file

Donald B Miller, Jr
*Site Manager*
*Midland Project*

Midland Project: PO Box 1963, Midland, MI 48640 • (517) 631-8650

| PRINCIPAL STAFF | | | |
|---|---|---|---|
| BA | | DL | |
| D/BA | | NF | |
| A/BA | | RC | |
| DPS&P | | PCD | |
| DEP&QS | | SLO | |
| DEGTP | | | |
| ML | | | |
| OL | | FILE | |

cmg +3

October 27, 1982

Mr. W. D. Shafer, Chief
Midland Project Section
US Nuclear Regulatory Commission
Region III
799 Roosevelt Road
Glen Ellyn, IL 60137

MIDLAND PROJECT GWO 7020
NON-Q MATERIALS FOR UNDERPINNING
File: 0485.16 UFI: 42*05*22*04 Serial: CSC-6397

Additional reviews of material procurement has resulted in identification of items not previously noted in our letter CSC-6323 dated September 17, 1982. We therefore are confirming your authorization to procure the following non-Q items:

1. All deep seated benchmark material
2. Drift steel for C-195(Q)
3. Procurement and installation of all materials associated with the Circulating Water and Service Water structures hydraulic seal is "non-Q." The visual verification from the surface that the pipe and bentonite pellets have been installed is "Q". The verification from the Resident Geotechnical Engineer daily reports that the monitoring of the bentonite level was performed is also "Q".

The above items will be purchased "non-Q" however, CPCo will invoke Quality Assurance Program requirements upon receipt and installation except as specifically noted.

This letter confirms discussions with Dr. Landsman on site on October 21, 1982 and October 26, 1982 that Region III concurs with the list.

D. B. Miller
Site Manager

DBM/RMW/dmw

NOV 1 1982

file

James W Cook
*Vice President - Projects, Engineering and Construction*

General Offices: 1945 West Parnall Road, Jackson, MI 49201 • (517) 788-0453

October 5, 1982

| PRINCIPAL STAFF | | | |
|---|---|---|---|
| RA | | OL | |
| D/RA | | ENF | |
| A/RA | | SP | Aug 3 |
| DD&RP | | PAO | |
| DE&QS | | SLO | |
| DE&TP | | | |
| ML | | | |
| OL | | FILE | mas |

Harold R Denton, Director
Office of Nuclear Reactor Regulation
Division of Licensing
US Nuclear Regulatory Commission
Washington, DC 20555

J G Keppler
Administration, Region III
US Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL 60137

MIDLAND NUCLEAR COGENERATION PLANT
MIDLAND DOCKET NOS 50-329, 50-330
MIDLAND PLANT INDEPENDENT REVIEW PROGRAM
FILE: 0485.16 SERIAL: 18879

REFERENCES: (1) R L TEDESCO LETTER TO J W COOK DATED JULY 9, 1982.
(2) J W COOK LETTER TO H R DENTON, SERIAL 18850 DATED SEPTEMBER 17, 1982.

ENCLOSURES: (1) MIDLAND PLANT INDEPENDENT REVIEW PROGRAM
(2) PERFORMANCE OBJECTIVES AND CRITERIA FOR CONSTRUCTION PROJECT EVALUATION INPO, SEPTEMBER 1982

The ACRS interim report on the Midland Plant, dated June 8, 1982, contained a recommendation for a broader assessment of Midland's design adequacy and construction quality. In its correspondence of July 9, 1982, which is Reference 1 above, the NRC endorsed this ACRS recommendation and requested our proposal for performing an independent design adequacy review.

We briefly outlined several assessment activities for the Midland Project in our correspondence of September 17, 1982, identified above as Reference 2. Additional details of the program referred to in Reference 2 are enclosed for the NRC's review.

We have contacted our NRC Project Manager, Darl Hood, to arrange a meeting with the NRC Staff to discuss our Independent Review Program and to receive your concurrence or redirection of our plans. We will complete the planning phase, including team orientation and training, for the INPO program by



OCT 7 1982

October 29, 1982. We wish to initiate the implementation phase of the INPO program by November 8, 1982, in order to support our own and industry commitments to NRC.

James W. Cook

JWC/GSK/RLT/bjw

CC Atomic Safety and Licensing Appeal Board, w/a 1
CBechhoefer, ASLB, w/a 1
MMCherry, Esq, w/a 1
FPCowan, ASLB, w/a 1
RJCook, Midland Resident Inspector, w/a 1 & 2
RSDecker, ASLB, w/a 1
SGadler, Esq, w/a 1
JHarbour, ASLB, w/a 1
GHarstead, Harstead Engineering, w/a 1
DSHood, NRC, w/a 1 & 2 (2)
FJKelley, Esq, w/a 1
WHMarshall, w/a 1
WDPatton, Esq, w/a 1
WDShafer, NRC, w/a 1 & 2
BStamiris, w/a 1
MSinclair, w/a 1
LLBishop, Esq, w/a 1

oc0982-0249a100

CONSUMERS POWER COMPANY
Midland Units 1 and 2
Docket No 50-329, 50-330

Letter Serial 18879 Dated October 5, 1982

At the request of the Commission and pursuant to the Atomic Energy Act of 1954, and the Energy Reorganization Act of 1974, as amended and the Commission's Rules and Regulations thereunder, Consumers Power Company submits Midland Plant Independent Review Program.

CONSUMERS POWER COMPANY

By J W Cook
J W Cook, Vice President
Projects, Engineering and Construction

Sworn and subscribed before me this 5 day of Oct, 1982.

Barbara R Townsend
Notary Public
Jackson County, Michigan

My Commission Expires September 8, 1984

oc0982-0249a100

MIDLAND PLANT INDEPENDENT REVIEW

1. INTRODUCTION & SUMMARY
2. BIENNIAL QUALITY AUDITS
3. INPO CONSTRUCTION EVALUATION
4. INDEPENDENT DESIGN VERIFICATION
5. APPENDIX: PREVIOUS ASSESSMENTS

# 1. INTRODUCTION AND SUMMARY

The ACRS report dated June 8, 1982 on Midland Units 1 and 2 stated that "the NRC should arrange for a broader assessment of Midland's design adequacy and construction quality with emphasis on installed electrical, control, and mechanical equipment as well as piping and foundations."

On July 9, 1982, the Staff issued a letter to Consumers Power Company requesting a report on Midland Design Adequacy and Construction Quality. In this letter, the Staff stated that "With respect to assessment of Midland's design adequacy, such assessment would represent a significant contribution to the licensing review process if performed by a qualified, independent source following procedures utilized by some operating plants for Independent Design Verifications."

On September 17, 1982, the Company issued a letter to Mr Harold R Denton and Mr J G Keppler outlining the approach Consumers Power Company proposed for an Independent Review of the Midland Project and indicated that there had also been a Bechtel Corporate Staff project evaluation performed (described in more detail in attached appendix). It was stated that Consumers Power Company believes that the approach we are proposing for the forthcoming Independent Review will give a broader overview than assessments currently being recommended by the NRC for other NTOL plants.

The overall Independent Review Program described herein consists of three specific evaluations combined into a single program. The INPO type construction evaluation (horizontal type review), will examine the current

overall project against the criteria developed by INPO for this program (a copy of the INPO Performance Objectives and Criteria for Construction Project Evaluations is attached). As indicated in the September 17, 1982 letter to Mr Denton and Mr Keppler, the INPO program for Midland will be different from most of industry's self-initiated evaluations in that an independent contractor rather than utility personnel will carry out the INPO evaluation. The second part of the Program described is the Biennial QA Audit which has been a requirement of the Company's QA Program for several years. The third part of the Program described in more detail is the Independent Design Verification (Vertical slice) of all aspects, historical and current, of a critical plant system or subsystem.

Consumers Power Company received proposals from several potential contractors to perform the complete program described above. With respect to the INPO type construction evaluation and Biennial QA Audit, we have selected Management Analysis Company (MAC) to perform these activities based on our evaluation of their technical capabilities and experience.

MAC has many years of experience in the Nuclear Industry and has performed Biennial QA Audits in addition to other type reviews of Company activities. MAC has previously consulted extensively at nuclear construction sites with identifed QA problems. MAC was also a major participant in the development and implementation of the Palisades Regulatory Performance Improvement Program which has resulted in significant improvement to date at that facility. A description of other MAC assessments of Midland activities is included in the Appendix to this document.

The MAC Team will be under the direction of Mr L J Kube who has over 20 years experience in project management, engineering management, marketing, planning/scheduling, and design engineering having been employed by General Atomic and A O Smith Corporation prior to his employment with MAC. Mr Kube has been involved in the development of the INPO evaluation criteria, has participated in the three INPO Pilot evaluations and is the Project Manager for MAC for conducting an INPO evaluation on River Bend. The INPO type evaluation will be independent in that no Consumers Power Company or Bechtel personnel will be involved and MAC has never performed a direct line engineering or construction activity for Consumers Power Company.

For performance of the Independent Design Verification, we have selected Tera Corporation based on our evaluation of their technical capabilities and experience. Tera has many years of varied experience in the nuclear industry including independent design reviews, FSAR preparation, initial design of certain systems, and engineering, construction, operation and administration planning. Tera personnel are experienced in system design in the areas of mechanical, electrical, structural, and thermal hydraulic evaluations. Mr John W Beck, Vice President of Tera will be Project Manager for the Tera team. Mr Beck previously worked for Vermont Yankee Nuclear Power Corp as Executive Vice President serving as Chief Operating Officer. Prior to that he was Director of Engineering for Yankee Atomic Electric Co responsible for supervision and management of the plant, reactor, and environmental engineering departments. Prior to employment with Yankee, he was a Scientist at Bettis involved in Shippingport core design.

Individuals taking part in any of the three specific evaluations which make up the overall Independent Review Program will meet the "Independency Criteria" of Chairman Palladino's February 1, 1982 letter to Representative John Dingell and which are described as follows:

1. No individuals on the Project team will have been previously utilized by Consumers Power Company to perform design or construction work.

2. No individual involved will have been previously employed by Consumers Power Company.

3. No individual owns or controls significant amounts of Consumers Power Company stock.

4. No members of the present household of individuals involved are employed by Consumers Power Company.

5. No relatives of individuals involved are employed by Consumers Power Company in a management capacity.

MAC will be responsible for integrating an overall evaluation report made up of the three inputs.

The major objective of the overall evaluation report is to provide the NRC, ACRS, and the Consumers Power Company Chief Executive Officer with an assessment of the overall quality of the Midland Project. We believe that this assessment will adequately address the NRC, ACRS, and public's questions regarding the adequacy and construction quality of the plant.

The final report will be submitted to the NRC and an auditable record will be maintained of all comments on any draft or final reports, any changes made as a result of such comments, and the reasons for such changes.

# 2. BIENNIAL QUALITY AUDITS

## Background Of Biennial Quality Audit Requirements

The Consumers Power Company Quality Assurance Program Manual For The Midland Nuclear Plant, Topical Report CPC-1-A, requires the review of the Consumers Power Corporate Nuclear Quality Assurance Program to be performed at least once every 24 months or once every second calendar year by a Quality Assurance Program Audit (referred to as the Biennial Quality Audit).

This audit may be accomplished by a team consisting of Environmental & Quality Assurance personnel, selected employees from other Consumers Power Company departments or by an audit team of Quality Assurance personnel under contract to Consumers Power Company.

## Plans For The 1982 Biennial Quality Audit

The scope of the 1982 Biennial Quality Audit will be similar to the audits conducted in 1976, 1978 and 1980. The audit will evaluate the Quality Assurance Program being utilized by Consumers Power Company and by Bechtel and will evaluate on a sampling basis, the degree of compliance with the Program by Consumers Power Company and by Bechtel. Specifically, the 1982 Biennial Quality Audit will be conducted by Management Analysis Company (MAC) and will comply with the requirements of NRC Regulatory Guides 1.144 (9/80, Rev 1) and 1.146 (8/80, Rev 0).

# 3. INPO CONSTRUCTION EVALUATION

## General

In early 1982, utility nuclear power plant construction problems stimulated industry initiative and action to ensure that programs in effect nationwide meet performance goals as intended. Accordingly, the Institute of Nuclear Power Operations (INPO) was tasked by the Utility Industry to develop and manage a construction project evaluation program. The first effort was to define Performance Objectives and Criteria for project evaluations. Use of these criteria for an overall evaluation is intended to provide considerably more depth than an audit, for an audit generally does not go beyond conformance to program requirements. The evaluations include some assessment of administrative and quality records, but more important, focus on evaluating the success and efficiency of the project organization, systems and procedures in achieving the desired end results.

Following the drafting of the Performance Objectives, three pilot evaluations were conducted by INPO on plants under construction ie, Vogtle, Shearon Harris, and Hope Creek. During the last pilot a representative from NRC was present during data collection, evaluation and exit interview with utility personnel.

Following the pilot evaluations, the Performance Objectives and associated Criteria were modified to reflect experiences gained. A copy of the criteria to be used for the INPO evaluation is attached.

The performance objectives are broad in scope; each generally covers a single, well-defined area. The supporting criteria are more narrowly focused statements of activities that support or help meet the performance objectives. Several criteria are listed under each performance objective.

There are five Performance Objectives and associated Criteria which specifically address design effort. These are:

DC.1 Design Input

Process for defining and controlling design input

DC.2 Design Interfaces

The identification and coordination of interfaces to ensure input requirements are satisfied

DC.3 Design Process

Process followed to ensure safe, reliable and verifiable designs in compliance with requirements

DC.4 Design Output

Development of designs which are complete, accurate, understandable and constructable

DC.5 Design Changes

Control of changes to ensure compliance with design requirements

In addition there are numerous Performance Objectives which support evaluating design control. These include: Construction Engineering, Project Planning, Training, Independent Assessments, etc.

The above INPO Performance Objectives and associated Criteria will be utilized for planning the Independent Design Verification.

The INPO type self evaluation is aimed at achieving a level of performance above that required to meet Regulatory Requirements. Members of 35 Utilities (including Consumers Power) met, drafted and reviewed performance objectives and criteria to support the performance objectives of seven areas including design. A complete list of the areas whose objectives are intended to define optimum performance is:

Organization and Administration

Design Control

Construction Control

Process Support

Training

Quality Programs

Test Control

The thrust of this type of evaluation is that if utilities attempt to meet standards above those normally required to achieve quality, there will be greater assurance that Regulatory Requirements are met. The program was then applied during three pilot evaluations and modified based on the experience gained during the pilot evaluations. It essentially looks at all aspects of work in progress. This program has been developed during the calendar year 1982 and industry has made a commitment to the NRC to initiate INPO type evaluation on nuclear plants under construction by the end of 1982. The only exceptions will include those plants very close to fuel load.

Consumers Power Company selected MAC to perform the INPO Construction Evaluation primarily because of MAC's involvement in the development of the Performance Objectives and participation in all three pilot evaluations. The team supplied by MAC will be individuals experienced in multi-discipline activities associated with nuclear power plant engineering and construction. In addition, team members will be experienced in interviewing and evaluating ie, the type of activity MAC has been performing for the nuclear industry over the past seven years.

PREPARATION FOR INPO TYPE EVALUATION

The evaluation team leader will review the job status, select work areas to be evaluated and select team members based on the above. A request will then be made to CP Co for background documents. The team will then review the documents and prepare a schedule. Individual assignments will also be made. Three Tera members of the team organization representing Civil, Mechanical, and Electrical disciplines will be part of the MAC INPO type evaluation team. Prior to actually performing the evaluation, all team members will receive training in plant orientation, procedures and INPO evaluation techniques.

PERFORMING THE EVALUATION

The entire evaluation team will initially meet at the Site to review the work in progress. Sections of the team will then move to the Designer's and Owner's Offices. Team members will then begin the task of collecting pertinant facts relative to various aspects of the job via observations, inspections, discussions and review of documents. These facts will be assigned to the appropriate performance objective and reviewed against that

objective. As findings develop, additional investigations may take place. During this time, the team will communicate with the project personnel to assure validity of findings and draft evaluation summaries will be prepared.

REPORTING

At the conclusion of the evaluation, the team will verbally communicate their findings to the project. A formal report will then be prepared and presented to CP Co management. CP Co will acknowledge the findings and transmit the findings with their plans for corrective action concurrently to the NRC and INPO. INPO will assimilate various utilities reports into a comprehensive summary document and report the overall program progress to the NRC.

# 4. INDEPENDENT DESIGN VERIFICATION

## Goals and Objectives

The independent design review is directed at verifying the quality of design engineering for the Midland Plant. The approach selected is a review and evaluation of a detailed "vertical slice" of the project design by a technically competent, independent organization. The design and as-built configuration of a selected safety system will be reviewed to assure its adequacy to function in accordance with its safety design bases and to assure applicable licensing commitments have been properly implemented.

## Summary and Scope of Effort

The independent design verification (IDV) will consist of an independent design review of the Unit 2 auxiliary feedwater system (AFW) as an applicable sample of the design engineering effort at Midland Plant. This system was selected based upon system selection criteria discussed below. The review will be conducted by Tera Corporation and will utilize a multidisciplinary team of senior staff personnel to assure that the design and as-built configuration of the AFW conforms to its safety design bases and Consumers Power Company's licensing commitments as a benchmark for its acceptability. The design process, from concept to installation, will be identified and interfaces between design engineers evaluated to assure sufficient controls were placed on the transfer and specification of important design information. Although the review will focus on the AFW, the interfacing systems will be reviewed to determine that appropriate design constraints were imposed to

assure functionability of the AFW. Initially, important design elements for AFW will be outlined to assure the IDV includes an appropriate sample of the design interfaces between Consumers Power, B&W the nuclear steam supply system (NSSS) vendor, Bechtel the architect engineer, and other service related contractors. Design elements such as environmental qualification envelopes, seismic analysis, hydraulics and system control requirements will be selected to allow a diverse review of the various engineering disciplines (eg, Mechanical, Civil, Electrical). The design reviews in each area will evaluate the design approach used and, where appropriate, independent analytical techniques will be used to confirm questionable approaches or to permit assessment of the significance of any identified discrepancies.

To assure that the installed equipment reflects system design requirements, design specifications and drawings will be reviewed and in-field inspection of selected sections of the AFW conducted. The in-field inspection will confirm that the AFW is configured as specified in the design documents.

Throughout the IDV, all findings will be documented by each reviewer. Each finding will then be evaluated by the team leaders and more significant findings forwarded to a senior review team. At the conclusion of the effort, a preliminary report will be provided to Consumers Power and the original designers for review and provision of additional documentation that could have an impact on the final report findings. An auditable record of comments and additional information provided will be maintained. The final report will summarize the work accomplished, procedures used and a complete list and description of all findings from the review.

System Selection Criteria

The selection of a system to be reviewed by the independent contractor was based on the six criteria which follow.

- Importance to Safety - The system should have a relatively high level of importance to the overall safety of the Midland Plant.

- Inclusion of Design Interfaces - The system should be one which involves multiple design interfaces among engineering disciplines as well as design organizations, such as the NSSS vendor, architect engineer and sub-tier contractors. The system should also be one where design changes have occured and thus provide the ability to test the effectiveness of the design process exercised by principal internal and external organizations or disciplines in areas of design change.

- Ability to Extrapolate Results - The system should be sufficiently representative of other safety systems such that the design criteria, design control process and the design change process are similar so that extrapolation of findings to other systems can be undertaken with confidence.

- Diverse in Content - The major engineering disciplines should all have input to the design of the system.

- Sensitive to Previous Experience - The system should be one which includes design disciplines or interfaces which have previously exhibited problems and thus a test of the system should be indicative of any generic condition.

Ability to Test As-Built Installation - The system construction should be sufficiently completed that the as-built configuration can be verified against design.

The auxiliary feedwater system was selected for the independent design review after consideration of a number of other candidate systems. The auxiliary feedwater system had a sufficiently high profile for each of the criterion to justify its selection. Specifically, it involves interface with the NSSS vendor criteria, with containment design criteria, interface with design organizations, and the methodology of determining a water system's mechanical, electrical, and control component design criteria.

Technical Approach

The independent design verification (IDV) effort is comprised of three phases; Program Development, Review and Reporting.

The Program Development Phase includes the preparation of an IDV work plan and the development of a detailed review scope. The IDV work plan will include procedures and instructions for the work to be performed by Tera Corporation, the IDV contractor. An initial identification of the specific verification methods and depth of review to be utilized in addressing system design elements will also be completed as part of this phase.

The Review phase is the major activity of the IDV. This phase includes a design review of the systems as well as a field installation/as-built review to assure conformance of the design and the constructed facility. Initial efforts of the system design review will focus on the identification of the design process (chain) for the selected system. Emphasis will be placed on identifying design organizations and their subelements who contributed to the design and understanding the design practices and interactions between the design engineers. Paralleling this effort, the design and licensing criteria will be reviewed. It is anticipated that system design criteria information will include utility, B&W and Bechtel design requirements, licensing commitments, as well as other sub-tier documents.

The methods to be utilized in the review of system design elements will vary in depth. Depending upon the design area, the specific method may be a review of design criteria, a review of design calculations, a "blind" confirmatory

evaluation (eg alternative calculation or computer analysis by the IDV contractor) or a combination. Where appropriate, independent analytical techniques will be used to confirm design calculations or to permit assessment of the significance of any identified discrepencies. It is anticipated that the primary review method will be a review of calculations. Ultimately, the choice of review method will depend upon the nature of the design area and the type of verification method which is most effective in enabling the IDV reviews to reach a judgement as to the design adequacy in that design area.

This review will concentrate on each major step in the design process, for example:

- Design input information (transfer among designers, conformance with design criteria and commitments).
- Analyses and Calculations (selected review of inputs, assumptions, methodology, validation and usage of computer programs and reasonableness of certain analytical outputs).
- Drawings and Specifications (selected reviews for conformance with system design criteria, commitments, and incorporation of results of analyses and calculations).
- Field Verification (audit to assure that the as-built configuration reflects design requirements and pre-operational tests verify design analyses).

Findings from the INPO review as well as input from other sources such as, audit reports, 50.55e reports, design change reports and other documents will

also be considered to concentrate review in more depth in any areas where the design process may be suspect by historical evidence.

The IDV review scope will be broad enough in terms of design elements to include samples from each significant design organization, design interface and major engineering discipline.

The design elements to be evaluated include:

- Civil/Structural design of structures housing the AFW (eg, external or internal flooding, wind or tornado loads, seismic analysis, foundation design or missile protection).

- Mechanical/Electrical design of AFW systems and components (eg, pipe rupture protection, swismic subsystem evaluation, ASME code considerations, equipment qualification, penetration design, cable routing and separation, instrumentation and control system, system interlocks, fire protection, seismic and quality group classification or use of appropriate codes and standards).

- System performance requirements (requirements for accident mitigation, design transients and normal operation, hydraulic design, over-pressure protection, reliability, NPSH for pumps).

The installation/as-built verification review will include a walkdown of the selected system and inspection of system components. This review is intended to confirm system geometry and component nameplate data. Input from this evaluation will be assessed for its compatability with design documents such as specifications and drawings.

The IDV will be conducted under project instructions and procedures that will require apparent discrepancies to be documented throughout the review. Initially, these findings will be categorized based upon the lead reviewer's judgement as to status as follows:

1) Open- The finding has the potential for becoming a confirmed error, but additional investigation or confirmatory analysis is necessary to make a final judgement;

2) Confirmed - The finding is judged to be an apparent error by the review team and will require corrective action, such as additional documentation not utilized by the team that documents the resolution of the findings or additional analysis, design or construction changes or procedural changes that may be necessary to resolve the finding;

3) Resolved - Sufficient additional information was available in the ongoing review to resolve the findings and to completely close out any additional concern about the findings.

Additionally, findings will be categorized as to whether or not they affect the AFWs safety function or licensing criteria. Additional design information will be solicited to allow the lead reviewers to reach disposition of each finding. As the reviews of each major design element reach a suitable stage, the individual findings will be evaluated in an integrated manner by the project team to further define or resolve the findings and to assure the classification is proper. After the team has completed its review, each finding will be submitted to a senior level review team to provide additional professional opinion regarding the classification of the finding.

Reporting will be in two stages, preliminary and final. The preliminary report, including the findings, as modified by the senior review team, will be provided to Consumers Power Company for review by the original designers. The preliminary report will provide an opportunity for additional information to be supplied which could have an impact on the findings but was not known to the IDV project team. All comments, additional information and changes to the findings will be maintained in an auditable manner. The final report will summarize the work accomplished, procedures used and include a complete description of all findings.

# APPENDIX

## PREVIOUS ASSESSMENTS OF DESIGN AND CONSTRUCTION QUALITY AT MIDLAND

Historically, Consumers Power Company and its contractors have been committed to perform their work using QA programs which respond to all 10CFR50 Appendix B Quality Assurance criteria.

In addition to the Consumers Power Company audits in the areas of design and construction, the Company has utilized outside consultants to conduct Biennial Quality Audits. The Consumers Power Company Biennial Quality Audits were first instituted in 1976 and were subsequently conducted during 1978 and 1980. These audits were conducted to determine the Program's adequacy and to determine, on a sampling basis, the degree of compliance with the program. A summary of those audits are as follows:

A. 1976 Biennial Quality Audit

In 1976, the Biennial Quality Audit was conducted by the Nuclear Audit and Testing Company (NATCO) and included approximately 24 man-days of audit effort. The audit involved auditing for adequacy and implementation of the Consumers Power Company QA Program Procedures at the Consumers Power Company General Office in Jackson, Michigan and at the Midland Site. In addition, the audit involved auditing for adequacy and implementation of the Bechtel Nuclear Quality Assurance Manual at the Midland Site. Audit findings resulting from this audit have been closed out.

B. 1978 Biennial Quality Audit

In 1978, the Biennial Quality Audit was conducted by the Management Analysis Company (MAC) and included approximately 70 man-days of audit effort. The audit involved auditing for adequacy and implementation of the Consumers Power Company QA Program Procedures at the Consumers Power Company General Office in Jackson, Michigan and at the Midland Site. In addition, the audit involved auditing for adequacy and implementation of the Bechtel Nuclear Quality Assurance Manual at the Bechtel Ann Arbor, Michigan offices (engineering) and at the Midland Site. Audit findings resulting from this audit have been closed out.

C. 1980 Biennial Quality Audit

In 1980, the Biennial Quality Audit was conducted by the Management Analysis Company (MAC) and included approximately 46 man-days of audit effort. The audit involved auditing for adequacy and implementation of the Consumers Power Company QA Program Procedures at the Consumers Power Company General Office in Jackson, Michigan and at the Midland Site. In addition, the audit involved auditing for adequacy and implemenation of the Bechtel Nuclear Quality Assurance Manual at the Bechtel Ann Arbor, Michigan offices and at the Midland Site. Audit findings resulting from this audit have been closed out.

MAC also performed a special Assessment of Midland in 1981 which covered the following areas: Corrective actions resulting from 50.55e items including adequacy of corrective action, hardware inspection and system walkdown, corrective action status closeout of 1980 biennial Corporate Audit, assessment

of adequacy of Midland QA program (based on first two items), review of documentation (supplier quality verification records, radiographic records, certificates of compliance, and Bechtel FLAGS program), and assessment of Bechtel and Consumers personnel (Bechtel QC and auditors, Consumers auditors, and Bechtel welders' qualification).

Starting in 1976 upon the discovery of missing rebar in three areas of the auxiliary building (later this was determined to not be a safety problem), Consumers instigated a surveillance of construction activities by Consumers QA personnel. Consumers Power surveillance provides formalized quality control inspections beyond those quality control inspections performed by the Bechtel Quality Control group.

In August 1980 the Quality Assurance Organizations of Consumers Power Company and Bechtel were integrated into one group with Consumers having the responsibility for direction and management. Consumers Power at this time set up a Design QA Engineering (DQAE) group at the Bechtel Ann Arbor offices to conduct day to day monitoring of engineering activities of Bechtel. The Consumers Power DQAE provides design and procurement quality/reliability services of problem prevention and early problem detection, resolution, and corrective action. DQAE personnel are degreed and have had direct design related experience in the areas of nuclear, mechanical, electrical, electronics and civil engineering. The DQAE functions consist of:

1. Technical reviews of Design and Procurement documents (engineering procedures/instruction, selected design and procurement documents, and supplier design deviation requests).

2. Monitors that requirements of controlling documents are being implemented (FSAR, engineering procedures, Appendix B, codes and standards) into specifications, drawings, material requisitions, supplier documentation and design calculations.

3. Audits of engineering, supplier QA Department, Bechtel Quality Engineering and Document Control.

Starting in January 1979, NRC Region IV Vendor Inspection Branch has conducted seven inspections of the Bechtel Ann Arbor Office. The latest inspections were in May and July 1982. In three of these inspections, there were no findings. Corrective action has been completed on all of the findings from inspections prior to 1982. There were no findings from the May 1982 inspection and the one finding from the July 1982 inspection has not been closed out as yet.

Although not requested by the NRC, Consumers Power Company decided in early 1982 that based on occurrences at Diablo Canyon and other plants, an Independent Design Audit or Review was prudent. The Company did not know what NRC staff requirements would be applied to an independent audit for plants that are in the construction and licensing stage similar to Midland. It was decided that this particular Independent Design Review would be undertaken as soon as possible in order to provide timely identification of problems so that corrective action could be taken consistent with overall project schedules. The purpose was to review Bechtel Project Engineering activities to determine if design criteria are being correctly implemented and if design assumptions, design methods and the design processes are satisfactory. It was also decided that the review could be optimized by using people who were knowledgeable

about the Bechtel design process but were not working on Midland design such as Bechtel personnel located in offices other than Ann Arbor or Consumers personnel that have not been directly involved in Midland.

The review team consisted of six Bechtel and one Consumers Power Company employees with disciplines represented in the areas of mechanical, nuclear, electrical, civil/structural, plant design, control systems and technical support for plant operations. Short term assistance was provided by specialists and consultants from other Bechtel offices in specific areas such as piping design and seismic analysis. The general approach of the review was to conduct a broad review of important design methods and then to review in-depth, including field walkdowns, four features of the plant. Emphasis was on engineering and factors important to safety, calculations, and design features which will not be demonstrated by tests during construction and start-up. Interfaces within Bechtel and between Bechtel and B&W were also reviewed. The basic criteria and commitments used by the review team were the FSAR, Bechtel Topical Reports, project procedures, and industry guides and standards. Design methods selected for review included piping analysis, equipment qualification, separation hazards, instrumentation, structural and seismic analysis, and various nuclear analyses. The piping review included independent computer analysis of selected stress problems and hanger designs and a review of unique computer programs developed for the Midland Project. The four features of the plant for an in-depth review were: reactor cavity design, on-site electrical systems, decay heat removal system and piping for the high pressure safety injection system outside containment. The review has been completed with findings issued and replied to. The final report as well

as other design review information will be submitted to MAC and Tera for use in the performance of their activities.

September 1982
Criteria
Preliminary

# Performance Objectives and Criteria for Construction Project Evaluations

INPO

# PERFORMANCE OBJECTIVES

# AND CRITERIA

# FOR CONSTRUCTION

# PROJECT EVALUATIONS

INSTITUTE OF NUCLEAR POWER OPERATIONS

September 1982

PRELIMINARY
For Use In
SELF-INITIATED EVALUATIONS

## FOREWORD

In early 1982, utility nuclear power plant construction problems stimulated industry initiative and action to ensure that programs in effect nationwide meet performance goals as intended. Accordingly, the Institute of Nuclear Power Operations (INPO) was tasked to develop and manage a construction project evaluation program. The first effort was to define performance objectives and criteria for project evaluations. Use of the criteria is intended to provide considerably more depth than an audit, for an audit generally is regarded to be no more than a check of the paper trail. An evaluation includes some assessment of administrative records, but more important it focuses on evaluating the quality of the end result of implementing the project systems and procedures. It also includes assisting the utility by transferring technology, management systems, and procedural systems when the utility is not as strong as has been observed elsewhere in the industry. Such an evaluation can result in an uplifting, or upgrading, by specific recommendations on how to achieve a higher level of excellence.

This program is not intended to evaluate whether or not the design is adequate. Rather, the program will evaluate if the design documents are controlled and if the plant is being constructed as the design specifies; therefore, design control and quality of construction are the key objectives being evaluated.

These performance objectives and criteria are intended for use by INPO member utilities and third parties in the evaluation of the quality of engineering and construction of nuclear power plants. The scope of this document addresses the phase of the project beginning with the plant design process and extending through design, construction, and testing to issuance of the Nuclear Regulatory Commission operating license.

The performance objectives are broad in scope; each generally covers a single, well-defined area. The supporting criteria are more narrowly focused statements of activities that support or help meet the performance objectives. Several criteria are listed under each performance objective.

Corporate and project organizations among INPO member utilities vary widely. Accordingly, no specific organization has been assumed in developing this document. The areas addressed represent those relevant to achieving the highest standards in construction of a nuclear power plant. Rather than addressing a specific organizational structure, the program is designed to evaluate the systematic control of functions and approaches that are necessary to produce the desired results for project completion. The performance objectives and criteria emphasize management involvement in the design and construction of a nuclear power plant, since monitoring and control at the management level are essential to the achievement of an optimum end product.

This document is intended to provide a basis for INPO and INPO member utilities to assess the quality of utility management in select areas related to nuclear plant design and construction. Since the performance objectives and criteria are intended for use in evaluating the results, they do not necessarily prescribe or establish methods of achieving those results.

PERFORMANCE OBJECTIVES AND CRITERIA
FOR
CONSTRUCTION PROJECT EVALUATIONS

INDEX


| PART | TITLE | PAGE |
|---|---|---|
| **OA** | **ORGANIZATION AND ADMINISTRATION** | 1 |
| OA.1 | ORGANIZATION STRUCTURE | 3 |
| OA.2 | MANAGEMENT INVOLVEMENT AND COMMITMENT TO QUALITY | 5 |
| OA.3 | THE ROLE OF FIRST-LINE SUPERVISORS AND MIDDLE MANAGERS | 8 |
| **DC** | **DESIGN CONTROL** | 11 |
| DC.1 | DESIGN INPUTS | 13 |
| DC.2 | DESIGN INTERFACES | 15 |
| DC.3 | DESIGN PROCESS | 16 |
| DC.4 | DESIGN OUTPUT | 18 |
| DC.5 | DESIGN CHANGES | 19 |
| **CC** | **CONSTRUCTION CONTROL** | 21 |
| CC.1 | CONSTRUCTION ENGINEERING | 23 |
| CC.2 | CONSTRUCTION FACILITIES AND EQUIPMENT | 25 |
| CC.3 | MATERIAL CONTROL | 26 |
| CC.4 | CONTROL OF CONSTRUCTION PROCESSES | 27 |
| CC.5 | CONSTRUCTION QUALITY INSPECTIONS | 28 |
| CC.6 | CONSTRUCTION CORRECTIVE ACTIONS | 29 |
| CC.7 | TEST EQUIPMENT CONTROL | 30 |
| **PS** | **PROJECT SUPPORT** | 31 |
| PS.1 | INDUSTRIAL SAFETY | 33 |
| PS.2 | PROJECT PLANNING | 34 |
| PS.3 | PROJECT CONTROL | 35 |
| PS.4 | PROJECT PROCUREMENT PROCESS | 37 |
| PS.5 | CONTRACT ADMINISTRATION | 38 |

| PART | TITLE | PAGE |
|---|---|---|
| PS.6 | DOCUMENT MANAGEMENT | 39 |
| **TN** | **TRAINING** | 41 |
| TN.1 | TRAINING MANAGEMENT SUPPORT | 43 |
| TN.2 | TRAINING ORGANIZATION AND ADMINISTRATION | 44 |
| TN.3 | GENERAL TRAINING AND QUALIFICATION | 45 |
| TN.4 | TRAINING FACILITIES, EQUIPMENT, AND MATERIAL | 46 |
| **QP** | **QUALITY PROGRAMS** | 47 |
| QP.1 | QUALITY PROGRAMS | 49 |
| QP.2 | PROGRAM IMPLEMENTATION | 50 |
| QP.3 | INDEPENDENT ASSESSMENTS | 51 |
| QP.4 | CORRECTIVE ACTIONS | 52 |
| **TC** | **TEST CONTROL** | 53 |
| TC.1 | TEST PROGRAM | 55 |
| TC.2 | TEST GROUP ORGANIZATION AND STAFFING | 56 |
| TC.3 | TEST PLAN | 57 |
| TC.4 | SYSTEM TURNOVER FOR TEST | 58 |
| TC.5 | TEST PROCEDURES AND TEST DOCUMENTS | 59 |
| TC.6 | SYSTEM STATUS CONTROLS | 60 |

# ORGANIZATION AND ADMINISTRATION

## OA.1 ORGANIZATIONAL STRUCTURE

**PERFORMANCE OBJECTIVE**

The owner's corporate organization and all other project organizations responsible for the design, engineering, planning, scheduling, licensing, construction, quality assurance, and testing of a nuclear plant should provide an organizational structure that ensures effective project management control.

**CRITERIA**

A. The project organizational structure is defined clearly and establishes an effective relationship among the owner's and contractors' responsible executives and managers for design, construction, procurement, planning, testing, quality assurance, and licensing of a nuclear power plant to support the success of the project.

B. Managers associated with the project, either owner's, nuclear steam system vendors', architect/engineering firms', or contractors', at the executive, corporate, project, design, procurement, construction, start-up, operations, and quality assurance levels, understand clearly their relationships regarding the project, including their authorities, responsibilities, and accountabilities.

C. An owner's manager is assigned responsibility for the project activities (hereafter referred to as project manager). This is his primary responsibility and preferably his sole responsibility. Also, he has the authority to direct the project.

D. The owner's project-level managers are assigned responsibility for the following listed functional areas in support of the nuclear project activities. Sufficient authority is held by each individual to carry out assigned responsibilities.

1. project control, including planning, scheduling, and cost control
2. engineering, analysis, and design control
3. procurement control
4. construction control
5. management information systems
6. training and qualifications
7. construction testing and turnover control
8. quality assurance
9. material receipt, handling, storage, and maintenance
10. record and document management
11. legal and licensing requirements
12. staffing, personnel policy, and salary administration

E. The project manager exercises control in those functional areas assigned to managers who do not report to him to ensure that the plant is engineered, designed, constructed, and licensed in a manner resulting in a safe and reliable plant.

F. The project manager's relationship to higher corporate management and ultimately to the chief executive officer is defined clearly and documented.

G. Clearly defined access to the project manager is provided to other managers having responsibility for the functional areas under Criterion D.

H. Corporate administration of contracts is delegated clearly with contractual obligations well-understood and enforced. Responsibility and appropriate authority for prompt action on contract changes, renegotiations, or violations of contracts have been assigned.

I. Staffing for all project organizations is adequate for the authorities and responsibilities assigned.

## QA.2 MANAGEMENT INVOLVEMENT AND COMMITMENT TO QUALITY

**PERFORMANCE OBJECTIVE**

Senior and middle managers in the owner's corporate office, designer's office, and at the construction site who are assigned functional responsibility for matters relating to the nuclear project should exhibit, through pe sonal interest, awareness, and knowledge, a direct involvement in significant decisions that could affect their responsibilities.

**CRITERIA**

A. Procedures or written statements of policy address subjects relating to the engineering, design, and construction of nuclear projects. They include policies related to project quality, such as workmanship, problem identification and correction, action item tracking, reporting, and procedural compliance.

B. Project personnel in the corporate office and at the construction site and designer's offices are aware of these procedures and policy statements and have them readily available for reference. They are able to explain how they are put into practice.

C. Project personnel demonstrate compliance with these policy statements and the statements have a high degree credibility

D. Both vertical and horizontal communication of significant problems and corrective actions are effective and coordinated to provide an accurate representation of conditions.

E. Meetings involving corporate and project management personnel result in the regular review of key aspects of the nuclear project.

F. Corporate managers are made aware of and utilize appropriate design and construction progress data and trends in setting goals and objectives and in management decisions involving the project.

G. Methods are established that permit data and trends to be compared with results at other utilities with similar construction projects.

H. Corporate managers responsible for the nuclear project are familiar with activities and reports that affect design and construction. They are cognizant of and sensitive to problems and external factors that might affect progress or quality. Examples of such involvement include the following:

1. review of applicable audit, evaluation, and inspection results conducted by internal and external organizations
2. personal interface with the engineering, design, and construction organizations and personal observations of their activities
3. review of industry's engineering, design, and construction experience and trends
4. review of project plans and schedules and reports of actual progress versus planned progress
5. review of worker performance indicators such as rework and reject rates

I. Management support and actions reflect appropriate attention to areas such as project management, scheduling, planning, staffing, training, personnel relations, and owner-contractor relations that affect project quality.

J. Corporate managers responsible for nuclear matters are committed to seek out and employ methods and information systems for identifying problem areas and their underlying causes and for taking coordinated, corrective action to eliminate these problems.

K. Designated managers associated with the project have responsibility and authority, by policy and practice, to stop or delay engineering, design, or construction activities when their judgement indicates that continuation will result in a failure to meet the project objectives.

L. Management accountability for the project is consistent with the project structure and extends to the contractors, architect/engineering firm, and nuclear steam supply system supplier contractor.

M. A complementary relationship is evident between management and quality assurance that supports implementation of a strong corporate commitment to quality.

N. Decisions are made known to appropriate individuals for implementation.

## OA.3 THE ROLE OF FIRST-LINE SUPERVISORS AND MIDDLE MANAGERS

**PERFORMANCE OBJECTIVE**

The project first line supervisors and middle managers should be qualified by verified background and experience and have the necessary authority to carry out their functional area responsibilities.

**CRITERIA**

A. Position descriptions or the equivalent are employed for each key management and supervisory position.

B. Minimum qualification, experience, and training requirements are defined for project first-line supervisors and middle managers.

C. Authorities and responsibilities are defined clearly. Personnel clearly understand and accept their relationship in the organization and their authorities, responsibilities, and accountabilities.

D. The first-line and middle managers are actively and personally involved in the nuclear project functional activities. Functions that could be performed include the following:

1. approval of qualification requirements for positions that report directly to them
2. provisions for input to and understanding of project policies governing each functional area covered in this document
3. assessment of selected programs and activities relating to project activities, including follow-up on corrective actions
4. close involvement with safety review groups performing independent reviews of matters affecting safety and reliability
5. assurance that effective actions are taken on reports of significant and unusual project deficiencies in the managers' areas of responsibility

6. regular review of project status and current problems
7. review of selected data and trends discussed in the functional sections of this document
8. monitoring of organization's performance against established goals and objectives
9. involvement in and understanding of trending programs and corrective actions related to developing adverse trends
10. active involvement in ensuring that construction practices and procedures are followed in a manner that enhances the quality of the end product
11. responsibility for ensuring that workers are qualified for their individual assignments and that they perform their work to project standards

E. The project middle managers are sensitive to the need to control work assignments to ensure that project-related effort is not diluted.

F. Appropriate supervisory, technical, and procedural training is conducted for first-line and middle managers having responsibilities for functional areas in support of project activities. Appropriate records of attendance, material presented, and test results (if given) are retained to document this training.

DESIGN CONTROL

## DC.1 DESIGN INPUTS

**PERFORMANCE OBJECTIVE**

Inputs to the design process should be defined and controlled to achieve complete and quality designs.

**CRITERIA**

A. Design inputs such as codes, standards, regulatory commitments and requirements, criteria, and other design bases are identified, defined clearly, documented, evaluated, approved, and their scope of applicability is defined prior to their use in the design process.

B. The design inputs include consideration of all of the requirements necessary to produce a quality design including feedback from pertinent industry engineering, design, and construction experience.

C. Plant constructability, operability, inspectability and maintainability are considered in plant designs.

D. The design inputs are provided at a level of detail and clarity necessary to be useable and understandable by all persons using these inputs.

E. A systems, components, and materials experience information base, to the extent available, is a key element in the design process. Specifications for key safety-related equipment that does not have a substantial service history contain a requirement for supplier acceptance tests.

F. The issuance and use of design inputs is controlled by the use of complete and understandable procedures.

G. All changes to the approved design inputs are documented and approved prior to their use.

H. Design personnel utilize supplier expertise as applicable in the design process.

I. Design and design control information is readily available for use by all design personnel.

H. Design personnel utilize supplier expertise as applicable in the design process.

I. Design and design control information is readily available for use by all design personnel.

## DC.2 DESIGN INTERFACES

**PERFORMANCE OBJECTIVE**

Design organization external and internal interfaces should be identified and coordinated to ensure a final design that satisfies all input requirements.

**CRITERIA**

A. Design organization engineering authority is documented, and limits of responsibility and authority are defined clearly.

B. The flow of design information between both external and internal organizations is controlled and timely.

C. The external and internal interfaces and responsibilities are defined and controlled by procedures.

D. Oral and other informal means of communication, including letters and memos, which provide significant design information, are confirmed and promptly made a part of the design input by a controlled document.

E. System interaction is considered in system design and analysis.

F. Systematic and effective lines of communication are established.

G. Design and design change information are coordinated effectively with all affected disciplines and operating personnel.

H. Transfer of design responsibilities and documents from one organization to another is planned and implemented in a controlled manner.

## DC.3 DESIGN PROCESS

**PERFORMANCE OBJECTIVE**

The management of the design process should result in designs that are safe, reliable, verifiable, and in compliance with the design requirements.

**CRITERIA**

A. The design process is documented, planned, and scheduled to ensure an orderly, sequenced process for completing design.

B. Responsibility for controlling each function of the design process, including the preparation, review, and approval of input, in process, and output documents, is defined clearly, documented, and understood.

C. The overall design review process includes system design reviews; verifications of calculations, methods, and computer runs; and validations of computer codes and models. The reviews or verifications are performed by individuals or groups other than those who performed the original design.

D. Design documents include scope and applicability as well as the identity of the originator and checker.

E. Calculations and analyses clearly specify information such as applicability, assumptions, design inputs, references, methods, and results in a manner that allows a technically qualified person to understand the calculations or analyses.

F. When an independent check of calculations and analyses is required, it is performed by a technically qualified person, and the method of checking is noted on the documents.

G. Design process problems are identified, and decisions are made to resolve the problems in a timely and effective manner.

H. Supervisory and management involvement in the design process is evident by the quality and timeliness of the output information and resolution of design problems.

I. Design personnel provide timely technical support and follow-up on systems they have designed.

J. Design processes are monitored for compliance with design commitments.

K. Design control measures, such as procedures and checklists, are used to ensure that design inputs, such as design criteria, design bases, regulatory requirements, codes, and standards, are translated correctly into design documents, including specifications, calculations, drawings, procedures, instructions, and other documents needed to build a plant.

L. Drawings, specifications, and other design documents are prepared under a controlled process that establishes standards for pertinent items such as format, content, status, and revision.

## DC.4 DESIGN OUTPUT

**PERFORMANCE OBJECTIVE**

Project design documents should specify constructable designs in terms of complete, accurate, and understandable design requirements.

**CRITERIA**

A. The purpose of each type of design document is defined clearly.

B. Design output documents reflect a constructable, operable and maintainable design that meets the design input requirements.

C. The total design package is complete and understandable without the need for extensive coordination or interpretation by construction or vendor personnel.

D. The design organization is aware of the capabilities and requirements of the supplier and the construction organization.

E. Sufficient detail, legibility, and clarity for interpretation and reproduction are provided in design output documents to facilitate correct implementation of the design.

F. The design organization is responsive to the need for clarification of design output documents where these needs are identified.

G. Design output documents are issued and kept current using a controlled process.

## DC.5 DESIGN CHANGES

**PERFORMANCE OBJECTIVE**

Changes to released project design documents should be controlled to ensure that constructed designs comply with the most recent design requirements.

**CRITERIA**

A. The design organization's response is timely and effective regarding identified changes.

B. Reasons for the change are identified, evaluated, and, if necessary, actions taken to avoid future problems.

C. The responsible design organization considers inputs to the original design before a change is issued.

D. Design changes are coordinated with any affected discipline and/or organization in a timely manner.

E. Appropriate procedures and methods are revised if design changes make these revisions necessary.

F. Prior to the approval of the design change, consideration is given to quality, safety, cost, and schedule.

G. Changes are subject to control measures commensurate with those of the original design.

H. A system is utilized to determine whether or not the change being made impacts other parts of the system being changed, other areas of the plant, or other plants under construction.

I. Methods are in place to ensure that changes are implemented in a timely manner.

J. All changes, including those initiated by regulation, construction, vendor, or design, are properly reviewed by the design organization and, if approved, incorporated into the design documents.

K. Appropriate design changes are evaluated promptly by each affected discipline, and necessary corrective action is taken and documented in a timely manner.

L. Design change review considers the change impact on items such as calculations, system functional requirements, original safety analysis assumptions, inspectability, maintainability, and selection of equipment and material.

# CONSTRUCTION CONTROL

## CC.1 CONSTRUCTION ENGINEERING

**PERFORMANCE OBJECTIVE**

Engineering and design performed under the authority of the construction organization should be controlled as to consistency with the basic design criteria to ensure compliance with applicable codes, standards, and regulatory commitments.

**CRITERIA**

A. Construction engineering authority is documented, and limits of responsibility and authority are defined clearly.

B. Procedures are effective in controlling the engineering and design processes of the construction engineering organization.

C. Guidelines are issued to ensure that the basic design criteria used by the construction engineering organization is consistent with that used in the original plant design.

D. Interface links between architect/engineering home office and the construction engineering group are efficient, effective, and defined clearly.

E. Interface links among major vendors and subcontractors and the construction engineering group are efficient, effective, and defined clearly.

F. Construction engineering field change control is maintained effectively as required to support the construction effort and to ensure final as-built conditions are defined.

G. Construction engineering supports major construction equipment processes (e.g., special rigging studies and transportation studies) with calculations and design prior to important field construction effort.

H. State-of-the-art engineering and design verification exists for construction engineering processes.

I. Adequate engineering and design issuance procedures are in effect to support the engineering and construction process and to ensure management awareness of generic design or constructability problems.

J. Field detail sketches and drawings for fabrication and installation accurately reflect basic design drawings and documents.

K. Linkage to the document control system exists to ensure engineering and design documents are handled properly.

## CC.2 CONSTRUCTION FACILITIES AND EQUIPMENT

**PERFORMANCE OBJECTIVE**

Construction facilities and equipment should be planned for, acquired, installed, and maintained consistent with project needs to support quality construction.

**CRITERIA**

A. A site plan has provided for key location of facilities such as warehouses, craft shops, equipment storage, and production facilities.

B. Construction equipment is acquired in a manner to support the construction schedule and is maintained in optimum condition to support quality work.

C. Facilities and equipment, both temporary and permanent, meet the project needs and specifications, and are maintained in accordance with established requirements.

D. Periodic inspections or surveillances of the work areas and activities are performed to ensure that facilities and equipment support construction needs.

## CC.3 MATERIAL CONTROL

**PERFORMANCE OBJECTIVE**

Material and equipment should be inspected, controlled, and maintained to ensure the final as-built condition meets design and operational requirements.

**CRITERIA**

A. The receiving process ensures that receiving inspections include evaluations of incoming materials and equipment against the procurement specifications. This process results in proper and timely disposition of deviations.

B. Materials and equipment are identified properly to control installation and use.

C. Quality documentation for received material is accounted for, reviewed, accepted, filed, and retrievable.

D. Items received are processed in a timely manner to allow early identification of those items requiring special handling, storage, and preventive maintenance.

E. Nonconforming items are identified and controlled to prevent unapproved use.

F. Material and equipment storage, handling, and security are controlled effectively in accordance with specified requirements.

G. The warehousing facility has an accurate inventory control system that provides for the effective location of items.

H. The issuance process ensures that correct material is issued in accordance with engineering requirements.

I. Effective preventive maintenance, including maintenance of cleanliness standards, is initiated at the appropriate time and continues throughout the construction process.

J. Environmentally sensitive equipment is protected adequately from the degrading effects of temperature, humidity, and dirt.

## CC.4 CONTROL OF CONSTRUCTION PROCESSES

**PERFORMANCE OBJECTIVE**

The construction organization should monitor and control all construction processes to ensure the project is completed to design requirements and that a high level of quality is achieved.

**CRITERIA**

A. Construction activities are identified in advance to allow for development of procedures and selection, training, and qualification of personnel.

B. Work procedures and instructions have sufficient detail to ensure that construction activities are in accordance with engineering requirements.

C. Construction activities are performed in accordance with work procedures, instructions, and current revisions of drawings approved for construction.

D. Rework activities are performed in accordance with established procedures and are subject to required inspections.

E. Work is performed by and under the supervision of qualified personnel who recognize and accept a responsibility for quality.

F. Proper tools are available and are used correctly.

## CC.5 CONSTRUCTION QUALITY INSPECTIONS

**PERFORMANCE OBJECTIVE**

Construction inspections should verify and document that the final product meets the design and quality requirements.

**CRITERIA**

A. The inspection process is defined accurately prior to the start of the work and is controlled to meet the requirements of the project.

B. An effective system is in place to encourage the reporting of degraded quality.

C. Inspection procedures are clear, define the inspection process in detail, and reference appropriate acceptance criteria.

D. Inspections are integrated into the construction processes and work schedules.

E. Inspections are performed using written procedures.

F. Calibrated equipment used in inspections is of the proper type, range, and accuracy.

G. The quality control inspectors are separate from the production function.

H. The records clearly indicate the scope of the inspections, the inspector, and the results.

I. Records are reviewed for completeness and accuracy prior to their storage in accordance with project requirements.

## CC.6 CONSTRUCTION CORRECTIVE ACTIONS

**PERFORMANCE OBJECTIVE**

The construction organization should evaluate audits, inspections, and surveillances; process replies and follow-up; and take corrective action to prevent recurrence of similar problems.

**CRITERIA**

A. The construction organization tracks construction audits and surveillances, prepares well-researched replies that address the deficiencies, and takes prompt and effective corrective action.

B. The construction organization evaluates audits for generic problems and trends and takes appropriate action to prevent recurrence.

C. Nonconformances are identified, tracked, and closed out in a timely manner.

D. The construction organization reviews nonconformances to ensure corrective actions have been taken, evaluates for trends, and reports problem areas to upper management.

## CC.7 TEST EQUIPMENT CONTROL

**PERFORMANCE OBJECTIVE**

Measuring and test equipment should be controlled to support construction testing effectively.

**CRITERIA**

A. Measuring and test equipment utilized for testing is identified uniquely.

B. Measuring and test equipment is controlled to ensure that only properly calibrated equipment is used for testing.

C. Specific programs are implemented to provide regular calibration of instrumentation and to track status and calibration of each instrument used for testing.

D. Special procedures are implemented to identify retest requirements when instrumentation is found to be defective.

E. The construction organization tracks equipment out-of-tolerance reports and work performed to correct work previously done incorrectly.

F. The construction organization establishes regular maintenance and calibration intervals for all equipment and ensures timely calibration for each device.

G. Calibration is accomplished correctly using certified equipment traceable to recognized standards or methods. Calibration records are retained and retrievable.

PROJECT SUPPORT

## PS.1 INDUSTRIAL SAFETY

**PERFORMANCE OBJECTIVE**

The construction site industrial safety program should achieve a high degree of personnel safety.

**CRITERIA**

A. An effective industrial safety program with clearly defined policies, procedures, scheduled training requirements, and individual responsibilities is implemented with the full support of managers and supervisors.

B. Selected data and trends of industrial safety activities are monitored, including the following:
   1. summary analysis of first aid treatments
   2. analysis of accidents requiring doctor's care
   3. incidence of lost-time accidents
   4. frequency of safety violations identified

C. General housekeeping practices prevent the accumulation of debris and trash.

D. A safe and orderly job site working environment exists.

E. Lifting and rigging equipment is checked regularly.

F. A fire protection program is defined, organized, and well-publicized.

G. The site controls hazardous materials effectively.

H. A safety tagging program exists and is implemented effectively to protect equipment, personnel, and material.

## PS.2 PROJECT PLANNING

**PERFORMANCE OBJECTIVE**

Project plans should ensure completion of the project to the highest industry standards by identifying, interrelating, and sequencing the tasks of the project organizations.

**CRITERIA**

A. The project master plan presents the interrelationships of tasks within and among the plans for the various elements of the project.

B. The project plans are documented and approved by the appropriate level of management.

C. The project plans are updated to reflect changing conditions.

D. The project plans are communicated to the responsible project members.

E. Clear lines of authority and responsibility exist between the individual assigned responsibility for plan development and those responsible for plan implementation.

F. Individuals assigned responsibility for planning for each functional area of the project are provided the necessary data.

## PS.3 PROJECT CONTROL

**PERFORMANCE OBJECTIVE**

Project scheduling and work planning and coordination should ensure that the objectives of the project plan are met through effective and efficient use of project resources.

**CRITERIA**

A. Individuals responsible for functional areas demonstrate an awareness of the need for and knowledge of project controls and utilize these controls as required.

B. Elements of work are defined into manageable segments that can be accomplished by a typical work unit on a definite schedule.

C. Elements of work are defined in a way that identifies clearly the construction unit or discipline responsible for the work.

D. Based on input and feedback from responsible project personnel, a controlling construction schedule exists that provides a plan for completion of work elements and commitments and that provides management with a clear, concise, and understandable method of tracking project milestone completion.

E. Elements of work are recorded in a tracking system that is established prior to the work being performed and that allows project construction completion to be monitored based on installed quantities.

F. Work elements are integrated into the construction schedule in a manner that facilitates construction erection sequence, mimimizes interferences and rework, and optimizes project resources.

G. Deviations from the project schedule and plan, caused by regulatory, productivity, design and other changes and interferences, are communicated to the proper level

of management and analyzed for trends. Corrective actions are taken to modify the schedule and plan.

H. Quality control hold point inspections are integrated with the work activities.

I. The work activities address support requirements for the segments of work to be accomplished.

J. Work plans provide for a smooth transition from bulk scheduling to system completion scheduling.

## PS.4 PROJECT PROCUREMENT PROCESS

**PERFORMANCE OBJECTIVE**

The project procurement process should ensure that equipment, materials, and services furnished by suppliers or contractors meet project requirements.

**CRITERIA**

A. Procurement documents provide clear and adequate technical, quality assurance, commercial, and administrative requirements necessary to define the scope and requirements of the contract.

B. The preparation, review, and approval of procurement documents are controlled in accordance with established procedures.

C. A list of qualified suppliers or contractors is used to identify sources of quality products and services.

D. Only those suppliers or contractors who are listed as qualified are requested to furnish bids or proposals.

E. Proposals and bids are evaluated for compliance with the requirements and scope defined in the procurement documents. These evaluations are performed by the personnel responsible for the preparation of the procurement specifications.

F. The recommendation and contract award are conducted in accordance with established procedures.

G. Subtier suppliers or contractors are contractually bound to adhere to related portions of the contract.

H. Supplier and contractor performance histories are used to improve the procurement process.

I. Purchasing and contract documents are reviewed to ensure inclusion of requirements to achieve quality.

## PS.5 CONTRACT ADMINISTRATION

**PERFORMANCE OBJECTIVE**

Methods for administering and controlling contractors and suppliers and for managing changes to their contracts should ensure effective control of performance.

**CRITERIA**

A. Changes are prepared, reviewed, and approved in a manner consistent with the original requirements.

B. Changes are justified with respect to quality, safety, cost, and schedule and are approved by an appropriate level of management.

C. All verbal or informal changes are approved and confirmed promptly in writing within the guidelines of the change procedures.

D. Performance is monitored, and corrective action is implemented as required.

## PS.6 DOCUMENTATION MANAGEMENT

**PERFORMANCE OBJECTIVE**

The management of project documentation should support the effective control and coordination of project activities and provide a strong foundation for the documentation/ information requirements of the plant's operational phase.

**CRITERIA**

A. A comprehensive records mangement plan and schedule exists to do the following:
   1. identify the documents and records required by regulations, purchase specifications, corporate requirements, and standards
   2. specify the minimum content and format requirements and acceptance criteria for each record/document type
   3. clearly designate responsibility for receipt, review of acceptability, resolution of deficiencies, and control of documents during construction
   4. contain proper methods for declaring appropriate documents "as-built" during construction
   5. determine what, when, how, to whom, by whom, and in what format records will be turned over to the plant's oeprational staff

B. The records management plan is effective in identifying the current status of project documents such as the following:
   1. design drawings
   2. specifications
   3. structure/system descriptions
   4. vendor drawings and manuals
   5. design criteria and procedures

C. The records management plan effectively incorporates approved changes or revisions into the project documents within an acceptable time frame.

D. The distribution system is defined and ensures timely distribution of current project documents to engineering, construction, and project support personnel within the project organization and to appropriate contractors and vendors.

E. The project maintains master files of the latest revision of project documents that are correct and accessible.

F. Storage facilities provide secure maintenance of permanent and nonpermanent records.

# TRAINING

## TN.1 TRAINING MANAGEMENT SUPPORT

**PERFORMANCE OBJECTIVE**

Management should ensure that an effective program exists for indoctrination, training, and qualification of personnel involved in the project.

**CRITERIA**

A. Corporate managers in each area have an active interest and involvement in the training program.

B. Managers are trained and have adequate knowledge in areas related to their roles in the design and construction of a safe and reliable plant.

C. Training is neither interrupted, deferred, or cancelled, nor are personnel diverted routinely from training to other activities.

D. Management and supervisors are involved actively in assessing the qualifications and training needs of individuals with respect to their assigned tasks.

E. Management makes use of feedback information to improve the effectiveness of the training program.

F. Actions taken as a result of monitoring training and qualification trends are reviewed by appropriate levels of management on a periodic basis.

## TN.2 TRAINING ORGANIZATION AND ADMINISTRATION

**PERFORMANCE OBJECTIVE**

The training organization and administration should ensure effective control and implementation of training activities.

**CRITERIA**

A. The training organization is defined clearly.

B. Training and qualification goals and objectives are established.

C. Training and qualification efforts are governed by procedures that outline responsibilities of the training organization.

D. Training personnel are provided training and opportunities to enhance their performance as instructors.

E. Training programs address organizational needs at appropriate levels.

F. Technical and nontechnical training requirements for individuals are defined clearly and documented.

G. An active program exists to acquire feedback for the purpose of developing, modifying, and improving the training programs.

H. Training activities are conducted regularly, and results are documented.

## TN.3 GENERAL TRAINING AND QUALIFICATION

**PERFORMANCE OBJECTIVE**

The training program should ensure that all employees receive indoctrination and training required to perform effectively, and that employees are qualified as appropriate to their assigned responsibilities.

**CRITERIA**

A. Initial selection, training and indoctrination enable individuals to perform assigned responsibilities effectively.

B. The previous qualification and training of new hires and transfers are verified.

C. Individuals are qualified as appropriate for their assigned responsibilities.

D. Training on a continuing basis, both formal and on-the-job, maintains the employee's ability to perform consistently and effectively.

E. Continuing training provides an effective means of keeping employees up-to-date regarding changes to policies, procedures, processes, instructions, and commitments.

F. Individuals are requalified or recertified as required to keep their qualifications current.

G. Feedback is acquired and used to modify and improve training methods and content.

## TN.4 TRAINING FACILITIES, EQUIPMENT, AND MATERIAL

**PERFORMANCE OBJECTIVE**

The training facilities, equipment, and material should support and enhance training activities.

**CRITERIA**

A. Classroom facilities are provided for group instruction.

B. Reference materials are up-to-date and readily accessible.

C. Equipment is available as needed to support training material development.

D. Training aids and material are provided to support the program.

E. Test and certification records are available and are updated regularly, and a follow-up system for required recertification of personnel is utilized.

QUALITY PROGRAMS

## QP.1 QUALITY PROGRAMS

**PERFORMANCE OBJECTIVE**

The quality assurance program scope, content, and applicability should be appropriate, defined clearly, and understood.

**CRITERIA**

A. The quality assurance and quality control programs include all necessary program elements.

B. Day-to-day activities are observed and monitored under a continuing program designed to ensure the highest quality of personnel performance, workmanship and attention to detail.

C. The quality assurance program is applied to the project in an appropriately graduated way.

D. The relationship between manuals and the applicability of procedures is defined clearly and understood.

E. Audit and surveillance schedules are modified as appropriate to verify the effectiveness of program implementation and to reflect the need for increased monitoring.

F. The utility conducts evaluations of contractors' quality assurance program with sufficient regularity and in sufficient depth to ensure program effectiveness.

G. The programs provide for indoctrination and training of personnel as necessary to ensure that suitable proficiency is achieved and maintained.

H. The "stop process" and "stop work" authority is understood clearly and implemented effectively.

## QP.2 PROGRAM IMPLEMENTATION

**PERFORMANCE OBJECTIVE**

Quality assurance and quality control functions should be performed in a manner to support and control the quality of the project activities.

**CRITERIA**

A. The relationship of the quality assurance and quality control organizations with other organizations and individuals is defined clearly to ensure their independence.

B. Quality assurance and quality control personnel experience a cooperative relationship with other project personnel and are free of harrassment and intimidation.

C. Quality assurance and quality control areas function in a manner that supports management.

D. The quality assurance programs of vendors and contractors include measures to achieve quality and are implemented in an effective manner.

E. Project organizations utilize technical specialists in the implementation of the quality requirements.

## QP.3 INDEPENDENT ASSESSMENTS

**PERFORMANCE OBJECTIVE**

Management should provide an effective, independent assessment of project activities affecting the quality of the project.

**CRITERIA**

A. A plan is implemented to ensure that audits and surveillances effectively assess applicable project activities in a timely manner.

B. The results of the independent assessments identify substantive issues affecting performance.

D. Independent assessments are performed by individuals with no direct functional responsibilities for the area being assessed.

E. Independent assessments are performed by individuals suitably qualified to conduct the assessment.

F. The analysis of the assessments properly evaluate the activity assessed.

G. The results of the assessments and evaluations are directed to and used by the management of organizations to improve their effectiveness.

H. Periodic evaluations of the effectiveness and adequacy of the total quality program are performed. Results are reported to the senior management level, and appropriate action is implemented.

## QP.4 CORRECTIVE ACTIONS

**PERFORMANCE OBJECTIVE**

Conditions requiring corrections or improvements should be resolved in an effective and timely manner.

**CRITERIA**

A. Conditions adverse to quality are reported promptly and accurately.

B. The responsible organization assumes its responsibility for and its management is involved in and supports the correction of adverse quality.

C. The senior levels of management are apprised of adverse quality conditions and hold the responsible supervisors accountable.

D. Corrective action resolves not only the reported item, but also the basic cause in a manner that ensures the quality of future activities.

E. Effective corrective action is taken in a timely manner.

F. The quality assurance, quality control, and project organizations cooperate in identifying and solving problems effectively.

G. Quality performance trends are developed and analyzed to effectively address generic problems and basic causes of degraded quality.

TEST CONTROL

## TC.1 TEST PROGRAM

**PERFORMANCE OBJECTIVE**

The test program should verify the plant's full capability to operate as intended by testing the plant's systems functionally.

**CRITERIA**

A. A clear policy is developed and endorsed by top management that describes the test organization's responsibility for component, system, and preoperational testing.

B. The principal design organization is involved in formulating test objectives and acceptance criteria.

C. The test program describes the scope of system testing, provides detailed guidance for conduct of testing, and includes methods for evaluation of completed tests.

D. Nonconforming conditions and discrepancies are identified and tracked, and appropriate resolution or corrective action is achieved.

E. Adequacy of plant operating and maintenance procedures is demonstrated.

F. The test program describes the quality assurance program under which it functions.

## TC.2 TEST GROUP ORGANIZATION AND STAFFING

**PERFORMANCE OBJECTIVE**

The test group organization and staffing should ensure effective implementation of the test program.

**CRITERIA**

A. The test group organizational structure and organizational relationship to interfacing organizations are defined clearly.

B. The staff build-up accommodates the early requirements for testing procedure and schedule preparation.

C. The staff size is sufficient to accomplish the assigned tasks as dictated by the test schedule.

D. Permanent plant personnel are utilized during testing, to the maximum extent practical, in order to enhance their experience and training.

E. Key management, supervisory, and professional positions are described in writing.

F. Personnel who are assigned to perform testing meet the experience and qualification requirements as delineated in the written position descriptions.

G. Qualifications of test personnel are maintained.

## TC.3 TEST PLAN

**PERFORMANCE OBJECTIVE**

The test organization should prepare a plan and a schedule that describe the sequence of system or component testing to support major schedule milestones.

**CRITERIA**

A. The plan and schedule are developed by personnel experienced in test and start-up operations.

B. The plan and schedule are coordinated with the engineering and construction schedules so restraints are identified for project management action.

C. The plant systems are scoped into logical, bounded, well-defined subsystems that can be tested as units.

D. The schedule for individual system or component testing describes the required elements of testing, including those systems required to support individual system testing.

E. The status of testing is monitored by a tracking system.

## TC.4 SYSTEM TURNOVER FOR TEST

**PERFORMANCE OBJECTIVE**

The construction testing and turnover process should be controlled effectively to ensure that program objectives are met.

**CRITERIA**

A. Jurisdiction is delineated for organizations responsible for the conduct of tests, acceptance of results, and turnover to succeeding test programs.

B. Tests are performed and results evaluated for conformance to design requirements.

C. Retests are performed when necessary and are controlled to ensure completeness of verification.

D. System walk-downs are conducted by appropriate and qualified individuals and entities who effectively identify engineering, maintenance, and construction deficiencies.

E. System turnover procedures identify clearly participants, duties, responsibilities, and documentation necessary for the turnover process.

F. Turnover documents identify boundaries, material, equipment, deficiencies, and exceptions existing at the time of turnover.

G. Turnover exceptions are tracked effectively and are corrected in a timely manner.

H. The lead design, construction, quality control, and testing organizations integrate project needs effectively and accomplish the turnover process in a timely manner.

I. System and area cleanliness and maintenance programs are continued during the test phase.

## TC.5 TEST PROCEDURES AND TEST DOCUMENTS

**PERFORMANCE OBJECTIVE**

Test procedures and test documents should provide appropriate direction and should be used effectively to verify operational and design features of respective systems.

**CRITERIA**

A. The necessary technical data are used in test procedure preparation.

B. Approved test procedures are available in advance of their intended use to allow adequate test preparation and training.

C. The test procedures describe clearly the objectives, prerequisites, system boundaries, and acceptance criteria for tests.

D. Test procedures receive the prescribed review before approval.

E. Tests are performed in accordance with approved procedures.

F. Necessary retesting is conducted when design changes occur during or after completion of the test phase.

G. The results of the test program receive an independent review and approval.

## TC.6 SYSTEM STATUS CONTROLS

**PERFORMANCE OBJECTIVE**

A method should exist to identify the status of each system or component and the organization holding control or jurisdiction over that system or component to prevent interference and ensure equipment and personnel safety.

**CRITERIA**

A. Policies and procedures for plant status controls are implemented during testing.

B. A system is implemented to ensure current knowledge of the status of systems.

C. Activities affecting the status of systems and changes of status are authorized by designated personnel and are appropriately documented.

D. Tagging systems are coordinated among the various groups involved in the project to ensure control of status and of equipment and personnel safety.

E. Procedures are implemented to install, control, remove, and review periodically temporary field modifications.

F. Jurisdiction and control of construction work on systems after initial turnover are defined clearly and implemented.

G. Complete and current system documentation packages, including all changes and revisions resulting from the testing program, are provided to the plant operating staff in a timely manner.

[illegible] is operated by contractors from the Tennessee Valley Authority (TVA), a Federal agency. Under Title VI of the Civil Rights Act of 1964 and subsequent TVA regulations, no person shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under this program. If you feel you have been excluded from participation in, denied the benefits of, or otherwise subjected to discrimination under this program on the grounds of race, color, or national origin, you or your representative, have the right to file a written complaint with TVA not later than 90 days from the date of the alleged discrimination. The complaint should be sent to Tennessee Valley Authority, Office of Equal Employment Opportunity, 400 Commerce Avenue, EPB 14, Knoxville, Tennessee 37902. The applicable TVA regulations appear in Part 1303 of Title 18 of the Code of Federal Regulations. A copy of the regulations may be obtained on request by writing TVA at the address given above.

Printed in U.S.A.

INPO

Institute of
Nuclear Power
Operations

1820 Water Place
Atlanta, Georgia 30339
Telephone 404 953-3600
TWX 810-766-0467

3