region V.

NRC Inspection Reports (IR) relative to earthwork prior to submittal of Module C3-01 were reviewed. These included IRs 50-508/86-04 (March 24-28, 1986), 50-508/86-05 (April 28-May 2, 1986), 50-508/86-6 (May 19-23, 1986), 50-508/86-08 (July 15-18, 1986), and 50-508/86-9 (August 1, 1986). Also, inspection report 50-508/86-10 (September 15-19, 1986), for an inspection performed after the licensee submitted Module C3-01, was reviewed.

An additional inspection was performed by the primary reviewer and a technical consultant to examine an independent sample of critical elements of earthwork. Reference inspection report 50-508/86-11 (October 27-31, 1986) and Table 1 Earthwork Critical Elements.

In addition, the NRC reviewers examined prior NRC inspection reports issued during the earthwork construction time period, prior Systematic Assessment of Licensee Performance (SALP) reports, and other reference material. Section D contains a list of selected references.

The NRC team reviews of the nine sections of Module C3-01 Earthwork, and the evaluations, with reference by number to the Sections of Module C3-01, are included in the following portion of this report.

C. NRC Staff Evaluations-Findings

1. Section 1.0 - Introduction

a. Discussion

This section of Module C3-01 provides brief background information regarding the WNP-3 Readiness Review Program, the purpose and scope of the Construction Assurance Program (CAP), and specifically, the review of earthwork construction activities; how and by whom it was implemented; and how it was reported.

It was noted under paragraph 1.1 that it is stated: "The scope of the Readiness Review of earthwork is all Quality Class 1 (QC-1) soils and soil-cement backfill operations, materials, inspection, and testing that were completed prior to the construction delay period which began May 23, 1983. This earthwork is all that could be considered safety-related, ..."

Also, it was noted under paragraph 7.2 of Section 7.0 that it is stated: "The work remaining to complete the WNP-3 earthwork is identified in paragraph 7.4.7...." Paragraph 7.4.7 was not found in the WPPSS report, but paragraph 7.6.7 identifies incomplete work and it was noted that Figure 7.2-2 of the report shows uncompleted safety-related earthwork.

Also, it was noted that paragraph 3.1 implies that the Engineering Assurance Program (EAP) for earthwork is a part of Module C3-01. Since EAP Module E3-02 Civil/Structural, which includes earthwork, has not yet been completed or submitted to the NRC, discussions with WNP-3 personnel revealed that it was intended that Module C3-01 be reviewed for acceptance of only Construction Assurance Program (CAP) aspects of earthwork, and that any questions regarding EAP aspects would be noted for follow-up.

b. Findings

This section was reviewed for background information only. No violations or deviations were noted. However, the licensee should review the uncompleted earthwork and assure that future safety-related earthwork is performed in accordance with requirements.

2. Section 2.0 - Executive Summary

a. Discussion

This section of Module C3-01 provides a brief summary of the status of WNP-3, and results of the WPPSS Review Team activity.

It was noted that the third paragraph includes a statement: "The in-depth examination of records shows that FSAR commitments and specification requirements were satisfied, and that NRC commitments were met for all safety-related earthwork of the plant." Since Figure 7.2-2 Uncompleted Earthwork of the report indicates that safety-related earthwork has not been completed, the statement is not entirely correct for the remaining earthwork. FSAR commitments must be applied when completing the earthwork construction, and open items identified in this report must be resolved.

Also, it was noted that the fourth paragraph includes a statement: "...this report also establishes that earthwork design and engineering was properly accomplished...." Since Module E3-02 has not yet been completed or submitted, NRC evaluation of this statement for earthwork design and engineering is deferred pending submittal of Module E3-02. Follow-up is required, and this item is identified as OI 50-508/86-12-01 Interface With Module E3-02.

b. Findings

No violations or deviations were noted in Section 2.0 of Module C3-01. However, receipt of Module E3-02 is required to permit

NRC evaluation of earthwork design and engineering, and any impact on construction Module C3-01. Also, open items identified in this report and summarized in the Summary/Statement of Module Acceptability (Conclusions) must be resolved and closed.

3. Section 3.0 - EAP Summary Report on Earthwork Design

This section of Module C3-01 provides an excerpt from Module E3-02 Civil/Structural. Since Module E3-02 has not been completed or submitted to the NRC, review of the excerpt material included in Module C3-01 was limited as further review will be required when the completed Module E3-02 is submitted. A prerequisite to the acceptance of Module C3-01 is the review and acceptance by the NRC of completed Module E3-02, particularly aspects pertaining to Earthwork.

The following paragraphs cover the limited review of excerpt material from Module E3-02 that was submitted in Module C3-01.

a. Discussion

The excerpt material from Module E3-02 presented in this section of Module C3-01 included an Earthwork Checklist with listings of Criteria/Commitments, Source Document, Review Results and Remarks. Also a FSAR Commitment Matrix with references to items on the Earthwork Checklist was included. The following observations were made:

(1) FSAR changes were mentioned under Remarks for items 1.a, 10, 15, 18 and 20 on the Earthwork Checklist. The licensee stated that such items had not been processed through review and approval cycles, however, they were placed in the Commitments on the WNP-3 General Tracking System which is auditable (reference: IR 50-508/86-11). Follow-up OI 50-508/86-12-02 FSAR Changes.

(2) A question was raised by NRC inspectors regarding the design of the Reactor Auxiliary Building (RAB) exterior wall below grade without results of in-situ rock stress test measurements and the resulting rock pressure on the RAB exterior walls below grade. The licensee indicated that this matter would be addressed in Engineering Assurance Program (EAP) Module E3-02 Civil/Structural (reference: IR 50-508/86-11). Follow-up OI 50-508/86-12-03 Rock Stress Data.

(3) A question was also raised by NRC inspectors regarding the mathematical model used in the dynamic analysis of the RAB and whether the 32 foot excavation for the circulating water pipes along the west wall of the RAB had been considered in selecting mathematical properties of the dynamic analysis model. The licensee indicated that this matter would be addressed in EAP Module E3-02 Civil/Structural (reference: IR 50-508/86-11). Follow-up OI 50-508/86-12-04 Excavation Consideration In Dynamic Analysis.

(4) Geological mapping aspects were not reviewed. Since geological mapping will be included in EAP Module E3-02 Civil/Structural for the WNP-3 project, NRC review will be performed when Module E3-02 is submitted.

(5) The Engineering Branch of the Division of PWR Licensing-B has reviewed the Washington Nuclear Project-3 (WNP-3) Readiness Review Program Earthwork Module C3-01 Final Report with respect to identification and implementation of Final Safety Analysis Report (FSAR) commitments. FSAR Section 2.5.4 and FSAR Appendices 2.5A, 2.5B, 2.5C, 2.5D, and 2.5L through FSAR Amendment 6 were reviewed for earthwork commitments and compared with the Earthwork Module C3-01 Final Report (Final Report).

FSAR Section 2.5.4.5.2 in discussing the excavation of Category I structures states, "All exposed sandstone surfaces of the excavation disturbed during construction were cleaned by air jetting; mapped (see Appendix 2.5F) and protected against slaking and weathering by means of shotcreting over welded wire fabric. The final excavated fresh sandstone bottom was also mapped and covered with a protective concrete mud mat." This commitment is not identified in the Final Report.

FSAR Appendix 2.5A Section 2.5.A.2.1.3 in discussing soil sampling states, "Standard penetration tests were performed in accordance with ASTM Standard D1586-67. The maximum depth interval between tests was 5 ft. ...Material recovered from the split spoon was used for index property determination in the laboratory. Undisturbed soil samples were obtained by using thin wall tube samples. ...The sampling procedure was in accordance with ASME Standard D1587-67." This commitment is not identified in the Final Report.

As a result of the review of the documentation, we conclude that the FSAR commitments identified in the Final Report have been implemented except for those identified in Section 7.6.7 of the Final Report and those FSAR commitments identified in the preceding two paragraphs, which were not identified in the Final Report.

In addition, the Office of Nuclear Reactor Regulation issued a Draft Safety Evaluation Report (DSER) for WNP-3 in November 1985 documenting the staff review of the FSAR to that date. The staff's evaluation findings in the DSER together with the staff's review findings as stated above pertaining to the WNP-3 Readiness Review Program Final Report constitute the staff's position in this subject area.

b. Findings

Since EAP Module E3-02 Civil/Structural has not yet been completed or submitted to the NRC, further review of EAP aspects is required when Module E3-02 is submitted. Follow-up is required to verify that FSAR commitments mentioned above as not identified in the Final Report are covered, and to determine the impact on construction Module C3-01 of deficiencies, if any, that may be found during the review of EAP Module E3-02. This follow-up item is identified as OI 50-508/86-12-01 Interface With Module E3-02.

Also, follow-up is required for OI 50-508/86-12-02 FSAR Changes, OI-50-508/86-12-03 Rock Stress Data, and OI 50-508/86-12-04 Excavation Consideration in Dynamic Analysis mentioned above.

4. Section 4.0 - Review Program Description

a. Discussion

This section of Module C3-01 provided a brief description of the review program for completed safety-related earthwork construction at WNP-3. Applicable contractors were identified, program content was described, and related project reviews were noted. Lists and brief descriptions of applicable Construction Assurance Program (CAP) procedures and instructions were provided. Also, a review plan (Appendix 1) and a list of checklists used in the earthwork review were included.

The NRC inspectors noted that design mix control for soil cement fill should have been included as an attribute. Also, it was considered that the review of soil cement lift thickness should have been covered as a separate attribute instead of being combined with curing. However, review of records indicated that field personnel used proper mixes and that lift thickness was controlled.

b. Findings

The contents of this section were found to be reasonable. No violations or deviations were noted.

5. Section 5.0 - Program Management

a. Discussion

This section of Module C3-01 described the organization, internal controls, management involvement, NRC involvement, and oversight committee.

b. Findings

This section was reviewed for background information. The contents of this section were found to be reasonable. No violations or deviations were noted.

6. Section 6.0 - Methodology

a. Discussion

The rationale applied to sampling and the techniques used to select items for inspection for this module were found generally acceptable except as noted below.

As stated in paragraph 6.2, Review and Inspection Philosophy, the primary method of determining that earthwork met specified requirements was by review of key quality documentation prepared at the time the work was in progress. This is necessary but not sufficient in that a limited number of "as-built" reviews should be made as shown in Section C.3.a(2) of this report with the example of the question regarding in-situ rock stresses and resulting pressures on the RAB exterior walls below grade. The rationale as stated in Module C3-01 did not require this type of review.

The introduction to this section indicates that it covers the philosophy applied to reviews and inspections in the Readiness Review Program generally and the methods used to perform them. The following comments pertain to this philosophy:

(1) Review and Inspection Philosophy

The attributes reviewed to provide added assurance that a given construction area such as "concrete" is in conformance to regulatory requirements must be selected using "good engineering judgement." A sufficient set of these attributes may not always be effectively drawn from a random sample of contractor-generated documents. The attributes should also include those that have already been identified as "problem areas" from previous licensee, NRC, and INPO audits and inspections. This should include experiences of both WPPSS and other utilities with plants similar to WNP-3.

(2) Sampling Rationale

The sampling methodology described in Module C3-01 is geared to "binomial populations." As such, its use in the CAP should be limited to those situations which meet the necessary conditions for application of the binomial probability distribution theory, such as:

- homogeneity of items within a population
- random selection of items from a population
- ability to classify - with certainty - each item as acceptable or unacceptable.

(3) Earthwork Module C3-01 Methodology

The review of earthwork documents by WPPSS was noted to cover such items as in-place density testing and equipment calibration. In these cases, 100% of the reports were reviewed.

The NRC inspectors reviewed prior NRC inspection reports and conducted an inspection October 27, 1986 through October 31, 1986 during which 100% of earthwork records were reviewed for nonconformance reports, measuring and test equipment, placement and compaction and density test records for soil cement fill, and density test records for Class A-1 backfill. No significant violations or deviations were identified.

b. Findings

In general, the methodology used for earthwork by WPPSS was found acceptable.

However, the methodology to be used by WPPSS for future modules will be reviewed by the NRC on a case by case basis in view of the comments made above.

7. Section 7.0 - Program Results

a. Discussion of Results of Licensee CAP Reviews of Earthwork

This section of Module C3-01 presents the results of licensee CAP reviews of earthwork, and required extensive review by the NRC reviewers and inspectors. The NRC review included examination of results of CAP reviews of earthwork and the results of an independent NRC inspection (Reference IR 50-508/86-11) to review a selected sample of critical elements and attributes of earthwork (see Table 1 Earthwork Critical Elements). Comments regarding NRC review of this section of Module C3-01 relative to numbered paragraphs, and results of the independent NRC inspection are as follows:

(1) Paragraph 7.1 General Findings

This paragraph provided a brief summary of the WNP-3 review program activity for earthwork. It includes a statement: "A review of the original laboratory testing for soil cement was made to verify the establishment of the soil-cement mix design." It does not address the fact that the design mix was changed twice during the placement of soil cement. Also, it does not address the effect of these changes on the soil cement properties. However, review of records indicated that the proper mixes were used and verified by field inspection personnel.

(2) Paragraph 7.2 Placement Areas

This program includes, with figures, identification of placement areas for both soil cement and Class A-1 structural backfill. It included a statement: "The work remaining to complete WNP-3 earthwork is identified in paragraph 7.4.7...." Paragraph 7.4.7 was not included in the report, but paragraph 7.6.7 identifies incomplete work and figure 7.2-2 Uncompleted Earthwork was included. It was noted that safety-related earthwork has not been completed.

(3) Paragraph 7.3 Checklist Findings

This portion describes findings and resolutions of deficiencies found in the WNP-3 review of earthwork. The analysis provided a summary of results for each of the 21 checklists developed by the licensee including findings and resolutions of deficiencies found. Review by NRC inspectors resulted in the following comments:

In paragraph 7.3.1 the report states: "All in-place density test reports were found to exceed the specified compaction requirements and the moisture content was within specified limits." This was not found to be completely accurate, in that the NRC inspectors found one density test and ten moisture contents that were not within specified limits. Also, in section 7.3.15 the report is misleading when it states that all the in-place density tests for Class A-1 backfill exceeded the specified requirements. The NRC inspectors found two tests that were slightly below the specified minimum dry density. However, the specifications allow for 10% of the minimum dry density tests to fall 5% below the specified limit.

In table 7.5-1, item 4 states that the sand used in the production of soil cement will be reviewed in Concrete Module C3-02. This review should have been made as part of module C3-01 Earthwork. However, WNP-3 representatives stated that the physical and chemical qualifications of cement and sand met requirements, and that confirming information would be included in Module C3-02. Follow-up is required to confirm that the cement and sand used in soil cement fill is acceptable. Follow-up OI 50-508/ 86-12-05 Cement and Sand Qualification Data.

In table 7.5-1, item 7 states that the optimum moisture content of the soil cement was 10.4%. The mix changed twice and so did the optimum moisture content (11.2% and 11.1%). See Section C.6.b.(2)(b) of this report for further discussion which indicates that proper mixes were used by field personnel.

(4) Paragraph 7.4 Evaluation of Contractor Performance

This portion provides a discussion of activities of the contractors directly involved with earthwork, and performance charts were included. The NRC inspectors reviewed the material presented in the module C3-01 report, and also the Ebasco specifications for soil cement and structural backfill, the Ebasco Specification for supply and delivery of concrete, the Morrison-Knudsen placement procedures, the PTL inspection and field test procedures and placement and compaction records. The reviews indicated that performance of the contractors was reasonable, and that, in general, soil cement and Class A-1 backfill had been placed in accordance with specifications and contractor procedures. No significant violations or deviations were identified.

(5) Paragraph 7.5 FSAR Commitments

Refer to C.3.a(5) of this document for discussion of FSAR commitments.

(6) Paragraph 7.6 Other CAP Technical Assessments

This portion contains discussions of Excavation Permit Review, Sand Sieve Analysis Review, NRC Items of Non-compliance, NRC Circular No. IEC-81-08-Foundation Materials, Construction Management Activities, Drainage System Walkdown, Identification of Incomplete Work, Summary of NCRs Written During Earthwork Operations and Soil Cement Laboratory Testing. In general, these items were found to be acceptable and no significant violations or deviations were identified. The discussion of incomplete work and the referenced figures showed that safety-related earthwork had not been completed.

b. Discussion of Independent NRC Inspection Results

The independent NRC inspection covered programmatic and other critical elements of safety-related earthwork, including critical element attributes of soil-cement backfill and Class A-1 backfill (reference Table 1 Earthwork Critical Elements). The results of the independent NRC inspection are as follows:

(1) Programmatic Critical Elements Inspection

a. Resumes of the Five WPPSS Readiness Review Team members for Module C3-01: T. McCormick, N. Blais, A. Cochran, L. Fields and F. Teague were reviewed, and their qualifications were found to be reasonable and acceptable for Module C3-01 Earthwork.

b. Quality Assurance (QA) manuals and applicable Quality Control (QC) procedures for three contractors involved with earthwork: Pittsburgh Testing Laboratory (PTL), Associated Sand and Gravel Company (AS&G) and Morrison-Knudsen Company, Inc. (M-K) were reviewed and found to be acceptable.

c. Corrective actions pertaining to earthwork were reviewed. A total of 20 Nonconformance Reports (NCRs) were reviewed and corrective actions/dispositions with proper signatures and approvals were found to be reasonable and acceptable.

d. Audit reports for 12 internal audits by three contractors involved with earthwork were reviewed: 6 by PTL, 4 by AS&G and 2 by M-K. Also, three audits of the contractors by WPPSS/Ebasco were reviewed: one each for PTL, AS&G and M-K. It was found that findings and concerns revealed by these audits were reasonably resolved and dispositioned.

e. Material control and traceability records were reviewed. Mill test reports for 9343 tons of cement (3 lots: No. 45, No. 46 and No. 47) were examined and found acceptable. It was noted that records included a copy of the applicable mill test report for each truck load of cement.

f. The control of Measuring and Test Equipment (M&TE) was reviewed. It was noted that PTL controlled the M&TE applicable to earthwork activities of PTL, AS&G and M-K. Calibration records for 24 items of M&TE were reviewed and control was found to be acceptable. In one case, PP-10 Automatic Soil Compactor, calibration was found to be 8.38% out of tolerance. A NCR was issued (No. 204-10) and appropriate evaluation and disposition of prior work was performed. The control of M&TE was found to be reasonable and acceptable.

g. A question regarding the status of required changes to the FSAR as mentioned in Module C3-01 Earthwork was discussed. The applicant stated that four changes had not been processed through review and approval cycles. However, these items were placed in the Commitments On the WNP-3 General Tracking System as of October 29, 1986: LIC-RRCA-0001, -0002, -0003, and -0004. The applicant stated that contents of the Tracking System were auditable.

In general, the control of programmatic critical elements was considered to be reasonable and acceptable. However, follow-up is required to confirm that FSAR changes are processed and approved.

(2) Earthwork Critical Elements Inspection

(a) Construction Assurance Program - Earthwork Module Review

A review of construction aspects of earthwork was performed at the WNP-3 site with emphasis on critical elements of earthwork which include soil-cement backfill with significant attributes and Class A-1 backfill with significant attributes for safety-related applications. The following construction procedures, specifications and earthwork placement and compaction records were reviewed:

- Ebasco Specification WPPSS-3240-466 Soil Cement and Structural Backfill, Rev. 2 dated August 2, 1982
- Ebasco Specification WPPSS-3240-466 Soil Cement Engineered Backfill for RAB Access Ramps and Adjacent Areas, Rev. 1 dated October 24, 1979
- Ebasco Specification 3240-209 Supply and Deliver of Concrete, Rev. 16 dated March 2, 1986
- Morrison-Knudsen Co., Inc. CP 17 Procedure for Placing, Compacting, Curing and Inspection of Soil Cement and Class A-1 Structural Fill, Rev. 5 dated May 4, 1983. The NRC inspector examined the original and latest revisions and noted that the latest revision included minor improvements in definition of work control
- Woodward-Clyde Report dated March 25, 1981 Soil Cement Engineered Backfill Design Mix Test Program
- Pittsburgh Testing Laboratory Procedure QC-ST-1 Soils Inspection and Tests-Field, Rev. 3 dated May 24, 1979. The NRC inspector examined the original and latest revisions and noted that the latest revision included minor improvements in definition of work control
- Placement and Compaction records for soil cement placed in the RAB access ramp between June 2, 1980 and June 16, 1980.
- Placement and Compaction records for soil cement placed beneath diesel oil storage tank.
- Placement and compaction records for soil cement placed beneath dry cooling tower, electrical vault and duct bank area.

(b) Soil-Cement Backfill

Soil Cement Backfill was placed in the RAB access ramp area, below the diesel storage tank A and under the Dry Cooling Tower in the area of the electrical vault and duct banks.

Approximately 150 compaction records were reviewed and only one was slightly below the specified compaction. The specification allows 10% of tests to be 5% below specified compaction.

Ten moisture contents exceeded specification limits. These were accepted by Ebasco field personnel. The specification and the procedure do not specifically state that the Ebasco field personnel have this authority. However, the in-place density tests were acceptable and, therefore, the moisture content variations were not significant.

The soil cement design mix was specified in Ebasco Specification 3240-209 and is basically 90% sand and 10% cement. This is in agreement with the FSAR and the Woodward-Clyde test report.

However, during the placement of the soil cement fill, the type of sand was changed two times. This changed the basic test acceptance criteria, that is the minimum dry unit weight and the optimum moisture content. The three mixes (original and two changes) are as follows:

Mix	Lab Test No.	Minimum Dry Unit Weight #/C.F.	Optimum Moisture Content-%
SO Cem	N/A	119.9	10.4
SO Cem #1	276	131.4	11.2
SO Cem #2	277	124.6	11.1

The CAP Checklist Instruction CAP-D-C-01-01 lists the acceptance criteria for the soil cement mixes as follows:

Mix Content-% ± 2%	Lab Test No.	Minimum Dry Unit Weight Lbs./C.F.	Optimum Moisture
SO Cem RAB Access Ramp	--	113.9	10.4
--	276	124.8	11.2
--	277	118.4	11.1

It does not appear that specific acceptance criteria was given to the site inspectors, and the NRC inspectors were not able to confirm the laboratory test number from approximately 60% of the inspection reports. The laboratory test number is listed on the in-place density tests as N/A. The specifications are not specific as to the type of sand to be used. The specifications state that the sand shall be similar to the sand used in the mixing of concrete. However, review of the records indicated that the proper mixes were used and evaluated by field inspection personnel.

Three NCRs were written by the CAP earthwork module team as follows and were dispositioned as acceptable with appropriate approvals:

NCR No.	Description
20000	Horizontal location of soil tests are not identified on the test reports.
20001	Weather data is not identified on soil test reports.
20002	Testing frequency for 28 lifts of soil cement placed on RAB Access Ramp was not in accordance with specification.

In general, the soil cement placement appeared to be acceptable and no significant violations or deviations were identified.

(c) Class A-1 Backfill

Class A-1 Backfill was used as bedding and part of the overburden for the ASME piping south and east of the RAB. This piping included chemical and volume control systems, the component cooling water system and emergency generator system.

Approximately 80 density tests results were reviewed with only two falling slightly below the specified minimum dry density. This is acceptable in accordance with the specifications.

The horizontal location and weather data were not incorporated in the test reports as specified and were dispositioned in NCRs 20000 and 20001.

The Class A-1 backfill appeared to be placed in a controlled manner, and no significant violations or deviations were identified.

c. Findings

No significant violations or deviations were noted. This Section is generally acceptable for completed earthwork with consideration of comments mentioned in the above paragraphs. Followup is required to confirm that the cement and sand used in soil cement fill is acceptable. This open item is identified as OI 50-508/86-12-05 Cement and Sand Qualification Data.

8. Section 8.0 - Conclusions and Recommendations

a. Discussion

This section of construction Module C3-01 includes a brief summary and discussion of results of the activities of the WNP-3 Review Team. Conclusions stated that: "...the earthwork performed to date at WNP-3 is of high quality and meets appropriate standards for safety-related construction." Recommendations stated: "The Review Team recommends that this report provide the basis for acceptance of WNP-3 earthwork, with no outstanding quality issues to be addressed after restart of construction."

The NRC review of construction Module C3-01 revealed that engineering/design Module E3-02 Civil/Structural, which contains earthwork aspects had not been completed or submitted, and that final NRC acceptance of Module C3-01 is contingent upon review and acceptance of Module E3-02, particularly earthwork engineering/design aspects. Also, the NRC review revealed that physical and chemical requirements and qualifications for cement and sand used in the production of soil cement fill would be included in Module C3-02 Concrete which has not yet been completed or submitted.

b. Findings

The conclusions and recommendations are generally acceptable, pending acceptable resolution of prior mentioned open items, as follows:

(1) OI 50-508/86-12-01 Interface With Module E3-02, including:

- OI 50-508/86-12-02 FSAR Changes
- OI 50-508/86-12-03 Rock Stress Data
- OI 50-508/86-12-04 Excavation Consideration in Dynamic Analysis

(2) OI 50-508/86-12-05 Cement and Sand Qualification Data

9. Section 9.0 - Oversight Committee Assessment

a. Discussion

This section of Module C3-01 briefly described the activities of the WNP-3 Oversight Committee. Mr. Specer H. Bush, PE, Chairman, stated in a letter dated September 10, 1986: "In our opinion, this issue is resolved by the report which provides an excellent basis with regard to Earthwork for future reactivation of WNP-3."

b. Findings

The contents of this section were found to be reasonable. No violations or deviations were noted. However, the licensee must resolve open items identified in this report.

D. References

Washington Public Power Supply System, Final Report of Earthwork Module C3-01 of the WNP-3 Construction Assurance Program of the WNP-3 Readiness Review Program, September, 1986.

September 10, 1986, letter from D. W. Mazur, Managing Director, Washington Public Power Supply System forwarding Earthwork Module C3-01 for NRC evaluation.

NRC Inspection Report No. 50-508/86-10 covering an inspection conducted September 15-19, 1986.

NRC Inspection Report No. 50-508/86-11 covering an inspection conducted October 27-31, 1986.

Other NRC Inspection Reports applicable to Earthwork Module C3-01:

50-508/86-04
50-508/86-05
50-508/86-06
50-508/86-08
50-508/86-09

Other NRC Inspection Reports applicable to construction:

50-508/78-04	50-508/81-08
50-508/78-06	50-508/82-15
50-508/78-09	50-508/82-16
50-508/79-01	50-508/82-20
50-508/79-04	50-508/82-23
50-508/79-05	50-508/82-06

SALP Report, September 15, 1982 transmitted January 3, 1983

SALP Report, transmitted November 4, 1981

E. Tables

1. Earthwork Critical Elements

TABLE 1

EARTHWORK CRITICAL ELEMENTS

Programmatic

Team Qualifications*
QA Manuals*
QC Procedures*
Corrective Actions*
QA Audits*
Material Control
and Traceability*
Measuring and Test
Equipment Control*
Design Change Control

Safety-Related Soil Cement		Safety-Related Class A-1 Backfill	
Materials	Production	Materials	Production
Cement*	Batching*	Granular Backfill	Placing*
Sand	Mixing*		Compacting*
Water*	Transporting		Testing*
	Placing*		
	Compacting*		
	Testing*		

*Critical elements inspected by NRC inspectors for conformance to FSAR commitments, specifications, procedures and industry standards.

F. List of Persons Contacted

a. Washington Public Power Supply System

G. Block, Readiness Review, Engineering Assurance Program (EAP) Manager
A. Carlyle, Sr. QA Engineer
D. Coleman, Licensing Manager
D. Coody, Project QA Manager
J. Garvin, Readiness Review Program Manager
D. Dulbert, Project Technical Manager
R. Knawa, Readiness Review, Construction Assurance Program (CAP) Manager
C. Love, Project Support Manager
M. Monopoli, Plant Manager
P. Olson, WNP-3 Program Director
E. Staugger, Plant QA/QC Manager

b. Ebasco Services, Inc.

P. Pitman, QA Manager (Acting)
F. Teague, Civil/Structural Engineer
R. Taylor, Project General Manager

c. Bechtel Power Corporation

T. McCormick, Readiness Review, Construction Assurance Program

d. United Engineers and Constructors

N. Amaria, Readiness Review, Engineering Assurance Program
(via telephone conferences)

G. Acronyms

AS&G	Associated Sand and Gravel Company
CAI	Conditionally Acceptable Item
CAP	WPPSS Construction Assurance Program
C.F.	Cubic Foot
EAP	WPPSS Engineering Assurance Program
Ebasco	Ebasco Services Company
FSAR	Final Safety Analysis Report
IE	NRC Office of Inspection and Enforcement
IR	NRC Inspection Report
M-K	Morrison-Knudsen Company
M&TE	Measuring and Test Equipment
NCR	Nonconformance Report
NRC	U.S. Nuclear Regulatory Commission
NRR	NRC Office of Nuclear Reactor Regulation
OGC	NRC Office of the General Counsel
PTL	Pittsburgh Testing Laboratory
QA	Quality Assurance
QC	Quality Control
QC-1	WPPSS Quality Class 1
RAB	Reactor Auxiliary Building
WNP-3	Washington Nuclear Project No. 3
WPPSS	Washington Public Power Supply System