UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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| In the Matter of | ) | |
| | ) | |
| CONSUMERS POWER COMPANY | ) | Docket Nos. 50-329 OM & OL |
| | ) | 50-330 OM & OL |
| (Midland Plant, Units 1 and 2 | ) | |

NRC STAFF TESTIMONY OF DARL S. HOOD, JEFFREY K. KIMBALL AND EUGENE GALLAGHER

ON STAMIRIS CONTENTION 1

Q. 1. Please state your names and positions with the NRC.

A. My name is Darl S. Hood. I am a Senior Project Manager in the Division of Licensing, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission.

My name is Jeffrey K. Kimball. I am a Seismologist/Geophysicist reviewer within the Geosciences Branch, Division of Engineering, Office of Nuclear Reactor Regulation, U. S. Nuclear Regulatory Commission.

My name is Eugene J. Gallagher. I am a civil engineer with the U.S. Nuclear Regulatory Commission. Since February, 1981, I have been assigned to the Reactor Engineering Branch, Division of Resident and Regional Reactor Inspection, Office of Inspection and Enforcement. Prior to February,1981, I was a reactor inspector assigned to the Region III, Reactor Construction and Engineering Support Branch, Office of Inspection and Enforcement.

Q. 2. Have you prepared statements of professional qualifications?

A. Yes. Copies of these statements are Attachment 1.

Q. 3. Please state the duration and nature of your responsibilities with respect to the Midland Plant, Units 1 and 2.

A. I, Darl Hood, am the Project Manager for the Midland Plant application for operating licenses. I have served in that position from August 29, 1977, when the application for operating licenses was tendered to the NRC for acceptance review, up to the present time. My responsibilities include management of the Staff's environmental and radiological safety review. I am responsible for the Staff testimony on the following parts of Stamiris' Contention 1: (a); Supplemental Items 2, 3, 4 and 6; and portions of Supplemental Items 1 and 5.

I, Jeffrey Kimball, have served in the position of Seismologist/ Geophysicist reviewer for the Midland Plant since July 1980. I am responsible for the Staff testimony on part 1 (b) of Stamiris Contention 1.

I, Eugene Gallagher, was assigned to the Midland Plant (among others) from October, 1978 until January, 1981. Since October of 1978, I have spent approximately one year of effort performing inspections, reviewing quality control records and procedures, observing work activities, reviewing Consumers Power Company (hereafter CPC or Applicant) responses to 10 CFR 50.54(f) questions 1 and 23, and attending meetings and presentations by CPC and Bechtel regarding the soil settlement matter at the Midland Plant. I am responsible for the Staff testimony for portions of Supplemental Items 1 and 5 to Stamiris' Contention 1.

Q. 4. Please state the purpose of this testimony.

A. The purpose of this testimony is to address Contention 1 of the Contentions of Barbara Stamiris as identified in the Appendix to Prehearing Conference

Order Ruling on Contentions and on Consolidation of Proceedings, dated October 24, 1980, and as supplemented by Intervenor Answer To Applicant's Interrogatories, dated April 20, 1981. This testimony does not address Stamiris Contention 1 (d) since this relates to matters to be addressed at a later time.

Stamiris' Contention 1 reads as follows:

> Consumers Power Company statements and responses to NRC regarding soil settlement issues reflect a less than complete and candid dedication to providing information relevant to health and safety standards with respect to resolving the soil settlement problems, as seen in:
>
> a) the material false statement in the FSAR (Order of Modification, Appendix B);
>
> b) the failure to provide information resolving geologic classification of the site which is pertinent to the seismic design input on soil settlement issues (Responses to FSAR Questions 361.4, 361.5, 361.7 and 362.9);
>
> d) the failure to provide adequate acceptance criteria for remedial actions in response to 10 CFR §50.54(f) requests (as set forth in part II of the Order of Modification);
>
> and this managerial attitude necessitates stricter than usual regulatory supervision (ALAB-106) to assure appropriate implementation of the remedial steps required by the Order Modifying Construction Permits, dated December 6, 1979.

April 20, 1981 Supplement to Contention 1

Examples of CPCo. reluctance to provide requested information

1. 3/31/80 NRC meeting notation of Applicant's reluctance to provide NRC consultants with requested information.

2. Vol. III, tab 65 50-54f, 8/6/79 meeting, attitude that "needlessly conservative decisions may be formulated on the 'what if' type questions" by the NRC on dewatering.

3. The 11/24/80 S.A.L.P. assessment on CPCo - NRR interface as presented by D. Hood in the following statements regarding soil settlement issues:

"A big contributor to the inability to make meaningful progress in this matter is the quality of responses gotten. We have set some kind of record on the number of questions re-asked, which speaks poorly for CPCo-NRR interface. ...The bottomline is there seems to be a lack of appreciation or support of Staff review necessities and a tendency to push ahead despite the lack of proper assurances."

4. The perfunctory manner in which CPCo. deponents answered questions. (I will tabulate examples from the depositions I attended.)

Examples of information withheld or incorrectly given:

5. The failure of CPCo. to discuss the Administration Building settlement problem with the NRC, as they did with their consultants, in the early meetings on the DGB settlement.

6. The false FSAR statements beyond the one cited as a "material false statement" in the Dec. 6 Order, as discussed in the 4/3/79 Keppler-Thornburg memo, and the 6/13/79 Thornburg - Thompson memo.

Q. 5. What is the NRC Staff response to Contention 1(a)?

A. Information submitted as part of an application for licenses in accordance with 10 CFR 50.30 is "material" if that information should or could have an influence upon a safety conclusion of the NRR Staff. A material statement which is false is of concern if it could have resulted in an improper finding or a less probing analysis by the NRR Staff.

The material false statement referred to in Contention 1(a) is described in Appendix B to the Order Modifying Construction Permits, dated December 6, 1979. Specifically, the material false statement was made in Section 2.5.4.5.3 of the FSAR. That section provided that "all fill and backfill were placed according to Table 2.5-9". Had the Staff relied on this statement, it would or could have erroneously concluded that the fill and

backfill placed for the support of structures and the Diesel Generator Building consisted of "clay" (Table 2.5-9 under "Soil Types") or "controlled compacted cohesive fill" (Table 2.5-14 under "Supporting Soils") which had been compacted, as a minimum, to 95% of ASTM D 1557-66 T modified to get 20,000 foot-pounds of compactive energy per cubic foot of soil (see Table 2.5-9 under "Compaction Criteria"). The reality of the situation is that the fill and backfill beneath the structures and the Diesel Generator Building are neither "clay" nor a "controlled compacted cohesive fill", but consist of a heterogeneous mixture of sand, clay, silt and lean concrete, and the minimum compaction criterion implied as having been achieved by the quoted statement from FSAR Section 2.5.4.5.3 was not achieved.

Therefore, a conclusion by the Staff that the fills and backfills were of a different type or had been compacted to known minimum standards would have been eroneous and would or could have precluded a more probing analysis or further questioning. Based upon the FSAR information, the Staff would or could have concluded that the structure was adequately supported, that it would not experience detrimental settlement, that its foundations would remain stable under both static and earthquake loading, and that the fill properties would be at least equal to design values provided in the FSAR. The Staff's conclusion would have been relevant to the NRC findings pursuant to 10 CFR 50.57 (3) for issuance of operating licenses and would have contributed to a finding that there is reasonable assurance that the activities authorized by the operating license can be conducted without endangering the health and safety of the public.

I do not agree with Contention 1(a) to the extent that the material false statement is a reflection of "a less than complete and candid dedication to providing information relevant to health and safety standards with respect to resolving the soil settlement problems." In my opinion the material false statement in the FSAR is a reflection of the breakdown in quality assurance and quality control that existed for the Midland plant prior to December 6, 1979 for requirements such as design control (Criterion III of 10 CFR Part 50, Appendix B) and document control (Criterion VI of 10 CFR Part 50, Appendix B). I have no reason to believe, nor do I believe, that this material false statement was intentional. Similarly, I have heard no one else express this view that the was intentional.

Q. 6. What is the NRC Staff response to Contention 1(b)?

A. FSAR Questions 361.4, 361.5 and 361.7 referred to in Contention 1(b) were asked by the NRC's Geosciences Branch as part of its review of the Midland Plant application for operating licenses. Question 361.4 was issued on June 20, 1978; the Applicant's latest response prior to issuance of the December 6, 1979 Order on Modification was by FSAR Revision 15 (Amendment 54) dated November 27, 1978, (Attachment 2) and the current response was by FSAR Revision 30 (Amendment 83) dated October 21, 1980 (Attachment 3). Question 361.5 was also issued on June 20, 1978; the Applicant's latest response prior to December 6, 1979 was by FSAR Revision 14 (Amendment 51) dated October 17, 1978 (Attachment 4), and the current response was by FSAR Revision 30 (Amendment 83) dated October 21, 1980 (Attachment 5). Question 361.7 was issued on February 14, 1979; the Applicant

responded by FSAR Revision 24 (Amendment 69) dated September 28, 1979 (Attachment 6).

Question 362.9 was asked by the NRC's Geotechnical Engineering section on August 30, 1978; the Applicant's latest response prior to December 6, 1979 was by FSAR Revision 24 (Amendment 69) dated September 28, 1979 (Attachment 7) and the current response is by FSAR Revision 26 (Amendment 73) dated J nuary 30, 1980 (Attachment 8).

The Applicant did not fail to provide information in responding to Questions 36..4, 361.5 and 361.7 as alleged in Contention 1(b); however, the information contained in the responses to these three questions did not resolve the open issue involving which tectonic province the Midland site is in. Specifically, the Applicant had used the Michigan Basin tectonic province whereas the NRC staff has been reluctant to accept subdivision of the whole Central Stable Region tectonic province.

Question 362.9 inquired about structural settlement measurements from certain benchmark numbers. The relationship, if any, of this subject to information resolving geologic classification of the site as alleged in Contention 1(b) is not understood, and Question 362.9 was not asked for such a purpose.

The Staff does not view the tectonic province disagreement between itself and CPC as any reflection of "a less than complete and candid dedication" to providing information relevent to resolving the open issue which is necessary for approval of the remedial actions associated with the soil settlement matter.

Q. 7. What is the NRC Staff response to Item 1 in Stamiris' supplement to Contention 1?

A. Item 1 refers to a March 31, 1980 "meeting notation". This is a reference to the "Summary of February 27 & 28, 1980 Meeting and Site Tour with Consultants to Review Soil Settlement" (Attachment 9). The statement of interest is the first paragraph on page 3 of this meeting summary:

> The staff noted that such documents as above are needed by its consultants for their independent assessment of the adequacy of the proposed remedial measures and requested that these be made publicly available. The applicant indicated a reluctance to this end, and noted that these were available through the I&E audit mechanism. The staff will issue a formal request for these documents.

The above statement refers to a discussion by the Applicant during the meeting in response to our request for documents. The Applicant replied, as best I can recall, that many of these documents are of a type not normally found within the docketed material of an application for licenses, and that the documents requested would be quite volumnious. The purpose of the comment, I believe, was to explore the possibility that the Staff's need for the documents might be accomplished through a less burdensome and expensive mechanism, such as the audit mechanism which would provide for NRC review at a local record center such as Bechtel, in Ann Arbor, Michigan.

The Staff, in fact, formally requested the documents by letter dated April 1, 1980 (Attachment 10). The Applicant replied initially by coverletter dated May 5, 1980 forwarding Amendment 77 and copies of Revision 7 to the document

entitled "Responses to NRC Requests Regarding Plant Fill." This coverletter acknowledged that five of the requested reports were not being forwarded at that time; two of the five had been superseded and the two replacement documents, also named in the staff request, would be forwarded as they became available. These four reports discuss the Sondex system and Borros Anchor procedures.

The fifth document identified for submittal at a later time in the Applicant's May 5, 1980 coverletter discussed qualification of compaction equipment. The documentation for qualification of compaction equipment had been previously requested by the Office of Inspection and Enforcement (IE) on December 4, 1978 as described by "Summary of December 4, 1978 meeting on Structural Settlements" (Attachment 11), page 4, which states in part:

> The NRC Resident Inspector asked for a list of the equipment, with a discussion of the compaction capability and limitations of each, used for compacting the fill for the DG Building from elevation 618 to 628 feet. Bechtel will provide this information.

This documentation was again requested unsuccessfully during IE site visits around mid 1979 and in May 1980 (Attachment 12). The Applicant's reply of August 15, 1980 forwarded, in part, a report on the Test Fill Program (tab 150 in "Responses to NRC Requests Regarding Plant Fill") which was conducted between May 1979 and October 1979 to requalify various compactors for structural and pit run sands. The August 15, 1980 reply also noted that "further testing is being conducted in order to substantiate qualification of certain equipment."

While the difficulty and delay associated with acquiring documentation with respect to qualification of soils compaction equipment represents an instance of poor cooperation with NRC, the Staff does not believe that the discussions during the meetings of February 27 and 28, 1980, nor the subsequent actions of the Applicant to comply with the Staff request for documents other than those documents on qualification of soils compaction equipment, reflect an overall a deficiency in attitude. However, this poor cooperation reflected adversely upon the responsible officials involved in execution of CPC's quality assurance program.

Q. 8. What is the NRC Staff response to Item 2 in Stamiris' supplement to Contention 1?

A. The statement referred to in Item 2 is found in tab 66 of the document "Responses to NRC Requests Regarding Plant Fill". It specifically appears in the last paragraph of an internal correspondence by T. C. Cooke/RMW (R.M.Wheeler) which was prepared either on August 6 or 7, 1979 to summarize a pre-meeting of June 27, 1979 between CPC, Bechtel and Bechtel's consultants (Attachment 13).

The meeting summary is somewhat ambiguous as to the source of this statement. The entire last paragraph of the meeting summary, including this statement, appears to indicate the views of the consultants. From my reading of this paragraph, I believe the intent is to reflect the expressions of the consultants.

I am unable to conclude that the cited example reflects the view of any member of CPC. Views expressed by Bechtel's consultants on their own behalf, as may possibly be the case here, would not be a reflection on the Applicant's dedication to providing information nor the Applicant's managerial attitude. Furthermore, this cited example has nothing to do with CPC's alleged reluctance to provide requested information. Similarly, the statement does not demonstrate one way or the other whether CPC has a "less than complete and candid dedication to providing information."

Q. 9. What is the NRC Staff response to Item 3 in Stamiris' supplement to Contention 1?

A. Item 3 refers to the SALP assessment of CPC. SALP, or Systematic Assessment of Licensee Performance, is an NRC program for the comprehensive overview of licensee or applicant performance. The program was included as Task I.B.2 in the "Action Plans for Implementing Recommendations of the President's Commission and Other Studies of TMI-2 Accident", NUREG-0660. The program is also discussed in House Report No. 96-1452, by the Committee on Government Operations, entitled, "Evaluating Nuclear Utilities Performance: Nuclear Regulatory Commission Oversight." The objectives of SALP are:

(1) Identification of unacceptable licensee performance;

(2) Improvement of licensee performance;

(3) Improvement of IE Inspection Program;

(4) Providing a basis for NRC management's allocation of resources; and

(5) Achieving regional consistency by appraising licensee performance from a national perspective.

Further description of SALP is provided in SECY 80-83 (Attachment 14).

Performance reviews and evaluations for SALP are conducted semiannually by a board consisting of NRC individuals who are involved in the inspection and licensing activities of the applicant or licensee such as resident inspectors, regional inspectors, regional managers, and NRR Project Managers. As Project Manager for the Midland plant, I, Darl Hood, am a member of the SALP Board responsible for the review and evaluation of the Midland Plant, Units 1 and 2. I participated in a meeting on November 24, 1980 between the SALP Board and CPC which was held to advise CPC of the results of the SALP evaluation for its nuclear plants, including Midland Plant, Units 1 and 2. During this meeting I made the statement:

> A big contributor to the inability to make meaningful progress in this matter is the quality of responses gotten. We have set some kind of record on the number of questions re-asked, which speaks poorly for CPCo - NRR interface. ...The bottomline is there seems to be a lack of appreciation or support of Staff review necessities and a tendency to push ahead despite the lack of proper assurance.

Two examples that I had in mind when I made the above bottomline statement were associated with the Applicant's decision (1) to place and remove the surcharge for the Diesel Generator Building without first providing an adequate response to 50.54(f) Request 4, and (2) to proceed with construction of the Borated Water Storage Tanks without first performing the analyses for variable foundation properties and cracks as discussed in the response to 50.54(f) Request 14.

The statement cited above notes my agreement with Ms. Stamiris' contention that CPC has exhibited a reluctance to provide requested information.

Q. 10. What is the NRC Staff response to Item 4 in Stamiris' supplement to Contention 1?

A. Without the tabulated examples of "the perfunctory manner in which CPCo deponents answered questions" promised by Ms. Stamiris in her contention, the Staff is unable to evaluate or address this contention.

Q. 11. What is the NRC Staff response to Item 5 in Stamiris' supplement to Contention 1?

A. This contention lists an example which claims to represent information withheld by the Applicant from the NRC. The specific example cited is, "The failure of CPCo. to discuss the Administration Building settlement problem with the NRC, as they [ CPCo ] did with their consultants, in the early meetings on the DGB settlement."

Ms. Stamiris is correct in her statement that CPC did not discuss the settlement of the Administration Building grade beam with the NRC during early meetings on the Diesel Generator Building settlement or associated site visits of late 1978. Although the Administration Building is not a safety related structure and CPC was not bound by 10 CFR 50.55(e) to report such a problem, the existance of that earlier problem was clearly of relevance to the 50.55(e) reports and reviews regarding Diesel Generator Building settlement.

The NRC first learned of the Administration Building grade beam problem during the NRC investigation into the Diesel Generator Building settlement while at Bechtel's Ann Arbor office in January 1979. At that time, the Bechtel civil design supervisor, Mr. G. Tuveson, informed the NRC of a similiar problem with the Administration Building and provided the NRC with a December 1977 report on the issue.

The NRC documented this information in pages 21-23 of NRC investigation report 78-20 (see Attachment 2 of Staff Testimony on Stamiris' Contention 3), which describes various simularities between the Administration Building settlement and the Diesel Generator Building settlement.

The Staff agrees with the contention that the Adminstration Building example represents information initially withheld from NRC. This information was known to the Applicant and was clearly relevant to the full understanding of the Diesel Generator Building settlement.

Q. 12. What is the NRC Staff response to Item 6 of Stamiris' supplement to Contention 1?

A. Item 6 refers to "false statements" discussed in the April 3, 1979 Keppler - Thornburg memorandum (Attachment 15) and the June 13, 1979 Thornburg - Thompson memorandum (Attachment 16)

The significance or "materiality" of these FSAR statements to NR's review is described in D. Hood's memorandum to file dated August 9, 1979, (Attachment 17). As indicated therein, these other statements would not or could not have had an influence upon a safety conclusion of the NRR staff. Rather, these other statements were viewed as an indicator of poor quality assurance performance.

DARL S. HOOD

OFFICE OF NUCLEAR REACTOR REGULATION
U.S. NUCLEAR REGULATORY COMMISSION

## PROFESSIONAL QUALIFICATIONS

I am a Senior Project Manager in the Division of Licensing, Office of Nuclear Reactor Regulation. I am responsible for managing licensing activities by the Commission with respect to Midland Plant, Units 1 and 2

I have served in the position of Project Manager with the Commission since August 1976. This position provides for the managing of radiological safety reviews of applications for licenses and authorization to construct or operate light water nuclear power plants. As of April 1980, the position also provides for the managing of the environmental reviews of such applications. I assumed responsibility for Midland Plant, Units 1 and 2, when the application for operating licenses was tendered in August 1977. Other nuclear plants for which I have previously served in this capacity are the standardization design of Westinghouse which is designated RESAR-414 (Docket STN50-572), Catawaba Nuclear Station, Units 1 and 2 (Dockets 50-413 and 50-414), and River Bend Station, Units 1 and 2 (Dockets 50-458 and 50-459).

Between June 1969 and August 1976 I held two sequential positions within the Nuclear Power Systems Division of Combustion Engineering, Inc. (C-E) at Windsor, Connecticut. After March, 1973, I was Assistant Project Manager for the Duke Power Project. This position provided assistance in directing all efforts by C-E to design, fabricate, purchase and license the nuclear steam supply systems, reactor core, and associated auxiliary systems for Cherokee Units 1, 2 & 3 and Thomas L. Perkins Units 1, 2 & 3. The position assured that all aspects of the contracts were met and that safe and reliable systems were provided to the required schedule and at a reasonable profit to C-E. I assisted Duke Power in preparing the Preliminary Safety Analysis Report (PSAR) and provided for all C-E licensing support for these units. I also provided coordination of all other nuclear plants referencing the C-E Standard Safety Analysis Report to assure compatibility with C-E standard reference design. Until March, 1973, I was a Project Engineer in C-E's Safety and Licensing Department and was responsible for licensing of nuclear power plants. I coordinated the preparation of the Millstone Unit 2 PSAR and FSAR and the Calvert Cliffs Units 1 & 2 FSAR and interfaced with NRC, the utility, architect engineer and all C-E functional departments on licensing support matters. I ensured that NRC criteria, standards, and guides were incorporated into the nuclear steam supply system design.

Between August 1966 and June 1969, I was a Nuclear Safety and Radiation Analysis Engineer in the Nuclear Safety Unit, Nuclear Division of the Martin Marietta Corporation at Baltimore, Maryland. The purpose of this position was to perform hazard evaluations for nuclear power sources applied in space missions. My primary duty was to determine public exposure to radiation for malfunctions occurring during the intended mission. I also determined means by which the hazard potential for nuclear space systems could be mitigated to the extent that nuclear safety criteria were met. I conducted research with regards to the development of suitable criteria for permissable exposure levels and their probabilities, taking into account the dependence of acceptable risk on the benefit to be derived. My primary assignment was with the SNAP 29 (Systems for Nuclear Auxiliary Power) project. My evaluations of this nuclear power source included the formulation and application of computerized models for the transport of fuel released at high altitudes, in deep ocean and in shallow waters. I derived models for these release areas to incorporate the activity into human food chains and determined the expected ingestion dose, the number of people involved and the exposure probabilities. Inhalation dose was determined for radioactive fallout from the high-altitude release.

Between February 1965 and August 1966 I was a Nuclear Quality Control Engineer within the Electric Boat Division of General Dynamics at Groton, Connecticut. The purpose of this position was to provide control of quality for naval reactor systems, components, and shielding during the construction or overhaul of submarines by this shipyard. My primary area of responsibility was shielding. Duties included establishing procedures for the inspection of fabrication and installation of lead and polyethylene shielding, and resolving problems in complying with these or other shielding procedures. The position required a knowledge of nuclear theory, S5W systems design, Bureau of Ships contract and design requirements, non-destructive testing techniques, and quality control requirements.

Between November 1963 and February 1965, I was an Aeronautical Engineer for Nuclear Propulsion and Power at the George C. Marshall Space Flight Center, National Aeronautics and Space Administration in Huntsville, Alabama. I performed investigations of the nature and magnitude of the nuclear radiation environment, shielding systems and safety systems associated with proposed nuclear space vehicles for candidate space missions.

Between November 1963 and college graduation in 1962, I held various positions including chief of a missile electronics training unit at Redstone Arsenal, Alabama; student at the U.S. Army Signal Officer's Orientation Course at Fort Gordon, Georgia; and Marine Engineer for ordinance and special weapons within the Design Division of the Norfolk Naval Shipyard, Portsmouth, Virginia.

I received a Bachelor of Science Degree in Nuclear Engineering from North Carolina State University in 1962. I am a member of the Health Physics Society.

EUGENE J. GALLAGHER

OFFICE OF INSPECTION AND ENFORCEMENT
U.S. NUCLEAR REGULATORY COMMISSION

## PROFESSIONAL QUALIFICATIONS

I am a Civil Engineer in the Division of Resident and Regional Reactor Inspection, Reactor Engineering Branch, Office of Inspection and Enforcement.

I received a Bachelor of Engineering Degree in Civil Engineering from Villanova University in 1973 and a Master of Science Degree in Civil/Structural Engineering from Polytechnical Institute of New York in 1974. I am a registered Professional Engineer in the States of Illinois (#37828), Florida (#29114) and Louisiana (#16376). I am a member of the American Society of Civil Engineers, American Concrete Institute and Tau Beta Pi National Engineering Honor Society.

In my present work at the NRC, I provide technical assistance in the area of civil engineering to Regional offices and resident inspectors with particular emphasis on the design and construction of reinforced and prestressed concrete structures, foundations, structural steel buildings and in structural testing and surveillance. In addition, I provide technical input for the development and interpretation of industry codes, standards and regulatory requirements relating to inspection activities.

From 1978 to 1981 I was a member of the NRC Region 3 inspection staff responsible for the inspections of civil engineering aspects of plants under construction and in operation. This included the Inspection of laboratory and field testing of concrete, steel and soils materials, earth embankments and dams, material sources, piping systems and reinforced and prestressed concrete structures. In addition, a review of management controls and quality assurance programs were performed at plants under construction. I participated in approximately 90 inspections of reactor facilities.

Prior to joining the NRC Staff I was employed by EBASCO Services, Inc. in New York City from 1973 to 1978. I performed designs of reinforced concrete and steel structures, design of hydraulic and water supply systems and preparation of specifications for construction. From 1976 to 1978, I was the civil resident engineer at the Waterford 3 Nuclear Plant site responsible for providing technical assistance to construction.

During 1972 and 1973 I was employed by Valley Forge Laboratory in Devon, PA performing inspection and testing on concrete, steel and soil materials.

ADDITIONAL NRC TRAINING

Fundamentals of Inspection, NRC, February 1978 (40 hours)
BWR Fundamentals Course, NRC, March 1978 (40 hours)
Concrete Technology and Codes, Portland Cement Assoc., May 1978 (80 hours)
Quality Assurance Course, NRC, August 1978 (40 hours)
Nondestructive Examination and Codes, Rockwell Int'l., August 1978 (120 hours)
PWR Fundamentals Course, NRC, November 1978 (40 hours)
Welding Metallurgy, Ohio State University, September 1980 (80 hours)

JEFFREY K. KIMBALL
GEOSCIENCES BRANCH, P-314
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U. S. NUCLEAR REAGULATORY COMMISSION
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My name is Jeffrey K. Kimball. I am employed as a Seismologist/Geophysicist reviewer, Geosciences Branch, Division of Engineering, Office of Nuclear Reactor Regulation.

I received a B.S. degree in Oceanography from the University of Michigan in 1977 and a M.S. degree in Geology from the University of Michigan in 1979, with a specialty in seismology and geophysics.

I have been employed by NRC since May 1980 as a Seismologist/Geophysicist reviewer as applied to the evaluation of applications for construction and operation of nuclear facilities, and to determine the thoroughness of this information for defining the seismic hazard for which facilities must be designed. Since joining the Nuclear Regulatory Commission staff, I have participated in the licensing activity for approximately ten sites.

From 1977 to 1980, I was a research assistant and teaching assistant at the University of Michigan. My activity as a research assistant included seismic data compilation studies for the U. S. Geological Survey and data analysis and operation of a nine station seismic network. My M.S. thesis work involved a study on surface wave dispersion of the Atlantic Ocean Basins and has been presented at national meetings of professional societies and published in a professional journal. Teaching assistant experience consisted of helping teach both introductory and advanced geology field courses in Wyoming for two summers and an introductory geology laboratory class at the University of Michigan.

I am a member of the American Geophysical Union and the Seismological Society of America, and have co-authored 7 publications including abstracts of presentations to professional societies and NUREG documents.

Question 361.4 (2.5)

You conclude that the Michigan basin fits the Appendix A to 10 CFR Part 100 description of a tectonic province. Yet the basin is characterized by the same geologic structural features and has essentially the same geologic and tectonic history as the remainder of the Central Stable Region (Eardley, 1962).

a. The Precambrian basement complex in the Michigan basin does not appear to be unique with respect to the surrounding region.

b. The Precambrian crustal features, the Keweenawan rift zone (see Hinze and others, 1975, on the Mid-Michigan gravity anomaly associated with the Keeweenawan rift zone), and Grenville Front transect the boundary of the basin. 12

c. The subsidence and deposition in the basin occurred concurrently with subsidence, arching, and doming in other parts of the Central Stable Region during the Paleozoic.

Please provide information demonstrating the distinct characteristics of the Michigan basin which distinguish it from the Central Stable Region. Include geophysical and remote sensing data which may reflect structural characteristics of the Basin and adjoining portions of the Central Stable Region.

Response

Subsection 2.5.1.1.3.1 has been revised in response to this question. 14

In addition to the information presented in revised Subsection 2.5.1.1.3, various investigations directed at evaluating inferred structures beneath Lake Michigan were recently completed by Wisconsin Electric Power Company relative to the Haven, Wisconsin, project. The results of this work are to be submitted to the NRC by Wisconsin Electric Power Company in 1979. 15

2.5.1.1.2.4 Cenozoic

Pleistocene unconsolidated surface deposits rest unconformably on the Mesozoic and Paleozoic rocks throughout the lower peninsula of Michigan. These extensive surface deposits are attributable to the last major period of continental glaciation, the Wisconsin stage, active in Michigan from 50,000 to 13,000 years ago. During the numerous periods of glacial advance and retreat of the Wisconsin stage, drift of various types was deposited across the state, including till, outwash, and glaciolacustrine deposits. Figure 2.5-2 shows the surface deposits present in the region. Glacial deposits across the state range in thickness from only a few feet in the northern portion to over 400 feet in the central portion of the state. Beneath the site the glacial drift is approximately 350 feet thick and consists primarily of outwash and till. A detailed discussion of the glacial deposits at the site is presented in Subsection 2.5.1.2.2.

2.5.1.1.3 Regional Geologic and Tectonic Structures

The north central United States is situated in the central portion of the continental craton of North America, the stable core of the continent. The craton is composed of two major tectonic divisions: the Precambrian Canadian Shield to the north and the Paleozoic age sedimentary strata to the south.[2] The contact between these major divisions is roughly located along the Canadian-United States border. To the north a complex mixture of metamorphic, igneous, and sedimentary rocks of the Canadian Shield is present in most of the eastern two-thirds of Canada. These rocks have been stable for at least the last 500 million years and contain some of the most ancient rock units exposed on earth. To the south the geologic structure of the Paleozoic portion of the craton is characterized by essentially flat lying sedimentary rocks modified only by a series of broad shallow structural basins separated by low arches. These sedimentary strata of the craton are present under the central United States. 5

✓ 2.5.1.1.3.1 Michigan Basin

Michigan's entire lower peninsula, as well as part of the upper peninsula, eastern Wisconsin, northern Illinois, Indiana, Ohio, and parts of Canada, are underlain by a broad, shallow, structural depression tectonic province with an area of approximately 122,000 square miles which is known as the Michigan Basin (see Figure 2.5-6). The Michigan Basin underwent nearly continuous subsidence and deposition from the Cambrian through Pennsylvanian Periods[3] (see Subsection 2.5.1.1.2). The general shape of the existing basin was first formed in Ordovician time, and has remained fairly constant since the end of Niagaran (Silurian) time.[52] The maximum accumulation of sediments in the center of the basin is over 14,000 feet[81] (see Figure 2.5-5). 14

The forces which produced this nearly continuous subsidence for a period of almost 300 million years were undoubtedly different than those beneath the surrounding structural highs or the Canadian Shield.

The arches and domes surrounding the Michigan Basin remained as essentially stable areas throughout most of the Paleozoic. The Wisconsin dome to the west was a structural high at the beginning of the Cambrian[82], whereas the Michigan area was part of a large basin which included the Illinois Basin.[53] Lockett[82] indicates the structural highs which form the boundaries on the southern half of the Michigan Basin were more or less positive features throughout the entire Paleozoic era. Green[83] indicated that the positive regional structures in the Indiana-Ohio area are due to subsidence of the Appalachian, Michigan, and Illinois Basins, rather than uplift between the basins. Eardley[53] indicates that the Kankakee and Findlay Arches formed during the Ordovician.

Green[83] discusses the Cincinnati Arch geologic province and states:

> Subsidence in the Michigan basin began near the close of Niagaran (middle Silurian) time. Before that subsidence, the area of Indiana, Ohio, and southern Michigan is considered to have been part of a sea floor which sloped gently toward the southeast from Illinois to Pennsylvania and Virginia. This relatively flat sea floor may be considered as having then been a structural shelf.

Green also indicates that a broad shelf area over 150 miles wide existed between the Illinois and Michigan Basins until Mississippian time. There is general agreement that the "arches" between the Illinois, Michigan, and Appalachian basins have resulted from "resistance to subsidence" rather than from actual uplift.

Development of the Michigan Basin was most rapid during the upper Silurian. About 30% of the total Paleozoic sediments was accumulated during this time. Only small patches of lower Devonian sediments are known in the basin[84] and the area was probably a low land mass during most of this time. During middle and upper Devonian, deposition resumed and over 3,000 feet of sediments accumulated in the central part of the basin.

Depsotion continued into the Mississippian without interruption. There was a short break in sediment accumulation during mid-Mississippian, and another longer break in late Mississippian which continued through mid-Pennsylvanian time. Ham and Wilson[84] state:

Clearly the most widely developed and profound Paleozoic unconformity of the craton occurs below strata of Early Pennsylvanian age.

Most of the folding related to the development of the small anticlinal features in the Michigan Basin have been assigned by Ells[9] to this late Mississippian and early Pennsylvanian activity.

Since Pennsulvanian time, the Michigan Basin has apparently been a low land mass subject to erosion. Some localized deposition occurred in the Jurassic, but this deposition appears to have occurred in low areas on the eroded Paleozoic surface.[3]

As discussed in Subsection 2.5.2 of the FSAR, only eight earthquakes of epicentral intensity greater than III (Modified Mercalli Scale) have been located on the southern peninsula of Michigan in the past 350 years. Around the basin margin, but within the Michigan Basin area as outlined in Figure 2.5-6, an additional 14 earthquakes of epicentral intensity greater than III or magnitude greater than 3.0 have been recorded. None of the events located within the Michigan Basin have had intensities greater than VI. There is no known geological control for the distribution or occurrence of the earthquakes within the basin. It has been suggested that seismic activity in this area may be related to crustal rebound resulting from the retreat of glacial ice since Pleistocene time.[85] 14

Gravity and magnetic data (Figures 2.5-86 and 2.5-9) indicate that several types of Precambrian basement rocks occur beneath the Michigan Basin. The zoning of these rocks into "structural provinces" and evaluation of their significance to the development of the basin structure have been discussed by several authors.[84,86,81] Distribution of basement rocks into zones or "provinces" by isotopic ages[87] has been modified[81] based on interpretation of gravity and magnetic data and available drill hole data and is shown in Figure 2.5-87. The basement "provinces" of Hinze[81] are very similar to the areas of basement rocks shown by Ham and Wilson.[84] The mid-Michigan gravity and magnetic anomaly have been correlated with Keeweenawan igneous activity (1.05 to 1.15 billion years). Isotopic age determinations for samples from drill holes in southeastern Michigan indicate the basement rocks in that area rang from 0.8 to 1.1 billion years. They have been correlated with the Grenville province of southern Ontario. No isotopic age determinations younger than 0.8 billion years have been recorded. Development of the Michigan Basin most likely occurred after activity along Precambrian structural zones had ceased. Movement on these zones apparently had no effect or control on the development of the basin.

Some movement along zones of structural weakness within the Precambrian basement during Paleozoic time has been postulated by Ells,[9] Hinze,[81] and others, but there is no direct evidence

of differential movement within or between basement provinces since the Precambrian. In discussing the relationship of the Precambrian basement to structures within the Paelozoic sedimentary cover, Hinze states:

> In general, the structural (anticlinal) petroleum reservoirs in the Southern Peninsula trend east-southeast to southeast, paralleling the Penokean structural trends and the mid-Michigan and southwest Michigan anomalies south of 43°30'N lat. This correlation suggests a strong relation between the basement and intrabasin structures, perhaps as a result of movement along Precambrian basement zones of weakness caused by sinking of the basin or externally applied stress fields. Hinze and Merritt (1969) cited specific examples of these relations and, as they pointed out, some intrabasin structures may be related to topographic relief on the basement surface. However, this interpretation does not rule out the presence of intrabasin structures that are unrelated to the basement.

In general, the anticlinal structures within the Michigan Basin are small, and there is insufficient data to determine the relationship, if any, between these flexures and the basement rocks. If, however, these anticlinal structures were formed by movement along basement zones of weakness during late Mississippian/early Pennsylvanian time (the date of folding indicated by Ells,[9] ) then they have been essentially stable since that time, or for over 300 million years. There are no indications that the basement rocks have had any effect on basin or intrabasin structures since the close of the Paleozoic, about 230 million years ago. Therefore, the extent of lithologic or structural provinces within the Precambrian basement (such as the Keweenawan rift zone) are not relevant to the delineation of the Michigan Basin Tectonic Province. 14

The Michigan Basin has been largely isolated from the tectonic activity which has affected other major basins in the Central Stable Region. It is located deep within the central craton area and is surrounded by features which have remained essentially stable since the Ordovician. The late Paleozoic activity, which so strongly affected the Appalachian Basin to the southeast and the Ouachita fold belt to the southwest, is also reflected in the development of the LaSalle anticlinal belt in the Illinois Basin,[53] uplifts in Texas and Oklahoma,[84] and the uplift of the Nemaha Ridge in eastern Kansas.[52] However, the effect of this widespread late Paleozoic activity in the Michigan Basin was minor. At most, it may have caused the formation of small anticlinal folds trending generally northwest-southeast.[9]

The period of slight tectonic activity within the Michigan Basin roughly correspond in time with tectonic activity elsewhere within the Central Stable Region, but this is also true for tectonic events in orogenic belts outside the Central Stable Region (i.e., the Appalachian Basin and the Ouachita fold belt). The markedly different magnitude of tectonic activity in Illinois, Kansas, Nebraska, Texas, and Oklahoma from that experienced by the Michigan Basin combined with the size of the basin (over 120,000 square miles) supports the concept of the Michigan Basin being a tectonic province as defined in 10 CFR 100, Appendix A. The basin is and has been a persistent, distinct region which has been geologically and structurally distinguishable from the remainder of the Central Stable Region since the upper Silurian over 400 million years ago. There is nothing in the seismic history of the region which suggests that the Michigan Basin should not be considered to be a tectonic province. The seismic history of the Michigan Basin clearly demonstrates that it is a region which has experienced very few events in the past 350 years, the period for which records are available. All of the events which have occurred were small (maximum intensity VI). All the data indicate that the Michigan Basin can be readily separated from the remainder of the Central Stable Region for the purposes of evaluating the potential for future vibratory ground motion. 14 5

2.5.1.1.3.2 Intrabasin Structural Features

2.5.1.1.3.2.1 Folds

Within the Michigan Basin, numerous small anticlinal flexures are present, trending generally northwest-southeast, and occurring throughout the basin (Figure 2.5-7). The knowledge of the existence of these flexures is based mostly upon data obtained from exploratory drilling for oil, primarily in Silurian and Devonian age strata.

These fold structures are described by Ells in reference to a 1930 paper by Newcombe as:

> . . . irregular, elongate plunging anticlines with local domes superimposed. In cross section the folds were said to be asymmetrical with the strong dip toward the basinward side . . . .
>
> The dips off-structure were shown to vary in the different fields from 125 to 200 feet per mile, and from 50 to 75 feet per mile on the gentle side.

These northwest-southeast trending flexures are best defined in the eastern, southeastern, and central portions of the Lower Peninsula. 5

The origin of these intrabasin structures is not known, and several mechanisms have been postulated. While the method of structural development is not fully understood, there is general agreement on the age (Paleozoic) of the features. Ells summarizes the type and origin of these structures: 5

Question 361.4 (2.5)

You conclude that the Michigan basin fits the Appendix A to 10 CFR Part 100 description of a tectonic province. Yet the basin is characterized by the same geologic structural features and has essentially the same geologic and tectonic history as the remainder of the Central Stable Region (Eardley, 1962).

a. The Precambrian basement complex in the Michigan basin does not appear to be unique with respect to the surrounding region.

b. The Precambrian crustal features, the Keweenawan rift zone (see Hinze and others, 1975, on the Mid-Michigan gravity anomaly associated with the Keeweenawan rift zone), and Grenville Front transect the boundary of the basin. 12

c. The subsidence and deposition in the basin occurred concurrently with subsidence, arching, and doming in other parts of the Central Stable Region during the Paleozoic.

Please provide information demonstrating the distinct characteristics of the Michigan basin which distinguish it from the Central Stable Region. Include geophysical and remote sensing data which may reflect structural characteristics of the Basin and adjoining portions of the Central Stable Region.

Response

Subsection 2.5.1.1.3.1 has been revised in response to this question. 14 30

Question 361.5 (2.5)

The basis for your definition of the safe shutdown earthquake rests upon the acceptance of the Michigan Basin as a separate tectonic province. The staff has been reluctant to accept subdivision of the Central Stable Region into smaller tectonic provinces. Provide additional information, such as a comparative analysis of historic and instrumental seismicity, that would permit acceptance of a lower reference acceleration than that normally used for the Central Stable Region (0.20g). Include in your analysis all those events listed in "Seismic Disturbances in Michigan" Circular 14, Geological Survey Division, Department of Natural Resources, State of Michigan (1977) or provide a rationale for their exclusion. The analysis should compare the seismicity of the region within 200 miles of the site with other similar sized areas in the Central Stable Region. 12

Response

It is our opinion that the Michigan Basin is an area that, for the purpose of evaluating the SSE at the Midland site in the context of 10 CFR 100, Appendix A and Regulatory Guide 1.70, is sufficiently distinctive, when both its geologic and seismic characteristics are considered, to justify its acceptance as a convenient and realistic tectonic or seismotectonic province. With regard to seismic considerations alone, it is difficult to see how reluctance to accept subdivision of the Central Stable Region into smaller tectonic provinces can be based on historical and instrumental seismicity. Several zones of clearly distinguishable, relatively high seismic activity occur within the Central Stable Region. However, no such zones occur within the Michigan Basin tectonic province which, on the contrary, has experienced only a few scattered small events in historic time; the maximum intensity of these was only VI (Modified Mercalli Scale). All earthquakes in the Central Stable Region larger than Intensity VII have been associated with geologic structure, except for the Anna, Ohio, activity (e.g., Marble Hill Nuclear Generating Station Units 1 and 2, Safety Evaluation Report, 1972). However, the clustering of historical seismic activity near Anna argues strongly for the association of localized structure or structures with these events as well. Additionally, several workers[1,2] have identified subsurface faults in the basement in this area. The proximity of these faults to three reliably located earthquakes, and the epicentral uncertainity of other nearby historical earthquakes, has led Mauk[3] tospeculate that the Findlay and Anna-Champaign faults may be the sources of the seismicity for this part of western Ohio. He also states[4] that, although the data are now inconclusive, it is strongly suspected that the Anna seismic zone's seismicity is related to these fault systems (which includes the Auglaize and the Logan-Hardin faults). On the basis 14

of this suspicion, the seismograph and gravity networks in the area have been restructured accordingly.

Recent studies by Algermissen,[5] Nuttli,[6] Hadley and Divine,[7] Algermissen and Perkins,[8] and Donovan et al,[9] done with the intent of providing guidance for seismic design or engineered structures, contain information applicable to the Michigan Basin and the Midland site area. These studies are all somewhat different in intent and all show somewhat different results. However, they all have three important features in common: (1) they are all based on both historic seismicity and geologic considerations; (2) all show significant differences in seismic hazard characterization within the Central Stable Region; and (3) all show the area around the Midland site to be among those areas characterized by the lowest seismic hazard level within the Central Stable Region. No later studies are known that call these general features of the Central Stable Region and the site area into questions on the basis of more recent seismicity. In particular, the updated earthquake list in the Midland FSAR does not alter the characterization of the Midland site area as a seismically quiet area within the seismically differentiable Central Stable Region. In our opinion, any new analysis using this data, such as one comparing the seismicity of the region within 200 miles of the site with other similar sized areas in the Central Stable Region, would show very similar results.

14

As requested, all vents listed in Circular 14, Seismic Disturbances in Michigan, Geological Survey Division, Department of Natural Resources, state of Michigan, have been considered. The FSAR has been amended to reflect this consideration. Of the 34 events listed in this publication as occurring in Michigan since 1872, 22 of them are outside the 200 mile radius site region, or have an intensity that is either too small (≤III) or which is unknown and presumed to be too small to be of interest. These events are excluded from further consideration in agreement with the approach taken in the FSAR.

Of the twelve remaining earthquakes listed in Circular 14, seven were included in FSAR Table 2.5-2. The intensities listed in the FSAR for these seven events are all greater than or equal to the corresponding intensities listed in Circular 14. Coordinates are given in the FSAR for five of the seven events and they agree well with those given in Circular 14. The remaining two events (May 18, 1945, and February 2, 1967) were not given precise coordinates in the FSAR but coicide in location with the coordinates in Circular 14. The maximum intensity of the remaining five events in Circular 14 is IV. They are discussed briefly below.

October 10, 1899, St. Joseph, Michigan (42°05'N, 86°31'W, intensity IV). Docekal[10] contains this account: "St. Joseph, Michigan, felt a distinct shock followed by lesser shocks. The

southern part of the city reported many dwellings swayed, windows rattled, and many families abandoned their homes. The earthquake was clearly felt for a radius of 15 miles. Kenosha, Wisconsin, reported a slight shock which was plainly felt in all parts of the city". It should be noted that Kenosha, Wisconsin is roughly 75 miles from St. Joseph, Michigan, and that this event was not report felt in GRand Rapids which is about the same distance in the opposite direction. At any rate, this intensity IV event appears genuine and has been included in the list of earthquakes felt within the site region.

February 22, 1918, Morrice, Michigan (42°51'N, 84°11'W, intensity IV). "An abrupt bump was felt at Morrice, Michigan. A first crack 150 feet long and 4 feet deep with numerous diverging cracks was reported."[10] This event has been added to the earthquake list.

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Consideration of these five earthquakes does not alter the conclusions reached in the FSAR. With the exception of the February 22, 1918, Morrice, Michigan, earthquake, the events added from Circular 14 all lie 100 or more miles away from the site. Addition of the events listed in Circular 14 increases the total number of earthquakes with intensity greater than III known to have occured within the site tectonic province, but it does not alter the maximum historical intensity at the site (estimated to be V), nor increase the maximum historical intensity (VI) within the Michigan Basin tectonic province.

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[2]Stone and Webster Engineering Corporation, "Faulting in the Anna, Ohio region,"" PSAR, Wisconsin Utilities Project, Koshkonong Nuclear Plant, Units 1 & 2, Amendment 12, Appendix 21, 1976

[3]F.J. Mauk, "Geophysical Investigations of the Anna, Ohio Earthquake Zone," NUREG Technical Report Contract No. NRC-04-76-192, Annual Progress Report, August 1, 1978, 1978

[4]F.J. Mauk, "Geophysical Investigations of the Anna, Ohio Earthquake Zone," NUREG Technical Report Contract No. AT(49-24)-0192 Quarterly Progress Report, May 1, 1977 - November 1, 1977, 1977

[5]S.T. Algermission, "Seismic Risk Studies in the United States," Proceedings of the Fourth World Conference on Earthquake Engineering, Santiago, Chile, 1969

[6]O.W. Nuttli, Design Earthquakes for the Central United States, U.S. Army Engineer Waterways Experiment Station Miscellaneous Paper S-73-1, 1973

[7]J.B. Hadley, and J.F. Devine, Seismotectonic Map of the Eastern United States, U.S. Geologic Survey, publication MF-620, 1974

[8]S.T. Algermissen, and D.M. Perkins, A Probabilistic Estimate of Maximum Acceleration in Rock in the Contiguous United States U.S. Geologic Survey, Open File Report 76-416, 1976

[9]N.C. Donovan, B.A. Bolt, and R.V. Whitman "Development of Expectancy Maps and Risk Analysis," American Society of Civil Engineers annual convention, Philadelphia, Preprint 2805, 1976

[10]Docekal, Earthquakes of the Stable Interior, with Emphasis on the Midcontinent (Vol 1 and 2), University of Nebraska, PhD thesis University Microfilms, 1970

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Response

It is our opinion that the Michigan Basin is an area that, for the purpose of evaluating the SSE at the Midland site in the context of 10 CFR 100, Appendix A and Regulatory Guide 1.70, is sufficiently distinctive, when both its geologic and seismic characteristics are considered, to justify its acceptance as a convenient and realistic tectonic or seismotectonic province. With regard to seismic considerations alone, it is difficult to see how reluctance to accept subdivision of the Central Stable Region into smaller tectonic provinces can be based on historical and instrumental seismicity. Several zones of clearly distinguishable, relatively high seismic activity occur within the Central Stable Region. However, no such zones occur within the Michigan Basin tectonic province which, on the contrary, has experienced only a few scattered small events in historic time; the maximum intensity of these was only VI (Modified Mercalli Scale). All earthquakes in the Central Stable Region larger than Intensity VII have been associated with geologic structure, except for the Anna, Ohio, activity (e.g., Marble Hill Nuclear Generating Station Units 1 and 2, Safety Evaluation Report, 1972). However, the clustering of historical seismic activity near Anna argues strongly for the association of localized structure or structures with these events as well. Additionally, several workers[1,2] have identified subsurface faults in the basement in this area. The proximity of these faults to three reliably located earthquakes, and the epicentral uncertainity of other nearby historical earthquakes, has led Mauk[3] to speculate that the Findlay and Anna-Champaign faults may be the sources of the seismicity for this part of western Ohio. He also states[4] that, although the data are now inconclusive, it is strongly suspected that the Anna seismic zone's seismicity is related to these fault systems (which includes the Auglaize and the Logan-Hardin faults). On the basis 14 30 14

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A.J. Eardley, Structural Geology of North America, Second Edition Harper Row, 1962

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Question 361.7 (2.5)

You have not responded fully to Question 361.5. Provide a comparative quantitative analysis of the seismicity within 200 miles of the site and other similar sized areas in the Central Stable Region. The purpose of this analysis is to permit a more detailed evaluation of your contention that the Michigan Basin should be considered separate from the Central Stable Region. 18

Response

As stated in the response to Question 361.5, it is our opinion that the Michigan Basin is an area that, for the purpose of evaluating the safe shutdown earthquake at the Midland site in the context of 10 CFR 100 Appendix A and Regulatory Guide 1.70, is sufficiently distinctive in both its geologic and seismic characteristics to justify its acceptance as a convenient and realistic tectonic or seismotectonic province separate from the Central Stable Region as a whole. The historical seismicity is certainly consistent with subdividing the Central Stable Region into smaller tectonic provinces. Several zones of clearly distinguishable, relatively high seismic activity occur within the Central Stable Region in terms of both numbers of events and size of the maximum historical event. However, no such zones occur within the Michigan Basin tectonic province. It has experienced only a few scattered small events in historic time, and none have had an intensity greater than VI. (The Modified Mercalli Intensity Scale has been used to measure the intensities of seismic events referred to throughout this response.) 24

To quantify these observations, a statistical test has been performed using earthquake activity rates in several subareas of the Central Stable Region. In this analysis, the Michigan Basin is compared to similar size subareas within the Central Stable Region. In this context, the Central Stable Region of the eastern United States is as outlined and described by King.[1] This region is shown in Q&R Figure 2.5-3. Although other slightly different characterizations of the precise boundaries of the Central Stable Region exist,[2,3] the outline shown in Q&R Figure 2.5-3 is conservative for the purposes of this analysis.

All historic earthquakes within this region of intensity greater than or equal to V were tabulated. The principal data sources used in this tabulation were Coffman and von Hake,[4] Docekal,[5] and Nuttli.[6] The total data set thus derived, after all obvious aftershocks are removed, consists of 174 earthquakes, with the earliest noted event occurring in 1776. Because the earthquake detection and recording process has not been uniform during the approximate 200 year interval from the first recorded event to the present (as may be readily seen by plotting a histogram of the number of events per decade for this data set), an

alternative and more uniform subset was also considered. This subset contains the 141 earthquakes of the original data set that occurred after 1900.

A total of five nonoverlapping subareas within the Central Stable Region were selected for initial analysis. These are shown in Q&R Figure 2.5-3. Subarea A of this group is the 100,000 square mile Michigan Basin as shown in FSAR Figure 2.5-6. Subareas B through E are approximately 180 mile radius circles centered near Middleport, Ohio; Springfield, Illinois; Omaha, Nebraska; and Cherokee, Oklahoma. The subarea centered near Middleport, Ohio, was selected to include the cluster of historic activity in the Anna, Ohio area, while Subarea C, centered near Springfield, Illinois, was chosen to encompass the large historic earthquake sequence north of the Mississippi embayment. Subareas D and E were selected with no particular attempt to include or exclude pockets of seismic events.

For the complete earthquake data set, 4, 25, 42, 13, and 19 earthquakes of intensities greater than or equal to V occur in Subareas A through E, respectively. For the truncated, post-1900 data set, the equivalent numbers are 2, 21, 32, 8, and 19.

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The statistical test performed using these subarea earthquake activity rates is as follows: If the Central Stable Region is assumed to be homogeneous in terms of its seismic characteristics, and if the historic earthquake record affords a reasonable estimate of the earthquake recurrence properties of the region as a whole, what are the probabilities of observing the above numbers of earthquakes in each subarea for the time intervals of the two data sets?

Assume, as is generally done, that earthquakes occur as Poisson arrivals. The Poisson process has been found to adequately describe the occurrence of large events when aftershocks are disregarded, and the assumption of this process has been used in previous analyses of eastern United States earthquakes.[7] Under this assumption, the probability of observing "n" earthquakes in "$\tau$" years given an activity rate "$\nu$" is:

$$P\ (n \text{ in } \tau/\nu) = \frac{e^{-\nu\tau}\ (\nu\tau)^n}{n!}$$

Under the conditions of the statistical test proposed above, a reasonable estimate of the activity rate is provided by the historical earthquake data. Considering first the complete data set,

$\nu$ = 174 events/200 years/1,300,000 square miles

where the area shown is that of the Central Stable Region. For a subarea of 100,000 square miles, the equivalent activity rate becomes:

$$\nu_{subarea} = 13.38 \text{ events/200 years/100,000 square miles}$$

Thus, for any subarea with data collection over a 200 year period, $\nu_T = 13.38$. For a Poisson distribution, this value is both the mean and variance. Therefore, the first integer numbers of earthquakes to fall outside the mean $\pm 1$ standard deviation range are 9 on the low side and 18 on the high side of the mean. Numbers for events outside the mean $\pm 2$ standard deviations are 6 on the low side and 21 on the high side of the mean.

Performing a similar analysis in the case of the truncated data set,

$$\nu_{subarea} = 10.85 \text{ events/76 years/100,000 square miles}$$

With data collected over a 76 year period, $\nu_T = 10.85$. The integer numbers of earthquakes falling outside the mean $\pm 1$ and $\pm 2$ standard deviations in this case are 7 and 15, and 4 and 18, respectively. 24

The integer ranges may be compared to the observed number of earthquakes in the various subareas. For the complete data set, only Subarea D falls within the mean $\pm 1$ standard deviation limits, and Subareas D and E fall within the mean $\pm 2$ standard deviation limits. For the truncated data set, only Subarea D falls within either the mean $\pm 1$ or mean $\pm 2$ standard deviation limits.

The Michigan Basin contains far fewer events and the subarea including the Anna, Ohio, activity contains far more events than would be expected from random fluctuation of a statistically homogeneous process under both data set calculations. In particular, the probability of four or less earthquakes occurring within the Michigan Basin in a 200 year period under the assumption of the above analysis is just under 0.003, while the similar probability of two or less events in a 76 year period using post-1900 data only is 0.0014.

It is our opinion that this analysis supports our previous conclusion that historic earthquake data is consistent with subdivision of the Central Stable Region into smaller tectonic provinces. Along with a number of previous and independent studies, [8,9,10,11,12,13] it shows that significant differences

in seismic hazards within the Central Stable Region exist, and that the area around the Midland site is among the areas within the Central Stable Region characterized by the lowest hazard levels.

Although the separation of Subarea B (containing the Anna, Ohio, activity) and the Michigan Basin is already clearly implied by the above analysis, a more direct consideration of the historical seismicity of the Central Stable Region suggests even more strongly that the area immediately around Anna, Ohio, should be separated both from the Central Stable Region as a whole, and from the Michigan Basin in particular, for the purposes of specifying proper seismic design parameters applicable in the near future. This has been done in all the studies referenced in the previous paragraph.

Consider, for example, the recent characterization of the Anna, Ohio, seismic source zone appearing in Nuttli and Herrman.[13] With the geography of this source zone so characterized, it has an area of about 14,000 square miles and has been the site of 12 earthquakes since 1875 with intensities of V or more. Four of these events were of epicentral intensity VII, and one was an epicentral intensity of VII to VIII. Body-wave magnitudes of 5.3 are assigned to these five earthquakes in the Nuttli and Herrmann study.[13] 24

A very distinctive feature of the Anna, Ohio, source zone seismicity is this preponderance earthquakes that have intensities of VII or greater. Of the 20 earthquakes in this intensity range within the Central Stable Region, five have occurred very near Anna, Ohio. This represents 1/4 of the earthquakes in this intensity range within approximately 1/90 of the total area. This source zone is also distinctive because 12 earthquakes with intensities of V or greater have occurred in this zone. Under the assumptions of the probability analysis above, the random occurrence of 12 or more events in such a small area is over seven standard deviations from the expected number of approximately two. This concentration of earthquake activity is equalled within the Central Stable Region, as shown in Q&R Figure 2.5-3, only in the Ozark uplift and Wabash Valley outliers of the New Madrid seismic zone.

In these ways (occurrence of large events which have an intensity of V or greater, additional relative concentration of events which have an intensity of VII or greater), the area around Anna, Ohio, is in marked contrast to the Central Stable Region as a whole and in striking contrast to the Michigan Basin.

When this data on historical seismicity is considered along with the facts that the Michigan Basin is geologically distinguishable from the remainder of the Central Stable Region and that the Michigan Basin is characterized by a consistency of the structural features within it, it is our opinion that this is an

adequate basis for considering the Michigan Basin to be a tectonic province as defined in 10 CFR 100 Appendix A.

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(1) P.B. King, The Tectonics of Middle North America, Princeton University Press, Princeton, New Jersey, 1951

(2) A.J. Eardley, Structural Geology of North America, Harper & Brothers, New York, 1951

(3) P.B. King, The Evolution of North America, Princeton University Press, Princeton, New Jersey, 1959

(4) J.L. Coffman and C.A. von Hake, (ed), Earthquake History of the United States, Publication 41-1, Revised Edition, U.S. Department of Commerce, 1973

(5) J. Docekal, Earthquakes of the Stable Interior, With Emphasis on the Midcontinent, University of Nebraska (Ph.D. Thesis), 1970

(6) O.W Nuttli, Magnitude Recurrence Relation for Central Mississippi Valley Earthquakes, Bull. Seismo. Soc. Am. 64, 1974

(7) R.K. McGuire, Effects of Uncertainty in Seismicity on Estimates of Seismic Hazard for the East Coast of the United States, Bull. Seismo. Soc. Am. 67, 1977

(8) S.T. Algermissen, Seismic Risk Studies in the United States Proceedings of the Fourth Work Conference on Earthquake Engineering, Santiago, Chile, 1969

(9) O.W. Nuttli, Design Earthquakes for the Central United States, Miscellaneous Paper S-73-1, Report 1 (1973), U.S. Army Engineer Waterways Experiment Station

(10) J.B. Hadley and J.F. Devine, Seismotectonic Map of the Eastern United States, Publication MF-620 (1974), U.S. Geological Survey

(11) S.T. Algermissen and D.M. Perkins, A Probabilistic Estimate of Maximum Acceleration in Rock in the Contiguous United States, Open File Report 76-416 (1976), U.S. Geological Survey

(12) N.C. Donovan, B.A. Bolt, and R.V. Whitman, Development of Expectancy Maps and Risk Analysis, Preprint 2805 (1976),

24

American Society of Civil Engineers Annual Convention, Philadelphia, Pennsylvania

[13] O.W. Nuttli and R.B. Hermann, Credible Earthquakes for the Central United States, Miscellaneous Paper S-73-1, Report 12 (1978), U.S. Army Engineer Waterways Experiment Station

24

Question 362.9 (2.5.4)

The response to Request 362.4 is insufficient. Table 2.5-14A shows the structural settlement measurements available to date. Provide the reasons for the lack of survey data at Benchmark Numbers A-3 and 4; C-2, 3, 4, 5, 6, and 7; and T-2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, and 15. In Subsection 2.5.4.13.1 of the FSAR, reference is made to Figure 2.5-78. The figure number is in error and should be corrected. 14

Response

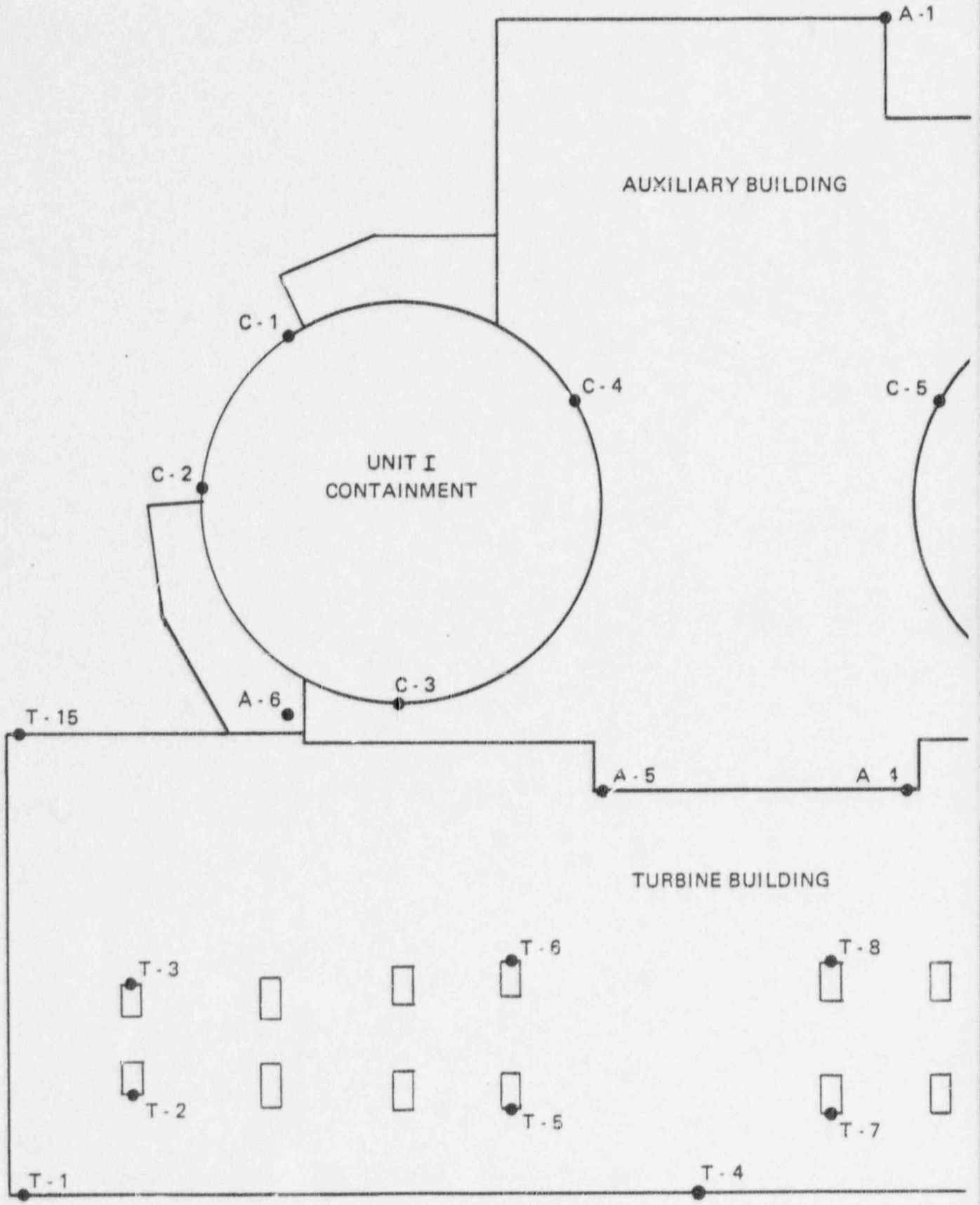
Table 2.5-14A has been revised to include the settlement measurements for the subject benchmark numbers.

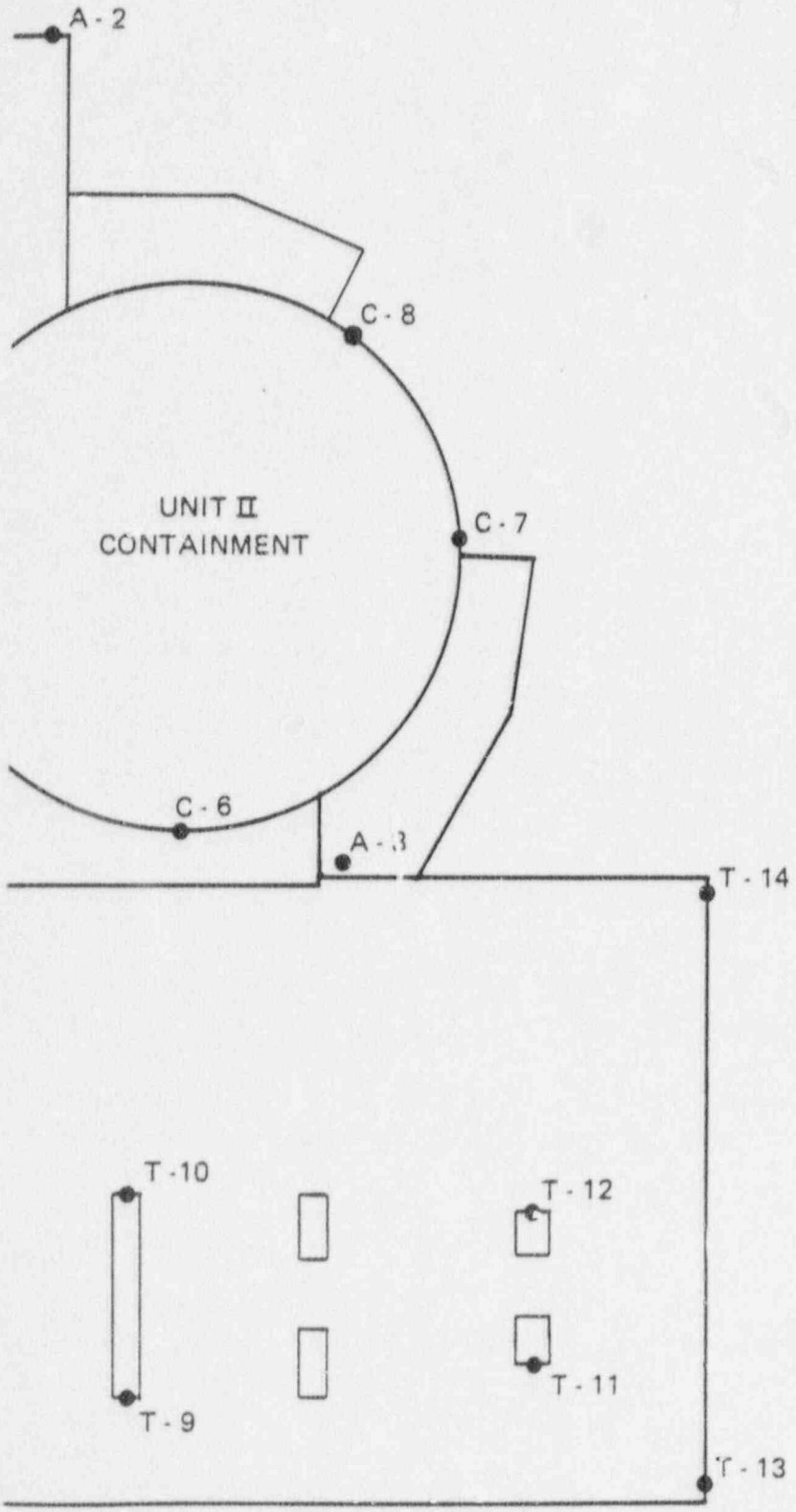
Subsection 2.5.4.13.1 has been revised to reference the correct figure.

Settlement benchmarks have been installed and monitored at selected locations on the major plant structures. Benchmark locations are shown in Figure 2.5-48A. Benchmark elevation measurements are presented in Table 2.5-14A. 18

Measured settlements were not measured from the start of construction. Available settlement measurements are presented graphically in Figures 2.5-89 through 2.5-91 for the reactor, auxiliary, and turbine buildings. Building load intensities estimated from actual material quantities used in construction are also shown in Figures 2.5-89 through 2.5-91.

Subsurface conditions for various Seismic Category I structures on fill are under investigation. The maximum predicted settlements will be recomputed based on this investigation. A comparison of the observed settlement and the maximum predicted settlement will be provided by amendment in January 1980. 20 24


A-1
AUXILIARY BUILDING
C-1
C-4
C-5
C-2
UNIT I
CONTAINMENT
C-3
A-6
T-15
A-5
A 1
TURBINE BUILDING
T-3
T-6
T-8
T-2
T-5
T-7
T-1
T-4




NOTE

A-1 MONITORING SETTLEMENT BENCH MARK LOCATION


CONSUMERS POWER COMP
MIDLAND PLANT UNITS 1
FINAL SAFETY ANALYSIS RE

Settlement Bench Mark Locati
the Power Block
(SK-G-209)

FSAR Figure 2.5-48A

10/78 Revi

Question 362.9 (2.5.4)

The response to Request 362.4 is insufficient. Table 2.5-14A shows the structural settlement measurements available to date. Provide the reasons for the lack of survey data at Benchmark Numbers A-3 and 4; C-2, 3, 4, 5, 6, and 7; and T-2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, and 15. In Subsection 2.5.4.13.1 of the FSAR, reference is made to Figure 2.5-78. The figure number is in error and should be corrected. 14

Response

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Subsurface conditions for various Seismic Category I structures on fill are under investigation. The maximum predicted settlements will be recomputed based on this investigation. A comparison of the observed settlement and the maximum predicted settlement will be provided by amendment. 20 26

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

Attachment 9

MAR 31 1980

Docket Nos.: 50-329/330

APPLICANT: Consumers Power Company

FACILITY: Midland Plant, Units 1 & 2

SUBJECT: SUMMARY OF FEBRUARY 27 & 28, 1980 MEETING AND SITE TOUR WITH CONSULTANTS TO REVIEW SOIL SETTLEMENT

On February 27 and 28, 1980, the NRC staff and three organizations recently acquired to support the staff safety review of geotechnical and interfacing matters, met with Consumers Power Company (the applicant), Bechtel and Bechtel consultants at the site for Midland Plant, Units 1 & 2. The three organizations supporting the staff review are the U. S. Army Corps of Engineers, Energy Technology Engineering Center, and U. S. Naval Surface Weapons Center. The purpose of the visit was to review and observe site backfill deficiencies and effects. This was the initial visit for the staff's consultants and the meeting was held to assist these consultants with their review of existing documentation on the background, remedial work and present status of this matter. Meeting attendees are listed in Enclosure 1.

The information reviewed at this meeting is contained in Amendment 72 to the Midland FSAR, December 19, 1979, for which referenced material is forwarded in two volumes by the applicant's letter of February 11, 1980. One of the volumes entitled "10 CFR 50.55(e), Interim Reports, Settlement of Diesel Generator Foundations and Building," consists of the 10 CFR 50.55(e) reports sent by the applicant to the staff's Office of Inspection and Enforcement from November 7, 1978 through September 5, 1979. The other volume, entitled "Responses to NRC Requests Regarding Plant Fill," consists of the applicant's 10 CFR 50.54(f) responses to the Office of Nuclear Reactor Regulation submitted April 24, 1979 through November 13, 1979. These documents represent the applicant's reports upon which the staff's order of December 6, 1979 requiring modification of the construction permits is based. The meeting also included a preview of information to be contained in Revision 5 to the applicant's responses in the latter volume intended for submittal about the end of February, 1980. Revision 5 will include responses to the staff's supplemental requests of November 19, 1979. Only information not contained in these documents is included in this meeting summary.

In opening remarks, Mr. G. Keeley announced that Consumers Power Company has elected to defer all remedial work on inadequately supported structures until acceptance of the proposed work is received from the staff. This action is

voluntary on the applicant's part since the effective date for the staff's December 6, 1979 order is to be established by the Hearing Board pursuant to 10 CFR 2.204. The basis for this decision was said to be to preclude potential loss of revenue associated with expenditures for which staff approval has not been granted. The staff observed that this was a prudent decision, particularly in view of the significant slip in construction completion projected by Bechtel and currently under review by the applicant and due to other causes, principally the TMI-2 accident.

Presentations were also given by Bechtel consultants. Mr. C. H. Gould described the procedure for placement of caissons beneath the electrical penetration area (i.e., wing walls) of the Auxiliary Building and beneath the Feedwater Isolation Valve Pit area. Mr. M. T. Davisson described the procedure for placement of piles to support the northern portion of the Service Water Building. Dr. A. J. Hendron, Jr. reviewed the preloading program completed for the Diesel Generator Building and discussed why the preload option was elected in lieu of other possible corrective alternatives. Dr. R. B. Peck summarized the recommendations of the Bechtel consultants and emphasized that the preloading option is considered to eliminate the need for any further testing or measurements as a basis for establishing confidence for future settlement potential of the Diesel Generator Building. A summary of these discussions by the Bechtel consultants will be submitted as an amendment to the FSAR.

During the meeting, references were made to certain information and reports which have not been made available to the NRR staff, although some of these have been examined by I&E through the audit mechanism. Examples include:

1. Some of the figures listed in the drawing summary for the interim reports to MCAR #24 which are not included with the compilation of reports forwarded by the applicant's letter of February 11, 1980, even after noted figure replacements and redundancy are taken into account.

2. Installation details of each piezometer used to monitor pore water pressures during the preload program (e.g., type and actual elevations of installed piezometers, backfill materials and zone thickness).

3. Reports, meeting summaries, or other written communications with or by consultants recommending or supporting remedial measures for structures and utilities located upon or in questionable soils.

4. Reports of the evaluation (e.g., bases, procedure, execution and results)of the initial qualification and subsequent requalification of compaction equipment.

5. The report "Tank Farm Investigation; Midland Units 1 & 2," issued October, 1979.

The staff noted that such documents as above are needed by its consultants for their independent assessment of the adequacy of the proposed remedial measures and requested that these be made publicly available. The applicant indicated a reluctance to this end, and noted that these were available through the I&E audit mechanism. The staff will issue a formal request for these documents. The staff also noted that the boring logs provided in Appendix 2A of the FSAR did not reflect those borings associated with piezometer installation; the applicant replied that these would be added.

Site tours were provided in groups based upon the following engineering disciplines: (1) Geotechnical, (2) Structural, (3) Mechanical, and (4) Hydrologic.

During the tour the Corps noted that except for the use of temporary blocks, the service water pipe would otherwise be in direct contact with the base of the penetration through the northern wall of the Service Water Building. It is postulated that this results from the more rapid settlement of the buried pipe relative to the building's cantilevered settlement. The Corps emphasized that special attention should be given this area to avoid stressing the pipe at the penetration, particularly during pile driving and after attachment of the piles to the structure.

The staff noted that the presentation by Mr. C. H. Gould included the specification of some quantitative criteria to be applied during the remedial action for the Auxiliary Building. The staff asked if similar criteria were specified by the other Bechtel consultants, but was advised that these other criteria were more of a qualitative, subjective nature.

The staff also requested the applicant to submit a description of the services to be performed by consultants R. B. Peck, A. J. Hendron, Jr., C. H. Gould and M. T. Davisson through the completion of construction on the remaining remedial fixes. This description should identify the extent of continued involvement of the consultants in overseeing construction operations and in evaluating the effectiveness of completed fixes for which they have provided major design input.

Darl S. Hood

Darl S. Hood, Project Manager
Light Water Reactors Branch No. 4
Division of Project Management

Enclosures:
1. Attendees
2. Agenda

cc w/enclosures:
See next page.

ENCLOSURE 1

ATTENDEES

Consumers Power

G. S. Keeley
T. C. Cooke
T. Thiruvengadam
D. E. Horn

Bechtel

Harris Burke
Sherif Afifi
Don Riat
Bimal Dhar
Bill Paris
Julius Rotc
Jim Wanzeck
Karl Wiedner
John Rutgers
Lynn Curtis
Al Boos
Chuck McConnel
Walter Ferris

Consultants

R. B. Peck
A. J. Hendron, Jr.
C. H. Gould
M. T. Davisson

NRC

L. Heller

J. Kane
A. Cappucci
F. Rinaldi
R. Gonzalis

D. Hood
G. Gallagher
R. Cook

US Corp Of Engineers

N. Gehring
J. Grundstrom
W. Otto
W. Lawhead
P. Hadala
J. Simpson

J. Norton

R. Erickson

ETEC

W. P. Chen
J. Brammer

US Navy Weapons Center

P. Huang
J. Matra

ENCLOSURE 2

AGENDA FOR

MEETING WITH NRC ON MIDLAND PLANT FILL STATUS AND RESOLUTION

February 27 & 28 1980

Midland Site

| | | |
|---|---|---|
| 1.0 | INTRODUCTION | G. Keeley |
| 2.0 | PRESENT STATUS OF SITE INVESTIGATIONS | T. Cooke |
| | 2.1 Meetings with Consultants and Options Discussed (Historical) | |
| | 2.2 Investigative Program | |
| | A. Boring Program<br>B. Test Pits<br>C. Crack Monitoring and Strain Gauges<br>D. Utilities | |
| | 2.3 Settlement | |
| | A. Area Noted<br>B. Preload<br>C. Instrumentation | |
| 3.0 | WORK ACTIVITY UPDATE | J. Wanzeck |
| | 3.1 Summary of work activities and settlement surveys for all Category I structures and facilities founded partially or totally on fill | |
| 4.0 | REMEDIAL WORK IN PROGRESS OR PLANNED (Q4, 12, 27, 31, 33 & 35) | S. Afifi |
| | 4.1 Diesel Generator Structures<br>4.2 Service Water Pump Structures<br>4.3 Tank Farm<br>4.4 Diesel Oil Tanks<br>4.5 Underground Facilities<br>4.6 Auxiliary Building and FW Isolation Valve Pits<br>4.7 Liquefaction Potential | |
| 5.0 | EVALUATION OF PIPING (Q16, 17, 18, 19 & 20) | D. Rist |
| 6.0 | DEWATERING (Q24) | B. Paris |
| 7.0 | ANALYTICAL INVESTIGATION | B. Dhar |
| | 7.1 Structural Investigation (Q14, 26, 28, 29, 30 & 34)<br>7.2 Seismic Analysis (Q25)<br>7.3 Structural Adequacy with Respect to PSAR, FSAR, etc. | |
| 8.0 | SITE TOUR | All |
| 9.0 | CONSULTANTS SUMMARY | Peck/Hendron<br>Gould/Davis |
| 10.0 | DISCUSSION | All |

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

APR 1 1980

Docket Nos.: 50-329/330

Mr. S. H. Howell
Vice President
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Dear Mr. Howell:

SUBJECT: REQUEST FOR REPORTS, DRAWINGS AND OTHER INFORMATION REGARDING PLANT FILL SETTLEMENT AND EFFECTS

As indicated in previous correspondence and our meeting with your staff on February 27 and 28, 1980, the NRC staff reviews of the adequacy of the backfill soils, settlement effects and associated remedial actions are proceeding with the support of three outside organizations or agencies: the U. S. Army Corps of Engineers, the U. S. Naval Surface Weapons Center, and the Energy Technology Engineering Center. In order that they may perform the independent assessments of these areas as we have requested, we and they require detailed reports and drawings on these matters.

Drawings

Our review of the "Drawing Summary" in Management Corrective Action Request 24 indicates that several of the 91 drawings listed in Interim Report 8 are not included with the compilation of reports forwarded by your letter of February 11, 1980 as the volume entitled "10 CFR 50.55(e), Interim Reports, Settlement of Diesel Generator Foundations and Building." Some of the drawings listed in the summary are noted to be replaced by other drawings, and overlaps in drawings occur with the successive updating of the list from one interim report to the next. Notwithstanding this replacement and overlap, some drawings are not provided. We request that you amend this volume to include all missing drawings and to provide an index table specifying the location of each drawing.

Reports

We request that you provide 40 copies of all reports, including meeting summaries and other written communications, with or by consultants who have performed investigations or tests or made recommendations regarding the supporting soils or remedial measures for structures and utilities located on or in questionable materials. An example of the reports needed is provided by Enclosure 1 which lists a few of the reports by Bechtel and

DUPE OF 8004250001

by Bechtel's consultant, Goldberg-Zonino-Dunnicliff. The list is not intended to be complete nor to identify all consultants involved. Rather, it is intended to illustrate the level of technical detail needed. We request that you include our consultants for direct receipt of a set of these documents.

Other Information

We require information detailing the installation of each piezometer used to monitor pore water pressures during the surcharging program. This should include the type and actual elevations of the installed piezometers, the types of backfill material placed and their extent in the drilled hole.

We also require a description of the services to be performed by consultants R. B. Peck, A. J. Hendron, Jr., C. H. Gould and M. T. Davison. This description should identify the extent of the continued involvement of these consultants in overseeing the remedial construction operations and in evaluating the success of the completed fixes intended to provide stable foundations for the various structures.

We would appreciate receipt of the above documents, drawings and information within 20 days of receipt of this letter. Please advise us within 7 days if you will meet this schedule so that we may adjust our review schedules accordingly.

Sincerely,

L. S. Rubenstein, Acting Chief
Light Water Reactors Branch No. 4
Division of Project Management

Enclosure:
List of Reports

cc w/enclosure:
See next page.

Consumers Power Company

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Consumers Power Company

ccs (continued):
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Weapons Center
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White Oak
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Mr. L. J. Auge, Manager
Facility Design Engineering
Energy Technology Engineering Center
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Canoga Park, California 91304

Mr. William Lawhead
U. S. Corps of Engineers
NCEED - T
477 Michigan Avenue
7th Floor
Detroit, Michigan 48226

ENCLOSURE 1

Sample Listing of Reports Needed by Staff's Consultants

I. Reports Prepared by Goldberg-Zonino-Dunnicliff

1. Report entitled "Test Pits 1, 2 & 3," dated Feb. 1980
File No. 2190 (Index C-79(Q)-20)

2. Report "Data Summary and Laboratory Procedures," dated Feb. 1980
(Index C-79(Q)-16)

3. Report "Consolidation Tests," dated Feb. 1980
(Index C-79Q-17)

4. Report "Strength Tests," dated Feb. 1980
(Index C-79Q-18)

5. Report "Miscellaneous Tests," dated Feb. 1980
(Index C-79Q-19)

6. "Soil Classification and Moisture Density Relation" dated Feb. 1980
(Index C-79(Q)-21)

7. "Diesel Generator Building Instrumentation," dated October 1979
(Index C-82(Q)-5)

8. "Aquaducer Hose Settlement Gage Instrumentation Manual"
(Index C-79(Q)-4)

9. "Report on Sondex Gages and Borros Anchors"
(Index C-82(Q)-8)

10. "Report on Sondex Gages and Borros Anchors"
(Index C-82(Q)-9)

11. "Procedure for Reading Sondex System"
(Index C-82(Q)-2)

12. "Procedure for Reading Modified Borros Anchors"
(Index C-82(Q)-3)

II. Bechtel Reports

13. "Test Pit 1 Data," dated Sept. 1979 (Index C-79(Q)-10)

14. "Test Pit 2 Data," dated Sept. 1979 (Index C-79(Q)-11)

15. "Test Pit 3 Data," dated Sept. 1979 (Index C-79(Q)-12)

16. "Test Pit 4 Data," dated Sept. 1979 (Index C-79(Q)-13)

17. "Plate Load Test PL-1," dated Sept. 1979 (Index C-79(Q)-14)

18. "Plate Load Test PL-2," dated Sept. 1979 (Index C-79(Q)-15)

19. "Qualification of Compaction Equipment"

20. "Tank Farm Investigation"

Attachment 11

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JAN 12 1979

DOCKET NOS. 50-329
50-330

APPLICANT: Consumers Power Company

FACILITY: Midland Plant, Units 1 & 2

SUBJECT: SUMMARY OF DECEMBER 4, 1978 MEETING ON STRUCTURAL SETTLEMENTS

On December 4, 1978, the NRC staff met in Midland, Michigan with Consumers Power Company (CPCO), Bechtel Associates, and consultants in geotechnical engineering to discuss excessive settlement of the Diesel Generator (DG) Building and pedestals, and settlement of other seismic Category I structures. These technical discussions followed a site tour on December 3, 1978 during which the NRC staff observed each of these structures. Attendees for the tour and technical discussions are listed in Enclosure 1. Enclosure 2 is the agenda used during the technical discussion.

1. Background

Pursuant to 10 CFR 50.55(e), CPCO notified Region III of the Office of Inspection and Enforcement (I&E) on September 7, 1978, that settlement of the Midland DG Building foundation and generator pedestals was greater than expected and that a soils boring program had been started to determine the cause and extent of the problem. An interim status report was provided I&E by CPCO's letter of September 29, 1978. I&E conducted inspections on this matter on October 24-27, 1978 and issued inspection report number 50-329/78-12; 50-330/78-12.

2. History

The Bechtel representative identified the Category I structures and the type of material supporting the structure:

a. Containment - Glacial Till

b. Borated Water Storage Tank - Plant Fill

c. Diesel Generator Building and Pedestal - Plant Fill

d. Auxiliary Building - Part Glacial Till & Part Plant Fill

e. Service Water Intake - Glacial Till (Completed portion only)
- Plant Fill (Small portion yet to be constructed)

The settlement monitoring program began in June 1978; to date the measured settlements are as follows:

Containment - 1/4" to 5/8" over last 1-1/2 years

Auxiliary Building - Approximately 1/8" (central portion)

Service Water Pump House - 0 to 1/8"

Diesel Generator Building - 3 to 4" since footing was poured October 1977 and walls in Spring 1978.

The four electrical duct banks rising into the DG Building, and which extend downward into the glacial till, were cut loose to remove the settlement restriction on the north side of the DG Building. When the duct banks were cut loose, settlement on the order of 2" occurred on the north side of the DG Building at a rapid rate. The east wall exhibited rapid settlement (1/8" in one week), but the west wall showed very little subsequent settlement. This indicates that the east wall was being held up by the duct pedestal.

3. Soils Exploration

Bechtel discussed the soil exploration program, including the boring program and laboratory testing of the foundation materials. The conclusion that was made by Bechtel is that the material varies across the site in strength properties, i.e., unconfined compressive strength from 200 PSF to 4000 PSF and shear strength from 100 PSF to 2000 PSF. The soils classification ranged from Cl to Ml.

Bechtel also discussed possible causes based on input from a consultant, Dr. R. Peck. Some of these causes were:

(1) Variable quality of material used in the plant fill, however, the quality control records do not indicate the variation.

(2) Fill may have been placed on the dry side of optimum moisture, and then when the water table rose inundating the fill, the material may have become "soft."

(3) Initial fill may have been placed satisfactorily but after installing pipe trenches and duct banks, the fill may have been disturbed.

4. Consultants Perspective

Dr. R. B. Peck stated the following:

a. The compacted fill is comprised mainly of glacial till and was excavated from the cooling pond area.

b. Evidence exists from the Dutch cone curve that the looser and softer areas are limited to local zones or lenses.

c. Water content is higher than at the time the fill was placed. Settlement of the till has been occurring since original placement of fill, accelerated by increased moisture content resulting from filling of the discharge cooling pond. Soil settlement is occurring under its own weight and the added weight of the building is believed to be insignificant.

d. The DG Building would probably not have settled as much if the material had not been so wet (moisture content is high).

e. Bearing capacity is not a problem for the footings.

f. Short of removing all the fill above the hard glacial till, a "preload" program would be the best approach. The preload purpose would be to consolidate the fill materials.

g. The settlement with the preload would tend to be rapid (a few weeks to a few months).

h. The preload is a necessary first step even though other measures might be necessary.

i. The main unknown is what might happen to the rate of settlement as the water table rises and saturates the fill.

j. Preloading would occur in early 1979 and the sand used as the surcharge would be removed in mid-1979.

Mr. C. J. Dunnicliff of Goldberg, Zoino, Dunnicliff & Associates described the instrumentation program to monitor the settlement of the foundation material and structures during the preload. The purpose of the instrumentation is to determine if the surcharge is doing its job of consolidation and if it is causing any harm to the structures or utility lines under and around the building.

a. Instrumentation for the structure will include optical survey measurements as well as monitoring of cracks using electrical devices. Four locations for the electrical devices have been chosen; two on the exterior of the east wall of the DG Building and two on the west wall of bay number four in the DG Building. A mapping of cracks will be developed.

b. Foundation monitoring will include devices to measure settlement and pore water pressure. A total of 60 anchors will be installed (20 groups of 3 at different elevations). A total of 40 piezometers are to be installed to measure the pore water pressure.

The consultants indicated that 6" settlement would not be a surprise and that up to as much as 18" could occur. The preload will be made up of 15 to 20 feet of sand piled in and around the DG Building. No more than a 5-foot differential in the sand level between bays would be permitted.

The NRC questioned the effect of settlement and preloading on the condensate lines located under the DG Building. Fixed points for the piping, such as the Turbine Building wall, are also of interest for the potential of cantilever effects. Bechtel explained that the 20-inch condensate lines are encased in 24-inch lines surrounded by concrete and resting in well compacted sand. Instrumentation will be included to monitor the condensate lines. The possibility of cutting the lines loose at the DG Building and the Turbine Building is also being studied. The condensate lines have no safety-related function for the Midland design.

The NRC also expressed concern for the effect of settlement on the fuel oil lines under the building. CPCO stated that re-routing of lines can be readily accommodated if necessary. This matter is also under review.

The NRC Resident Inspector asked for a list of the equipment, with a discussion of the compacting capability and limitations of each, used for compacting the fill for the DG Building from elevation 618 to 628 feet. Bechtel will provide this information.

5. Program Status

Bechtel summarized the activities completed, in progress, and planned for the future:

a. Activities Completed

(1) Boring program

(2) Isolation of the electrical duct banks on the north side of the DG Building

b. Activities in Progress (or soon to be initiated)

(1) Foundation settlement monitoring program

(2) Preload instrumentation program

(3) Actual preload of the structure and foundation

(4) Filling the cooling pond to maximum elevation (Elevation 627)

(5) Complete construction of the rest of the DG Building structure

c. Activities Planned

(1) After removal of the surcharge, assure contact between footings and soil foundation material

(2) Verify utilities and structure integrity

6. Project Schedule

Bechtel presented the following project schedule information:

Construction is 58% completed as of November 1978
Engineering is 80% complete
Structural concrete is 97% complete
Fuel load target date is November 1980
Earliest requirement for one diesel generator is January 1980
Current completion date for one diesel generator is January 1980
Latest date for one diesel generator is June 1980

Bechtel emphasized that the installed instrumentation will show when the preload surcharge may be removed and therefore the present schedule is somewhat tentative. Most settlement is predicted to occur rapidly as the area is being preloaded and frequent readings will be taken during this period and used as a basis for further projections. The rate of settlement will decrease thereafter and the total settlement is expected to be reached within a few months.

CPCO stated that if necessary, temporary diesels could be used during preoperational testing prior to fuel loading and that this matter is presently under study.

7. Response to Open Items in NRC Inspection Report

Bechtel addressed the open items included in NRC inspection report Nos. 50-329/78-12 and 50-330/78-12. CPCO stated that a written response would be sent to I&E Region III to resolve the conflict between the FSAR and site implementing procedures:

a. Conflict between FSAR Table 2.5-14 and Table 2.5-10 regarding the description of fill material and what was actually used in the random fill: Bechtel stated that this conflict was an oversight and that an FSAR amendment would be issued. The NRC staff stated that any such amendment should address both the previous and the adjusted entries such that the basis for the previous staff review is not obscured in the documentation.

b. Conflict between FSAR Table 2.5-21 and Bechtel Specification C-210 regarding number of passes for compaction: Bechtel stated that FSAR Table 2.5-21 is for the embankments for the cooling pond dikes.

c. FSAR Section 3.8.5.5 regarding expected settlement: Bechtel stated that 1/2-inch indicated in the FSAR was a mistake and that the FSAR would be amended to correct this mistake.

d. Conflict between FSAR Figure 2.5-47 and project drawing regarding foundation elevation: Bechtel stated the elevations in the FSAR was also a mistake and would be corrected.

e. Conflict in Bechtel Specification C-210 regarding compactive effort: Bechtel stated that Field Change Request C-302 dated 10/31/75 clarified this conflict and permitted the "Bechtel Modified Protector" using 20,000 ft-lbs compactive effort rather than the ASTM standard of 56,000 ft-lbs.

f. Conflict between Dames & Moore recommendation regarding lift thickness of 6 to 8 inches and the Bechtel specification permitting up to 12 inches: Bechtel stated that the greater depth permitted by their specification should not matter because of performance qualification tests. However, the NRC was then informed that the test qualifications performed were for Zone 1 clay only, and that no test qualifications on the random fill material using 12 inches was performed to qualify such lift thicknesses. Dr. Peck stated that the thicker the layer, the more differences in compaction through the thickness of the layer would occur.

g. Tolerance of ± 2% in moisture content permitted in Bechtel Specification C-210: Bechtel stated that this tolerance is in line with industry practice.

Dr. Peck was asked his view on this ± 2% tolerance. He stated that the important question is "± 2% of what material." Since the material used in the fill was variable, the ± 2% tolerance could cause a problem if the material is not consistent.

h. Cracks in the building structure: Bechtel stated that all cracks greater than the ACI 318-71 limit would be identified and repaired after the preload program.

i. FSAR question 362.2: Bechtel stated that the answer had been sent to NRC via FSAR revision 15 in November 1978.

CPCO stated that the reply to the inspection report is in process, and that the reply will include copies of all data, slides, and drawings presented during this meeting.

In concluding remarks, CPCO stated its intent to proceed with the preloading program as described during the meeting.

In its closing comments, the NRC staff stated that the proposed solution is at the risk of the applicant and that NRC intends to review and evaluate this matter in accordance with the original compaction requirements as set forth in the commitments in the PSAR. The staff also stated that while attention to remedial action is important, determination of the exact cause is also quite important for verifying the adequacy of the remedial action, assessing the extent of the matter relative to other structures, and in precluding repetition of such matters in the future.

Darl Hood

Darl Hood, Project Manager
Light Water Reactors Branch 4
Division of Project Management

Enclosures:
As stated

Consumers Power Company

JAN 12 1979

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ENCLOSURE 1

JAN 12 1979

ATTENDEES DECEMBER 4, 1978 MEETING

P. A. Martinez, Bechtel
Karl Wiedner, Bechtel
* S. S. Afifi, Bechtel
R. B. Peck, Bechtel Consultant
* W. R. Ferris, Bechtel
M. O. Rothwell, Bechtel
* D. B. Miller, CPCO - Project
* J. P. Betts, Bechtel
W. L. Barclay, Bechtel
* A. J. Boos, Bechtel
G. L. Richardson, Bechtel
* D. E. Horn, CPCO - QA
W. R. Bird, CPCO-QA
* R. M. Wheeler, CPCO - PMO
* C. A. Hunt, CPCO - Engineering Services
D. E. Sibbald, CPCO Project
John Dunnicliff, Bechtel Consultant
* Austin Marshall, Bechtel - Geotech
* Y. K. Lin, Bechtel - Geotech
* B. C. McConnel, Gechtel - Geotech
* B. Dhar, Bechtel
* N. Swanberg, Bechtel
* Darl Hood, NRC LPM
* Gene Gallagher, NRC Region III (I&E)
* Daniel Gillen, NRC/NRC Geosciences
* Lyman Hiller, NRC/NRR Geosciences
* Ronald Cook, NRC Resident Inspector

*Present during both the 12/3/78 site tour and the 12/4/78 meeting.

Enclosure 2

SUBJECT: CPCo Midland Plant Units 1 & 2
Diesel Generator Building

Meeting with NRC at Midland

JAN 12 1979

DATE: December 4, 1978

AGENDA

I. Introduction by CPCo

II. History by Bechtel (N. Swanberg)

a. Plant description
b. Settlement monitoring program
c. Brief history of site fill placement
d. Settlement of Category 1 structure
e. Settlement of diesel generator building and pedestals
f. Review settlement data and drawings (SK-C-620/623)
g. Consultants

III. Soil Exploration by Bechtel (S. Afifi)

a. Soil borings
b. Dutch cone penetrations
c. Laboratory tests
d. Possible causes

IV. Consultant's Recommendation by Dr. R.B. Peck and C.J. Dunnicliff

a. Preload
b. Instrumentation

V. Status report by Bechtel (B.C. McConnell)

a. Activities completed
b. Activities in progress
c. Activities planned for future
   1) Corrective action
   2) FSAR conformance

VI. Schedule by Bechtel (P. Martinez)

a. Overall project
b. Impact on project schedule
c. Schedule for remedial measures

VII. Responses to open items in NRC Inspector's report dated 11/17/78 by Bechtel (B. Dhar)

JAN 12 1979

a. Responses to Gallaghar's concerns:
   1) Conflict between FSAR Table 2.5-14 and Table 2.5-10 regarding fill material description
   2) Conflict between FSAR Table 2.5-21 and Specification C-210 regarding required number of passes for compaction
   3) FSAR Section 3.8.5.5 - expected settlement
   4) Conflict between FSAR Figure 2.5-47 and project drawing regarding foundation elevation
   5) Conflict in Specification C-210 regarding compactive effort in test method
   6) Conflict between consultant's recommendation and Specification C-210 regarding 1 ft thickness
   7) ± 2% tolerance in moisture content permitted in Specification C-210
   8) Cracks in the building structure

b. FSAR Question 362.2 (Section 2.5.4.5.1)

VIII. Closing Comments by CPCo

Attachment 12

Consumers Power Company

# ORAL COMMUNICATIONS RECORD

PROJECTS, ENGINEERING AND CONSTRUCTION - QUALITY ASSURANCE DEPARTMENT

QA5-0

CROSS FILE NO WRB 51-80

PAGE 1 OF 2

DATE OF COMMUNICATION 5/12/80 & 5/13/80 IN-PLANT PERSONNEL PARTICIPATING WRBird (DHorn 5/13/80 only)

TIME OF COMMUNICATION _____ OTHER PARTY(S) G Gallagher, NRC

PREPARED BY WRBird

PROJECTS AND/OR SUBJECTS DISCUSSED

DIESEL GENERATOR SETTLEMENT PROBLEM - 50.54(f) COMMITMENTS ON EQUIPMENT QUALIFICATION

SUMMARY OF CONVERSATION

5/12/80 - Mr Gallagher asked my assistance in obtaining compaction equipment qualifications. NRC had asked for their submittal. The latest 50.54(f) response did not submit the data. He said he had talked to D Horn several times over the last weeks about the NRC concerns that the qualification records were not available. The following three points were made: 1) Qualifications are considered a permanent "Quality Record." 2) If they don't exist how can CPCo justify old work or justify continuing work? 3) Letters stating equipment is qualified is not good enough - a qualification report is needed.

I stated that I would investigate the situation and take appropriate action. Mr Gallagher stated that he would ask to see, report on his next visit, and that there are other vehicles to accomplish their needs.

5/13/80 - We called Mr Gallagher back to give him a status of what my investigation revealed and what specific actions we had directed:

1) Bechtel will release an official design disclosure (most likely SCN to Specification C-211) which will list the equipment qualifications and the limits of the qualification.

(OVER)

2) Bechtel Engineering had completed their review of the qualification report and Consumers will be finishing up our review today.

Mr Gallagher wondered how we could have been placing soils since last summer if a qualification report had not been reviewed and approved by Quality. He stated it would be a very serious situation if the analysis of the report showed there was equipment deemed to be not qualified which had been used for soils placement. Don Horn stated that his review to date has resulted in some questions on qualifications for placement of clay but that no Q placements have been made with this equipment. The qualification of the equipment for placement of sands appear to be substantiated. To our knowledge, no Q placements had been made prior to Bechtel Project Engineering's release of the equipment in writing to the field.

We stated that the qualification report was planned to be submitted in a June submittal.

WRB/lr

Editorial Note - Neither our 50.54(f) response nor the Bechtel Program requirements require a Quality Assurance line involvement in the Engineering activities to certify the qualification of the compaction equipment. FIC 1.100 places the qualification and records for qualification of compaction equipment with Geotech.

CC: JWCook, P14-116A
JLCorley, Midland
LHCurtis, Bechtel AA
LEDavis, Bechtel-Midland
LADreisbach, Bechtel-Midland
[redacted]
DEHorn, Midland
BWMarguglio, JSC-220A
JMMandin, Bechtel AA
DBMiller, Midland
JARutgers, Bechtel AA

Attachment 13

To File

From TCCooke/RMW

Date August 7, 1979

Consumers Power Company

Internal Correspondence

Subject MIDLAND PROJECT CWO 7020
PRE-MEETING WITH CONSULTANTS 6/27/79
File: B3.0.3 Serial: CSC-4274 UFI#-00234-S-

cc Attendees
GSKeeley, P14-408B
DBMiller
KCBrooks (2)

---

Attendees:

Karl Wiedner, Bechtel Power
Phil Martinez, Bechtel Power
Sherif Afifi, Bechtel Power
Dr. Ralph Peck, Consultant
Dr. A. Hendron, Jr., Consultant
Dr. M. T. Davisson, Consultant
Tom Cooke, Consumers Power Company

There was a brief discussion on the various options. One of the main reasons for Option Five (Areal Dewatering) was that it grew to a large extent out of the dewatering process for Option One. The consultants expressed the opinion that we had to answer liquefaction questions wherever anyone might think they could occur (for example, the control tower at 6KSF loading). It could be a real thorn in the job at a later date, andareal dewatering is the only clean method. It is very hard to argue against dewatering, and it would be very difficult to prove the effectiveness of grouting. The question was asked about the water that could be trapped in clay. The consultants responded that over the long haul, it would drain with permanent drainage and could be proven by piezometers. While peripheral wells would probably do the job, there would be some intermediate wells. Any vein of water would be drained. Piezometers would convincingly prove that the area was dry. The construction dewatering process for the Auxiliary Building electrical penetration areas will assist in determining how much dewatering and how many wells, etc., are required. P. Martinez indicated that Bechtel would have to take another look at the design calculations in the foundation areas.

The Auxiliary Building electrical penetration area is a high narrow structure with a torsion box at the lower portion. The soil was designed to take the horizontal shear. The low soil blow counts values indicate that this structure is possibly being cantilevered to some extent off of the control tower. Dr. Peck expressed the need for the design basis for this structure. Dr. Hendron indicated that the borings were not necessarily indicative of what was beneath the structure. A parametric study for the structure should be made based on a range of soil properties. A quick rough analysis should first be done, followed by a detailed analysis. Karl Wiedner discussed the possible outer end settlement and his theory on how the structure had possibly picked up a cantilevered load during construction phases.

Tom Davisson then mentioned that, since we were thinking of permanent dewatering, a different underpinning method may be acceptable (one that would take vertical loads only). The Auxiliary Building control tower and the material below the electrical penetration areas have potential for horizontal shear resistance. The three options would be to: (1) do nothing, (2) supply something for vertical loads only, and (3) supply something for vertical loads and horizontal shear. The first step would be to check the horizontal shear resistance required. Possibly horizontal support could be picked up from the Reactor Building and/or Turbine Building. If we remove material and fix the end of the Auxiliary Building electrical penetration areas, we still would have to analyze for an unsupported mid span. Caissons were mentioned as another option. It was noted that even clay with an average blow count of three would have modest shear strength. The consultants noted that they did not have sufficient design information. Karl Wiedner and other Bechtel personnel present did not have all the answers on the design basis at the time of this meeting. However, at T. C. Cooke's suggestion, the consultants agreed to formulate their questions in writing for Bechtel response.

The consultants noted that in their opinion, $ Dollar Amounts Withheld for the underpinning of the Auxiliary Building electrical penetration areas was very low, especially when compared to the estimate of $ for permanent dewatering. They also stated that we definitely have a diesel-generator liquefaction problem although the sand would probably never actually liquefy during an earthquake. The problem was the difficulty in providing calculations which verify this and would not be subject to argument.

A brief discussion then followed concerning possible liquefaction regarding utilities, sand backfill around buildings, tank farm, railroad bay and control tower, etc. For the tank farm, railroad bay and control tower, a safety factor of 1.5 is generally acceptable. However, if for any reason, the acceleration criteria goes up in the future, Dr. Peck felt that it may be difficult to prove no liquefaction problems. The borings may not be completely satisfactory for the purpose of proving beyond a shadow of a doubt that everything was satisfactory because needlessly conservative decisions may be formulated on the "what if" type questions. The consultants noted that they were still in favor of a general dewatering program, especially in light of possibly more stringent seismic requirements in the future and the knowledge now available to the effect that generally speaking sand exists in more areas than originally anticipated in the power block area. The consultants believed that the permanent dewatering program, in general, was a must. The temporary dewatering system would show how the permanent system would work. The water can be lowered sufficiently to make the site acceptable in the new licensing arena. Dr. Peck stated that he could attend a meeting on the 18th of July in Washington to discuss the situation with the NRC.

To File

From TCCooke

Date August 10, 1979

Consumers Power Company

Internal Correspondence

Subject MIDLAND PROJECT GWO 7020 - PRE-MEETING AND GENERAL MEETING WITH CONSULTANTS
File: B3.0.3 UFI: 00234-S Serial: CSC-4306

CC Attendees
GSKeeley, P14-408B
DBMiller
RMWheeler
KCBrooks(2)

---

Attendees:

Karl Wiedner, Bechtel
Phil Martinez, Bechtel
Sheriff Afifi, Bechtel
Bimal Dhar, Bechtel
Al Boos, Bechtel
Art Arnold, Bechtel
Dr. Ralph Peck, Consultant
Dr. A. Hendron, Jr., Consultant
Dr. M. T. Davisson, Consultant
Chuck Gould, Consultant
Dick Loughney, Consultant
Tom Cooke, Consumers Power Company
Don Sibbald, Consumers Power Company
Don Horn, Consumers Power Company
Thiru Thiruvengandam, Consumers Power Co.

Please note that serials CSC-4274 and CSC-4255, above subject, omitted the location and dates of the meetings. Both meetings were held in Denver, Colorado. The Pre-Meeting (CSC-4274) was held on June 27, 1979, and the General Meeting (CSC-4255) was held on June 28, 1979.

Please attach this letter to your copy of the meeting notes.

sld

February 12, 1980 SECY-80-83 Attachment 14

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

# INFORMATION REPORT

For: The Commissioners

From: Victor Stello, Jr., Director
Office of Inspection and Enforcement

Thru: Executive Director for Operations

Subject: SYSTEMATIC ASSESSMENT OF LICENSEE PERFORMANCE

Purpose: The purpose of this paper is to inform the Commission regarding the status of efforts by the Office of Inspection and Enforcement in the evaluation of licensee performance.

Discussion: In October 1978, IE submitted SECY 78-554 "Licensee Regulatory Performance Evaluation," which requested, and subsequently obtained, Commission approval for a two-year trial program for evaluating licensee regulatory performance. "Regulatory performance" was defined as the licensee's ability to meet regulatory requirements and to avoid reportable events.

SECY 78-554 indicated that an "integrated methodology" would be developed that incorporated selected aspects of the three previously considered methods (Statistical, Trend Analysis, and Regional Survey) that were described in the paper. The objectives of this methodology were defined as:

- Identification of factors that lead to different levels of regulatory performance;
- Effective and efficient use of NRC inspection resources; and
- Evaluation of various aspects of the NRC inspection program.

The trial program was developed, but was never implemented because of the Three Mile Island (TMI) Accident.

A program for the comprehensive overview of licensee performance has been included as Task I.B.2 in the "Action Plans for Implementing Recommendations of the President's Commission and

Contact:
R. C. Thornburg, IE
49-28464

COPE OF 8002280101

Other Studies of TMI-2 Accident" (NUREG-0660). This program is described in the enclosed paper and is entitled "Systematic Assessment of Licensee Performance" (SALP). The objectives of SALP are:

- Identification of unacceptable licensee performance;
- Improvement of licensee performance;
- Improvement of IE Inspection Program;
- Providing a basis for NRC management's allocation of resources; and
- Achieving regional consistency by appraising licensee performance from a national perspective.

The SALP Program has been developed for power reactor licensees, but may, with modifications, be applicable to major materials licensees.

As was the case with the Licensee Regulatory Performance Evaluation, the SALP Program is designed to identify licensees whose regulatory performance warrants increased emphasis in licensing and inspection activities. If such licensees are identified, appropriate action will be initiated to upgrade the licensee performance; a major thrust of the SALP. The methodology has five (5) basic features:

- Evaluation of licensee performance by a board of regional inspectors, regional supervisors, and the NRR Project Manager (NMSS Project Manager for Materials licensees);
- Determination by regional management of the action necessary to upgrade performance;
- Holding annual meetings with licensee management to discuss the regional evaluations and planned actions;
- Review of the evaluations of licensee performance and planned corrective action by a SALP Review Group, composed of senior NRC management personnel, with inputs from the regional evaluations, NRR appraisals, and the appraisals of other NRC offices (i.e., AEOD, PAB, etc.); and
- Recommendations by the SALP Review Group to the appropriate NRC office director for major enforcement sanctions, license modifications, or increased (or decreased) inspection emphasis (frequency or scope) as warranted by the licensee evaluations.

Selected portions of the three previously considered methods of performance appraisal have been incorporated into the regional evaluations of licensee performance. An IE Manual Chapter (MC) defining the program for the regional evaluation of licensee performance is currently being reviewed by the regions. This MC will be issued in March 1980.

Regional evaluations will begin in April 1980 and will be completed in June 1980. The composition of the SALP Review Group, the procedures for Review Group operation, and details of the evaluations by the offices providing input to the Review Group, will be finalized by June 1980. The initial evaluations of the SALP Review Group will be completed in December 1980.

Coordination: The Offices of Nuclear Reactor Regulation, Management and Program Analysis, Analysis and Evaluation of Operational Data, and Standards Development concur. The Office of Nuclear Material Safety and Safeguards has no objection to the proposed program for reactor licensees.

The Executive Legal Director has no legal objections.

Victor Stello, Jr.
Director
Office of Inspection
and Enforcement

Enclosure:
"Systematic Assessment of
Licensee Performance"

This paper is scheduled for consideration at an open meeting on February 14, 1980.

# SYSTEMATIC ASSESSMENT OF LICENSEE PERFORMANCE

## 1. INTRODUCTION

This paper describes the Systematic Assessment of Licensee Performance (SALP) which is a refinement of a program previously referred to as the "Integrated Approach" to Licensee Regulatory Performance Evaluation (LRPE). SALP, like LRPE, is defined as an evaluation of the ability of a licensee to meet regulatory requirements and to avoid significant events that appear to be directly under the control of the licensee.

The SALP Program was developed for power reactor facilities in operation and construction, and is based on certain aspects of previously conducted NRC studies, with the methods substantially modified. The SALP Program, with modifications, may be applicable to major fuel facilities and major by-product licensed facilities.

The requirements for licensee performance appraisal were first established in NUREG-0397, "Revised Inspection Program for Nuclear Power Plants", which includes a national performance appraisal capability that provides the following elements:

- Evaluation of the performance of NRC licensees from a national perspective;
- Evaluation of the effectiveness of the NRC inspection program; and
- Confirmation of the objectivity of NRC inspectors.

During October 1978, IE submitted SECY 78-554, "Licensee Regulatory Performance Evaluation", to the Commission. As described in SECY 78-554, the objectives of LRPE were as follows:

- Identification of factors that lead to different levels of regulatory performance;
- Effective and efficient use of NRC resources; and
- Evaluation of various aspects of the NRC inspection program.

SECY 78-554 described three methods (Statistical Method, Trend Analysis Method, and Regional Survey Method) of licensee performance appraisal which had been studied by NRC. It also proposed the implementation of a trial program which was referred to as the "integrated approach" methodology to Licensee Regulatory Performance Evaluation (LRPE). This methodology was to be used to evaluate operating reactor licensees using 1978-1979 data. The trial program was developed, but its implementation was interrupted by the Three Mile Island Accident.

As a result of the investigative studies of the Three Mile Island Accident, a program for the comprehensive evaluation of licensee performance has

been included as Task I.B.2 in the "Action Plan for Implementing Recommendations of the President's Commission and Other Studies of TMI-2 Accident" (NUREG-0660). The program outlined by Task I.B.2 is a refinement of the LRPE methodology. This program which is the subject of this paper has been entitled the Systematic Assessment of Licensee Performance (SALP) to coincide with the recommendations of the Kemeny Report. The objectives of SALP have been defined as:

- Identification of unacceptable licensee performance;
- Improvement of licensee performance;
- Improvement of IE Inspection Program;
- Providing a basis for NRC management's allocation of resources; and
- Achieving regional consistency by appraising licensee performance from a national perspective.

These objectives will be accomplished through the performance of periodic evaluations of licensees by IE and NRR. The evaluations will be reviewed by a SALP Review Group of senior management personnel from NRC offices. The results of the evaluations, the reviews by the SALP Review Group, and the plans for appropriate action by NRC will be documented and distributed to the appropriate office director, to the licensees, and to the Public Document Rooms. In addition, the regional offices will hold annual management meetings with each of the evaluated licensees to discuss the results of the evaluations.

The appropriate action to upgrade licensee performance will be initiated by the regional offices as a result of the evaluations and may include enforcement action, or increased inspection frequency and scope.

## 2. INTEGRATED ASSESSMENT OF LICENSEE PERFORMANCE

### a. Program Inputs

Several groups within the NRC will provide inputs to SALP as follows:

(1) The IE regional office will perform an evaluation of the performance of each licensee semiannually. This evaluation will be used to determine the need for an increase or decrease in the frequency and scope of regulatory activities. The region will document the results of the evaluation and their plans for action, and forward this documentation to the SALP Review Group.

(2) NRR Project Managers will participate in the regional evaluations discussed in (1) above. The NRR Project Managers and technical support program personnel will also provide input

to the SALP Review Group. In addition, NRR will perform an independent study of the management capabilities and overall training of licensee employees. The results of this study will be submitted to the SALP Review Group for consideration during their initial evaluations.

(3) The IE Performance Appraisal Branch will perform Management Appraisal (MA) and Program Appraisal (PA) inspections at licensee facilities. The reports of their inspections will contain an appraisal of licensee management which will be forwarded to the SALP Review Group. All licensees will not receive these inspections during the first two years of this program. However, it is expected that the number of licensees inspected will be sufficient to verify regional consistency.

(4) Other NRC Offices (such as AEOD, etc) may provide input to the SALP Review Group as appraisal methodologies are developed with proven correlation to the safety of operations.

The regional evaluation discussed in (1) above will utilize appropriate portions of the three previously developed methods of performance evaluation. The details of the above evaluation/appraisal techniques will be discussed in Section 3 of this paper.

b. Review of Evaluation Results

Review of NRC evaluation results and the appropriate plans for upgrading performance will be conducted by the SALP Review Group consisting of senior managers from the NRC offices appointed by the Executive Director for Operations. The Review Group will provide an overview function of the evaluations and render an assessment of the safety adequacy of each facility and the adequacy of upgrading plans. Based on the findings, the Review Group is specifically charged to recommend major enforcement sanctions or license modifications to appropriate office directors. The Review Group will also confirm the consistency of regional evaluations and the regional implementation of NRC inspection programs.

The SALP Review Group, in addition to receiving inputs from regional evaluations, will receive inputs from NRR, IE Headquarters, and from other NRC offices as appropriate. The Review Group will convene at least once every six (6) months and review the evaluations of the licensees that are classified as needing "increased inspection scope/frequency." The remaining licensee evaluations will be evaluated once every twelve (12) months.

c. Feedback of Evaluation Results

The primary objectives of SALP are to identify unacceptable elements of licensee performance and to subsequently improve (upgrade) licensee performance. The former objective is achieved by the regional

evaluations and the reviews by the SALP Review Group, but to improve performance the results of these evaluations must be communicated to NRC management. The results of the regional evaluations and the recommended plan for the appropriate corrective action is forwarded to the Regional Director for review and approval. The results of the SALP Review Group are forwarded to the appropriate office director indicating a concurrence with the proposed regional action or recommending additional or alternate action.

NRC offices providing evaluation information will document the results of their evaluations with distribution to the licensee, PDR, and to the SALP Review Group. In addition, the region will submit an interoffice memorandum detailing the future plans for action by the region to correct the deficiencies identified during the evaluation.

The Review Group will issue a report at the conclusion of their periodic reviews to document the extent of their concurrence with the regional evaluations and proposed actions, or their recommendations for additional or alternate action.

Annual meetings will be conducted by regional management with the managements of the licensees evaluated by this program. These meetings will be utilized to discuss the results of the licensee performance evaluations and the NRC's general plan of action for correcting deficiencies.

3. METHODOLOGIES

a. Regional Evaluation

Each region will perform a detailed evaluation of their power reactor licensees semiannually. The evaluations will be performed by a board of the inspectors (including the resident inspector) and supervisors involved in the inspection program for that licensee. The board will also include the NRR Project Manager for the facility. The board will consider the enforcement actions, deficiency/event reports, technical and management performance, and safety attitudes of the licensee. The evaluations will also be based on the observations of the board members and their judgments of the licensee's performance. The evaluation will be the board's consensus of licensee performance; however, dissenting opinions with substantive comments will be included and transmitted to the SALP Review Group for concurrent evaluation. A number of functional areas will be evaluated by the board and a classification of "increase," "decrease," or "no-change" in the frequency and scope of inspection effort will be assigned for each functional area. The board will also provide an overall evaluation of the licensee and a detailed plan of the appropriate actions to upgrade performance.

The evaluation of each functional area will include the following considerations:

- Adequacy of administrative controls;
- Adequacy of supervisory review in the functional area;
- Adequacy of training and qualification of personnel;
- Adequacy of documentation and records control systems;
- Overall effectiveness in complying with NRC requirements;
- Attitude in assuring safe operations; and
- Significant performance deviations or trends noted from previous evaluations.

The board's evaluation of the licensee's enforcement history in each functional area will include identified items of noncompliance and escalated enforcement actions. A statistical analysis will not be performed on noncompliance data; but an indepth analysis of indicated trends and sanction points will be determined and will be considered in the evaluation.

The board's review of deficiency/event reports will consider the number, significance and repetitive nature of the non-routine events or construction deficiencies in each functional area. The board will provide an indepth analysis of these reports to identify adverse trends (causally-linked events) which indicate insufficient attention to the correction of the events or insufficient capabilities of licensee management in the functional areas. This analysis is similar to that developed in the Trend Analysis Method described in SECY 78-554.

The NRR Project Manager will provide input on the licensee's performance in those functional areas in which he is knowledgeable.

A manual chapter is being developed that specifies the functional areas to be evaluated and the methodology for performing the evaluations.

This evaluation differs from the Regional Survey Method performed by the Hays Associates (referenced in SECY 78-554) in that it is a structured evaluation which represents the consensus of regional personnel and is supportable by inspection results and event reports as opposed to the Hays questionnaire which contained anonymous unsupported opinions.

b. Evaluations by NRR

NRR project managers and NRR technical support program personnel will perform an evaluation of each power reactor licensee semiannually and will submit the evaluation to the SALP Review Group for inclusion in their review. The details of this evaluation are yet to be developed.

In addition, the NRR QA Branch and selected contractors are developing acceptance criteria to describe the capabilities (number of people, kinds of people, background, experience, training, etc.) required of licensee management. This program is Task I.8.1 in NUREG-0660. They will subsequently evaluate all licensees against these criteria. Deficiencies identified in this study will be discussed with each licensee and will be documented in a report. NRR plans to complete this effort in the spring of 1980. The results of this one-time study will be provided to the SALP Review Group for their initial evaluations.

c. Performance Appraisal Branch (PAB) Inspections

Management Appraisal (MA) Inspections will be performed by the PAB on selected licensees in each Region. The objectives of these inspections are to provide a national perspective of licensee performance; to identify performance traits that licensees may have in common; and to confirm inspector objectivity.

The MA inspections are conducted at the licensee's corporate offices and at the reactor site with emphasis on evaluating the effectiveness of the licensee's management in controlling licensed activities and in providing technical support to ensure compliance with regulatory requirements and safety of operations. Results of these inspections will be furnished to the the SALP Review Group.

The technique for appraising licensee management performance is discussed in detail in the PAB annual report for FY 79. Basically, the MA inspection involves an appraisal of the licensee in a number of functional areas. The appraisals in these functional areas are based on a mangement control system which should contain the following features:

- Written policies and procedures
- Adequacy of the program to cover current requirements and guidance
- Qualification and training of personnel implementing the program
- Awareness by the personnel implementing the program of their responsibilities

. Implementation of the program

IE Program Appraisal (PA) Inspections will also be conducted. These inspections are primarily designed to determine IE program effectiveness; however, information from these inspections will be provided to the SALP Review Group when the inspection results indicate a licensee performance problem or a significant program weakness.

Manual chapters are being developed specifying the methodologies of the MA and PA inspections and appraisals.